Natura Impact Statement (NIS)
for a proposed salmon farm site
at Shot Head, Bantry Bay,
County Cork, Ireland.

Consideration of the potential for negative impacts arising from the proposed salmon farm site on six named adjacent Natura sites and on the status of local populations of Northern Gannet, Common Guillemot and Northern Fulmar.

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Natura Impact Statement for a proposed salmon farm site at Shot Head, Bantry Bay, Cork, Ireland.

Executive summary.

The three seabird species and the six SPA sites for consideration in this NIS were selected through the Stage 1 Screening Assessment process. The general characteristics of the SPAs are summarised in Section 2.6, whilst their locations, SCI status data and straight line and over-water distances from the proposed CIFT salmon farm site at Shot Head are set out in Tables 2.8 and 4.4 and mapped in Figure 2.28

The three species for consideration are the Northern Gannet *Morus bassanus*, the Common Guillemot *Uria aalge* and the Northern Fulmar, *Fulmarus glacialis*. Their biology, behaviour and global and Irish status and distribution are all fully described in Section 3.

From Table 2.9 it is worthy of note that Northern Fulmar breed on all six named SPA sites, including four with populations of National and one of Regional Importance. Common Guillemot are SCIs for four of the sites, two of which accommodate Nationally Important and one a Regionally Important population, whilst the Gannet is a SCI of two of the sites, one of International Importance, being one of the largest colonies globally and the other, nearby, being of National Importance. Clearly this cluster of SPAs off the west Cork and Kerry coast is one of the most important in the country, individually and severally deserving of maximum protection.

The question to be addressed, although not specifically defined by the use of the word “significant” in the Stage 1 Screening Assessment that prompted the call for this NIS, is whether Salmon farming in general, or specifically in the case of the proposed CIFT salmon farm site in Bantry Bay could generate significant negative impacts to affect the status of the three named foraging seabird species, or their designated breeding sites.

There are two means through which such potential impacts may have effect. The first is any means, by which sufficient levels of any potential impactor might be capable of reaching the named SPA breeding sites and their SCI inhabitants, in situ. The quoted Guidelines advise that Natura sites up to 15km distant should normally be screened for such far-field effects. The second is restricted to foraging or voyaging SCIs from named SPAs, such as the three seabird species named, which have the potential to be negatively affected by impacts close to their sources, on voyaging to specific locations, where such impacts might be localised and where they reach their highest concentration. The former is considered in Section 2 of this document. Sections 3 and 4 are largely concerned with seeking evidence of potential impacts on the three named foraging seabirds, individually, both globally and in the locality of the Shot Head site itself. Potential impacts are considered, both in isolation and in combination with impacts from other sources, notably other aquaculture sites in Bantry Bay.

The 2016 RPS WQ Report submitted to ALAB uses a hydrodynamic model and waste discharge data provided by CIFT and Watermark to model the dispersal of the standard range of organic waste parameters, Dissolved Inorganic Nitrogen (DIN), Dissolved

Inorganic Phosphorus (DIP), Biochemical Oxidation Demand (BOD) and Solids (SS) from the Shot Head site. Impacts on existing ambient conditions in Bantry Bay are then assessed, with distance from their source at the site, as they dilute and disperse in tidal currents. An eight-stage worst-case scenario is used in the modelling procedure to provide a wide margin of safety in the modelled outcomes.

The study finds that, for DIN, typical mean Spring mid-flood and mid-ebb tide concentration plumes, from just Shot Head or from all salmon farm sites in Bantry Bay combined, do not breach the EQS at any point and elevation of ambient DIN levels is close to zero within 2-3km of the Shot Head site in all directions. Similar plots for DIP suggest much lower elevations than for DIN. In this case the EQS for DIP is not even approached, even at the source, in the Statistical Maximum Plume Plot. For BOD, whilst there is no EQS for BOD in Coastal waters, the elevated ambient conditions resulting from BOD discharges remain far lower than the BOD EQS for Transitional waters and the result of peak BOD discharges on oceanic influx of ambient oxygen into Bantry Bay is a reduction of no greater than 1%, such that mean ambient DO in the bay is not significantly affected. Again, the elevation of BOD is effectively zero within 2-3km of the Shot Head site. Finally, settled solids loadings are restricted to the locality of a seabed area under each farm site in all cases and the EQS that applies to solids settlement is not beached. A hypothetical worst case model shows that deposition of the peak monthly solids discharge every month for one year results in a deposition of just 13mm of settled solids on the seabed under the site.

The six named SPAs lie a minimum over-water distance (the shortest route taken, both by dispersing discharges and by voyaging / foraging SCIs, from the sites) of between 10.5 and 74km from Shot Head. Bearing in mind the rapid dilution of the range of organic waste pollution parameters tested, to the extent that no EQS is breached beyond the site boundary and that no elevation of ambient parameter levels occurs at all beyond 4km of the site in any direction, it is submitted that no far-field impacts will arise at any of the six SPAs named, or impact on their habitats or SCIs inhabitants. It is also observed that the seaward margin of the closest site, the Beara Peninsula SPA 004155 is at the high water mark, and that the site has effectively no marine habitat. Consequently, no waterborne impacts, were they to exist, could impact on this site, or on its SCI inhabitants, in situ.

It is also noted that whilst the worst case created includes waterborne discharges of DIN, DIP, BOD and SS, from all sites in the bay in order to track their dispersal patterns, the discharges from the existing sites in the bay, including those closest to the SPAs, have been making their contributions to ambient parameter concentrations in the Bantry Bay for many years, some 40 years in the case of the Roancarrig site. During this period, seabird populations in the aera have not been known to decrease and, in the case of the large Gannet colonies on the Bull and Cow SPA 004066 and the Skellig Islands SPA 004007, they have grown continually and considerably in numbers over the entire recording period, as Section 3 demonstrates.

Thus, in conclusion, no far-field impacts are expected to arise from the operation of any existing or proposed salmon farm sites in Bantry Bay on any of the six named SPAs or their seabird SCIs. Thus none of the terms of the published Conservation Objectives for the sites will be breached, should the Shot Head site be licensed.

As referred to elsewhere in this document, whilst, apparently, all other classes of impacts on seabirds are extensively and deeply considered and reported upon in the scientific, government, professional / consultancy, NGO, environmental and anti-group lobbyist literature, there is a contrasting dearth of scientific and referenced information on the spatial and disturbance impacts of both finfish and longline marine farming systems on seabirds.

Amongst the classes of impacts that are described in the literature, sources range from those caused by:-

- Organic pollution.
- Disturbance and exploitation or eggs, just pre-fledged chicks and adults for human food.
- Human disturbance of colonies by bird tourism.
- Overfishing.
- Fishery bycatch and fishery waste.
- Trawling, netting and longlining, where impacts include hooking, drowning, net entanglement, trapping and injury. Estimated death toll is at least 320,000 seabirds pa.
- Driftnetting for wild salmon, estimated to cause 90,000 bird deaths pa in Northern Norwegian waters alone prior to almost universal banning of the practice, albeit primarily for reasons other than its terrible toll on seabird populations.
- Marine renewables installations, from windfarms to water-based, wave and current operated renewable energy devices, leading to flight path obstruction (in particular for gannets) and widespread foraging ground obstruction.
- Oil leakage from oil tankers and oil fields. Includes the sinking of the Betelgeuse at Whiddy Island, Bantry Bay on 8th January 1979 and the wrecking of the Kowloon Bridge off Casltetownsend, County Cork on 5th December 1986. Traumas to wildlife, including seabirds, by injury and death due to contamination with both oil and detergents.
- Severe weather, to which Auks, including Common Guillemot are particularly prone (storm wrecks). Severity and frequency increasing due to climate change
- Plastic ingestion and plastic use in nesting (includes Gannets), sourced from marine litter, with the risk of entanglement, alimentary blockage, choking and poisoning.
- Climate change and consequent migration of important feed resources for birds, including plankton and planktotrophic fish species (in the last decade and ongoing).
- Poisoning of apex predators due to poison accumulation from food sources.

- Predation, mainly of eggs and chicks, by birds (gulls, white-tailed eagle etc) and both invasive, naturally resident and feral mammals, such as foxes, mink, mice and rats.

Additionally, what little information there is on interactions with marine farming, is quite old and therefore considers aquaculture systems, in particular for marine finfish farming, that have become outdated in the industry's rapid technical development over the last forty years. For Ireland itself it is also noticeable that impacts of marine farming on seabirds is not a topic that has attracted the attention of the main NGOs, notably Birdwatch Ireland, who have been very active in recent years in campaigning for the reform of the capture fishery sector, and An Taisce.

In order to track down information on impacts on birds, Section 3 of this document individually investigates the proximity of the colonies and foraging ranges for the three subject species, to the densest assemblages of aquaculture activity in Europe, if not the world, on the Scottish West Coast and along the Norwegian coastline. This work concludes that there is little difference in the status of colonies or foraging densities for all three species between those close to dense aquaculture activity and those far removed from it.

As a prime example, all gannet colonies globally and their global population has grown continually for at least six decades. In individual cases in Norway, a process of colonisation by Gannets, colony extinction and recolonisation has occurred at a small number of locations. However, this is readily explained in the literature as being the result of disturbance and predation by White-tailed Eagle. Even in this case the majority of the displaced birds have moved onto new colonies and the overall population has not diminished.

Sea bird population data is collected and collated between UK and Ireland on an approximate 15 to 20-year cycle. The most recent data, from the Sea Monitoring Project (SMP) of 2014-15 is yet to be published and the majority of the data is not yet available. However, recent data for all three subject species that has been made available under a data request to NPWS shows that the national Irish populations of Northern Gannet, Common Guillemot and Northern Fulmar have increased since the last survey, Seabird 2000.

There is a clear absence of information from any source on interactions between the subject seabird species (and all other species) and aquaculture. It is respectfully submitted that is most likely to be due to lack of evidence and that the only reasonable conclusion to this NIS is that there are no known significant impacts on the subject seabird species. This is primarily as a result of the mitigating measures incorporated into current best practice in salmon farming as operated by CIFT.

This NIS therefore concludes that no impacts are expected to arise, either from the proposed CIFT Shot Head site in isolation, or in combination with any other current floating aquaculture operations in Bantry Bay.

Natura Impact Statement for a proposed salmon farm site at Shot Head, Bantry Bay, Cork, Ireland.

Main Report.

Section 1. Introduction.

1.1. Brief.

The Aquaculture and Foreshore Licences for proposed Shot Head salmon farm site in Bantry Bay were granted by the Minister of Agriculture, Food and the Marine in September 2015. The licences have been under appeal with the Aquaculture Licences Appeals Board (ALAB), under the terms of the Fisheries (Amendments) Act 1997, since that time.

This Natura Impact Statement (NIS) has been compiled in response to a Requirement, issued by ALAB to Mowi Ireland on 20th June 2019 (ALAB reference AP2/1-14/2015) under Regulation 42 Paragraphs (8) and (3) of S1 477 2011, the European Communities (Birds and Natural Habitats) Regulations 2011. This requirement followed the execution of a Stage 1 Screening Stage Assessment in accordance with Article 6 (3) of the Habitats Directive and S1 477 2011. ALAB commissioned the Screening Stage Assessment from the Ecological Consultant Dr Olivia Crowe by ALAB in April 2019.

As stated in the assessment, Dr Crowe has identified a number of Special Protection Areas (SPAs) designated for breeding seabirds, which, based on published seabird foraging ranges and previously published surveys, demonstrate potential connectivity with the vicinity of the proposed Shot Head salmon farm site in Bantry Bay.

Dr Crowe's assessment concludes that, consequent on demonstrated connectivity, impacts on three named seabird species of conservation interest (SCIs) which breed on some or all of six named SPAs considered to be adjacent to the Shot Head site, cannot be ruled out. The three specific seabird species identified by Dr Crowe are:-

Northern Gannet	*Morus bassanus*
Common Guillemot	*Uria aalge*
Northern Fulmar	*Fulmarus glacialis*

Dr Crowe recommends that assessment for these three species and their six named home SPAs must therefore proceed to Stage 2 under Article 6 (3) of the Habitats Directive, as now mirrored in Irish law by SI 477 2011, Section 42, (1) and (2). These both require the compilation of a Natura Impact Statement. It is understood from ALAB's letter to Mowi Ireland of 20th June 2019 that these are the sole tasks to be undertaken in the NIS, in terms of the range and significance of impacts the proposed Shot Head site, both in isolation and in cumulative combination, with other potential impactors in the locality of the site.

1.2. Observations on the legal context and circumstances of the Section 42 requirement for a Natura Impact Statement.

Article 6 (3) of the Habitats Directive 92/43/EEC requires that:-

"3. Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site, in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public."

This requirement is transposed in Irish law in Part 5, Section 42 of SI 477 of 2011:-

(1) A screening for Appropriate Assessment of a plan or project for which an application for consent is received, or which a public authority wishes to undertake or adopt, and which is not directly connected with or necessary to the management of the site as a European Site, shall be carried out by the public authority to assess, in view of best scientific knowledge and in view of the conservation objectives of the site, if that plan or project, individually or in combination with other plans or projects is likely to have a significant effect[1] *on the European site.*

(2) A public authority shall carry out a screening for Appropriate Assessment under paragraph (1) before consent for a plan or project is given, or a decision to undertake or adopt a plan or project is taken.

(3) At any time following an application for consent for a plan or project, a public authority may give a notice in writing to the applicant, directing him or her to:-

(a) furnish a Natura Impact Statement and the applicant shall furnish the statement within the period specified in the notice, and

(b) furnish any additional information that the public authority considers necessary for the purposes of this Regulation.

Thus, both European and Irish legislation concur (as would be expected) that, if a plan or project not directly connected with (i.e. not lying within) a European conservation site is likely to have a significant effect, either on the site or its

[1] Underline inserted by author.

Species of Conservation Interest (SCIs), screening for Appropriate Assessment shall be carried out to establish whether or not this is the case. It was presumably on this basis Dr Crowe was commissioned to carry out a Stage 1 Screening Stage Assessment of the proposed Shot Head site.

It is noted that Dr Crowe's assessment is not the only assessment requisitioned by ALAB with the brief, to "*provide expert advice on* (the) *possible requirement for an Appropriate Assessment under the terms of the Habitats Directive"*[2]. The first assessment was required of Dr Tom Gittings by ALAB under Section 47(1)(a) of the Fisheries (Amendment) Act 1997 and was submitted by Dr Gittings in February 2018[3]. The only reason that seems to justify a second assessment, by Dr Crowe, is that, presumably in error, Dr Gittings omitted to consider one of the Species of Conservation Interest (SCI) present in Natura sites with potential connectivity to the proposed Shot Head site, namely the Common Guillemot, *Uria aalge*.

It is also notable that Dr Gittings' conclusions, stated in his report, on the other two species to be considered in the required NIS in the context of cumulative impacts, which are presumably likely to be the most severe, include the statements:-

Northern Gannet : "…*However, based on the assessment presented here, a stage 2 Appropriate Assessment of the potential impact of Gannet mortalities on the Gannet SCI of the Bull and the Cow Rocks SPA <u>may</u> be required*." (p 27 of report).

Northern Fulmar : "…*Therefore, it can be concluded that cumulative impacts from the development of the proposed fish farm site in-combination with wider aquaculture activity in Bantry Bay <u>are unlikely to occur</u>."* (p 24 of report).

Section 3 of Dr Crowe's Screening Assessment is entitled "*Assessment of Significance*" (sic; of impacts). This is the only section of her assessment which addresses the likelihood of impacts and, specifically, their significance.

Section 3.1 projects potential impacts of the proposed site in isolation. It includes a tabulated questionnaire, with responses. In its eight boxed sections, where questions are posed and responses given, the questionnaire seeks to qualify / quantify "impact significance". However, the responses given are qualified / quantified only by the use of the words "may", "could", "possible / possibly", "likely", and "unknown". Neither the word "significant", nor any synonym is used anywhere in the assessment to qualify or quantify any potential impact.

2 Abstracted from the Section 47 requirement briefing letter from ALAB to Dr Tom Gittings, December 2017.

3 Gittings, T. 2018. Bird Expert's Report: Briefing Note; Bird impact assessment: 5th February 2018 Report to the Aquaculture Licencing Appeals Board (ALAB) under Section 47 by the Board. www.ALAB.ie.

The last of the eight questions in Section 3.1 is more specific on this point, in seeking a response as to "*where the above impacts are likely to be significant or where the scale or magnitude of impacts is not known*". In its three responses to this question, the descriptive phrases used (by potential impact source) are:-

Species movements : "*very little information*".
Loss of foraging habitat and disturbance : "*largely unknown*".
Bird entanglement in nets : "*very little information*".

Section 3.2 of the assessment briefly examines "*cumulative and in-combination effects*" with existing "*aquaculture and salmon farming in the southwest*". However, impacts on the three SCIs identified are not described, qualified or quantified. Again, the word significant / significance or any synonym does not appear.

Thus, despite the requirement, confirmed by the title of Section 3, the assessment provides no information to qualify or quantify the significance of any potential impact but suggests, rather, that *very little information* is available or that potential impacts are *largely unknown*. The assessment concludes that "…*it is not possible to rule out potential impacts of the proposed development at Shot Head*…", again with no mention of the words significant, or significance, or any synonym. It is presumed that Dr Crowe reached her conclusions because the scientific literature and other information sources that she consulted provided only very little, or no information regarding the existence or scale of the potential impacts that she was charged to investigate.

It is strongly suggested that the usual and rational reason why a particular phenomenon should be "*largely unknown*", or have elicited "very little information", for example in the scientific literature, media, or in NGO or anti-lobby campaigns, is simply because no cause or effect exists, with sufficient substance or empirical evidence to be reported upon. That is, such a phenomenon can only be viewed, not as significant, but as insignificant, or as non-existent, from the outset.

In contrast to this view of the findings of the screening assessment, the letter from ALAB addressed to Mowi Ireland, dated 20th June 2019, takes another view. In giving notice of the requirement for the compilation of a NIS, the letter states that:-

"Independent Appropriate Assessment screening commissioned by ALAB has concluded that, based on a preliminary assessment and objective criteria, it is not possible to rule out potential significant adverse impacts[4] resulting from the installation of the proposed salmon farm…"

4 Underlines inserted by author.

It is now contended that, contrary to ALAB's apparent understanding, the Screening Assessment does not reach this conclusion. Indeed, it fails singularly to cite or reference any substantive evidence or to conclude that any "*potential significant adverse impacts*[3] *resulting from the installation of the proposed salmon farm.."* are likely to occur. At no point does the assessment use the word "significant", or any synonym, to describe any potential impact.

It is also submitted that ALAB's use of the phrase "*potential significant adverse impacts*" to justify the requisition of a NIS under SI 477 2011 Section 42, is not only inconsistent with the findings of Dr Crowe's Screening Stage Assessment but also with the findings of other documents requisitioned by ALAB under Section 47 as part of the application and appeal processes for the Shot Head licence[5], [6].

In the present context, it is regarded as unfortunate that ALAB should effectively put the opinion that "*it is not possible to rule out potential significant adverse impacts resulting from the installation of the proposed salmon farm…"* into the public domain when screening assessments provided to them by acknowledged experts in the field neither state nor support that view.

By way of information, the reason why the application for the proposed Shot Head site did not include a NIS in the first place is that it has been in process by the Department and by ALAB for so long that it actually preceded the signing of SI 477 2011 into law. It has also become out of date in other ways that appellants and others have not been slow to criticise. It may well therefore have been appropriate for a NIS to be required by the Department well before the licence was granted by the Minister, to take account of new knowledge and legislation. No such requirement was received by the applicant at any time until that of ALAB on 20th June 2019.

1.3. Note re change of name of applicant.

This NIS forms part of an application first submitted to the Department of Agriculture, Food and the Marine (DAFM), for licensing of a proposed new salmon farm site at Shot Head, Bantry Bay, County Cork, by Comhlucht Iascaireachta Fanad Teoranta (CIFT), in October 2010. This application is still in process, ten years later, at the time of writing.

Up to and including 31st December 2018, the Irish salmon farming company Comhlucht Iascaireachta Fanad Teoranta, or CIFT, Registration No. 66929, traded as Marine Harvest Ireland (MHI), as a subsidiary of the Norwegian multinational aquaculture company, Marine Harvest ASA. From January 1st,

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5 Gittings, T. 2018. Bird Expert's Report: Briefing Note; Bird impact assessment: 5th February 2018 Report to the Aquaculture Licencing Appeals Board (ALAB) under Section 47 by the Board. www.ALAB.ie.

6 Response of the Marine Institute dated March 28, 2018 to the section 47 Notice; from Dr. Jeff Fisher, Director of Marine Environment, Marine Institute.

2019, the trading name of CIFT was changed to Mowi Ireland. This change was concurrent with the change of company and trading names respectively of CIFT's Norwegian owners, to Mowi ASA and Mowi. The Irish registered company name remains unchanged as Comhlucht Iascaireachta Fanad Teoranta (CIFT).

As a consequence of this change in name, the licence applicant (which also commissioned this NIS and made the original Shot Head licence application in June 2011) will be referred to in this document as CIFT, or, on occasion as Mowi Ireland. The global company will be referred to as Mowi ASA. The former trading name of CIFT, Marine Harvest Ireland or MHI, will only be used, if necessary, in context, for historical accuracy.

1.4. The purpose and function of this document.

Guidance on Appropriate Assessment of plans and projects in Ireland is provided by the Department of Environment, Heritage and Local Government (DEHLG)[7]. This NIS does not fully follow the standard format because, rather than assessing the potential impacts of the proposed CIFT Shot Head salmon farm development on "within range" adjacent Natura 2000 sites and on all their Species of Conservation Interest (SCIs), its scope has been restricted by ALAB, as informed by the Stage 1 Screening Assessment, to the consideration of the impacts of the proposed development on just three named SCIs and on the six named Special Protection Areas, which some or all of them inhabit. The three SCIs to be considered are all foraging seabird species; the Northern Gannet (*Morus bassanus*), the Common Guillemot (*Uria aalge*) and the Northern Fulmar (*Fulmarus glacialis*).

The guidance document referred to above requires that a Stage 2 Assessment or NIS fulfils the following functions:-

1. Description of the proposed development in terms of its scale and objectives.

2. Description of baseline conditions, conservation objectives, and relevant ecological and environmental issues in relation to local Natura 2000 sites (in this case six named SPA sites).

3. Identification and estimation of the significance of potential adverse impacts, both direct and indirect, on these local Natura 2000 sites.

4. Consideration of combined impacts of the proposed development with impacts from other developments in its locality.

5. Proposals to mitigate possible impacts of the proposed development, if any.

7 Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities. DEHLG 2009.

Because none of the named Natura sites overlap the proposed Shot Head site, there are no *direct*, but only *indirect* impacts to be considered, by definition. The range of potential *indirect* impacts to be assessed include both *far-field impacts* and *near-field impacts*, defined as follows:-

- Potential far-field impacts.
  Potential for *far-field impacts* are those which may extend, from the source site/s in Bantry Bay, as far as the locations of the six named "in-range" SPAs and any of their three named SCIs, in situ. Such impacts may arise from the Shot Head site, either in isolation or in combination with other, potential sources of the same impact categories in Bantry Bay. The geographical range of the effects of such impacts is governed by:-

  - Impact concentration at source.
  - Rate of impact dispersion from source and dilution with distance / time.
  - Distance from the impact source/s to each named SPA site.

  Such impactors may be airborne or waterborne, such as waste streams, but are not expected to include obstructive, spatial, activity disturbance or noise disturbance impacts associated with the site/s. These, as defined, are most likely to be relatively near-field occurrences, limited in their zones of effect by distance and attenuation.

- Potential near-field impacts.
  Potential *near-field impacts*, must also be considered if arising, both from Shot Head in isolation and from the site, in cumulative combination with other impact sources in Bantry Bay. As a result of their near-field effects, such impacts are highly unlikely to interact significantly with the named Natura sites, but only arise as a result of the foraging abilities of each of the three named SCIs, which may, on occasion, enable them fly from their home SPAs into interaction range with the impact sources themselves. Such near-field impacts to be considered may include both air-dispersed and water-dispersed wastes from the site/sites, including settled solids wastes, as well as potential obstructive, spatial, activity and noise disturbance impacts, which can all be expected to increase with proximity to the source.

Section 2 considers items 1 to 3 in the bulleted list above. Section 3 investigates relevant aspects of the biology and status of the three species concerned, whilst Section 4 reviews of the relationships between the subject seabirds and the Shot Head site in isolation and in combination with other aquaculture activity in Bantry Bay as a whole. Mitigation measures are addressed at a number of points in the document.

Section 2.
Summary description of the proposed development in terms of its scale and objectives.

2.1. Timescale of licence application, granting and appeal.

The subject of this Natura Impact Statement (NIS) is a proposed organic salmon farm, to be located on a site between Shot Head and Mehil Head, on the north shore of Bantry Bay. The applicant for the Aquaculture Licence and Foreshore Licence, required to install and operate the site, is the salmon farming company CIFT, trading as Mowi Ireland. For the full description of the proposed development see the EIS attached to the June 2011 licence application and subsequent associated documentation, submitted either to DAFM or ALAB.

Research, surveying, scoping and Environmental Impact Assessment (EIA) for the project commenced in 2007 and was completed in 2010. The Enviromental Impact Statement (EIS)[8] was compiled between 2009 and 2010 and was submitted, as part of the Licence Application for the site. This followed internal consultation and approval by the Aquaculture and Foreshore Management Division (AFMD) of the Department of Agriculture Food and the Marine (DAFM). The submission date of the approved application was June 2011. The application was subsequently published by AFMD for public and statutory consultation. Following this, the licence for the proposed Shot Head site, numbered T5/555, was granted by the Minister in September 2015. The reasons for the decision provided by the Minister were stated in his determination as follows[9]:-

“The Minister for Agriculture, Food and the Marine has determined that it is in the public interest to grant an Aquaculture/Foreshore Licence for site numbered T5/555. This determination takes into consideration that the proposed aquaculture will be located in suitable waters, has potential economic benefits, will have no significant ecological effects on wild fisheries, natural habitats, flora and fauna or the environment generally.”

The licences for the project were appealed to the Aquaculture Licences Appeals Board (ALAB) upon granting in September 2015. The appeal has been ongoing over the last 5 years.

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8 Note that the term “Environmental Impact Statement (EIS)” was superceded by “Environmental Impact Assessment Report (EIAR)” under the terms of SI 240 2018, which brought Directive 2014/52/EU, amending Directive 2011/92/EU, into Irish law. The term Environmental Impact Statement (EIS) is only used herein, where it refers to documents that preceded the required change of title.

9 https://www.agriculture.gov.ie/media/migration/seafood/aquacultureforeshoremanagement/aquaculture licensing/aquaculturelicencedecisions/cork/T5555LicensingApplication140915.pdf

A considerable number of reports and other documentation and correspondence has been generated during the application, licensing and appeals processes for the Shot Head site. The most significant of these are available on the DAFM and ALAB websites[10], or otherwise from CIFT.

2.2. The proposed Shot Head site.

The operation of the proposed site is fully described in Volume 1 of the EIS, which accompanied the June 2011 application. Figures in this section are taken mainly from the EIS, published in 2011 or the Supplementary EIS, submitted to ALAB, following its requirement under Section 47 of the Fisheries (Amendment) Act 1997, and published in 2018. Figure 2.1. shows the location of the site, and the distances to existing salmon farms in the bay.

Figure 2.2 provides a Rural Place Map showing the location and layout of the proposed site. Note that the number of pens on the site may now vary to a maximum of 18, in order to assist the production process. However, production tonnage and the number of fish held on the site as a whole will not increase as a result of the increase in pen numbers. Experience in the years since the publication of the EIS in 2011 has demonstrated to the applicant that increased pen numbers provides a more sustainable way of maintaining the organic status of the stock on the site. This is now achieved by stocking each grow out pen with a fixed number of smolt, which will not be graded or moved, as was the case in the past, except for any standard treatments required, which involve the use of wellboat tanks, prior to harvest. This approach reduces stress on the stock and its consequences, including mortality and interruption of growth. Up to two of the pens installed on the site will be reserved for fish husbandry and harvesting procedures.

10 https://www.alab.ie

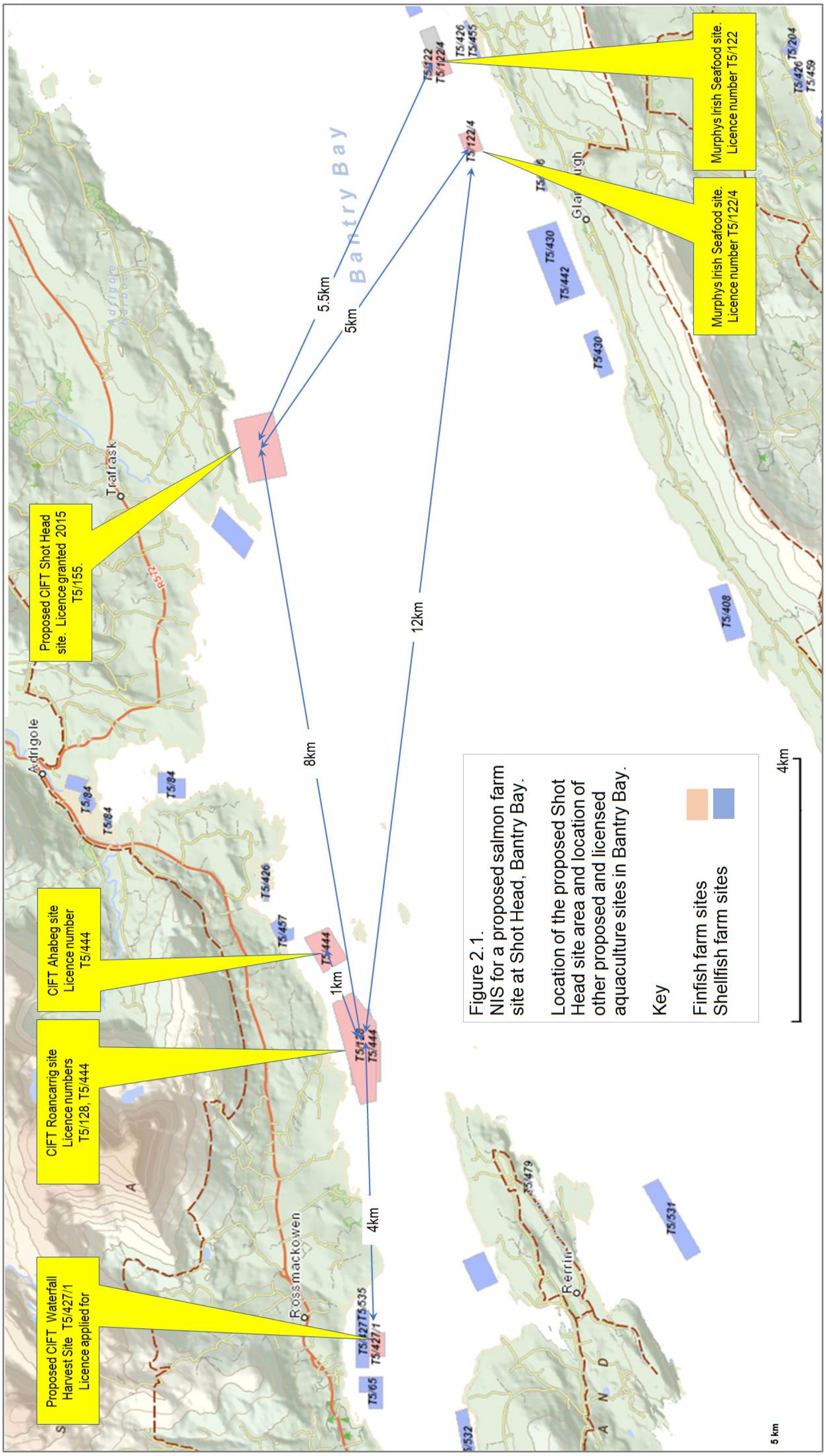

Figure 2.1.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

Location of the proposed Shot Head site area and location of other proposed and licensed aquaculture sites in Bantry Bay.

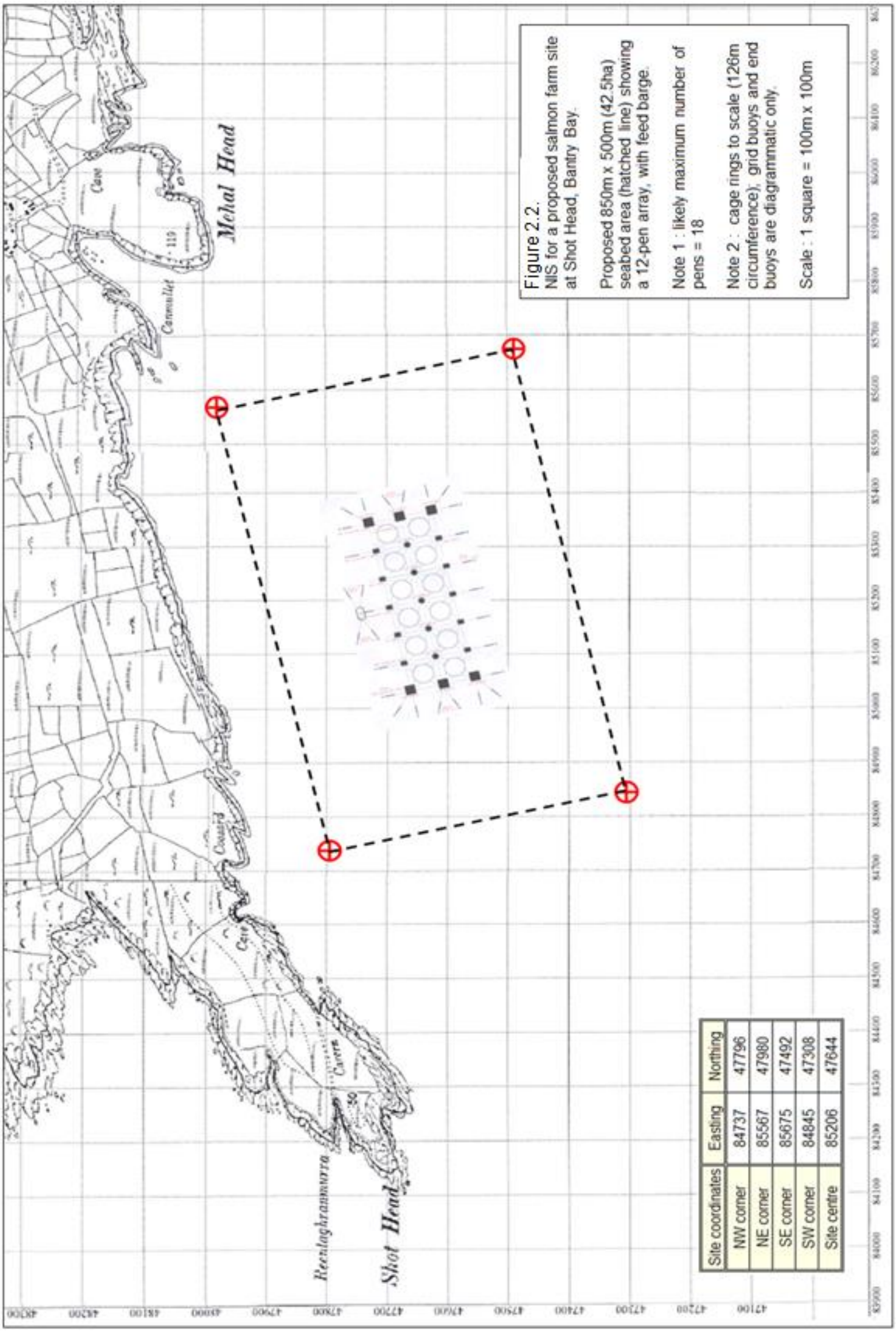

Figure 2.2.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

Proposed 850m x 500m (42.5ha) seabed area (hatched line) showing a 12-pen array, with feed barge.

Note 1 : likely maximum number of pens = 18

Note 2 : cage rings to scale (126m circumference); grid buoys and end buoys are diagrammatic only.

Scale : 1 square = 100m x 100m

Site coordinates	Easting	Northing
NW corner	84737	47796
NE corner	85567	47980
SE corner	85675	47492
SW corner	84845	47308
Site centre	85206	47644

2.3. Baseline conditions; hydrographic climate and ecological status of the waters of Bantry Bay.

2.3.1. Meteorology and conditions at the proposed Shot Head site.

Local meteorology and hydrography are relevant to the operation of the proposed site and its potential impacts from the points of view of:-

- Site access and potential for storm damage to the site and contained stocks.
- Dilution and dispersal of waste discharges from the proposed site, both in isolation and in combination with other discharge sources in the bay.

The applicant commissioned the global engineering and services consultancy, RPS Group, and Watermark, to undertake a number of hydrographic and related modelling studies, which are all calibrated against empirical data collected in the Shot Head site area and further afield. This database is reported in the Shot Head EIS of June 2011, whilst the modelled data arising are contained in various reports issued by RPS [11], [12]. These are either summarised in the EIS or, if written after the application, have been submitted in full to ALAB since [13], [14].

Tides in Bantry Bay are diurnal, with a mean tidal range from MLWS of 3m on spring tides and 1.6m on neaps. Equinoctial (maximum) tidal ranges approach 4.5m from MLWS on spring tides and 3.5m on neaps.

Prevailing winds blow from south-westerly at >5.5msec^{-1} for >50% of the year. Rainfall is approximately 1,200mm pa at sea level and 2,000mm pa over 150m above sea level.

Currents in Bantry Bay are driven by tidal forces, influenced by wind for some 50% of the time, in particular in winter. The axis of the bay runs roughly in the prevailing wind direction. Mean still-weather currents in the area of the proposed site are ≈6cmsec^{-1} in midwater and ≈5cmsec^{-1}, near the seabed. Site mean depth is 36.5m. Based on mean current data, the site is classified as a Level 2 site, deemed by the regulator as suitable for farmed salmon production of ≥1,000 tonnes per annum[15].

[11] RPS 2009. Detailed assessment of the wave climate at the fish farming sites at Bantry Bay and Dunmanus Bay, south west coast Ireland Report IBE0368/AKB/Bantry 20th December 2009.

[12] RPS 2011. Settlement study, Shot Head, Bantry Bay. IBE0490/R02/NS April 2011.

[13] RPS 2016. Water Quality Modelling for all existing and currently proposed salmon farm sites in Bantry Bay. IBE0744/R07/Rev03/NS Feb 2016.

[14] Watermark 2018. Supplementary Environmental Impact Statement (EIS) for a proposed salmon farm site at Shot Head, Bantry Bay, County Cork, Ireland. Submitted to ALAB under Section 47 F(A)A1997, April 2018.

[15] Anon 2008. Monitoring Protocol No.1. for offshore finfish farms -benthic monitoring. DAFM 2008

The RPS wave climate analysis, summarised in the EIS, concludes that the wave climate in Bantry Bay is influenced by Atlantic storm or local storm conditions, or both operating simultaneously. The model predicts that the wave climate at Shot Head will be of medium to high intensity, intensifying with increase in storm return period. However, there would be few days when access to the site or site work would be hindered, due to the dissipation of Atlantic swell waves as they penetrate the bay. Local storm waves are less severe due to the shortness of local fetches. Maximum significant wave height at the proposed site centre in a 1-in-50-year return period storm is expected to be ≈5m (trough to peak), whilst the worst average storm (1-in-1-year return period) will have a significant wave height of ≈3m. A similar wave climate is experienced on other salmon farm sites in Ireland and is deemed acceptable for the proposed operation. An active wave climate assists in wastes dispersion.

Based on the findings of the hydrographic study, as reported in the EIS, the still-weather flushing time for the Bantry Bay area is estimated to be 8.3 to 17.8 days, for mean spring tide to mean neap tide. Mean still-weather tidal flushing rate is estimated at 2.7 $x10^{10}m^3$ per month. This very large tidal flushing volume is the single biggest influence on the maintenance of water column conditions, and oxygen saturation in the bay; see Section 2.5.2 and Figure 2.26.

2.3.2. Baseline Ecological Status of Bantry Bay as defined under WFD.

Monitoring of the Ecological Status of all coastal and transitional waters within the EU is required under the terms of the Water Framework Directive (WFD) 2000/60/EC and in Ireland under SI 272 2009. Ecological Status is assessed by scoring a range of Quality Elements (QE), for monitored parameters, under the remit of the EPA. The QEs for Coastal and Transitional Waters, as apply in this case, are summarised in Table 2.1.

Table 2.1.
NIS for a proposed salmon famr site at Shot Head, Bantry Bay.
Quality Element list for Transitional and Coastal Waters; abstracted from SI 272 2009.

Quality Element			Transitional Waters	Coastal Waters
Biological Quality Elements		Composition, abundance and biomass of phytoplankton		
		Composition and abundance of other aquatic flora		
		Composition and abundance of benthic invertebrate fauna		
		Composition and abundance of fish fauna		
Hydromorphological Quality Elements	Morphological conditions	Depth variation		
		Quantity structure and bed substrate		
		Structure of intertidal zone		
	Tidal regime	Freshwater flow		
		Dominant direction of currents		
		Wave exposure		
Physicochemical Quality Elements	General conditions	Transparency, thermal, oxygenation,salinity and nutrient conditions		
	Specific pollutants	Listed synthetic or non-synthetic substances		

Bantry Bay as a whole comprises three Transitional (estuarine) and two Coastal Water Bodies. Their locations and Ecological Status and Risk Status, as calculated by the EPA, are shown in Figures 2.3 and 2.4.

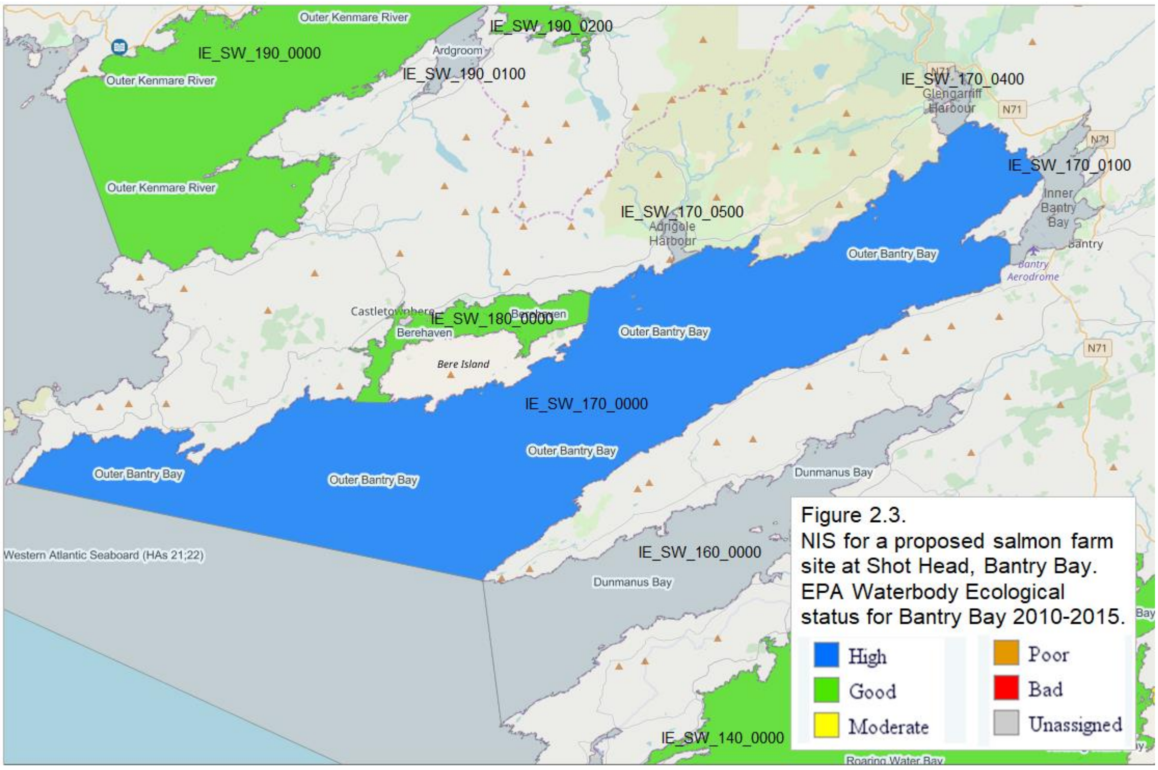

Figure 2.3.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
EPA Waterbody Ecological status for Bantry Bay 2010-2015.

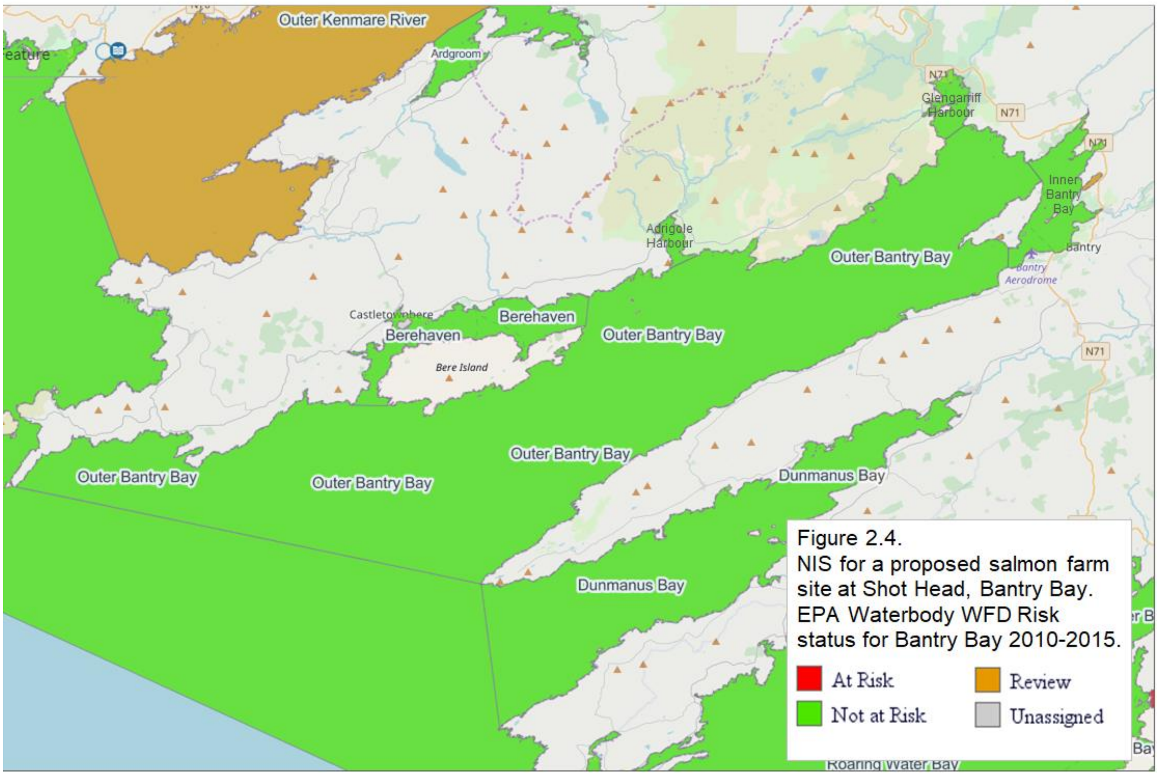

Figure 2.4.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
EPA Waterbody WFD Risk status for Bantry Bay 2010-2015.

Figures 2.3 and 2.4 are based on monitored data for the period 2010-2015 and are the most recent generated by the EPA. They are available online[16]. They show the results of EPA monitoring in Bantry Bay from the start of the second WFD 6-year cycle, which runs from end 2015 to end 2021. It should be noted that the Ecological Status for the three Transitional Water Bodies in the bay, at Adrigole Harbour, Glengarriff Harbour and Inner Bantry Bay, had not been assessed by the end of the last WFD cycle, although their status had been assessed as Not At Risk of deterioration. It should also be noted that, in making Ecological Status assessments, Quality Elements are grouped under type headings. Thus, all biological parameters are grouped together as Biological Quality Elements and hydromorphological parameters as Hydromorphological Quality Elements etc. To allow for a sufficient margin of error in the assessment of each Quality Element group, only the lowest-scoring Quality Element in each group is considered in determining the Ecological Status of each water body.

All existing salmon farm sites in Bantry Bay lie within the main Outer Bantry Bay coastal water body, where the proposed CIFT Shot Head site will also be located, should the required licences be granted. Most of the shellfish culture sites in the bay are also located in this water body, although some can be found in the Berehaven Coastal Water Body and in the three Transitional Water Bodies in the bay; see Figure 2.1 and 4.3-4.5. These sites all ultimately contribute to the ambient conditions in the bay, upon which the finding of High Ecological Status of Outer Bantry Bay under SI 272 is partly based. It is noted that the Ecological Status for the Berehaven Coastal Water Body is ranked as Good Status, one rank lower than High Status, presumably largely due to the inputs from the town of Castletownbere and local hydrography.

In summary, the EPA found that conditions in the Outer Bantry Bay Coastal Water Body at the end of the 2010-2015 WFD cycle stood at the highest Ecological Status level and that the level of risk of change during the next cycle was also assessed by the EPA to stand at its lowest Risk Status level.

The Minister licensed the proposed CIFT Shot Head site in September 2015. Therefore, the EPA's Ecological and Risk Status assessments for the 2010-2015 WFD cycle represent baseline conditions in Outer Bantry Bay at the time of the Minister's decision. Since no further finfish farm development has occurred in Bantry Bay during the appeal period to the present and since the Risk Status Assessment for 2010-2015 of Not at Risk, the Ecology and Risk assessments shown in Figures 2.3 and 2.4 can be safely taken to reflect current baseline conditions in the bay. This includes the contributions from all existing salmon farm sites.

16 www.catchments.ie

Baseline conditions (as current or historical ambient conditions) for individual water column parameters are further considered in the water quality modelling study in Section 2.5, under the terms of the Environmental Quality Standards (EQS) Directive 2008/105/EC. Whilst these are separately derived, it will be seen that they closely reflect the data provided under the Water Framework Directive, in this section.

2.4. Proposed CIFT Shot Head salmon farm; predicted stock growth, metabolism and waste.

2.4.1. Predicted stock growth.

The design capacity of the proposed Shot Head salmon farm site is for a biennial production of 3,500 tonnes of salmon, produced under organic standards, where maximum stocking density is 10 kg of salmon per m^3 of water. The production cycle is shown in the multi-generation grow out model in Table 2.2, taken from the 2011 EIS. Growth rate, mortality, harvesting rate, feed conversion rate (FCR) and consequent feed usage data are derived from empirical in-house CIFT data and information provided by the supplying feed company. The figures highlighted in yellow show the Maximum Allowable Biomass applied for, for the site, of a maximum site standing stock of 2,800 tonnes, which occurs between February and March in Year 2 of the production cycle. This immediately follows the peak growth month of January and coincides with the start of harvesting. All waste discharge and dispersal data, used in the licence application and in this document, are calculated for the highest growth month of January Year 2 only, representing the worst case scenario.

2.4.2. Calculating salmon farm waste outputs.

Monthly waste generation from the proposed site is calculated from the growth model data shown in Table 2.2, along with feed analytical and digestibility data provided by the feed manufacturers, shown in Table 2.3. To estimate potential discharge impacts on receiving water quality, four standard waste parameters are employed that are widely used for the calculation of waste inputs:-

- Dissolved Inorganic Nitrogen (DIN)
- Dissolved Inorganic Phosphorus (DIP)
- Biological Oxidation Demand (BOD)
- Suspended / Settleable Solids (SS)

Note that some of the calculations used for the 2016 RPS study update those used in the 2011 EIS. This applies mainly to the calculation of BOD outputs. The later method includes a means to calculate soluble BOD outputs, resulting in higher total BOD outputs that the earlier model. These updated figures are used for the discharge budget in Table 2.4 and in the resulting RPS dispersal models, both because they are more up to date and because they exhibit a worse case than that used in the EIS. These are set out and explained in bullets 1 to 4 following.

Table 2.2.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Projected multi-generation grow-out model for proposed Shot Head site.
Notes : SD = Stocking density; based on November input of S0 smolts. Abstracted from 2011 Shot Head EIS.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Year	Month	Months growth	Fish number		Mortality		Mean weight gms		Total Biomass T		Mean SD @ total cage vol 280,000m³	Biogain/ month tonnes	Harvest			FCR	Feed used T / month
			Start month	End month	% per month	Number / month	Start month	End month	Start month	End month			Number	Mean wt kg	Harvest tonnes		
1	Nov	1	835,884	814,987	2.50	20,897	75	101	62.7	82.3	0.3	19.6	0	0	0	0.95	18.6
1	Dec	2	814,987	802,762	1.50	12,225	101	141	82.3	113.2	0.4	30.9	0	0	0	0.95	29.3
1	Jan	3	802,762	796,340	0.80	6,422	141	198	113.2	157.7	0.6	44.5	0	0	0	1.00	44.5
1	Feb	4	796,340	792,358	0.50	3,982	198	275	157.7	217.9	0.8	60.2	0	0	0	1.10	66.2
1	Mar	5	792,358	788,397	0.50	3,962	275	375	217.9	295.6	1.1	77.8	0	0	0	1.20	93.3
1	Apr	6	788,397	784,455	0.50	3942	375	505	295.6	396.1	1.4	100.5	0	0	0	1.20	120.6
1	May	7	784,455	777,394	0.90	7060	505	670	396.1	520.9	1.9	124.7	0	0	0	1.23	152.8
1	Jun	8	777,394	768,066	1.20	9,329	670	880	520.9	675.9	2.4	155.0	0	0	0	1.25	193.8
1	Jul	9	768,066	756,545	1.50	11,521	880	1,130	675.9	854.9	3.1	179.0	0	0	0	1.27	227.3
1	Aug	10	756,545	739,144	2.30	17,401	1,130	1,417	854.9	1,047.4	3.7	192.5	0	0	0	1.27	244.4
1	Sep	11	739,144	725,840	1.80	13,305	1,417	1,745	1,047.4	1,266.6	4.5	219.2	0	0	0	1.27	278.4
1	Oct	12	725,840	721,485	0.60	4,355	1,745	2,120	1,266.6	1,529.5	5.5	263.0	0	0	0	1.27	334.0
2	Nov	13	721,485	712,827	1.20	8,658	2,120	2,550	1,529.5	1,817.7	6.5	288.2	0	0	0	1.27	366.0
2	Dec	14	712,827	707,124	0.80	5,703	2,550	3,025	1,817.7	2,139.1	7.6	321.3	0	0	0	1.27	408.1
2	Jan	15	707,124	702,174	0.70	4,950	3,025	3,540	2,139.1	2,485.7	8.9	346.6	0	0	0	1.27	440.2
2	Feb	16	702,174	693,748	1.20	8,426	3,540	4,036	2,485.7	**2,800**	10.0	314.3	0	0	0	1.27	399.1
2	Mar	17	693,748	600,423	1.20	8,325	4,036	4,534	**2,800**	2,722.3	9.7	304.9	85,000	4.500	382.50	1.27	387.2
2	Apr	18	600,423	475,620	0.80	4,803	4,534	4,975	2,722.3	2,366.2	8.5	207.9	120,000	4.700	564.00	1.27	264.0
2	May	19	475,620	336,815	0.80	3,805	4,975	5,248	2,366.2	1,767.6	6.3	110.1	135,000	5.250	708.75	1.27	139.9
2	Jun	20	336,815	229,794	0.60	2,021	5,248	5,420	1,767.6	1,245.5	4.4	44.9	105,000	5.400	567.00	1.27	57.0
2	Jul	21	229,794	118,645	0.50	1,149	5,420	5,544	1,245.5	657.8	2.3	28.3	110,000	5.600	616.00	1.27	35.9
2	Aug	22	118,645	0	0.40	475	5,544	5,600	657.8	0.0	0.0	4.0	118,170	5.600	661.75	1.27	5.1
2	Sep	23	Harvest completed. Site fallow until next smolt input.														
2	Oct	24															
2	Nov	1	835,884	814,987	2.50	20,897	75	101	62.7	82.3	0.3	19.6	0	0	0	0.95	18.6
2	Dec	2	814,987	802,762	1.50	12,225	101	141	82.3	113.2	0.4	30.9	0	0	0	0.95	29.3
3	Jan	3	802,762	796,340	0.80	6,422	141	198	113.2	157.7	0.6	44.5	0	0	0	1.00	44.5
3	Feb	4	796,340	792,358	0.50	3,982	198	275	157.7	217.9	0.8	60.2	0	0	0	1.10	66.2
3	Mar	5	792,358	788,397	0.50	3,962	275	375	217.9	295.6	1.1	77.8	0	0	0	1.20	93.3
3	Apr	6	788,397	784,455	0.50	3942	375	505	295.6	396.1	1.4	100.5	0	0	0	1.20	120.6
3	May	7	784,455	777,394	0.90	7060	505	670	396.1	520.9	1.9	124.7	0	0	0	1.23	152.8
3	Jun	8	777,394	768,066	1.20	9,329	670	880	520.9	675.9	2.4	155.0	0	0	0	1.25	193.8
3	Jul	9	768,066	756,545	1.50	11,521	880	1,130	675.9	854.9	3.1	179.0	0	0	0	1.27	227.3
3	Aug	10	756,545	739,144	2.30	17,401	1,130	1,417	854.9	1,047.4	3.7	192.5	0	0	0	1.27	244.4
3	Sep	11	739,144	725,840	1.80	13,305	1,417	1,745	1,047.4	1,266.6	4.5	219.2	0	0	0	1.27	278.4
3	Oct	12	725,840	721,485	0.60	4,355	1,745	2,120	1,266.6	1,529.5	5.5	263.0	0	0	0	1.27	334.0
3	Nov	13	721,485	712,827	1.20	8,658	2,120	2,550	1,529.5	1,817.7	6.5	288.2	0	0	0	1.27	366.0
3	Dec	14	712,827	707,124	0.80	5,703	2,550	3,025	1,817.7	2,139.1	7.6	321.3	0	0	0	1.27	408.1
4	Jan	15	707,124	702,174	0.70	4,950	3,025	3,540	2,139.1	2,485.7	8.9	346.6	0	0	0	1.27	440.2
4	Feb	16	702,174	693,748	1.20	8,426	3,540	4,036	2,485.7	**2,800**	10.0	314.3	0	0	0	1.27	399.1
4	Mar	17	693,748	600,423	1.20	8,325	4,036	4,534	**2,800**	2,722.3	9.7	304.9	85,000	4.500	382.50	1.27	387.2
4	Apr	18	600,423	475,620	0.80	4,803	4,534	4,975	2,722.3	2,366.2	8.5	207.9	120,000	4.700	564.00	1.27	264.0
4	May	19	475,620	336,815	0.80	3,805	4,975	5,248	2,366.2	1,767.6	6.3	110.1	135,000	5.250	708.75	1.27	139.9
4	Jun	20	336,815	229,794	0.60	2,021	5,248	5,420	1,767.6	1,245.5	4.4	44.9	105,000	5.400	567.00	1.27	57.0
4	Jul	21	229,794	118,645	0.50	1,149	5,420	5,544	1,245.5	657.8	2.3	28.3	110,000	5.600	616.00	1.27	35.9
4	Aug	22	118,645	0	0.40	475	5,544	5,600	657.8	0.0	0.0	4.0	118,170	5.600	661.75	1.27	5.1
4	Sep	23	Harvest completed. Site fallow until next smolt input.														
4	Oct	24															
4	Nov	1	835,884	814,987	2.50	20,897	75	101	62.7	82.3	0.3	19.6	0	0	0	0.95	18.6
4	Dec	2	814,987	802,762	1.50	12,225	101	141	82.3	113.2	0.4	30.9	0	0	0	0.95	29.3
5	Jan	3	802,762	796,340	0.80	6,422	141	198	113.2	157.7	0.6	44.5	0	0	0	1.00	44.5
5	Feb	4	796,340	792,358	0.50	3,982	198	275	157.7	217.9	0.8	60.2	0	0	0	1.10	66.2
5	Mar	5	792,358	788,397	0.50	3,962	275	375	217.9	295.6	1.1	77.8	0	0	0	1.20	93.3
5	Apr	6	788,397	784,455	0.50	3942	375	505	295.6	396.1	1.4	100.5	0	0	0	1.20	120.6
5	May	7	784,455	777,394	0.90	7060	505	670	396.1	520.9	1.9	124.7	0	0	0	1.23	152.8
5	Jun	8	777,394	768,066	1.20	9,329	670	880	520.9	675.9	2.4	155.0	0	0	0	1.25	193.8
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5	Sep	11	739,144	725,840	1.80	13,305	1,417	1,745	1,047.4	1,266.6	4.5	219.2	0	0	0	1.27	278.4
5	Oct	12	725,840	721,485	0.60	4,355	1,745	2,120	1,266.6	1,529.5	5.5	263.0	0	0	0	1.27	334.0
5	Nov	13	721,485	712,827	1.20	8,658	2,120	2,550	1,529.5	1,817.7	6.5	288.2	0	0	0	1.27	366.0
5	Dec	14	712,827	707,124	0.80	5,703	2,550	3,025	1,817.7	2,139.1	7.6	321.3	0	0	0	1.27	408.1
6	Jan	15	707,124	702,174	0.70	4,950	3,025	3,540	2,139.1	2,485.7	8.9	346.6	0	0	0	1.27	440.2
6	Feb	16	702,174	693,748	1.20	8,426	3,540	4,036	2,485.7	**2,800**	10.0	314.3	0	0	0	1.27	399.1
6	Mar	17	693,748	600,423	1.20	8,325	4,036	4,534	**2,800**	2,722.3	9.7	304.9	85,000	4.500	382.50	1.27	387.2
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6	May	19	475,620	336,815	0.80	3,805	4,975	5,248	2,366.2	1,767.6	6.3	110.1	135,000	5.250	708.75	1.27	139.9
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6	Jul	21	229,794	118,645	0.50	1,149	5,420	5,544	1,245.5	657.8	2.3	28.3	110,000	5.600	616.00	1.27	35.9
6	Aug	22	118,645	0	0.40	475	5,544	5,600	657.8	0.0	0.0	4.0	118,170	5.600	661.75	1.27	5.1
6	Sep	23	Harvest completed. Site fallow until next smolt input.														
6	Oct	24															

1. Nitrogen (N) waste.
   The N retained for growth from ingested feed N is estimated on the basis that whole salmon contains approximately 3.4% of body dry weight as N (Ackefors and Enell, 1990[17]). Whilst protein content (and therefore N content) of farmed salmon vary with region, fish mean weight and growth conditions, Ackefors' and Enell's figure is broadly confirmed by Colwell et al [18]. This gives a means to calculate waste N, from the feed conversion rate and the monthly feed N content, less the N retained in growth. The insoluble and soluble N fractions are then derived by taking account of the digestibility of the protein fraction of the diet (see Tables 2.3 and 2.4). Feed consumed (97%) versus feed wasted (3%) is also taken account of in the equations:-

$$\text{N total pm} = [(1\text{-}0.03) \times \text{Biogain pm} \times (\text{ration protein\%} \times 0.16) \times \text{FCR} \times 10) - 34] + [0.03 \times (\text{ration protein pm} \times 0.16)]$$

$$\text{N soluble pm} = \text{N0}_3\text{N total pm} \times ((\text{protein digestibility \%})/100).$$

$$\text{N insoluble pm} = \text{N0}_3\text{N total pm} \times (1 - ((\text{protein digestibility \%})/100))$$

2. Phosphorus (P) waste.
   The equations for P waste are similar to those for N waste but assume that P solubility is 62% and that the P retained for growth is 0.5% of body weight (from whole body analysis; see also Tables 2.3 and 2.4 for calculated monthly total feed P content.

$$\text{P total pm} = [0.97 \times \text{Biogain pm} \times \text{ration P\%} \times \text{FCR} \times 10) - 5] + [0.03 \times \text{ration P pm}]$$

$$\text{P soluble pm} = \text{PO}_4\text{P total pm} \times \text{digestibility}.$$

$$\text{P insoluble pm} = \text{PO}_4\text{P total pm} \times (1\text{-digestibility})$$

3. Solids waste.
   The equations used in this document to calculate the production of faeces and wasted feed solids are as proposed by Cromey et al (2002)[19]. These equations have been modified here to give data as dry weight waste production per month, on the assumptions that the rations contain a standard 5% moisture, as advised by the feed manufacturer, and that 3% of the total feed supplied to the fish is wasted to the water column and seabed:-

17 Ackefors, H. and Enell M. 1990. Discharge of nutrients from Swedish fish farming to adjacent sea areas. Ambio, **19(1)**, 28-35.

18 Colwell P et al 2011. Nitrogen factors for Atlantic salmon, Salmo salar farmed in Scotland and in Norway and for the derived ingredient, "Salmon Frame Mince) in fish products. J. Assoc Pub Anal (online) 39, 44-78.

19 Cromey C.J., Nickell T.D., Black K.D. 2002. Depomod; modelling the deposition and biological effects of waste solids from marine pen farms. Aquaculture 214, 211-239.

Total waste solids per month (pm) = faeces (pm) + waste feed (pm)

Faeces (dry wt pm) = feed pm x (1-0.03) x (1 – digestibility) x (1 – 0.05)

Waste feed (dry wt pm) = feed wt pm x (1-0.5) x 0.03

4. Organic Carbon (C) waste.
The estimation of Organic C settlement from fish farms is an important consideration because it is used to calculate *Benthic Impact Index*, in the Scottish Executive's Locational Guidelines for fish farming (Gillibrand et al 2002[20]). Equations are shown for the calculation of Insoluble C wastes, in both waste feed and faeces, which are then used in waste solids dispersal modelling.

In the past, the C content of salmon feeds and wastes was based on the findings of Gowen et al (1987)[21], who estimated this at 44% and apportioned 30% of consumed C to faeces. However, changes in dietary formulations and the need for more accurate estimates of BOD in salmon farm wastes, which arise in part from C oxidation, has led to a reappraisal of the C content of salmon feeds and wastes. A revised method uses the C content of the three main constituents of salmon feed, that is protein (55% C), fat (75% C) and carbohydrate (40% C)[22]. Thus:-

% Feed C = (Feed protein % x 0.55) + (Feed fat % x 0.75) + (Feed CHO % x 0.40)

Wang X et al (2013)[23] estimated that 19% of feed C is released in salmon faeces, giving a new basis to calculate Faecal C:-

Faecal C dry weight per month = Feed C pm x (19 / 100)

Settled waste feed C dry weight per month = Feed pm x (1-0.05) x 0.03

Note that the proximate analysis of feed varies with formulation. Thus % C content of both feed and faeces will also vary with feed type, which is taken into account by these equations.

20 Gillibrand PA, Gubbins MJ, Greathead C and Davies IM. 2002. Scottish Executive locational guidelines for fish farming: predicted levels of nutrient enhancement and benthic impact. Scottish Fisheries Research Report 63

21 Gowen, R.J. and Bradbury, N.B. 1987. The ecological impact of salmonid farming in coastal waters: a review. *Oceanog. Mar. Biol. Ann. Rev*., 25, 563-575.

22 Bradbury N.B. BioMar UK, *pers. comm.*

23 Xinxin Wang, Andresen K, Handå A, Jensen B, Reitan KI and Olsen Y. 2013. Chemical composition and release rate of waste discharge from an Atlantic salmon farm with an evaluation of IMTA feasibility. Aquacult Environ Interact 4: 147–162, 2013.

5. Combined BOD of all wastes:-
   Up until 2011, the equation below was used by Watermark to calculate the BOD of wastes from salmonid farms. It describes a trend line through scatter plots of empirical BOD analytical data from solid wastes only, produced by freshwater-farmed rainbow trout. This method fort BOD estimation was developed by the Danish Environmental Institute (DEI) in the 1980's and was used in the original Shot Head EIS for BOD calculation:-

   $$\text{BOD pm} = \text{Biogain pm} \times [686 - [(1671 \times \text{FCR})] + [1544 \times \text{FCR}^2)] - [354 \times (\text{FCR}^3)]]$$

   A revised method, proposed by Boyd in 2009[24], offers a more accurate assessment of waste BOD production by calculating the BOD of both solid (insoluble) and soluble salmon farm wastes. This is based on the definition of BOD as the oxygen-depletion effect of waste contaminants, which Boyd defines as the amount of oxygen required to oxidise all organic C and N components from feed inputs, which are not recovered in the fish biomass at harvest. This comprises the BOD of both solid and soluble N and C wastes, but also includes the BOD of soluble C respiratory waste, which is not taken into account in the DEI equation given above. Boyd's calculation of total BOD is expressed by the formula:-

   $$\text{BOD} = ((\text{Total feed N} - \text{Total fish N}) \times 4.57) + ((\text{Total feed C} - \text{Total fish C}) \times 2.67).$$

   The raising factors of 4.57 and 2.67 proposed by Boyd relate to the atomic weights of N and C and describe the weight in kg of oxygen required to oxidise 1kg of waste N and 1kg of waste C respectively.

   For this calculation, it is also necessary to know the N content and the C content of whole salmon. N content of salmon is taken as 3.4% of whole salmon dry weight (see Bullet 1 above), after Ackefors and Enell. C content can be calculated from the protein and fat content of whole farmed salmon, which, for this purpose, are taken as 17% and 20% respectively. Since protein contains 55% C and fat 75% C (see Bullet 4 above), the following calculation can then be made:-

   $$\text{Total salmon C\%} = (17 \times 0.55)\% + (20 \times 0.75)\% = 24.35\%$$

[24] Boyd C. 2009 Estimation of mechanical aeration requirement in shrimp ponds form the oxygen demand of feed. Proceeding of the Word Aquaculture Society Meeting Sept 25th-29th, Vera Cruz Mexico. See also Global Aquaculture Performance Index (GAPI) BOD calculation methodology available at http://web.uvic.ca/~gapi explore-gapi/bod.html.

Table 2.3.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Proprietary feed specifications; BioMar EcoLife Pearl organic ration.

	Proximate analysis and digestibility															Feed Carbon content		
Ration detail organic	Ration size mm	Mean fish weight range g	Gross energy MJ/kg	Digestible energy MJ/kg	Thus feed digestibility %	Oil %	Protein %	Phosphorus %	Digestible protein %	Thus % protein digestibility	Potential FCR	Carbo-hydrate %	NFE %	Ash %	Moisture %	Protein C %	Fat C%	CHO C%
MHI Ireland Biomar EcoLife Pearl organic ration																		
Pearl 2mm	2.0	15-50	22.20	18.50	83.33	22	46.0	1.0	40.4	87.83	0.70	14.00	12.00	11.00	5.00	25.30	16.50	5.60
Pearl 3mm	3.0	50-150	22.20	18.50	83.33	22	46.0	1.0	40.4	87.83	0.70	14.00	12.00	11.00	5.00	25.30	16.50	5.60
Pearl 4.5mm	4.5	150-500	22.70	18.80	82.82	24	44.0	1.0	38.2	86.82	0.78	14.00	12.00	10.00	5.00	24.20	18.00	5.60
Pearl 6.5mm	6.5	500-1000	23.30	19.20	82.40	26	42.0	0.9	36.1	85.95	0.80	16.00	14.00	9.00	5.00	23.10	19.50	6.40
Pearl 9mm	9.0	1000-2000	24.10	20.20	83.82	32.5	37.9	0.9	34.4	90.77	0.98	17.00	14.00	8.50	5.00	20.85	24.38	6.80
Pearl 12mm	12.0	2000-	24.10	20.20	83.82	32.5	37.9	0.9	34.4	90.77	1.05	17.00	14.00	8.50	5.00	20.85	24.38	6.80

Table 2.4.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Feed specifications and monthly usage for calculation of discharge budget for Shot Head site; see Table 2.4.

Month ending	Biogain T pm	FCR	Fish mw g month end	Feed specification							Feed and nutrient content tonnes / month					Digestibilty %	
				Type	Size mm	Protein %	Oil %	Phos. %	CHO%	Total C %	Feed fed	Feed protein	Total N	Total P	Total C	Total feed	Protein
Nov	19.62	0.95	101	Eclolife Pearl	3.0	46.0	22.0	1.0	14.0	47.4	18.64	8.57	1.37	0.19	8.84	83.33	87.83
Dec	30.88	0.95	141	Eclolife Pearl	3.0	46.0	22.0	1.0	14.0	47.4	29.33	13.49	2.16	0.29	13.90	83.33	87.83
Jan	44.49	1.00	198	Eclolife Pearl	4.5	44.0	24.0	1.0	14.0	47.8	44.49	19.57	3.13	0.44	21.26	82.82	86.82
Feb	60.22	1.10	275	Eclolife Pearl	4.5	44.0	24.0	1.0	14.0	47.8	66.25	29.15	4.66	0.66	31.67	82.82	86.82
Mar	77.75	1.20	375	Eclolife Pearl	4.5	44.0	24.0	1.0	14.0	47.8	93.30	41.05	6.57	0.93	44.60	83.82	86.82
Apr	100.50	1.20	505	Eclolife Pearl	4.5	44.0	24.0	1.0	14.0	47.8	120.60	53.06	8.49	1.21	57.65	83.82	86.82
May	124.70	1.23	670	Eclolife Pearl	6.5	42.0	26.0	0.9	16.0	49.0	152.76	64.16	10.27	1.37	74.85	82.40	85.95
Jun	155.04	1.25	880	Eclolife Pearl	6.5	42.0	26.0	0.9	16.0	49.0	193.80	81.40	13.02	1.74	94.96	82.40	85.95
Jul	179.00	1.27	1,130	Eclolife Pearl	6.5	42.0	26.0	0.9	16.0	49.0	227.33	95.48	15.28	2.05	111.39	82.40	85.95
Aug	192.47	1.27	1,417	Eclolife Pearl	9.0	37.9	32.5	0.9	17.0	52.0	244.44	92.64	14.82	2.20	127.16	83.82	90.77
Sep	219.22	1.27	1,745	Eclolife Pearl	9.0	37.9	32.5	0.9	17.0	52.0	278.41	105.52	16.88	2.51	144.83	83.82	90.77
Oct	262.96	1.27	2,120	Eclolife Pearl	9.0	37.9	32.5	0.9	17.0	52.0	333.96	126.57	20.25	3.01	173.72	83.82	90.77
Nov	288.16	1.27	2,550	Eclolife Pearl	12.0	37.9	32.5	0.9	17.0	52.0	365.96	138.70	22.19	3.29	190.37	83.82	90.77
Dec	321.34	1.27	3,025	Eclolife Pearl	12.0	37.9	32.5	0.9	17.0	52.0	408.10	154.67	24.75	3.67	212.30	83.82	90.77
Jan	346.65	1.27	3,540	Eclolife Pearl	12.0	37.9	32.5	0.9	17.0	52.0	440.24	166.85	26.70	3.96	229.01	83.82	90.77
Feb	314.27	1.27	4,036	Eclolife Pearl	12.0	37.9	32.5	0.9	17.0	52.0	399.12	151.27	24.20	3.59	207.62	83.82	90.77
Mar	304.85	1.27	4,534	Eclolife Pearl	12.0	37.9	32.5	0.9	17.0	52.0	387.16	146.73	23.48	3.48	201.40	83.82	90.77
Apr	207.89	1.27	4,975	Eclolife Pearl	12.0	37.9	32.5	0.9	17.0	52.0	264.02	100.06	16.01	2.38	137.34	83.82	90.77
May	110.15	1.27	5,248	Eclolife Pearl	12.0	37.9	32.5	0.9	17.0	52.0	139.89	53.02	8.48	1.26	72.77	83.82	90.77
Jun	44.88	1.27	5,420	Eclolife Pearl	12.0	37.9	32.5	0.9	17.0	52.0	57.00	21.60	3.46	0.51	29.65	83.82	90.77
Jul	28.28	1.27	5,544	Eclolife Pearl	12.0	37.9	32.5	0.9	17.0	52.0	35.92	13.61	2.18	0.32	18.69	83.82	90.77
Aug	3.99	1.27	5,600	Eclolife Pearl	12.0	37.9	32.5	0.9	17.0	52.0	5.06	1.92	0.31	0.05	2.63	83.82	90.77
Sep	No feeding; site fallow																
Oct																	

Table 2.5.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Projected discharge budget for Shot Head, including BOD discharges; T pm

Month ending	"Old" BioMar DEI values		Settleable solids			Settleable solids Carbon			Nitrogen discharge T / month			Phosphorus discharge T / month			"New" Total BOD discharge Tpm			Total solids BOD only T pm
	BOD5 T pm	Solids T pm	Feed waste T pm	Faeces T pm	Total solids T pm	Feed waste C T pm	Faecal C T pm	Total solids C T pm	Settleable N T pm	Soluble N T pm	Total N T pm	Settleable P T pm	Soluble P T pm	Total P T pm	N BOD T pm	C BOD T pm	Total BOD T pm	
Nov	3.699	0.793	0.531	2.863	3.394	0.252	1.628	1.880	0.088	0.637	0.725	0.035	0.057	0.091	3.313	10.835	14.147	8.333
Dec	5.820	1.248	0.836	4.505	5.341	0.396	2.562	2.959	0.139	1.002	1.141	0.055	0.089	0.144	5.212	17.048	22.261	13.112
Jan	9.120	2.046	1.268	7.043	8.311	0.606	3.919	4.525	0.219	1.445	1.665	0.087	0.142	0.229	7.608	27.853	35.461	19.689
Feb	14.753	3.802	1.888	10.488	12.376	0.902	5.836	6.738	0.353	2.325	2.678	0.141	0.230	0.370	12.236	45.393	57.629	30.228
Mar	22.738	6.825	2.659	13.913	16.572	1.271	8.219	9.490	0.528	3.476	4.004	0.211	0.345	0.556	18.299	68.526	86.825	43.638
Apr	29.391	8.822	3.437	17.984	21.421	1.643	10.624	12.267	0.682	4.494	5.176	0.273	0.446	0.719	23.653	88.578	112.232	56.407
May	38.065	11.854	4.354	24.771	29.125	2.133	13.796	15.929	0.864	5.289	6.153	0.293	0.477	0.770	28.119	118.784	146.903	70.649
Jun	49.357	15.933	5.523	31.426	36.949	2.706	17.502	20.208	1.111	6.799	7.910	0.377	0.615	0.992	36.150	152.754	188.904	90.107
Jul	58.894	19.554	6.479	36.862	43.340	3.175	20.529	23.704	1.317	8.056	9.373	0.448	0.730	1.178	42.835	181.038	223.872	106.124
Aug	63.327	21.025	6.967	36.451	43.418	3.624	23.435	27.059	0.783	7.692	8.475	0.481	0.785	1.266	38.731	214.375	253.106	110.979
Sep	72.129	23.948	7.935	41.518	49.452	4.128	26.692	30.820	0.891	8.762	9.653	0.548	0.894	1.442	44.114	244.171	288.285	126.403
Oct	86.518	28.725	9.518	49.800	59.318	4.951	32.017	36.968	1.069	10.509	11.579	0.657	1.073	1.730	52.915	292.882	345.797	151.620
Nov	94.811	31.478	10.430	54.573	65.003	5.426	35.086	40.512	1.172	11.517	12.689	0.721	1.176	1.896	57.987	320.954	378.941	166.153
Dec	105.728	35.103	11.631	60.858	72.489	6.050	39.126	45.177	1.307	12.843	14.150	0.803	1.311	2.114	64.664	357.911	422.575	185.285
Jan	114.054	37.867	12.547	65.650	**78.197**	6.527	42.207	**48.734**	1.410	13.854	**15.264**	0.867	1.414	**2.281**	69.756	386.095	**455.851**	199.875
Feb	103.401	34.331	11.375	59.518	70.893	5.917	38.265	44.182	1.278	12.560	13.838	0.786	1.282	2.068	63.241	350.035	413.276	181.208
Mar	100.302	33.302	11.034	57.734	68.768	5.740	37.118	42.858	1.240	12.184	13.423	0.762	1.244	2.006	61.345	339.544	400.889	175.776
Apr	68.400	22.710	7.525	39.371	46.896	3.914	25.312	29.227	0.845	8.309	9.154	0.520	0.848	1.368	41.834	231.548	273.382	119.869
May	36.240	12.032	3.987	20.860	24.847	2.074	13.411	15.485	0.448	4.402	4.850	0.275	0.449	0.725	22.165	122.681	144.845	63.510
Jun	14.766	4.903	1.624	8.499	10.124	0.845	5.464	6.309	0.182	1.794	1.976	0.112	0.183	0.295	9.031	49.986	59.017	25.877
Jul	9.306	3.090	1.024	5.357	6.380	0.533	3.444	3.976	0.115	1.130	1.245	0.071	0.115	0.186	5.692	31.503	37.195	16.309
Aug	1.312	0.435	0.144	0.755	0.899	0.075	0.485	0.560	0.016	0.159	0.176	0.010	0.016	0.026	0.802	4.440	5.242	2.299
Sep	No feeding; site fallow																	
Oct																		
T per cycle	1,102.130	359.825	122.715	650.800	773.515	62.889	406.681	469.570	16.058	139.238	155.295	8.532	13.921	22.454	709.700	3,656.934	4,366.634	1,963.450
T pa Yr 1	453.811	144.574	51.394	277.624	329.018	25.788	166.761	192.549	8.045	60.485	68.531	3.605	5.883	9.488	313.185	1,462.236	1,775.421	827.290
T pa Yr 2	648.320	215.251	71.321	373.176	444.497	37.101	239.920	277.021	8.013	78.752	86.765	4.927	8.039	12.966	396.515	2,194.697	2,591.212	1,136.161

As well as enabling the calculation of total waste BOD, Boyd's method can also be used to calculate the BOD of solid C and N wastes only, by applying the same raising factors to the formulae given for insoluble C and insoluble N production in Sections, of 4.57 (N) and 2.67 (C) respectively.

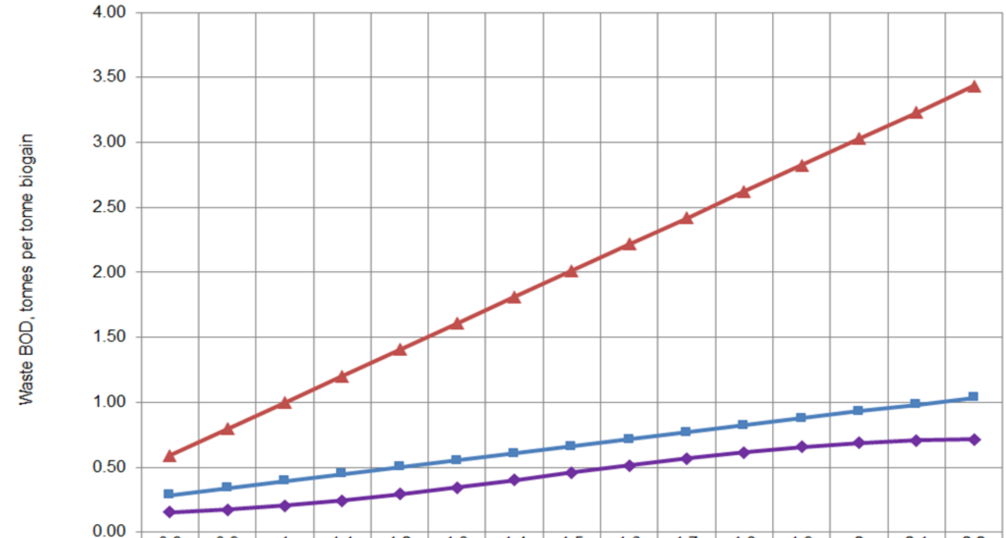
The Boyd method for calculating BOD of aquaculture waste has also been adopted by the Aquaculture Stewardship Council (ASC) for use in their certification process for farm standards, now applied to the standard of operation of a number of CIFT salmon farm sites. The proposed CIFT Shot Head site will monitored and certified by ASC if the Minister's licence decision is upheld by ALAB.

Figure 2.6 compares the DEI method (as used in the 2011 EIS) and the Boyd method for calculating the BOD in salmon farm wastes. This plots the BOD in salmon farm waste discharges, per tonne of salmon growth, calculated using the equations in Section 2.4.2, Bullet 5 above, at FCRs of 0.8 : 1 to 2.2 : 1. This clearly shows the beneficial influence of improving FCR on BOD. Figure 2.7 provides similar plots, per tonne of salmon growth, for the full range of salmon farm waste parameters and illustrates similar trends.

The whole-cycle mean FCR of modern salmon feeds is about 1.25 : 1, having dropped from at least 2 : 1 over the last 30 years or so. Figure 2.7 shows that the BOD of discharges of all wastes has also dropped by over 50% in this period, as a result of this FCR improvement.

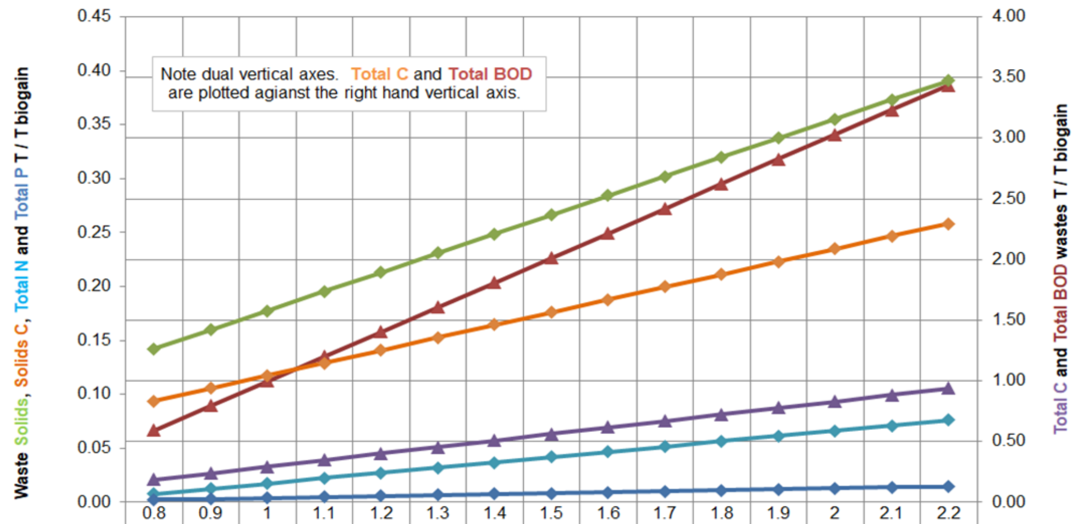
The two plots for the BOD of salmon farm solid wastes in Figure 2.6 compare favourably, bearing mind that the "old" DEI plot represents a trend line through empirical solids waste BOD data for freshwater farmed rainbow trout, from over 30 years ago. Figure 2.6 also shows that soluble waste BOD (including respiratory waste) accounts for over two-thirds of the total BOD in salmon farm wastes.

Figure 2.6.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Comparison of settled waste BOD and total waste BOD (incl. respiratory C waste) based on Boyd /ASC method vs. old DEI calculation method (solids BOD only), showing change with FCR.
Using discharge equations given in Section 2.4.2 and feed data given in Sections 2.3 for 12mm pellet.



	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2
BOD all waste T	0.59	0.80	1.00	1.20	1.40	1.61	1.81	2.01	2.22	2.42	2.62	2.83	3.03	3.23	3.43
BOD solid waste only T	0.29	0.34	0.39	0.45	0.50	0.55	0.61	0.66	0.72	0.77	0.82	0.88	0.93	0.98	1.04
BOD solid waste DEI T	0.16	0.17	0.21	0.24	0.29	0.35	0.40	0.46	0.52	0.57	0.62	0.66	0.69	0.71	0.71

Figure 2.7.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Variation of main discharge parameters, tonnes discharges per tonne Biogain, at FCRs between 0.8:1 and 2.2:1 ; based on Boyd /ASC calculation method.
Using discharge equations given in Section 2.4.2 and feed data given in Sections 2.3 for 12mm pellet.



	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2
Total C T	0.19	0.24	0.29	0.35	0.40	0.46	0.51	0.56	0.62	0.67	0.72	0.78	0.83	0.89	0.94
Total BOD T	0.59	0.80	1.00	1.20	1.40	1.61	1.81	2.01	2.22	2.42	2.62	2.83	3.03	3.23	3.43
Solids T	0.14	0.16	0.18	0.20	0.21	0.23	0.25	0.27	0.28	0.30	0.32	0.34	0.36	0.37	0.39
Solids C T	0.09	0.11	0.12	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.21	0.22	0.23	0.25	0.26
Total N T	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08
Total P T	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

2.5. The RPS Water Quality (WQ) model.

The RPS document "*Water Quality Modelling for all existing and currently proposed salmon farm sites in Bantry Bay; Water Quality Modelling Report IBE0744_RO7_Rev03*" of February 2016 is one of a number of reports that investigates the hydrodynamics of Bantry Bay and the dispersal and settlement of salmon farm wastes in its waters, commissioned from RPS by CIFT. It was submitted to ALAB on its completion, as part of the Shot Head licence appeal process, effectively as an update of the Shot Head EIS, because the techniques used had not been fully developed for aquaculture use at the time of writing of the EIS document, prior to 2011. The report comprises two main elements. The first is a detailed hydrodynamic model for Bantry Bay, calibrated against a wide range of empirical marine hydrometric and bathymetric data, ranging from global to local, including 14 empirical datasets of hydrographic data collected in and around Bantry Bay. The hydrodynamic model created is used to drive the second element; a dispersional model for projected waste discharges from the Shot Head site and all other existing and proposed salmon farm sites in the bay, for the consideration of combined impacts, as required for this NIS.

2.5.1. Hydrodynamic (HD) modelling in Bantry Bay; summary of results.

Summary results of the hydrodynamic model are shown in Figures 2.8 to 2.9 (flood current flow), 2.10 to 2.11 (ebb current flow) and to 2.12 to 2.13 (residual current flow). Residual currents result from the differences between the vectoral components of flood and ebb currents over the course of complete tidal cycles and determine the nett direction and nett water movement through a given area. Flow characteristics and dispersion potential increase in proportion to residual current speed.

Figures 2.9 and 2.11 illustrate flood and ebb currents at higher resolution around Shot Head and show that current flow around the proposed site is relatively faster on ebb tide than on the flood tide at mean spring tide, creating higher residual currents. This is further illustrated in Figures 2.12 and 2.13, which show that residual currents are relatively low in the main body of Outer Bantry Bay but that they are highest around islands and promontories, some where salmon farms are located. High residual currents reduce solids accumulation and encourage solid and soluble wastes to disperse from such areas, in the direction of the residual flow.

These plots, together with others in the full RPS report, confirm the relatively complex nature of flow in Bantry Bay. A tidal convergence just outside the bay is a factor in limiting tidal currents overall to less than 10cm sec^{-1}. Tidal flow is also complicated by the presence of Bear and Whiddy Islands, where the tide floods and ebbs from both ends of their inshore channels, leaving neutral current zones in their lee; see Figures 2.8 and 2.10.

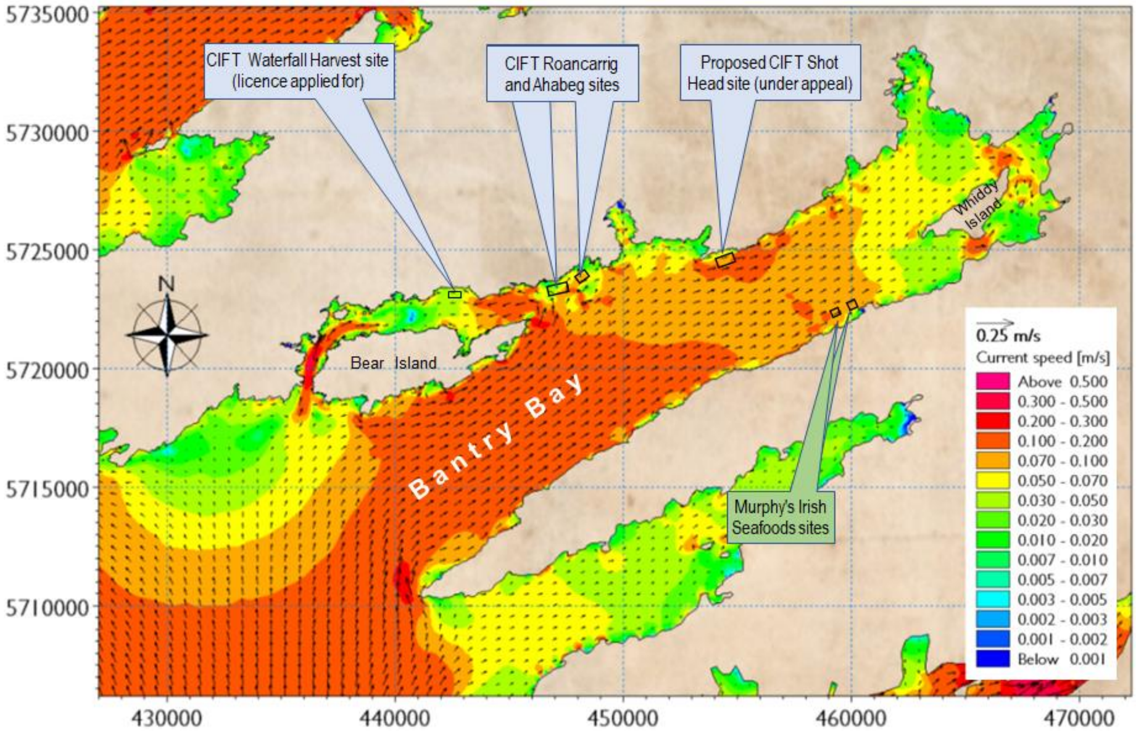


Figure 2.8.
Mean spring tide flood current flow conditions in Bantry Bay.
Exisitng and proposed salmon farm sites are also shown.

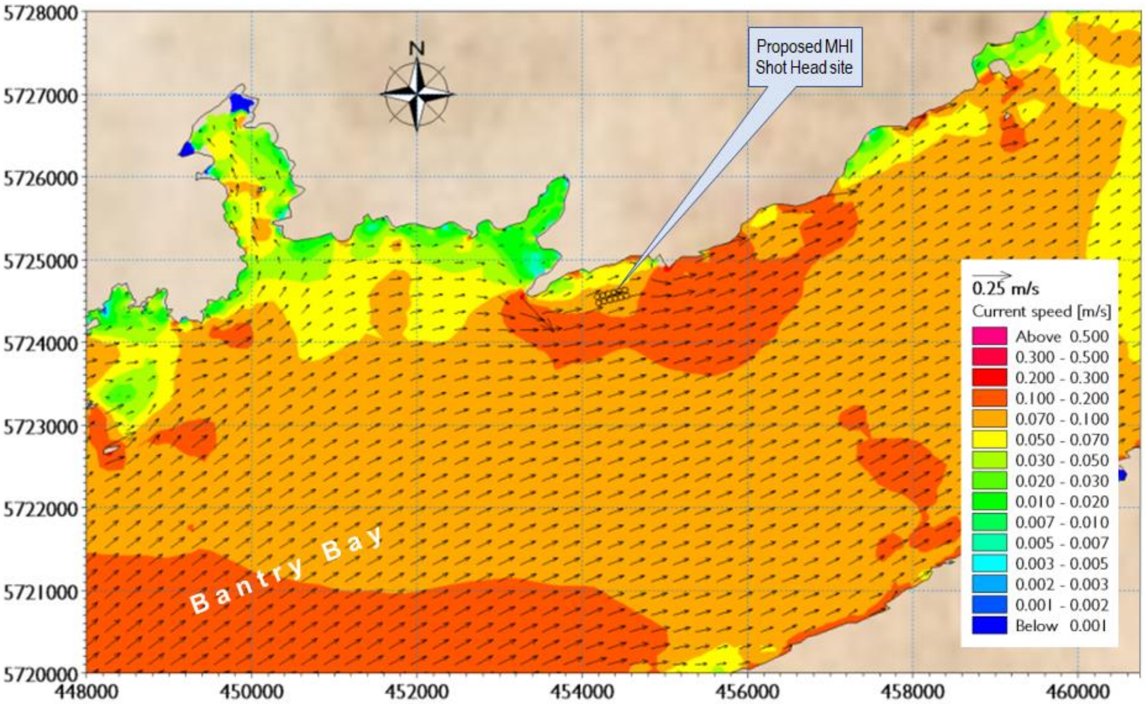


Figure 2.9.
Higher resolution view of mean spring tide flood current flow conditions in the vicinity of the proposed Shot Head site.

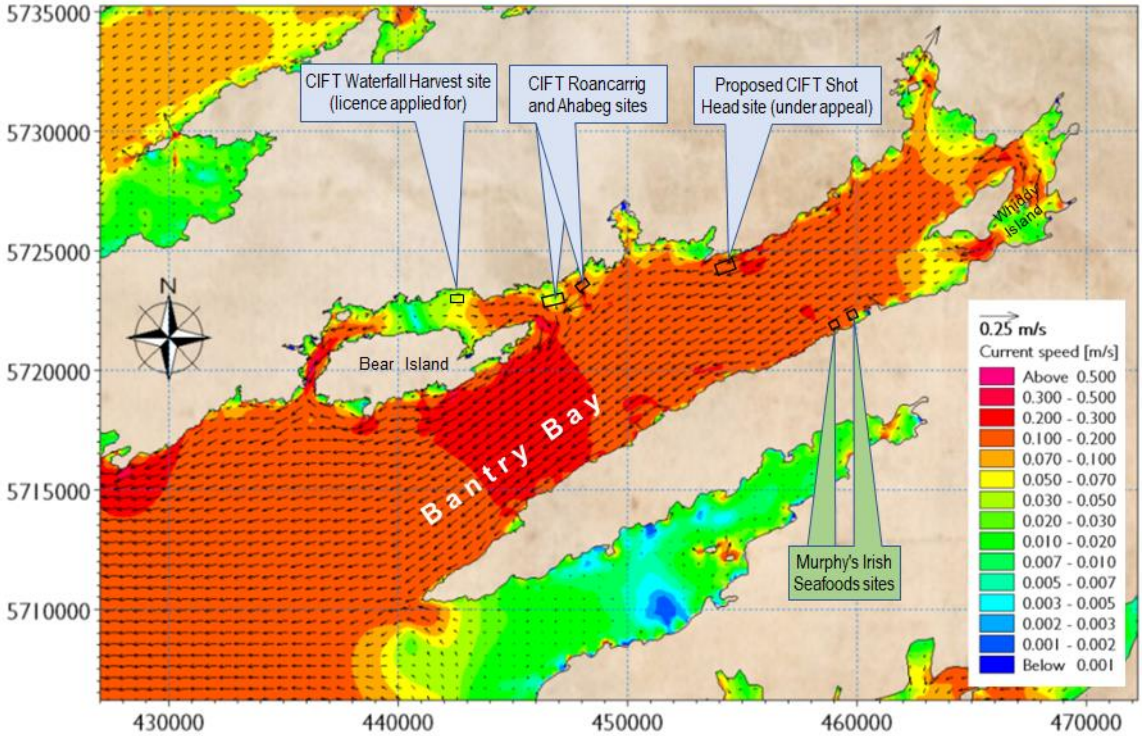


Figure 2.10.
Mean spring tide ebb current flow conditions in Bantry Bay.

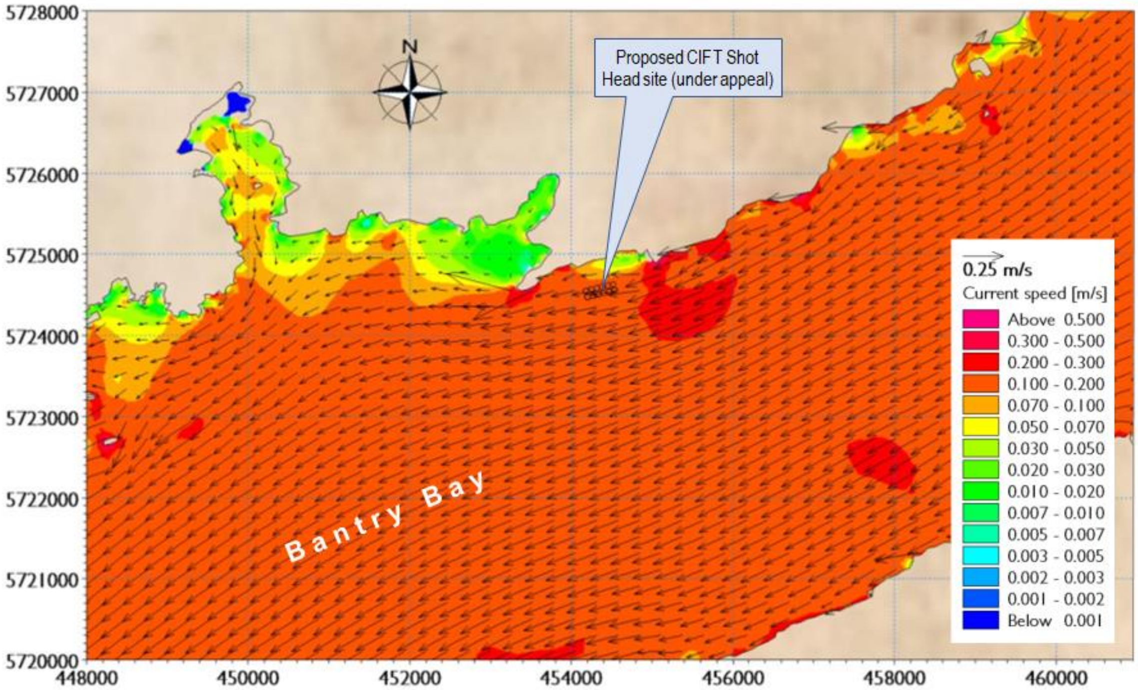


Figure 2.11.
Higher resolution view of mean spring tide ebb current flow conditions in the vicinity of the proposed Shot Head site.

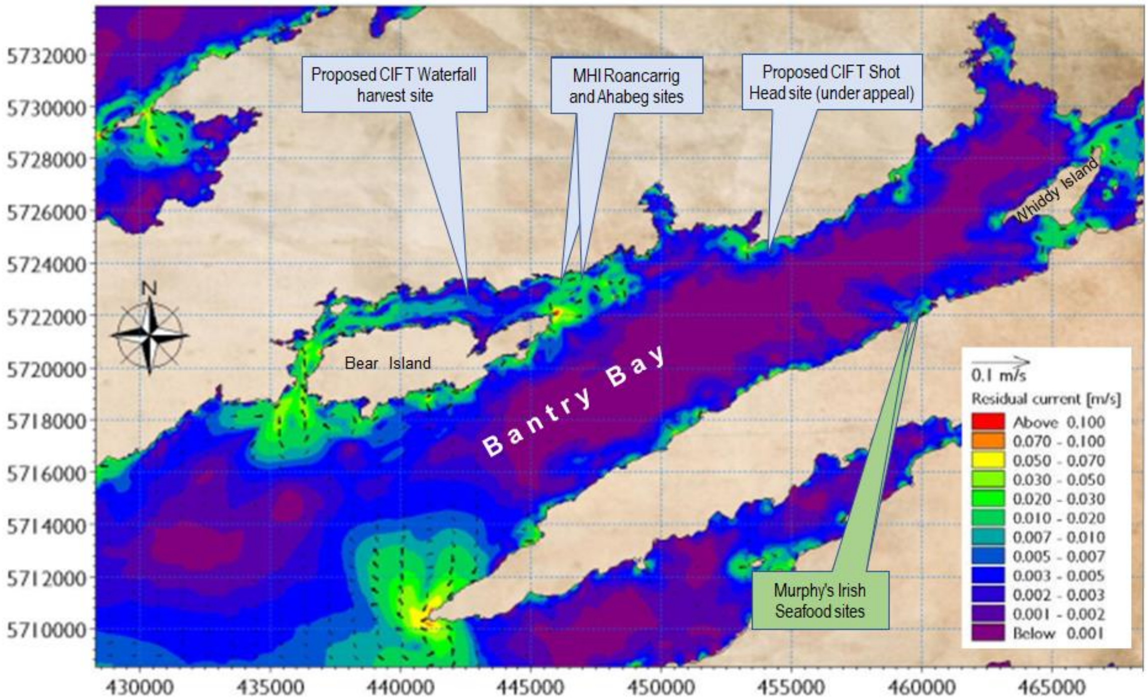


Figure 2.12.
Residual currents for Bantry Bay; Mean Spring Tide.

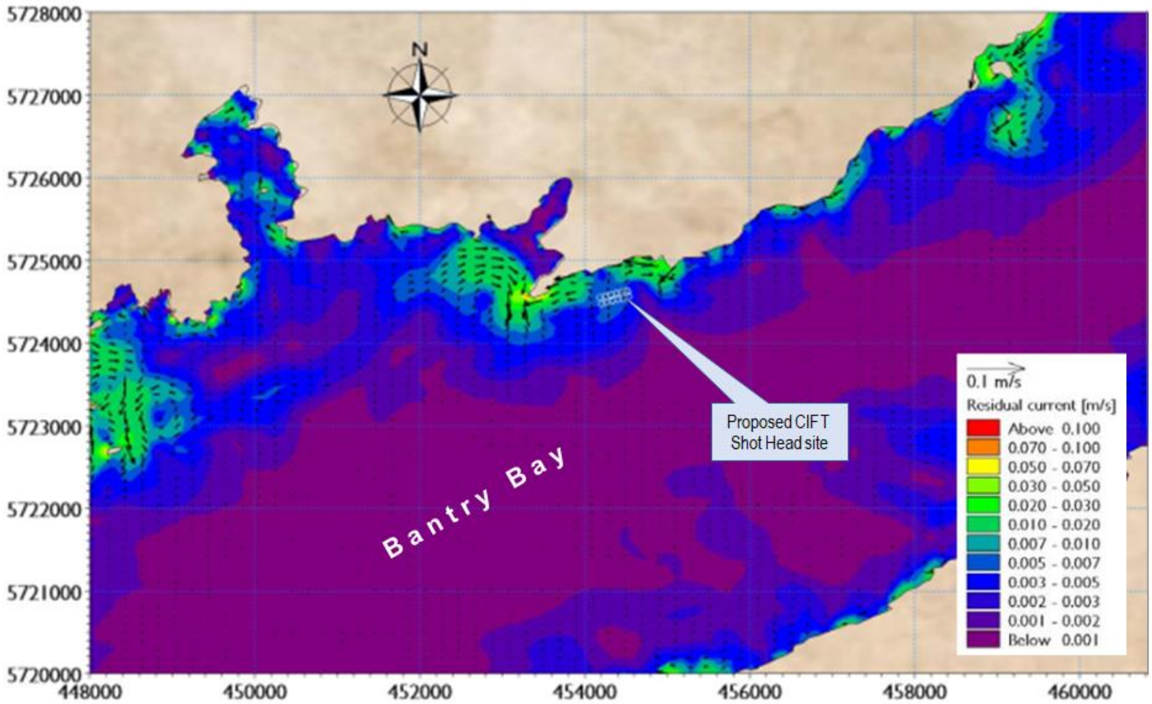


Figure 2.13.
Residual currents for the Shot Head area; Mean Spring Tide.

2.5.2. Water quality modelling in Bantry Bay; summary of results.

The 2016 RPS Water Quality model[25] of February 2016 uses the discharge data for the four main pollution parameters described in Section 2.4.2 and Tables 2.2 to 2.5. Similar growth and discharge models were generated for all other salmon farm sites in the bay (see the 2011 EIS), although all BOD calculations have been updated post-EIS publication, using Boyd's method. The RPS study models the hydrodynamic dispersal and dilution of these parameters, under the influence of the tidal and current regime, described at length in their report and summarised here, in Section 2.5.1.

All dispersional models are based on a 8-level, worst-case scenario, to provide safety and confidence in the findings of the models. The following worst-case layers are used to augment each modelled outcome:-

- All dispersal simulations only use discharge values for the highest discharge month, as highlighted in Table 2.5. Also note from this table that the lowest monthly discharges are <2% of the peak figure used. Discharges peak in the January of Year 2, when growth peaks, taking the site to maximum biomass (Maximum Allowable Biomass, MAB), when harvesting starts.

- The RPS hydrodynamic models use still-weather conditions. However, Bantry Bay faces into the prevailing winds. These blow at Force 4-6 (5.5-13.8 $msec^{-1}$) for 33% of the time and at >Force 7 (>13.9$msec^{-1}$) for 3% of the time. Sustained winds of >Force 4 augment tidal currents and therefore dispersal. This is not accounted for in the dispersion models.

- The Roancarrig, Ahabeg and Fastnet sites are already in full production and therefore fully contribute to ambient nutrient and physicochemical levels in the bay. Discharges calculated for these existing sites are therefore "double accounted for" in the dispersal models, by creating "new" discharges for all existing sites, in order to track their dispersals, as well as those from Shot Head.

- It is intended that the major sites in the bay will alternate in their 24-month cycles, as proposed in the Shot Head EIS, which shows the Shot Head and Murphy's (Fastnet) sites alternating in their biennial cycles with those at Roancarrig and Ahabeg. Thus, the Shot Head and Fastnet sites are "dominant" in the models; that is, they are in their second production year whilst Roancarrig and Ahabeg are in their first year.

[25] Shannon N. 2016. Water Quality Modelling for all existing and currently proposed salmon farm sites in Bantry Bay; Water Quality Modelling Report IBE0744_RO7_Rev03". 102pp. RPS International Belfast

- Roancarrig and Ahabeg discharges combined are elevated to those for a biennial production of 3,500 tonnes, to match those for Shot Head, considerably higher than their current licensed production.

- No decay rate for wastes is incorporated into the model. In reality, DIN, DIP, BOD and SS are all readily and rapidly assimilated through primary production, bacterial growth and local shellfish production.

- A further double-accounting of all dispersals is built into the model outputs in that the total value for each parameter (rather than separate soluble and solids fractions, as applicable) is used in dispersal simulations. The total figures used are highlighted for Shot Head dispersals in Table 2.5 and are summarised for all sites in Table 2.6.

- Discharges are incorporated into the model as arising from point sources at each pen centre on each site. In reality, discharges occur across each pen and therefore are more dispersed and dilute at the outset of the simulation than in the scenario selected.

It is considered important to clarify the extent of the worst case modelled now, to leave no doubt whatsoever that the modelled outcomes are not based in any way on minimal values. It is our contention that they should be regarded as maximum values under all circumstances, which fully underpins the safety of the projections provided.

Table 2.6.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Table of peak discharges of main pollution parameters from all existing and proposed Bantry Bay sites. Abstracted from peak discharge tables used by RPS for worst-case dispersal . See, for example, Table 2.5 for Shot Head.
Note : two rows are used for solids because waste feed and faeces have diffent sinking rates.

	Peak main parameter discharge rates, tonnes per month. See Table 2.5. Peak occurs January Year 2 in each production cycle, except for Waterfall harvest site			
Site	CIFT Shot Head	Murphys Irish Seafoods	CIFT Roancarrig / Ahabeg	CIFT Waterfall Harvest site
Projected production T	3,500T	1,000T	3,500T	Harvest site only
Cycle month	January Year 2.	January Year 2	January Year 1	Monthly harvesting, with limited feed
Peak Total N	15.26	3.82	1.66	0.13
Peak Total P	2.28	0.57	0.23	0.02
Peak Total BOD	319.289	79.822	22.376	2.617
Peak Solids : Feed waste	12.55	3.14	1.27	0.1
Peak Solids : Faecal waste	65.65	16.41	7.04	0.54

Note that the small site at Waterfall, licensed for trout production, was out of service at the time of the 2011 EIS and was excluded from discharge calculations. Following purchase of the site, CIFT applied to licence it as a salmon harvest site in 2014. Since fish would be transferred to the site monthly for harvest preparation and not grown out, its growth and discharge profiles, used in the 2016 RPS model, differ from those of grower sites; see Table 2.6 and Figures 2.2 to 2.6.

A summary of RPS' dispersal projections are shown in Figures 2.14 to 2.27. Dispersion of solutes is modelled on a flexible mesh grid across Bantry Bay, where the mesh grid points can be concentrated around discharge sources, as required, for greater accuracy. Nominal mean grid cell area is $20m^2$. Values are generated at every grid point, at ≤10 second time-steps throughout each 22-day simulation period. This was selected to allow for the full development of dispersal and to cover the full range of spring and neap tidal fluctuations. This provides a total of >190,000 timesteps and up to 2 x 10^{12} data points per simulation. In order to condense the results for analysis, four types of graphical outputs are generated by the model:-.

- Maximum Concentration Plume Envelope Plot.
  The Maximum Concentration Plume Envelope is not an actual plot. It is a hypothetical, statistical model, the only purpose of which is to show the <u>maximum</u> parameter value reached at <u>every</u> grid location during all >190,000 timesteps, over the simulation period. It is emphasised that, whilst helpful in showing the *maximum* values reached during simulations, it is a hypothetical plot and does <u>not</u> represent concentrations at any real point in time because there is little chance of the values recorded occurring simultaneously, as a first view of the plot might suggest. Further, the duration of each maximum value will vary but is likely to be very short, lasting no more than a few ≤10 second timesteps, out of the 190,000 timesteps in each 22-day simulation.

- Average Concentration Plume Envelope Plot
  The Average Plume Plot shows the <u>average</u> parameter concentration for every grid point and is derived by averaging all 190,000 values generated at each grid point throughout each simulation. This plot is also hypothetical, because it is <u>not</u> related to a single point in time but show average values for the simulation period. It can be useful when viewed alongside the Maximum Plume Envelope Plot to gauge "typical" values and to indicate how often maximum values occur.

- Typical Flood and Ebb Concentration Plume Envelope Plots.
  These plots project <u>actual</u> dispersion patterns for each parameter at given time steps, being "snapshots" from the model. The two selected for examination here are for typical mid-flood and mid-ebb tidal situations. Unlike the previous plots, they are not hypothetical but <u>show actual dispersion values</u> and relate to real points in time.

1. Dissolved Inorganic Nitrogen (DIN) discharges.
   The results for four DIN discharge dispersal simulations are shown in Figures 2.14 to 2.17. These show the DIN contours for the elevation of ambient DIN in the bay due to salmon farm DIN discharges. The Scottish Environmental Agency (SEPA) terms the ambient concentration the Concentration Equilibrium (CE) and its elevation, post new discharges, the Elevation of Concentration Equilibrium or ECE[26]. SEPA sets an Environmental Quality Standard (EQS)[27] for maximum winter ambient DIN in seawater of 168µgDIN/l (0.168mgDIN/l) against which ECE can be assessed. This is very close to the SI 272 DIN quality standard for High Status waters of 0.170mgDIN/l (=170µgDIN/ml), which currently applies in the Outer Bantry Bay Coastal Water Body, see Figure 2.3.

   The ambient DIN data used in the 2011 EIS originates from the monitoring of control sites at the CIFT control sites at Boatyard in Berehaven and off Lamb's Head in Outer Kenmare Bay, for which mean CE data is shown in Table 2.7.

Table 2.7.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Mean monthly ambient nutrients at CIFT conrol sites;
Boatyard site, Berehaven Sound and Lamb's Head site, Kenmare Bay.

Month	Monhtly mean ambient concentration					
	Boatyard control site			Lambs Head control site		
	Inorganic N µg/l	Inorganic P µg/l	DO mg/l	Inorganic N µg/l	Inorganic P µg/l	DO mg/l
Jan	125.11	22.03	9.32	88.00	23.35	9.22
Feb	114.87	18.91	9.32	63.00	21.89	9.48
Mar	84.08	17.34	9.67	96.00	20.46	9.32
Apr	53.95	17.57	10.22	40.54	9.92	9.06
May	6.49	3.10	9.88	10.34	7.37	8.81
Jun	3.22	4.55	9.15	4.67	4.48	8.35
Jul	1.59	5.43	9.46	16.60	5.48	8.39
Aug	2.43	5.37	8.75	3.76	6.13	8.25
Sep	19.83	11.26	8.01	23.12	10.99	8.26
Oct	38.13	9.92	8.30	37.74	11.37	8.58
Nov	76.14	16.12	8.66	72.92	15.88	8.96
Dec	93.29	19.30	9.03	80.00	20.67	9.09

26 ECE; Elevation of Concentration Equilibrium; meaning elevation of ambient parameters by fish farm wastes; a term coined in Scotland in the context of Gillibrand PA, Gubbins MJ, Greathead C and Davies IM. 2002. Scottish Executive locational guidelines for fish farming: predicted levels of nutrient enhancement and benthic impact. Scottish Fisheries Research Report 63.

27 Environmental Quality Standard (EQS) is a term in environmental statistics. It can be defined as *the limit for environmental disturbances, in particular from ambient concentrations of pollutants and wastes, that determines the maximum allowable degradation of environmental media, based on their environmental consequences*. See Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997.

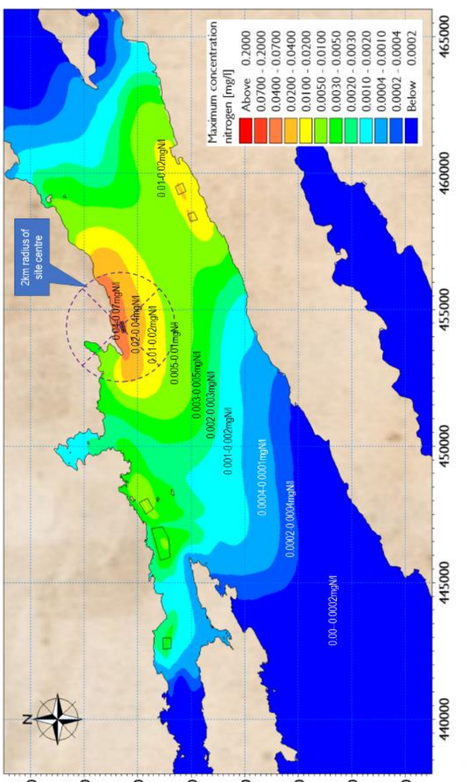


Figure 2.14.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Maximum Concentration Plume Envelope for discharged Dissolved Inorganic Nitrogen (DIN) from existing and proposed salmon farm sites in Bantry Bay .

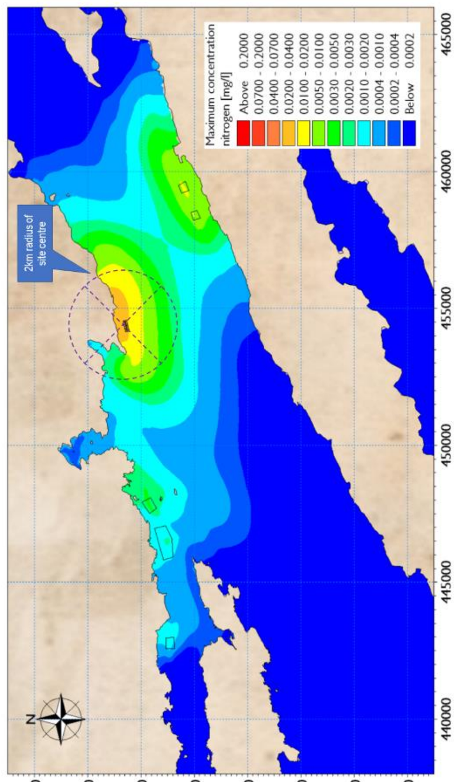


Figure 2.15.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Maximum Concentration Plume Envelope for discharged Dissolved Inorganic Nitrogen (DIN) from existing and proposed salmon farm sites in Bantry Bay .

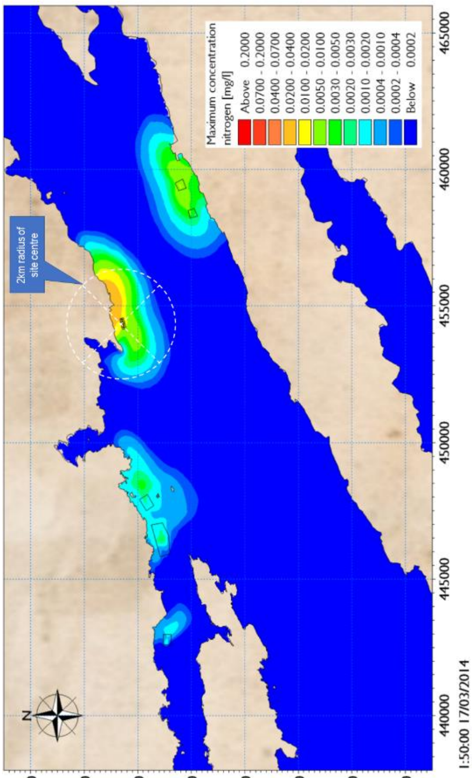


Figure 2.16.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Typical concentration plume for Dissolved Inorganic Nitrogen (DIN) discharged from existing and proposed salmon farm sites in Bantry Bay at Mean Spring, mid-flood tide.

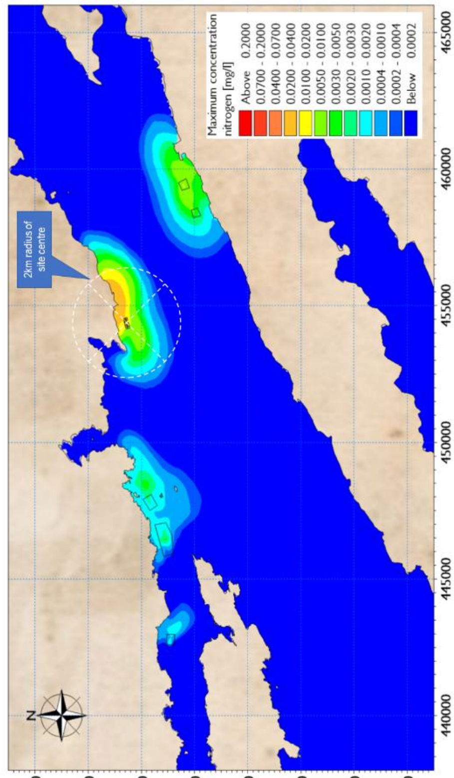


Figure 2.17.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Typical concentration plume for Dissolved Inorganic Nitrogen (DIN) elevation discharged from existing and proposed salmon farm sites in Bantry Bay at Mean Spring, mid-ebb tide.

DIN levels at the Boatyard site are influenced by local discharges from Castletownbere town and port, which is part of the reason why the Berehaven Coastal Water Body is assessed as being of Good, rather an High Ecological Status, unlike Outer Bantry Bay, where all the salmon farm grower sites are located; see Figure 2.3. Consequently, a nominal mean winter (January) ambient of 100µgDIN/ml (0.1mgDIN/l) was selected between the two datasets as the CE for elevation by farm-origin DIN. This therefore means that the CE can be elevated by up to 0.068mg DIN before the EQS is breached:-

0.1mgDIN/l + 0.068mgDIN/l = 0.168mgDIN/l = EQS value

With reference to Figures 2.16 to 2.17, the typical plots show a peak elevation of 0.02 to 0.04mgDIN/l, from the site DIN source at the site itself, along the shoreline, within 2km east of the site, before it disperses to a lower concentrations with distance. This shows that the EQS is not breached at typical mid-flood or mid-ebb tide, when Shot Head and the Murphy's sites are dominant (i.e. in their second production year and at peak discharges, see Table 2.16). The Statistical Average Plot (Figure 2.15) indicates that an elevation close to the waste DIN source at Shot Head of 0.02 – 0.04mgDIN/l is typical for the duration of the simulation, whilst the Maximum Plot in Figure 2.14 shows that some values of up to 0.04-0.07mgDIN/l can occur in a similar area in some grid cells and at some ≤10second timesteps during the simulation. However, even here, peak values barely breach the EQS, in the few grid cells and during the relatively few, ≤10sec timesteps during the simulations, when these levels would actually coincide, in time.

It is also argued that these close-to source values all occur within the Mixing Zone of the discharges, an area reasonably taken into account in waste dispersion, by both the Water Framework Directive (and therefore SI 272 2009) and by the EQS Directive.

More to the point, the plots show that DIN elevation values attenuate rapidly with distance from the site, with values effectively reaching zero (0m – 0.0002mgDIN/l in Typical Plots (Figures 2.16-2.17) within 1-3km of all sites in all directions. The Maximum Plot (Figure 2.14) also shows rapid dilution of DIN elevation with distance from its sources, with statistical intermittent peak values, being no higher than 0.005-0.001mgDIN/l at any time point within some 4km of the source, in any direction. Such values do not add sufficiently to the selected worst-case ambient value to breach the EQS of 168µgDIN/l by a wide margin, even in the worst case projection provided.

No outputs are illustrated for the Shot Head site in isolation here but the outputs dispersing from Shot Head alone in the typical combined plots in Figures 2.16 and 2.17 are identical to those in the individual plots for Shot Head that can be found in the full RPS WQ Report.

The RPS WQ Report does not provide outputs for the years when the Roancarrig / Ahabeg and Waterfall sites would dominate discharges, in their two-year cycles every other year, in alternation with Shot Head / Murphy sites dominance. This would be likely to show plume envelopes going further into Berehaven and possibly also reaching main Outer Bantry Bay waters, offshore from some sections of the Beara Peninsula SPA 004155, where one of the species for consideration in this NIS, the Northern Fulmar (Fulmarus glacialis) is an SCI. However, judging by the results shown in Figures 2.14 to 2.17, it is submitted firstly that it is unlikely that the DIN EQS will be breached at such distances from these sources. In addition to this, the plumes described from these sites are only added into this exercise as a worst-case consideration, since they have been making their full contribution to ambient conditions in Bantry Bay since their establishment, up to 40 years ago.

2. Dissolved Inorganic Phosphorus (DIP) discharges
Dissolved Inorganic Phosphorus (DIP) is an important QE for rivers and transitional water bodies, where elevated DIP is the main driver of primary production (subject to salinity level). This role is taken by DIN in coastal waters. Whilst unlikely to cause a significant impact in coastal waters, DIP discharges are still fully considered in the Shot Head EIS and RPS WQ Report, using an established winter EQS provided by OSPAR[28] for DIP of 0.119mgDIP/l (neither SEPA nor SI 272 provide an EQS or standard for DIP in coastal waters). As can be seen, OSPAR's EQS is far short of being breached by the DIP elevations predicted to arise from the operation of the Shot Head site in isolation, or in combination with other, existing or proposed sites in Bantry Bay, where the maximum value for DIP elevation, even on the statistical Maximum plot, is only 0.002 to 0.007mgDIP/mg, which would raise the maximum mean winter ambient level from, say 0.023mgDIP/l to a maximum of 0.030mgDIP/l, approximately one quarter of the OSPAR EQS for DIP in coastal waters.

Thus, in summary, DIP discharges from any or all of the proposed and existing salmon farm sites in Bantry Bay will not contribute to a breach of the DIP EQS by a wide margin under any circumstance and therefore no significant impact on ambient ecological conditions, habitats or their inhabitants is expected to arise as a result of the installation of the proposed salmon farm site at Shot Head.

[28] The Convention for the Protection of the Marine Environment of the North-East Atlantic or OSPAR Convention is the current legislative instrument regulating international cooperation on environmental protection in the North-East Atlantic. Work carried out under the convention is managed by the OSPAR Commission, which is made up of representatives of the Governments of the 15 signatory nations, and representatives of the European Commission, representing the European Union.

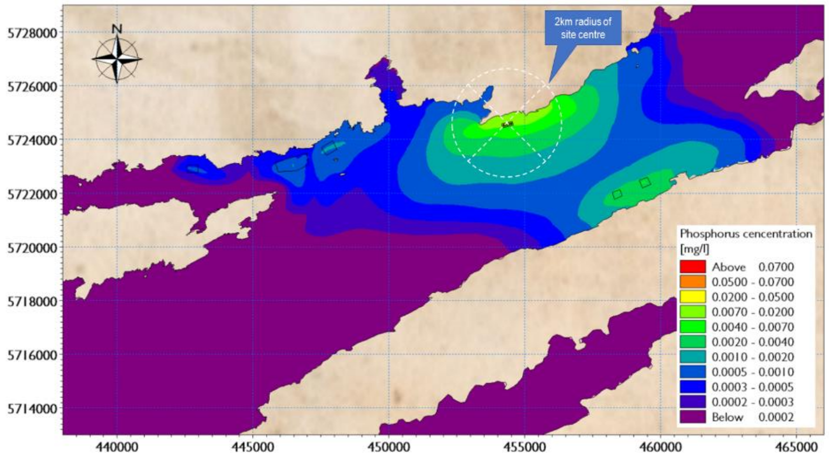


Figure 2.18.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Maximum Concentration Plume Envelope for discharged Dissolved Inorganic Phosphorus (DIP) from existing and proposed salmon farm sites in Bantry Bay. Shot Head / Murphy's sites dominant.

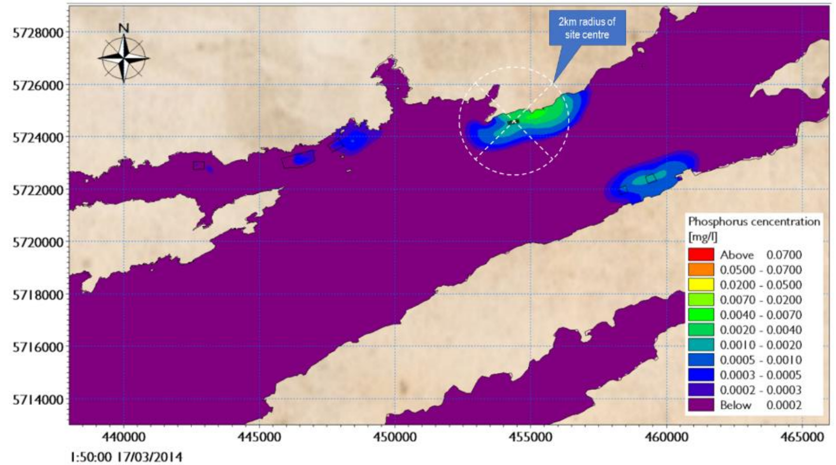


Figure 2.20.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Typical concentration plume for DIP, discharged from existing and proposed salmon farm sites in Bantry Bay at Mean Spring, mid-flood tide. Shot Head / Murphy's sites dominant.

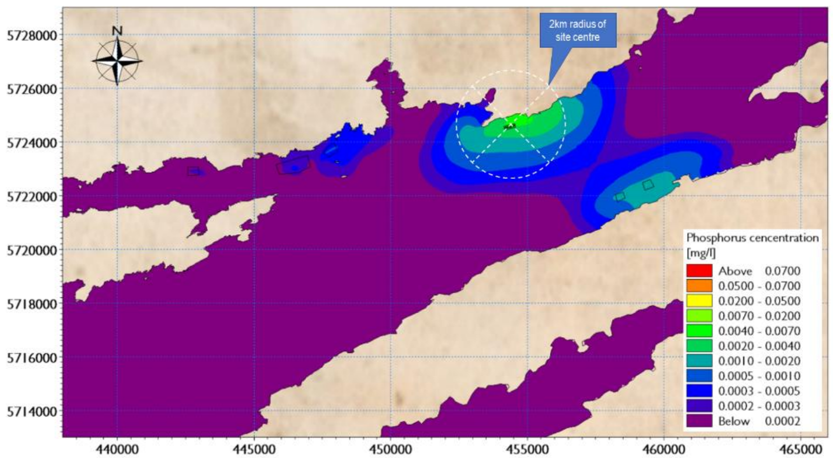


Figure 2.19.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Average Concentration Plume Envelope for discharged Dissolved Inorganic Phosphorus (DIP) from existing and proposed salmon farm sites in Bantry Bay. Shot Head / Murphy's sites dominant.

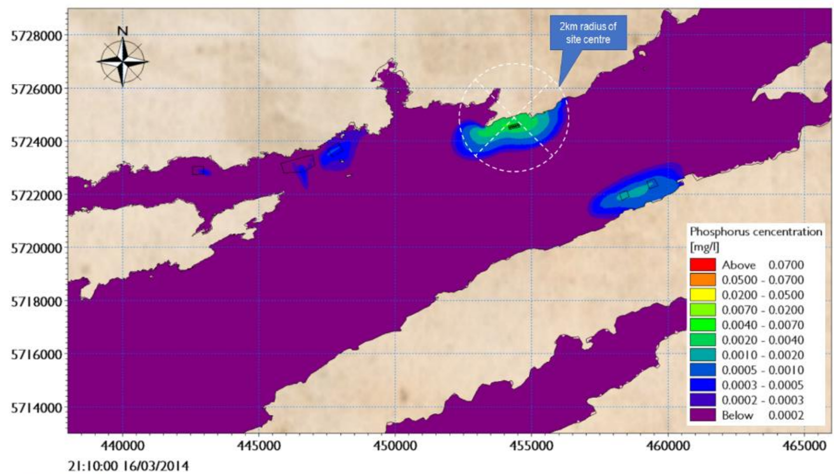


Figure 2.21.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Typical concentration plume for DIP, discharged from existing and proposed salmon farm sites in Bantry Bay at Mean Spring, mid-ebb tide. Shot Head / Murphy's sites dominant.

3. Biological Oxidation Demand (BOD) discharges.
   BOD is also not considered by SI 272 as a QE for Coastal water bodies, although it is an important QE for River and Transitional water bodies. Even so, BOD discharges and their potential to cause impact are projected in the Shot Head EIS and in the 2016 RPS WQ Report. The outputs provided in the RPS report for combined discharges of BOD from existing and proposed salmon farm sites into Bantry Bay, now calculated by Boyd's method, are shown in Figures 2.22 to 2.25.

   Typical BOD Plots for Spring mid-flood and mid-ebb tides in Figures 2.24 and 2.25, show a peak value of 0.50-0.75mgBOD/l, running for some 1.5km east along the shoreline with the tide. This diminishes to the lowest contour value of 0-0.005mgBOD/l, 1.25-3km of the site centre in all directions. The peak contour on the ebb tide is higher, at 0.75-1.00mgBOD/l, spreading along the shore for 0.5-1km both east and west of the site before diminishing to the lowest value of 0-0.005mgBOD/l within 2-3km of the site in all directions. As with DIN and DIP, the typical values shown do not coalesce with elevated values dispersing from other sites to augment elevation, but the Average Plot in Figure 2.22 suggests that this will happen at some states of tide, presumably around slack water. Nonetheless the contour values between sites are low on the scale provided, at between 0.02 and 0.03mgBOD/l, with levels diminishing to the lowest value contour 0-0.005mgBOD/l within 5km of the site.

   The statistical Maximum Plot shows both contour values and spread higher than indicated by the Average Plot, suggesting that values, close to the site area in the Maximum Plot, of up to 2-3mgBOD/l can occur at some states of tide, in limited numbers of grid cells and over low numbers of timesteps during the simulation period.

   No EQS is provided for BOD in Coastal Waters. However as observed by RPS, a limit is set for BOD in Transitional waters in SI 272 2009, of ≤4.0mgBOD/l (95%ile), which also sets a 95%ile upper limit of >80% Dissolved Oxygen (DO) Saturation at a salinity of 35‰.

   BOD is rarely monitored in Coastal Waters. However, EPA data shows a median value of 0.499mgBOD/l in their monitoring of Bantry Bay during the 2010-2015 WFD cycle, reported in the Supplementary EIS for Shot Head, submitted to ALAB in April 2018,Table 3.3, Page 97. Given the peak contour value outside the mixing zone of 0.50-0.75mgBOD/l in the Typical and Average Plots in Figures 2.23-2.25, with rapid attenuation to 0-0.005mgBOD/l as shown, ECE is unlikely to breach 1.50mgBOD/l outside the mixing zone at any site or at any time. Taking the EQS of a 95%ile value of ≤4.0mgBOD/l for Transitional waters, there is strong evidence that the BOD elevation values projected around the Bantry Bay salmon farm sites will have no environmental consequences, even in the near-field.

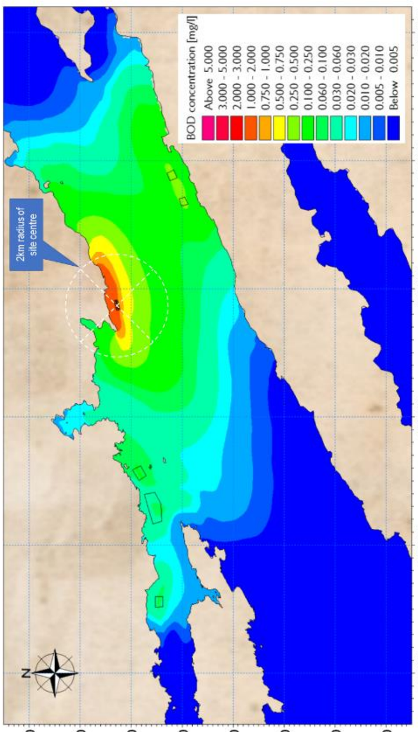


Figure 2.22.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Maximum Concentration Plume Envelope for discharged Biological Oxidation Demand (BOD) from existing and proposed salmon farm sites in Bantry Bay. Shot Head / Murphy's sites dominant.

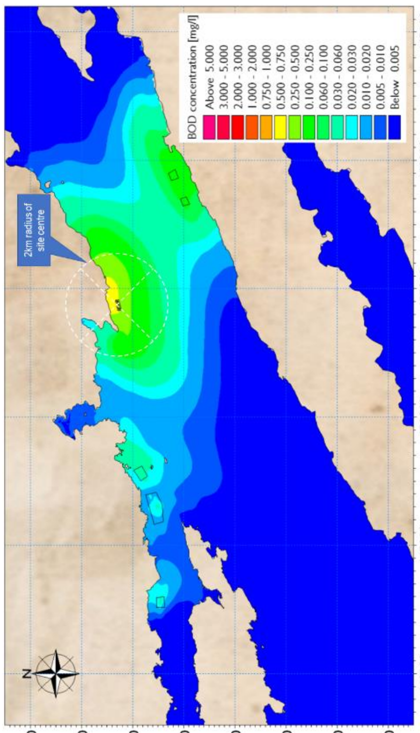


Figure 2.23.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Average Concentration Plume Envelope for discharged Biological Oxidation Demand (BOD) from existing and proposed salmon farm sites in Bantry Bay. Shot Head / Murphy's sites dominant.

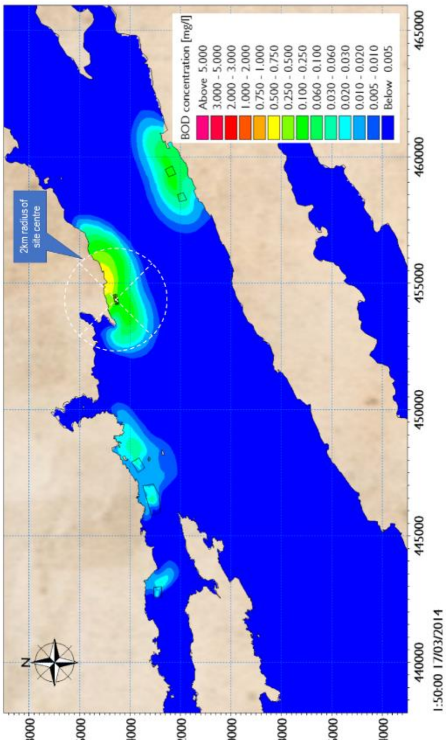


Figure 2.24.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Typical concentration plume for discharged BOD elevation from existing and proposed salmon farm sites in Bantry Bay at Mean Spring flood tide.

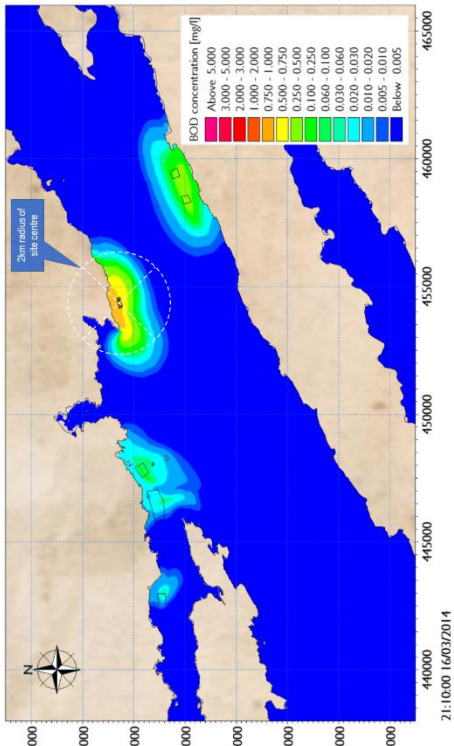


Figure 2.25.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Typical concentration plume for discharged BOD elevation from existing and proposed salmon farm sites in Bantry Bay at Mean Spring ebb tide.

In the absence of a specific EQS for BOD in coastal waters, the 2011 Shot Head EIS provides another means of estimating BOD impact, in Section 4.7, pages 201-209. A tidal prism box model is employed, using a notional box to enclose an area of Bantry Bay of some 57km^2, which contains all existing and proposed salmon fam sites. Graphs are provided which show the impact of total farm BOD discharges on the total oceanic flux of DO through the selected box area. This figure is reproduced in Figure 2.26, revised to take account of total BOD discharged, as calculated by Boyd's method.

Figure 2.26.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Bantry Bay 57km^2 box model; estimated monthly oceanic dissolved oxygen (DO) flux in tonnes DO and predicted DO change in Bantry Bay due to combined BOD discharges from all Bantry Bay salmon farm sites (licensed and proposed).
Taken from Figure 83, 2011 EIS with BOD values amended using Boyd's method*.

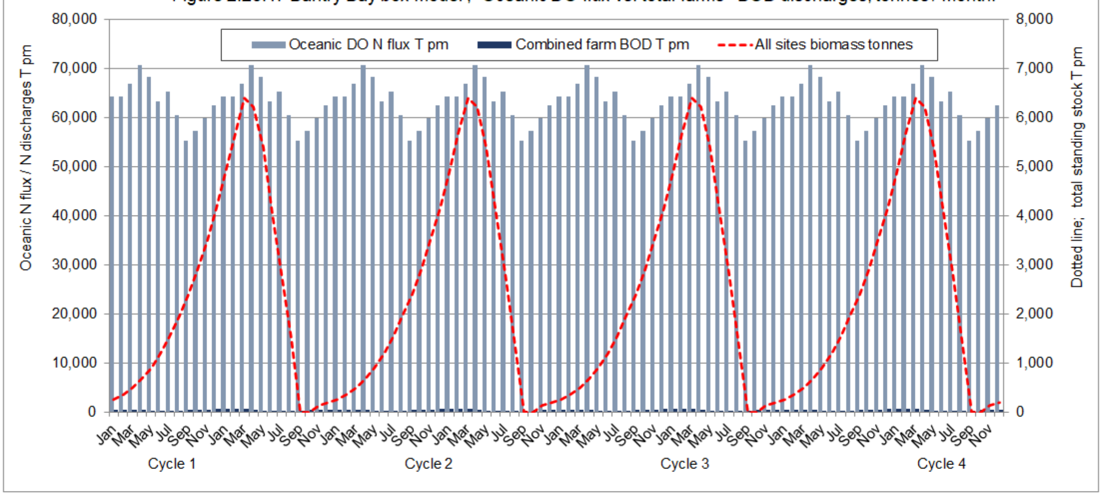


Figure 2.26.1. Bantry Bay box model ; Oceanic DO flux vs. total farms' BOD discharges, tonnes / month.

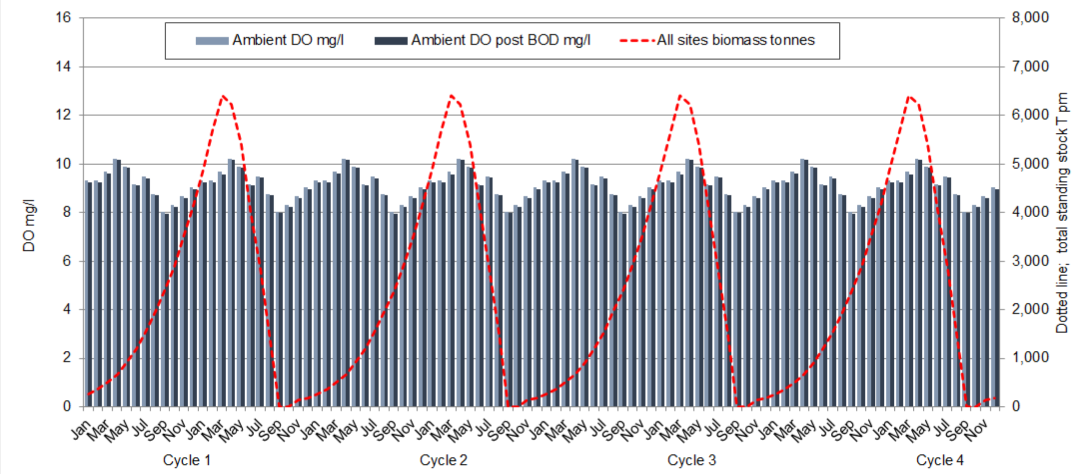


Figure 2.26.2. Bantry Bay box model projected DO change due to combined farms' BOD loading mg/l.

* Boyd C. 2009. Estimation of mechanical aeration requirement in shrimp ponds form the oxygen demand of feed.
Proceedings of the Word Aquaculture Society Meeting Sept 25th-29th, Vera Cruz Mexico.
See also Global Aquaculture Performance Index (GAPI) BOD calculation methodology available at http://web.uvic.ca/~gapi explore-gapi/bod.html.

In fact, the peak total BOD discharge (not just soluble discharges) using Boyd's method is now approximately three times higher than it was as calculated under the DEI method, used in the EIS in 2011 (see also Figure 2.26 where this is also indicated). However, this really makes little impact on the DO which flushes in and out of Bantry Bay on the tide, a monthly basis. In fact, assimilation of the January peak BOD discharge for all sites (see Table 2.6) still only requires less than 1% of the Dissolved Oxygen that flushes in and out of the bay during the same period. This finding suggests that, to all intents and purposes, BOD discharges from existing and proposed salmon farm sites in Bantry Bay make no material impact on DO saturation conditions in the bay as a whole. This topic is covered in greater detail in the 2011 EIS.

The finding of the RPS report and this NIS is that no measurable impacts from BOD discharges will affect Bantry Bay or related protected habitats or species targets in the vicinity.

4. Solids settlement.
As Table 2.1 shows, settled solids is not currently used as a Quality Element for deriving the Ecological Status of Coastal or Transitional water bodies under SI 272. However, settlement of solids discharged from the Shot Head site is projected and assessed in the Shot Head EIS of 2011 and in the 2016 RPS WQ Report, using an EQS developed by the Scottish Environmental Protection Agency (SEPA). This calculates the effects of settled solids on the benthic community over a period of one year, using the Infaunal Trophic Index (ITI). The basis of ITI calculation is the classification of the organisms found in the seabed in terms of their population density and the trophic (feeding) group into which they fall. See Section 2.9 of the 2011 Shot Head EIS for a fuller explanation of ITI.

Settleable solids from fish farm sites comprise two components; salmon faeces and waste feed pellets. The formulae for calculating both are set out in Section 2.4.2. Monthly solids discharge rates are tabulated in the discharge budget in Table 2.5. Solids discharge modelling is carried out on a similar multi-level worst-case basis as used for other farm discharges, using only peak farm solids discharge rates. The peak monthly faecal and waste feed discharge rates for all sites in Bantry Bay are tabulated in Table 2.6.

SEPA regards some organic loading and consequent benthic degradation on the seabed in the immediate locality of salmon farm pens as acceptable. This is taken into account by their application of a biological EQS, within Allowable Zones of Effect (AZE), with their seabed areas bounded by lines set 25m and 100m beyond the pen footprint, respectively, within which a minimum ITI of <30 may apply.

The 2016 RPS report considers solids settlement under the standards set for salmon farming by SEPA and concludes that the EQS that applies is met. The most illustrative plot provided by RPS is for a hypothetical, absolute worst-case seabed sediment depth, following a full year of sedimentation at the highest monthly rate (for January Year 2) for the Shot Head site of 65.65 tonnes pm of faecal waste and 12.55 tonnes pm of feed waste; see Tables 2.5 and 2.6. Even under the hypothetical circumstances, Figure 2.27 illustrates that the peak under-pen sediment depth would be just 13mm. Such a depth would be both sustainable and aerobic and would be readily grazed down by aerobic organisms, in particular during fallowing.

Note combined models for multiple sites, used for dispersing solutes, are not employed for solids settlement because settlement is discreet and limited to the localities of the pens. The consequences of solids breakdown into soluble components, of DIN, DIP, and BOD are nonetheless all taken into account in the dispersal models for those parameters, in this document and in the EIS and RPS report.

Solids settlement modelling is required to ascertain the degree and extent of settlement and the consequential impact on benthic communities in the vicinity of the proposed site. However, in the specific context of this NIS and the three named foraging seabird species that it is required to consider, solids settlement is unlikely to pose any environmental threat, unless the extent of all discharges is unsustainable either in terms of the rates of deposition of settling components or an inability of ambient current regimes to disperse them. These conditions clearly do not apply. Certainly, under all circumstances, the effects of solids settlement near salmon farms, if any, are localised, in the vicinity of the seabed under or near the sites in question, so indirect impacts on Natura 2000 sites and SCIs resident upon them are not in prospect. However, there may be some small prospect of impacts on foraging / diving seabirds which voyage close to such sites, although the likelihood of such an occurrence is regarded as insignificant.

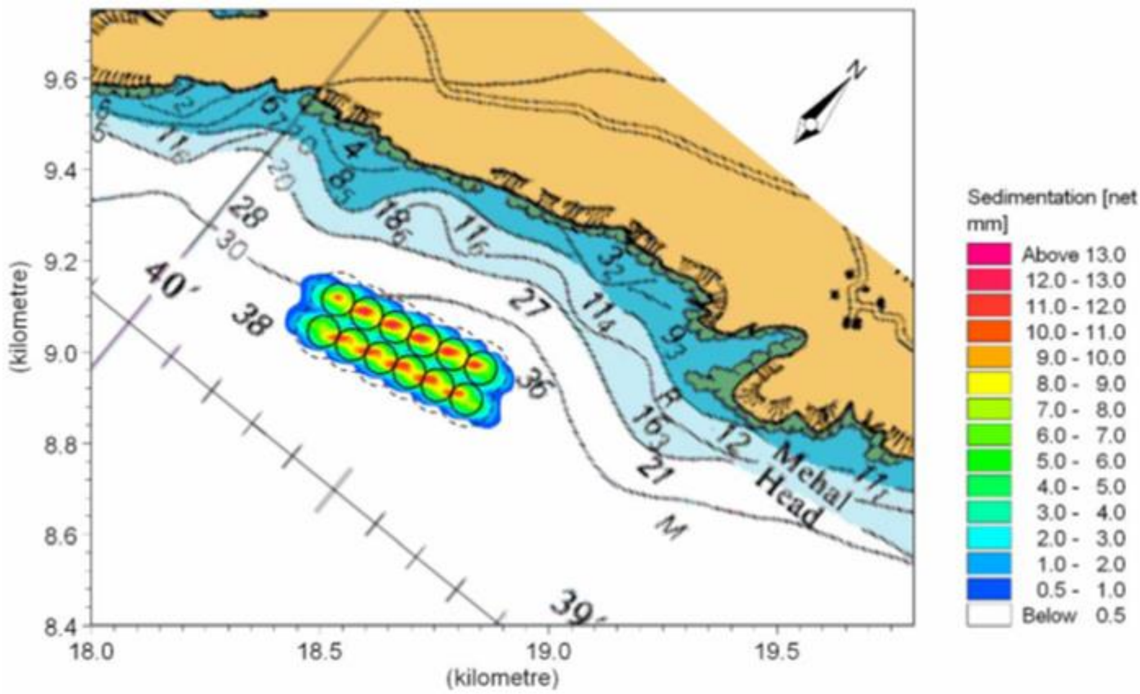


Figure 2.27.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Sediment depth (mm) following solids sedimentaion under the Shot Head site for one year at peak solids settlement rate (hypothetical worst case).

The RPS WQ Report also considers the dispersal of two anti-lice medications. Neither of these chemicals is listed as a priority substance in the EQS Directive or in SI 272 but their use is controlled via EQS in Ireland, under SI 466 2008. Since these medications are not reported as harmful to foraging seabirds, their use is infrequent in Bantry Bay and their EQSs apply just 100m from the treatment site, 24-hours post completion of treatment, they are not considered further in this document.

The RPS WQ report further considers the dispersal of sea lice from the Bantry Bay sites. Since sea lice are not a known parasite of seabirds they also are not considered further in the NIS.

2.6 The subject SPA sites to be considered in this NIS

The Stage 1 Screening Assessment identifies six Natura 2000 sites, all of them SPAs, that it regards as lying adjacent to the proposed CIFT Shot Head salmon farm site. These are the Beara Peninsula SPA 004155, the Bull and the Cow Rocks SPA 004066, Deenish Island and Scariff Island SPA 004175, the Iveragh Peninsula SPA 004154, the Skelligs SPA 004007 and Puffin Island SPA 004003. The assessment concludes that it is not possible for stage 1 screening to rule out potential impacts of the proposed development at Shot Head on these SPAs and on three named Species of Conservation Interest (SCIs) that breed on some or all of the named SPA sites. The three named SCIs are the Northern Gannet *Morus bassanus*, the Common Guillemot *Uria aalge* and the Northern Fulmar, *Fulmarus glacialis*. Therefore, the Stage 1 Assessment recommends that the assessment proceeds to Stage 2 Appropriate Assessment, otherwise known as a Natura Impact Statement. Under the terms of the Habitats and Birds Directives and available National Guidance, the effects of potential impacts on these sites and their named SCIs must be considered in the NIS, not only as they arise from the Shot Head site in isolation but also as they arise in combination, between the Shot Head site and other sources of the same range of impacts, in the locality of the Shot Head site, where augmentation of impact concentration may apply.

The classes and extent of the habitats protected by the six named SPA designations are given in Table 2.8. All SCIs, along with other bird species listed in Annex 1 of the Birds Directive and other important species, listed on the Natura Forms for the sites, are shown in Table 2.9.

Table 2.8.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
General site character; habitat classes by % cover; extracted from the Natura Standard Data Forms for the sites.

Habitat class code		N01	N02	N03	N04	N05	N06	N07	N08	N09	N10	N11	N12	N14	N15	N16	N22	N23		
Habitat class description		Marine areas, Sea inlets	Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins)	Salt marshes, Salt pastures, Salt steppes	Coastal sand dunes, Sand beaches, Machair	Shingle, Sea cliffs, Islets	Inland water bodies (Standing water, Running water)	Bogs, Marshes, Water fringed vegetation, Fens	Heath, scrub, maquis and garrigue, phygrana	Dry grassland, steppes	Humid grassland, Mesophile grassland	Alpine and sub-Alpine grassland	Extensive cereal cultures (including Rotation cultures with regular fallowing)	Improved grassland	Other arable land	Broad-leaved deciduous woodland	Inland rocks, Screes, Sands, Permanent Snow and ice	Other land (including towns, villages, roads, waste places, mines, industrial sites)	Total habitat cover %	Total site area hectares
Beara Peninsula	SPA 004155	1%		10%	10%	20%	1%		25%	6%	7%	3%	5%	5%	5%		2%		100%	2,430.70
The Bull and the Cow Rocks	SPA 004066	98%			2%														100%	380.12
Deenish Island and Scariff Island	SPA 004175	70%				5%			15%	9%								1%	100%	845.35
Iveragh Peninsula	SPA 004154	1%			13%	20%	1%		25%	5%	5%			20%	10%				100%	3,486.97
Skellings	SPA 004007	94%				4%				1%								1%	100%	624.08
Puffin Island	SPA 004003					30%			5%	45%	20%								100%	221.15

Table 2.9.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Outline details of the seven SPAs selected for consideration in this NIS, along with status data for their main avian SSCIs, including the three foraging seabird species for consideration, highlighted in green

Key: R M / O B = Resident / Migratory / Overwintering / Breeding; Maximum Population = Numbers reported in site Natura Forms / Synopses.

p = pairs; i = individuals. Site importance R = Regional N = National I = International

Site-specific descriptors:-

Black script = site SCIs; green highlight = SCI's for NIS assessment; Blue script = Other Article 4 / Annex II birds; Purple script = Other important birds not in Article 4 / Annex II.

Beara Peninsula SPA 004155				
Minimum straight-line distance from Shot Head site 10.5km				
Minimum over-water distance from Shot Head site 10.5km. Maximum 50.0km				
Species	Common name	Site importance	R M O B	Maximum population
Fulmarus glacialis	Northern Fulmar	N	B	575p
Pyrrhocorax pyrrhocorax	Chough	-	B	54p
Falco peregrinus	Perigrine Falcon	-	B	4p
Larus Argentatus	Herring gull	-	B	20p
Phalacrocorax arostitelis	Shag	-	O	12p
Cepphus grylle	Black Guillemot	-	B	87i

Bull and the Cow SPA 004066				
Minimum straight-line distance from Shot Head site 43.5km				
Minimum over-water distance from Shot Head site 44.5km				
Species	Common name	Site importance	R M O B	Maximum population
Morus bassanus	Northern gannet	N	B	3,694p
Hydrobates pelagicus	Storm petrel	N	B	3,500p
Fratercula arctica	Puffin	N	B	200p
Fulmarus glacialis	Northern Fulmar	R	B	40p
Uria aalge	Common Guillemot	R	B	938p
Alca torda	Razorbill	R	B	88p
Larus argentatus	Herring gull	-	B	20p
Phalacrocorax carbo	Cormorant	-	B	40p
Rissa tridactyla	Kittiwake	R	B	350p
Larus marinus	Great black-backed gull	-	B	280p

Iveragh Peninsula SPA 004154				
Minimum straight-line distance from Shot Head site 32.0km				
Minimum over-water distance from Shot Head site 63.0km. Maximum 106.0km				
Species	Common name	Site importance	R M O B	Maximum population
Fulmarus glacialis	Northern Fulmar	N	B	766p
Uria aalge	Common Guillemot	N	B	2860p
Falco peregrinus	Perigrine Falcon	-	B	5p
Rissa tridactyla	Kittiwake	N	B	1150p
Pyrrhocorax pyrrhocorax	Chough	-	B	86
Alca torda	Razorbill	-	B	90p
Larus argentatus	Herring gull	-	B	30p
Phalacrocorax arostitelis	Shag	-	B	11p
Phalacrocorax carbo	Cormorant	-	B	33p
Cepphus grylle	Black Guillemot	N	B	118i
Larus marinus	Great black-backed gull	N	B	63p

Deenish Island and Scarriff Island SPA 004175				
Minimum straight-line distance from Shot Head site 38.0km				
Minimum over-water distance from Shot Head site 60.0km				
Species	Common name	Site importance	R M O B	Maximum population
Fulmarus glacialis	Fulmar	-	B	385p
Puffinus puffinus	Manx Shearwater	N	B	2,311p
Hydrobates pelagicus	Storm petrel	-	B	1,400p
Larus fuscus	Lesser black-back gull	-	B	97p
Sterna paradisea	Arctic tern	N	B	54p
Larus argentatus	Herring gull	-	B	28p
Pyrrhocorax pyrrhocorax	Chough	-	B	2p
Cepphus grylle	Black Guillemot	-	B	10p
Larus marinus	Great black-backed gull	-	B	7p

Skelligs SPA 004007				
Minimum straight-line distance from Shot Head site 60.0km				
Minimum over-water distance from Shot Head site 68.0km				
Species	Common name	Site importance	R M O B	Maximum population
Fulmarus glacialis	Northern Fulmar	N	R	806p
Morus bassanus	*Northern gannet*	I	B	29,683p
Uria aalge	Common Guillemot	N	B	1,709p
Falco peregrinus	Peregrine falcon	-	B	1p
Puffinus puffinus	Manx shearwater	N	B	738p
Hydrobates pelagicus	Storm petrel	I	B	9,994p
Rissa tridactyla	Kittiwake	N	B	944p
Fratercula arctica	Puffin	N	B	4,000p
Alca torda	Razorbill	-	B	304p
Pyrrhocorax pyrrhocorax	Chough	-	B	1p

Puffin Island SPA 004003				
Minimum straight-line distance from Shot Head site 53.0km				
Minimum over-water distance from Shot Head site 74.0km				
Species	Common name	Site importance	R M O B	Maximum population
Fulmarus glacialis	Northern Fulmar	N	B	447p
Puffinus puffinus	Manx sheerwater	-	B	6,329p
Hydrobates pelagicus	Storm petrel	I	B	5,177p
Larus fuscus	Lesser black-back gull	N	B	139p
Alca torda	Razorbill	N	B	800p
Fratercula arctica	Puffin	I	B	5,125p
Larus argentatus	Herring gull	-	B	47p
Pyrrhocorax pyrrhocorax	Chough	-	R	3p
Rissa tridactyla	Kittiwake	-	B	250p
Uria aalge	Common Guillemot	.-	B	250p
Larus marinus	Great black-backed gull	N	B	72p

The state body primarily responsible for the designation and protection of habitats and species of conservation interest in Ireland is the National Parks and Wildlife Service, (NPWS), which is fully integrated into the Heritage Division of the Department of Culture, Heritage and the Gaeltacht (DCHG). NPWS is responsible for the designation of conservation sites in Ireland and works with farmers, other landowners and national and local authorities, to achieve the best balance between farming and land-use / waters-use on the one hand, and meeting the requirement to conserve nature, primarily as set out in the Habitats and Birds Directives and in National legislation, on the other. The supporting information published by NPWS for each Natura-designated conservation site under the EU Directives is available on the NPWS website (www.NPWS.ie). This includes three items for each site; the Site Synopsis, the Natura 2000 Standard Data Form and the Conservation Objectives. These are updated from time to time and can be found along with other information supporting and informing the designations on the website.

The Site Synopsis for each site provides a summary of the natural history and ecological information available for the designated habitats and species on the site. The Natura Form provides the basic numerical and spatial data regarding the site and its designated species and habitats, as further summarised in Tables 2.8 and 2.9 above. The Conservation Objectives document describes the aims in respect of the maintenance or restoration of the habitats and species of community interest on the site. The Conservation Objectives documents published for each of the six sites to be considered in this NIS are entitled Generic Conservation Objectives, where the objectives set out cover the general conservation policy for all six (and many more) sites, where the only specific content relates to the species of conservation interest (SCIs) for each site, which are listed at the bottom of each document. The generic content of all six Conservation Objectives documents states as follows:-

"The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:-

- *its natural range, and area it covers within that range, are stable or increasing, and*
- *the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and*
- *the conservation status of its typical species is favourable.*

The favourable conservation status of a species is achieved when:-

- *population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and*
- *the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and*
- *there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.*

Objective: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:-……."

This is followed in each of the six Conservation Objectives document by an individual list of the SCIs specific to the site in question. This list is incorporated into Table 2.9, where the SCIs listed in the Conservation Objectives documents are tabulated in black script. The three species named for assessment in this NIS are highlighted by a green background, where they occur. All species listed as SCIs are included amongst the 193 bird species and subspecies included in Annex 1 of the Birds Directive. Annex 1 includes all European birds regarded as being in danger of extinction, vulnerable to habitat change, or otherwise compromised, which Member States must protect, under the terms of the Birds and Habitats Directives by the creation of SPAs.

For reader information (and not a required topic of this NIS), other species known from each SPA, listed in Annex 1 of the Birds Directive which are not SCIs for each site are shown in blue script. Other species, not on Annex 1 but still regarded by the site Natura Forms as important for each site are listed in purple script.

For the most part, the three named SCIs, which are all Annex 1 species, are SCIs for the sites where they breed. The only apparent exceptions to this are to be found on the Bull and the Cow Rock SPA, where populations of both Northern Fulmar (*Fulmarus glacialis*) and Common Guillemot (*Uria aalge*) breed but they are not included as SCIs for the site, even though both populations are regarded as regionally important. By the same token, a population of Common Guillemot (*Uria aalge*) is recorded as breeding on Puffin Island but is not listed as an SCI in in the Conservation Objectives document for the site; see Table 2.9. These three populations are still considered in the assessment as named species and are therefore highlighted in green, in Table 2.9.

In all cases, the published Generic Conservation Objectives for the six named SPAs sites, along with the statutory requirement arising from the conclusions of the Stage 1 Screening Assessment, require that this NIS examines the range of impacts that could arise from the proposed Shot Head site, both in isolation and in combination with other sources of the same impacts from the locality. The NIS must them assess whether the potential impacts described could significantly affect the conservation status of the habitats present in the named adjacent SPAs and / or the three seabird species named in the Stage 1 assessment, which are SCIs of some or all the SPAs in question.

As further defined in Section 1.4, it is submitted that there are two means by which the potential impacts described may have such effects. The first is through any means by which sufficient levels of any potential impactor might be capable of reaching the named SPA breeding sites, their habitats and their SCI inhabitants in situ. For the purposes of this study these are termed potential *far-field effects*. The Habitats Directive Guidelines quoted in this document advise that Natura 2000 sites up to 15km distant should normally be screened for such far-field effects. The Stage 1 Assessment requires that the NIS considers the potential for impact effects on six SPAs that lie a minimum across-water distance of between 10.5 and 74km from the Shot Head site.

The second means by which the potential impacts described may have such effects is restricted to foraging or voyaging species, such as the three seabird species named, which have the potential to be negatively affected by impacts close to their impact source, on voyaging to the specific locations where such impacts might be localised.

The former is considered in this section, whilst Sections 3 and 4 of this document are largely concerned with evidence for potential near-field impacts on the three named foraging seabirds, in the locality of the Shot Head site itself, both in isolation and in or combination other impact sources in the locality.

2.7. The potential for effects on named SPAs and SCIs from far-field impacts.

This topic is largely covered in the consideration of the connectivity of the three seabird species from the SPAs under consideration, to the proposed CIFT Shot Head site and other aquaculture sites in Bantry Bay, in Section 3 of this NIS.

The characteristics of the six SPA sites to be considered, largely summarised from the Natura Forms and Synopses for the sites, are as follows:-

2.7.1. Beara Peninsula SPA 004155.

The Beara Peninsula SPA site is 2,162ha in area, and covers a considerable length of sea cliffs and coastal margin, from most of the southern side of Bear Island, around the seaward end of the Beara Peninsula in both Bantry Bay and Kenmare Bay, where it stretches to Cod's Head. It also includes the coastal margin of Dursey Island, where the main Fulmar colony is located.

According to the Natura Form for the site, whilst it occupies the coastal strip and 300m of hinterland for much of its length, the high water mark denotes the seaward boundary of the site and consequently only 1.34% of its area comprises marine habitats. It is noteworthy that the coastal edge on the seaward side of Bear Island is the closest SPA area to salmon farm sites, being a straight-line distance of 10.5km from the Shot Head site centre; see Table 2.8 and Figure 2.28.

The site is noted for its Vegetated Sea Cliffs, an Annex 2 habitat, and its Internationally Important breeding population of 54 pairs of the Annex 1 and red book bird species Chough. It also accommodates breeding populations of four seabirds amongst its SCIs, one of which is a Nationally Important population of 575 pairs of Northern Fulmar, *Fulmarus glacialis*, a subject of this investigation, which breed on Dursey Island. The other seabird SCIs for this site are the Herring Gull, *Larus argentatus*, the Shag, *Phalacrocorax aristotelis*, and the Black Guillemot, *Cepphus grylle*. Four pairs of the Peregrine Falcon are known to breed on the site. The two other named seabirds for consideration in this NIS, the Gannet and the Common Guillemot, are not SCIs of this site.

The stated Conservation Objective for this site is "*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:-*"

The Fulmar colony on Dursey Island is an across water distance of some 40km from the Shot Head site, even though the nearest sections of the SPA are to the south of Bear Island, some 10.5km distant. Fulmar populations nationally have been very stable for the last twenty years at around 33,000. The only population data for Fulmar in the Dursey Island colony are from the Seabird 2000 count, when 575 birds were counted, whilst 487 were present in 2016; see Section 3.44. From the data available this population is regarded as stable and therefore satisfies its conservation objective..

It is noted that only 1.34% of the habitats present on the site are marine, being the medium through which soluble far-field impacts from the Shot Head site, both in isolation and in-combination with other sources could affect the site's habitats and SCIs. The results of wastes discharge calculation and water quality modelling for all Bantry Bay salmon farm sites, at worst case, show that no standard parameter EQS will be breeched by Shot Head discharges. Parameter elevation, even in the statistical Maximum Plume Plot will be zero over ambient within 4km of the Shot Head site. Thus, it is concluded that no far-field impact can significantly affect the habitats and named SCI in situ on the site, which is a minimum distance of 10.5km from Shot Head.

The same outcome applies to in-combination impacts, including other sources in the locality, since, whilst all existing salmon farms in the bay are double accounted for in the water quality models, they already contribute to ambient parameter concentrations in the bay. The baseline condition of the bay as a whole is currently at High Ecological Status as set out in Section 2.3 and will remain so if the Shot Head site is licensed to operate as Section 2.5 establishes, since no EQS or SI 272 2009 Quality Element will be breached.

Thus, should the Shot Head site be licensed, the Conservation Objective for the Beara Peninsula SPA will be fully met and both habitats and SCIs will be unaffected by far-field impacts.

2.7.2. The Bull and the Cow Rocks SPA 004066.

This site comprises two small rocky islands, the Cow and the Bull, situated 2.5 km and 4 km respectively from Dursey Head off the coast of Co. Cork. The islands, which are composed of vertically stratified sandstone, rise to over 60m and are generally precipitous. Vegetation is sparse and is a typical maritime flora, mostly comprising a sward of Thrift (*Armeria maritima*) and Sea Campion (*Silene maritima*). A few rocky islets occur off the main islands. The surrounding water, between and to a distance of 500 m around each island, is included within the site for the benefit of the breeding seabirds. The Commissioners of Irish Lights maintain a lighthouse on the Bull. The Bull and the Cow is the second closest of the named SPAs to the proposed Shot Head site, lying some 44.5km from the Shot Head site centre; see Figure 2.28.

The site, total area 380ha and 98% marine, is a Special Protection Area (SPA) is an SCI for Storm Petrel, Gannet and Puffin. The site holds one of the most important seabird colonies in the country, with populations of Storm Petrel and Gannet of at least National Importance. The petrels breed on both the Cow and the Bull but have not been censused in recent years. The Seabird 2000 survey estimated that there were 3,500 pairs at the site. The Gannet colony on the Bull is long established and the second-largest colony in Ireland. It held 6,388 pairs in 2013-2014.

The site also supports a good diversity of other seabird species though these have not been surveyed since at least the early 1990s. The populations of Puffin (200 pairs) and Great Black-backed Gull (280 pairs) may be are of National Importance. Other species which breed are Cormorant (40 pairs), Kittiwake (350 pairs), Common Guillemot, a subject of this study, (938 pairs), Fulmar (40 pairs), Herring Gull (<20 pairs) and Razorbill (88 pairs). Both islands are extremely inaccessible and difficult to land on and hence are seldom visited.

Owing to their importance, both islands have been designated as Refuges for Fauna. The Cow is State-owned.

The stated Conservation Objective for this site is "*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:-"*

The results of wastes discharge calculation and water quality modelling for all Bantry Bay salmon farm sites, at worst case, set out in Section 2.5 show that no standard parameter EQS will be breeched by Shot Head discharges, either in isolation or in combination with other impact sources in the locality of Bantry Bay. Parameter elevation, even in the statistical Maximum Plume Plot, will be zero over ambient within 4km of the Shot Head site. Thus, it is concluded that no far-field impact can significantly affect the habitats and named SCI in situ on the site, which is a minimum distance of 44.5km from Shot Head.

Thus, should the Shot Head site be licensed, the Conservation Objective for the Bull and the Cow Rocks SPA will be fully met and both habitats and SCIs will be unaffected by far-field impacts.

2.7.3. Deenish Island and Scarriff Island SPA 4175

Deenish Island and Scariff Island are small to medium-sized islands situated between 5 and 7 km west of Lamb's Head to the northern side of Outer Kenmare Bay. Total area of the SPA is 845ha. Scariff is the larger of the two islands, being steep-sided, with its highest cliffs to its south side, rising to a peak of 252 m. Island vegetation is a mix of maritime grassland, bracken and heath with Ling Heather. The islands lie an over-water distance of 60km from the Shot Head site; see Table 2.9 and Figure 2.28.

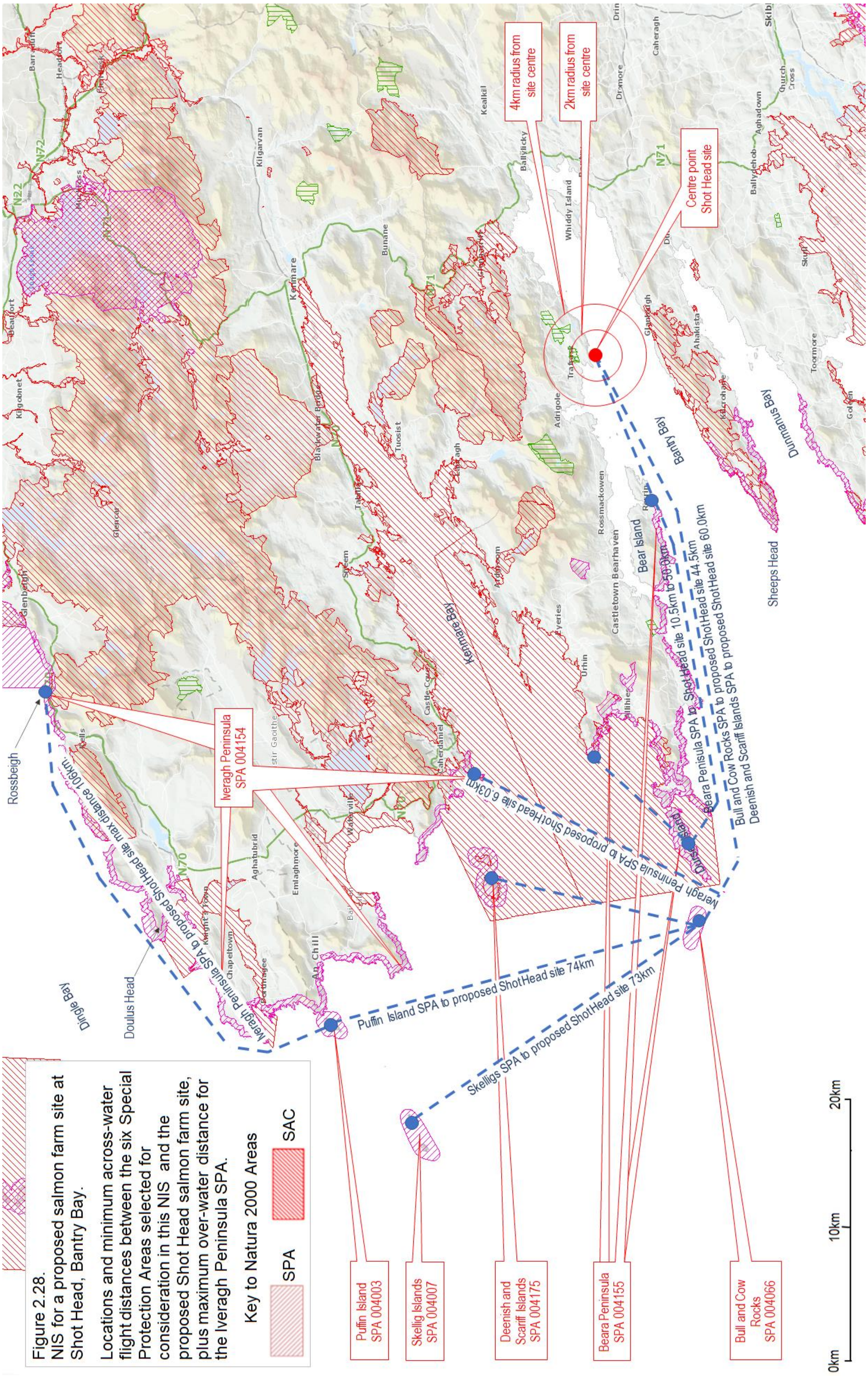


Figure 2.28.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

Locations and minimum across-water flight distances between the six Special Protection Areas selected for consideration in this NIS and the proposed Shot Head salmon farm site, plus maximum over-water distance for the Iveragh Peninsula SPA.

Deenish Island is less rugged, rising to 144 m to its south and lower and flatter on its northern side. To cater for the needs of its seabird populations, the marine margin around the island is included in the site to a distance of 500m from the shore. It is notable that a large salmon farm, CIFT Deenish Island Salmon Farm has operated on its eastern side, preceding the Natura designation by some years, partially within the marine margin of the SPA and also within the Kenmare River SAC 002158.

The site is of special conservation interest for the following sea bird species: Fulmar (*Fulmarus glacialis*) 385 pairs; Manx Shearwater (*Puffinus puffinus*) 2,311 pairs, of National Importance; Storm Petrel (Hydrobates pelagicus) 1,400 pairs (*Internationally Important*); Arctic Tern (*Sterna paradisaea*) 54 pairs; Shag (*Phalacrocorax aristotelis*) 10 pairs, Herring Gull (*Larus argentatus*) 28 pairs; Great Black-Backed Gull (*Larus marinus*) 7 pairs, Lesser Black-backed Gull (*Larus fuscus*) 97 pairs and Black Guillemot (*Cepphus grylle*) 10 pairs. Of terrestrial bird species, Chough (*Pyrrhocorax pyrrhocorax*) 2 pairs, are recorded as breeding in small numbers on Scariff Island. Oystercatcher (*Haematopus ostralegus*), Skylark (*Alauda arvensis*), Wheatear (*Oenanthe oenanthe*), Stonechat (*Saxicola rubicola*), Rock Pipit (*Anthus petrosus*) and Raven (*Corvus corax*), have also been recorded on Deenish and Scariff Islands. Chough, Storm Petrel and all Tern species are listed on Annex I of the EU Birds Directive.

Deenish Island and Scariff Island SPA is a site of high ornithological importance on account of the internationally important population of Storm Petrel and Nationally Important populations of Manx Shearwater, Fulmar, Lesser Black-backed Gull and Arctic Tern. Also of note is that Storm Petrel and Arctic Tern, as well as Chough, are listed on Annex I of the E.U. Birds Directive.

The stated Conservation Objective for this site is "*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:-*"

The results of wastes discharge calculation and water quality modelling for all Bantry Bay salmon farm sites, at worst case, set out in Section 2.5 show that no standard parameter EQS will be breeched by Shot Head discharges, either in isolation or in combination with other impact sources in the locality of Bantry Bay. Parameter elevation, even in the statistical Maximum Plume Plot, will be zero over ambient within 4km of the Shot Head site. Thus, it is concluded that no far-field impact can significantly affect the habitats and named SCI in situ on the site, which is a minimum distance of 44.5km from Shot Head.
Thus, should the Shot Head site be licensed, the Conservation Objective for the Scarriff Island and Deenish Island SPA will be fully met and both habitats and SCIs will be unaffected by far-field impacts.

2.7.4. Iveragh Peninsula SPA 004514

The Iveragh Peninsula SPA covers some 75km of coastline sections, from Rosbehy on the southern side of Dingle Bay at its northern limit, via Valencia Island and Bolus Head (excluding Ballinskelligs Bay) to Derrynane and Lambs Head to the south. Its various sections lie an over water distance of between 63km and 106km from the Shot Head site. It total area is 3,487ha, of which only 4.79% is marine.

The primary features of SPA 004514 comprise vegetated sea cliffs and high coast adjacent to the cliff edge to 300m inland (to protect breeding and foraging ground for Chough), as well as dunes at Derrynane (there is also a blue flag beach at Derrynane) and Beginish, to the north of the site. The special conservation interests of the site are for Chough (*Pyrrhocorax pyrrhocorax*), Peregrine (*Falco peregrinus*), Guillemot (*Uria aalge*), Fulmar (*Fulmarus glacialis*) and Kittiwake (*Rissa tridactyla*). These species are distributed amongst scattered, suitable habitat throughout the SPA and nest out of the range under consideration of possible indirect impacts, although sea-foraging may bring voyaging species into range. The site is also designated for a number of other protected habitats, including dry heath, wet heath, upland acid grassland, bracken semi-improved and improved grassland, dune grassland, streams, bedrock shores and islets. These are out of range of, or otherwise of little relevance to indirect impacts from aquaculture sites in Bantry Bay, bearing in mind their terrestrial locations.

The stated Conservation Objective for this site is "*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:-"*

The results of wastes discharge calculation and water quality modelling for all Bantry Bay salmon farm sites, at worst case, set out in Section 2.5 show that no standard parameter EQS will be breeched by Shot Head discharges, either in isolation or in combination with other impact sources in the locality of Bantry Bay. Parameter elevation, even in the statistical Maximum Plume Plot, will be zero over ambient within 4km of the Shot Head site. Thus, it is concluded that no far-field impact can significantly affect the habitats and named SCI in situ on this site, which is a minimum distance of 63km from Shot Head.

Thus, should the Shot Head site be licensed, the Conservation Objective for the Iveragh Peninsula SPA will be fully met and both habitats and SCIs will be unaffected by far-field impacts.

2.7.5. Skelligs SPA 004007.

The Conservation plan for this SPA is generic and conservation objectives have yet to be published. The site comprises the Great Skellig and Little Skellig islands, total area 624ha, of with 95% is marine habitat.

Both islands are precipitous rocky sea stacks, Great Skellig rising to 218 m and Little Skellig to 134 m. The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for Fulmar, Manx Shearwater, Storm Petrel, Gannet, Kittiwake, Guillemot and Puffin. It is also of special conservation interest for holding an assemblage of over 20,000 breeding seabirds.

The Skelligs comprise one of the most important seabird colonies in the country for populations and species diversity. Great Skellig has an Internationally Important population of Storm Petrel (*Hydrobates pelagicus*) numbering 9,994 pairs in 2002, with birds nesting both in the stonework associated with the monastic settlement and in natural crevices amongst the scree and rock. Little Skellig is best known for its long established and Internationally Important Gannet colony (*Morus bassanus*), with 35,294 pairs in 2014 Gannet census . This is one of the largest Gannet colonies in the world and the largest in Ireland. Great Skellig also has one of the largest Puffin (*Fratercula arctica*) colonies in the country, with 6,000 pairs estimated in 2002. Other seabird species which occur on the islands in nationally important numbers are Fulmar (*Fulmarus glacialis*); 830 pairs, Manx Shearwater (*Puffinus puffinus*), 902 pairs, Kittiwake (*Rissa tridactyla*) 1,035 pairs and Common Guillemot (*Uria aalge*) 1,652 pairs; all data quoted from 2002. Razorbill (*Alca torda*) 283 pairs occur (five-year mean between 998 and 2002) but are below the threshold of national importance.

Great Skellig is a traditional Chough site, although its relatively small size supports only one nesting pair. Peregrine Falcon also nest in some years. Also of note is the regular presence of three species, Storm Petrel, Chough and Peregrine Falcon, which are on Annex I of the EU Birds Directive.

The stated Conservation Objective for this site is "*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:-"*

The results of wastes discharge calculation and water quality modelling for all Bantry Bay salmon farm sites, at worst case, set out in Section 2.5 show that no standard parameter EQS will be breeched by Shot Head discharges, either in isolation or in combination with other impact sources in the locality of Bantry Bay. Parameter elevation, even in the statistical Maximum Plume Plot, will be zero over ambient within 4km of the Shot Head site. Thus, it is concluded that no far-field impact can significantly affect the habitats and named SCI in situ on the site, which is a minimum distance of 68km from Shot Head.

Thus, should the Shot Head site be licensed, the Conservation Objective for the Skelligs SPA will be fully met and both habitats and SCIs will be unaffected by far-field impacts.

2.7.6. Puffin Island SPA 004003

The Conservation plan for this SPA is generic and conservation objectives have yet to be published. Puffin Island lies off the Iveragh Peninsula, an over-water distance of 74km from the Shot Head site; see Figure 2.28. This long, thin island is almost divided into two halves, the southern half being a long narrow, rocky ridge, rising to 130 m, while the northern half broadens into a grassy plateau though has a high point of 159 m. The island is surrounded by mostly steep cliffs and slopes. The vegetation of the main part of the island is a typical maritime grassy sward, though nine different plant communities have been distinguished, including a small area of Ling Heather (*Calluna vulgaris*) heath. A Thrift (*Armeria maritima*) community dominates the slopes. In the past Puffin Island was grazed quite heavily by sheep, and today rabbits are common.

The site, total area 349ha is 85% marine and is an SPA of Special Conservation Interest for a number of seabird species. It support Internationally Important populations of Storm Petrel (5,177 pairs) and Manx Shearwater (6,329 pairs), being the second most important site for this species in Ireland. The Nationally Important breeding population of Puffin (5,125 pairs) was the largest recorded in Ireland during the Seabird 2000 survey. The island also supports Nationally Important populations of Fulmar (most recent count 447 pairs in 2000), Razorbill (402 pairs in 1985 - incomplete survey in 2000) and Lesser Black-backed Gull (139 pairs in 2000). The site is also of special conservation interest for holding an assemblage of over 20,000 breeding seabirds. Puffin Island is one of the most important seabird sites in Ireland.

Other seabirds recorded during the Seabird 2000 survey include Shag (5 pairs), Kittiwake (25 pairs), Common Guillemot (92 pairs) and Great Black-backed Gull (72 pairs). Chough also breeds on Puffin Island with up to 3 pairs recorded in 1992 and at least one pair in 2002. During winter, the resident population may be joined by other birds that breed on the mainland.

Puffin Island SPA is of International Importance for its breeding seabird assemblage. The presence of Chough and Storm Petrel is of particular note as these species are listed on Annex I of the EU Birds Directive. The island is owned by BirdWatch Ireland and is managed for conservation. Puffin Island is a Statutory Nature Reserve.

The stated Conservation Objective for this site is "*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:-*"

The results of wastes discharge calculation and water quality modelling for all Bantry Bay salmon farm sites, at worst case, set out in Section 2.5

show that no standard parameter EQS will be breeched by Shot Head discharges, either in isolation or in combination with other impact sources in the locality of Bantry Bay. Parameter elevation, even in the statistical Maximum Plume Plot, will be zero over ambient within 4km of the Shot Head site. Thus, it is concluded that no far-field impact can significantly affect the habitats and named SCI in situ on this site, which is a minimum distance of 74km from Shot Head.

Thus, should the Shot Head site be licensed, the Conservation Objective for the Puffin Island SPA will be fully met and both habitats and SCIs will be unaffected by far-field impacts.

2.8. Discussion and Conclusions.

The three seabird species and the six SPA sites to be considered in this NIS were selected for consideration through the Stage 1 Screening Assessment process. The general characteristics of the six SPAs are summarised in Section 2.7, whilst their locations, SCI status data and straight line and over-water distances from the proposed CIFT salmon farm site at Shot Head are set out in Table 2.9 and mapped in Figure 2.28; see also Table 4.4

The three species for consideration are the Northern Gannet *Morus bassanus*, the Common Guillemot *Uria aalge* and the Northern Fulmar, *Fulmarus glacialis*. Their biology, behaviour and global and Irish status and distribution are all fully described in

From Table 2.8 it is worthy of note that Northern Fulmar breed on all six named SPA sites, including four with populations of National and one of Regional Importance. Common Guillemot are SCIs for four of the sites, two of which accommodate Nationally Important and one a Regionally Important population, whilst the Gannet is an SCI of two of the sites, one of International Importance, being one of the largest colonies globally and the other, nearby, being of National Importance. Clearly this cluster of SPAs off the west Cork and Kerry coast is one of the most important in the country, individually and severally deserving of maximum protection.

The 2016 RPS WQ Report submitted to ALAB uses a hydrodynamic model and waste discharge data provided by CIFT and Watermark to model the dispersal of standard organic waste parameters, Dissolved Inorganic Nitrogen (DIN), Dissolved Inorganic Phosphorus (DIP), Biochemical Oxidation Demand (BOD) and Solids (SS) from the Shot Head site and assesses their impact on existing ambient conditions, with distance from the site, as they dilute and disperse in the tidal currents. An eight-stage, worst-case scenario is employed in the modelling procedure to provide a wide margin of safety in the modelled outcomes.

The study finds that, in the case of DIN, typical mean Spring mid-flood and mid-ebb tide concentration plumes, from Shot Head alone or in combination with all other existing and proposed salmon farm sites in Bantry Bay, do not breach the EQS at any point and elevation of ambient DIN levels are close to zero within 2-3km of the Shot Head site in all directions. Similar plots for DIP suggest much lower elevations of ambient overall than for DIN; in this case the EQS for DIP is not even approached, even at the dispersal source in the Statistical Maximum Plume Plot. For BOD, whilst there is no EQS for BOD in Coastal waters, the elevated ambient conditions resulting from BOD discharges remain far lower than the BOD EQS for Transitional waters and the result of peak BOD discharges on oceanic influx of ambient oxygen into Bantry Bay is shown to be a reduction of no greater than 1%, such that mean ambient DO in the bay is barely affected. Again, the elevation of BOD is effectively zero within 2-3km of the Shot Head site. Finally, settled solids loadings are restricted to the locality of a seabed area under each farm site in all cases and the EQS that applies to solids settlement is not beached. A hypothetical worst case model shows that deposition of the peak monthly solids discharge every month for one year results in a deposition of just 13mm of settled solids on the seabed under the site.

The six named SPAs lie a minimum over-water (the route taken by dispersing discharges in the water column or on the seabed) distance of between 10.5 and 74km. Bearing in mind the rapid dilution of all organic waste parameters tested, it is submitted that no impacts will arise at any of the six SPAs named, or impact on their SCIs, in situ. It is also observed that the seaward margins of the closest site, the Beara Peninsula SPA 00415, is at the high water mark, and the site has effectively no marine habitat. Consequently, no waterborne impacts, were they to exist, could impact on this site.

It is also noted that whilst the worst case created includes waterborne discharges of DIN, DIP, BOD and SS, from all sites in the bay in order to track their dispersal pattern the discharges from the existing sites in the bay, including those closest to the SPAs, have been making their contributions to ambient parameter concentrations in the Bantry Bay for many years, some 40 years in the case of the Roancarrig site. During this period, seabird populations in the aera have not been known to decrease and, in the case of the large Gannet colonies on the Bull and Cow SPA 004066 and the Skellig Islands SPA 004007, they have continued to grow continually and considerably in numbers over the entire recording period, as Section 3 demonstrates. It is also note that, despite the considerable presence of salmon farming in Bantry Bay over a number of decades, the Ecological Status of the Outer Bantry Bay Coastal Water Body is assessed as High by the EPA, with a further assessment of being Not at Risk of deterioration, under the terms of SI 272 and the Water Framework Directive.

Thus, in conclusion, no far-field impacts are expected to arise from the operation of any existing or proposed salmon farm sites in Bantry Bay on any of the six named SPAs or their seabird SCIs.

Section 3
The three named subject bird species for consideration in this NIS.

3.1. Background.

As per the letter to the applicant, CIFT, on 20th June 2019, ALAB limited the scope of this NIS to the consideration of the impact potential on three named seabird species, due the installation of the proposed salmon farm site at Shot Head, Bantry Bay, County Cork, both as a result of the presence and operation of the proposed site only, and in combination with other possible local impact sources. The three seabird species are Northern Gannet (*Morus bassanus*), Common Guillemot (*Uria aalge*) and Northern Fulmar (*Fulmarus glacialis*). The biology and ecology of each species is considered in Sections 3.2 to 3.4.

3.2. Northern Gannet; *Morus bassanus*.

3.2.1. Biology and distribution.

The specific name of the Northern Gannet is taken from the name of the Bass Rock, in the Firth of Forth, the world's largest gannetry, which accommodated 75,259 pairs at the last full census in 2014. The global extent of occurrence of the Northern Gannet (breeding and resident birds) covers some 41,700,000km^2 [29] of the North Atlantic; see Figure 3.1.

The Gannet is the largest European seabird. Adults are sexually monomorphic and reach 110cm in length, with a 165-180cm wingspan and a weight of 3.0-3.5kg[30]. They are mainly white, with a long, sleek body and neck. Wingtips and tail are black and the head yellow-orange, with a similarly coloured, dagger-like bill. Legs are short, with webbed feet, making the bird ungainly on land. Gannets are long-lived, intelligent, highly sociable birds. Average life span is 17 years and maximum age over 30 years. Unlike most other seabirds, Gannets have binocular vision, which assists them when locating and range-finding feed resources.

Juvenile Gannets are brown-black, speckled with white and remain far out to sea to for up to four or five years. Most travel further than adults and remain at sea for at least the first two years of their life before returning to the locality of their home colony. Most fly south from their home waters in Northern Europe, to the Bay of Biscay and the coast of West Africa during this period.

[29] BirdLife International data zone; datazone.birdlife.org/species/factsheet/22696657.

[30] https://en.wikipedia.org/wiki/Northern gannet.

Figure 3.1.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Global native resident Northern Gannet distribution 2019.
Source Birdlife International 2019 Species Factsheet http://www.birdlife.org.

The world breeding population of Northern Gannet is spread through 54 coastal colonies. Some 57.4% of the birds are resident in the UK in some 20 colonies, and 46.3% in Scotland. In 2014, Murray[31] estimated the global population of Northern Gannet to be 526,000 breeding pairs. In 2019, Birdlife International[32] estimated the global population to be 1.5-1.8M individuals, although data quality for the estimate is described as poor.

9.1% of the global population breeds in Ireland, in six colonies. There are no gannetries in Northern Ireland. Other European colonies are found mainly on the Norwegian, Icelandic and French coasts, whilst there are three gannetries on the east coast of Newfoundland and three in the Gulf of St Lawrence, between Quebec and New Brunswick, Canada.

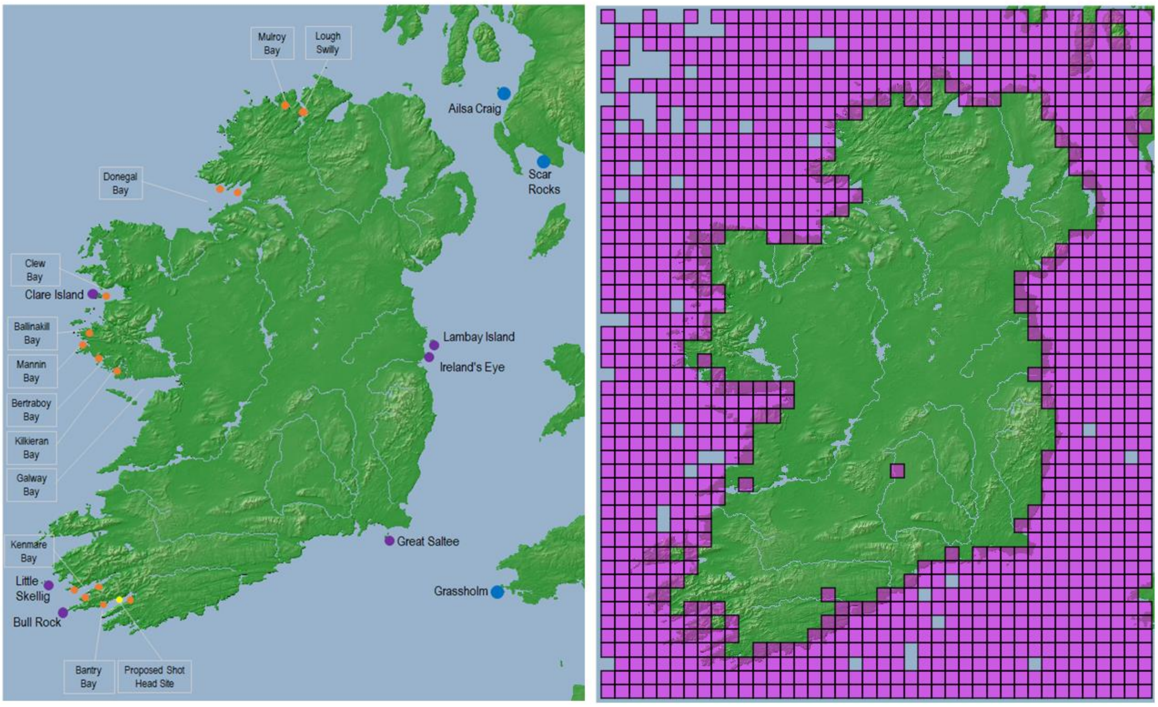
Juvenile Gannets are brown-black, speckled with white and remain far out to sea to for up to four or five years. Most travel further than adults and remain at sea for at least the first two years of their life before returning to the locality of their home colony. Most fly south from their home waters in Northern Europe, to the Bay of Biscay and the coast of West Africa during this period.

31 Murray S et al 2014. The status of the Gannet in Scotland in 2013–14 Scottish Birds 35:1 3-18

32 BirdLife International (2019) Species factsheet: *Morus bassanus*. http://www.birdlife.org

Due to their wide-ranging foraging habit, Gannet can be observed all around the British and Irish coastline, often far from their home colonies. They also penetrate all coastal inlets where suitable conditions (e.g. adequate depth) for foraging or scavenging exist. This is illustrated for Ireland in Figure 3.2.

Figure 3.2.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Map of Ireland's six Gannet colonies (purple) and nearby western British colonies (blue) and main Irish aquaculture areas / sites (orange), along with map of Irish Gannet sitings on a 10km^2 grid.
Source of sitings map; record of >57,000 sitings; https://biodiversityireland.ie.

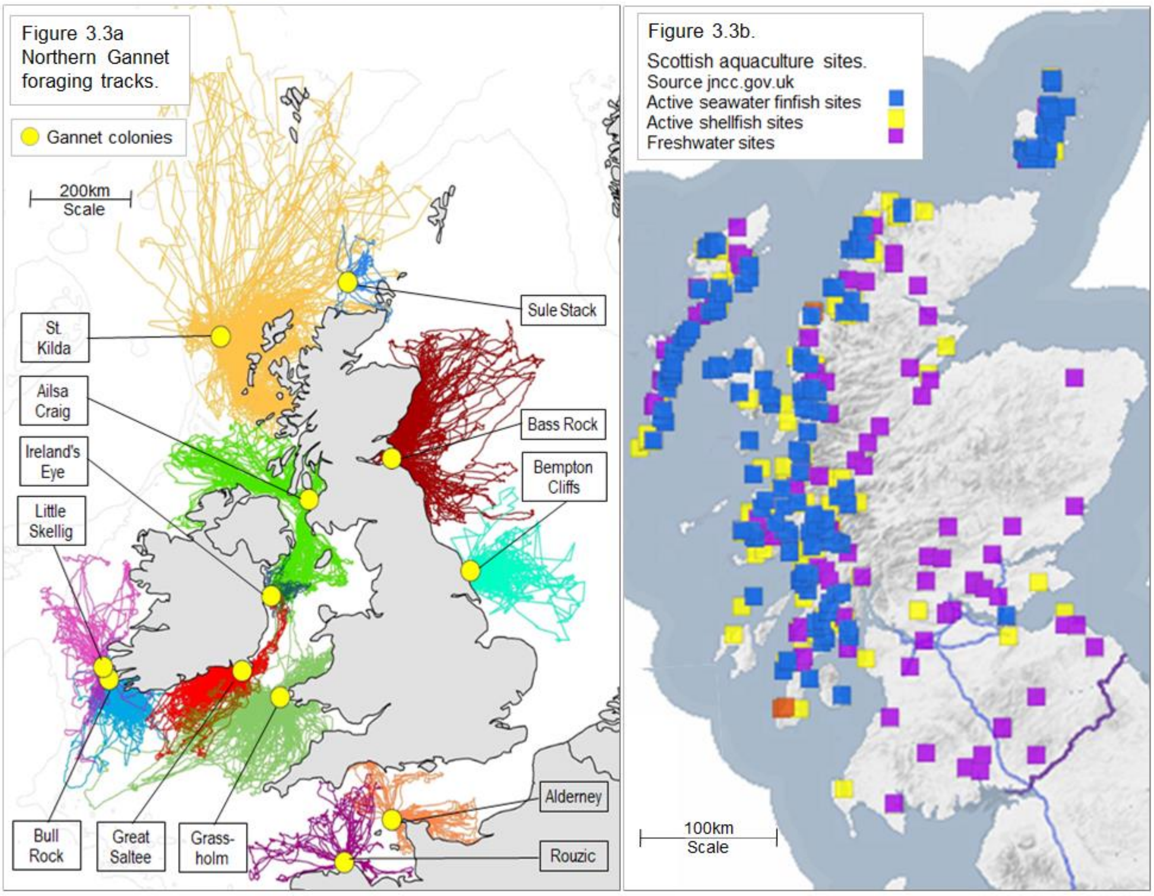


Similar, wide-ranging, foraging and scavenging behaviour is also exhibited by Northern Gannet along the Scottish and Norwegian coastlines. Foraging of Gannets off Scotland and Norway may not seem to be material to this study. However, it is submitted that it is highly relevant because aquaculture activity is considerably denser in these areas than it is along the Irish west coast. This therefore provides further and possibly enhanced opportunities to investigate the probability of negative interactions between seabirds and aquaculture sites, at locations where the risks of such interactions would be expected to be considerably higher.

Foraging ranges along the Scottish and Irish coastlines, tracked by satellite from GPS loggers fitted to individual birds, are shown in Figure 3.3[33], along with locations of Scottish salmon farm sites. Figure 3.4 shows equivalent information, using similarly tracked Gannet density data, for Norway.

33 Wakefield ED et al 2013. Space partitioning without territoriality in Gannets. Science 341, 69.

Figure 3.3.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Map of Northern Gannet satellite tracks of foraging from 12 British, Irish and French SPA / colonies, alongside a map of Scottish aquaculture site locations.
Sources Gannet colony foraging tracks (total 184 birds) after Wakefield et al, 2013. Science 341, 68.

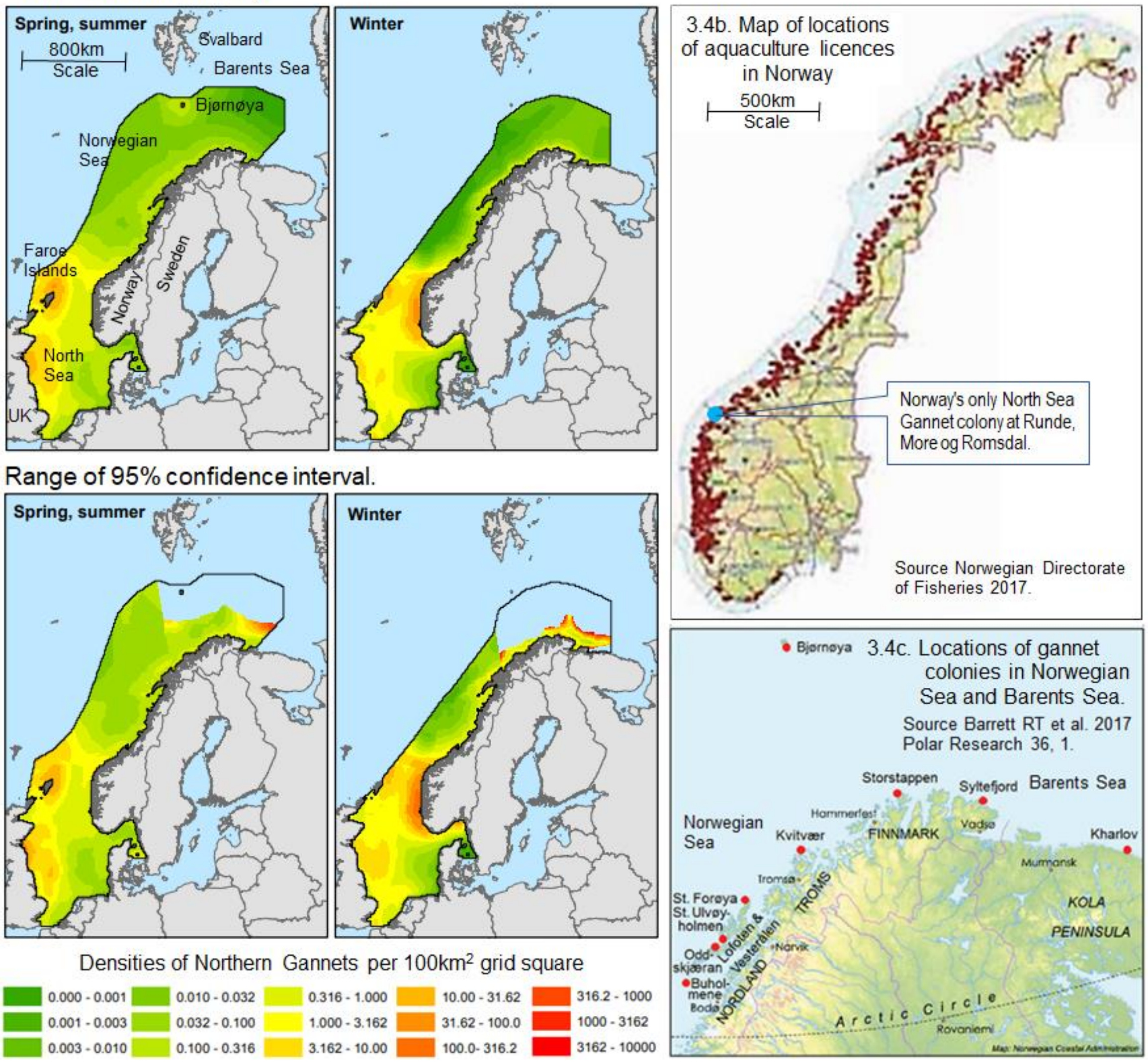


The tracking and density data provided in Figures 3.2 to 3.4 show that, largely due to their significant migratory and foraging ranges and colony locations, Northern Gannet are likely to encounter large concentrations of marine aquaculture in the NE Atlantic, along with other potentially impacting human activities, throughout their geographical range. The question is whether or not this results in negative impacts on any seabird species, in particular on the three considered in this NIS.

Figure 3.5 shows that Norway accommodates some 7 times the salmonid production of Scotland and well over 100 times Irish production levels. Whilst not necessarily directly equivalent to total area, there are almost 5 times more active salmonid farm sites in Norway than in Scotland and almost 60 times more in Norway than in Ireland. Whilst there are other variables at play, for example relative bird population densities and coastline length, such stark differences in aquaculture density could reasonably be expected to show up broadly pro-rata differences in impact consequences, on foraging seabirds, if indeed impacts do occur.

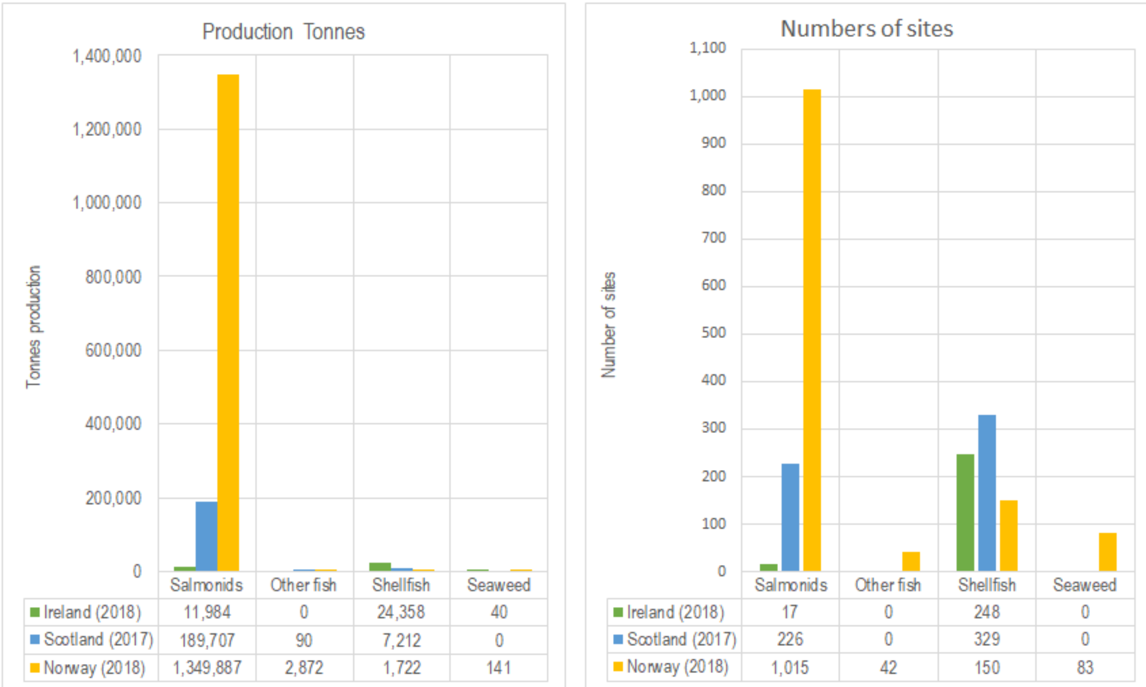
Figure 3.4.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Estimated seasonal densities of Northern Gannet off the Norwegian coast, from GPS tracking studies coupled with locations of aquaculture site licences and gannetry locations.
Source of density maps http://www.seapop.no/en/distribution-status/distribution/at-sea/#northerngannet.

3.4a. Estimated density.



In the case of the Norwegian-monitored Gannet foraging density data, given in Figure 3.4a, it is notable that the highest densities shown (orange to red shaded contours) are, for the most part, around the largest Gannet colonies in the figure; those offshore from Bass Rock (rising to 75,259 breeding pairs in 2014), in the Firth of Forth, Scotland; around the Shetland Islands (where there are four SPA / colonies, the largest being Hermaness, on Unst, rising to 25,580 breeding pairs in 2014) and offshore from Runde, the largest Gannet colony in Norway (rising to 6,900 breeding pairs in 2016).

Figure 3.5.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Aquaculture production and site numbers compared; Ireland vs. Scotland vs. Norway.
Sources : BIM Irish Aqualculture Survey 2018, www.bim.ie; Scottish Fish Farm and Shellfish Farm Production Surveys, 2017 and 2018, www.gov.scot; Key Figures from Norwegian Aquaculture Industry 2018, www.fiskeridir.no.



Bass Rock is some 325km removed from the nearest finfish farm, (on the Orkney Islands; the nearest Norwegian site is some 625km away) and is therefore likely to be outside the range of any significant potential impacts from aquaculture. The Hermaness colony, on the most northerly Shetland Island of Unst, is only 17km from the nearest Shetland salmon farm sites, in Balta Sound. There are 75 salmon farm sites in the Shetlands, producing some 50,000Tpa of salmon, along with 6,000Tpa of rope mussel. These are all between 10km and 50km of their nearest gannetry.

The small island of Runde in Norway is an internationally important seabird reserve, with breeding populations of Gannets, Common Guillemots, Puffins, and Razorbills amongst others. Runde lies just offshore from the largest concentration of salmon farm sites in the world. These mainly occupy the Norwegian Fjords which meet the sea along the length of the Norwegian coastline; see Figure 3.4b.

It is submitted that there is no discernible difference in the health status of the three Gannet populations described, to indicate that Bass Rock is so far removed from any potential impact of aquaculture origin whilst the colonies described in the Shetlands and Norway are well within foraging range of such extensive potential site impacts. This strongly suggests that, whilst other sources of impact might apply, no significant impacts from salmon farm operations have affected the breeding or survival of Gannets around the concentrated marine farming areas of the Shetlands or Norway over the 40-year lifetime of the marine aquaculture industry in Europe.

With further reference to Figure 3.5, if no such impacts are evident on Shetlands and Norwegian colonies, it seems highly unlikely that they will affect the status of Gannets on the Skelligs and Bull Rock colonies, the closest to Bantry Bay, where aquaculture activities are so much less concentrated. The inexorable increases in Gannet populations on these SPAs for the last century or more would suggest that this is indeed the case.

3.2.2. Feeding; foraging and scavenging behaviour in Gannets

Gannet feed on a wide range of fish species, with a marked preference for energy-rich, oily fish, including mackerel, herring, sprat and in particular sand eel. Feed items taken are in the size range of 2.5 to 30.5cm. As the largest European seabird, Gannets have the highest food requirement, and consume an average of 1,179g (winter) to 1,360g (summer) of fish daily[34], or about 50% of their body weight per day.

Gannet fall into an ecological group of bird species defined as Pelagic Divers[35], which also includes the Common Guillemot, although the two differ in their diving behaviour; see also Section 3.3. Gannet feed by foraging, over a wide range, often in groups and sometimes in mixed flocks with other species, such as Guillemots and Razorbills, which employ "cooperative diving" strategies to drive fish shoals closer to the surface. Gannets locate prey shoals whilst flying at heights of between 10 and 30m. Fish are primarily caught by *plunge-diving*, beak first, with legs folded back against the body. Wings also fold back at point of water entry to optimise streamlining. Water entry speed is up to 100kph. This propels the bird through the water to depths of up to 11m. Deeper fish or shoals can then be reached by swimming on, using their wings for propulsion rather than their webbed feet, to a maximum depth of 24m. Maximum dive duration is about 40 seconds. Northern Gannets have a number of physical adaptations to accommodate the physical stresses of their diving behaviour, including streamlined bodies, powerful neck muscles, and a spongy bone plate at the base of the bill. The nostrils are inside the bill and can be closed to prevent water entry; their eyes are protected by strong nictitating membranes[36]. They are also equipped with extensions of their respiratory system in the form of air sacs, located between the ribs and the intercostal muscles that cushion their bodies against impact when they hit the water[37].

34 Grandgeorge et al. 2008. Resilience of the British and Irish seabird community in the 20th century

35 Fauchald P et al 2015 The status and trends of seabirds breeding in Norway and Svalbard. NINA Report 1151.

36 www.wikipedia.org

37 www.oceania.org

Large fish are eaten whole and head-first before the Gannet surfaces from a dive. Gannets also take fish that they can see, whilst surface-swimming, with their heads beneath the water surface.

Gannets are known to adapt and to learn new foraging and feeding strategies for a wide range of fish species and to memorise good and poor foraging spots. They have also learnt scavenging behaviour and to target scraps and discards around commercial fishing vessels. This includes the use of their binocular vision to locate and estimate the distance to fishing vessels from up to 11km away and to select those worth expending energy on, to reach[38], [39]. This provides an additional anthropogenic food source, which, although not necessarily providing fish species with optimal energy values, may offset the consequences of human overfishing activity on feed availability, for Gannets at least. This ability is thought to explain, at least in part, the dramatic increases in both Irish and global Gannet populations in recent decades. This is discussed further in Section 3.2.3.

The foraging range of Gannets and other seabird species was described by Thaxter[40]. As the paper title suggests, this work was intended for use as a preliminary tool in the identification of marine protected areas (such as SPAs in Ireland). Foraging strategies vary on a temporal or seasonal basis in Gannet in order to provide for both the forager and its offspring[41], as required. Table 3.1 gives the foraging ranges and other summary data for the three seabird species considered in this NIS. The data given for Gannet support the foraging ranges indicated from the gannetries shown in the satellite tracks plotted in Figure 3.3.

Figure 3.3 also shows the non-territorial partitioning of foraging areas exhibited by Gannets from different colonies, further discussed by Wakefield[42]. Foraging timing and trip length are dictated by colony size and population pressure. Gannets do not fly, forage or dive in darkness.

GPS tracking has also shown that Gannets also exhibit rafting behaviour within a radius of about 2km of their colonies both before and after foraging[43]. This behaviour may be associated with foraging activity.

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38 Bodey T et al. 2014.Seabird movement reveals ecological footprint of fishing vessels. Cur Biol 24 (11) 514-515.

39 Votier S et al 2013. A Bird's Eye View of Discard Reforms: Bird-Borne Cameras Reveal Seabird/Fishery Interactions. PLoS ONE 8(3): e57376. doi:10.1371/journal.pone.0057376

40 Thaxter, C. B. et al., 2012. Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Biological Conservation, 156: 53-61.

41 Garthe et al. 2003. Temporal patterns of foraging activities of northern gannets, Morus bassanus, in the northwest Atlantic Ocean. Can. J. Zool. 81, 453-461.

42 Wakefield ED et al 2013. Space partitioning without territoriality in Gannets. Science 341, 69.

43 Carter MID et al 2016. GPS tracking reveals rafting behaviour of Northern Gannets (Morus bassanus): implications for foraging ecology and conservation, Bird Study (2016), 1–1

Table 3.1.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Summary characteristics of all three indicated bird species for this NIS.
Sources; Dive depth data Birdwatch Ireland, RSPB, www.wikispaces.com www.wikipedia.com
Foraging range data from Thaxter et al 2012.

Bird species	Migration / distribution	Irish nesting / breeding grounds	Behaviour etc	Foraging range km			Dive depth m	
				Mean	Mean max	Max	Mean	Max
Northern Gannet *Morus bassanus*	Adults overwinter at sea but resident in Ireland throughout year. North Atlantic distribution	Ground nesting in large colonies, on sea cliffs and offshore islands.	Pelagic plunge diver; plunge-feeds, often in large flocks. Also by-catch scavenger. Rafts up to 2km from colony.	92.5	229.4	590	8.8	34
Common Guillemot *Uria aalge*	Winters offshore within breeding range. Both both N Atantic (further N than Gannet) and N Pacific distribution.	Breeds on wide or narrow ledges on steep cliff faces or on low flat islands	Pelagic pursuit diver; dives by swimming, not plunging. By-catch scavenger. Forms large rafts just offshore from nesting colonies.	37.8	84.2	135	90	200
Northern Fulmar *Fulmarus glacialis*	Some transoceanic (young birds); move south to breed. Widest and most northerly distribution, N Atlantic and N Pacific.	Mainly breeds on sea cliffs and rock faces in colonies on narrow ledges or in hollows.	Pelagic surface feeder and by-catch scavenger. Oceanic; spends much of time at sea; can be seen on the coast year-round.	47.5	400	580	-	<2

3.2.3. Breeding and population status.

As a long-lived species, Gannets first breed between their fifth to seventh year post-hatch. Breeding takes place during the summer in large, crowded colonies, mainly on isolated, offshore, rocky islands, islets, stacks and cliffs. Gannets are monogamous and pair for life. Only one egg is laid each season. This is guarded and fed by both parents until fledged. Breeding success is high in that about 72% of all eggs hatched fledge. About 30% of the hatch generally survives to age four and at least 90% of four-year-olds live through to full adulthood in all UK and Irish colonies monitored, including those on the Bull Rock and Little Skellig in SW Cork and Kerry[44], [45]. The majority of adult Gannets voyage widely across the oceans between breeding seasons, although some remain relatively close to their breeding colonies, from which they tend to forage out of sight of land.

The global population of Northern Gannet and that in most individual colonies, including those in Ireland, have shown constant and steady population increase, at an average of about 2% per annum growth over the last six or more decades[46]. This follows a virtual extinction in some colonies, including the gannetry on the Little Skellig, off Ireland's southwest coast, as a result of exploitation, because, at one time, Gannets and other large seabirds were an important human food

[44] Wanless S et al 2006. Survival of Northern Gannets in Britain and Ireland, 1959–2002. Bird Study (2006) 53, 79–85

[45] Warwick-Evans V et al 2016. Survival estimates of Northern Gannets in Alderney. Bird Study 63-3, 380-386.

[46] Wanless S et al 2005 The Status of Northern Gannet in Britain and Ireland 2003-2004. Br Birds 98 280-294.

resource in isolated coastal communities. In the case of Gannets, both eggs and chicks were taken. Adult Gannets were also extensively exploited for their feathers for the fashion industry, up to the 1920s. Such was the extent of exploitation that, having been known as a Gannet colony since before 1700, only 30 Gannet nests remained on the Little Skellig by 1880. However, the introduction of the Wild Birds Protection Act in Ireland in that year and similar legislation elsewhere banned the exploitation of a wide range of birds, (including all three seabirds considered in this NIS). Gannets started to recover in the Little Skellig colony immediately, with 150-200 nests counted in 1882, which had increased to 20,000 by 1908.

It is noteworthy that an annual harvest of 2,000, just pre-fledged Gannet chicks is still permitted on the island of Sula Sgeir. The island is a SPA for the protection of its bird populations, off the Isle of Lewis, the northernmost of the Western Isles. The birds are used for the preparation of a smoked delicacy known as "*Guga*"[47], [48]. The colony is known to have been occupied since the 16th century, and Guga have been harvested annually almost ever since. The Gannet population in the Sula Sgeir SPA in 2013 (latest available data) was 11,230 breeding pairs[49], which, taking account of a national average fledged chick productivity in 2013 of around 0.75 chicks per breeding pair, presumably gave rise some 8,400 fledglings. Thus, the annual guga harvest probably represents about 24% of pre-fledged chicks in the colony.

A similar harvest also takes place on the only Gannet colony in the Faroes, on the southern island of Mykines. In this case, 650 chicks are taken annually from a population of approximately 2,000 breeding pairs, probably representing over 30% of the fledgling productivity of the colony. It is claimed that these two harvests are sustainable and do not affect the status of the two colonies from which they are taken. It is a matter of record that the colony on Sula Sgeir has shown sustained growth in recent years and grew by 22% in the period 2004-2013. The harvest from Sula Sgeir was reduced from 3,200 fledglings pa some years previously; there are moves now afoot to increase it again, on the strength of the 2013 population data.

Whilst not condoning such practices in any way, such levels of exploitation and disturbance appear to put some perspective on the view expressed by Dr Gittings on Page 23 of his report to ALAB that a loss of 10 Gannets pa to aquaculture impacts would be required *"…to cause a potentially significant increase in the annual mortality rate of the Bull and the Cow Rocks SPA colony…"* This colony accommodated 6,388 breeding pairs in 2013-2014; see Table 3.3.

47 McDonald F 2014. The Hebridean guga hunt is 'ancient and sustainable', not a crime. The Guardian 27/01/2014.

48 Murray S. et al. 2015. The status of the Gannet in Scotland in 2013–14. Scottish Birds 35:1 3-18.

49 jncc.gov.uk/our-work/northern-gannet-morus-bassanus.

Increases in Gannet populations of (and those of some other foraging seabird species) in recent decades may be explained in part by their learned habit of scavenging around trawlers, for released bycatch and discards; and longliners, where they scavenge on both baits and hooked fish. Although scavenging is recognised as a useful food source, it can provide feed of variable quality and energy content in addition to which many seabird species including Gannet suffer trawl net entanglement, hooking and drowning when feeding around fishing vessels.

Factors underlying the sustained growth of Irish Gannet populations are not fully understood, but food supply has clearly not been a limiting factor for this species up to the present time. Recent changes in European fisheries policy on discarding (Common Fisheries Policy; CFP) which come into effect in January 2020 may reduce food sources for Gannets and this might curtail further population expansion, or even reverse it[50].

In the past, overfishing in specific areas has been blamed with limiting the availability of important prey items such as sand eel for some seabird species but that does not seem to have affected population growth in Gannet at least, in the last 60 years or more, through the majority of their geographic range. It should also be noted that the sustained increase in Gannet populations in most NE Atlantic colonies has occurred during the entire period of expansion of the marine aquaculture industry, from effectively zero six decades ago, in terms of both production parameters and occupied sea surface area. Aquaculture expansion has been far more marked in Norway and Scotland than in Ireland (see Figures 3.2 to 3.5) but Gannet populations have continued to increase in most colonies well within foraging range of aquaculture in all three areas. Data by country for UK and Ireland are shown in Table 3.2.

Table 3.2.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Summary country count data for UK and Ireland Northern Gannet pairs,
Apparently on Nest (AON), as available, 1969 to 2015.
Source; www.jncc.gov.uk/our-work/northern-gannet-morus-bassanus/; dated April 17th 2019.

Survey name	Operation Seafarer	Seabird Colony Register	Gannet census 2003-2004	Gannet census 2013-2014	Operation Seafarer	Seabird Colony Register	Gannet census 2003-2004	Gannet census 2013-2014
Year	1969-1970	1985-1988	2003-2004	2014-2015	1969-1970	1985-1988	2003-2004	2014-2015
Scotland	96,860	127,867	182,511	243,505	-	+32%	+43%	+33%
England	18	780	3,940	12,494	-	+4233%	+406%	+217%
Wales	16,128	28,545	32,095	39,011	-	+77%	+12%	+21%
Northern Ireland*	0	0	0	0	-	-	-	-
Isle of Man*	0	0	0	0	-	-	-	-
Channel Islands	3,000	4,521	7,409	7,885	-	+51%	+64%	+6%
Total UK	113,006	157,247	218,546	293,161	-	+39%	+39%	+34%
Ireland	23,665	24,740	36,111	47,946	-	+4.6%	+46%	+32.2%

* Gannet do not breed in N Ireland or Isle of Man.

50 Newton S. et al 2015. Census of Gannet *Morus bassanus* colonies in Ireland 2013-2014. Irish Birds 10 215-220.

It is noticeable that national Gannet populations have only grown and never shrunk in UK and Ireland over the last 50 years, with broadly similar growth patterns. The only significant difference was the 32% increase in Scotland prior to the Seabird Colony Register Survey in 1985 to 1988, relative to only 4.6% in Ireland. Aquaculture was expanding at a far greater rate in Scotland than in Ireland during this period, suggesting strongly that this had no noticeable impact on population growth or status. Overall, no environmental or other factor seems to limit colony growth in UK or Ireland over the record period, once exploitation was curtailed, or at least radically reduced, in the late 19th century.

Historical data for Ireland's six gannetries is shown in Table 3.3. These all show similar population growth characteristics to all the major Scottish Gannet colonies[51], which are also all SPAs. In particular, almost without exception, all show sustained positive growth, over the recorded period, irrespective of location. Thus, population growth in the Scottish west coast, Western Isles and Shetlands regions, where aquaculture is concentrated, has been much the same as it has been on the east coast, where there are no finfish or shellfish aquaculture sites

Table 3.4 examines % growth rates in the six Irish gannetries between the four census dates in the last 50 Years. This shows that Ireland's two oldest gannetries, at Little Skellig and Bull Rock have had the greatest growth, accounting for 87% of the Irish Gannet population at the last census. However, their % growth has been the slowest overall. There may be a number of reasons for this, including overcrowding and lack of unused nest sites relative to newer colonies. It is thought that the Bull colony originated as an overflow site for Little Skellig. However, what is notable is that these two sites are within easy foraging range of existing and proposed salmon farm sites and other aquaculture, in both Kenmare and Bantry Bays, with which they have both coexisted and grown consistently and significantly over the last forty years.

Great Saltee Island, Co. Wexford, has rapidly increased its Gannet population, in part as an overflow from the world's second largest gannetry, Grassholm, 100km to its east, off the Wales. Great Saltee is within foraging range of intertidal and subtidal shellfish aquaculture developments in Bannow Bay, Co. Wexford and in Waterford and Dungarvan Harbours, Co. Waterford. Ireland's Eye and Ireland's most recently established gannetry at Lambay Island[52] are on the E coast. Both have expanded faster than the SW sites and are far removed from any aquaculture development. However, the Clare Island gannetry has shown the fastest % growth of all Irish gannetries in recent years and is only 7.5km from the salmon farm site at Portlea, Clare Island.

These results yield no obvious trend, negative or positive, to link the growth of Irish gannetries with aquaculture development of any type, since the inception of the Irish aquaculture industry, some 40 years ago.

51 See jncc.gov.uk/our-work/northern-gannet-morus-bassanus.

52 Collins R. 2007. This gannet colony chooses an odd spot. Irish Examiner Monday August 2007.

Table 3.3.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Northern Gannet population data for all Irish colonies, where available, AOS.

Data sources :
NPWS; SPA Natura Forms and Synopses; Newton SF et al, Birdwatch Ireland Irish Birds, 10 (2015)
Collins R 2007. Irish Examiner August 13th 2007; SMP online database, archive.jncc.gov.uk/smp/
Mitchell P et al 2004 Seabird Populations of Britain and Ireland JNCC.defra.gov.uk.

Survey title							Operation Seafarer	Seabird Colony Register		
Colony site / SPA No.	1880	1882	1908	1929	1954	1955	1968-70	1984	1985	1986
Little Skellig 004007	30	<200	20,000				22,000	22,500		
Bull Rock 004066							1,500	1,815	1,511	
Great Saltee 004002	-	-	-	2	4	17	155	560		595
Irelands Eye 004117	-	-	-	-	-	-	-	17		
Lambay Island 004069	-	-	-	-	-	-	-	-		
Clare Island 004136	-	-	-	-	-	-	-	2		
All Ireland							23,655	24,740		

Survey title										
Colony site / SPA No.	1987	1989	1990	1991	1992	1993	1994	1995	1996	1997
Little Skellig 004007							26,436	27,241		
Bull Rock 004066								1,815		
Great Saltee 004002	710	950	1,050			1,175	1,250		1,480	1,805
Irelands Eye 004117		18	27	39	47		45	70	106	113
Lambay Island 004069		-	-					-		
Clare Island 004136								3	3	2
All Ireland										

Survey title				Gannet Census						BWI Gannet Census
Colony site / SPA No.	1998	1999	2000	2003-04	2005	2007	2009	2010	2011	2013-14
Little Skellig 004007		28,799		29,683						35,294
Bull Rock 004066		1,879		3,694						6,388
Great Saltee 004002	1,860	1,960		2,446						4,722
Irelands Eye 004117	141	147	188	285	313	375		360	504	547
Lambay Island 004069			-	-		83	187	138		728
Clare Island 004136	4	3	3	3						267
All Ireland			32,758	36,111						47,946

Table 3.4.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Northern Gannet colony AOS population and % growth data for all Irish colonies, between census dates, 1968 to 2014
Data source Newton SF et al, Birdwatch Ireland Irish Birds, 10 (2015)

Survey title	Operation Seafarer	Seabird Colony Register	Gannet Census	BWI Gannet Census	Operation Seafarer	Seabird Colony Register	Gannet Census	BWI Gannet Census
Colony site / SPA No.	1968-70	1984	2003-04	2013-14	1968-70	1984	2003-04	2013-14
Little Skellig 004007	22,000	22,500	29,683	35,294	-	2.3%	31.9%	18.9%
Bull Rock 004066	1,500	1,815	3,694	6,388	-	21.0%	103.5%	72.9%
Great Saltee 004002	155	560	2,446	4,722	-	261.3%	336.8%	93.0%
Irelands Eye 004117	-	17	285	547	-	-	1,576.5%	91.9%
Lambay Island 004069	-	-	-	728	-	-	-	-
Clare Island 004136	-	2	3	267	-	-	50.0%	8800.0%
All Ireland	23,655	24,740	36,111	47,946	-	4.6%	46.0%	32.2%

By way of comparison, the situation with Norwegian Gannet populations is more complex. Gannets first settled in Norway, on the Seabird colony at Runde, in 1947; see Figure 3.4b. Runde is still Norway's largest Gannet colony. Some other Norwegian colonies have failed or have become extinct in recent years, especially in the Barents and Norwegian Seas, in what seems to be a dynamic process of colonisation, extinction and recolonisation whilst, overall, the National population is little changed. Pettex et al[53] suggest, supported by other literature, that food limitations which have affected some other seabird species, are unlikely to be driving this trend. The prime suspect is predation by the European White-tailed Eagle, which, after a dramatic population decline in the early 20th century, has been in recovery, since it became legally protected in 1968[54]. Pettex recommends that food availability, White-tailed Eagle predation, human disturbance during breeding and tick parasitism are potential hazards for Gannets in Norway that should be further investigated to better explain the observed phenomena. Extensive further information on seabird status in Norway is provided by the Norwegian Institute for Nature Research (NINA) in their NINA Report 1151[55]. Aquaculture is not raised as a suspect in this authoritative government document or in any associated literature, despite the density of aquaculture installations along the Norwegian coastline, relative to that in Scotland, let alone that in Ireland; see Figures 3.4 and 3.5.

53 Pettex E. et al 2014. Contrasting population trends at seabirds colonies: is food limitation a factor in Norway? J. Ornithol. 2014.

54 Barrett R et al 2006 Status of breeding seabirds in Mainland Norway. Atlantic Seabirds 8(3) 97-126.

55 Fauchald P. et al 2015. Status and trends of seabirds breeding in Norway and Svalbard. NINA Report 1151.

3.2.4. Protected status of Northern Gannet and the proposed Shot Head site.

Northern Gannet is protected throughout its geographical range. According to the IUCN Red List (August 2018), the conservation status for Gannet is listed as being of Least Concern at a global level. The current global population, which stands at 1.5-1.8M individuals, shows a long-term, consistent, increasing trend [56]. In Ireland, the Irish Red Book lists Gannet as being of Amber Conservation Status, even though the population on all six colonies is increasing. This is due to the highly localised nature of Irish Gannet colonies.

All six Irish gannetries are Special Protection Areas (SPAs) and are also listed for a range of mainly seabird SCIs, other than Gannets. Population statistics for gannets in these SPAs are reviewed in Section 3.2.3, in Tables 3.3 to 3.4. Colony locations are shown in Figure 3.2.

The largest and the second largest gannetries in Ireland are those on Little Skellig, within the Skellig Islands SPA 004007, off SW Kerry and on the Bull Rock, 25km to the south of the Skelligs, within the Bull and Cow Rocks SPA, off SW Cork. The Little Skelligs colony is considered to be of International Importance, with a current population (2014 Gannet Census) of 35,294 breeding pairs. The Bull Rock colony is considered to be of National Importance with a current population (2014 Gannet Census) of 6,388 pairs.

These two SPAs are amongst six SPAs close to the proposed Shot Head site, in which all three seabird species to be investigated in this NIS are SCIs (which includes the two SPAs with Gannet colonies). These are listed in Table 3.5. Note that all data in Table 3.5 is taken from the Natura Forms and Site Synopses for the six SPAs which still cites only 2004 census data. Figure 3.6 shows the location of all six local SPAs relative to Shot Head and also illustrates approximate linear distance between each and Shot Head site. Figure 3.7. highlights the two SPAs with gannetries, at Little Skellig Island and Bull Rock and shows the across-water flying distance between each SPA and Shot Head (foraging seabirds do not generally fly across land so minimum across-water distances apply).

Based on their foraging ranges, (Table 3.1), the populations in both gannetries can be expected to have connectivity with the proposed Shot Head site and other Bantry Bay aquaculture sites, but both are considerably closer, across-water, to existing salmon farm sites, within the Kenmare River Special Area of Conservation, SAC 002158, than they are to Shot Head; see Figure 3.6. Deenish Salmon Farm, which lies at the boundary of the 500m wide marine area, surrounding the Deenish and Scariff Islands SPA 004175 is 20.5km across-water from the Little Skellig and 19km from the Bull Rock.

56 BirdLife International 2018. *Morus bassanus*. *The IUCN Red List of Threatened Species* 2018: e. T22696657A132587285. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22696657A132587285.en.

Table 3.5
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
SCI bird species from nearest seven Special Protection Areas (SPAs) to Shot Head site with subject long-range foraging SCI species highlighted, Gannet colonies highlighted in green.

Key: R M / O B — Resident / Migratory / Overwintering / Breeding; Maximum Population — Numbers reported in site Natura Forms / Synopses.
p = pairs; i = individuals   Site importance R = Regional N = National I = International

Beara Peninsula SPA 004155				
Minimum straight-line distance from Shot Head site 10.5km				
Minimum over-water distance from Shot Head site 10.5km. Maximum 50.0km				
Species	Common name	Site importance	R M O B	Maximum population
Falco peregrinus	Perigrine Falcon	-	B	4p
Fulmarus glacialis	Northern Fulmar	N	B	575p
Larus Argentatus	Herring gull	-	B	20p
Phalacrocorax arostitelis	Shag	-	O	12p
Pyrrhocorax pyrrhocorax	Chough	-	B	54p
Cepphus grylle	Black Guillemot	-	B	87i

Sheeps Head to Toe Head SPA 004156				
Minimum straight-line distance from Shot Head site 9.13km. Maximum 73.5km				
Minimum over-water distance from Shot Head site 14.0km				
Species	Common name	Site importance	R M O B	Maximum population
Cepphus grylle	Black Guillemot	N	B	137i
Falco peregrinus	Perigrine Falcon	-	B	7p
Larus Argentatus	Herring gull	-	B	30p
Fulmarus glacialis	Northern Fulmar	-	B	57p
Larus marinus	Great black-backed gull	-	B	1p
Phalacrocorax arostitelis	Shag	-	O	17p
Pyrrhocorax pyrrhocorax	Chough	-	B	82p
Risa tridactyla	Kittiwake	-	B	20p

Deenish Island and Scarriff Island SPA 004175				
Minimum straight-line distance from Shot Head site 38.0km				
Minimum over-water distance from Shot Head site 60.0km				
Species	Common name	Site importance	R M O B	Maximum population
Cepphus grylle	Black Guillemot	-	B	10p
Fulmarus glacialis	Fulmar	-	B	385p
Hydrobates pelagicus	Storm petrel	-	B	1,400p
Larus argentatus	Herring gull	-	B	28p
Larus fuscus	Lesser black-back gull	-	B	97p
Larus marinus	Great black-backed gull	-	B	7p
Puffinus puffinus	Manx Shearwater	N	B	2,311p
Pyrrhcorax pyrrhocorax	Chough	-	B	2p
Sterna paradisea	Arctic tern	N	B	54p

Skelligs SPA 004007				
Minimum straight-line distance from Shot Head site 60.0km				
Minimum over-water distance from Shot Head site 68.0km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	-	B	304p
Fratercula arctica	Puffin	N	B	4,000p
Fulmarus glacialis	Northern Fulmar	N	R	806p
Hydrobates pelagicus	Storm petrel	I	B	9,994p
Puffinus puffinus	Manx shearwater	N	B	738p
Pyrrhocorax pyrrhocorax	Chough	-	B	1p
Rissa tridactyla	Kittiwake	N	B	944p
Morus bassanus	*Northern gannet*	I	B	29,683p
Uria aalge	Common Guillemot	N	B	1,709p

Bull and the Cow SPA 004066				
Minimum straight-line distance from Shot Head site 43.5km				
Minimum over-water distance from Shot Head site 44.5km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	R	B	88p
Fulmarus glacialis	Northern Fulmar	R	B	40p
Fratercula arctica	Puffin	N	B	200p
Hydrobates pelagicus	Storm petrel	N	B	3,500p
Larus argentatus	Herring gull	-	B	20p
Larus marinus	Great black-backed gull	-	B	280p
Phalacrocorax carbo	Cormorant	-	B	40p
Rissa tridactyla	Kittiwake	R	B	350p
Morus bassanus	Northern gannet	N	B	3,694p
Uria aalge	Common Guillemot	R	B	938p

Puffin Island SPA 004003				
Minimum straight-line distance from Shot Head site 53.0km				
Minimum over-water distance from Shot Head site 74.0km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	N	B	800p
Fratercula arctica	Puffin	I	B	5,125p
Fulmarus glacialis	Northern Fulmar	N	B	447p
Hydrobates pelagicus	Storm petrel	I	B	5,177p
Larus argentatus	Herring gull	-	B	47p
Larus fuscus	Lesser black-back gull	N	B	139p
Larus marinus	*Great black-backed gull*	N	B	72p
Puffinus puffinus	Manx sheerwater	-	B	6,329p
Pyrrhocorax pyrrhocorax	Chough	-	R	3p
Rissa tridactyla	Kittiwake	-	B	250p
Uria aalge	Common Guillemot	.-	B	250

Iveragh Peninsula SPA 004154				
Minimum straight-line distance from Shot Head site 32.0km				
Minimum over-water distance from Shot Head site 63.0km. Maximum 106.0km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	-	B	90p
Falco peregrinus	Perigrine Falcon	-	B	5p
Fulmarus glacialis	Northern Fulmar	N	B	766p
Larus argentatus	Herring gull	-	B	30p
Phalacrocorax arostitelis	Shag	-	B	11p
Phalacrocorax carbo	*Cormorant*	-	B	33p
Cepphus grylle	Black Guillemot	N	B	118i
Larus marinus	Great black-backed gull	N	B	63p
Pyrrhocorax pyrrhocorax	Chough	-	B	86
Rissa tridactyla	Kittiwake	N	B	1150p
Uria aalge	Common Guillemot	N	B	2860p

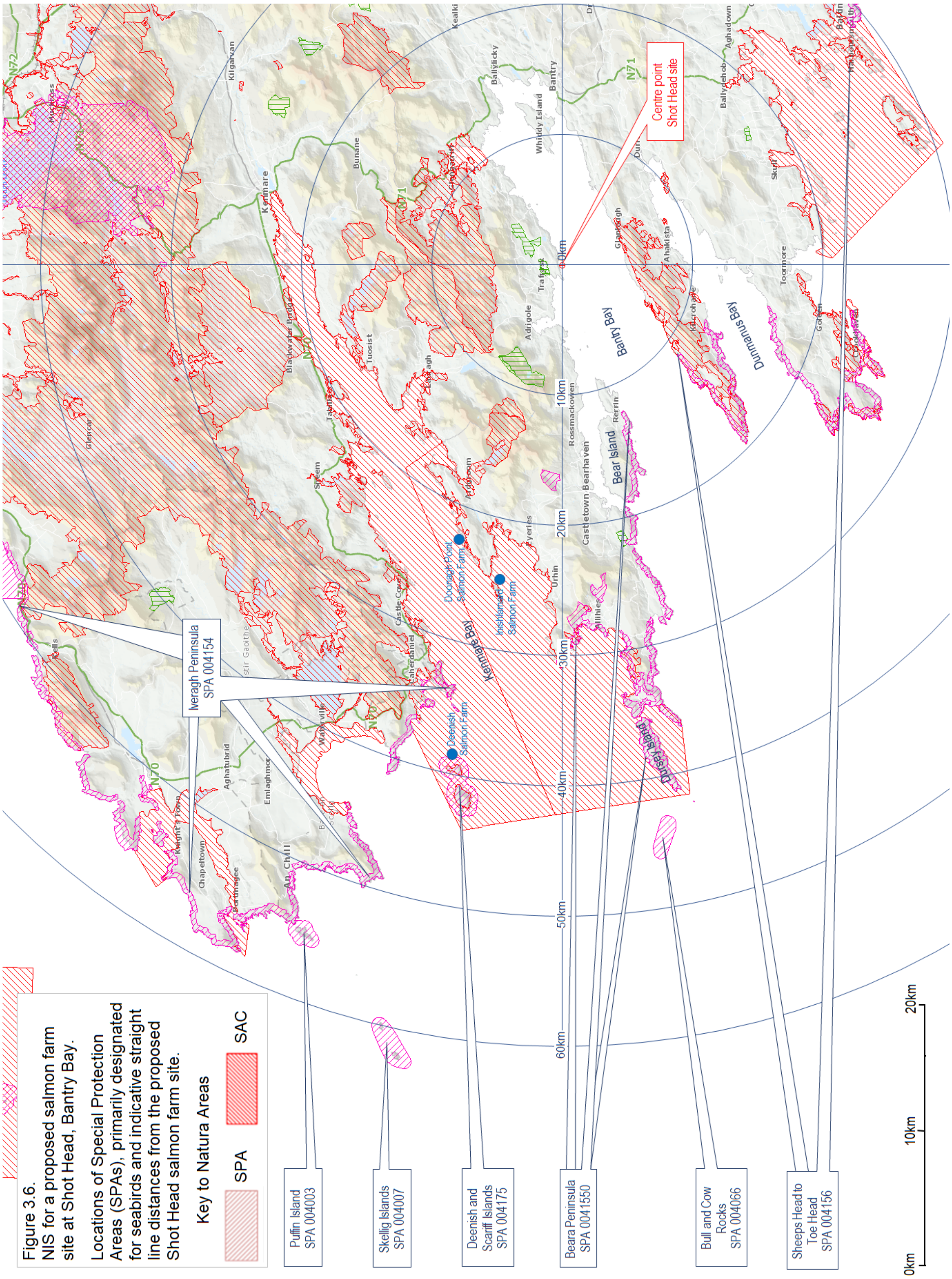


Figure 3.6.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Locations of Special Protection Areas (SPAs), primarily designated for seabirds and indicative straight line distances from the proposed Shot Head salmon farm site.

Inishfarnard Salmon Farm, in Coulagh Bay, lies 36.2km across-water from the Little Skellig and 22.4km from the Bull Rock; Doonagh Point Salmon Farm lies 38.3km across-water from the Little Skellig and 26.9km from the Bull Rock.

It should also be noted that, on the basis of the mean maximum and maximum foraging ranges quoted by Thaxter for Northern Gannet, of 229.4km and 590.0km respectively, see Table 3.1, all other Irish gannetries fall within the theoretical maximum across-water foraging range to Bantry Bay and the Shot Head site. Wakefield's work[57] on foraging, using gannets fitted with GPS trackers, see Figure 3.3, suggests that whilst non-territorial spatial partitioning of foraging areas based on a core foraging distance around each colony is the norm, much longer foraging trips do occur. Bearing in mind that the sample size used for Wakefield's paper is very small (183 birds for all tracks shown in Figure 3.3), it is notable that one (green) track from Grassholm goes as far as the Irish SW coast (≈300km), whilst another reaches Ireland's Eye (≈ 200km). Some tracks from St Kilda reach as far as the Faroes and beyond (>500km), demonstrating Thaxter's stated maximum foraging range for the species.

Further on foraging distance, Lewis et al observed that the mean foraging trip duration / distance of breeding Gannets is positively correlated with colony size, both among colonies of different sizes in the same year, and within colonies as they change in size. This is largely due to the disturbance of prey fish by foraging activity, which Lewis suggests generates conditions under which Gannets from larger colonies must then travel further to obtain food[58]. Grecian et al[59] developed a model based on Lewis' work and proposed re-evaluations of the mean foraging distances for Gannet from those proposed by Thaxter (see Table 3.1). These revised figures were derived from the populations on each of the colonies counted in the 2004 Gannet Census; see Table 3.3. Grecian's revised mean foraging ranges increased from 92.5km to 99.3 from the Little Skellig colony and decreased from 92.5km to 60.9km from the Bull Rock colony respectively. The Skelligs Gannet population increased by 18.9% between 2004 and 2014 and that on Bull Rock increased by 72.9%; see Figure 3.4. Taking this into account, in particular from the point of view of assessing the potential of cumulative impacts, it is reasonable to assume that the entirety of Bantry Bay aquaculture activity is likely to be within the mean foraging range of Gannets from both SPAs. As an aside, this also applies to the salmon farms and other aquaculture activities in Kenmare Bay.

57 Wakefield ED et al 2013. Space partitioning without territoriality in Gannets. Science 341, 69.

58 Lewis S et al 2001. Evidence of intra-specific competition for food in a pelagic seabird Nature 412 816-819.

59 Grecian WJ et al 2012. A novel projection technique to identify important at-sea areas for seabird conservation: An example using Northern gannets breeding in the North East Atlantic. Biol Cons 2012 in press.

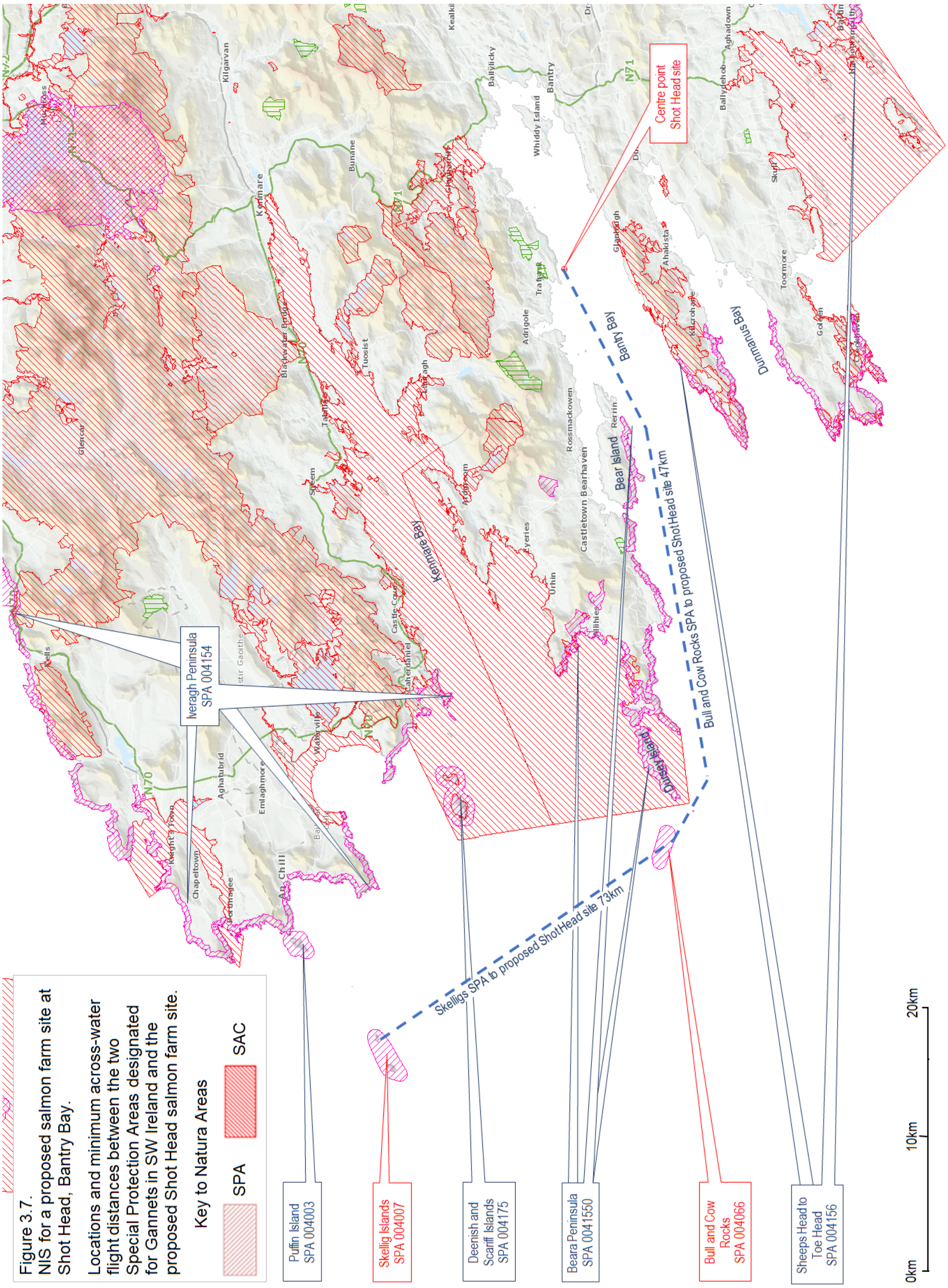


Figure 3.7.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

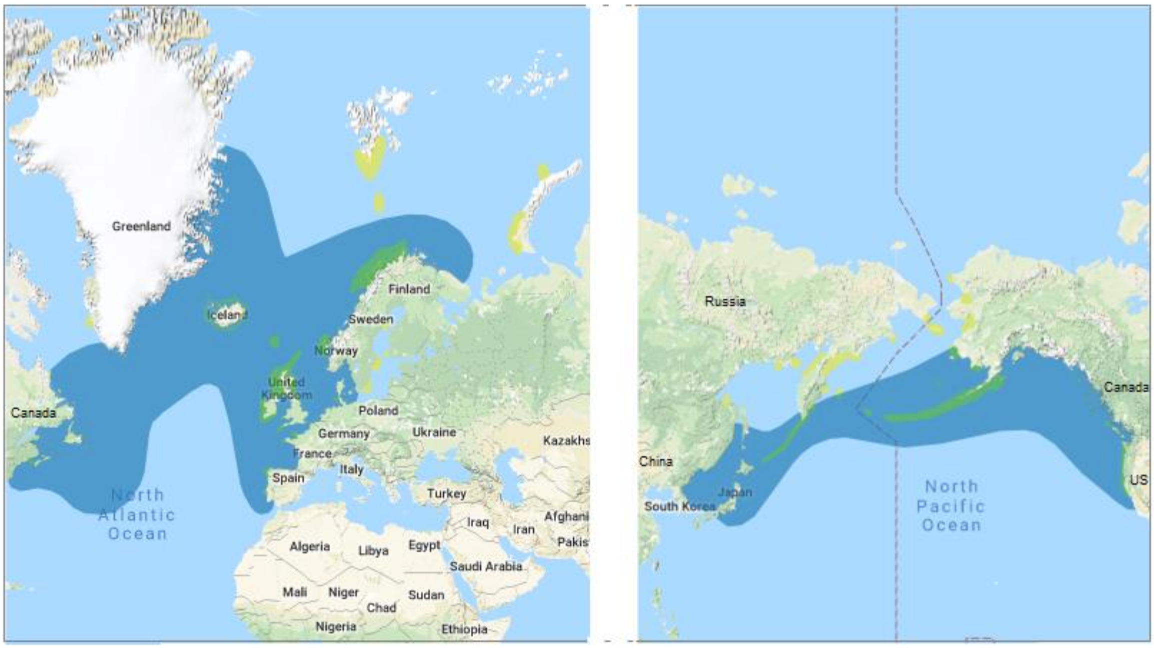
Locations and minimum across-water flight distances between the two Special Protection Areas designated for Gannets in SW Ireland and the proposed Shot Head salmon farm site.

3.3. Common Guillemot or Guillemot or Common Murre; *Uria aalge*.

3.3.1. Biology and distribution.

The Common Guillemot is also known as the Common Murre, mainly in North America and around the North Pacific. It is the largest and most common member of the Family Alcidae or Auks, which includes the Atlantic Puffin (*Fratercula arctica*) and the Black Guillemot (*Cepphus grylle*). The Common Guillemot is the most common seabird in both UK and Ireland. Its distribution is circumpolar, in the low Arctic and Boreal waters of both the North Atlantic and North Pacific (breeding, non-breeding and resident birds), across a total sea area 80,700,000km^2, as shown in Figure 3.8.

Figure 3.8.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Global Common Guillemot distribution 2019.
Source Birdlife International 2019 Species Factsheet http://www.birdlife.org.
Key
Native resident Native breeding Native non breeding



Mitchell et al (2004) estimated the global population of Guillemot at 7.3M breeding pairs[60], or >18M individuals[61]. The European population was estimated at >3M mature individuals[26]. There have been some dramatic fluctuations in populations in some areas of their geographic range in the last forty years or so, due to a variety causes, as further described in Section 3.3.3. That said, overall, populations by region have generally shown an increasing trend over the last number of years.

[60] Mitchell PI, Newton SF, Ratcliffe N, Dunn TE. (eds.) 2004. JNCC: *Seabird Populations of Britain and Ireland*. Poyser, London. ISBN 0-7136-6901-2

[61] BirdLife International (2012). "*Uria aalge*". *IUCN Red List of Threatened Species. Version 2013.2*. International Union for Conservation of Nature, after Del Hoyo et al 1996., Handbook of the Birds of the World. Vol. 3.

Common Guillemots are sexually monomorphic, with short wings and a long bill and neck. They reach 46cm in length, with a 61-73cm wingspan and weigh 0.775 to 1.250kg. They are dark brown above the midline and white below. They develop distinct breeding plumage, with a dark brown head and neck. In winter, the bib and face are white. They are similar to a closely related Auk, the Razorbill (*Alca torda*), but the Guillemot has a longer body, with browner upperparts, less white on its flanks and a lighter bill. Legs are short, with webbed feet, making the bird ungainly on land. Guillemots are sociable birds with an average life span of 21-23 years although birds up to 38 years old have been recorded.

Guillemots are widespread around the British and Irish coasts. The Seabird 2000 Census recorded 1.4163M individuals AOS in the UK, estimated as 13% of the global population. 1.16184M were in Scottish colonies. The equivalent Irish count in 2000 was 138,108 Individuals[62], rising to 177,388 on the 2013-2014 SMP count; see Table 3.6.

The number of distinct Guillemot colonies (*looneries*) recorded in Ireland is forty-two[63], although they can also breed on any cliff ledge able to accommodate them, where safe from predators, not always in Natura-protected areas. They also breed in inaccessible spots amongst boulders at the base of cliffs. In mixed colonies, they tend to occupy the widest ledges at up to 20 pairs/m^2. Guillemots do not make nests but lay their single egg directly onto bare rock, guano or soil. Figure 3.9 shows the colonies recorded by Hutchinson (1989). Those shared with Gannets are highlighted with pale yellow labels. As shown, Guillemot are a SCI alongside Gannets on all 6 Irish Gannet SPAs, in particular Lambay Island SPA 004069, County Dublin on the east coast. This holds an Internationally Important colony of up to 67,314 individuals[64].

There are several other Irish SPAs where Guillemot is a SCI, notably the Cliffs of Moher SPA 004005 Co. Clare, which now holds a Nationally Important Guillemot population of 34,827 Individuals[65], over double the Seabird 2000 survey figure; see Table 3.7. There are also several SPAs to the west of salmon farms and other aquaculture installations, in Bantry and Kenmare Bays, including near Shot Head, see Figure 3.13.

Unlike Gannet, Guillemot breeds in Northern Ireland, in 5 SPA / colonies, including Rathlin Island. This holds an Internationally Important population of up to 130,335 Individuals (2011 data; latest available data at time of writing)[66]. This is the largest Common Guillemot colony in Ireland and the UK, by a considerable margin.

62 www.jncc.gov.uk/our-work/guillemot-uria-aalge/

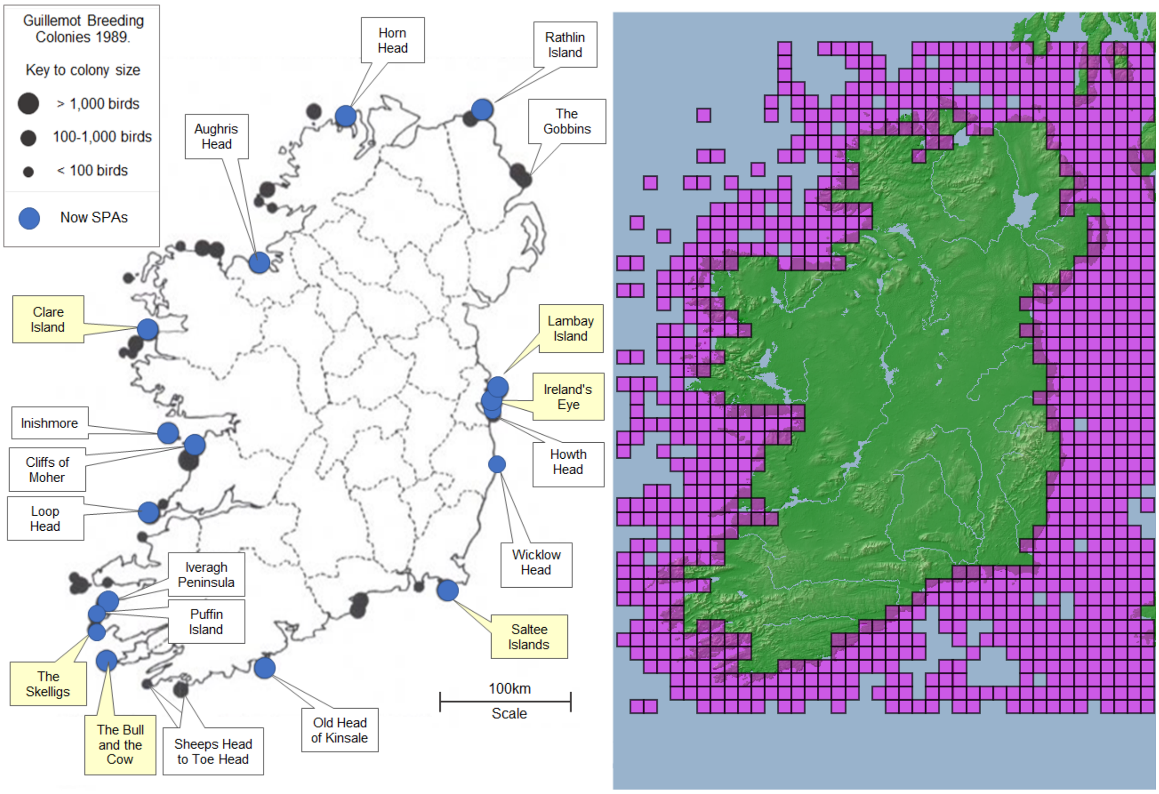
63 Hutchinson CD 1989. Birds in Ireland. A&D Black. Reprinted 2010 T & AD Poyser Ltd. ISBN9781408137017

64 Seabird Monitoring Program (SMP) 2009 survey. www.jncc.gov.uk/our-work/guillemot-uria-aalge/

65 SMP 2015 survey; national Guillemot population was counted as 34,827 pairs (AOS) NPWS 15th October 2019.

66 2011 data; increased from 95,117 individuals in 1999 (+37%). **jncc**.gov.uk/our-work/guillemot-uria-aalge.

Figure 3.9.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Map of Ireland's Guillemot breeding colonies along with Guillemot sitings on a 10km^2 grid.
Map sources :
Breeding colonies map from Hutchinson Clive D. 1989. Birds in Ireland. A & C Black. Reprinted 2010.
Sitings map; record of >57,000 sitings; https://biodiversityireland.ie.



As with Gannet, the wide-ranging foraging habit of Guillemots means that they are observed all around the British and Irish coastlines, often far from their home colonies, although their foraging range statistics are somewhat lower than those for Gannet; see Table 3.1.[67] They also penetrate all coastal inlets as illustrated for Ireland in Figure 3.9. This means that they can be seen in all main Irish embayments also occupied by floating aquaculture installations, including Bantry Bay, location of the proposed Shot Head site; see Figure 3.2.

Much the same is true in Scotland, which holds about 1.17M birds, about 75% of the total Guillemot population of Great Britain and Ireland (Seabird 2000 data; the latest currently available). GPS trackers have been used to track Guillemots and to calculate their relative foraging densities, taking account of all colonial populations all around the British and Irish coastline[68]. This is illustrated in Figures 3.10a-c.

67 It can be assumed that the foraging ranges for Guillemot could also be revised using Grecian's 2012 model but for the current study, it is just assumed that the entirety of the Bantry Bay aquaculture sector would be within the foraging range of Guillemots, as shown for Gannet in Section 2.2.4.

68 Wakefield ED et al. 2017. Breeding density, fine-scale tracking and large-scale modelling reveal the regional distribution of four seabird species. Ecological Applications 27, 2074-2091.

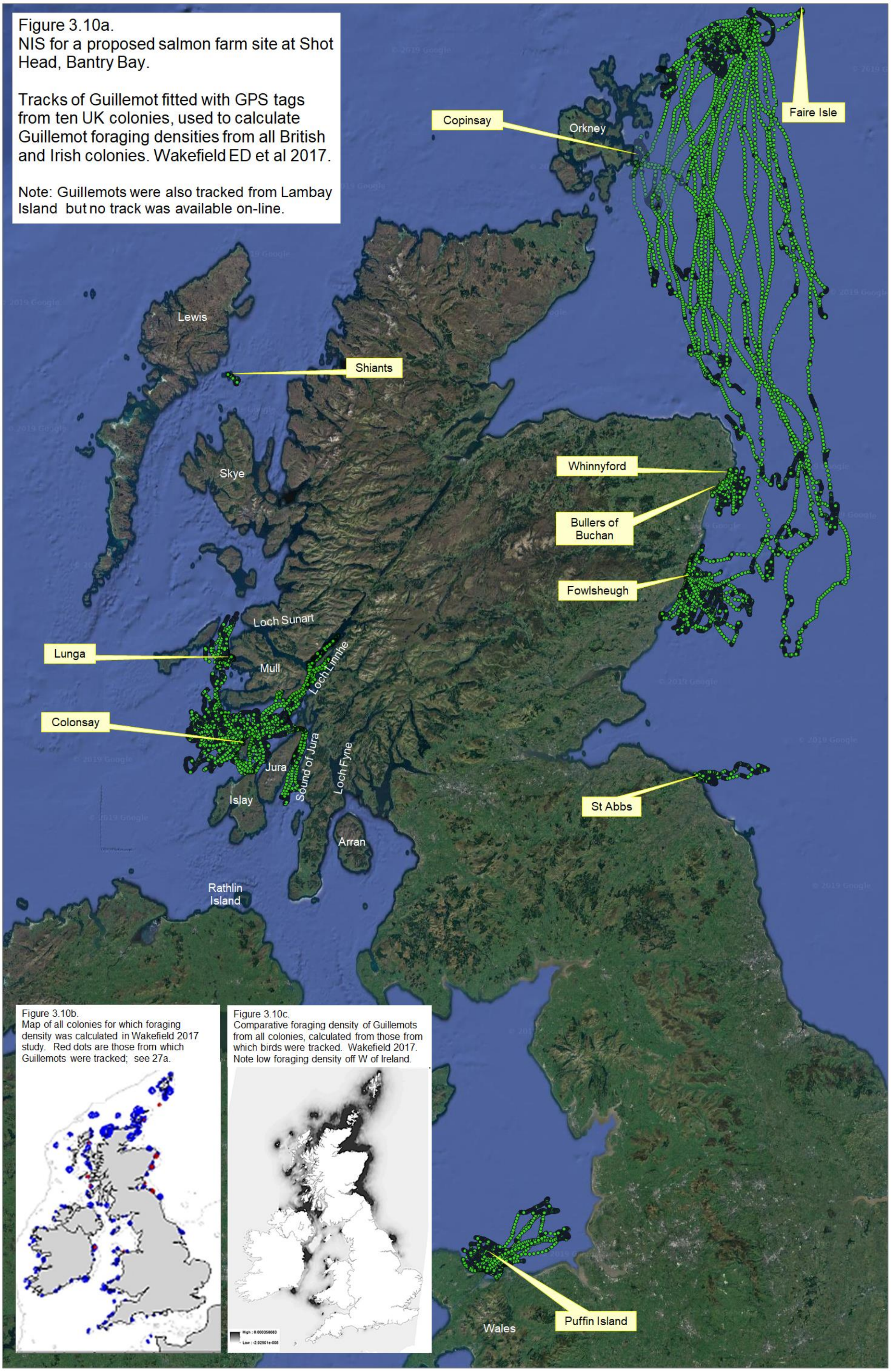


Figure 3.10a.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

Tracks of Guillemot fitted with GPS tags from ten UK colonies, used to calculate Guillemot foraging densities from all British and Irish colonies. Wakefield ED et al 2017.

Note: Guillemots were also tracked from Lambay Island but no track was available on-line.

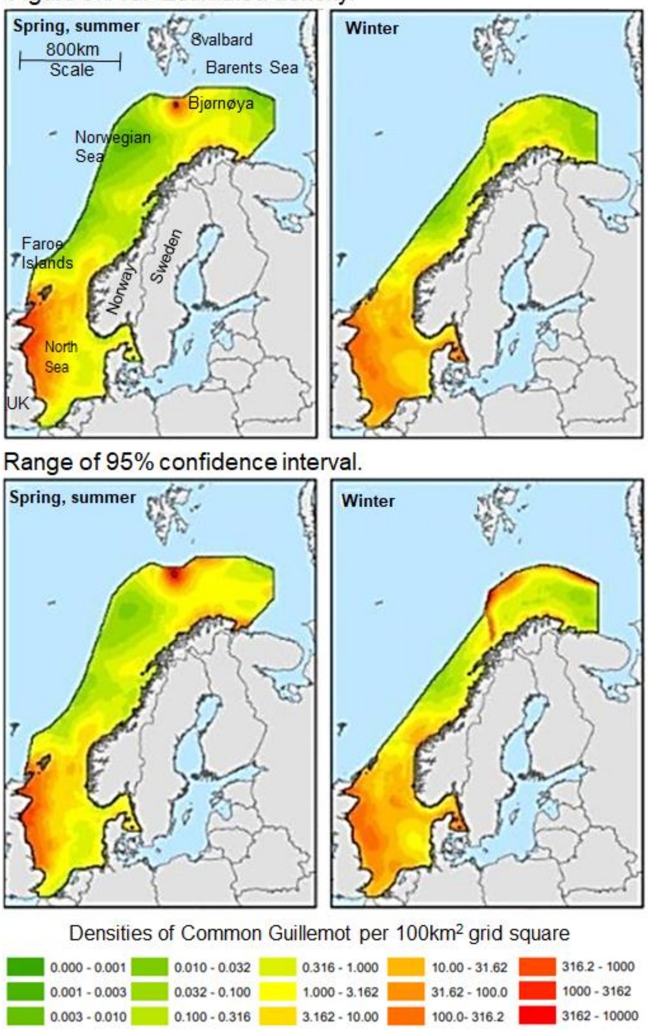
Figure 3.10b.
Map of all colonies for which foraging density was calculated in Wakefield 2017 study. Red dots are those from which Guillemots were tracked; see 27a.

Figure 3.10c.
Comparative foraging density of Guillemots from all colonies, calculated from those from which birds were tracked. Wakefield 2017. Note low foraging density off W of Ireland.

Figure 3.10a shows that Guillemots from the Colonsay and Lunga colonies penetrate areas with high concentrations of aquaculture activity in Scotland, around Mull, the Sound of Jura and Loch Linnhe. Figure 3.10c shows, in lower resolution, the foraging densities calculated by Wakefield, around UK and Ireland. Clearly Guillemots from Rathlin Island penetrate the Scottish aquaculture area around Loch Fyne and the Firth of Clyde. Scotland's other west coast aquaculture areas (see Figure 3.3b) show mid- to high-range foraging densities. Notably, Figure 3.10c shows that only low foraging densities penetrate aquaculture areas on Ireland's SW and W coastline, relative to those on the Scottish west coast. This is presumably indicative of relative colony size and the greater extent of foraging area seawards. Guillemot densities on the Norwegian coastline are shown in Figure 3.11.

Figure 3.11.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Estimated seasonal densities of Common Guillemot, off the Norwegian coast, from GPS tracking studies, coupled with locations of aquaculture site licences and gannetry locations.
Source of density maps http://www.seapop.no/en/distribution-status/distribution/at-sea/#guillemot.

Figure 3.11a. Estimated density.



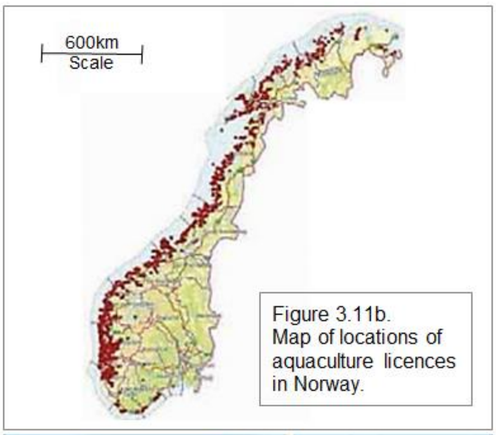


Figure 3.11b.
Map of locations of aquaculture licences in Norway.

Figure 3.11c.
Norway; main Guillemot colonies.

Figure 3.11a shows that, in Spring and Summer, when Guillemot are in their breeding colonies, foraging is most concentrated along the eastern Scottish and English coasts, from the Shetlands to the Wash. There are a total of 12 SPA / Guillemot colonies along this section of the UK coast, at least four of which hold >50,000 individuals (2007 to 2015 data). Bjørnøya, the most southerly of the Svalbard Islands, around which distribution is also dense, also holds a significant Guillemot colony. There are slightly lower densities along the Norwegian and Sea North Sea coastlines of Norway. In winter, the highest densities are slightly lower than summer values and more dispersed; they also run further south between the UK and Norway, covering most of the North Sea area.

Whilst there are no aquaculture assemblages along the E mainland UK coast, development around Shetland and Orkney and, by far the most, Norway, is dense, as already discussed. Thus, as with Gannet, if impacts on Guillemots are likely to occur as a result of aquaculture development, a sharp contrast in impact consequences should be evident, between E mainland UK colonies, relative to those in Orkney, Shetland and Norway. A further contrast in impact consequences should be discernible between W coast Scotland and both E coast Scotland, and W coast Ireland, where Wakefield suggests that foraging densities are relatively low, see Figure 10c. However, these differences in colony performance are not evident and consequences of such aquaculture impacts are not raised in the literature.

3.3.2. Feeding; foraging and scavenging behaviour in Common Guillemot.

Guillemot mainly feed on small pelagic fish of maximum length 200mm, including cod, herring, whiting, haddock, capelin, sandeels and sprats, with a marked preference for energy-rich, oily fish. These species mainly are taken from midwater. Crabs, shrimps, and prawns are also taken, along with molluscs and squid. Benthic organisms are captured by diving to the seabed. Sandeels, capelin and sprats are caught in shoals out at sea and are regarded as particularly important feed resources for Guillemot chicks in the summer months. Guillemot feed consumption averages 417g per day in the winter months and 426g per day in the summer[69], or about 50% of body weight daily. Prey fish selection varies with region. Sand eel and clupeids are the most important dietary items around Scotland and Ireland, whilst Capelin have been shown to be the most important fish species for Guillemot around the Barents Sea.

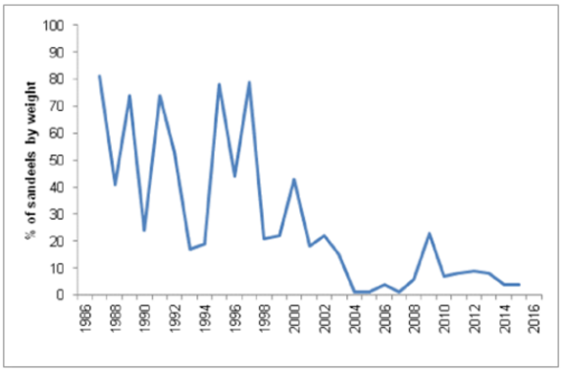
The dependence of some seabird species, Guillemots amongst them, on specific prey items cannot be overemphasised, primarily for the high energy levels that some provide, in particular for the feeding of chicks. Poor local availability of sand eel on the Scottish coast led to population collapses of Guillemot, Fulmars, Razorbills, Kittiwakes and other species on the St Kilda SPA, from 1999[70]. The Guillemot population on the Isle

69 Grandgeorge et al. 2008. Resilience of the British and Irish seabird community in the 20th century.

70 Upstill-Goddard ED 2016 Scotland's cliffs falling silent. www.wildlifearticles.co.uk/scotlands-cliifs-falling-silent

of May SPA in the Firth of Forth and colonies elsewhere in the North Sea suffered similarly in 2004[71]. Both were blamed on a combination of factors, including the overfishing of prey species, including sand eels, and consequent reductions in the energy values of the prey species fed to chicks. The evidence regarding the percentage of sand eel in young Guillemot rations was made clear by Newell et al, in their report to the JNCC in 2014[72]; see Figure 3.12.

Figure 3.12.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Percentage of sandeels by weight in the diet of young Guillemots in the Isle of May colony in the Firth of Forth, 1987 to 2015.
After Newell M. et al 2014. Report to JNCC.



More worrying and highlighted by increasing volumes of literature, is the impact of climate change, now widely blamed for the more northerly and deeper distribution of some plankton communities[73]. These in turn, have been followed N over the last decade by planktotrophic fish species such as sand eels, a major, energy-rich prey item for seabirds and, in particular their chicks. Research also suggests that, whilst seabirds may be capable of some adaptations to such climate-driven change, by relocation, skipped breeding[74] and longer foraging trips involving both parents, such changes can have negative consequences, with some in evidence already. With the need for both parents to forage, chicks are left unattended, leading to chick killing by neighbouring adults. Research suggests that bird adaptation rates may be too slow for population maintenance in affected areas, as climate change progresses[75].

[71] Wanless S et al 2005. Low energy values of fish as a probable cause of a major seabird breeding failure in the North Sea. Mar. Ecol. Prog. Ser. 294, 1-8.

[72] Newell, M., Harris, M.P., Gunn, C.M., Burthe, S., Wanless, S. and Daunt, F. 2014. Isle of May seabird studies in 2014. Unpublished report, JNCC, Peterborough.

[73] Beaugrand G. et al 2002. Reorganisation of N Atlantic marine biodiversity and climate. Science 296 1692-1694.

[74] Reed TE et al 2015. Skipped breeding in common guillemots in a changing climate: restraint or constraint? Front. Ecol. and Evol. 2105, 3, 1-13.

[75] Radchuk V. et al. 2019. Adaptive responses of animals to climate change are most likely insufficient. Nat. Comm. https://doi.org/10.1038/s41467-019-10924-4.

A related fate befell Guillemot colonies around the Bering sea, where overfishing of their primary prey item, Capelin, led to an 80% mortality in the Hornøya colony in the winter of 1986-1987, when the abundance indices of all fish prey species were very low. ICES research and changes in catch regulations have mitigated against a recurrence of these episodes and the affected colonies have recovered since[76], [77]. Thus, whilst Gannet populations have been seen to increase consistently throughout their range over the last five decades, Guillemot populations have been more vulnerable regionally to a range of impacts, although as far as can be seen to date, aquaculture activity has not been reported as being one of these.

Guillemot flight is fast and direct. They fly close to the water when foraging or around their breeding grounds and only fly high when dispersing long distances, often in flocks, from home grounds. Thus, in terms of foraging behaviour, they tend to occupy a different airspace to that occupied by Gannet, which fly at up to 30m above the sea when foraging, selecting their prey from a height before plunge diving. The Guillemot's small wing size and fairly large body makes take-off from the water surface difficult and they run along the water surface first to achieve lift and then flight[78].

The characteristics of the forage-diving action of Guillemots also differs markedly from that in Gannets. Whilst Gannets plunge-dive directly onto prey that they have already targeted and where the height of the descent dictates the depth of the plunge, Guillemot only pursue their prey underwater by swimming downwards, using their strong, short wings for propulsion, in much the same manner as penguins. The dive starts with a "jump" from a surface position, following which they swim rapidly and with great agility, steering with their feet. They can chase prey to a depth of 60m, with a dive duration of up to 60 seconds. Some dives can be up to 200m deep. Benthic organisms such as mussels and prawns can be taken from the seabed. Unlike Gannet, Guillemots bring their catch to the surface or to the nest whole, rather than swallowing before they reach the surface.

The clear differences in plunge-diving behaviour is likely to affect any potential for impacts on individual species from aquaculture assemblages. Whereas Gannet mainly plunge-dive from height to capture prey, Guillemot commence their plunge from a near-surface position. Thus, whilst there is potential, as yet unquantified in this document or elsewhere as far as can be seen, for Gannets to plunge-

[76] Erikstad KE et al. 2013. Seabird−fish interactions: the fall and rise of a common guillemot Uria aalge population. Mar. Ecol. Prog. Ser. 475, 267-276.

[77] Gorman J. 2016. Animals die in large numbers, and researchers scratch their heads. New York Times Jan 18, 2016

[78] BCu Common Guillemot of UK and Ireland.

dive into a finfish pen bird net on sight of fish beneath it, Guillemot do not plunge dive from height, any more than the third subject of this NIS, Northern Fulmar, do. Fulmar feed at or close to the surface, whilst swimming. Thus, there is effectively zero potential for Guillemots and Fulmars to become entrapped in finfish pen bird nets.

Guillemots also participate in cooperative foraging activities with other species such as Gannets and Razorbills. Such cooperation can be valuable in driving pelagic shoals into surface waters, making them easier to catch.

Like Gannet, Guillemot exhibit scavenging behaviour around commercial fishing vessels, in order to depredate fish, discards and offal. This provides an additional anthropogenic food source, which, although not necessarily providing a dietary contribution of fish species with adequate energy values, may offset some of the consequences of human overfishing activity on feed availability and the effects of some other anthropogenic impacts, including climate change. Due to their attraction to fisheries vessels, all three subject species are certainly open to entrapment, drowning and injury when scavenging around fishery vessels, an activity which is now said to kill up to 320,000 seabirds each year, on pelagic and demersal longlines alone (i.e. excluding trawlers)[79].

3.3.3. Breeding and population status of Common Guillemot.

Guillemots are monogamous and pair for life. They breed in the summer and, as a long-lived species, are most likely breed for the first time at 6 or 7 years of age. Each pair bears a single egg each season, in crowded colonies. Breeding success is highest where birds breed at high density and where sites are well protected from predators[80]. The egg is incubated by both parents for about 32 days to hatch. Chicks are downy with blackish feathers dorsally and white below. By 12 days post-hatch, contour feathers are well-developed except on the head. At 15 days, facial feathers show the dark eye stripe against the white throat and cheek. Chicks leave the nest at about 22 post-hatch, before fully fledged and glide and flutter down to the sea from their ledge, from heights of up to 460m. They remain on the water until able to fly, about 14 days post-fledging. The males remain with their chicks to feed and protect them until they can fly. They then return to the nest. Females remain at their nest sites. Both parents then moult post-breeding and are flightless for two months, until refeathered.

Generally, one parent stays with the chick whilst still on the nest while the other forages. However, both parents may be forced forage, leaving the chick unprotected and vulnerable, when food is in short supply. Climate change has increased the necessity for this strategy in recent years, which can have consequences for chick survival.

79 Anderson RJ. 2011. Global seabird bycatch in longline fisheries. Endang. Species Res. 14, 91-106.

80 JNCC Guillemot status and trends. jncc.gov.uk/our-work/guillemot-uria-aalge/

Young birds disperse from their birth colonies and mainly stay far out to sea, until up to five years old before returning to the area of their home colony. British and Irish birds fly as far south as the Portuguese coast, or north to Norway, to the Baltic and Barents Seas.

At the Seabird 2000 census, the UK Guillemot population was 1.416M individuals, 12.9% of the world population (latest available data). The Irish population was 138,108 and increased to 177,388 by the SMP 2014-5. These data show consistent growth between consecutive surveys, more than doubling in the 30 years since Operation Seafarer. However, more recent data, not yet fully available may indicate differing regional trends, due to a range of impacts, including climate change and overfishing. This has impacted on UK regional productivity where the index of chicks fledged per pair dropped from a stable and sustainable average of 0.75 per egg to as low as 0.23 per egg from 2004 to 2008, before starting to increase again, albeit erratically[81]. As a result, populations decreased in affected colonies in the Northern Isles and on E and W mainland Scottish coasts, although the colonies at Rathlin Island (Northern Ireland) and Skomer and Skokholm Islands (Welsh coast) both saw considerable increases, confirming the discrete regionality of such problems. Available population data for Guillemots at the time of writing are shown in Tables 3.6 and 3.7.

Table 3.6.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Summary country count data for UK and Ireland Common Guillemot individuals, AOS Apparently on Site (AOS), as available, 1969 to 2015.
Sources; www.jncc.gov.uk/our-work/common-guillemot-uria-aalge/; dated April 17th 2019.
NPWS data request 16th October 2019.

Survey name	Operation Seafarer	Seabird Colony Register	Seabird 2000	SMP	Operation Seafarer	Seabird Colony Register	Gannet census 2003-2004	SMP
Year	1969-1970	1985-1988	1998-2002	2014-2015	1969-1970	1985-1988	2003-2004	2014-2015
Scotland	519,461	943,098	1,161,841	-	-	+82%	+24%	-
England	29,910	61,070	91,986	-	-	+104%	+51%	-
Wales	17,238	32,126	57,961	-	-	+86%	+45%	-
Northern Ireland	44,672	45,047	98,546	-	-	+1%	+119%	-
Isle of Man	1,050	2,195	4,566	-	-	+109%	+108%	-
Channel Islands	201	345	476	-	-	+72%	+38%	-
Total UK	611,281	1,081,341	1,416,334	-	-	+77%	+31%	-
Ireland	39,643	98,910	138,108	177,388	-	+149%	+40%	+28.4%

Although Table 3.6 shows strong growth in Guillemot populations for UK and Ireland over the 30-years between Operation Seafarer and Seabird 2000, more recent UK results, from the SMP 2014-2015, are not fully available. Whilst the Irish population has continued to expand, some Scottish colony data may indicate a slowing of population growth during this period; JNCC data shows that, of 18 UK SPAs for Guillemot, 14 showed modest to considerable population reductions since 2000. Of the four showing population gains, two were on the northern English E coast and two on the UK W coast, at Skomer and Skokholm (Wales) and Rathlin Island (Northern Ireland). Scottish W coast sites (close to aquaculture) and E coast sites (distant from aquaculture) failed equally

81 JNCC Guillemot status and trends. jncc.gov.uk/our-work/guillemot-uria-aalge/

during this period; the performance of Rathlin Island, from which birds can forage into the Loch Fyne and Firth of Clyde aquaculture area, exhibited substantial growth, of 37% between 1999 and 2011.

Interestingly, a small colony south of the Rathlin Island SPA, at the Gobbins ASSI[82], in County Antrim, did not fare so well. An entire section of Guillemot nests was wiped out by two herring gulls, predating eggs, in 2015. In previous breeding seasons, hooded crows, carrion crows, and herring gulls also predated of many Guillemot eggs at the Gobbins colony. Whilst Guillemot from the Gobbins are likely to have connectivity with SW Scottish aquaculture sites, the colony will also have connectivity with the Glenarm Organic Salmon Farm site in Glenarm Bay, which is only 30km south of the colony. However, demonstrably, connectivity to aquaculture sites is not associated with survival problems on this site.

A further reason for downward trends in some colonies, in the last 5 years or so is the outcome of *wrecks*[83] during severe winter storms. One such wreck, in the winter of 2013/14, resulted in 54,000 seabirds, mainly adults and mostly auks, were washed ashore, dead or dying, mainly on French beaches. Many of the birds were emaciated with empty stomachs, indicating weather-induced starvation as the main cause of death. A small proportion showed signs of oil contamination[84]. Overall, about 30% of the count were Guillemots[85]. Biometric data and recovered rings indicated that the birds originated from the coastal areas from SW Scotland down to Iberia, as well as from other areas around the UK and Ireland. It is likely that total mortality was much higher than counted, because not all beaches were checked. In addition, birds were washed ashore over weeks and many corpses would drifted away, unrecorded.

Wrecks are not that infrequent; recent events include 20–50,000 Guillemot and 3–5,000 Shags mortalities in 1994[86] off the Scottish coast and 58,000 seabirds being washed ashore between NE UK and W Europe[87] in February 1983, following prolonged storms. At least 10,000 birds from Saltee Island also met a similar fate in 1969. There have also been significant, unexplained die-offs of Guillemots, for example off California in 1983 and in the NE Pacific in 2016. However, most regional populations have recovered and are now increasing again.

82 Area of Special Scientific Interest; conservation designation, Northern Ireland.

83 "Wreck" is a descriptor for seabird mass mortality due to severe weather. Common Guillemot and some other Auk species are prone to extreme weather conditions, presumably due to their choice of nesting habitat.

84 Sellers, R.S. 2014. Mass mortality of razorbills and other seabirds on the coast of Cumbria in February 2014. Lakeland Naturalist 2: 63-71.

85 Jessop, H. Seabird tragedy in the north-east Atlantic winter 2013/14. Unpublished report, RSPB, Sandy.

86 Harris, M. P. & Wanless, S. 1996. Differential responses of Guillemot *Uria aalge* and Shag *Phalacrocorax aristotelis* to a late winter wreck. Bird Study 43: 220–230.

87 Underwood, L. A. & Stowe, T. J. 1984. Massive wreck of seabirds in E. Britain, 1983. Bird Study 31: 79–88.

Table 3.7.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Counts by colony and national counts of Guillemots individuals, Apparently on Site (AOS) for main Irish SPAs / colonies, and those in West Cork and Kerry, as available, 1669 to 2015.
Main sources; www.jncc.gov.uk/our-work/guillemot-uria-aalge/; dated April 17th 2019.
SMP online database, archive.jncc.gov.uk/smp/, also from NPWS data request 11th-16th October 2019.

Survey name		Operation Seafarer	Seabird Colony Regisater								
County	Year	1969-1970	1985	1986	1987	1988	1989	1991	1993	1994	1995
Donegal	Horn Head										
Mayo	Clare Island										
Clare	Cliffs of Moher				12,957						
Clare	Loop Head										
Kerry	Puffin Island		478								
Kerry	Doulus Head									1,176	917
Kerry	Great Skellig								1,038		
Kerry	Little Skellig										
Cork	Bull and Cow								938	14,584	
Cork	Old Head Kinsale				4,179	3,616	4,630				
Wexford	Great Saltee				16,329		17,488				
Dublin	Howth Head		431		584		592				
Dublin	Irelands Eye			1,458				1,725		1,498	2,223
Dublin	Lambay Island				44,495			41,734			51,777
National censi		39,643	98,910								

Survey name				Seabird 2000 (34 colonies)							
County	Year	1996	1997	1998	1999	2000	2002	2004	2005	2007	2009
Donegal	Horn Head				6,548						
Mayo	Clare Island				3,681						
Clare	Cliffs of Moher				16,433				19,962		
Clare	Loop Head						5,000				
Kerry	Puffin Island					92					
Kerry	Doulus Head	865	934	893	1,422						899
Kerry	Great Skellig						1,129				
Kerry	Little Skellig										
Cork	Bull and Cow			18,274		21,436					
Cork	Old Head Kinsale					3,610				2,500	
Wexford	Great Saltee					4,253					
Dublin	Howth Head		740		990					1,023	
Dublin	Irelands Eye	2,468	2,268		2,191			3,568		2,341	
Dublin	Lambay Island				60,754			58,207			67,314
National censi				138,108							

Survey name							Seabird Monitoring Program			
County	Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Donegal	Horn Head									
Mayo	Clare Island									
Clare	Cliffs of Moher						34,827			
Clare	Loop Head									
Kerry	Puffin Island							226		279
Kerry	Doulus Head					1,625				
Kerry	Great Skellig	1,092	1,094	1,059		3,250	4,432	2,399	2,664	1,908
Kerry	Little Skellig						4,138			
Cork	Bull and Cow				27,501			Bull 322		
Cork	Old Head Kinsale									
Wexford	Great Saltee		33							
Dublin	Howth Head									
Dublin	Irelands Eye	3,154								
Dublin	Lambay Island						59,613			
National censi							177,388			

* Incomplete data; 26 colonies only. No further data available at time of writing.

The results for Irish colonies, where a national figure from the Seabird Monitoring Program is available for 2015, suggest that they have not been significantly affected by the kinds of events that may have befallen Guillemot populations elsewhere around the UK and North Sea area over the recording period. Within the limitations of recording frequency and current lack of colony data from the Seabird Monitoring Program for 2015, all Irish colonies monitored have increased their populations between the beginning and the end of the recording period and, with few fluctuations up to and including the SMP 2015, the national population has a record of continual increase going back at least 45 years, over which time the total increase, from Operation Seafarer, 1969-1970 to the Seabird Monitoring Program of 2015 has been almost 350%. This would suggest that the Irish populations (including on the Irish Sea, where the biggest colony, Lambay Island, is located, face a lower incidence of threats from anthropogenic, predatory and natural impacts than experienced by Guillemots from the Barents, Norwegian, Baltic and North Seas and further south to Iberia, all of which are reported in the literature to have suffered a range of population-impacting problems. However, it is emphasised again that the literature has not reported impacts from aquaculture development on Guillemots to be amongst these, even in the densest areas of aquaculture development.

3.3.4. Protected status of Common Guillemot and the proposed Shot Head site.

The Common Guillemot is protected throughout its geographical range. The species is Amber listed in Birds of Conservation Concern in both UK and Ireland 2014-2019 (2014 update), although it is listed as being of Least Concern globally in the IUCN Red List, due to its extremely large range and global population, which appears to show a constantly increasing trend[88].

For this NIS, the most important Guillemot population data is that relating to colonies with potential connectivity to Shot Head and surrounding aquaculture assemblages in Bantry Bay. These are the colonies within the Iveragh Peninsula SPA 004154, the Puffin Island SPA 004003, the colonies on the Great and Little Skelligs, within the Skellig Islands SPA 004007, and the Bull Rock colony, part of the Bull and Cow Rocks SPA 004066, all four of which support Guillemot colonies; see Table 3.8. The other two local SPAs, the Beara Peninsula SPA 004155, and the Deenish and Scariff Islands SPA 0044175, do not have Common Guillemot colonies; see Table 3.8 for seabird SCI lists for these sites. The four SPAs with connectivity for Guillemots are mapped, showing minimum across-water distances to the Shot Head site in Figure 3.13.

Note that a maximum across-water distance is also added to Table 3.8 and Figure 3.13 for the Iveragh Peninsula SPA, because this SPA stretches right around the peninsula from Kenmare Bay into Dingle Bay. The Doulus Head Guillemot colony, which holds approximately 50% of the Guillemots in the SPA is to the north of the SPA, a minimum across-water distance of 93.5km from Shot Head. The northern limit of the SPA, near Kells, County Kerry, is approximately 106km from Shot Head.

88 BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org.

Table 3.8.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
SCI bird species from nearest seven Special Protection Areas (SPAs) to Shot Head site with subject long-range foraging SCI species highlighted, Common Guillemot SPA / colonies highlighted in green.

Key: R M / O B = Resident / Migratory / Overwintering / Breeding; Maximum Population = Numbers reported in site Natura Forms / Synopses.
p = pairs; i = individuals; Site importance R = Regional N = National I = International

Beara Peninsula SPA 004155				
Minimum straight-line distance from Shot Head site10.50km				
Minimum over-water distance from Shot Head site 10.50km Maximum 50.0km				
Species	Common name	Site importance	R M O B	Maximum population
Falco peregrinus	Perigrine Falcon	-	B	4p
Fulmarus glacialis	Northern Fulmar	N	B	575p
Larus Argentatus	Herring gull	-	B	20p
Phalacrocorax arostitelis	Shag	-	O	12p
Pyrrhocorax pyrrhocorax	Chough	-	B	54p
Cepphus grylle	Black Guillemot	-	B	87i

Sheeps Head to Toe Head SPA 004156				
Minimum straight-line distance from Shot Head site 9.13km				
Minimum over-water distance from Shot Head site 9.13 km. Maximum 73.5 km				
Species	Common name	Site importance	R M O B	Maximum population
Cepphus grylle	Black Guillemot	N	B	137i
Falco peregrinus	Perigrine Falcon	-	B	7p
Larus Argentatus	Herring gull	-	B	30p
Fulmarus glacialis	Northern Fulmar	-	B	57p
Larus marinus	Great black-backed gull	-	B	1p
Phalacrocorax arostitelis	Shag	-	O	17p
Pyrrhocorax pyrrhocorax	Chough	-	B	82p
Risa tridactyla	Kittiwake	-	B	20p

Deenish Island and Scarriff Island SPA 004175				
Minimum straight-line distance from Shot Head site 38.0km				
Minimum over-water distance from Shot Head site 60.0km				
Species	Common name	Site importance	R M O B	Maximum population
Cepphus grylle	Black Guillemot	-	B	10p
Fulmarus glacialis	Northern Fulmar	-	B	385p
Hydrobates pelagicus	Storm petrel	-	B	1,400p
Larus argentatus	Herring gull	-	B	28p
Larus fuscus	Lesser black-back gull	-	B	97p
Larus marinus	Great black-backed gull	-	B	7p
Puffinus puffinus	Manx Shearwater	N	B	2,311p
Pyrrhcorax pyrrhocorax	Chough	-	B	2p
Sterna paradisea	Arctic tern	N	B	54p

Skelligs SPA 004007				
Minimum straight-line distance from Shot Head site 60.0km				
Minimum over-water distance from Shot Head site 68.0km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	-	B	304p
Fratercula arctica	Puffin	N	B	4,000p
Fulmarus glacialis	Northern Fulmar	N	R	806p
Hydrobates pelagicus	Storm petrel	I	B	9,994p
Puffinus puffinus	Manx shearwater	N	B	738p
Pyrrhocorax pyrrhocorax	Chough	-	B	1p
Rissa tridactyla	Kittiwake	N	B	944p
Morus bassanus	Northern gannet	I	B	29,683p
Uria aalge	Common Guillemot	N	B	1,709p

Bull and the Cow SPA 004066				
Minimum straight-line distance from Shot Head site 43.5km				
Minimum over-water distance from Shot Head site 44.5km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	R	B	88p
Fulmarus glacialis	Northern Fulmar	R	B	40p
Fratercula arctica	Puffin	N	B	200p
Hydrobates pelagicus	Storm petrel	N	B	3,500p
Larus argentatus	Herring gull	-	B	20p
Larus marinus	Great black-backed gull	-	B	280p
Phalacrocorax carbo	Cormorant	-	B	40p
Rissa tridactyla	Kittiwake	R	B	350p
Morus bassanus	Northern gannet	N	B	3,694p
Uria aalge	Common Guillemot	R	B	938p

Puffin Island SPA 004003				
Minimum straight-line distance from Shot Head site 53.0km				
Minimum over-water distance from Shot Head site 74.0km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	N	B	800p
Fratercula arctica	Puffin	I	B	5,125p
Fulmarus glacialis	Northern Fulmar	N	B	447p
Hydrobates pelagicus	Storm petrel	I	B	5,177p
Larus argentatus	Herring gull	-	B	47p
Larus fuscus	Lesser black-back gull	N	B	139p
Larus marinus	Great black-backed gull	N	B	72p
Puffinus puffinus	Manx sheerwater	-	B	6,329p
Pyrrhocorax pyrrhocorax	Chough	-	R	3p
Rissa tridactyla	Kittiwake	-	B	250p
Uria aalge	Common Guillemot	.-	B	250

Iveragh Peninsula SPA 004154				
Minimum straight-line distance from Shot Head site 32.0km				
Minimum over-water distance from Shot Head site 63.0km. Maximum 106km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	-	B	90p
Falco peregrinus	Perigrine Falcon	-	B	5p
Fulmarus glacialis	Northern Fulmar	N	B	766p
Larus argentatus	Herring gull	-	B	30p
Phalacrocorax arostitelis	Shag	-	B	11p
Phalacrocorax carbo	Cormorant	-	B	33p
Cepphus grylle	Black Guillemot	N	B	118i
Larus marinus	Great black-backed gull	N	B	63p
Pyrrhocorax pyrrhocorax	Chough	-	B	86
Rissa tridactyla	Kittiwake	N	B	1150p
Uria aalge	Common Guillemot	N	B	2860p

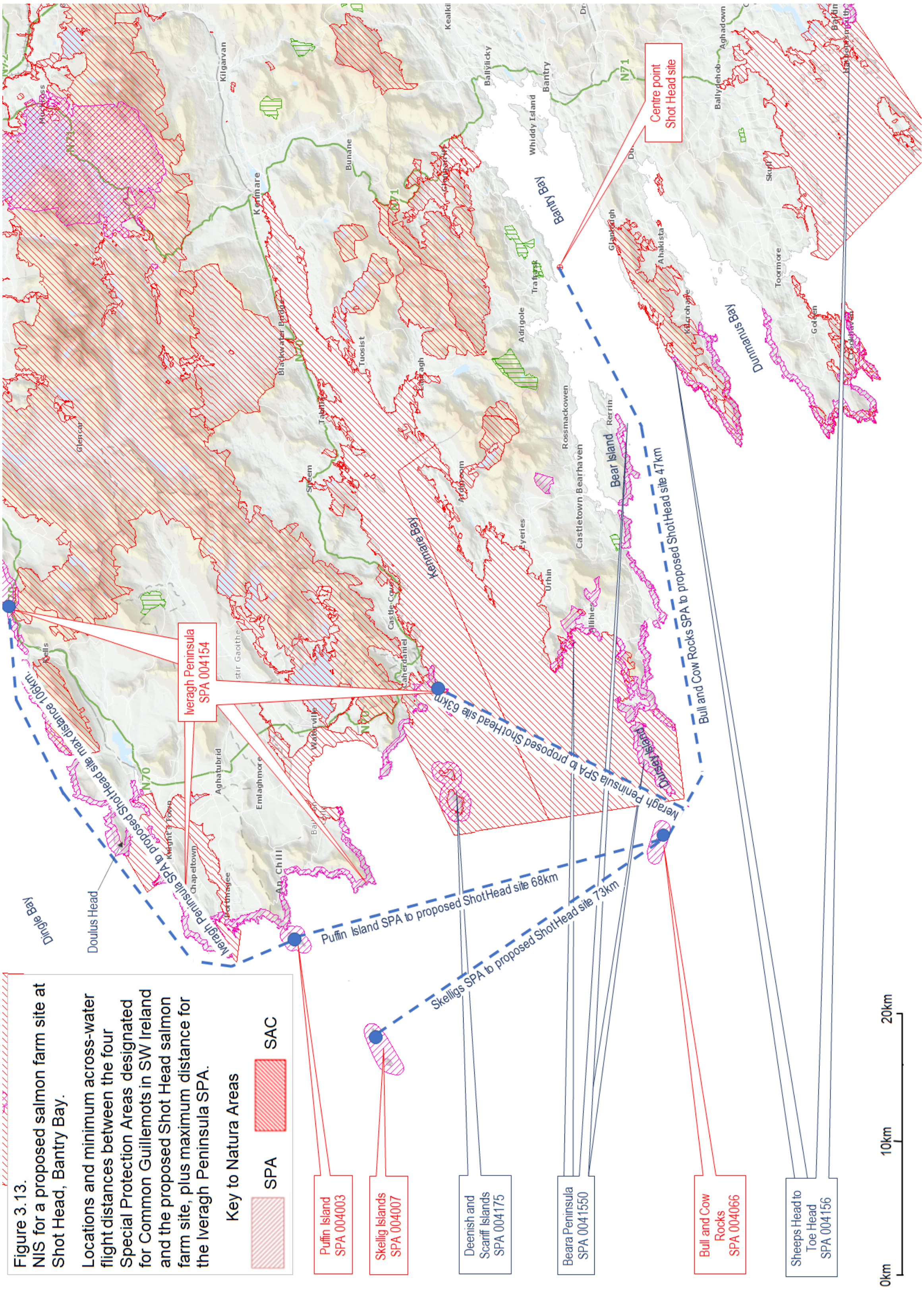


Figure 3.13. NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

Locations and minimum across-water flight distances between the four Special Protection Areas designated for Common Guillemots in SW Ireland and the proposed Shot Head salmon farm site, plus maximum distance for the Iveragh Peninsula SPA.

3.4. Northern Fulmar; *Fulmarus glacialis*.

3.4.1. Preface note.

As noted in Section 3.1, ALAB requisitioned an assessment of potential impact on Wild Birds (as per the title of the document) of the proposed Shot Head site, grant of licence now under appeal, Appeal Ref. No. AP2/2015, from Dr Tom Gittings, under Section 47 of the Fisheries (Amendments) Act 1997, in November 2017. Dr Gittings made his submission on 5th February 2018. On the Northern Fulmar, Dr Gittings observed the following:-

On the distribution and habitat preferences of Northern Fulmar on Page 14 of his report, Dr Gittings quotes Pollock et al[89], that the Beara Peninsula is exceptional in that high densities of Fulmar can be found inshore from February to May when, normally, they are found far offshore at this time of year. He also quotes from Roycroft[90], who states that Fulmar "*did not regularly forage within the* (sic Bantry) *bay"* (no foraging Fulmar were recorded along transects in Bantry Bay carried out by her).

Regarding sensitivity of Fulmar (Page 15), Dr Gittings notes that there appears to be no specific information about interactions between Fulmars and marine fish farms but cites Furness et al[91], that the indications are that Fulmar are "*unlikely to be significantly affected by disturbance from boat movements associated with marine farms*".

In closing, Dr Gittings notes on Page 15 that Fulmar are a *largely pelagic species and it is likely that most birds from colonies within the Beara Peninsula SPA head out to sea to forage*. There is no reason to suggest that this would not include Fulmar from other SPAs with connectivity to Shot Head, as well as Fulmar from non-SPA nesting sites on the shores of the bay. He also notes that "*the water depths within and around the proposed fish farm site (30-40 m) are also substantially shallower than the preferred water depth for foraging Fulmar (100 m)".*

In his section on interactions (Page 23), Dr Gittings observes that Fulmar "*may spatially overlap with aquaculture sites in the outer part of Bantry Bay"* but that, again, based on Roycroft's work, "*any spatial overlap is likely to mainly involve birds travelling to or from their breeding colonies, rather than feeding birds"*. This suggests that potential for interaction between these Fulmar and aquaculture sites is unlikely.

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89 Pollock C.M. et al. 1997. The Distribution of Seabirds and Cetaceans in the Waters around Ireland. JNCC Report No. 267. Joint Nature Conservation Committee, Peterborough.

90 Roycroft D. et al. 2007. Risk Assessment for Marine Mammal and Seabird Populations in South-Western Irish Waters (R.A.M.S.S.I.). Coastal and Marine Resources Centre, Cork.

91 Furness R.W. et al 2013. Assessing vulnerability of marine bird populations to offshore wind farms. J Env. Man. 119, 56-66.

In respect of cumulative impacts potential on Fulmar, Dr Gittings states Page 24) that "…*Therefore, it can be concluded cumulative impacts from the development of the proposed fish farm site in combination with wider aquaculture activity in Bantry Bay are unlikely to occur*"

It appears to this observer that, in his report entitled "Bird Expert's Report: Briefing Note; Bird impact assessment", commissioned by ALAB as a screening assessment of potential impacts on seabirds of the proposed Shot Head site, under Section 47 of the Fisheries (Amendment) Act 1997, that Dr Gittings is absolutely unequivocal in his view that, both in isolation and in combination with other aquaculture activity in Bantry Bay, the proposed Shot Head site will have no significant impact on Northern Fulmar.

On foot of Dr Gittings' evidence regarding potential impacts of the proposed Shot Head site on Northern Fulmar, it is unclear why ALAB should consider it necessary for this species to be reconsidered in a further screening assessment by Dr Crowe and why, on foot of her findings, which cite no evidence of impacts, they should decide to require a further review of aquaculture impacts on Fulmar in this NIS, requisitioned by them under Section 42 to SI 477 2011.

3.4.2. Biology and distribution of Northern Fulmar.

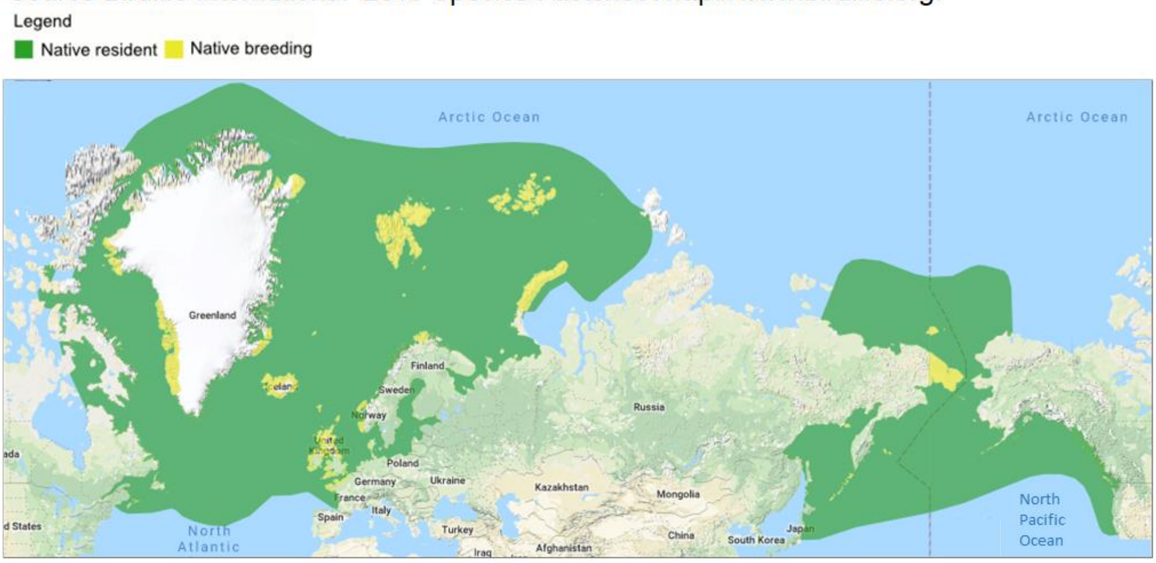
Like Northern Gannet and Common Guillemot, the Northern Fulmar is a pelagic species and an apex predator. It is a member of the Family Procellariidae or tubenoses, which includes Shearwaters, Petrels and Albatrosses, many of which are larger than the Northern Fulmar. Although medium in size for the group, the Northern Fulmar is the largest member of this family, which breeds in the UK and Ireland. Fulmar are 45-50cm in length, weigh 700-1,000gms and have a 1.0-1.2m wingspan.

Northern Fulmar are sexually monomorphic although the males tend to be slightly larger than the females. The head, short, thick neck and underparts are white, whilst the upper parts, upper wing and short stubby tail are grey. Superficially, the Fulmar resembles a gull, but it is larger and more thick-set. The Fulmar is adapted to a life on the wing and spends most of its life far from land, in oceanic conditions. Consequently, their pink legs are weak, and Fulmars can do little more than shuffle awkwardly on land, on their webbed feet. They cannot stand straight or perch. Other adaptations to their widely dispersed oceanic habit include the manner of their flight, which resembles that of the largest members of the family, the Albatrosses. This is characterised by a number of rapid wingbeats followed by long glides on stiffly held, straight wings. Air currents are used to carry them low along the water surface or to glide to higher altitudes. Two large nasal tubes are mounted on the ridge of the beak (or "tubenose"). This excretes the excess salt which accumulates from taking in seawater during their extended oceanic voyages or by drinking or imbibing it with their food.

Breeding and resident Northern Fulmar have an extremely large geographic range, estimated at up to 90,300,000km^2 [92]. The species is found throughout the Atlantic and Arctic Oceans in the Northern Hemisphere and as far south as Northern Spain to the east and Cape Cod, on the eastern US coast, to the west. In the Pacific they range from Arctic waters to the north and to as far south as Japan to the west and California to the east; see Figure 3.14. Northern populations are regarded as migratory, flying south as the sea freezes, whilst southern populations are more dispersive. Young birds may undertake transoceanic crossings and generally wander further afield than the less mobile adults[93] (del Hoyo *et al*. 1992). However, they do not stray further south than temperate waters.

The global population of Northern Fulmar is estimated to be 7M breeding pairs or 20M individuals, whilst in Europe there are 3.38-3.50M pairs[94].

Figure 3.14.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Global distribution for Northern Fulmar 2019.
Source Birdlife International 2019 Species Factsheet http://www.birdlife.org.



There is strong evidence that in the 17th century, Fulmar only bred in two colonies, on Grimsey, a small island 4km in length, 40km to the north of Iceland and Kolbeinsey, a rocky outcrop 74km further NNE, both within the Arctic Circle. Fulmar then extended their range, to of St Kilda, 1,200 km to the south and 90km west of the Western Isles, Scotland.

92 BirdLife International (2019) Species factsheet: Northern Fulmar. http://www.birdlife.org.

93 del Hoyo, J. et al. 1992. Handbook of the Birds of the World, Vol. 1: Ostrich to Ducks. Lynx Edicions, Barcelona.

94 Carboneras, C et al. 2016. Northern Fulmar (Fulmarus glacialis). In: del Hoyo, et al (Eds), Handbook of the Birds of the World, Lynx Edicions, Barcelona.

The population only started to increase and spread dramatically from the middle of the 18th Century, almost certainly strongly aided by the new availability of anthropogenic food sources, in particular regular supplies of fatty offal, initially from ship's-side flensing of whales and, following exhaustion of the supply of whales, from the early 20th Century, from trawler discards of waste and fish-guts, as well as depredation from trawlers and long-liners[95]. As a result, Fulmars first spread to the Faroes in the early 19th Century and thence to Foula off the Shetland Isles, where the first Shetland Fulmar colony was established, after which all the Shetland Islands were colonised. The species has subsequently spread around Britain, Ireland and NW Europe and across the Atlantic to Canada, ultimately spreading across the N Atlantic and Pacific.

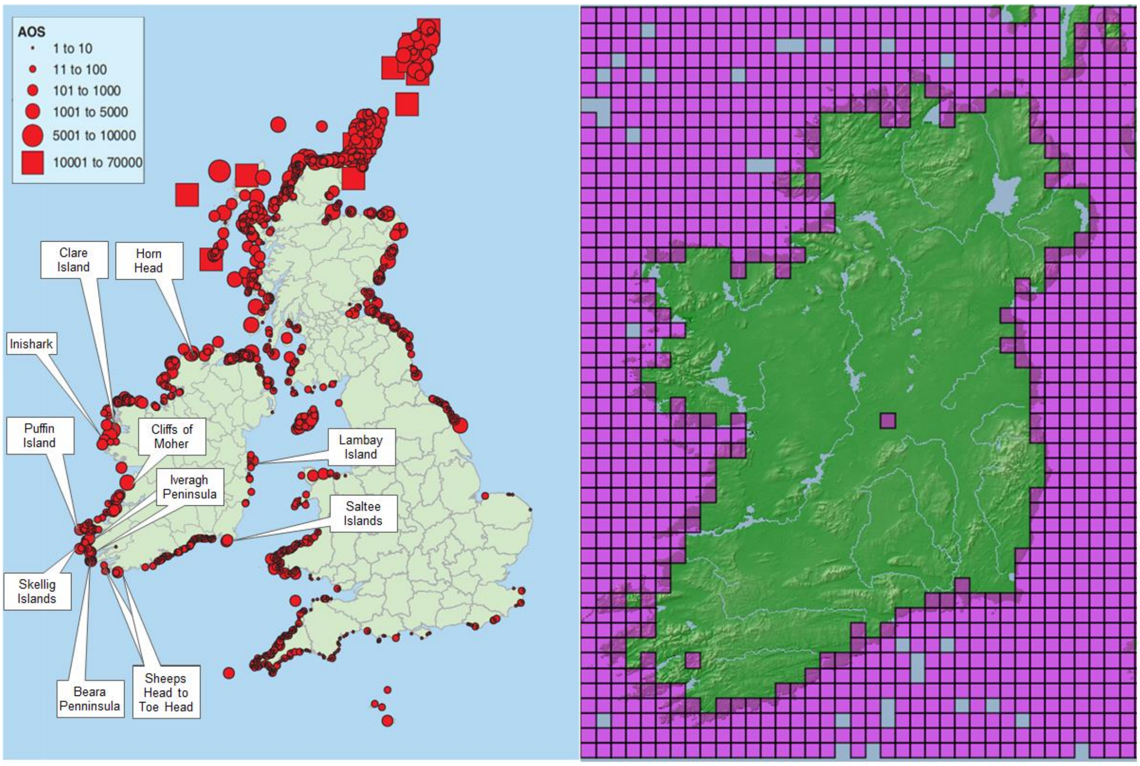
Numbers rapidly increased through most of the 20th century but this apparently inexorable rise in population ceased from the mid-1980’s with declines recorded in some areas. This dramatic change has been attributed to the decline in the North Sea whitefish industry since the mid-1970’s, which allowed a return of apex predators such as cod, which thrived on prey items such as sandeel, previously more available in large quantities for seabirds. There was an equally important and corresponding decline in the availability of fish offal, a trend which is likely to continue in Europe as a result of recent changes to the Common Fisheries Policy. More recent declines in the abundance of natural prey such as sandeels in the North Sea and of certain species of zooplankton in the North Atlantic, due their northerly migration, most likely as a result of climate change, have contributed to these declines. It is also likely that large numbers of Northern Fulmars are still being killed in their interactions with trawlers throughout their range and with the long-lining fleets in the Norwegian Sea and in the North Atlantic[96].

Fulmar can be observed on all Northern European coastlines and, due to their long foraging ranges (see Figure 3.1), often very far from their home colonies. Fulmar breed in very disparate colonies, both large and small, only a minority of which are protected, for example as SPAs, in Ireland and UK; see Figure 3.15. Fulmar also penetrate into coastal inlets and can be seen in all main Irish embayments, in particular along Ireland’s coastline from NW to SE, where floating aquaculture installations are concentrated, including the location proposed Shot Head salmon farm site in Bantry Bay; see Figure 3.2.

[95] Fisher J. 1952. A history of the Fulmar Fulmarus and its population problems. Ibis 94, 203-393.

[96] JNCC 2019. Northern Fulmar status and trends. https://jncc.gov.uk/our-work/northern-fulmar-fulmarus-glacialis

Figure 3.15.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Map of abundance and distribution of breeding Northern Fulmar in Britain and Ireland 1998–2002 along with Northern Fulmar sitings map of Ireland, based on a 10km^2 grid.
Map sources : Abundance map; Mitchell Pl. et al 2004. Seabird Populations of Britain and Ireland: results of the Seabird 2000 census (1998-2002). Published by T and AD Poyser, London.
Sitings map; https://biodiversityireland.ie.

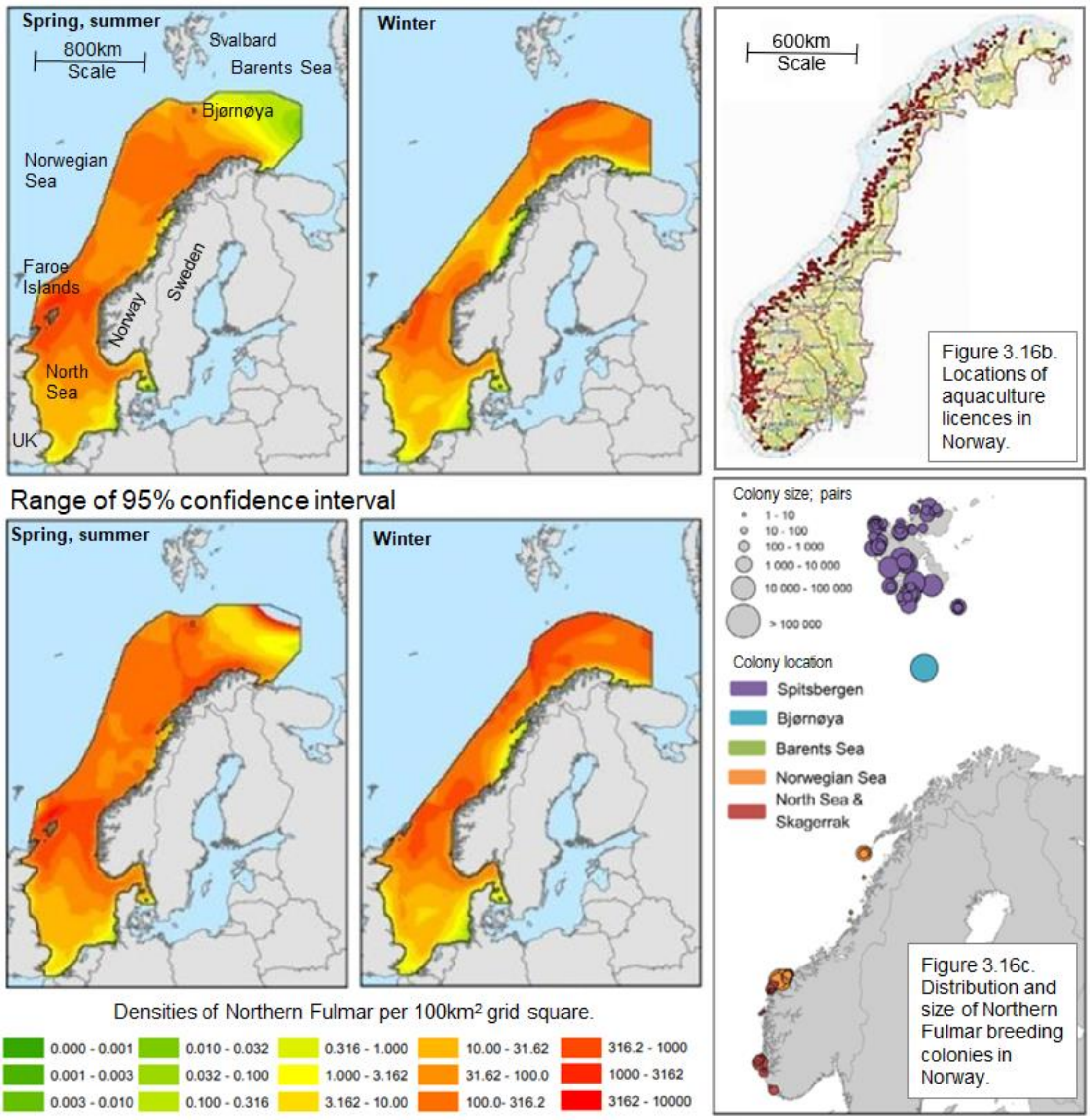


Much the same applies to Scotland's W coast and the Northern and Western Isles, where Fulmar colonies are very concentrated, close to Scotland's aquaculture development zone; see Figures 3.15 and 3.3b. At 501,609 pairs AOS (Seabird 2000), the UK held 8% of the global total of Northern Fulmar, of which Scotland held 96%. The population in Scotland increased by 77% between Operation Seafarer in 1969-1970 and the Seabird Colony Register in 1985-1988. At the date of the Seabird 2000 survey, Scotland held a total of 485,582 pairs, a reduction of 4% since the Seabird Colony Survey Register survey. It is understood that this total had dropped further by the 2015 survey (precise all-colony data currently not available). Available country data for UK and Ireland are summarised for Fulmar in Table 3.9.

Fulmar densities along the Norwegian coastline are shown in Figure 3.16. Figure 3.16a shows that, in Spring and Summer, Fulmar foraging densities are highest offshore from the main colony areas. These are around NE Scotland and the Northern Isles, between the Northern Isles and the Norwegian coast and further north, in the Norwegian Sea and as far north as the large colony on Bjørnøya Island. This picture is more or less maintained into the winter months, although densities tend to decrease between the Northern Isles and Norway and to increase offshore from the N Norwegian coast, into the Barents Sea. Again, it is evident that, as with Gannet and Guillemot, high foraging densities of Fulmar in most of these areas puts some of the largest and densest accumulations of salmon farming and other aquaculture activities in the world well within their core foraging range (see Table 3.1) .

Figure 3.16.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Estimated seasonal densities of Northern Fulmar off the Norwegian coast from GPS tracking studies, coupled with locations of aquaculture site licences and colonies.
Source of density maps http://www.seapop.no/en/distribution-status/distribution/at-sea/#fulmar.

3.16a. Estimated density.



3.4.3. Feeding; foraging and scavenging behaviour in Northern Fulmar.

The Northern Fulmar's dietary preferences are broader than those of Gannets and Guillemots They comprise zooplankton, fish, especially capelin, gadids and sandeels; squid and other invertebrates such as jellyfish, shrimp and crabs; carrion, taken mainly from whale and seal carcasses and fish discarded by or depredated from commercial fishing vessels. They are particularly attracted by high energy, oily fish and offal. Large flocks of Fulmar gather, with other birds such as Gannets, Guillemots, Razorbills and gulls, to feed, around active trawlers.

Fulmar are Pelagic surface feeders and forage for natural food by seizing their prey when swimming on the water surface or in flight just above the water surface, by diving to depths of up to 3m, with a duration of up to 8 seconds, often using short, regular dives in shallow water. This shallow diving behaviour generally only occurs in daylight. However, unlike Gannet and Guillemot, Fulmars forage both in daylight and at night, albeit mainly offshore. Night feeding is more or less restricted to planktonic prey, which rises towards the surface in low light, in offshore waters[97]. Fulmar feed consumption averages 329g per day in the winter months and 373g per day in the summer[98], when feeding young. This is almost equivalent to 50% of body weight daily.

Prey selection in the NE Atlantic has been found to vary with region and season, with a tendency for more discards to be consumed to the south of their range relative to the north. Capelin and sand eel are the most favoured fish species, albeit influenced by regional availability. In a study by Philips et al[99], Capelin and sand eel were major dietary components comprising 47-93% of food wet mass off Iceland, with one or other in the majority depending on region. Other fish species were mainly discards. In some regions, crustaceans, squid and pelagic invertebrates such as pteropods and large zooplankton, as well as benthic invertebrates (presumably taken whilst swimming in shallow water) could make up a considerable proportion of the diet.

Fulmar are therefore highly flexible and opportunistic in their feeding habits. However, despite this, like Guillemot, Fulmar have been affected by climate change in the last decade or so, plankton and planktotrophic fish species, in particular sand eel have moved north. Reduction in discarding, especially following changes in the European Common Fisheries Policy, has also taken its toll on the population status of Fulmar regionally and is likely to continue to do so.

97 Garth S et al. 2001. Shallow Diving by Northern Fulmar Feeding at Shetland. Waterbirds 24 287-289.

98 Grandgeorge et al. 2008. Resilience of the British and Irish seabird community in the 20th century.

98 Philips RA et al 1999. Diet of the northern fulmar *Fulmarus glacialis*: reliance on commercial fisheries? Mar Biol 135, 159-170.

3.4.4. Breeding and population status of Northern Fulmar.

Fulmar are the longest-lived of the three subject species. Average lifespan is some 40 years although individuals are known to live to over 60 years. They have a low reproduction rate. Adult mortality is regarded as low at <5%pa. Fulmar breed on rocky cliffs and islands and up to 1km inland but typically breed close to the coast or water. They occasionally nest in the built environment. Fulmar breed all around the North Atlantic region from Newfoundland in the southwest to Svalbard and Novaya Zemya in the Arctic. Its southern breeding limit is Northern France. They also breed in the North Pacific, in Alaska and Eastern Russia.

Perhaps, in consequence of their long spells at sea, Fulmar are very ungainly on land and can do little more than shuffle. They are unable to stand upright but tilt forward, making take-off difficult unless from a high ledge or from water, when they paddle the surface as they take flight.

Fulmar are monogamous and are known to have high fidelity to their nesting space and sometimes return outside the breeding season. They return to re-join their mate each season throughout their adult life. When nesting, Fulmar are highly sociable birds but spend little other time on land, being offshore for at least 7 years prior to returning to their home colony for the first time and returning to the oceanic habit between breeding seasons. Breeding normally starts when the birds are at least 8 or 9 years old for males and 12 years for females[100], [101]. They then breed annually for life.

A single white egg is laid each season onto a more or less bare ledge, or amongst rocks, in late May to early June. The egg takes 47 to 53 days to hatch. Fledging takes place in early September, up to 58 days post-hatch. At fledging, chicks are about 20% heavier than adults and, once at sea, need to lose weight before that are capable of becoming airborne.

The Fulmar population showed a trend of increasing numbers from 1969 until at least the Seabird 2000 survey. Currently available data suggests that this trend has either continued at a slower rate or has gone into decline, in some areas. For example, all main SPA colonies on both the west and east Scottish coast went into decline, some sharply, between 2000 and 2011. JNCC suggest a range of causes and consider that long-term increases and subsequent decreases in anthropogenic food sources (fish offal etc) and / or oceanographic changes may be involved[102]. However, a wide literature search shows that impacts from aquaculture has not been researched as part of this trend to date.

[100] Del Hoyo J 1992 Handbook of birds of the world. Volume 1. Lynx Edicions ISBN 10:84873334091

[101] Hatch, S.A., and Nettleship, D.N. 1998. Northern fulmar (Fulmarus glacialis). In The birds of North America. No. 361. Edited by A. Poole and F. Gill. Academy of Natural Sciences, Philadelphia, Pa., and American Ornithologists' Union, Washington, D.C. pp. 1–32.

[102] Salomonsen, F. 1965. Geographic variation of the Northern Fulmar (*Fulmarus glacialis*) and zones of the marine environment in the North Atlantic. *Auk* 85: 327-355.

Unlike Common Guillemot and other Auks, Fulmar are little affected by bad weather. Exploitation of Fulmar for human food was rife into the early 19th century in some areas and still persists in the Faroes and Iceland. Both fledglings and eggs are taken. Table 3.9 shows differing trends for Irish, relative to Scottish data from 1969-1970 to 1998-2002. No national data is available for UK for SMP 2015, but the Irish national population has almost maintained its 2000 population and now stands at 32,899. This is an encouraging result, bearing in mind the impacts that Fulmar populations have been facing throughout their geographical range. The data in Table 3.10 shows the extent of Irish colony data for Fulmar. The mixed picture emerging is likely to be due, partly or wholly, to gaps in the data record. Nonetheless, overall, the national population has been maintained since Seabird 2000 and currently stands at 92.6% higher than it did 50 years ago, prior to the advent of salmon farming or any other aquaculture in Ireland

Table 3.9.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Summary country count data for UK and Ireland Northern Fulmar pairs,
Apparently on Nest (AON), as available, 1969 to 2015.
Main sources; www.jncc.gov.uk/our-work/fulmar-fulmarus-glacialis/; dated April 17th 2019.
NPWS data request 16th Ocotber 2019.

Survey name	Operation Seafarer	Seabird Colony Register	Seabird 2000	Seabird Monitoring Program		Operation Seafarer	Seabird Colony Register	Seabird 2000	Seabird Monbitoring Program
Year	1969-1970	1985-1988	1998-2002	2014-2015		1969-1970	1985-1988	1998-2002	2014-2015
Scotland	285,067	504,640	485,852			-	+77%	-4%	
England	3,063	6,018	6,291			-	+96%	+5%	
Wales	925	2,741	3,474			-	+193.6%	+27%	
Northern Ireland	2,239	3,540	5,992			-	+58%	+59	
Isle of Man	586	2,463	3,147			-	+320.3	+28%	
Channel Islands	1	200	317			-	n/a	+59%	
Total UK	291,294	516,939	501,609			-	+77.5%	-3%	
Ireland	17,080	16,975	32,918	32,899		-	-0.6%	+94%	-0.06%

* Data for 31 colonies only.

The literature is unclear about specific or acute individual drivers of Fulmar population change over the last decade, but it does seem that a considerable number of species have been showing recent population declines in certain areas, throughout their geographical range, Northern Fulmar and Common Guillemot amongst them, although to date, apparently, not Gannet. The common view is that this is most likely due to a combination of drivers. Fauchald et al provide review of this phenomenon in the Norwegian Government publication, NINA Report 1151[103]. However, in considering a very wide range of natural, climatic and anthropogenic drivers that may be implicated in current population trends, there is no mention at all of any role on the part of aquaculture, in the NINA 1151 report or for that matter elsewhere, despite its considerable presence in Norwegian waters, well within the foraging ranges of the 17 species that the NINA document considers.

103 Fauchald P. et al 2015. The status and trends of seabirds breeding in Norway and Svalbard. NINA Report 1151

Table 3.10.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Counts by colony and national counts of Northern Fulmar pairs, Apparently on Nest (AON)
for Irish main SPAs / colonies, as available, 1969 to 2015.
Main sources; www.jncc.gov.uk; April 17th 2019, SPA Natura Forms and NPWS data request 11th Oct 2019.

Survey name		Operation Seafarer	Seabird Colony Regisater								
County	SPA	1969-1970	1985	1986	1987	1988	1991	1993	1994	1995	1996
Donegal	Horn Head										
Mayo	Clare Island										
Clare	Cliffs of Moher				3,097						
Clare	Loop Head										
Kerry	Puffin Island										
Kerry	Skellig Islands								857	632	745
Kerry	Scariff Island										
Kerry	Iveragh Peninsula										
Cork	Bull and the Cow Is.										
Cork	Dursey Island										
Cork	Sheeps Head										
Cork	Old Head Kinsale										
Wexford	Great Saltee		325								
Wexford	Little Saltee					233		259			
Dublin	Howth Head		52	106	48	81					
Dublin	Irelands Eye			45			46		43	53	53
Dublin	Lambay Island				560		737			573	
National censi		17,080	16,695								

Survey name			Seabird 2000								
County	SPA	1997	1998	1999	2000	2002	2004	2005	2006	2007	2009
Donegal	Horn Head			1,974							
Mayo	Clare Island			4,029							
Clare	Cliffs of Moher		3,362	204				4,709			
Clare	Loop Head										
Kerry	Puffin Island				447						
Kerry	Skellig Islands	863	726	761	806						579
Kerry	Deensih and Scariff Is.				385						
Kerry	Iveragh Peninsula				766						
Cork	Bull and the Cow Is.				40						
Cork	Dursey Island				575						
Cork	Sheeps Head				57						
Cork	Old Head Kinsale										
Wexford	Great Saltee		315								
Wexford	Little Saltee	292			205				186	214	
Dublin	Howth Head	37		33						41	
Dublin	Irelands Eye	45		70						55	
Dublin	Lambay Island			585			727			598	385
National censi			32,918								

Survey name							Seabird Monitoring Program			
County	SPA	2010	2011	2012	2013	2014	2015	2016	2017	2018
Donegal	Horn Head						558			
Mayo	Clare Island									
Clare	Cliffs of Moher						4,801			
Clare	Loop Head						235	68		
Kerry	Puffin Island		653					388		670
Kerry	Skellig Islands	662	590	638		765	796	764	787	552
Kerry	Scariff Island									377
Kerry	Iveragh Peninsula						183			
Cork	Bull and the Cow Is.									
Cork	Dursey Island							487		
Cork	Sheeps Head								154	
Cork	Old Head Kinsale									
Wexford	Great Saltee				225					
Wexford	Little Saltee									
Dublin	Howth Head									
Dublin	Irelands Eye	29								
Dublin	Lambay Island	530				765				
National censi							32,899			

3.4.5. Protected status of Northern Fulmar and the proposed Shot Head site.

The Northern Fulmar is protected throughout its geographical range. The species is Amber-listed in Birds of Conservation Concern for the UK (2015 update) but is not listed as a Bird of Conservation Concern in Ireland for 2014-2019 (2014 update), and is listed as being of Least Concern globally in the IUCN Red List, due to its extremely large range, global population, which appears to show a constantly increasing trend (2019 update)[104].

For this NIS, the most important population and conservation data is that relating to colonies within the potential connectivity range of resident Northern Fulmar to the Shot Head site and surrounding aquaculture assemblages in Bantry Bay. In fact, a number of Northern Fulmar colonies, some quite small and disparate, exist in all six SPAs in the immediate vicinity of Bantry Bay. These are the Iveragh Peninsula SPA 004154, the Puffin Island SPA 004003, the Skellig Islands SPA 004007, and the Bull and Cow Rocks SPA 004066, the Beara Peninsula SPA 004155 and the Deenish and Scariff Islands SPA 0044175. These are tabulated with the seabird SCI lists for each in Table 3.8. All six SPAs connected for Northern Fulmar are mapped, showing minimum across-water distances to the Shot Head site in Figure 3.17. There are other small colonies, each with no more than a few pairs, in particular in sites along the northern shore of Bantry Bay. These are not protected by SAC status.

It will be seen from Figure 3.17 that two of the SPAs local to Bantry Bay extend over considerable distances of the nearshore area. This applies in particular to the Iveragh Peninsula, which stretches over selected sections of high coast and sea cliff from Lamb's Head on the north shore of Kenmare Bay, to the south, to just west of Rossbehy, on Dingle Bay to the north. Thus, the across-water distance from the site to the proposed Shot Head site varies from 63km from Lamb's Head to 106km from its northernmost limit. Much the same applies to the Beara Peninsula SPA, which runs from the south eastern side of Bear Island in Bantry Bay to its south, to the sea cliffs at Cod's Head, in Kenmare Bay to its North. Across-water distance in this case varies from 10.5km to 50.0 km.

The other four sites comprise either one or two steep-faced islands, along with a 500m marine margin for rafting birds and are somewhat more compact. Puffin Island is 74km across water from Shot Head, The Skelligs 73km, Deenish and Scariff Islands 60km and the Bull and the Cow 44.5km. Whilst conservation features in terms of SCIs are summarised in Table 3.11, locations and distances are shown in the map in Figure 3.13.

104 BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org.

Table 3.11.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
SCI bird species from nearest seven Special Protection Areas (SPAs) to Shot Head site with subject long-range foraging SCI species highlighted, Northern Fulmar SPA / colonies highlighted in green.

Key: R M / O B — Resident / Migratory / Overwintering / Breeding; Maximum Population — Numbers reported in site Natura Forms / Synopses.
p = pairs; i = individuals; Site importance R = Regional N = National I = International

Beara Peninsula SPA 004155				
Minimum straight-line distance from Shot Head site 10.5km				
Minimum over-water distance from Shot Head site 10.5km, maximum 50km				
Species	Common name	Site importance	R M O B	Maximum population
Falco peregrinus	Perigrine Falcon	-	B	4p
Fulmarus glacialis	Northern Fulmar	N	B	575p
Larus Argentatus	Herring gull	-	B	20p
Phalacrocorax arostitelis	Shag	-	O	12p
Pyrrhocorax pyrrhocorax	Chough	-	B	54p
Cepphus grylle	Black Guillemot	-	B	87i

Sheeps Head to Toe Head SPA 004156				
Minimum straight-line distance from Shot Head site 9.13km				
Minimum over-water distance from Shot Head site 9.13km Maximum 73.5km				
Species	Common name	Site importance	R M O B	Maximum population
Cepphus grylle	Black Guillemot	N	B	137i
Falco peregrinus	Perigrine Falcon	-	B	7p
Larus Argentatus	Herring gull	-	B	30p
Fulmarus glacialis	Northern Fulmar	-	B	57p
Larus marinus	Great black-backed gull	-	B	1p
Phalacrocorax arostitelis	Shag	-	O	17p
Pyrrhocorax pyrrhocorax	Chough	-	B	82p
Risa tridactyla	Kittiwake	-	B	20p

Deenish Island and Scarriff Island SPA 004175				
Minimum straight-line distance from Shot Head site 38.0km				
Minimum over-water distance from Shot Head site 60.0km				
Species	Common name	Site importance	R M O B	Maximum population
Cepphus grylle	Black Guillemot	-	B	10p
Fulmarus glacialis	Northern Fulmar	-	B	385p
Hydrobates pelagicus	Storm petrel	-	B	1,400p
Larus argentatus	Herring gull	-	B	28p
Larus fuscus	Lesser black-back gull	-	B	97p
Larus marinus	Great black-backed gull	-	B	7p
Puffinus puffinus	Manx Shearwater	N	B	2,311p
Pyrrhcorax pyrrhocorax	Chough	-	B	2p
Sterna paradisea	Arctic tern	N	B	54p

Skelligs SPA 004007				
Minimum straight-line distance from Shot Head site 60.0km				
Minimum over-water distance from Shot Head site 73.0km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	-	B	304p
Fratercula arctica	Puffin	N	B	4,000p
Fulmarus glacialis	Northern Fulmar	N	R	806p
Hydrobates pelagicus	Storm petrel	I	B	9,994p
Puffinus puffinus	Manx shearwater	N	B	738p
Pyrrhocorax pyrrhocorax	Chough	-	B	1p
Rissa tridactyla	Kittiwake	N	B	944p
Morus bassanus	Northern gannet	I	B	29,683p
Uria aalge	Common Guillemot	N	B	1,709p

Bull and the Cow SPA 004066				
Minimum straight-line distance from Shot Head site 43.5km				
Minimum over-water distance from Shot Head site 44.5km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	R	B	88p
Fulmarus glacialis	Northern Fulmar	R	B	40p
Fratercula arctica	Puffin	N	B	200p
Hydrobates pelagicus	Storm petrel	N	B	3,500p
Larus argentatus	Herring gull	-	B	20p
Larus marinus	Great black-backed gull	-	B	280p
Phalacrocorax carbo	Cormorant	-	B	40p
Rissa tridactyla	Kittiwake	R	B	350p
Morus bassanus	Northern gannet	N	B	3,694p
Uria aalge	Common Guillemot	R	B	938p

Puffin Island SPA 004003				
Minimum straight-line distance from Shot Head site 53.0km				
Minimum over-water distance from Shot Head site 74.0km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	N	B	800p
Fratercula arctica	Puffin	I	B	5,125p
Fulmarus glacialis	Northern Fulmar	N	B	447p
Hydrobates pelagicus	Storm petrel	I	B	5,177p
Larus argentatus	Herring gull	-	B	47p
Larus fuscus	Lesser black-back gull	N	B	139p
Larus marinus	Great black-backed gull	N	B	72p
Puffinus puffinus	Manx sheerwater	-	B	6,329p
Pyrrhocorax pyrrhocorax	Chough	-	R	3p
Rissa tridactyla	Kittiwake	-	B	250p
Uria aalge	Common Guillemot	.-	B	250

Iveragh Peninsula SPA 004154				
Minimum straight-line distance from Shot Head site 32.0km				
Minimum over-water distance from Shot Head site 63.0km, maximum 106km				
Species	Common name	Site importance	R M O B	Maximum population
Alca torda	Razorbill	-	B	90p
Falco peregrinus	Perigrine Falcon	-	B	5p
Fulmarus glacialis	Northern Fulmar	N	B	766p
Larus argentatus	Herring gull	-	B	30p
Phalacrocorax arostitelis	Shag	-	B	11p
Phalacrocorax carbo	Cormorant	-	B	33p
Cepphus grylle	Black Guillemot	N	B	118i
Larus marinus	Great black-backed gull	N	B	63p
Pyrrhocorax pyrrhocorax	Chough	-	B	86
Rissa tridactyla	Kittiwake	N	B	1,150p
Uria aalge	Common Guillemot	N	B	2,860p

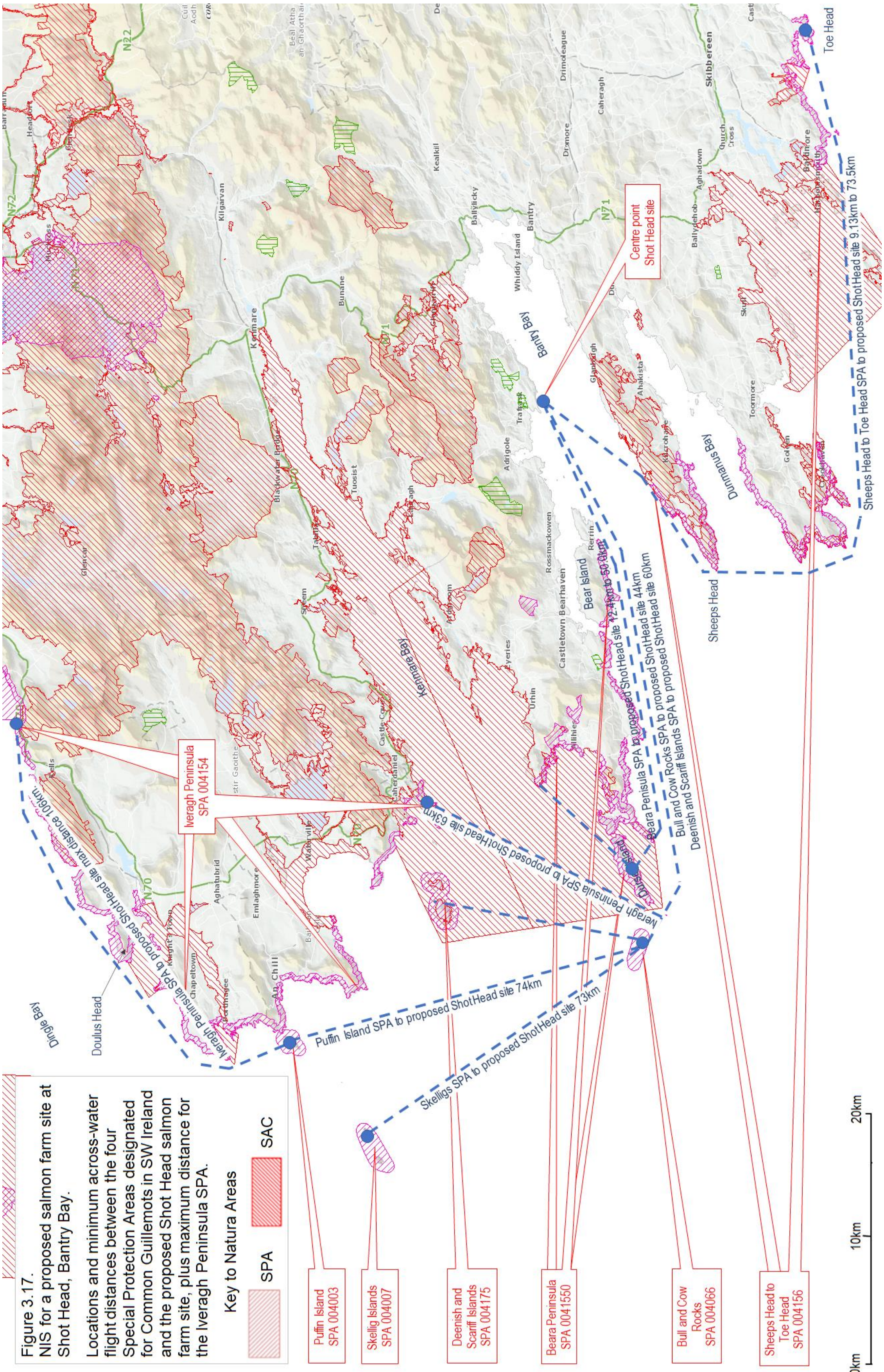


Figure 3.17.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

Locations and minimum across-water flight distances between the four Special Protection Areas designated for Common Guillemots in SW Ireland and the proposed Shot Head salmon farm site, plus maximum distance for the Iveragh Peninsula SPA.

Section 4.
Near-field impacts; a review of the relationships between the subject seabirds and aquaculture activity in Bantry Bay.

4.1. Consideration of the relative potential impacts of floating aquaculture on pelagic seabirds.

This section is restricted to the consideration of subtidal, surface-floating aquaculture installations, in the open marine waters of Bantry Bay, typified by:-

- Floating marine longline systems, where the longlines are anchored to the seabed, as used for mussel and seaweed culture.

- Floating pen marine finfish farming systems, each system supported on a floating mooring grid which is anchored to the seabed.

These are the two main types of aquaculture systems deployed in Bantry Bay. Intertidal installations such as bag and trestle systems used for oysters, and clam parks, laid directly onto the substrate in the intertidal zone and covered with an antipredator mesh, and other systems where the stock is submerged, on the seabed, are not considered, since these have no connectivity with pelagic seabirds.

Bivalves such as mussels on longlines are filter feeders which graze on suspended particles and nutrients in the water column. They selectively ingest phytoplankton and other organic material (e.g. small zooplankton and bacteria) and dispose of inorganic and larger organic matter in pseudofaeces, which is excreted into the water column. Faecal and pseudofaecal pellets are dispersed from their point of origin as they fall to the seabed and may cause localised organic enrichment, subject to water depth, current speed, density of culture and ambient water column suspended solids. There is no input to the system since nutrients and all other requirements growth and maintenance stock are taken up from the water column.

Finfish culture differs from shellfish culture in that there is a net input of nutrients to the system, from fish feed pellets. As a result, there is a net discharge of feed-origin organic matter into the water column. Discharges have three components; solid uneaten waste feed, faeces, being the indigestible fraction of the ration fed and soluble metabolic waste, as ammonia in solution, excreted via the gills. Waste also arises from the cleaning of fish nets which, like feed and faecal waste, can also accumulate on the seabed in amounts that are subject to the net cleaning regime, water depth and hydrography. As for shellfish, the amounts and concentration of wastes that are discharged into the water column or accumulate on the seabed, is a function of feeding regime, stocking density and biomass, water depth and hydrographic regime In all events, the soluble and neutrally buoyant waste fractions disperse and dilute in water currents whilst solids settle, mainly in the area immediately beneath the installation, from which they are assimilated by the seabed fauna.

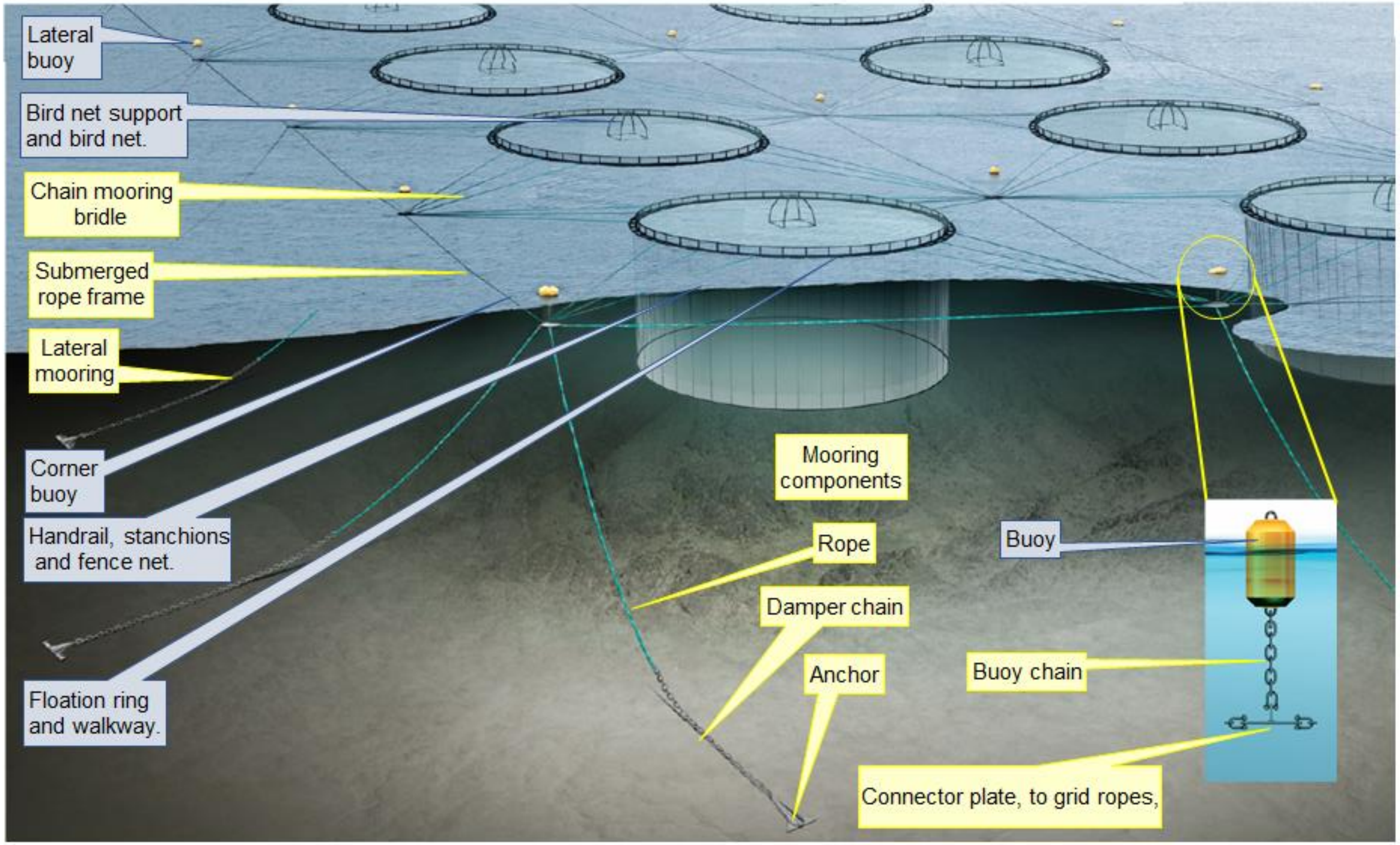
For the proposed Shot Head site, as for all other licenced finfish sites, empirical, calculated and modelled hydrographic data was used to drive dispersion models for all waste components discharged from the site. In the case of the Shot Head application, the proposed site was demonstrated to be sustainable within the hydrographic regimen and carrying capacity parameters of Bantry Bay, in combination with all other input sources in the bay, both in terms of the Environmental Quality Standards (EQS) Directive 2008/105/EC and the Water Framework Directive 2000/60/EC, through the Environmental Impact Statement (EIS), Supplementary EIS and other information provided in the application. As far as is known, all other potential impact consequences for the operation of the site have also been researched and found to be acceptable. This process has also addressed the potential impacts on seabirds of all impact parameters, with the exception of those associated with obstruction, disturbance, entrapment and other forms of injury that may arise specifically through interactions with the Shot Head site (in isolation) and in combination with other aquaculture in the bay (cumulative impacts), which must be considered in this NIS. As it is understood, these are the only potential impacts that remain to be considered.

No reliable guidance has been found in the literature to distinguish between the obstructive impacts to foraging seabirds of either marine finfish farms or longline shellfish and seaweed units. In general, finfish farms comprise one or rarely two blocks of pens, which effectively fully obstruct the sea surface. In the case of the Shot Head site, this area, to the limits of the grid frame which moors and supports the floating pens, will be no greater than 630m x 140m (if a maximum of 18, 126m circumference pens are deployed). This will cover a sea surface area of 8.82ha. The grid frame is moored, via grid buoys to the seabed by mooring ropes and seabed anchors, to a depth of about 35m. These extend the seabed area partially or fully obstructed by the installation to some 830m x 300m or 24.9ha, some 60% of the licensed area applied for; see Figure 4.1. Other ancillary equipment, the largest item being the feed barge, occupies an additional small percentage of the site area. All calculations for the Shot Head site in this document are based on the full licensed area applied for, of 850m x 500m, or 42.5ha; see Figure 4.2.

Mussel and seaweed longline installations comprise near-rectangular or polygonal sites, across which floating longlines are deployed, at 15-20m intervals. These are anchored to the seabed, more or less at the limits of the site area. Thus, unlike finfish farms, the entire site is generally occupied. This is evident in Figures 4.3 to 4.5. On mussel sites, the mussels are attached to droppers, which hang into the water from the longlines. On seaweed sites, seeded collector string is wound around the longlines before deployment. The seaweed then grows along the longlines and hangs down, to 2m below them. Both crops move in current, under the longlines. It is argued that the proximity and directionality of the stocked longlines is sufficient to obstruct adequate access of all foraging pelagic seabirds to the water column within the site area.

For the reasons given and in the absence of guidance from the literature, it is concluded that both finfish farm sites and longline sites have equal potential to obstruct sea-surface and seabed access to the subject seabirds species.

Figure 4.1.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
General pen, grid, and mooring layout; surface structures labelled blue, submerged structures labelled yellow.
Source of image; Polar Cirkel AS.



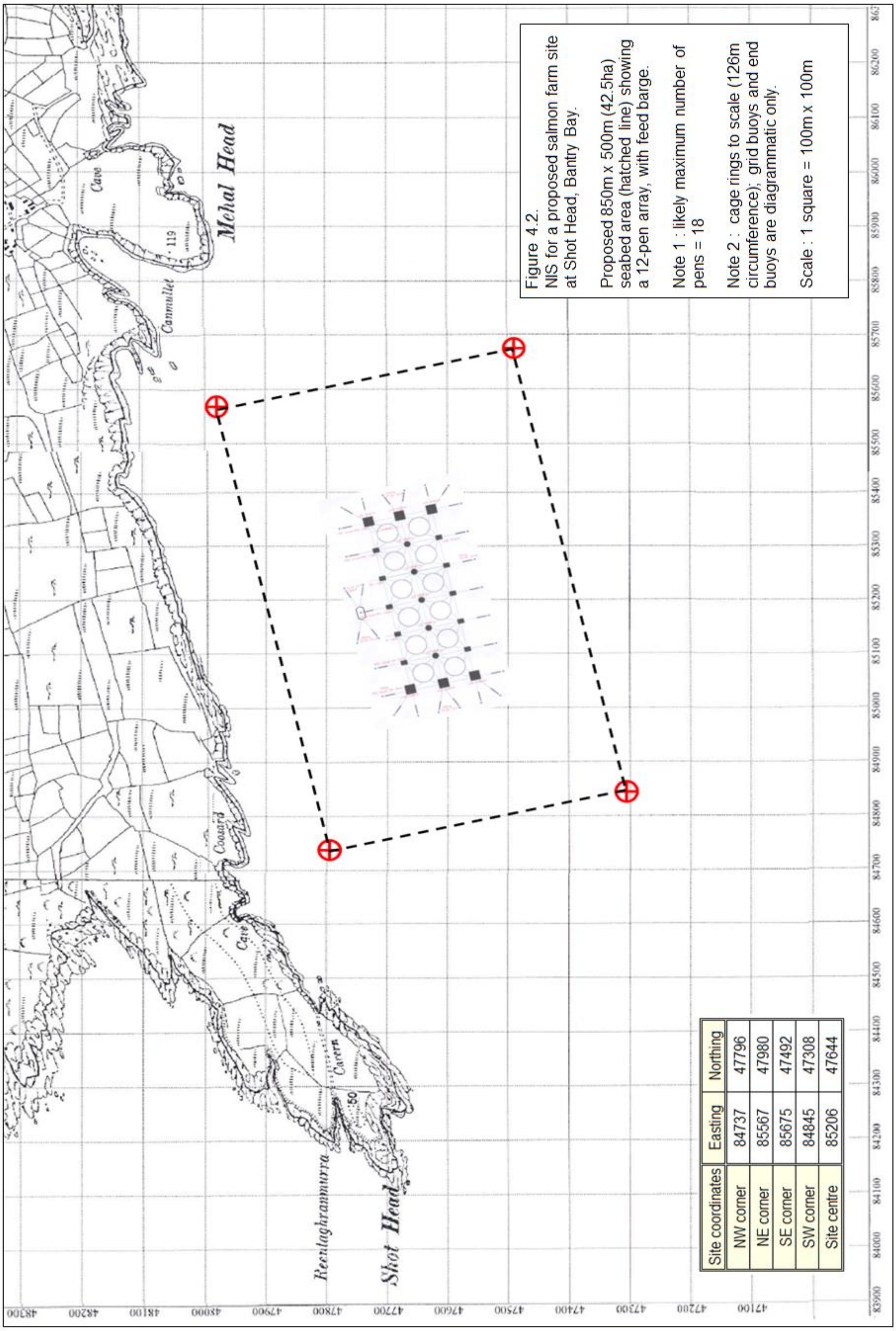


Figure 4.2.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

Proposed 850m x 500m (42.5ha) seabed area (hatched line) showing a 12-pen array, with feed barge.

Note 1 : likely maximum number of pens = 18

Note 2 : cage rings to scale (126m circumference); grid buoys and end buoys are diagrammatic only.

Scale : 1 square = 100m x 100m

Site coordinates	Easting	Northing
NW corner	84737	47796
NE corner	85567	47980
SE corner	85675	47492
SW corner	84845	47308
Site centre	85206	47644

4.2. The extent of aquaculture activity in Bantry Bay

As required under the Habitats Directive and SI 477 2011, this NIS must consider the potential for impacts on the subject seabird species that could arise from the presence of the proposed Shot Head installation, both in isolation, and in combination with other potential impactors in the locality. In order to satisfy this requirement, it is necessary to consider the extent and types of aquaculture in Bantry Bay, other than Shot Head, which have the potential to contribute to cumulative impact. It is submitted that there are no other fixed, potential, local impact sources that need to be taken into account

The aquaculture sites in Outer Bantry Bay are considered in the context of their proximity to adjacent Natura 2000 sites in the current *Screening Matrix for Aquaculture Activities in outer Bantry Bay County Cork*, dated May 2018, authored by the Marine Institute. This document can be found on the DAFM website[105] and is also appended herein, in Appendix 1. Such matrices have been developed for the majority if not all aquaculture areas in Ireland and are used as a basis for decisions on the granting of licences for shellfish and seaweed licence applications.

The Screening Matrix includes all finfish farms in the bay and assesses them alongside all other species cultured in the bay. Finfish farms are included in all steps in the assessment process employed in the matrix, including, for example, in this response in the context of *Disturbance of key species*, on Page 4:-

"There is no evidence in the scientific literature to suggest that aquaculture activities impact on seal species (Feature of Glengarriff Harbour and Woodlands SAC) and the bird species listed in the SPAs, i.e., Chough, Fulmar and Peregrine. Furthermore, any impacts on habitats are likely to be local and not extend beyond the footprint of the activities. Therefore, they are not likely to impact on any of the adjacent SACs".

Although the subject matter of the screening matrix suggests otherwise, they are not used in decisions on granting of licences for finfish, which are subject to a much more rigorous and lengthy process of Environmental Impact Assessment and the compilation of a detailed Environmental Impact Statement. Both are subject to appeal to ALAB.

Whilst the screening matrix considers the potential for impacts on the qualifying interests of adjacent Natura sites around outer Bantry Bay itself, it does not consider the qualifying interests of Natura sites further afield. It does not, therefore, consider the potential for impacts on birds which are SCIs of other SPAs, outside the bay, which have foraging ranges that give them potential

[105] https://www.agriculture.gov.ie/media/migration/seafood/aquacultureforeshoremanagement/aquaculturelicensing/appropriateassessments/ScreeningMatrixforAquaActBantryBay050618.pdf

connectivity to all aquaculture sites in the bay. Thus, of the six sites considered in this NIS, only one, parts of which lie within the bay area itself, are considered, that is the Beara Peninsula SPA 004155. However, for the Fulmar of the Beara Peninsula SPA, the text from the screening matrix quoted above concurs with the view expressed by Dr Tom Gittings in his February 2018 submission to ALAB under Section 47 and also with the Marine Institute's submission to ALAB under Section 47 of 27th February and 28th March 2018, namely that Northern Fulmar will have no interaction with or be negatively impacted by the presence of aquaculture sites in the bay. Further, if this applies to Fulmar SCIs in the Beara Peninsula SPA it is reasonable to conclude that it will apply equally to Fulmar SCIs from all five other SPAs considered in this document; see Table 4.4.

The Screening Matrix lists and maps the existing licences and licence applications in process at the time of its writing (May 2018). For surface-floating subtidal installations, as opposed to foreshore or intertidal installations, this includes the culture of the following species in outer Bantry Bay (numbers of sites / licences in parentheses); mussels (7), seaweed (2) and finfish (5). Additionally, applications were in process for the following sites; mussels (7), seaweed (5) and finfish (1). The locations and licence status of these sites at time of writing are shown in Figure 1 in the screening matrix document, which also gives an estimate of the total area of these installations (however, including foreshore installations) at 501ha, representing 1.15% of the surface area of outer Bantry Bay. The surface area calculation is not included in the document.

It should be noted that the matrix document does not consider aquaculture installations towards the head of the bay (Inner Bantry Bay), primarily east of Whiddy Island and including Glengarriff Harbour. These areas all accommodate considerable numbers of mussel longline sites and are shown in Figures 4.3 to 4.5, which may be within the foraging range of the subject foraging seabirds.

For the purposes of this NIS, the details of all licences, current and applied for, for all subtidal, floating sites in Bantry Bay, as listed on the DAFM website, have been examined and included in a new calculation of the total area of aquaculture sites in the entire bay. Table 4.1 shows the areas of the finfish farm sites in Bantry Bay to the limits of their site boundaries.

The total area of mussel longline sites reported on the DAFM website is 391.195ha, with currently licensed seaweed sites occupying 44.74ha. Thus, the total marine area of the bay occupied by subtidal, floating aquaculture in the entire bay is 556.305ha.

Thus, from Table 4.1, the proposed Shot Head site, measuring 42.50ha, would increase the current total area of licensed finfish farm sites in the bay, from 77.87ha to 120.37ha, an increase of 54.6%. This area would augment the total area of all aquaculture activity in all Bantry Bay by 7.6%.

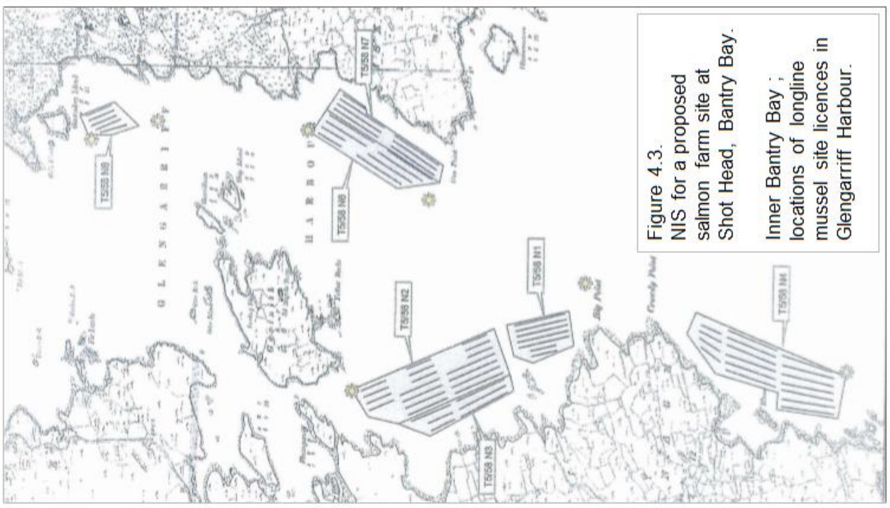


Figure 4.3. NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

Inner Bantry Bay ; locations of longline mussel site licences in Glengarriff Harbour.

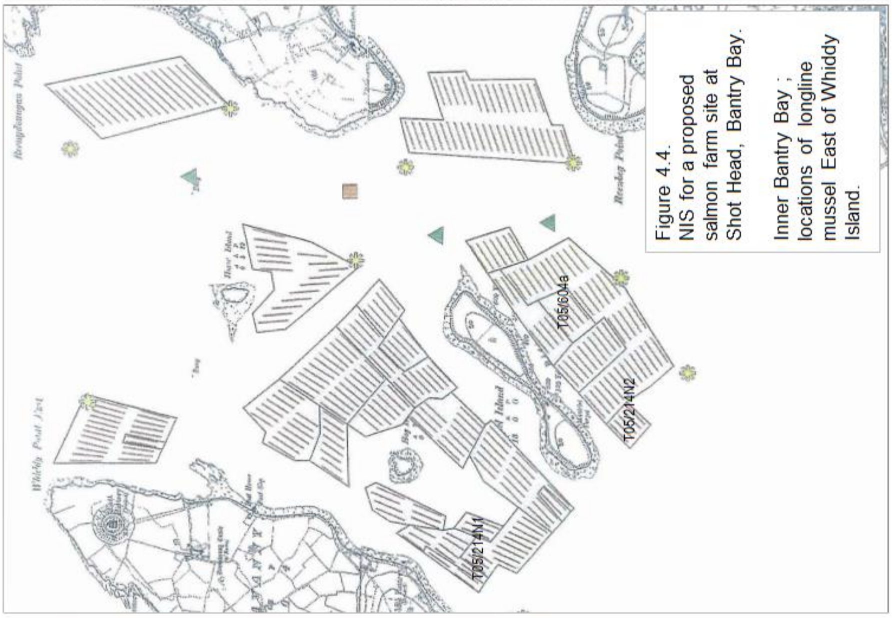


Figure 4.4. NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

Inner Bantry Bay ; locations of longline mussel East of Whiddy Island.

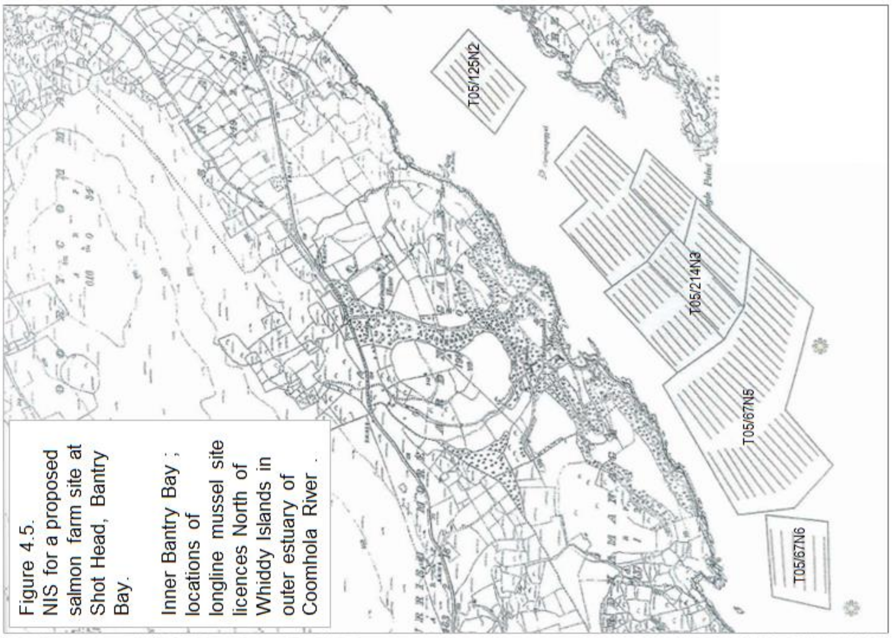


Figure 4.5. NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

Inner Bantry Bay ; locations of longline mussel site licences North of Whiddy Islands in outer estuary of Coomhola River .

Table 4.1.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Licensed site areas of finfish farm sites in Bantry Bay.

Site Name	Status	Approximate location	Licnece Number	Site area ha
CIFT Roancarraig	Licensed	West of Roancarraig Rocks	T05/128	36.27
CIFT Ahabeg	Licensed	South of Roancarrig Rocks	T05/444	16.6
CIFT Shot Head	Licence under appeal	East of Shot Head	T05/555	42.5
CIFT Waterfall	Licensed	Berehaven	T05/427/1	12
Murphy's Gearhies #1	Licensed	West of Gearhies	T05/122	6.8
Murphy's Gearhies #2	Licensed	East of Gearhies	T05/122a	6.2
Total site area finfish farm sites				120.37

The proportion of Bantry Bay's subtidal marine area occupied by aquaculture was then recalculated for the marine area of the bay, east of a line drawn between Sheep's Head and Dursey Head, to the head of the bay, as shown in Figure 4.6. This was recalculated because the origin and details of previous measurements were uncertain.

Figure 4.6.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Map for measurement of area of the subtidal marine area of Bantry Bay, east of a line between Dursey Head and Sheep's Head.
Measurement made using the Google Earth® area measurement tool.

Using these parameters, the subtidal area of the bay was calculated as 329km^2, or 32,900ha. On the basis of this measurement, See also Table 4.2:-

- The area of the Shot Head site (42.5ha) can be calculated as occupying 0.129% of the area of the bay.
- All finfish farm sites including Shot Head (120.37ha) occupy 0.367% of the area of the bay.
- All Bantry Bay aquaculture, including the Shot Head site and inner bay shellfish sites (556.305ha), would occupy 1.691% of the bay subtidal area.

4.3. Subject species foraging ranges, potential connectivity to Bantry Bay aquaculture sites and confirmation of degree of obstruction to foraging.

Additional measurements were taken to establish the accessibility of all aquaculture activity in Bantry Bay to foraging by the three subject species. This is most easily achieved by Fulmar resident in those sections of the Beara Peninsula SPA adjacent to the bay area itself, because it only involves straight-line, across-water flight, within the marine area of Bantry Bay alone, without the need to deviate to avoid land masses. Straight-line access will also be possible for Fulmar known to nest in small non-SPA colonies around the bay.

To indicate the foraging access available to these birds, measurements were taken from the mid-point of the western limit of Bantry Bay used for area calculation in Figure 4.6. This point is 29.3km from the centre point of the Shot Head site. A further measurement was taken from the same point to the limit of aquaculture installations at the head of the bay; this is the mussel longline site, licence number T05/125N2, which is located in the outer estuary of the Coomhola River, approximately 1.2km downstream of Snave Bridge; see Figure 4.5. This site lies 44.5km upstream of the bay entrance mid-point. Notional foraging range circles with their origins at the bay entrance mid-point were then drawn. Across-water foraging areas were then calculated from that point, by subtracting the land areas within each foraging circle from its total area; see Figure 4.7. From the measurements made using the Google Earth® measuring tool in Figures 4.6 and 4.7, Table 4.2 tabulates the marine foraging areas derived, along with the resulting percentages of foraging areas likely to be obstructed by the aquaculture installations in the bay. Table 4.3 again sets out Thaxter's foraging rangers for the three subject species, see also Table 3.1, whilst Table 4.4 lists the across-water distances from the limits of the 7 SPAs in the region within and immediately outside the limits of the bay, as described elsewhere in this report.

The following observations apply:-

- Even in the context of the bay area alone, the area taken up by aquaculture installations in Bantry Bay is extremely small, in the range of low 1000th's of the bay area.

- When viewed in the more realistic context of scaled notional marine foraging areas, rather than just the bay area itself, the obstruction of the bay surface area is reduced by a further order of magnitude.

- This can only lead to the conclusion that, whichever seabird species have the foraging ranges to access part or all of the bay area to feed, the level of obstruction caused, either by Shot Head alone, or by all finfish farm sites, or by all aquaculture activity combined, both the individual and cumulative obstruction and related impacts arising are so vanishingly small as to be of absolutely no consequence to the maintenance of normal foraging activities, in the overriding majority of the bay area, which is not obstructed.

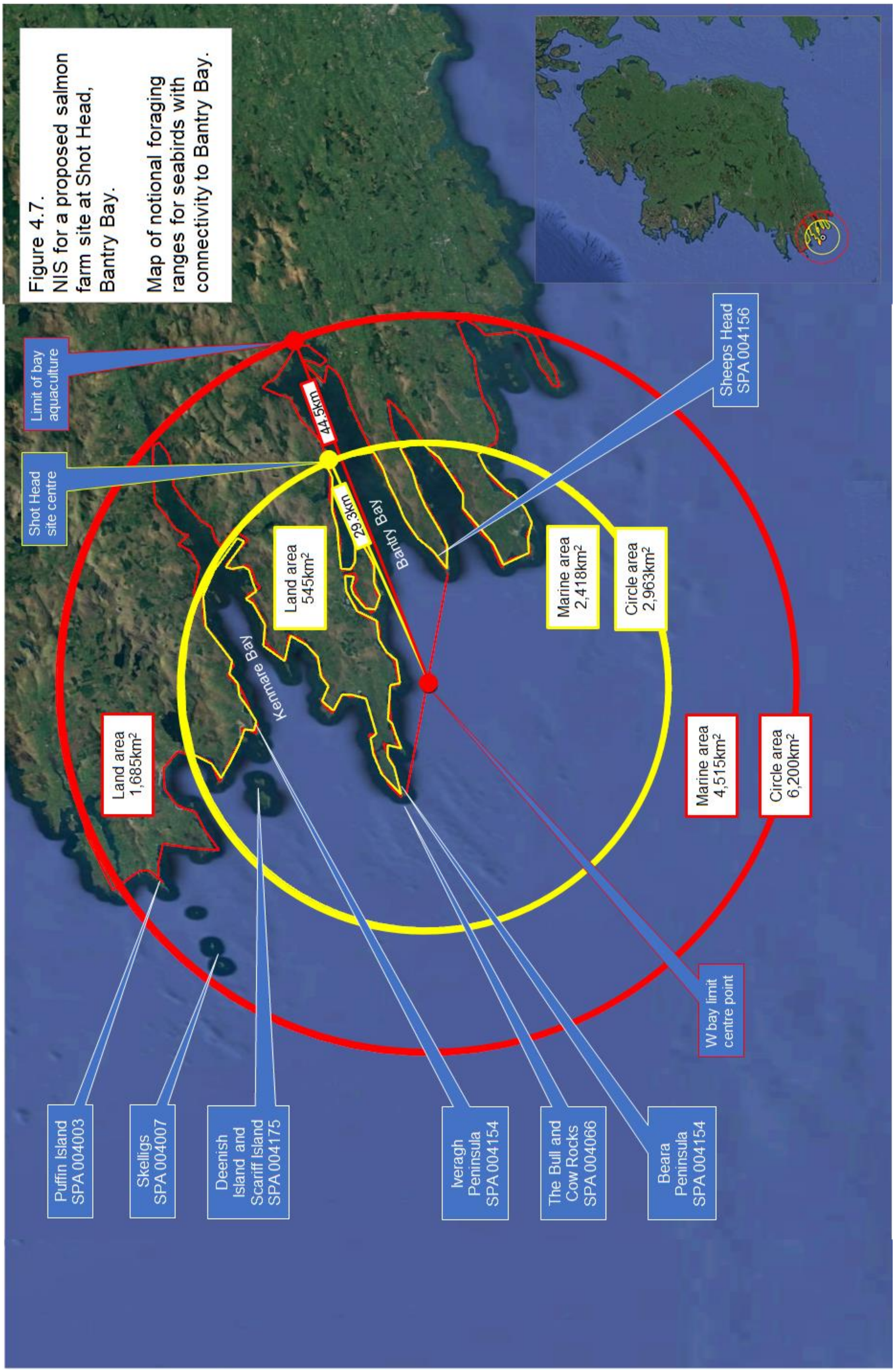


Figure 4.7.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.

Map of notional foraging ranges for seabirds with connectivity to Bantry Bay.

Table 4.2.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Bantry Bay area and notional foraging range circles; comparative data.

	Bantry Bay marine area only	Foraging circle area to Shot Head	Foraging circle area to Head of Bay	Shot Head site area ha	All finfish sites area ha	All aquaculture sites area ha
Radius km	-	29	44.5			
Total area ha	-	296,300	620,000	42.5	120.73	556.3
Land area ha	-	54,500	168,500			
Thus net marine area ha	32,900	241,800	451,500			
Shot Head as % of area	0.129	0.018	0.009			
All finfish sites as % of area	0.367	0.050	0.027			
All aquaculture sites as % of area	1.691	0.230	0.123			

Table 4.3.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Subject species foraging ranges (after Thaxter).

Bird species	Foraging range km		
	Mean	Mean max	Maximum
Northern Gannet *Morus bassanus*	92.5	229.4	590
Northern Fulmar *Fulmarus glacialis*	47.5	400	580
Commonm Guillemot *Uria aalge*	37.8	84.2	135

Table 4.4.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Measured across-water distances from local SPAs to Shot Head and to the head of Bantry Bay

Site	Number	Subject species	Across-water distance to the Shot Head site km		Across-water distance to the head of Bantry Bay km	
			Minimum km	Maximum km	Minimum km	Maximum km
Sheeps Head to Toe Head	SPA 004156	Fu	9.13	73.50	24.13	88.70
Beara Peninsula	SPA 004154	Fu	10.50	50.00	25.50	65.20
The Bull and Cow Rocks	SPA 004066	Fu Ga Gu	44.50	-	59.50	-
Deenish and Scariff Islands	SPA 004175	Fu	60.00	-	75.00	-
Iveragh Peninsula	SPA 004154	Fu Gu	63.00	106.00	78.00	121.20
Skelligs SPA	SPA 004007	Fu Ga Gu	68.00	-	83.00	-
Puffin Island	SPA 004003	Fu Gu	74.00	-	89.00	-

Further observations arise from the consideration of the data presented in Tables 4.3 (foraging ranges of subject species) and 4.4:-

- Northern Gannet is a SCI on two colonies offshore from Bantry Bay; see Table 4.4; these are the Bull and the Cow Rocks SPA and the Skelligs SPA. On the basis of the across-water flying distances given from each colony to both Shot Head and the head of the Bantry Bay, both lie well within Thaxter's mean foraging range for Gannet of 92.5km. Whilst foraging range may be modified by population pressure on an individual colony basis[106], [107], there is sufficient evidence, indicated by Wakefield's work, shown in Figure 3.3a for Gannet that, even for the small sample of birds tracked in this data, Gannets can and do penetrate the entirety of Bantry Bay and so are open to potential impacts from the entirety of the bay's aquaculture activity. However, given their likely marine foraging area (the total foraging circle, including land, for a foraging radius of 92.5km is 26,867km^2), the obstruction and related impacts likely to be presented by aquaculture in the bay will be far smaller than that calculated for the notional foraging circles described in Table 4.2.

- Gannets are a common sight, plunge-diving in Bantry Bay. However, they invariably dive, often in groups and clearly into shoals of fish, in the mid-channel of the bay. This is well-clear of all aquaculture activity, which is in the shoreward margins of the bay, generally in ≤25m of water.

- Common Guillemot are a SCI in four SPA colonies offshore from Bantry Bay; see Table 4.4. These are minimum across-water flying distances of between 44.5km and 74km from the Shot Head site and 59.5km and 89km from the head of the bay. However, one site, the Iveragh Peninsula SPA is extremely large and a known Guillemot colony within this site, at Dourus Point, is an across-water flight distance of approximately 96km from Shot Head and 111km from the head of the bay. Given a core foraging range of 37.8km, it may be unlikely that Guillemot from all these colonies will frequently access the locality of the Shot Head site, let alone the head of the bay, even though the foraging distances achieved by the Guillemot fitted with GPS loggers shown in Figure 3.10 would suggest that they can and do. In all events, Common Guillemots do frequent Bantry Bay, although those that do most likely originate from the nearest colonies, in particular from the colony within the Bull and Cow Rocks SPA, which lies only just outside the western limit of the Bay area and holds the second largest Guillemot colony in the locality.

- Northern Fulmar are a SCI on all six named local SPAs, including the nearest, parts of which are adjacent to the bay area itself , the Beara Peninsula SPA, as already stated. Fulmar have a core foraging range of 47.5 km and are therefore likely to have ready access to the entirety of the bay from at least three of the listed SPAs, if not more. However as with the other subject species, the obstruction impacts exerted by aquaculture activities in the bay will be extremely small.

[106] Lewis S et al 2001. Evidence of intra-specific competition for food in a pelagic seabird Nature 412 816-819.

[107] Grecian WJ et al 2012. A novel projection technique to identify important at-sea areas for seabird conservation: An example using Northern gannets breeding in the North East Atlantic. Biol Cons 2012 in press.

4.4. Relative impact potential to seabirds of finfish pen and longline shellfish installations in Bantry Bay.

4.4.1 Spatial impact

This is fully considered in Section 4.3, which concludes that both finfish sites and longline mussel and seaweed sites in Bantry Bay are equally obstructive to the activities of foraging seabirds. Section 4.3 also concludes that the proportion of the Bantry Bay marine area and of the notional circular foraging areas provided, that is obstructed by aquaculture is no more than in the low thousandths of the total areas calculated. For the Bantry Bay marine area alone, the obstructed area leaves a minimum of 99.87% of the bay marine area unobstructed if the proposed Shot Head site is considered in isolation and 98.31% of the bay area unobstructed if the cumulative obstructive impact of all aquaculture in the bay is taken into account.

It is therefore concluded that there are no material obstruction consequences for any of the three subject species arising from the Shot Head site in isolation, or cumulatively, from all floating aquaculture installations in Bantry Bay combined

4.4.2. Attraction and depredation.

The small number of literature contributions that exist suggest that finfish sites may act as attractant devices for seabirds[108], [109], [110], [111]. However, these papers are all between 12 and 30 years old. The NCC report concerns the entrapment of Gannets in the first Bridgestone pens to be installed in Ireland, over 30 years ago. These were protected only with twine stretched across the pens to act as a "bird defence" Plunge-diving Gannets could become entangled when trying to exit through the twine. There are also a number of anecdotal reports, dating back 40 years, of gulls plundering salmon pens immediately following smolt input, prior to bird net installation. References 87 and 88 refer to finfish systems in the Mediterranean that, historically, were unlikely to be adequately protected and were operated with poor food and feeding security. Experience with these units does not adequately represent the realities of current best practice salmon farming.

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108 NCC (1989). Fish Farming and the Safeguard of the Natural Marine Environment of Scotland. Nature Conservancy Council, Edinburgh.

87 Dempster T et al. 2002. Attraction of wild fish to sea-cage fish farms in the south-western Mediterranean Sea: spatial and short-term temporal variability. Marine Ecology Progress Series, 242, 237-252.

88 Sanchez-Jerez P et al. 2007. Ecological relationship between wild fish populations and Mediterranean aquaculture in floating fish cages. Impact of mariculture on coastal ecosystems (ed CIESM), pp. 21-24.

111 Carss, D.N. (1994). Killing of piscivorous birds at Scottish fin fish farms, 1984-1987. Biological Conservation, 68, 181-188.

It is fully accepted that, in the early days of the fin fish farming industry's learning curve, if and when bird defences were inadequate, depredation by seabirds brought risks of entanglement and worse. However, seabirds are long-lived, intelligent and opportunistic. They are known to memorise good, relative to bad, foraging spots and to recognise active trawlers from distance. Equally, they become rapidly habituated to any readily and easily accessible food source. For the obvious commercial reason of protection of stocks, finfish systems are now heavily protected against all attempts at depredation of their stock in trade and there is no doubt that the measures employed act together to mitigate all interactions with potential predators. Just as seabirds recognise and habituate to new food sources anywhere, be they natural or anthropogenic, they also recognise and habituate to non-availability. From a salmon farm operative's perspective, it is a recognised fact that seabird really are not seen in the immediate vicinity of modern salmon farm sites, unless to perch or roost and even this is not a habit of the three subject species, due to their anatomy and natural posture. This is in stark contrast to their aerial activity around active fishing vessels, as seen in a recent Prime Time presentation; see Figure 4.6.

The measures employed include management of stocking densities, and accurate feed management, which both act to reduce seabed and water column impacts and lead to improved security of farm sites. Computer controlled feed management and appropriate current regime also mitigate against the dispersal of waste feed through the pen meshes that can attract wild fish to the pens, which, in turn can attract seabirds. As a result, foraging species have no access at all to feed above or below the water surface, due to the storage of feed only on feed barges, secure feed distribution to the pens and surface-distribution of feed (to mitigate the effects of wind on feed application), all under the protection of bird nets. Pen specifications now provide no means of access to the fish stock for any wildlife, by the use of appropriate mesh sizes for bird nets, which are supported well clear of water level. Additional protection is provided at the fence net, between the bird net and the submerged net pen. All pen meshes are extremely durable and strong and are regularly checked and maintained, above water by crew and underwater by divers, as part of the routine surveillance of site security.

The latest development in bird net design, now used by CIFT on a number of its sites and due to be used at Shot Head if the licence is upheld by ALAB, is shown in Figure 4.7. It will be noted that there are no seabirds visible in this picture, in contrast to Figure 4.6.

The opinion expressed at site level is that such lack of access to food sources at sites is also something that marine bird and mammal wildlife have also become habituated to. Most importantly, once habituated,

Figure 4.6.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Northern Gannets plunge-diving at the bow of an Irish fishing vessel, on fish running ahead of the trawl, as it is winched in. There are over 20 birds in this frame.
Source RTE Prime Time 15th October 2019.

Figure 4.7.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Bird net of 6cm mesh supported, on 5m pole net supports.

Any urge to attempt pen entry or predation is negated. Equally, for the majority of the salmon farm production cycle, farmed fish are too large for depredation by most seabirds, including the three subject species. The largest fish taken by any of them, the Gannet, is approximately 300mm whereas some smolt are almost this length at input and grow rapidly from that point on.

Of the three subject species, only Gannet plunge dive to access food. Guillemot dive deeper than Gannet but do so by swimming down from the water surface, whilst Fulmar are surface feeders.

On this basis it is concluded that no harmful impacts to the three subject seabird species will arise due to their attraction to the Shot Head site alone. Longline sites may show floral and faunal growth on the buoys supporting the longlines which may attract grazing water birds, but these do not congregate in significant numbers. Seabirds, which are cumbersome on such surfaces, do not graze in this way. It is therefore concluded that there is no likelihood of cumulative impacts on the subject species from all aquaculture activity in Bantry Bay, combined.

4.4.3. Lighting

Lights are no longer used to increase feeding duration on modern marine salmon farms in Ireland. The only lighting anywhere on the system is required in law for navigational purposes at the corners of the site area (navigational buoys) and at the pen limits (winkies). Navigational markers are common, both to all aquaculture sites but also as part of standard navigational and fisheries infrastructure in all Irish waters. None of these provide constant light but intermittent, flashing light. Therefore, they do not prove to be an attraction for seabirds There is no experience on the Bantry Bay sites or elsewhere in the company of birds colliding with, or for that matter, being attracted to navigational lighting.

Gannet and Guillemot are not normally night feeders or flyers. Fulmar do feed at night, but this is generally offshore, for plankton, in surface waters; see Section 3.4.

Longline sites are equipped with similar navigational lights, under their licence terms. From the above observations, it is concluded that neither the Shot Head site in isolation, nor in combination with all other aquaculture in Bantry Bay will cause individual harmful impacts or cumulative impacts on the three named seabird species.

4.4.4. Other disturbance

There is little evidence that the three subject species are likely to be prone to anthropogenic disturbance impacts from the Shot Head site. The site is large, and activity is constant and relatively low key, even during harvest. Noise levels, for example from the feed barge, are low due to insulation and rapidly attenuate across water. The patter of feed as it is distributed by the spread plate in each pen is relatively constant and of low register across the site. The work vessels that are used to operate the site, some of which are quite large, are really no different from the trawlers and other vessels that travel in and out of Castletownbere Port 24 hours a day. Regular vessel traffic in Bantry Bay includes the oil tankers that enter the bay more or less weekly, en route to the Whiddy terminal. Cruise Liners also enter the bay, as far as Glengarriff in season; see EIS Volume 1. It is evident that all three subject species are long habituated to the maritime comings and goings of humans and fishery and other maritime traffic in Bantry Bay and indeed will take any opportunity to interact with it in the search for food.

It is concluded that activity and noise around the proposed Shot Head site in isolation is at such a low level that it will not cause disruptive impacts to the three subject species.

Longline sites use smaller vessels than finfish farms during the harvesting process but are otherwise subject to little human activity. On this basis it is regarded as highly unlikely that cumulative disruptive impacts will be any greater than the impacts of the Shot Head site in isolation, particularly bearing in mind the extremely small footprint of aquaculture in the bay, relative to the bay area, and subject species foraging areas as a whole.

4.4.5. Other evidence of use of mitigation measures.

In an Impact Assessment of Aquaculture on Seabird Communities off the coast of Western Australia[112], a potential range of impacts on seabirds from colonies on the Abrolhos Islands were considered as a precursor to the installation and operation of sites. In a risk assessment conducted for each bird species considered, the following mitigation measures were proposed to address the impact risks considered:-

- Fish fed dry, pelletised food (preferable to whole, wet fish).
- Sub-surface, slow release feeders.
- Feed rate controlled to reduce feed waste drift from the pens.
- Current speeds not sufficient to allow lateral export of feed through the pen meshes.
- Dead fish removed from nets.
- Appropriate bird netting mesh size(6cm) covering entire pen.
- Regular net checks and maintenance.
- Bird net maintenance including correct net tension.
- Design of railings, floats, net rings to reduce roosting sites.
- Use of visual bird deterrents (model hawks/owls).

112 Surman C et al 2015. Impact Assessment of aquaculture on seabird communities of the Abrolhos Islands. www.fish.wa.gov.au › other › public_comment › appendix_1d_-_seabirds_eia

It is observed that, with the exception of the use of visual bird deterrents, which have been found to be unnecessary (due to habituation), all other mitigations proposed are incorporated routinely into all CIFT marine installations on the basis of current best practice. With these measures in place, it has proved unnecessary to use any other deterrent methods, such as visual or audible deterrents, due to the habituation of seabirds to the non-availability of feeding opportunities at the sites.

4.4.6. Empirical evidence.

A wide range of Sustainability Indicators are collected and collated annually from member salmon farming companies worldwide under the auspices of the Global Salmon Initiative[113]. Mowi Ireland has been a member of GSI since 2015. One of the many Sustainability Indices monitored is for seabird mortalities. The results of the indices for bird interactions on Mowi Ireland sites, which can be found on the Mowi Ireland page of the GSI website, are given in Table 4.5.

Table 4.5.
NIS for a proposed salmon farm site at Shot Head, Bantry Bay.
Global Salmon Initiative (GSI) Sustainability Index for Mowi Ireland sites for seabirds (= seabird mortalities / operational sites pa).

Year	GSI Seabird Sustainability Index	
	Accidental	Intentional
2018	0.20	0.00
2017	0.11	0.00
2016	0.00	0.00
2015	0.00	0.00

The 2018 index represents the accidental loss of a total of two seabirds across ten operating sites in 2018 and one seabird across nine operating sites in 2017. These mortalities were all herring gulls.

The American NGO Monterey Bay Aquarium (MBA), which is privately funded and campaigns on environmental and sustainability matters, is widely regarded as the "rules police" of the global aquaculture and agriculture industries. Amongst many other reports, MBA has compiled three lengthy reports on the aquaculture industries of Norway[114], Scotland[115] and the Faroes[116]. MBA reviews and accepts the

113 https://globalsalmoninitiative.org/en/sustainability-report/sustainability-indicators/

114 Monterey Bay Aquarium 2018 Seafood Watch; Norway. Atlantic Salmon Norway Marine Net Pens.

115 Monterey Bay Aquarium 2018 Seafood Watch; Scotland. Atlantic Salmon Norway Marine Net Pens

116 Monterey Bay Aquarium 2018 Seafood Watch; Faroes Atlantic Salmon Norway Marine Net Pens

Sustainability Indicators provided for birds by GSI in each of these reports and regards then as totally acceptable. Unfortunately, there is no MBA report for Ireland's salmon farming industry, presumably because it is too small. However, since the Irish indices for seabirds fall within the range of those that MBA has reviewed, there can be no doubt that they would take the same view.

Section 5.
Discussion and Conclusions.

The three named SCI seabird species and the six named SPA sites to be considered in this NIS were selected for consideration through the Stage 1 Screening Assessment process. The general characteristics of the six SPAs are summarised in Section 2.7, whilst their locations, SCI status data and straight line and over-water distances from the proposed CIFT salmon farm site at Shot Head are set out in Table 2.9 and mapped in Figure 2.28; see also Table 4.4

The three species for consideration are the Northern Gannet *Morus bassanus*, the Common Guillemot *Uria aalge* and the Northern Fulmar, *Fulmarus glacialis*. Their biology, behaviour and global and Irish status and distribution are all fully described in Section 3.

From Table 2.9 it is worthy of note that Northern Fulmar breed on all six named SPA sites, including four with populations of National and one of Regional Importance. Common Guillemot are SCIs for four of the sites, two of which accommodate Nationally Important and one a Regionally Important population, whilst the Gannet is an SCI of two of the sites, one of International Importance, being one of the largest colonies globally and the other, nearby, being of National Importance. Clearly this cluster of SPAs off the west coast of Cork and Kerry is one of the most important in the country, individually and severally deserving of maximum protection.

The question to be addressed, although nowhere specifically qualified by the use of the word "significant" in the Stage 1 Screening Assessment that prompted the call for this NIS, is whether salmon farming in general, or specifically in the case of the proposed CIFT salmon farm site in Bantry Bay could generate significant negative impacts on the status of the three named foraging seabird species, or their designated breeding sites.

There are two means through which such potential impacts may have effect. The first is any means by which sufficient levels of any potential impactor might be capable of reaching the named SPA breeding sites and their SCI inhabitants in situ. The Guidelines quoted in this document advise that Natura sites up to 15km distant should normally be screened for such far-field effects. The second is restricted to foraging or voyaging species, such as the three seabird species named, which have the potential to be negatively affected by impacts close to the impact source, on voyaging to the specific locations where such impacts might be localised. The former is considered in Section 2, whilst Sections 3 and 4 of this document are largely concerned with evidence for potential impacts on the three named foraging seabirds, individually, both globally and in the locality of the Shot Head site itself, both in isolation and in or combination with other aquaculture in Bantry Bay.

The 2016 RPS WQ Report submitted to ALAB uses a hydrodynamic model and waste discharge data provided by CIFT and Watermark to model the dispersal of standard organic waste parameters, Dissolved Inorganic Nitrogen (DIN), Dissolved Inorganic Phosphorus (DIP), Biochemical Oxidation Demand (BOD) and Solids (SS) from the Shot Head site and assesses their impact of existing ambient conditions with distance from the site as they dilute and disperse in the tidal currents. An eight-stage worst-case scenario is used in the modelling procedure to provide a wide margin of safety in the modelled outcomes. Outcomes are assessed against the published Conservation Objectives for the six sites.

The study finds that, in the case of DIN, typical mean Spring mid-flood and mid-ebb tide concentration plumes, from just Shot Head or from all salmon farm sites in Bantry Bay combined, do not breach the EQS at any point and elevation of ambient DIN levels are close to zero within 2-3km of the Shot Head site in all directions. Similar plots for DIP suggest much lower elevations overall than for DIN; in this case the EQS for DIP is not even approached, even at the source in the Statistical Maximum Plume Plot. For BOD, whilst there is no EQS for BOD in Coastal waters, the elevated ambient conditions resulting from BOD discharges remain far lower than the BOD EQS for Transitional waters and the result of peak BOD discharges on oceanic influx of ambient oxygen into Bantry Bay is a reduction of no greater than 1%, such that mean ambient DO in the bay is barely affected. Again, the elevation of BOD is effectively zero within 2-3km of the Shot Head site. Finally, settled solids loadings are restricted to the locality of a seabed area under each farm site in all cases and the EQS that applies to solids settlement is not beached. A hypothetical worst-case model shows that deposition of the peak monthly solids discharge every month for one year results in a deposition of just 13mm of settled solids on the seabed under the site.

The six named SPAs lie a minimum over-water distance (the route taken by dispersing discharges in the water column or on the seabed) of between 10.5km and 74km. Bearing in mind the rapid dilution of all organic waste parameters tested, it is submitted that no impacts will arise at any of the six SPAs named, or impact on their inhabitants, such that there Conservation Objectives will be fully met, the that the status and extent of their habitats and the status of their SCI (and other) bird populations will be maintained. It is also observed that the seaward margins of the closest site, the Beara Peninsula SPA 004155, is at the high water mark, and the site has effectively no marine habitat. Consequently, no far-field waterborne impacts, were they to exist, could impact on habitats and SCIs of this site..

It is also noted that whilst the worst case created includes waterborne discharges of DIN, DIP, BOD and SS, from all sites in the bay, in order to track their dispersal patterns, the discharges from the existing sites in the bay, including those closest to the SPAs, have been making their contributions to ambient parameter concentrations in the bay for many years, being some 40 years in the case of the Roancarrig site. During this period, seabird populations in the aera have not been known to decrease and, in the case of the large Gannet colonies on the Bull and Cow SPA 004066 and the Skellig Islands SPA 004007, they have continued to grow continually and considerably in numbers over the entire recording period, as Section 3 demonstrates.

Thus, in conclusion, no far-field impacts are expected to arise from the operation of any existing or proposed salmon farm sites in Bantry Bay on any of the six named SPAs or their seabird SCIs.

As referred to elsewhere in this document, whilst apparently all other classes of impacts on seabirds are extensively and deeply considered and reported upon in the scientific, government, professional / consultancy, NGO, environmental and anti-group lobbyist literature, there is a contrasting dearth of scientific and referenced information on the spatial and disturbance impacts of both finfish and longline marine farming systems on seabirds.

Amongst the classes of impacts that are described in the literature, sources range from those caused by:-

- Organic pollution.
- Disturbance and exploitation or eggs, just pre-fledged chicks and adults for human food.
- Human disturbance of colonies by bird tourism.
- Overfishing.
- Fishery bycatch and fishery waste.
- Trawling, netting and longlining, where impacts include hooking, drowning, net entanglement trapping and injury; estimated death toll 320,000 seabirds pa).
- Driftnetting for wild salmon, estimated to cause 90,000 bird deaths pa in Northern Norwegian waters alone prior to almost universal banning of the practice.
- Marine renewables installations, from windfarms to waster-based, wave and current operated renewable energy devices, leading to flight path obstruction (in particular gannets) and foraging ground obstruction.

- Oil spillage from oil tankers and oil fields, including the sinking of the Betelgeuse at Whiddy Island, Bantry Bay on 8th January 1979 and the wrecking of the Kowloon Bridge off Casltetownsend County Cork on December 5th, 1986. Trauma, injury and death due to both oil and detergents.

- Severe weather, to which Auks, including Common Guillemot are particularly prone (storm wrecks). Severity and frequency increasing due to climate change

- Plastic ingestion and plastic use in nesting, sourced from marine litter, with the risk of entanglement, blockage, choking and poisoning.

- Climate change and consequent migration of important feed resources for birds, incusing plankton and planktotrophic fish species (in the last decade but ongoing).

- Poisoning due to apex predator poison accumulation from food sources.

- Predation, mainly for eggs and chicks, by birds (gulls, white-tailed eagle etc) and both invasive, naturally resident and feral mammals, such as foxes, mink, mice and rats.

Additionally, what little information there is on interactions with marine farming, is quite old and therefore considers aquaculture systems, in particular for marine finfish farming, that have become outdated in the industry's rapid technical development over the last forty years. For Ireland itself, it is also noticeable that impacts of marine farming on seabirds is not a topic that has attracted the attention of the main NGOs, notably Birdwatch Ireland, who have been very active in recent years in campaigning for the reform of the capture fishery sector, and An Taisce.

In order to track down information on impacts on birds, Section 3 of this document individually investigates the proximity of the colonies and foraging ranges for the three subject species, to the densest assemblages of aquaculture activity in Europe, if not the world, on the Scottish West Coast and along the Norwegian coastline. This work concludes that there is little difference in the status of colonies or foraging densities for all three species between those close to dense aquaculture activity and those far removed from it. As a prime example, all gannet colonies globally and their global population has grown continually for at least six decades. In individual cases in Norway, a process of colonisation, colony extinction and recolonisation has occurred at a small number of locations. However, this is readily explained in the literature as being the result of disturbance and predation by White-tailed Eagle. Even in this case the majority of the displaced birds have moved onto new colonies and the overall population has not diminished.

Sea bird population data is collected and collated between UK and Ireland on an approximate 15 to 20-year cycle. The most recent data, from the Sea Monitoring Project (SMP) of 2014-15 is yet to be published and the majority of the data is not yet available. However, recent data for all subject three species that has been made available under a data request to NPWS shows that the national Irish populations of Northern Gannet, Common Guillemot and Northern Fulmar have increased since the last survey, Seabird 2000.

There is a clear absence of information from any source on interactions between the subject seabird species (and all other seabird species) and aquaculture. It is respectfully submitted that is most likely to be due to lack of evidence and that the only reasonable conclusion to this NIS is that there are no known significant impacts on the subject seabird species. This is primarily as a result of the mitigating measures incorporated into current best practice in salmon farming as operated by CIFT.

This NIS therefore concludes that no far-field or near field impacts are expected to arise, either from the proposed CIFT Shot Head site in isolation, or in combination with any other current floating aquaculture operations in Bantry Bay.

Section 6.
Bibliography of technical literature reviewed in the compilation of this NIS.

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Appendix 1.

Screening Matrix for Aquaculture activities, in outer Bantry Bay, County Cork.

Bantry Bay Screening

Screening Matrix for Aquaculture activities in outer Bantry Bay, Co. Cork	
Brief description of the project or plan	There are currently 23 licenced aquaculture operations in outer Bantry Bay with a further 28 applications. The following species are cultured in outer Bantry Bay (number of licences in parenthesis) - oysters (6) clams (1) abalone (2), mussels (7), seaweed (2) and finfish (5). Additionally, applications have been received for the following species - oysters (8), scallops (5), clams (1), sea urchins (1), mussels (7), seaweed (5) and finfish (1). The locations of the sites (and licence status) are shown in Figure 1.

Brief description of the Natura 2000 sites	Bantry Bay is approximately 39km long and ranges in width from 3km at the eastern end to 22km at the mouth. The area of outer Bantry Bay in question is not located within any Natura 2000 sites. However, - it is bordered by two SACs, the Sheeps Head cSAC and the Glengarriff Harbour and Woodland SAC and two SPAs, Beara Peninsula SPA and Sheeps Head to Toe Head SPA (see Figure 2). ***Adjacent Sites:*** **Sheep's Head SAC (Site code: 000102)** is located on the southern approaches to Bantry Bay, extends to Three Castle Head and Mizen Head to the south. It is a narrow ridge of sandstone which encloses a number of rectangular basins filled either by peat bogs or lakes. The main value of the area is the presence of the terrestrial features, dry heath and wet heath, habitats listed on Annex II of the EU Habitats Directive. In addition, Annex I Birds Directive species, the Chough, and an Annex II species under the Habitats Directive, the Kerry Slug, are found in the area. **The Glengarriff Harbour and Woodland SAC (Site Code 00090)** consists of a glacial valley opening out into a sheltered bay with rocky islets. The site supports populations of the Kerry Slug (*Geomalacus maculosus*), the freshwater Pearl Mussel (*Margaritifera margaritifera*) as well as the largest colony of Common Seals (*Phoca vitulina*) in the south-west of Ireland, all of which are listed on Annex II of the Habitats Directive. **Beara Peninsula SPA (Site Code: 004155)** is a coastal site parts of which border the northern shore of Bantry Bay.The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for Chough and Fulmar. In addition the presence of Peregrine falcon is of particular significance. **Sheeps Head to Toe Head SPA (Site Code: 004156)** large site situated on the south-west coast of Co. Cork. Adjacent Bantry Bay the site includes sea cliffs, the land adjacent to the cliff edge and is one of the most important sites in the country for Chough. The presence of Peregrine falcon is of particular significance.

Bantry Bay Screening

	Caha Mountains SAC (Site Code: 00093) Is an inland SAC site with a number of freshwater aquatic, terrestrial and plant and animal species of conservation interest. **Glanmore Bog SAC (Site Code: 01879).** Is an inland SAC with a number of aquatic freshwater habitats and species of conservation interest, including the pearl mussel (*Margaritifera margaritifera*) in the Owenagappul system.

Assessment criteria	
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.	Oysters, clams, abalone, urchins, scallop, mussels and finfish are cultured in Bantry Bay. In addition, there are applications to culture macroalgae. Oyster culture is carried out using bags and trestles in the intertidal zone. The trestles are arranged in rows along the shore to maximise water movement over the oysters in the bags. Intertidal clam culture is carried out on mud and sand flats by placing the smaller seed clams in boxes of sediment and covered by mesh. As they grow the clams are spread directly into the sediment and covered by netting to prevent predation. Abalone and urchins are cultured in tanks on land or in cage structures in the lower intertidal and subtidal areas. They are contained at all times. The mussels are cultured using longlines. A long-line supported by a series of small floats joined by a cable or chain and anchored at the bottom on both ends is employed. Mussel spat (ssed) is collected on ropes or strings (droppers) are suspended on the line. From each of the lines there are a number of dropper lines (up to 5m in length). The depth of the droppers, which is directly related to the quantity of mussels being cultured, is dependant upon a number of factors including water depth, the floatation provided and the carrying capacity of the system. Scallops are culture intensively (bags suspended from longlines) and extensively (spread on the seafloor and harvest via dredging and/or diving). Finfish are contained in floating cage structures arranged in a grid system, which are secured to the seabed via ropes attached to anchors. Finfish are imputed into the cages as smolts and following a period of 18-24 months are harvested. Seaweed is cultured using longlines supported by floating structures similar to those used for mussel culture.

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Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with other plans or projects) on the Natura 2000 site by virtue of:	
size and scale;	There are no direct or indirect impacts from the culture operations on any of the SACs or SPAs adjacent to outer Bantry Bay.
Distance from the Natura 2000 site or key features of the site:	The activities in question occur within outer Bantry Bay the mouth of which is adjacent to the Sheeps Head cSAC, the Glengarriff Harbour and Woodland SAC, the Beara Peninsula SPA and Sheep's Head to Toe Head SPA. There are two inland SACs (Caha Mountains SAC and Glanmore Bog SAC) the conservation features of which, do not come into contact with Bantry Bay or likely interact with any of the aquaculture activities found therein (see Figure 2).
Resource requirements (water abstraction etc.):	Cultured bivalves (oysters, clams, scallops and mussels) are filter feeders and they feed upon suspended particulate matter. They selectively ingest phytoplankton and other organic material (e.g. small zooplankton and bacteria) and dispose of inorganic and larger organic matter in pseudofeces, which is excreted into the water column. Typically the fecal and pseudofecal pellets will fall to the sea floor and may cause localised organic enrichment and/or sedimentation. The level of enrichment is a function of, *inter alia*, water depth current speed, density of culture, the quantity of suspended particulate matter in the water column, or a combination of these. The shellfish production activities do not use any resources required by the qualifying features within the Natura 2000 sites. Abalone and urchin culture are carried out in contained systems and rely on the input of feed (usually seaweed sourced locally). The production of these shellfish species does not use any resources required by the qualifying features within the Natura 2000 sites Finfish culture differs from shellfish culture in that there is an input of feed into the system and as a consequence a net input of organic matter to the system. This material will be found in the system in the form of waste feed (on the seafloor), solid waste (faeces), waste as a consequence of net-cleaning all of which usually accumulates on the seafloor and dissolved material (predominantly fractions rich in nitrogen). For the most part, the majority of organic material builds up on the seabed generally in and around the footprint of the salmon cages with a 'halo' effect evident in areas where dispersion occurs driven by local hydrographic conditions. This is typically referred to as *near-field* effects. Similar to shellfish, the quantity of material that might accumulate on the seabed will be a function of the quantity of fish held in cages, the stage of culture, the health of the fish (unhealthy fish will generally

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	eat less), husbandry practices (are the fish fed too much too quickly?), the physical characteristic of the solid particles and surrounding hydrographic conditions. The production of finfish does not use any resources required by the qualifying features within the Natura 2000 sites The culture of seaweed is reliant upon ambient nutrient levels in the water column and solar Illumination. The production of seaweed does not use any resources required by the qualifying features of adjacent Natura sites.
Emissions (disposal to land, water or air):	There will be no direct or indirect effects on the adjacent Natura 2000 site.
Excavation requirements:	There are no excavation or similar activities associated with the aquaculture activity
Transportation requirements:	The produced aquaculture products are transported offsite by lorry using the existing national road network with no impact on the adjoining Natura 2000 sites.
Duration of construction, operation, decommissioning:	None
Other:	None

Describe any likely changes to the site arising as a result of:	
Reduction of habitat area:	There is no reduction in habitat area within any of the Natura 2000 sites considered arising from the shellfish production activities.
Disturbance to key species:	There is no evidence in the scientific literature to suggest that aquaculture activities impact on seal species (Feature of Glengarrif Harbour and Woodlands SAC) and the bird species listed in the SPAs, i.e., Chough, Fulmar and Peregrine. Furthermore, any impacts on habitats are likely to be local and not extend beyond the footprint of the activities. Therefore they are not likely to impact on any of the adjacent SACs.
Habitat or species fragmentation:	There is no habitat or species fragmentation within the Natura 2000 sites arising from the aquaculture production activities.
Reduction in species density:	There is no reduction in species density within the Natura 2000 sites arising from the shellfish production activities.
Changes in key indicators of conservation value (water quality):	There are no changes in key indicators of conservation value within the Natura 2000 sites arising from the shellfish production activities.
Climate change:	Given the nature and scale of the aquaculture production activities the contribution to climate change is considered insignificant.

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Describe any likely impacts on the Natura 2000 site as a whole in term of;	
Interference with the key relationships that define the structure of the site:	None of the activities associated with the shellfish and finfish production in outer Bantry Bay will interfere with the key relationships that define the structure of the adjacent Natura 2000 sites.
Provide indicators of significance as a result of the identification of effects set out above in terms of:	None identified
None identified:	None identified
Fragmentation:	None identified
Disruption:	None identified
Disturbance:	None identified
Change to key elements of the site (e.g. water quality etc..):	None identified

Describe from the above those elements of the project or plan, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts is not known.	None identified

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Finding of no significance effect report:	
Name of project or plan:	Aquaculture activities in outer Bantry Bay, Co. Cork.
Name and location of Natura 2000 site It would be helpful for a map or plan to be provided:	The Sheeps Head cSAC, the Glengarriff Harbour and Woodland SAC, the Beara Peninsula SPA and the Sheeps Head to Toe Head SPA, Caha Mountains SAC and Glanmore Bog SAC. (Figure 2).
Description of the project or plan	The plan is to licence the shellfish and fishfish culture activity in Bantry Bay, Co. Cork. The activities in question cover approx. 501 ha. in total, representing approximately 1.1% of the surface area of Bantry Bay.
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 or plan being assessed could affect the site (provide details)?	No.
Describe how the project or plan (alone or in combination) is likely to affect the Natura 2000 site.	The cultivation of shellfish, finfish and macroalgae in outer Bantry Bay is not likely to affect the conservation features of adjoining Natura 2000 sites.
Explain why these effects are not considered significant.	There is no spatial overlap of the aquaculture activities with Natura sites. In addition, there would be no interference with key relationships that define the function of the sites. The culture activities will not result in habitat loss, there will not be significant disturbance to key species and there will be no habitat or species fragmentation. There will be no direct discharge of pollutants into the environment during the works and water quality will not be affected. Consequently, it is concluded that the culture of shellfish and finfish, as it is currently constituted and proposed, in Bantry Bay does not pose significant risk to the conservation features of the adjacent sites and as such does not require a full appropriate assessment. On the basis of the above it is considered that there will be **no significant effects** on the qualifying interests' of the Natura 2000 sites.
Who carried out the assessment?	Marine Institute

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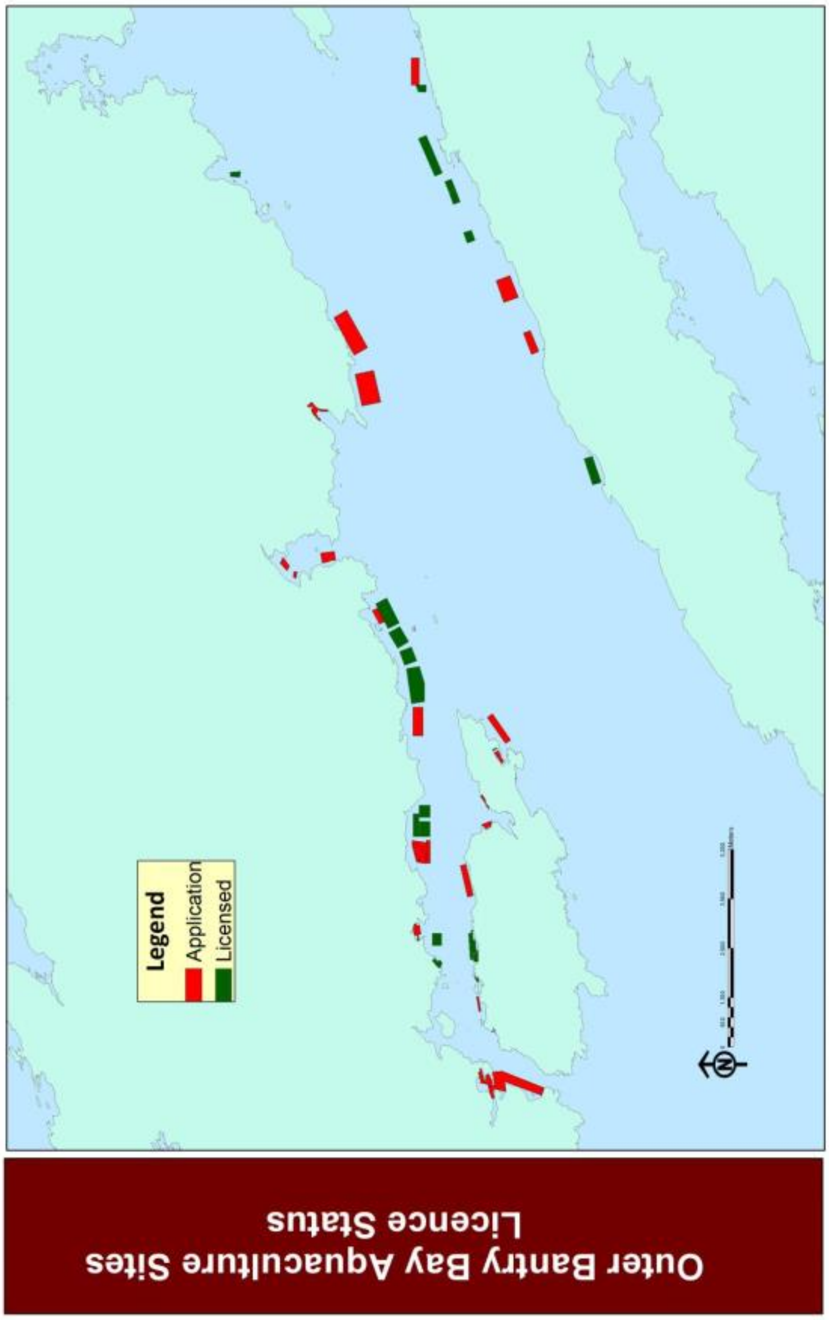
Figure 1. Aquaculture site status within the region of Outer Bantry Bay, Co. Cork.



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Bantry Bay Screening

Figure 2. Aquaculture activities and Natura Sites within the region of Outer Bantry Bay, Co. Cork.