Review and Renewal of Marine Finfish Aquaculture Licences at Clifden Bay, Mannin Bay and Ardbear Bay, Co. Galway.

Site Refs: T09/127A, T09/140A, T09/96B

Screening for Appropriate Assessment and Natura Impact Statement

Volume 1 – Main Report

Produced by

AQUAFACT – APEM Group

On behalf of

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Table of Contents

1. INTRODUCTION 1
1.1. OVERVIEW 1
1.2. REQUIREMENT FOR APPROPRIATE ASSESSMENT 4
1.3. PURPOSE OF THIS REPORT 5
1.4. GUIDANCE 5
1.5. STATEMENT OF AUTHORITY 6
1.6. STRUCTURE OF THIS REPORT 7
2. SCREENING FOR APPROPRIATE ASSESSMENT 9
2.1. MANAGEMENT OF EUROPEAN SITE(S) 9
2.2. DESCRIPTION OF THE PROJECT 9
2.2.1. Background 9
2.2.2. Location 10
2.2.3. Pens 11
2.2.4. Pen Grid Moorings 11
2.2.5. Nets 24
2.2.6. Shore Based Facilities 24
2.2.7. Service vessels 25
2.2.8. Production Model 27
2.2.9. Feed and Feeding 33
2.2.10. Husbandry Management 33
2.2.11. Waste Management 43
2.2.12. Health Management 43
2.2.13. Predator Control 52
2.2.14. Accidents and Emergencies 52
2.2.15. Single Bay Management 57
2.2.16. Decommissioning 58
2.2.17. Consideration of Alternatives 58
2.3. SCREENING EXERCISE 60
2.3.1. Source-Pathway-Receptor and Impact Assessment 60
2.4. PLANS OR PROJECTS THAT MIGHT ACT IN COMBINATION 102
2.5. SCREENING OUTCOME 102
3. NATURA IMPACT STATEMENT 104
3.1. SUMMARY OF SCREENING OUTCOME 104
3.2. AIM OF NIS 105
3.3. DESCRIPTION OF THE PROPOSED PROJECT 105
3.4. DESCRIPTION OF ASPECT OF SACS AND SPAS BROUGHT FORWARD TO NIS 106

3.4.1. Special Areas of Conservation 106
3.4.2. Special Protection Areas 118
3.5. IMPACT PREDICTION 121
3.5.1. Impact Mechanism 1 – SAC QI Annex I Habitats 124
3.5.2. Impact Mechanism 2, 3 and 4 - SAC QI Annex II Species – Mammals 131
3.5.3. Impact Mechanism 5, 6 and 7 - SAC QI Annex II Species – Atlantic salmon and Freshwater Pearl Mussel 133
3.5.4. Impact Mechanism 5, 6 and 7 – SAC QI Annex II Species – Otter 150
3.5.5. Impact Mechanism 3 and 4 – SPA SCI – Bird species 151
3.6. MITIGATION MEASURES 163
3.7. MONITORING 163
3.8. IN-COMBINATION EFFECTS 163
3.9. OUTCOMES 167
4. REFERENCES 168

List of Figures

Figure 1-1: The existing Hawk's Nest (T09/127A), Curhownagh (T09/140A) and Ardbear (T09/96B) sites.....2
Figure 1-2: The proposed Hawk's Nest (T09/127A) and Curhownagh (T09/140A) sites and the existing Ardbear site (T09/96B). 3
Figure 2-1: Pens at Hawk's Nest site. 13
Figure 2-2: Pens at Ardbear site. 14
Figure 2-3: Pens at Curhownagh site. 15
Figure 2-4: Pen schematics - Hawk's Nest site. 16
Figure 2-5: Pen schematics - Ardbear site. 17
Figure 2-6: Pen schematics - Curhownagh site. 18
Figure 2-7: General pen type (Source: Akvagroup; modified from www.akvagroup.com).....19
Figure 2-8: Generalised pen and farm layout with associated moorings (Source: Akvagroup; modified www.akvagroup.com). 20
Figure 2-9: Anchors and moorings - Hawk's Nest site. 21
Figure 2-10: Anchors and moorings - Ardbear site. 22
Figure 2-11: Anchors and moorings - Curhownagh site. 23
Figure 2-12: Access route to and from the Mannin Salmon Co. Ltd. pier at Errislannan and Curhownagh pier. 26
Figure 2-13: Mean weight growth of fish over one production cycle. 31
Figure 2-14: Mean biomass gain, feed fed and Feed Conversion Ratio (FCR) for one production cycle at Hawk's Nest, Ardbear and Curhownagh sites. 32
Figure 2-15: Total BOD of waste discharges (tonnes per month) for one production cycle. 38
Figure 2-16: Total solids discharge (tonnes per month) for one production cycle. 39
Figure 2-17: Total Carbon discharge (tonnes per month) for one production cycle. 40
Figure 2-18: Total nitrogen discharge (tonnes per month) for one production cycle. 41
Figure 2-19: Total phosphorus discharge (tonnes per month) for one production cycle. 42
Figure 2-20: G2020A Clifden Bay: Average lice counts (site total) per sample date with 1st, 2nd and 3rd nano-filtration treatment rounds. 51
Figure 2-21: SACs with 15 km of the sites. 63
Figure 2-22: SPAs within 15 km of the Hawk's Nest, Ardbear and Curhownagh sites. 64
Figure 3-1: Freshwater pearl mussel catchments in the vicinity of Clifden and Mannin Bay, Co. Galway. 112
Figure 3-2: Predicted total solids deposition depth (in mm) over full production cycle at Hawk's Nest site. 128
Figure 3-3: Predicted total solids deposition depth (in mm) over full production cycle at Ardbear Site 129
Figure 3-4: Predicted total solids deposition depth (in mm) over full production cycle at Curhownagh Site.. 130
Figure 3-5 Life cycle of *Lepeophtheirus salmonis* (O'Donohoe *et al*., 2017 after Schram, 1993 & Hamre, 2013). 139
Figure 3-6: Predicted tidal maximum Nauplius I larvae numbers (No./m^3) from the Hawk's Nest site. 143
Figure 3-7: Predicted tidal mean Nauplius I larvae numbers (No./m^3) from the Hawk's Nest site. 143
Figure 3-8: Predicted tidal maximum Nauplius I larvae numbers (No./m^3) from the Curhownagh site. 144
Figure 3-9: Predicted tidal mean Nauplius I larvae numbers (No./m^3) from the Curhownagh site. 144
Figure 3-10: Time Series Reference Sites for Hawk's Nest site. 145
Figure 3-11: Time Series Reference Sites for the Curhownagh site. 145

List of Tables

Table 1-1: Summary of the renewal sites and associated licences....1
Table 2-1: Production cycle for Hawk's Nest site (T09/127A) and Curhownagh site (T09/140A). 29
Table 2-2: Proximate analysis and digestibility of organic ration. 35
Table 2-3: Feed carbon content of organic ration....35
Table 2-4: Projected feed requirements for one production cycle 36
Table 2-5: Projected soluble and settleable waste discharge budget including BOD discharges....37
Table 2-6: Records of sea lice infestation at Hawk's Nest and Curhownagh sites between 2017 to 2022 (Counts exceeding the treatment trigger levels are highlighted). 48
Table 2-7: SAC within 15 km of Hawk's Nest, Curhownagh and Ardbear sites....65
Table 2-8: SPAs within 15 km of the Hawk's Nest, Curhownagh and Ardbear sites. 72
Table 2-9: Annex I habitats and Annex II species – S-P-R assessment of potential significant effects. Potential significant effects to QIs are highlighted in bold. 77
Table 2-10: SCI species – S-P-R assessment of potential significant effects. Potential significant effects to SCIs are highlighted in bold. 85
Table 2-11: SACs designated for Annex II marine mammal species. 92
Table 2-12: Seabird foraging ranges. 95
Table 2-13: SCIs of SPAs with foraging ranges overlapping the project area. Maximum foraging ranges used. 97
Table 3-1: Annex II Marine mammal records in the vicinity of Clifden and Mannin Bay from the NBDC database. 107
Table 3-2: SACs designated for the QIs Annex II Species. 113
Table 3-3: National Status of QIs Annex II Species. 117
Table 3-4: SCIs of SPAs with foraging ranges overlapping the project area. Maximum foraging ranges used. 118
Table 3-5: Impact mechanisms relevant to QIs and SCIs. 122
Table 3-6: Settleable solids loadings used in the hydrodynamics modelling study (see Table 3 Appendix 6)124
Table 3-7: Predicted Sea Lice Nauplius I Larvae Concentration statistics (No./m^3) at reference sites for Spring Average Fish Numbers Year 1 at the Hawk's Nest Production Site. 142
Table 3-8: Predicted Sea Lice Nauplius I Larvae Concentration statistics (No./m3) at reference sites for Spring Average Fish Numbers Year 1 at the Curhownagh Production Site. 142
Table 3-9: Disturbance risk categories of SCIs of SPAs (*sensu* Furness *et al*., 2013). 154
Table 3-10: Sensitivity criteria....155
Table 3-11: Habitat Suitability. 155
Table 3-12: Habitat Flexibility Scores (*sensu* Furness *et al*., 2013). 158
Table 3-13: Significance of Effects....159
Table 3-14: Potential impacts on bird populations....161
Table 3-15: Pollutants loadings used in the hydrodynamics modelling study (see Appendix 6)....164

Appendices[1]

Appendix 1 Aquaculture licences

Appendix 2 Company Management Plan

Appendix 3 Escape Procedures

Appendix 4 Single Bay Management Plan

Appendix 5 Summary Jaffa Papers (2016; 2019 & 2021)

Appendix 6 Hydrodynamic Modelling Report

Appendix 7 Benthic Audits Reports

Appendix 8 SLICE Treatment

[1] Appendices included in *Screening for AA and NIS Volume 2 - Appendices Review and Renewal of Marine Finfish Aquaculture Licences at Clifden Bay, Mannin Bay, and Ardbear Bay, Co. Galway Licence Refs: AQ180, AQ122, FCL591.*

1. Introduction

1.1. Overview

This *Screening for Appropriate Assessment and Natura Impact Statement* report accompanies aquaculture licence review and renewal applications by Ardbear Salmon Ltd. and Mannin Salmon Ltd. to the Department of Agriculture, Food and the Marine (DAFM) for marine finfish aquaculture licences at Clifden Bay, Mannin Bay, and Ardbear Bay, Co. Galway. The existing licensed areas at Ardbear, Hawk's Nest and Curhownagh are shown in red in Figure 1-1, and the proposed amended site boundaries are shown in Figure 1-2. Details of the existing sites licences are outlined in Table 1-1 below.

Table 1-1: Summary of the renewal sites and associated licences.

Licence reference	Site Reference	Licensee	Site location	Site Name	Current Annual Production Conditions
AQ180	T09/127A	Ardbear Seafarms Ltd.	Clifden Bay	Hawk's Nest	100 tonnes
AQ122	T09/140A	Mannin Salmon Co. Ltd.	Mannin Bay	Curhownagh	200 tonnes
FCL591	T09/96B	Ardbear Seafarms Ltd.	Ardbear Bay	Ardbear	At the decision of the Minister of DAFM

The application for renewal of the licences requests that the operating conditions attached to the licences be amended as follows:

- Hawk's Nest (AQ180 - T09/127A)
    - Harvest 200 tonnes from a net production of 625 tonnes of salmon every 21 months.
- Ardbear (FCL591 - T09/96B)
    - Harvest 182 tonnes from a net production of 86 tonnes of salmon every 21 months.
- Curhownagh (AQ122 - T09/140A)
    - Harvest 380 tonnes from a net production of 110 tonnes of salmon every 21 months.

The application for the review and renewal for the T09/127A and T09/140A licences also requests that the boundaries of the existing licensed area at Hawk's Nest and Curhownagh sites be amended; the amended areas are shown in red in Figure 1-2. The Ardbear site is a fish culture licence which will be renewed in 2060. The existing boundary of the Ardbear site will not change.

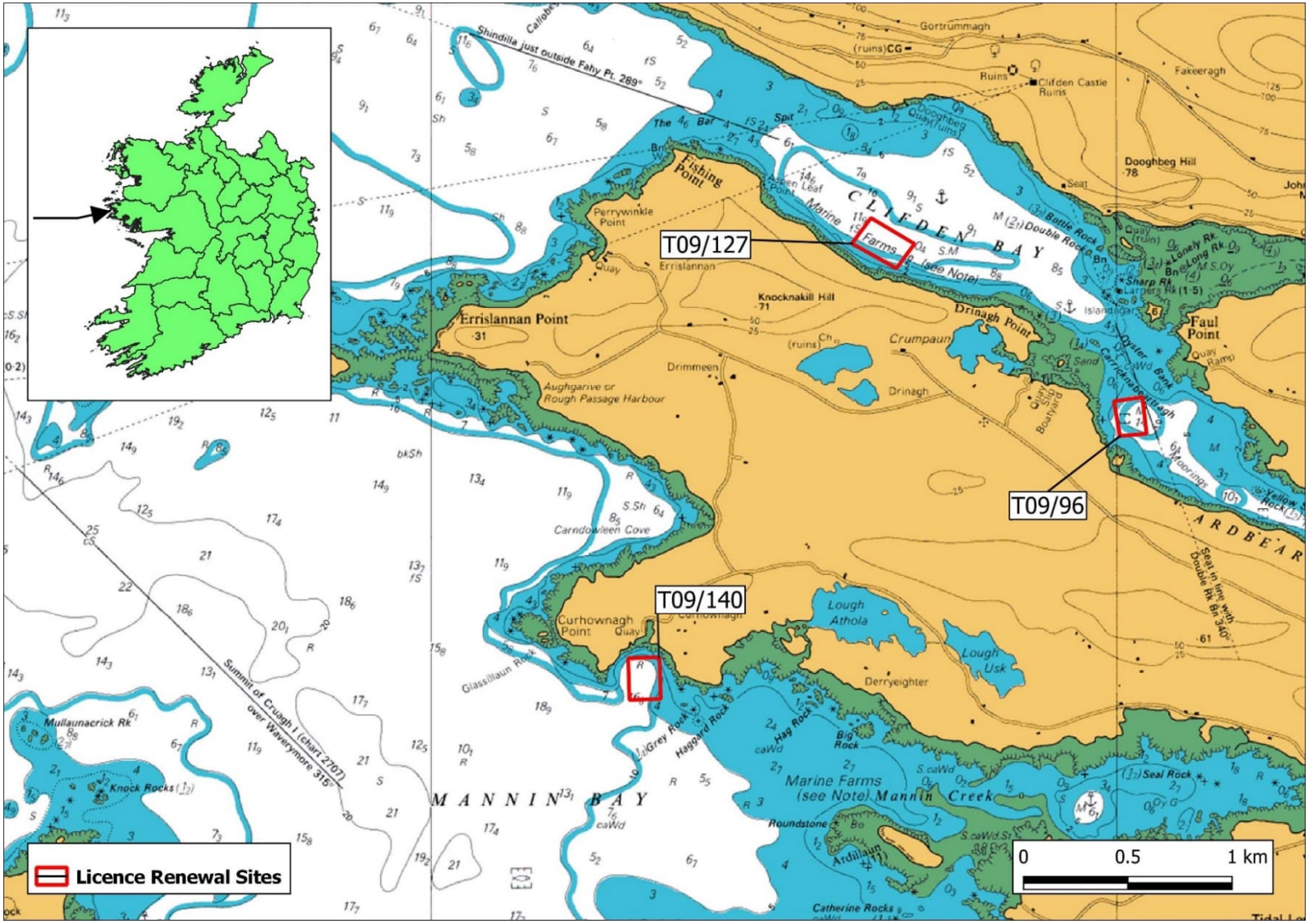

Figure 1-1: The existing Hawk's Nest (T09/127A), Curhownagh (T09/140A) and Ardbear (T09/96B) sites

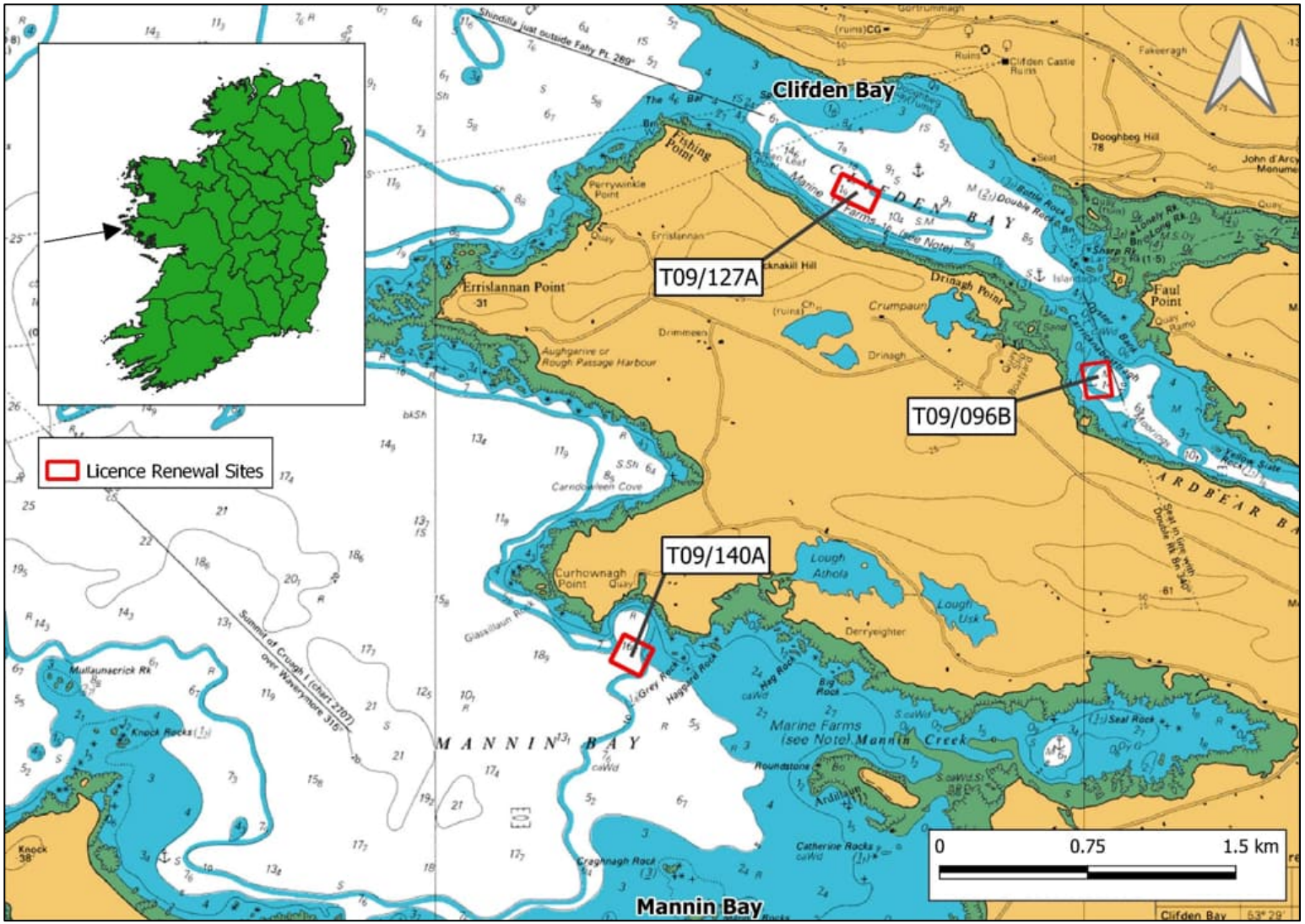

Figure 1-2: The proposed Hawk's Nest (T09/127A) and Curhownagh (T09/140A) sites and the existing Ardbear site (T09/96B).

1.2. Requirement for Appropriate Assessment

Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (commonly known as the Habitats Directive) is European Community legislation regarding nature conservation established to ensure biodiversity is conserved through the conservation of natural habitats and wild fauna and flora in Europe.

The Habitats Directive was originally transposed into Irish law by the *European Communities (Natural Habitats) Regulations, 1997* (S.I. No. 94 of 1997). The 1997 Regulations were subsequently revoked and replaced by the *European Communities (Birds and Natural Habitats) Regulations 2011*, as amended.

A network of sites of conservation importance hosting habitats and species identified respectively in Annex I and Annex II of the Directive as needing to be either maintained at or returned to favourable conservation status have been identified by each Member State. These sites are known as European sites within the Natura 2000 network. European sites in Ireland that form part of the Natura 2000 network of protected sites include SACs designated due to their significant ecological importance for species and habitats protected under Annex I and Annex II respectively of the Habitats Directive, and SPAs designated for the protection of populations and habitats of bird species protected under the EU Birds Directive (Council Directive 2009/409/EEC). Features for which SACs and SPAs are designated are called Qualifying Interests (QIs) and Special Conservation Interests (SCIs), respectively.

Following the requirements of Article 6(3) of the Habitats Directive, under Regulation 42 of the 2011 Regulations, if a plan or project is not connected with, or necessary for the management of a protected site and is likely to have a significant effect on the feature for which the site is designated either individually or in combination with other plans or projects, an Appropriate Assessment (AA) is required to assess whether a plan or project will have any adverse effect on the integrity of Natura 2000 site(s) in view of the Conservation Objectives set for the designated features.

This *Screening for Appropriate Assessment and Natura Impact Statement* (*Screening for AA and NIS*) has been prepared by AQUAFACT (APEM Group) on behalf of Ardbear Salmon Ltd. and Mannin Salmon Ltd. to address Article 6(3) obligations under the Habitats Directive. Specifically, this *Screening for AA and NIS* focus on the potential effects to European sites associated with the renewal of licences T09/127A, T09/140A and T09/96B.

1.3. Purpose of this report

Specifically, this report has been prepared to address Article 6(3) obligations under the European Community (EC) Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (commonly known the Habitats Directive), which is transposed into Irish legislation under the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended).

1.4. Guidance

This report has been prepared in accordance with the following guidance:

- EC (2018) Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC. Commission Notice,
- EC (2018) Guidance on Aquaculture and Natura 2000 – Sustainable aquaculture activities in the context of the Natura 2000 Network,
- EC (2021) Assessment of plans and projects in relation to Natura 2000 sites – Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC. Commission notice (2021),
- EC (2021) Guidance document on the strict Protection of animal species of Community interest under the Habitats Directive,
- OPR (2021) Appropriate Assessment Screening for Development Management. Practice Note PN01. Office of the Planning Regulator. March 2021,
- DEHLG (2009) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities (Revised 2010),
- DAHG - NPWS (2012) Marine Natura Impact Statements in Ireland Special Areas of Conservation, A Working Document, and
- CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland.

This assessment includes a desk-based review of available records of protected species and habitats including the following sources:

- Baseline desk studies and field surveys carried out for the Proposed Project area,

- Conservation Status Assessment Reports, Backing Documents and Maps prepared to inform national reporting required under Article 17[2] of the Habitats Directive and Article 12[3] of the Bird Directive,
- Site Synopsis, Conservation Objective Reports and Natura 2000 Forms available from NPWS,
- Published and unpublished NPWS reports on protected habitats and species including Irish Wildlife Manual reports, Species Action Plans, and Conservation Management Plans and
- Existing relevant mapping and databases *e.g.* waterbody status, species and habitat distribution *etc*. (sourced from the Environmental Protection Agency - http://gis.epa.ie/, the National Biodiversity Data Centre - http://maps.biodiversityireland.ie and the NPWS - http://www.npws.ie/mapsanddata/.

1.5. Statement of Authority

This report has been prepared by Dr Brendan O'Connor (BSc PhD MCIEEM), Marta Domingos (BSc MSc) and Tracy Paul (BSc MSc). Brendan O'Connor is the ecology lead for the Review and Renewal of Marine Finfish Aquaculture Licences in Clifden and Mannin Bays, Co. Galway – Screening Statement for Appropriate Assessment and Natura Impact Statement. He is expert in ecological matters and the full spectrum of environmental assessment techniques, methodologies and statutes. Professionally, he is a member of relevant institutes requiring the highest standards of professional competence and integrity. He is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM).

Brendan has 40 years of experience in the field of marine science and has published *c.* 75 scientific papers and numerous reports specialising in the biology and ecology of sea-floor communities. Brendan is an internationally recognised polychaete taxonomist and has led numerous international workshops in polychaete taxonomy including workshops as part of the UK BEQUALM/NMBAQC. He has 33 publications on marine invertebrate taxa including descriptions of new species, revisions of families and additions to the European and Irish fauna.

As Managing Director of AQUAFACT Brendan has been responsible for all aspects of management including the design, execution and reporting of numerous desk studies, surveys, assessments and environmental outputs including NIS, AA screening and EIARs.

[2] Most recent Article 17 report is available at https://www.npws.ie/publications/article-17-reports/article-17-reports-2019.

[3] Most recent Article 12 report is available at https://www.npws.ie/news/birds-directive-article-12-reporting

Marta Domingos holds a BSc in Meteorology, Oceanography and Geophysics and a First-Class Honours Degree (MSc) in Conservation Behaviour from ATU (previously GMIT), where she focused on predicting the spatial distribution of delphinid species in a critical conservation region in Portugal. She is specialised in spatial modelling using RStudio and Geographic Information System software with focus on the marine environment. She is also a licensed Marine Mammal Observer (MMO) certified by the Joint Nature Conservation Committee (JNCC) and has experience in both land and boat-based surveys around the Irish coast. She is currently a marine ecologist working on AA, NIS and Risk Assessments for Annex IV species on a variety of projects in the marine sector.

Tracy Paul holds a BSc in Marine Science & Technology and a First-Class Honours Degree (MSc) in Applied Marine Conservation from ATU (previously GMIT), where her focus during her master's programme was on assessing the depuration efficacy of microplastics from oyster species from Ireland and its implications for the aquaculture industry. She is specialised in benthic monitoring surveys within the intertidal areas (mostly tropical ecosystems), and she is also a trainee taxonomist for the identification of benthic fauna from Irish waters. She is also a marine ecologist working on AA, NIS and EIAR on an array of development projects within the marine sector.

1.6. Structure of this Report

The content of this report is as follows:

- Section 2: Screening for Appropriate Assessment
    - Section 2.1 Management of the European site(s)
    - Section 2.2 Description of the Proposed Project
    - Section 2.3 Characteristics of the European site(s)
    - Section 2.4 In-combination Effects
    - Section 2.5 Screening Outcome
- Section 3: Natura Impact Statement
    - Section 3.1 Summary of Screening Outcome
    - Section 3.2 Aim of NIS
    - Section 3.3 Description of the Proposed Project
    - Section 3.4 Description of Receiving Environment
    - Section 3.5 Impact Prediction
    - Section 3.6 Mitigation
    - Section 3.7 Monitoring
    - Section 3.8 In-combination Effects

- Section 0 Outcomes

2. Screening for Appropriate Assessment

2.1. Management of European Site(s)

Regulation 42 (1) of the 2011 Regulations requires that:

> *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 on the European site*.

The proposed aquaculture project is not associated with the 'management' of European sites within the Natura 2000 Network having regard to Article 6 of the Habitats Directive, and as such it is appropriate that the proposed project is subjected to screening for AA. This screening assessment investigates, in view of best scientific knowledge, whether the proposed project, individually or in combination with other plans and projects, would be likely to have a significant effect on European sites.

As outlined in Section 1, this *Screening for AA and NIS*, which has been prepared to address Article 6(3) obligations of the Habitats Directive and associated national regulations, focuses on the potential effect to European sites associated with the proposed project operations.

Section 2.2 below describes the activities proposed for the aquaculture project while Section 2.3 considers the likelihood of significant effects of the project on European sites both in isolation and in-combination with other projects.

2.2. Description of the Project

This section describes operations at the Hawk's Nest site (T09/127A), Curhownagh site (T09/140A), and Ardbear Bay (T09/96B). The production cycle at the Hawk's Nest, Curhownagh and Ardbear sites will be 21 months duration.

2.2.1. Background

Details of the Hawk's Nest site (T09/127A) and Ardbear site (T09/96B) and Curhownagh site (T09/140A) licences are presented in Table 1-1. The conditions of the current licences for the Hawk's Nest site and the Curhownagh site allow the harvest of 100 t and 200 t of salmon (dead weight) per

calender year, respectively (as written in the licences – Appendix 1). The fish culture licence for the Ardbear site states that the quantity of fish will be determined by the Minister of Agriculture Food and Marine (Appendix 1).

This section describes operations at the Hawk's Nest site (T09/127A), the Curhownagh site (T09/140A) and the Ardbear site (T09/96B) should DAFM approve the review and renewal of the licence and approve the requests to amend the operating conditions attached to the following:

- Hawk's Nest (AQ180 - T09/127A)
    - Harvest 200 tonnes from a net production of 625 tonnes of salmon every 21 months.
- Ardbear (FCL591 - T09/96B)
    - Harvest 182 tonnes from a net production of 86 tonnes of salmon every 21 months.
- Curhownagh (AQ122 - T09/140A)
    - Harvest 380 tonnes from a net production of 110 tonnes of salmon every 21 months.

The application for the review and renewal for the T09/127A and T09/140A licences request that the boundaries of the existing licensed area at Hawk's Nest and Curhownagh sites be amended; the amended areas are shown in red in Figure 1-2. The existing boundary of the Ardbear site will remain unchanged.

2.2.2. Location

Clifden Bay, Mannin Bay, and Ardbear Bay are located on the west coast of Co. Galway, in the Connemara region. Clifden Bay and Ardbear Bay is located to the north of Errislannan Peninsula while Mannin Bay is situated to the south of the peninsula.

Clifden Bay is a relatively sheltered, shallow bay and measures approximately 4.5 km in length. There are numerous small freshwater inputs draining into the bay from the mountainous valleys that surround the area, of particular note is the Owenglin River which flows through the Clifden town into the bay. Except for the channel of the Owenglin, the inner bay dries out completely on a low spring tide (AQUAFACT pers. comm.). The tidal range in the outer bay was recorded as being 4 m on spring tides and 1.2 m on neap tides. The range for the inner bay is similar with 4 m recorded for springs and 2 m recorded for neap tides. Sediments in the outer Clifden Bay are characterised by soft, muddy sands and muds with the seafloor in the inner Clifden bay area ranging from gravely sand to gravely silty sand.

Mannin Bay is a wide, comparatively deep inlet opening to the northwest. The bay is approximately 4.7 km long and is 2.9 km wide in the main channel. The bay contains numerous sandy beaches along

the south shore with a coral beach situated to the east. Along the north shore, narrow sandy beaches give way to mud in Mannin Creek while the southern shore has only a few low (7 m) cliffs. Predicted spring and neap tidal ranges in Mannin are in the region of 3.8 m and 1.8 m, respectively.

2.2.2.1. Clifden Bay – Hawk's Nest Site

The Hawk's Nest site is located near the southern shore of Clifden Bay, near Errislannan in water depths of approximately 10 m (Figure 2-1). This outer channel of Clifden Bay is approximately 600 m wide and runs for 2.5 km. The Hawk's Nest site has existed since 1984.

2.2.2.2. Ardbear Bay – Ardbear Site

The Ardbear site is located in Ardbear Bay in the southeast of Clifden Bay (Figure 2-2). The Ardbear site is approximately 1.2 km southeast of the Hawk's Nest site. The Ardbear site has been in existence since 1983.

2.2.2.3. Mannin Bay – Curhownagh Site

The Curhownagh site is located to the south of Curhownagh Quay in the outer part of Mannin Bay (Figure 2-3). The Curhownagh site has existed since 1988.

2.2.3. Pens

Subject to the approval of the licence review and renewal applications, 10 pens will continue to be deployed at the Hawk's Nest site (arranged in a 2 x 5 grid), 3 pens at the Ardbear site (1 x 3 grid) and 6 pens at the Curhownagh site (2 x 3 grid). Schematics of the pens at the sites are shown in Figure 2-4 through Figure 2-6. Coordinates for the corner points of the sites are also shown in Figure 2-1 through Figure 2-3. The pens are of the original 'PolarCirkle' design modified and supplied by both Aqualine and Fusion Marine The pen nets are supported within heavy duty polyethylene frame set on a flotation ring. Stanchions on the polyethylene frame support a heavy-duty handrail that runs around the pen (see Figure 2-7). Pen nets, mooring bridles and sinker ropes (as required) and seal nets (as required) are supported off the base frames of the floatation ring. Fence nets and bird (top) nets are supported off the handrails and stanchions. There are radar reflectors on the pens.

2.2.4. Pen Grid Moorings

At each site, the pens will be held in place in a mooring square secured together in a mooring grid. The pens are held to the mooring grid by mooring bridles attached to the pen floatation rings. There will be four sets of bridles on each pen ring (Figure 2-8). The mooring grid is composed of a heavy-duty rope-work structure comprising a series of squares, each of which supports a pen. In this case, the

mooring grid is submerged so that farm work vessels can pass freely across it. At every grid square corner, there are grid buoys supporting the grid. These are also the points at which the mooring bridles, which support the pen floatation rings within the grid squares, join the grid. The grid is then held in shape, submerged and in tension by moorings which, in turn, are anchored to the seabed. Lateral moorings join the grid at every square corner down each side of the grid, while end (axial) moorings join the grid on every square corner at the ends of the grid.

The shape of the grid is maintained by the tension provided through the grid moorings. Each mooring assembly comprises a heavyweight braided nylon rope running from each grid corner, which is attached to a length of heavy-duty stud link anchor chain of specified weight, which joins in turn to an anchor of specified design and weight. The purpose of the stud link chain is to maintain the tension on the grid with changing tidal water depths.

Details of the mooring and anchors at the Hawk's Nest, Ardbear and Curhownagh sites are shown in Figure 2-9 through Figure 2-11. Mooring bridles are used to connect the four corners of each grid square to at least eight points on the pen floatation ring. This maintains the position and shape of the pen floatation ring within the grid square with minimal deformation, even in adverse sea conditions. Marine LED lights for buoys and small beacons are supplied by JFC Marine and are positioned on the corners of the mooring grids. Corner site buoys with navigational lights (4 sec 2 mile) are located at the corners of the licensed sites. Grid moored systems require the application of more or less even tension on all moorings to keep the grid taught. Tension is maintained by the use of adequate moorings, anchor chains and anchors, to suit seabed and hydrographic conditions and the dimensions of the system.

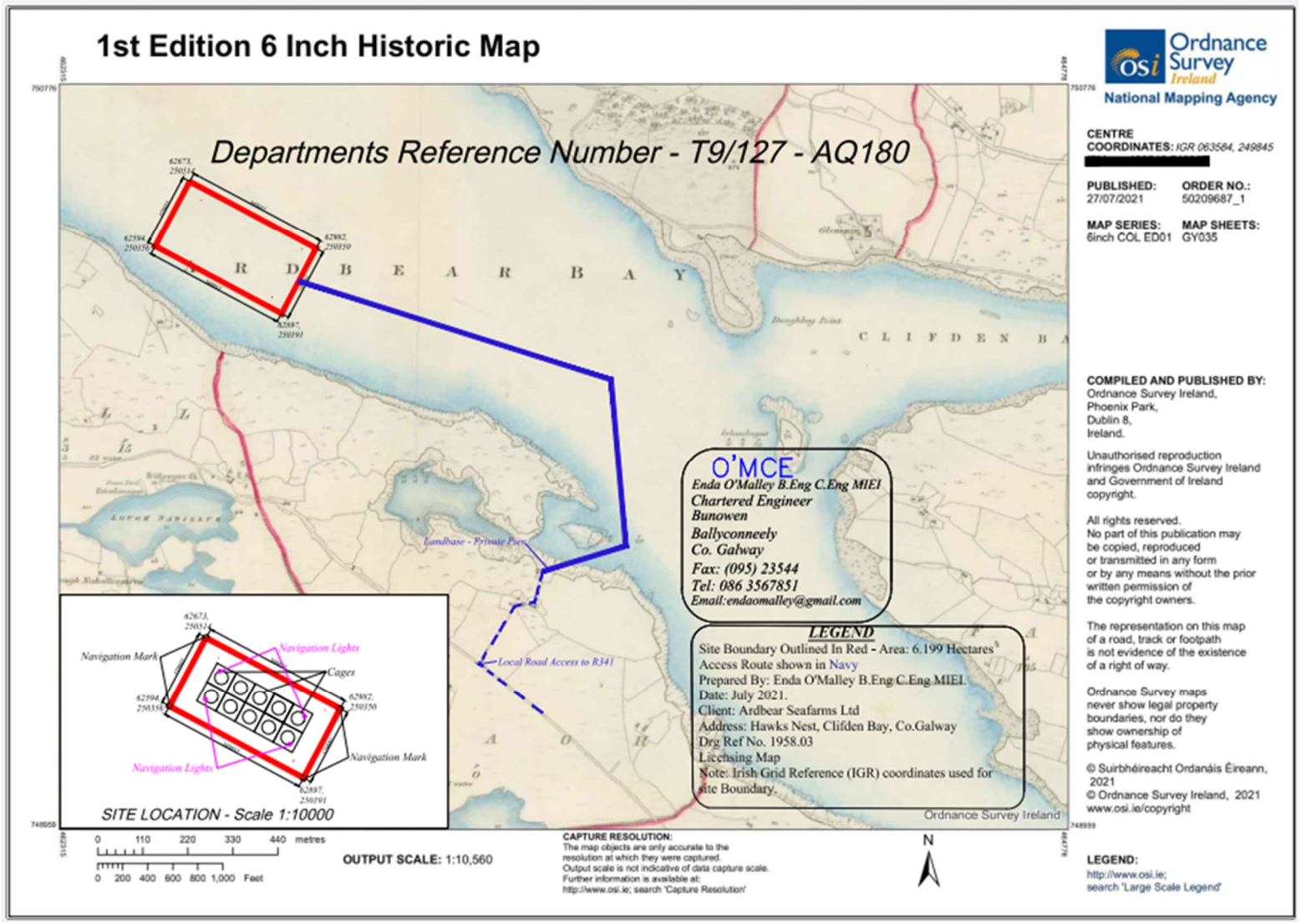

Figure 2-1: Pens at Hawk's Nest site.

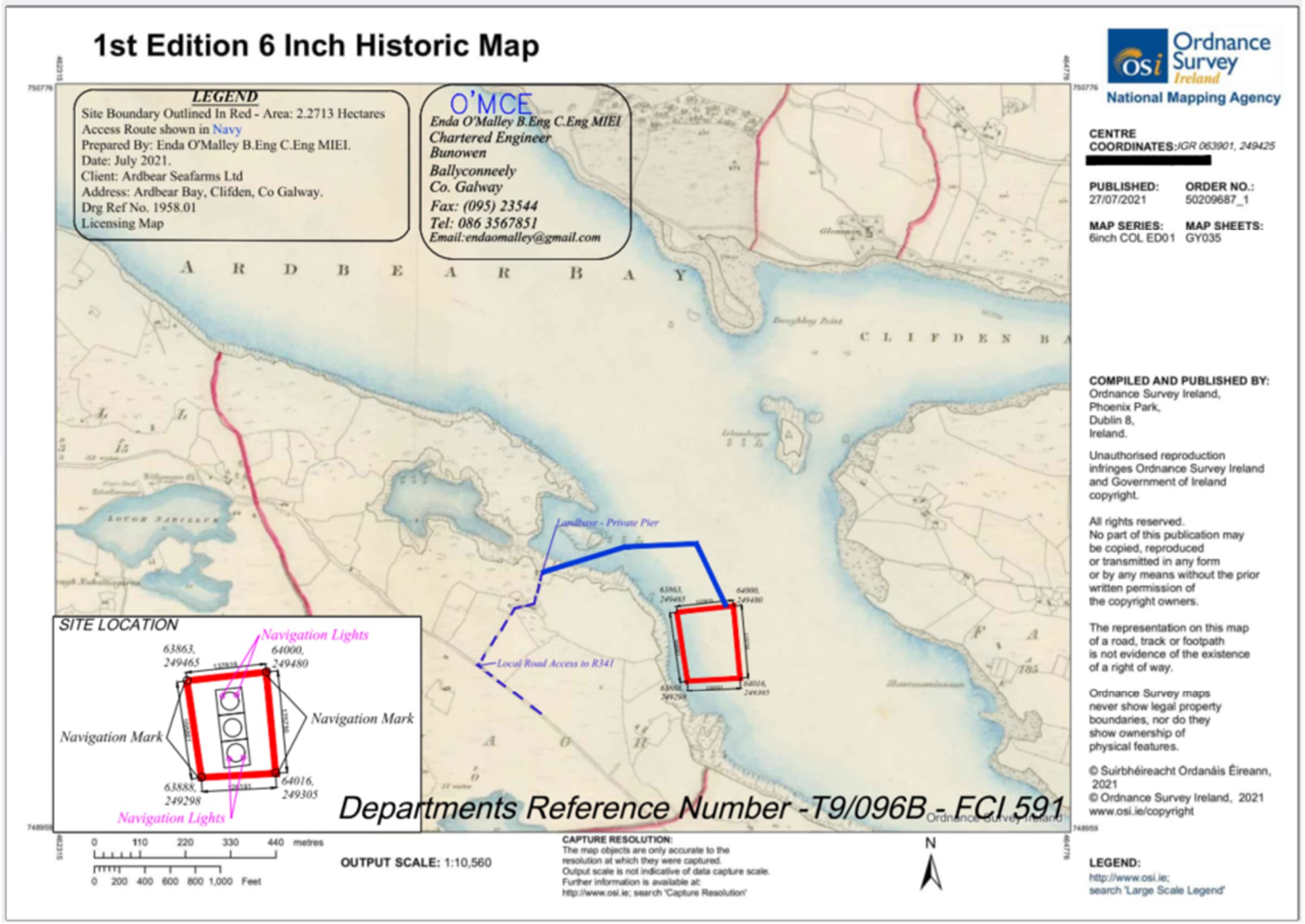

Figure 2-2: Pens at Ardbear site.

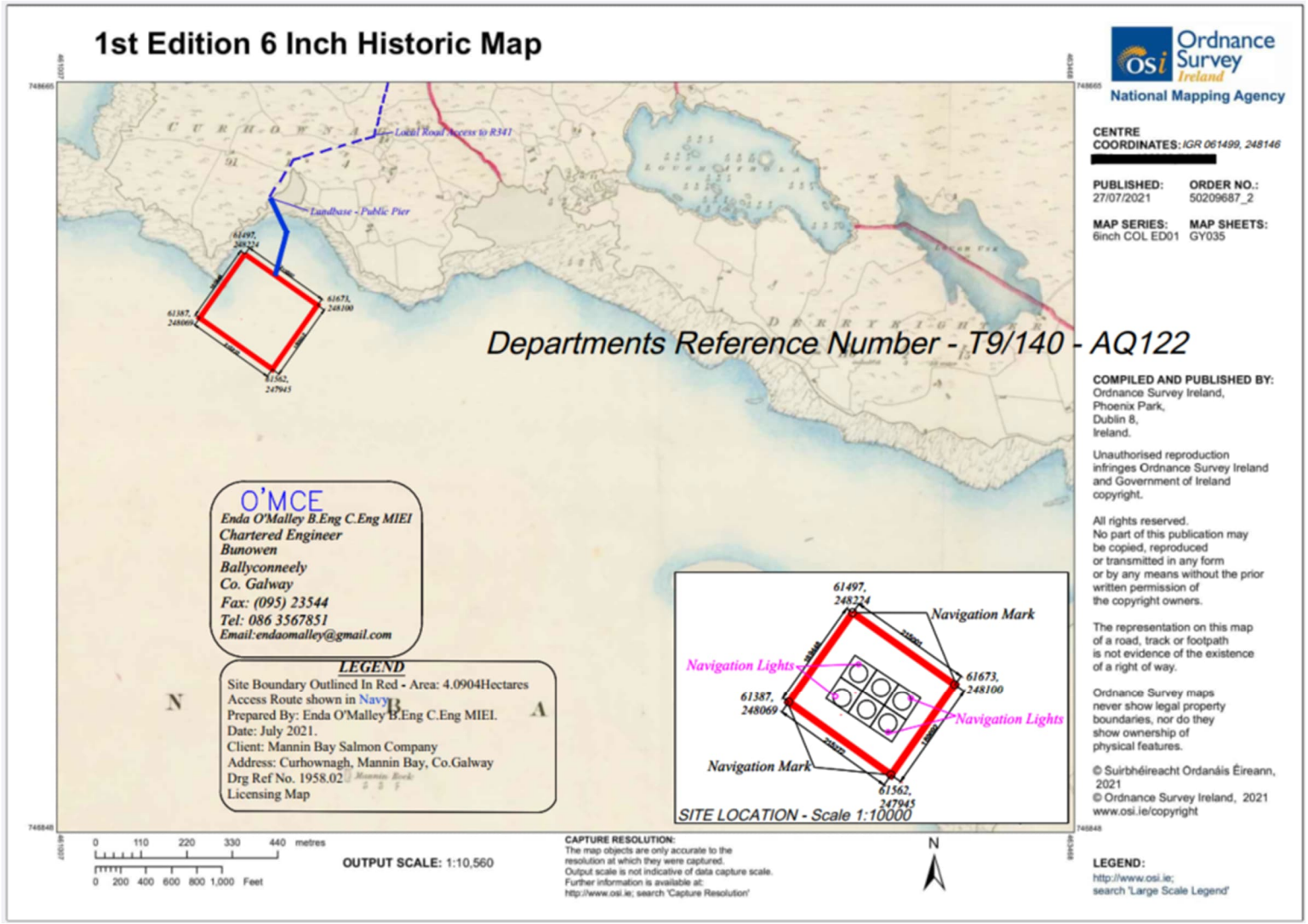

Figure 2-3: Pens at Curhownagh site.

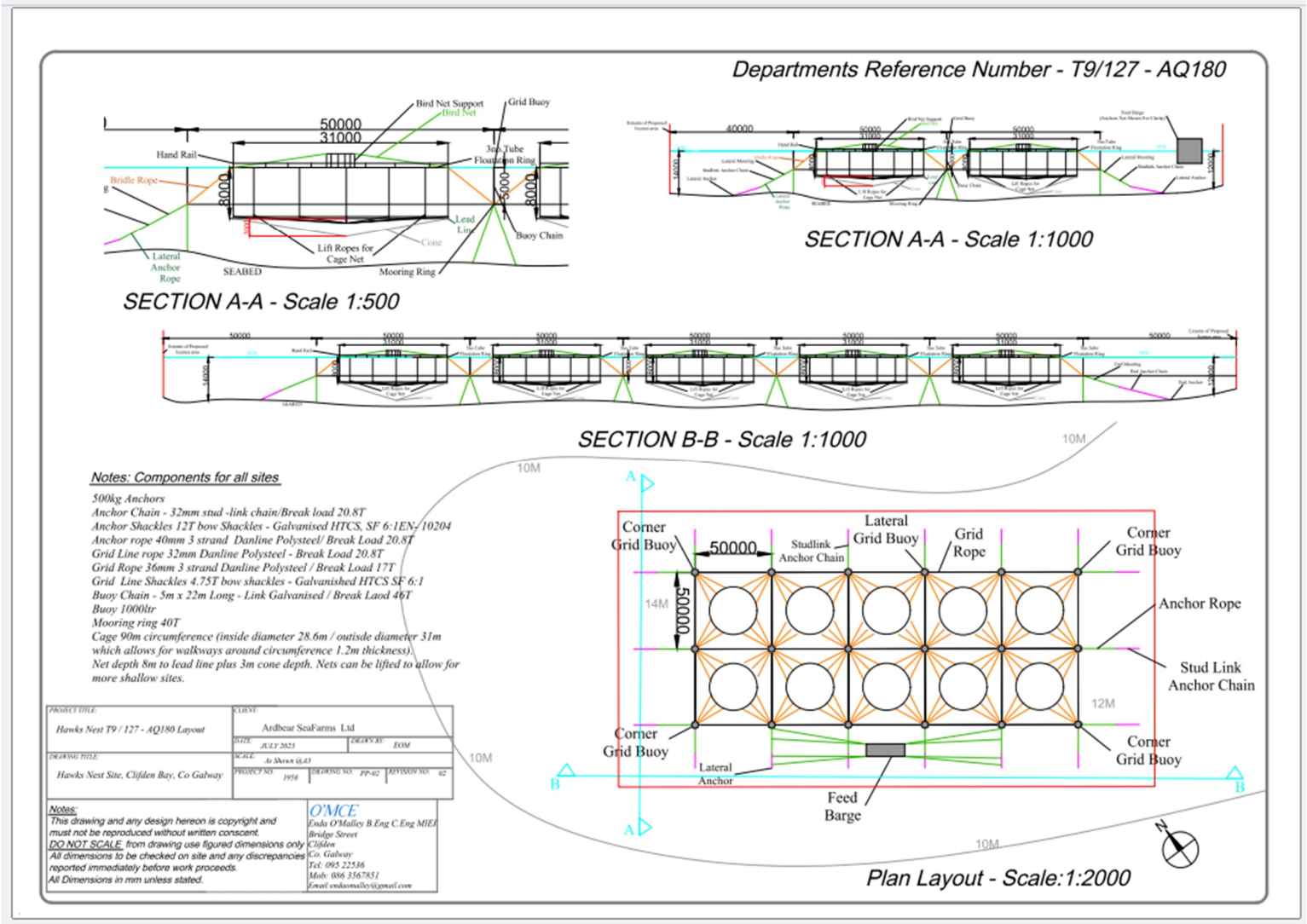

Figure 2-4: Pen schematics - Hawk's Nest site.

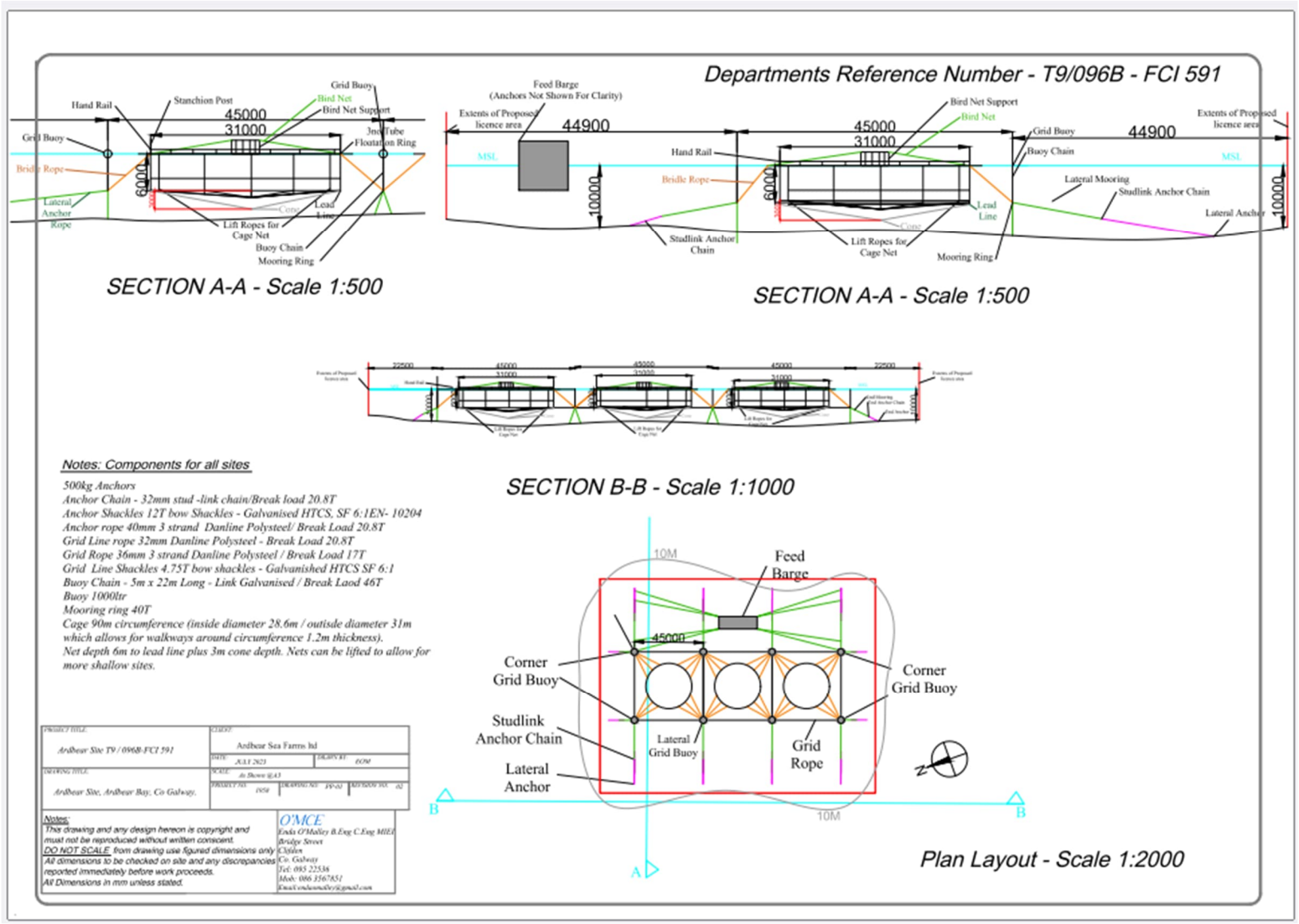

Figure 2-5: Pen schematics - Ardbear site.

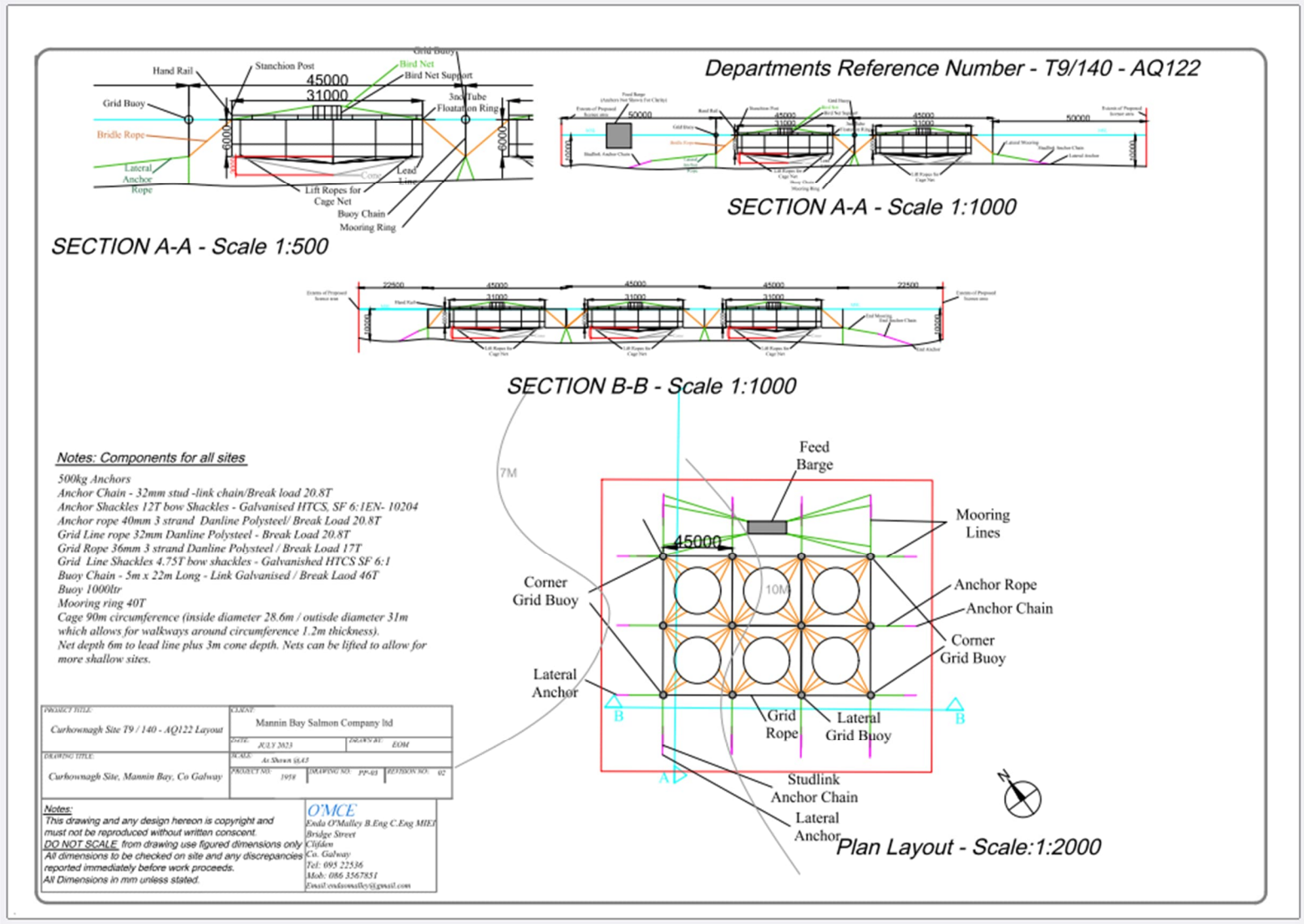

Figure 2-6: Pen schematics - Curhownagh site.

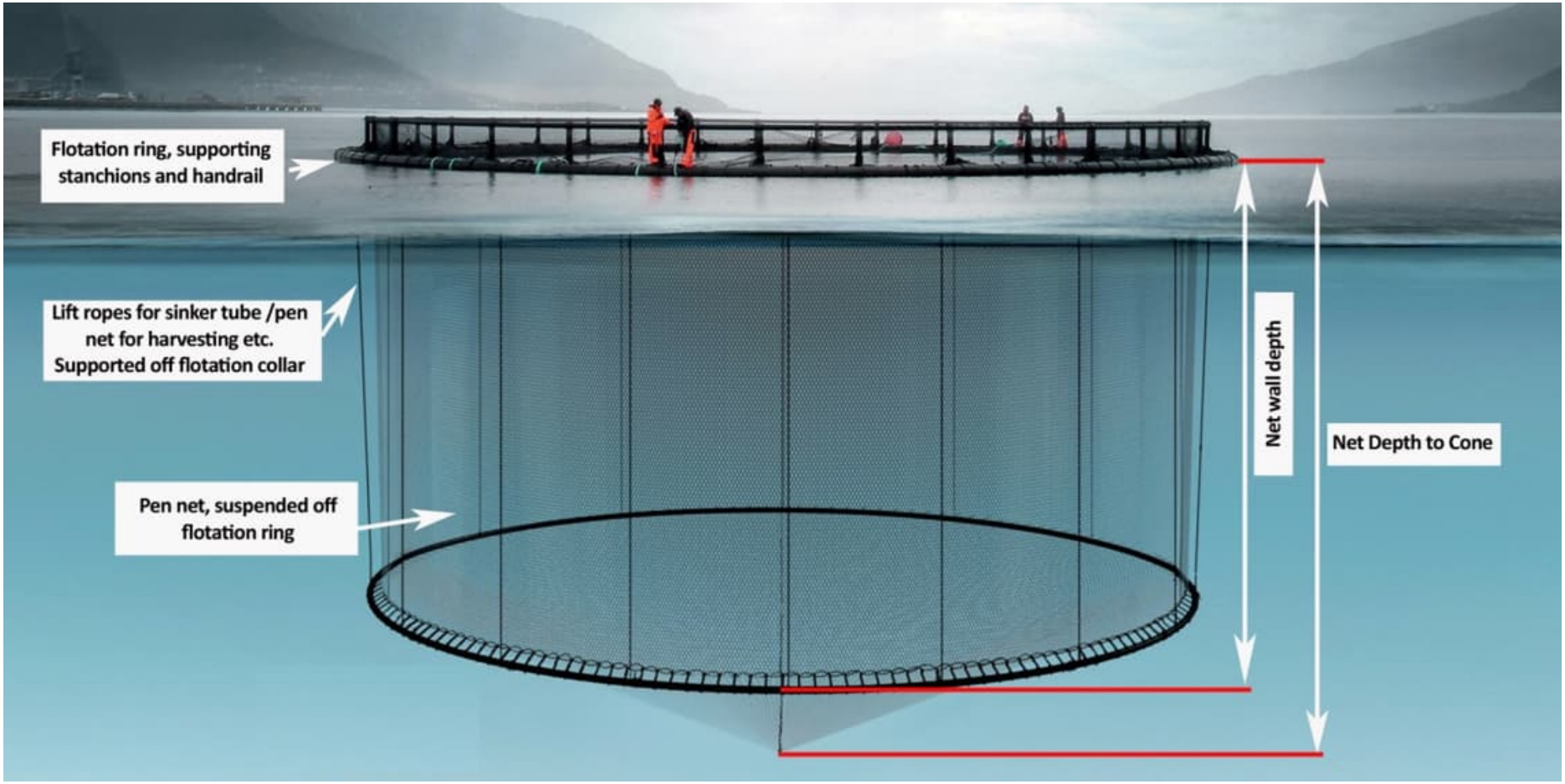

Figure 2-7: General pen type (Source: Akvagroup; modified from www.akvagroup.com).

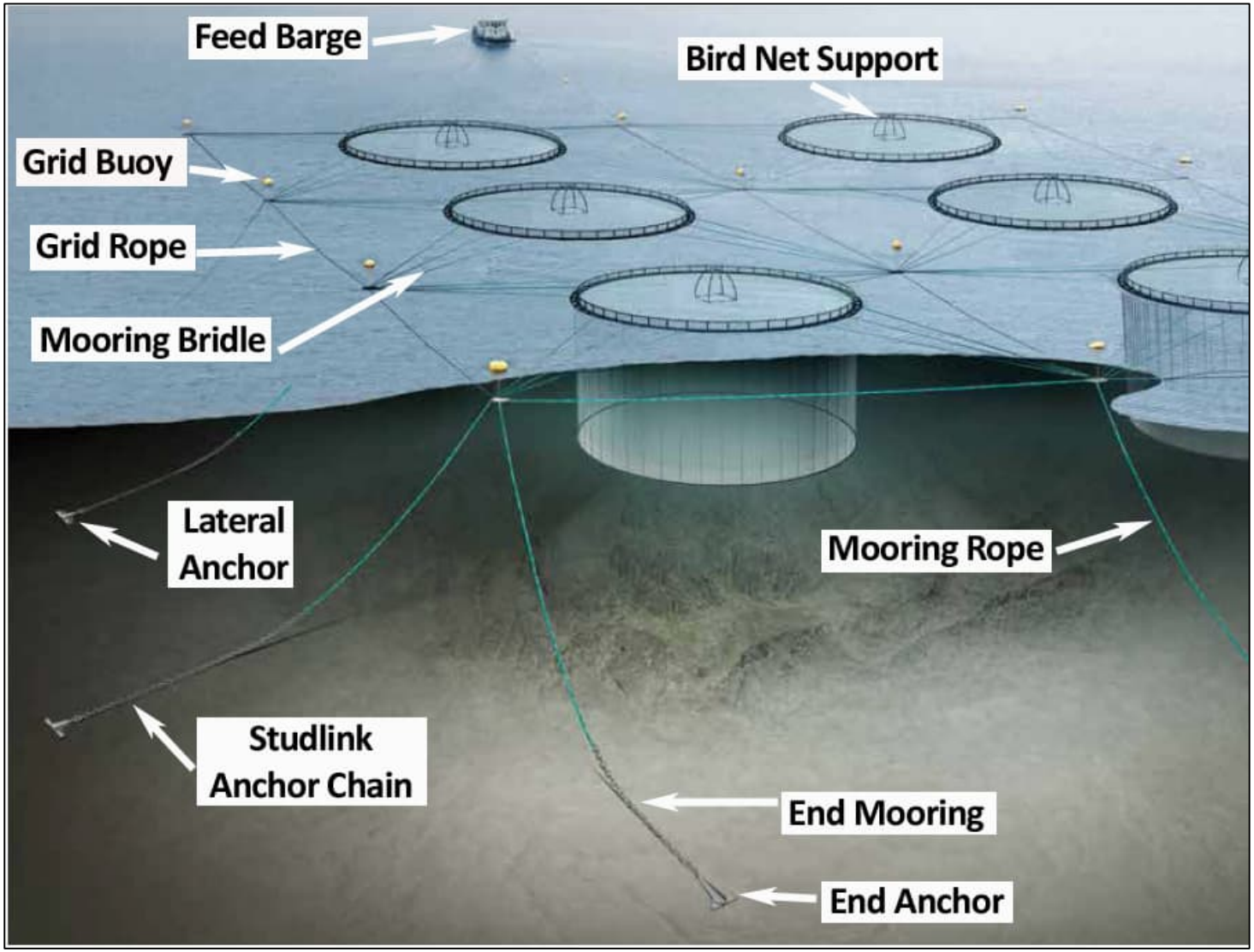

Figure 2-8: Generalised pen and farm layout with associated moorings (Source: Akvagroup; modified www.akvagroup.com).

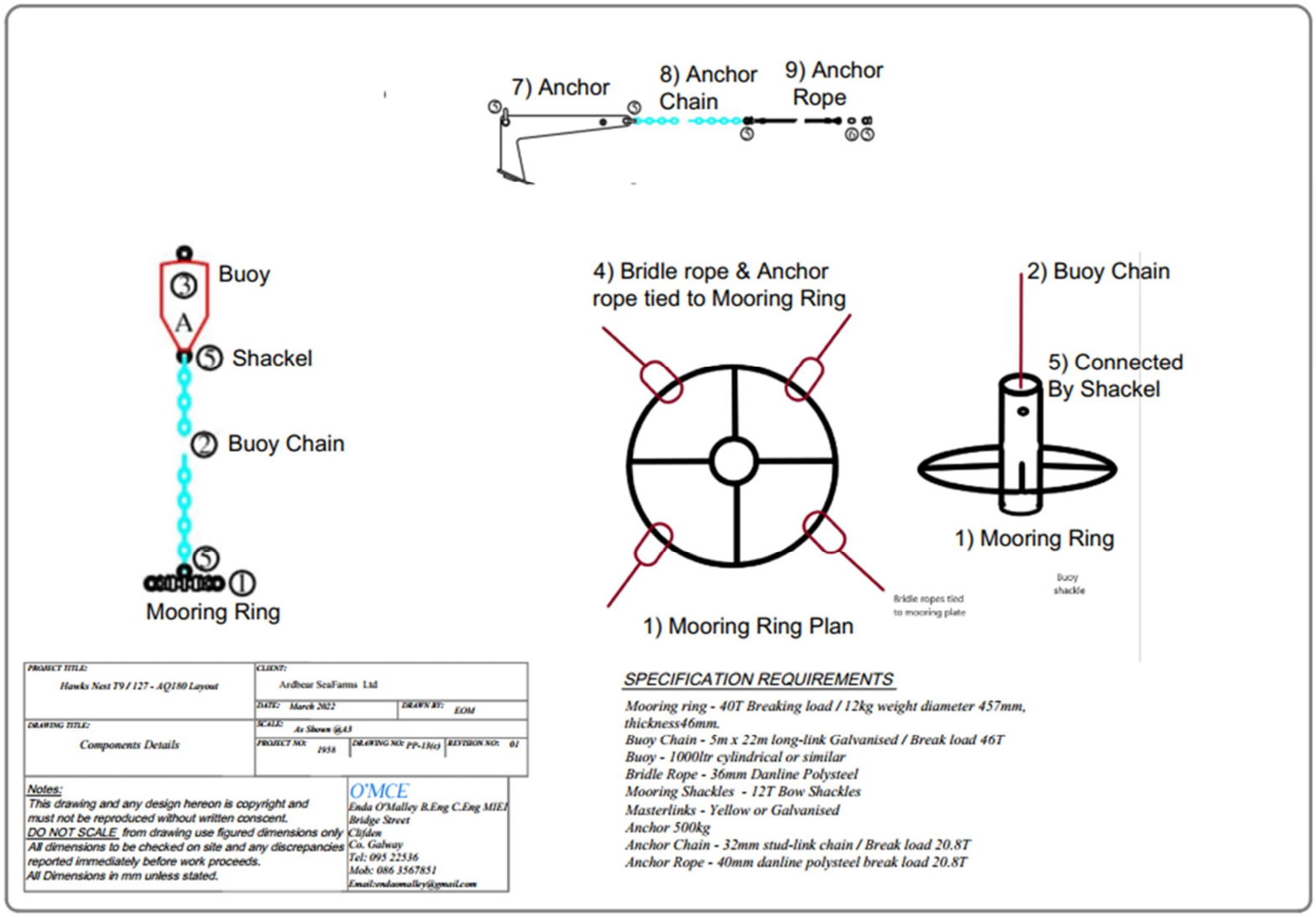

Figure 2-9: Anchors and moorings - Hawk's Nest site.

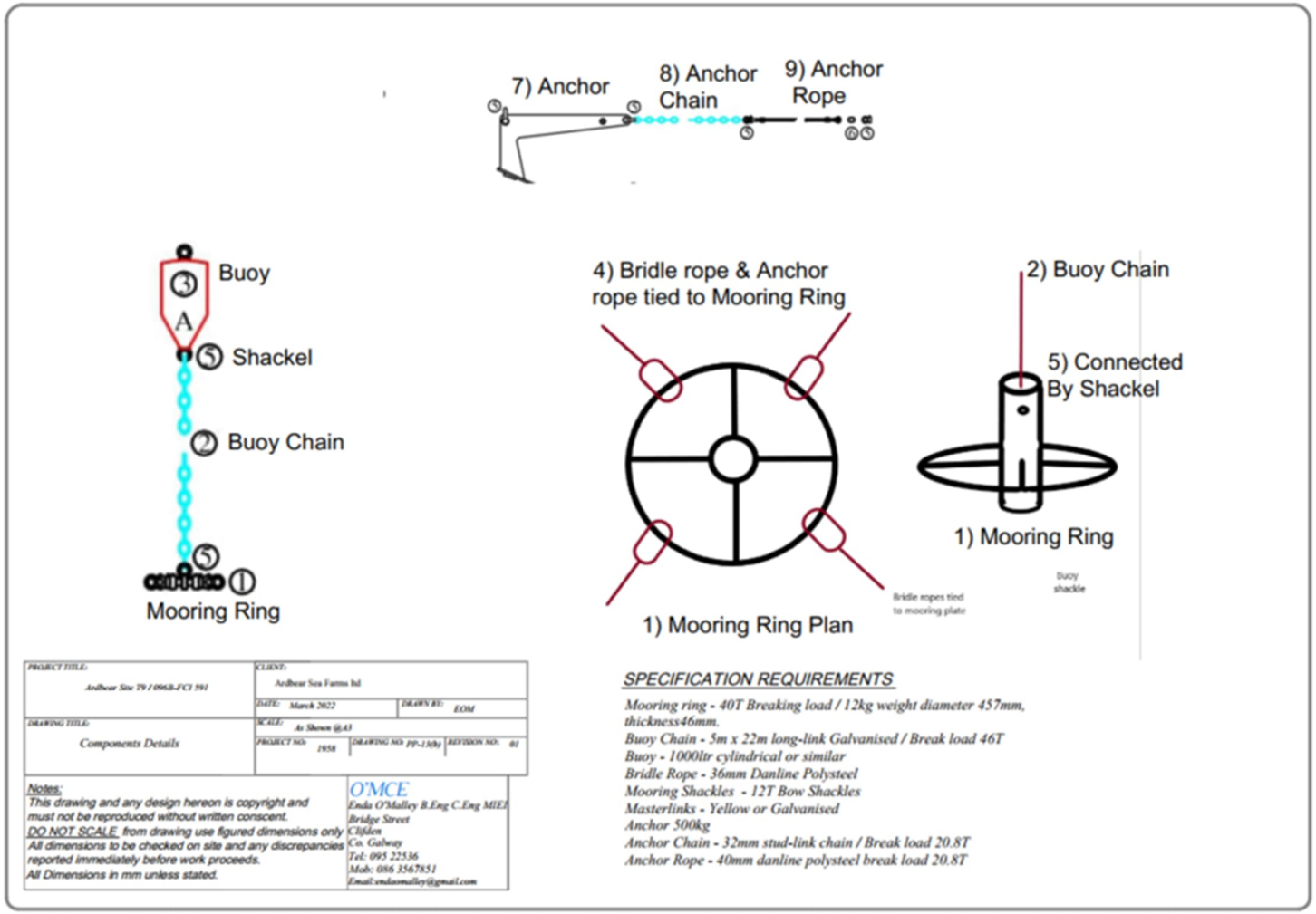

Figure 2-10: Anchors and moorings - Ardbear site.

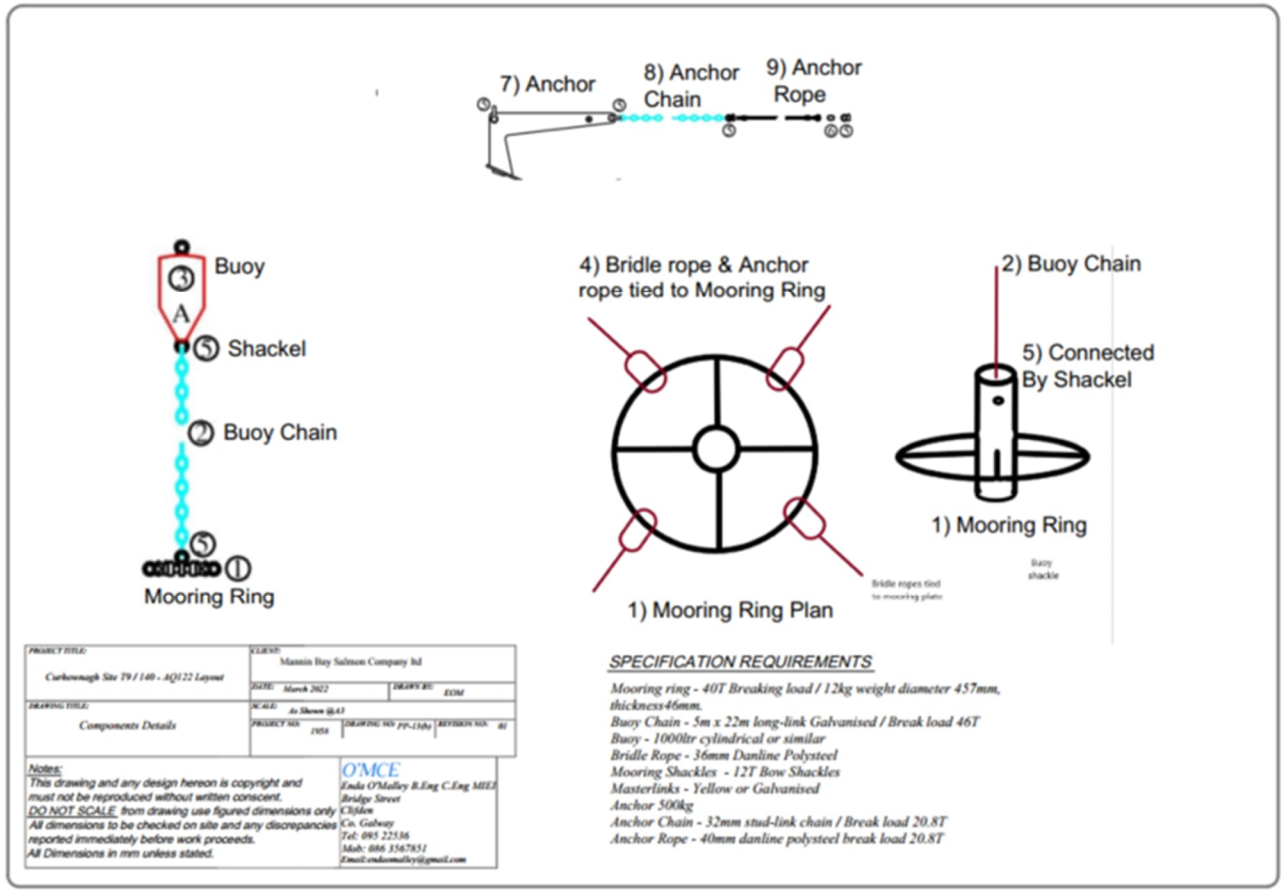

Figure 2-11: Anchors and moorings - Curhownagh site.

2.2.5. Nets

Nets are made of knotless nylon sheeting. In compliance with organic standards, no net antifouling treatment is used. Smolt nets, with a smaller mesh size than grower nets, is installed at the beginning of the cycle. These is made of 16 mm = 210/96 Nylon IRC 460 g/m^2 braided twine, with a 16 mm mesh. The smolt nets are changed in the spring after about three months and replaced with grower nets, made of 22 mm = 210/150 Nylon IRC 500 g/m^2 braided twine with a mesh size of 22 mm.

Fouled nets are exchanged with clean nets when the need arises during the growth cycle. Regular diver inspections check for net damage and fish mortalities. Minor repairs are generally made *in situ* whilst washing, disinfection and larger repairs are carried out at the company's shore-based facilities.

2.2.6. Shore Based Facilities

Shore based facilities used for the Hawk's Nest site and Ardbear site are located at Errislannan. The shore-based facilities Errislannan is serviced by a private pier at Drinagh which is owned by directors of Mannin Salmon Co. Ltd. (see Figure 2-12). The shore-based facilities at Mannin Bay are located at a local public pier at Curhownagh.

The shore-based facilities are used for feed storage, diving and staff and office facilities. The piers at the facilities are used as the access point for service vessels transiting to and from the sites and serve as the mooring points for vessels when not in use. Figure 2-12 shows the road access routes to the Errislannan facility and Curhownagh pier.

Vessels travelling between multiple locations (such as well-boats) have the potential to transfer Invasive Alien Species (IAS), such as *Didemnum*, *Styela*, *Undaria* etc., from one location to a new location. Well boats used are registered on the Aquaculture Animal Transport Register as a 'Specialist Transporter' in compliance with Regulation (EU) 2016/429 (Annex II amended Commission Delegated Regulation (EU) 2018/1629)[4] regarding the Health of Aquaculture Animals and products. As a specialist transporter, the well boat is obliged to comply with water exchange rules and biosecurity management and cleaning protocols which includes the external surfaces of the vessel. Feed is delivered by 30 to 40 articulated lorries per year.

At the sites, on average four to eight- full time employees are required for daily on-site operations. In addition, four part-time staff employed including divers.

[4] Transporting Aquaculture Animals article (Transporting Aquaculture Animals | Fish Health Unit)

Mortalities are transported from the sites on a weekly basis to a service facility at Knocknahaw, Moyard where they are ensiled and stored pending removal to an approved animal by-product processing facility. Additional traffic will occur during harvesting, the regularity depending on the harvest schedule.

2.2.7. Service vessels

The sites will be serviced by the following vessels:

- 2 x 5m PolarCirkel[5] HDPE boat
- 2 barges with 12 tonnes Palfinger cranes
- 1 well boat (chartered up to twice a year)

PolarCirkel boats, which are used to transfer crew and equipment, have the capacity to carry out a wide range of day-to-day farm tasks including towing, anchor handling and net changing. The feed barges are used to transfer feed to the sites. Vessels will operate from the shore at the Drinagh pier and Curhownagh pier and will be moored there or brought ashore in the case of the PolarCirkel boats, when not in operation.

[5] Boats - AKVA group

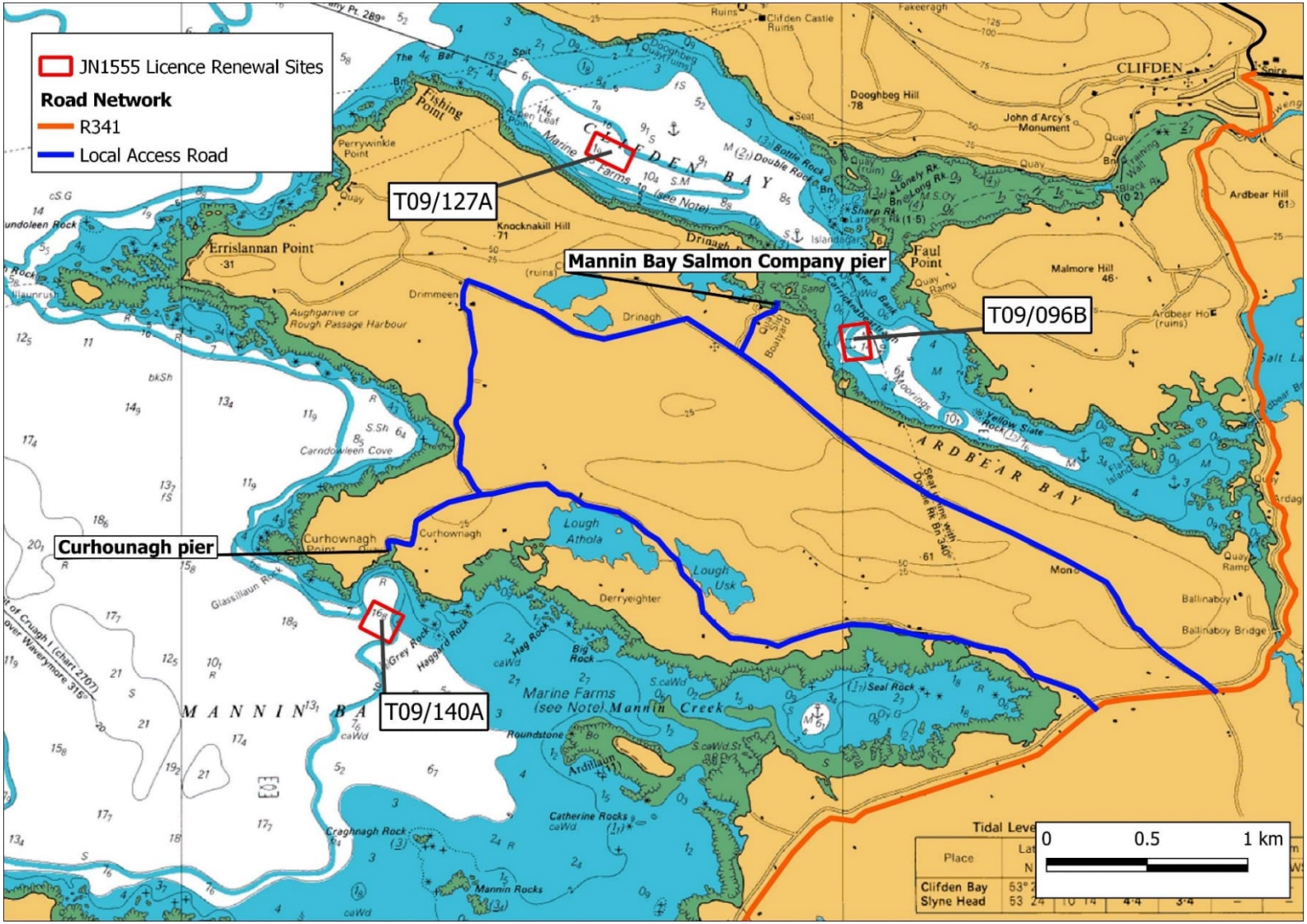

Figure 2-12: Access route to and from the Mannin Salmon Co. Ltd. pier at Errislannan and Curhownagh pier.

2.2.8. Production Model

Table 2-1 shows the production cycle for the Hawk's Nest, Curhownagh and Ardbear sites. Production will occur over a total 21 months across the three sites in Clifden Bay, Ardbear Bay and Mannin Bay:

- Hawk's Nest site - months 1 – 17 (October Year 1 to February Year 2)
- Ardbear site – months 14 –19 (November Year 2 to April Year 2)
- Curhownagh site – months 18 – 21 (March Year 2 to June Year 2)

The licence renewals requests that the operating conditions attached to the licences are amended to allow:

- Hawk's Nest (AQ180 - T09/127A)
    - Harvest 200 tonnes from a net production of 625 tonnes of salmon every 21 months.
- Ardbear (FCL591 - T09/96B)
    - Harvest 182 tonnes from a net production of 86 tonnes of salmon every 21 months.
- Curhownagh (AQ122 - T09/140A)
    - Harvest 380 tonnes from a net production of 110 tonnes of salmon every 21 months.

A summary description of the production cycle at Hawk's Nest site, Curhownagh site, and Ardbear site is given below.

Hawk's Nest site

Approximately 200,000 smolts with an average weight of 90 g are added to pens at the Hawk's Nest site at the beginning of the 21-month cycle (beginning in October Year 1). The smolts are S0 stock derived from MOWI or Aquagen genetic strains. The smolts are supplied by the Douglas Valley Hatchery in Kilworth, Co. Cork. Smolts are approximately 11 months when introduced to the Hawk's Nest site in October. In month 14, a proportion of the stock will be transferred from the Hawk's Nest site to the Ardbear site (approximately 100 t transferred). Approximately 200 tonnes of fish are harvested from the Hawk's Nest site from both months 15 and 16. In month 17, the remaining fish at the Hawk's Nest site (approximately 280 t) are transferred to Curhownagh site.

Ardbear site

The fish transferred from Hawk's Nest site to Ardbear site in month 14 (100 t) are grown out until harvest which occurs at the site in months 18 and 19. Respectively, approximately 86 t and 96 t are harvested in month 18 and 19.

Curhownagh site

Fish transferred to Curhownagh site from Hawk's Nest site in month 17 (280 t) are on-grown until harvest in month 20 and 21 (approximately 190 t and 200 t harvested in month 20 and 21, respectively).

Feed Conversion Rate (FCR)

The FCR for the stock held at the Hawk's Nest site will begin at 1.15 increasing to 1.2 in the months leading up to harvesting. The FCR will be kept at 1.20 at the Curhownagh and Ardbear sites The FCR will be maintained through vigilant observation utilising in-cage cameras for *in situ* monitoring allowing constant supervision of the feeding process.

An FCR rate of 1.2 equates to 1.2 kg of dry, propriety salmon feed will be required to achieve 1 kg of salmon (as wet weight). At an FCR of 1.15 – 1.2 throughout the cycle in Hawk's Nest, a total of 748,427 kg of feed will be fed to the fish stock in each production cycle (Table 2-1). At an FCR of 1.2; 129,962 and 102,702 kg of feed will be fed to the fish stock at the Curhownagh and Ardbear sites, respectively (see Table 2-1). Fish harvested at all sites are modelled to weigh approximately 4.2 – 5.1 kg when harvested (see Table 2-1). The average weight growth at the three sites over the production cycle can be visualised in Figure 2-13. A summary of the biomass gain, feed input and FCR over the production cycle for the three sites is depicted in Figure 2-14.

Fallow Periods

At the end of the cycle at Hawk's Nest, the site will be fallow for 8 months from February until the input of smolts at the start of the next production cycle in October.

The Curhownagh site will be kept fallow for 21 months from June to the following March (when it may be stocked again for the growing of fish).

The Ardbear site will be fallow for 20 months from April to the following October.

Table 2-1: Production cycle for Hawk's Nest site (T09/127A) and Curhownagh site (T09/140A).

Location (Year)	Month No.	Month	Fish No.	Fish Total Wgt. (kilograms)	Fish Avg. Wt. (kilograms)	Fish No. Mortalities	Fish Mortality Wt. (kilograms)	Feed Input (kilograms)	Cumulative Feed (kilograms)	Feed Conversion Ratio	Biomass (kilograms)	Biogain (kilograms)	Fish No. Transfer	Fish Wgt. Transfer (kilograms)	Percent Fish Fed	Fish Harvest No.	Fish Harvest Wgt. (kilograms)	Fish Harvest Avg. Wt. (kg)	Mortality Rate
			200,000	18,000	0.09						18,000								
Hawk's Nest	1	Oct	198,000	18,759	0.09	2000	180	1,080	1,080	1.15	18,759	939			0.06				0.01
Hawk's Nest	2	Nov	196,416	23,428	0.12	1,584	225	5,628	6,708	1.15	23,428	4,894			0.3				0.008
Hawk's Nest	3	Dec	194,845	31,295	0.16	1,571	281	9,371	16,079	1.15	31,295	8,149			0.4				0.008
Hawk's Nest	4	Jan	193,286	44,526	0.23	1,559	376	1,5648	31,726	1.15	44,526	13,607			0.5				0.008
Hawk's Nest	5	Feb	191,740	59,480	0.31	1,546	534	1,7811	49,537	1.15	59,480	15,487			0.4				0.008
Hawk's Nest	6	Mar	190,206	79,454	0.42	1,534	714	2,3792	73,329	1.15	79,454	20,689			0.4				0.008
Hawk's Nest	7	Apr	188,684	106,137	0.56	1,522	953	31,782	105,111	1.15	106,137	27,636			0.4				0.008
Hawk's Nest	8	May	185,854	137,898	0.74	2,830	2,388	39,271	144,381	1.15	137,898	34,149			0.37				0.015
Hawk's Nest	9	Jun	182,508	178,542	0.98	3,345	3,723	51,022	195,404	1.15	178,542	44,367			0.37				0.018
Hawk's Nest	10	Jul	177,946	226,185	1.27	4,563	6,695	62,490	257,893	1.15	226,185	54,339			0.35				0.025
Hawk's Nest	11	Aug	173,497	281,035	1.62	4,449	8,482	79,165	337,058	1.25	281,035	63,332			0.35				0.025
Hawk's Nest	12	Sep	169,160	337,944	2.00	4,337	10,539	84,310	421,368	1.25	337,944	67,448			0.3				0.025
Hawk's Nest	13	Oct	164,931	406,378	2.46	4,229	12,673	101,383	522,752	1.25	406,378	81,107			0.3				0.025
Hawk's Nest	14	Nov	122,049	417,215	3.42	1649	6096	142,232	664,984	1.2	417,215	118,527	41,233	101,595 (Transfer to Ardbear)	0.35				0.01
Hawk's Nest	15	Dec	97,357	376,189	3.86	1220	6258	83,443	748,427	1.2	376,189	69,536			0.2	23,471	104,304	4.44	0.01
Hawk's Nest	16	Jan	78,148	27,9320	3.57	487	2821				279,320					18,723	94,047	5.02	0.005
Hawk's Nest	17	Feb	78,147										78,147	279,313 (Transfer to Curhownagh)					
TOTAL						38,427	62,939	748,427				624,205				42,193	198,351		

Location (Year)	Month No.	Month	Fish No.	Fish Total Wgt. (kilograms)	Fish Avg. Wt. (kilograms)	Fish No. Mortalities	Fish Mortality Wt. (kilograms)	Feed Input (kilograms)	Cumulative Feed (kilograms)	Food Conversion Ratio	Biomass (kilograms)	Biogain (kilograms)	Fish No. Transfer	Fish Wgt. Tranfer (kilograms)	Percent Fish Fed	Fish Harvest No.	Fish Harvest Wgt. (kilograms)	Fish Harvest Avg. Wt. (kg)	Mortality Rate
			41,233	101,595							101,595			101595					
Ardbear	14	Nov	40,821	126,430	3.10	412	564	30,478	30,478	1.2	126,430	25,399			0.3				0.01
Ardbear	15	Dec	40,413	145,605	3.60	408	1,896	25,286	55,764	1.2	145,605	21,072			0.2	0	0		0.01
Ardbear	16	Jan	40,211	162,714	4.05	202	1,092	21,841	77,605	1.2	162,714	18,201			0.15	0	0		0.005
Ardbear	17	Feb	40,050	171,907	4.29	161	976	12,204	89,809	1.2	171,907	10,170			0.075	0	0		0.004
Ardbear	18	Mar	19,905	95,924	4.82	120	774	12,893	102,702	1.2	95,924	10,744			0.075	20,025	85,954	4.29	0.003
Ardbear	19	Apr														19,905	95,924	4.82	
TOTAL						1,304	5,302	102,702				85,585				39,930	181,878		

Location (Year)	Month No.	Month	Fish No.	Fish Total Wgt. (kilograms)	Fish Avg. Wt. (kilograms)	Fish No. Mortalities	Fish Mortality Wt. (kilograms)	Feed Input (kilograms)	Cumulative Feed (kilograms)	Food Conversion Ratio	Biomass (kilograms)	Biogain (kilograms)	Fish No. Transfer	Fish Wgt. Tranfer (kilograms)	Percent Fish Fed	Fish Harvest No.	Fish Harvest Wgt. (kilograms)	Fish Harvest Avg. Wt. (kg)	Mortality Rate
			78,147	279,313		625	931				279,313			279,313					0.008
Curhownagh	18	Mar	77,913	347,885	4.48	234	1,257	83,794	83,794	1.2	347,885	69,828			0.3	0	0		0.003
Curhownagh	19	Apr	77,601	374,788	4.84	312	2,087	34,788	118,582	1.2	374,788	28,990			0.1	0	0		0.004
Curhownagh	20	May	38,335	196,764	5.12	466	3,373	11,244	129,826	1.2	196,764	9,370			0.03	38,800	187,394	4.83	0.006
Curhownagh	21	Jun														38,335	193,390	5.04	
TOTAL						1,637	7,648	129,826				108,188				77,135	380,784		

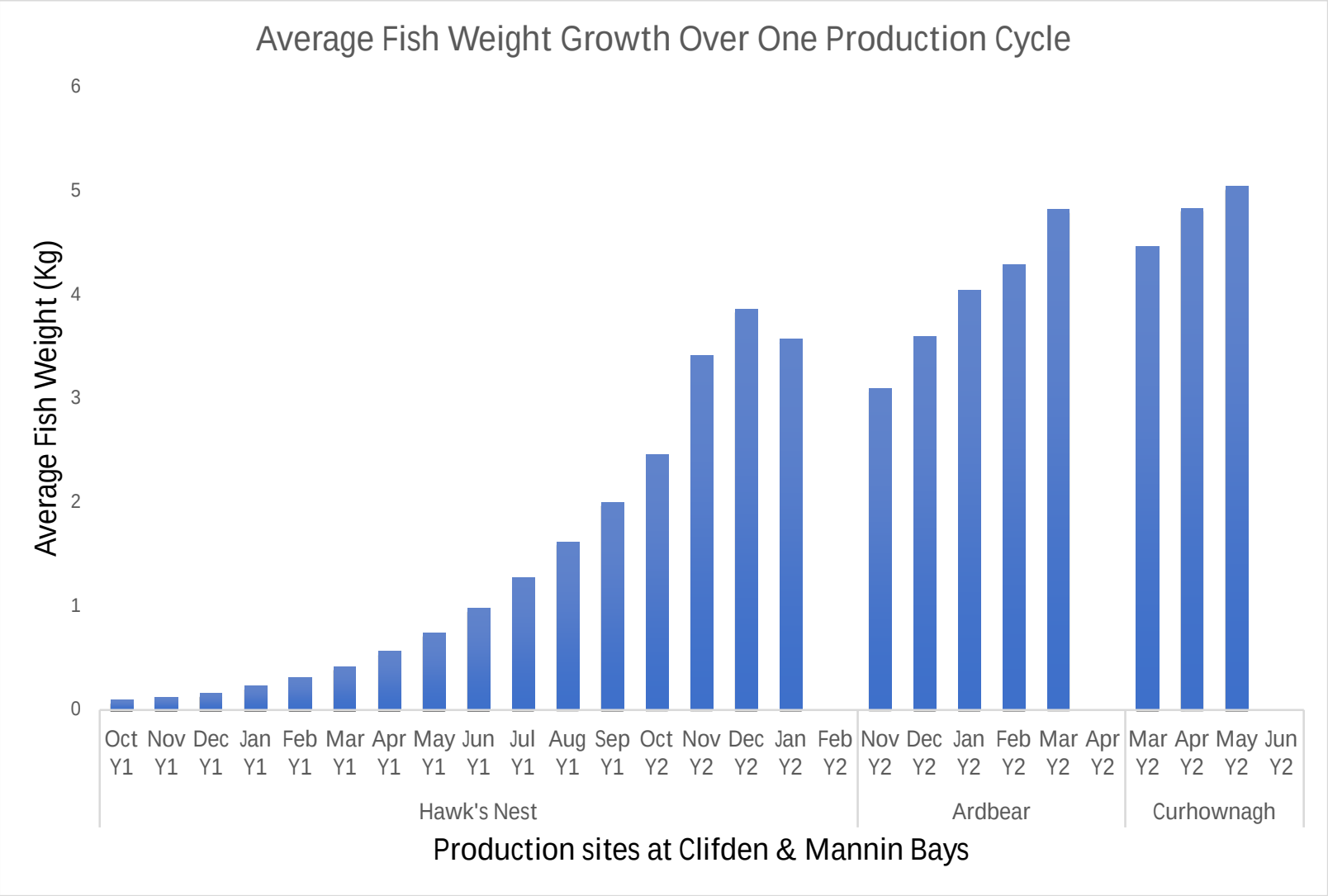

Figure 2-13: Mean weight growth of fish over one production cycle.

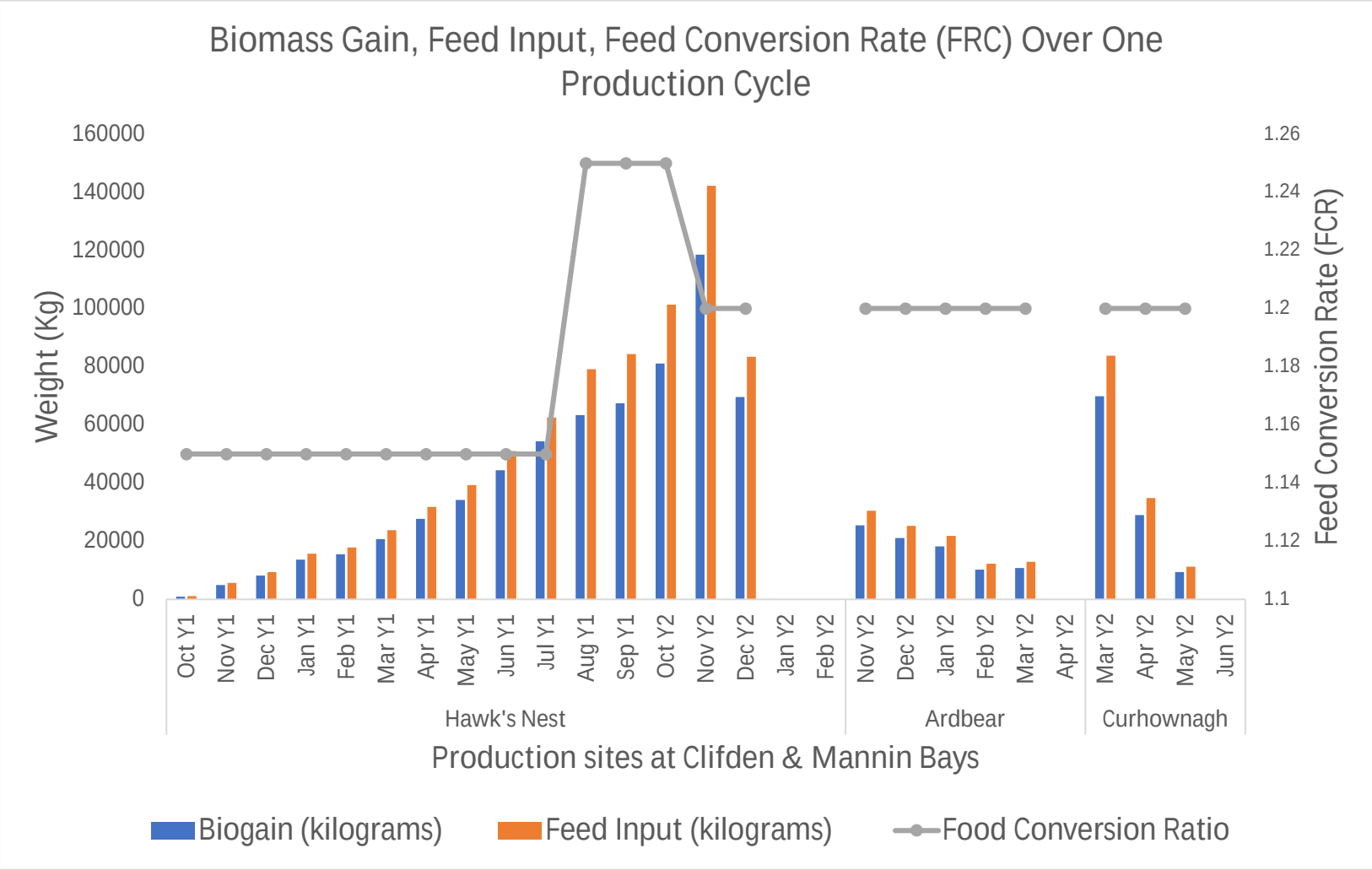

Figure 2-14: Mean biomass gain, feed fed and Feed Conversion Ratio (FCR) for one production cycle at Hawk's Nest, Ardbear and Curhownagh sites.

2.2.9. Feed and Feeding

Salmon at the Hawk's Nest, Curhownagh and Ardbear sites will be fed organic rations that comply with EU Regulation (EU) 2018/848. Under this regulation, organic production combines best environmental practices, contributes to environment protection and natural resources preservation and high animal welfare standards that replaces Regulation (EC) No. 834/2007. Organic feeds are certified in accordance with Irish Organic Association, Naturland (Germany) and Bio Suisse (Switzerland).

The main components of the feed that will are:

- protein 38-46%,
- lipid/oil 22-32.5%,
- nitrogen 12-14%
- phosphorous 0.9-1%.

During operations at the sites, a feed barge will be present. The purpose of the feed barge is to feed the fish automatically throughout the day, thereby allowing for staff to spend more time in the observation of the fish actually feeding, thus, minimising waste and optimising the FCR. The feed barges will be deployed on the shoreward, most sheltered side of the sites. Feed will be delivered by road to shore based facilities and from there by transport barge to the feed barges.

An automated feed delivery system is employed at each of the supported by a customised feed barge that contains silos, a generator and feed dosing system controlled by a dedicated computer using proprietary software.

2.2.10. Husbandry Management

2.2.10.1. Smolt Delivery

Smolts to be used will be sourced from the Douglas Valley Hatchery in Kilworth, Co. Cork. Smolts will be size-graded and counted at the hatchery prior to transportation to the Hawk's Nest site at Clifden. Smolts will be transported by road tankers from the hatchery to the Drinagh pier. They will then be loaded onto a well boat for delivery to the Hawk's Nest site, or from time to time using a helicopter.

The Company Management Plan is included in Appendix 2. Smolt transfer is covered in Section 2 (Stocking, on-growing and handling) of the Company Management Plan in Smolt transfer will be in accordance with SOP #8 of the Management Plan which ensures the stock health is assessed before smolts are inputted into pens. The prevention of escapes during smolt transfer is dealt with in the escape procedures (see Appendix 3).

2.2.10.2. Harvesting & Processing

Harvesting will be carried out for the Hawk's Nest and Ardbear stock at the pier at Drinagh. Fish from the Curhownagh sites will be harvested at the adjacent pier as has occurred since 1989. Harvesting will be undertaken in accordance with SOP#1 of the Company Management Plan to ensure that fish are moved from their pen to the packing plant as quickly and carefully as possible to avoid stress and damage.

2.2.10.3. Site Discharges

Organic feed is used at the Hawk's Nest, Ardbear and Curhownagh sites. The proximate analysis and digestibility of this organic feed is presented in Table 2-2 and Table 2-3. Table 2-4 shows the projected feed requirements for one production cycle based on growth and feed data outlined in Table 2-1 in Section 2.2.8 (Production Model).

Based on proximate analysis (*i.e.* determination of the values of the macronutrients in the rations) and digestibility of the feed (see Table 2-2 and Table 2-3), the breakdown of the feed into its soluble and settleable waste components (see Table 2-5) are used to calculate the following;

1) monthly total BOD discharges (see Figure 2-15),
2) monthly total solids discharges (see Figure 2-16),
3) monthly total carbon discharges (see Figure 2-17),
4) monthly total nitrogen discharges (see Figure 2-18), and
5) monthly total phosphorus discharges (see Figure 2-19)

Based on these outputs, growth and discharge parameters will increase monthly, from input until the peak site standing stock weight of 417.2 tonnes is reached at the Hawk's Nest site in November Year 2. Fish from the Hawk's Nest site will be transferred to the Ardbear and Curhownagh sites with on growing to a peak standing stock of 171.9 tonnes and 374.8 tonnes, respectively at these two sites. There will be no discharges from the site during the fallow period.

Table 2-2: Proximate analysis and digestibility of organic ration.

Ration size (mm)	Mean fish weight range (g)	Gross energy (MJ/kg)	Digestible energy (MJ/kg)	Feed digestibility (%)	Oil (%)	Protein (%)	Phosphorus (%)	Digestible protein (%)	Protein digestibility (%)	Potential FCR	Carbohydrate (%)	NFE %	Ash %	Moisture %
2.7	40-100	21.5	19.1	88.8	22	48	1.4	42.6	88.8	1.1	9.3	11	12.9	6.8
3.3	75-250	21.9	19.4	88.6	21-24	46-49	1.4	42.8	90.1	1.1	9.2	11.1	12.1	6.8
5	250-500	22.8	19.7	86.4	23-26	44-47	1.2	40.0	87.9	1.1	9.9	14.0	10.2	6
7	500-1000	23.4	20.5	87.6	26-29	41-44	1.1	37.6	88.5	1.1	10.3	13.6	9.9	6
9	1000-2500	24.3	21.3	87.7	31-34	38-41	0.9	33.7	85.3	1.1	10.9	14.8	8.7	6
9	2500	24.4	21.5	88.1	32-35	37-40	0.9	33.3	86.5	1.1	10.9	14.4	8.7	6

Table 2-3: Feed carbon content of organic ration.

Protein C (%)	Fat C (%)	CHO C (%)	Total C (%)
26.40	16.50	3.72	46.62
26.95	18.00	3.68	48.63
25.85	19.50	3.96	49.31
24.20	21.75	4.12	50.07
22.55	25.50	4.36	52.41
22.00	26.25	4.36	52.61

Table 2-4: Projected feed requirements for one production cycle

Hawk's Nest site																			
Month No.	Month ending	Biogain (tonnes)	FCR	Fish Avg weight. (grams)	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
1	Oct Y1	0.94	1.15	90.0	Organic	2.7	48	22	1.4	9.3	46.62	1.08	0.52	0.08	0.02	0.50	88.80	88.8
2	Nov Y1	4.89	1.15	120.0	Organic	2.7	48	22	1.4	9.3	46.62	5.63	2.70	0.43	0.08	2.62	88.80	88.8
3	Dec Y1	8.15	1.15	160.0	Organic	3.3	49	24	1.4	9.2	48.63	9.37	4.59	0.73	0.13	4.56	88.60	90.1
4	Jan Y1	13.61	1.15	230.0	Organic	3.3	49	24	1.4	9.2	48.63	15.65	7.67	1.23	0.22	7.61	88.60	90.1
5	Feb Y1	15.49	1.15	310.0	Organic	3.3	49	24	1.4	9.9	48.63	17.81	8.73	1.40	0.25	8.66	88.60	90.1
6	Mar Y1	20.69	1.15	420.0	Organic	5	47	26	1.2	9.9	49.31	23.79	11.18	1.79	0.29	11.73	86.40	87.9
7	Apr Y1	27.64	1.15	560.0	Organic	5	47	26	1.2	9.9	49.31	31.78	14.94	2.39	0.38	15.67	86.40	87.9
8	May Y1	34.15	1.15	740.0	Organic	7	44	29	1.1	10.3	50.07	39.27	17.28	2.76	0.43	19.66	87.60	88.5
9	Jun Y1	44.37	1.15	980.0	Organic	7	44	29	1.1	10.3	50.07	51.02	22.45	3.59	0.56	25.55	87.60	88.5
10	Jul Y1	54.34	1.15	1270.0	Organic	7	44	29	1.1	10.3	50.07	62.49	27.50	4.40	0.69	31.29	87.60	88.5
11	Aug Y1	63.33	1.25	1620.0	Organic	9	41	34	0.9	10.9	52.41	79.17	32.46	5.19	0.71	41.49	87.70	85.3
12	Sep Y1	67.45	1.25	2000.0	Organic	9	41	34	0.9	10.9	52.41	84.31	34.57	5.53	0.76	44.19	87.70	85.3
13	Oct Y2	81.11	1.25	2460.0	Organic	9	41	34	0.9	10.9	52.41	101.38	41.57	6.65	0.91	53.13	87.70	85.3
14	Nov Y2 (Transfer to Ardbear)	118.53	1.2	3420.0	Organic	9	41	34	0.9	10.9	52.41	142.23	58.32	9.33	1.28	74.54	87.70	85.3
15	Dec Y2	69.54	1.2	3860.0	Organic	9	40	35	0.9	10.9	52.61	83.44	33.38	5.34	0.75	43.90	88.10	86.5
16	Jan Y2	Harvest																
17	Feb Y2	Transfer to Curhownagh site																
		Fallow																
Ardbear site																		
Month No.	Month ending	Biogain (tonnes)	FCR	Fish Avg wgt. (grams)	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
14	Nov Y2	25.40	1.2	3100.0	Organic	9	40	35	0.9	10.9	52.61	30.48	12.19	1.95	0.27	16.03	88.10	86.5
15	Dec Y2	21.07	1.2	3600.0	Organic	9	40	35	0.9	10.9	52.61	25.29	10.11	1.62	0.23	13.30	88.10	86.5
16	Jan Y2	18.20	1.2	4050.0	Organic	9	40	35	0.9	10.9	52.61	21.84	8.74	1.40	0.20	11.49	88.10	86.5
17	Feb Y2	10.17	1.2	4290.0	Organic	9	40	35	0.9	10.9	52.61	12.20	4.88	0.78	0.11	6.42	88.10	86.5
18	Mar Y2	10.74	1.2	4820.0	Organic	9	40	35	0.9	10.9	52.61	12.89	5.16	0.83	0.12	6.78	88.10	86.5
19	Apr Y2	Harvest																
		Fallow																
Curhownagh site																		
Month No.	Month ending	Biogain (tonnes)	FCR	Fish Avg. wt (grams)	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
18	Mar Y2	69.83	1.2	4480.0	Organic	9	40	35	0.9	10.9	52.61	83.79	33.52	5.36	0.75	44.08	88.10	86.5
19	Apr Y2	29.07	1.2	4840.0	Organic	9	40	35	0.9	10.9	52.61	34.88	13.95	2.23	0.31	18.35	88.10	86.5
20	May Y2	9.41	1.2	5120.0	Organic	9	40	35	0.9	10.9	52.61	11.29	4.52	0.72	0.10	5.94	88.10	86.5
21	Jun Y2	Harvest																
		Fallow																

Table 2-5: Projected soluble and settleable waste discharge budget including BOD discharges.

Hawk's Nest																				
Month ending	Feed Values		Settleable solids			Settleable solids carbon			Nitrogen discharge T			Phosphorus discharge T			Total BOD discharge T			Total solids BOD only T	Total soluble waste N T	Total soluble waste N BOD T	Total soluble waste C BOD T	Total soluble waste BOD T
	BOD5 T	Susp solids T	Feed waste T	Faeces T	Total solids T	Feed waste C T	Faecal C T	Total solids C T	Settleable N T	Soluble N T	Total N T	Settleable P T	Soluble P T	Total T	N BOD T	C BOD T	Total BOD T					
Oct	0.25	0.07	0.03	0.11	0.14	0.01	0.09	0.11	0.01	0.05	0.05	0.00	0.01	0.01	0.24	0.73	0.97	0.52	0.05	0.21	0.45	0.66
Nov	1.31	0.36	0.16	0.58	0.74	0.07	0.48	0.56	0.03	0.24	0.27	0.02	0.03	0.06	1.24	3.82	5.06	2.73	0.24	1.10	2.33	3.43
Dec	2.18	0.61	0.27	0.98	1.25	0.13	0.84	0.97	0.05	0.42	0.47	0.03	0.06	0.09	2.13	6.87	9.00	4.72	0.42	1.92	4.28	6.20
Jan	3.65	1.01	0.45	1.64	2.09	0.22	1.40	1.62	0.08	0.70	0.78	0.06	0.09	0.15	3.56	11.47	15.03	7.88	0.70	3.20	7.15	10.35
Feb	4.15	1.15	0.51	1.87	2.38	0.25	1.60	1.84	0.09	0.80	0.89	0.07	0.11	0.17	4.05	13.06	17.10	8.97	0.80	3.65	8.14	11.78
Mar	5.54	1.54	0.68	2.98	3.66	0.33	2.16	2.50	0.13	0.97	1.11	0.07	0.11	0.19	5.06	17.87	22.93	11.72	0.97	4.45	11.21	15.65
Apr	7.40	2.06	0.91	3.98	4.89	0.45	2.89	3.33	0.18	1.30	1.48	0.09	0.15	0.25	6.76	23.88	30.63	15.66	1.30	5.94	14.97	20.91
May	9.15	2.55	1.12	4.49	5.61	0.56	3.62	4.18	0.19	1.45	1.64	0.10	0.17	0.27	7.49	30.30	37.79	18.66	1.45	6.63	19.13	25.75
Jun	9.15	3.31	1.45	5.83	7.28	0.73	4.71	5.44	0.24	1.88	2.13	0.13	0.21	0.35	9.73	39.36	49.09	24.24	1.88	8.61	24.85	33.46
Jul	14.56	4.05	1.78	7.14	8.92	0.89	5.77	6.66	0.30	2.31	2.61	0.16	0.26	0.42	11.91	48.21	60.13	29.69	2.31	10.54	30.44	40.98
Aug	20.16	6.51	2.26	8.97	11.23	1.18	7.65	8.83	0.46	2.65	3.10	0.15	0.25	0.41	14.19	69.60	83.79	37.76	2.65	12.10	46.03	58.13
Sep	21.47	6.93	2.40	9.56	11.96	1.26	8.14	9.40	0.49	2.82	3.31	0.16	0.27	0.43	15.11	74.13	89.24	40.22	2.82	12.89	49.02	61.91
Oct	25.82	8.34	2.89	11.49	14.38	1.51	9.72	11.23	0.58	3.39	3.98	0.20	0.32	0.52	18.17	88.03	106.20	48.16	3.39	15.50	59.15	74.65
Nov	34.66	10.40	4.05	16.12	20.17	2.12	13.74	15.86	0.80	4.62	5.42	0.27	0.44	0.71	24.78	121.97	146.75	67.13	4.62	21.13	79.62	100.75
Dec	20.34	6.10	2.38	9.15	11.53	1.25	8.00	9.25	0.41	2.64	3.05	0.16	0.26	0.41	13.93	70.64	84.57	38.62	2.64	12.05	47.31	59.36
Jan	No feeding; Harvest then site fallow																		No feeding; Harvest then site fallow			
Feb																						
Total T pa	179.79	55.00	21.33	84.91	106.24	10.98	70.81	81.78	4.03	26.24	30.27	1.68	2.75	4.43	138.32	619.96	758.28	356.68	26.24	119.91	404.07	523.98
Ardbear																						
Month ending	Feed Values		Settleable solids			Settleable solids carbon			Nitrogen discharge T			Phosphorus discharge T			Total BOD discharge T			Total solids BOD only T	Total soluble waste N T	Total soluble waste N BOD T	Total soluble waste C BOD T	Total soluble waste BOD T
	BOD5 T	Susp solids T	Feed waste T	Faeces T	Total solids T	Feed waste C T	Faecal C T	Total solids C T	Settleable N T	Soluble N T	Total N T	Settleable P T	Soluble P T	Total T	N BOD T	C BOD T	Total BOD T					
Nov	7.43	2.23	0.87	3.34	4.21	0.46	2.96	3.41	0.15	0.96	1.11	0.06	0.09	0.15	5.09	26.30	31.39	14.20	0.96	4.40	17.19	21.59
Dec	6.16	1.85	0.72	2.77	3.49	0.38	2.45	2.83	0.12	0.80	0.92	0.05	0.08	0.13	4.22	21.82	26.04	11.78	0.80	3.65	14.26	17.91
Jan	5.32	1.60	0.62	2.40	3.02	0.33	2.12	2.45	0.11	0.69	0.80	0.04	0.07	0.11	3.64	18.85	22.49	10.17	0.69	3.15	12.32	15.47
Feb	2.97	0.89	0.35	1.34	1.69	0.18	1.18	1.37	0.06	0.39	0.45	0.02	0.04	0.06	2.04	10.53	12.57	5.68	0.39	1.76	6.88	8.64
Mar	3.14	0.94	0.37	1.41	1.78	0.19	1.25	1.44	0.06	0.41	0.47	0.02	0.04	0.06	2.15	11.13	13.28	6.01	0.41	1.86	7.27	9.13
Apr	No feeding; Harvest then site fallow																		No feeding; Harvest then site fallow			
Total T pa	25.03	7.51	2.93	11.26	14.19	1.54	9.96	11.50	0.51	3.24	3.75	0.19	0.32	0.51	17.14	88.62	105.76	47.84	3.24	14.83	57.92	72.75
Curhownagh																						
Month ending	Feed Values		Settleable solids			Settleable solids carbon			Nitrogen discharge T			Phosphorus discharge T			Total BOD discharge T			Total solids BOD only T	Total soluble waste N T	Total soluble waste N BOD T	Total soluble waste C BOD T	Total soluble waste BOD T
	BOD5 T	Susp solids T	Feed waste T	Faeces T	Total solids T	Feed waste C T	Faecal C T	Total solids C T	Settleable N T	Soluble N T	Total N T	Settleable P T	Soluble P T	Total T	N BOD T	C BOD T	Total BOD T					
Mar	20.42	6.13	2.39	9.19	11.58	1.26	8.12	9.38	0.41	2.65	3.06	0.16	0.26	0.42	13.98	72.31	86.29	39.03	2.65	12.10	47.26	59.35
Apr	8.50	2.55	0.99	3.82	4.82	0.52	3.38	3.90	0.17	1.10	1.27	0.07	0.11	0.17	5.82	30.10	35.92	16.25	1.10	5.03	19.67	24.71
May	2.75	0.83	0.32	1.24	1.56	0.17	1.09	1.26	0.06	0.36	0.41	0.02	0.03	0.06	1.88	9.74	11.63	5.26	0.36	1.63	6.37	8.00
Jun	6.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jan	No feeding; Harvest then site fallow																		No feeding; Harvest then site fallow			
Feb																						
Total T pa	38.13	9.51	3.70	14.25	17.96	1.95	12.60	14.55	0.64	4.11	4.75	0.24	0.40	0.64	21.69	112.14	133.83	60.54	4.11	18.76	73.30	92.06

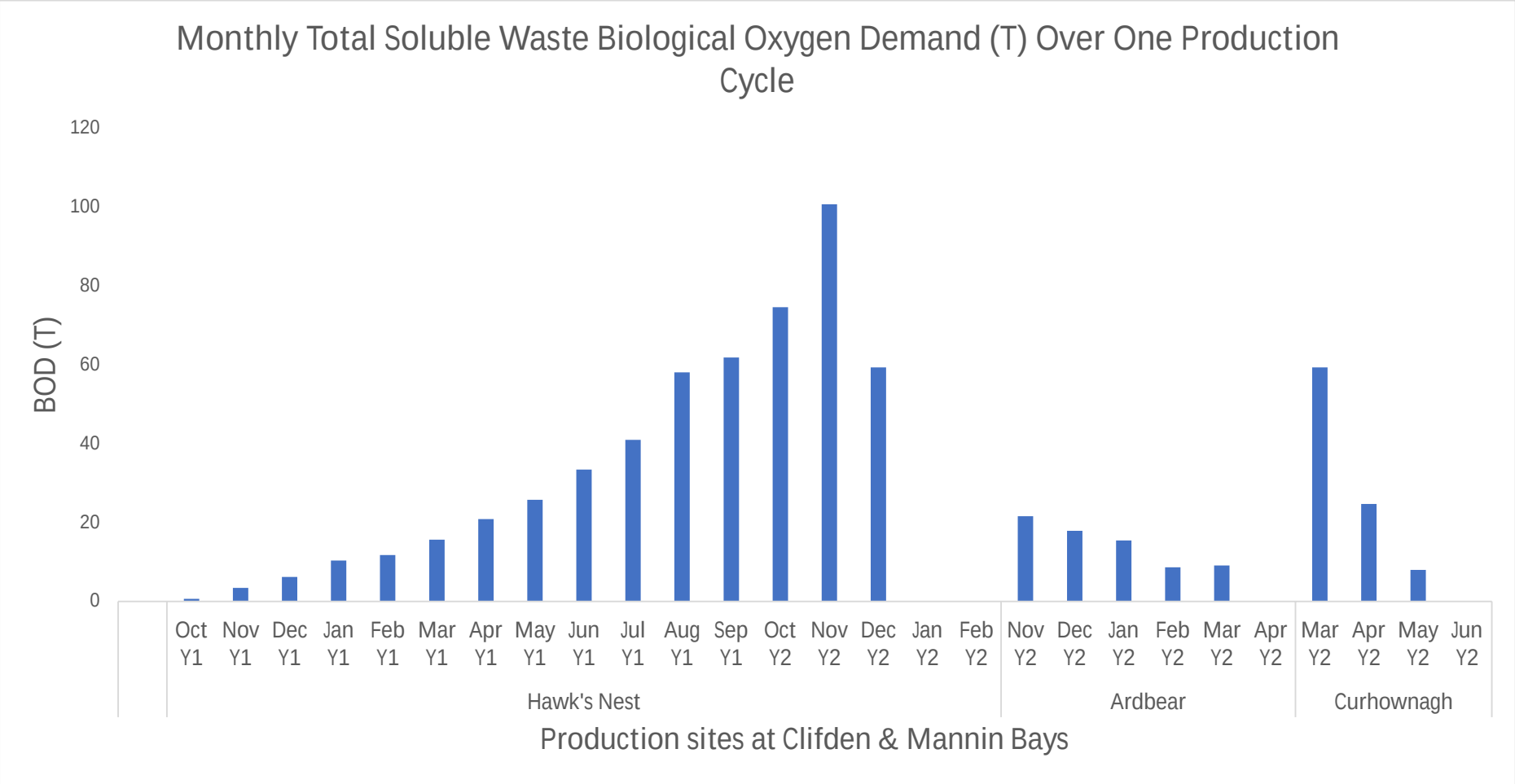

Figure 2-15: Total BOD of waste discharges (tonnes per month) for one production cycle.

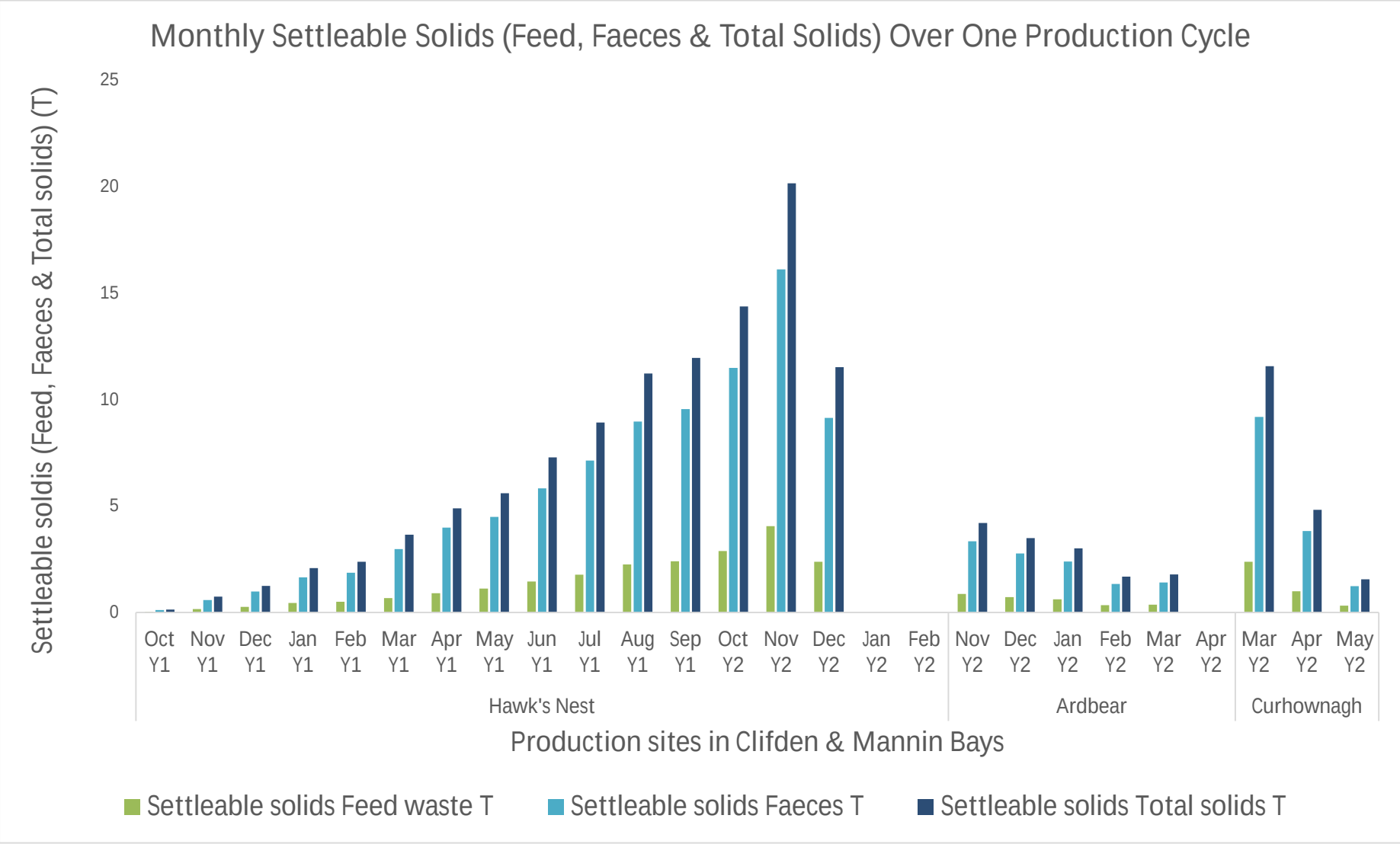

Figure 2-16: Total solids discharge (tonnes per month) for one production cycle.

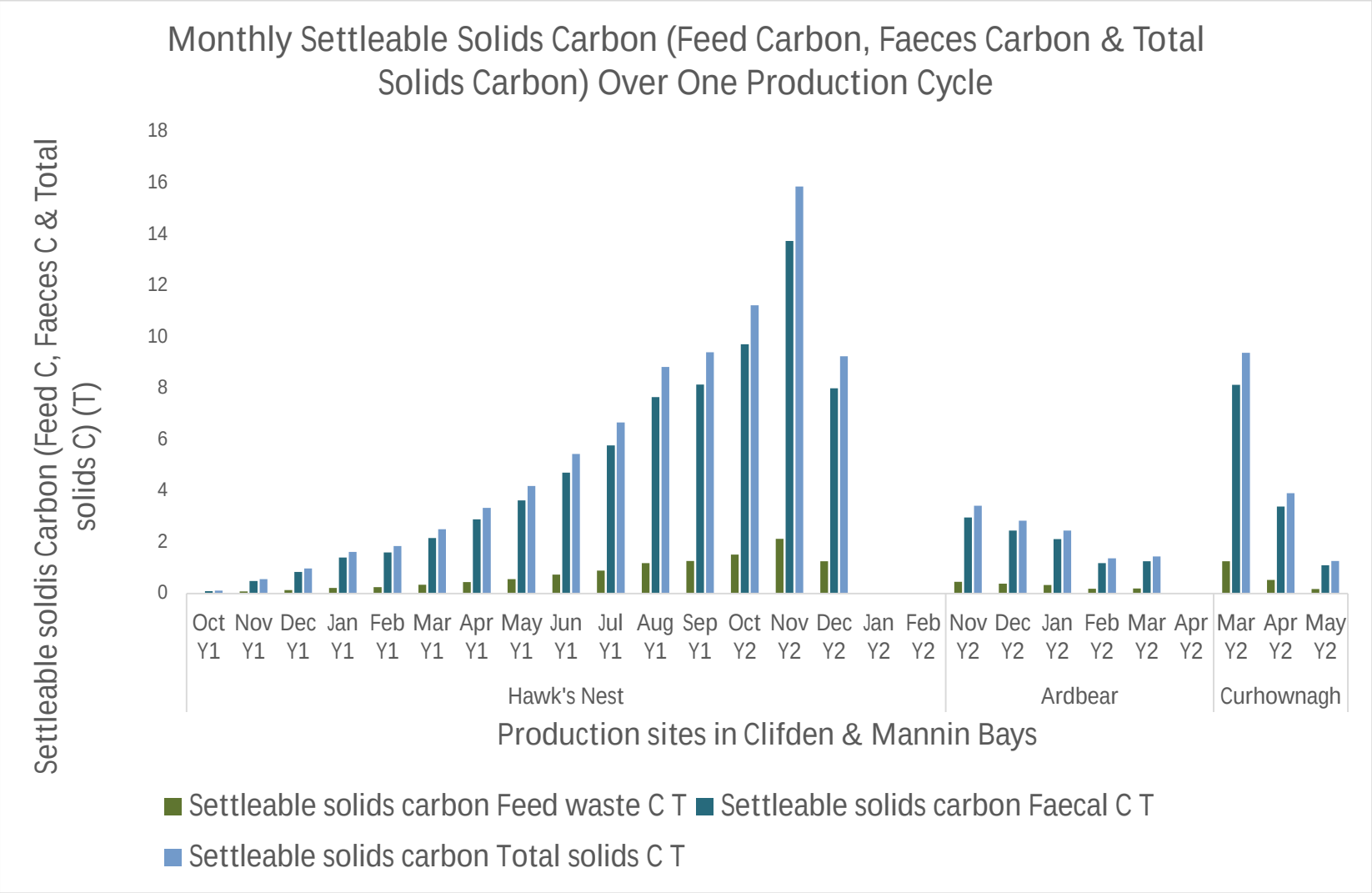

Figure 2-17: Total Carbon discharge (tonnes per month) for one production cycle.

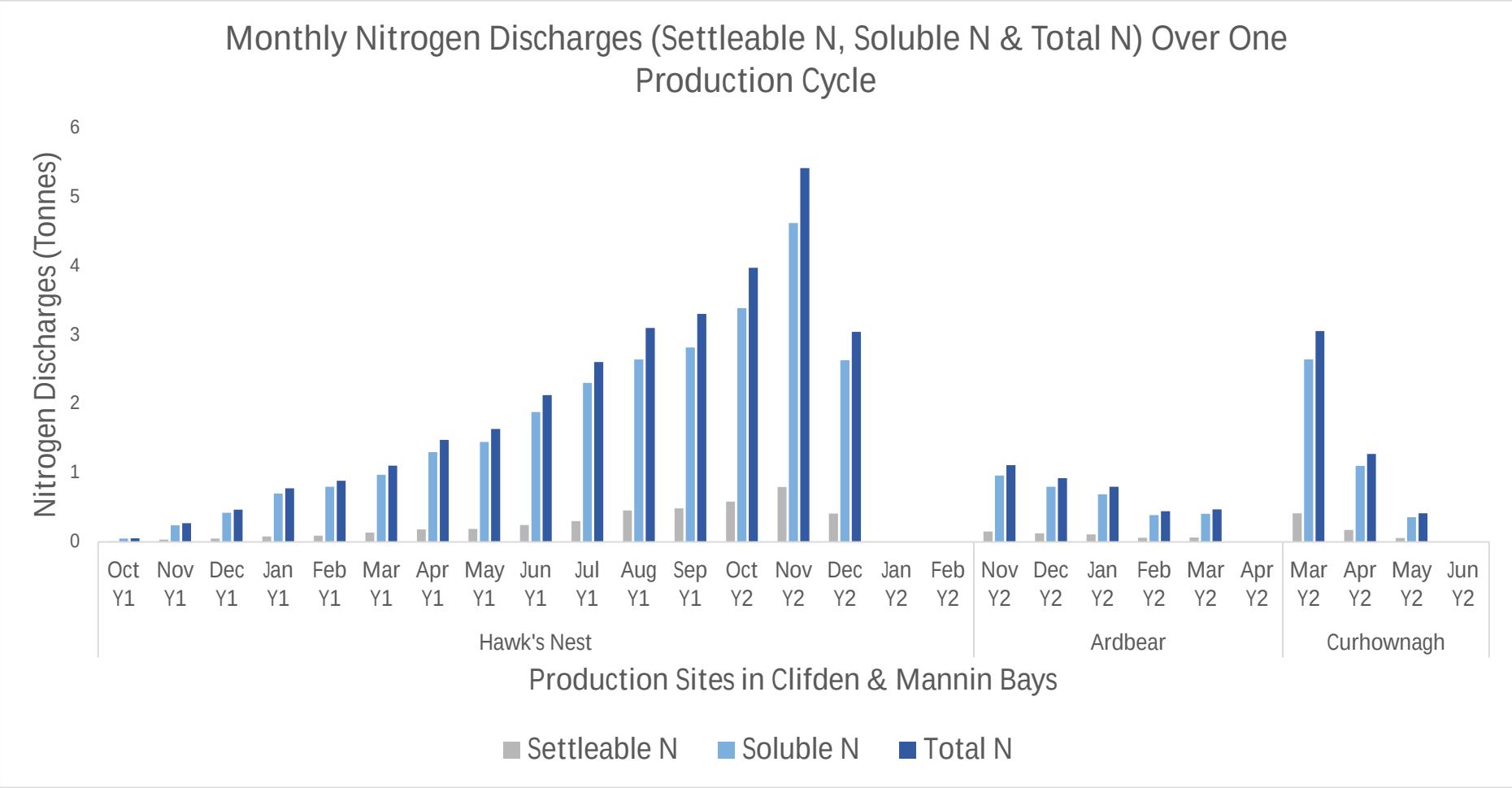

Figure 2-18: Total nitrogen discharge (tonnes per month) for one production cycle.

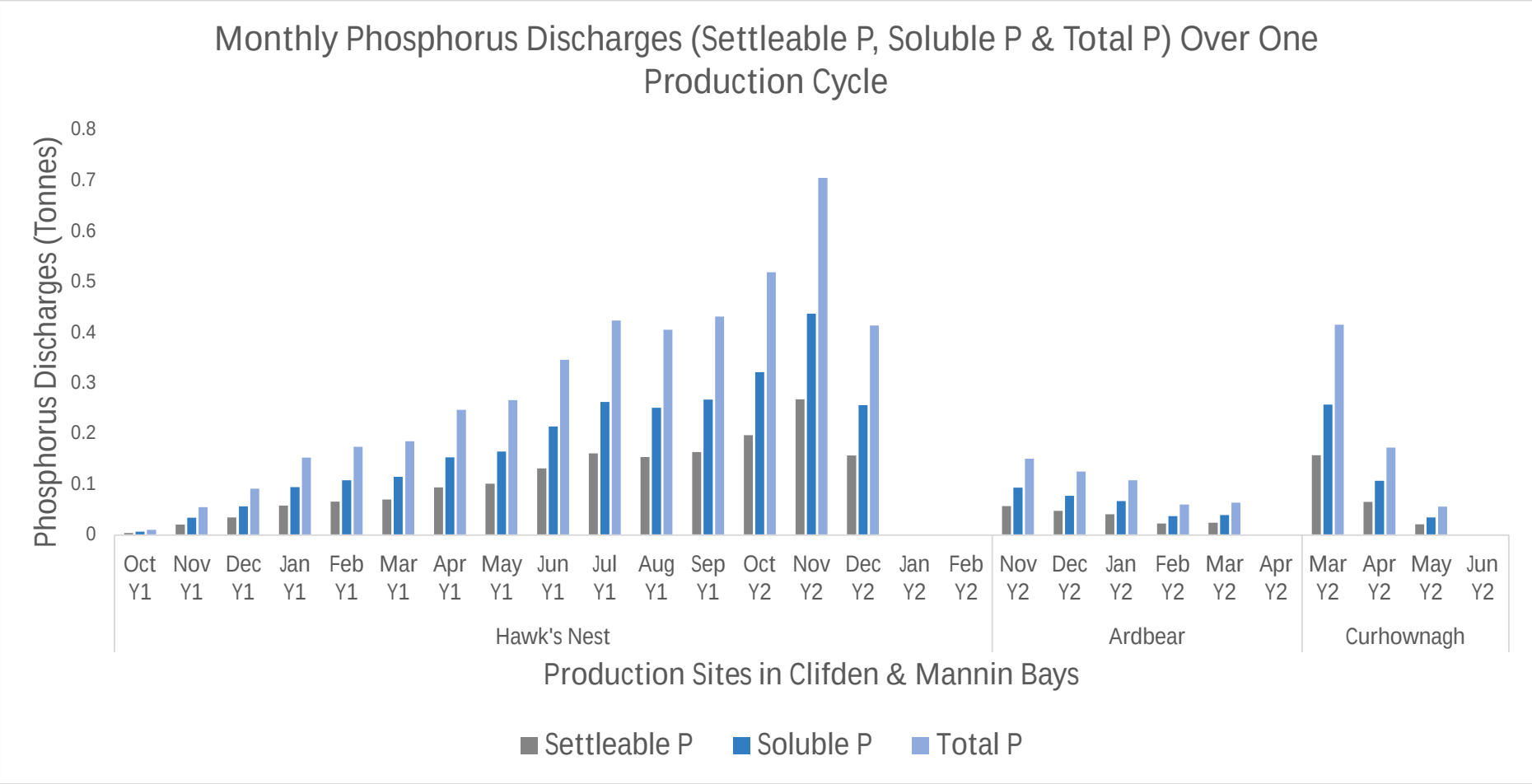

Figure 2-19: Total phosphorus discharge (tonnes per month) for one production cycle.

2.2.11. Waste Management

2.2.11.1. Waste

Mannin Salmon Co. Ltd. and Ardbear Seafarms Ltd. are committed to operating the salmon farming business in accordance with all relevant legislative requirements to ensure harmony with, and safeguarding of, the environment. It is company policy to establish environmental management systems that regularly monitor waste output to ensure that waste is minimised, and recycling is maximised. Operations will be regularly reviewed with regard to environmental safety and legislative requirements. Standard operating procedures (SOPs) and quality assurance procedures will be regularly reviewed to ensure they comply with environmental legislation. Ongoing staff training will be actively encouraged to ensure continued excellence in services provided and adherence to company protocols.

2.2.11.2. Mortality Disposal

Mortalities will be removed from pens by divers at least twice per week, or more frequently subject to observed mortality trends and to maintain the health of the stock. Mortalities will be moved to the dedicated ensiling facility located at Moyard, Ballinakill Bay, and stored there until dispatch to Ballaghdereen biodigester plant through a dedicated sub-contractor.

Collected mortalities will be transported for high temperature rendering at an approved animal by-products rendering plant, as required by DAFM guidelines.

2.2.12. Health Management

Health management on Ardbear Salmon Ltd. and Mannin Salmon Ltd. sites are conducted according to company *Health Plans*. The plans underpin the company's obligations under EU and national legislation, namely:

- European Communities (Health of Aquaculture Animals and Products) Regulations 2016 (Regulation (EU) 2016/429 (Annex II amended Commission Delegated Regulation (EU) 2018/1629)), as amended by the European Communities (Health and Aquaculture Animals and Products) (Amendment) Regulations 2010 (S.I. No 398 of 2010), 2011 (S.I. No 430 of 2011) and 2015 (S.I. No 23 of 2015).
- EC Council Directive 2001/82/EC and SI 144 of 2007 (Animal Remedies Regulations).
- Commission Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products

not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation).

- Commission Regulation (EU) No 142/2011 of 25 February 2011 implementing Regulation (EC) No 1069/2009 of the European Parliament and of the Council

The main goals of the *Health Plan* are as follows:

- To prevent and control fish diseases and ensure the maintenance of a high level of fish health and welfare,
- To minimise environmental impact; and
- To rear salmon in accordance with industry guidelines, current best practices and in accordance with organic standards.

The primary actions of the health plan are:

- Vigilance and regularity in stock monitoring against key performance indicators,
- Disciplined and detailed record keeping,
- Official notification in the event of disease outbreaks, and
- Application of therapy under veterinary supervision/prescription, in strict adherence to the organic standards that will apply at the site.

The health plan lays down that observation of the stock, from which all remedial actions will stem, will comprise:

- Daily (surface) observations of fish behaviour by site managers and feeding operatives, as well as during routine operations such as feeding and net changing,
- Professional diver observation of behaviour and general fish health at least weekly or more frequently, subject to mortality trends, with recording of all mortalities by number and likely cause of death,
- A minimum of bimonthly clinical examination of all stocks by veterinarian, and

The stock performance (*e.g.,* feeding rate, mortality rates) will be assessed at least once a week by the Production Manager for any indications of disease or abnormalities in the stock.

2.2.12.1. Treatment of Disease

The Production Manager shall notify the Fish Health Unit of the Marine Institute within 48 hours of the suspected appearance of any abnormal losses or mortalities and shall carry out instructions issued by the Fish Health Unit Manager as a result of notification including instructions relating to the treatment,

disposal and destruction of diseased stocks. In addition, the AFMD section of the DAFM will also be notified of any abnormal losses or mortalities.

Company veterinarians will determine, where necessary, the appropriate medication to control and/or prevent the outbreak of disease. The company biologist will provide the veterinarian with stock information such as stock type, number, average weights, feeding rates and food type used. The veterinarian will supply the remedy and prescription to the company biologist and/or to the feed mill, where appropriate. The company biologist will ensure that all animal remedies will be administered according to veterinary advice and/or the manufacturers' instructions. All animal remedies shall be administered in accordance with the relevant legislation SI 786 of 2007 (Animals Remedies Regulations 2007).

Medicines permitted are supplied on the advice of the company's veterinary surgeons on prescription. The operators take a preventative approach to the susceptibility of stock to exposure to the most common infectious diseases through the use of vaccines prior to transfer to seawater. Vaccine selection is based on a destination site risk assessment and recommendations of the company veterinarians.

As a generalisation, farmed fish are affected by a small range of "domestic" diseases, much as other domesticated stock. Some are indigenous to local wild fish species. Fish are vaccinated for the most common bacterial and viral diseases. If required, clinical outbreaks may be treated with medicines approved for salmon aquaculture, however, such instances have not occurred in recent years.

Although new or unrecognised diseases do occur, their antecedents can, more often than not, be found in other salmon farming areas such as Norway or Scotland. However, such occurrences are unusual, and in consequence, occurrences are treated with the utmost urgency by both the company and its veterinary consultants. Industry experience, over many years, is that disease is consequent with stock stress, caused, by high temperature/low oxygen conditions brought about by water quality. Water quality is a function of the levels of algae which can bloom with different species from year to year.

In the event of an outbreak of bacterial disease, which is normally indicated by the appearance of moribund fish and or the subsequent increase in mortality levels, the standard operating procedure entails isolation of the pathogen following veterinary diagnosis and sampling. Diagnosis now involves the use of 'Polymerase Chain Reaction - PCR' tests, the reading of 'histology slides' and the now more basic agar culture of the bug in a microbiology laboratory. Testing against a range of antibiotics is

conducted in the laboratory to establish a sensitivity pattern for the infection. This allows the best treatment to be selected. Treatments for fish disease is based on the advice of the vet.

In the event of an-in feed requirement for administration of the medicine then this is mixed by arrangement and direction from the Vet at the feed mill. Careful measured levels of the medicated feed are then administered according to the biomass held in each cage for the duration of the treatment. It is a condition of the organic accreditation agency that residue levels of the remedy are measured well in advance of harvest. Strict withdrawal periods are in place which are stringently audited both by the organic agency and also as a requirement of the sales company.

In general, mortalities from bacterial infections in recent years have been at a very low level. This improvement has been brought about as the result of the introduction of modern vaccines. These vaccines have also contributed greatly to the reduction of pancreas disease (a viral infection that affect young fish making them anaemic and susceptible to other diseases) which was been recorded as the most significant cause of mortality in Irish farmed sites in the early 1990s (Jansen *et al.*, 2016).

Other primary health problems relate to the exposure of fish stock to harmful phytoplankton and gelatinous zooplankton which cause damage to gills and can result in high mortality rates (Clinton *et al.*, 2021). Jellyfish are of also particular concern for marine finfish aquaculture. In recent years, swarms of jellyfish have caused mass mortality episodes of farmed fish on the island of Ireland (Cronin *et al.*, 2004a). The sites at Hawk's Nest, Curhownagh, and Ardbear have not had mass mortalities due to jellyfish but have had challenges from phytoplankton over the years.

2.2.12.2. Parasite Control

Sea lice are natural parasites of both wild and farmed fish. Two sea lice species are major parasites of European salmonids. The marine louse, *Caligus elongatus* parasitises many marine fish species including salmon. The salmon louse, *Lepeophtheirus salmonis* is more euryhaline in habit and is a parasite specific to salmonids in brackish to fully marine conditions (25 to 35 psu). *L. salmonis* is the more problematic of the two species for both wild and farmed salmonids. The Marine Institute has established levels for ovigerous female *L. salmonis* per fish above which treatment is required; further details on treatment trigger levels are provided in Section 2.2.12.3 below.

Amoebic Gill Disease (AGD) is caused by a microscopic protozoan parasite (amoeba) *Neoparamoeba perurans*, which colonises the gills causing severe gill pathology which appears as pale grey/white swellings and patches which can develop and spread over the gill surface (Downes *et al.*, 2018). The most typical signs associated with AGD are lethargy, respiratory distress and congregation at the water surface (Downes *et al.*, 2018) which can lead to increased mortalities (Rodger, 2014).

2.2.12.3. Monitoring of Sea Lice

Regular sea lice monitoring is carried out in Clifden Bay and Mannin Bay for the current operations and will continue under the renewed if granted. Statutory monitoring is carried out by the Marine Institute and follows the mandatory lice monitoring and control protocols described in Department of the Marine and Natural Resources (DMNR) guidance (DMNR, 2000a; b). This comprises the inspection and sampling of fish on every salmonid farm site in each Single Bay Management Area a minimum of fourteen times per annum. Inspections are carried out monthly, with the following exceptions:

- During the "susceptible spring period" for migrating wild salmonid smolt especially sea trout smolt, during March to May, when there are two inspections per month and treatment trigger levels are set at an average of 0.5 ovigerous female *L. salmonis* lice per fish,
- Over the two-month period of December to January lice growth is slow and therefore only one inspection is required. Trigger levels are set at an average of 2 ovigerous female *L. salmonis* per fish.

On each inspection, two samples of 30 fish are taken, under standard conditions. The first sample is taken from a standard pen, sampled on every inspection, whilst the second is taken from another pen, selected at random. During the susceptible spring period, if levels of ovigerous female *L. salmonis* numbers reach an average of 0.5 per fish then a treatment is mandatory. At all other times of the year the treatment trigger level is 2.0 ovigerous lice per fish.

A summary of sea lice monitoring records of the National Survey of Sea Lice[6] (O'Donohoe *et al.* 2018, 2019, 2020, 2021, D'Arcy *et al.*, 2023) (*L. salmonis* and *C. elongatus*) at Mannin and Clifden Bays is presented in detail in Table 2-6, alongside the treatment trigger levels (TTL) in place at the time.

There was only one inspection on the 28th of August 2019 that recorded a level above the TTL of 2 ovigerous female sea lice per fish at the Hawk's Nest site.

[6] National Survey of Sea Lice reports: Irish Fisheries Bulletin (marine.ie)

Table 2-6: Records of sea lice infestation at Hawk's Nest and Curhownagh sites between 2017 to 2022 (Counts exceeding the treatment trigger levels are highlighted).

Year	Stage of salmon	Site	Date	*Lepeophtheirus salmonis*				*Caligus elongatus*			Total Lice
				Treatment Trigger Level	Ovigerous Female Lice	Juvenile & Mobile Lice	Total *L. salmonis*	Ovigerous Female Lice	Juvenile & Mobile Lice	Total *C. elongatus*	
2018	Atlantic salmon 2017 1/2	Hawk's Nest	05/12/2018	2	0.33	0.84	1.17	0.00	0.00	0.00	0.00
			22/02/2018	2	1.78	2.06	3.84	0.00	0.00	0.00	3.84
			08/03/2018	2	1.60	2.17	3.77	0.00	0.07	0.07	3.84
	Harvested out										
2019	Atlantic salmon 2019 1/2	Hawk's Nest	11/01/2019	2	0.00	0.00	0.00	0.10	0.02	0.12	0.12
			06/02/2019	2	0.00	0.00	0.00	0.13	0.09	0.22	0.22
			14/03/2019	0.5	0.00	0.10	0.10	0.20	0.14	0.34	0.44
			21/03/2019	0.5	0.02	0.16	0.18	0.39	0.07	0.46	0.64
			04/04/2019	0.5	0.06	0.13	0.19	0.07	0.02	0.09	0.28
			25/04/2019	0.5	0.06	0.10	0.16	0.00	0.00	0.00	0.16
			09/05/2019	0.5	0.04	0.21	0.25	0.00	0.02	0.02	0.27
			28/05/2019	0.5	0.11	0.91	1.02	0.00	0.00	0.00	1.02
	Transferred to Curhownagh & Fraochoilean										
	Atlantic salmon 2019 1/2	Curhownagh	25/06/2019	2	0.13	0.22	0.35	0.00	0.00	0.00	0.35
			03/07/2019	2	0.08	0.96	1.04	0.02	0.01	0.03	1.07
			28/08/2019	2	2.65	5.73	8.38	0.02	0.00	0.02	8.40
			25/09/2019	2	0.86	8.08	8.94	0.02	0.00	0.02	8.96
	Transferred to Fraochoilean										
2020		Hawk's Nest	08/01/2020	2	0.06	0.20	0.26	0.00	0.01	0.01	0.27

	Atlantic salmon 2020 1/2		12/02/2020	2	0.00	0.09	0.09	0.00	0.00	0.00	0.09
			03/03/2020	0.5	0.02	0.06	0.08	0.00	0.00	0.00	0.08
			23/03/2020	0.5	0.00	0.21	0.21	0.00	0.00	0.00	0.21
			15/04/2020[7]	0.5	0.00	0.20	0.20	-	0.00	0.00	0.20
			29/04/2020	0.5	0.00	0.15	0.15	-	0.00	0.00	0.15
			07/05/2020	0.5	0.00	0.10	0.10	-	0.00	0.00	0.10
			27/05/2020	0.5	0.00	0.20	0.20	-	0.00	0.00	0.20
			11/06/2020	2	0.10	0.30	0.40	-	0.00	0.00	0.40
			13/07/2020	2	0.34	2.29	2.63	0.02	0.02	0.02	2.65
			06/08/2020	2	0.05	0.72	0.77	0.00	0.00	0.00	0.77
			11/09/2020	2	0.68	13.63	14.31	0.00	0.00	0.00	14.31
			07/10/2020	2	0.02	0.14	0.16	0.00	0.04	0.04	0.20
			04/11/2020	2	1.07	2.47	3.54	0.07	0.07	0.07	3.61
2021	Atlantic salmon 2020 S1/2	Hawk's Nest	29/01/2021	2	4.25	7.35	11.60	-	0.00	0.00	11.60
			23/02/2021	2	1.14	30.36	31.50	-	0.00	0.00	31.50
			05/03/2021	0.5	0.32	18.58	18.90	-	0.00	0.00	19.80
	Harvested out										
	Atlantic salmon 2020 S1/2	Curhownagh	22/07/2021	Harvested out							

[7] Following Covid-19 public health measures introduced by the Government, the sea lice monitoring programme was temporarily suspended from 24th March until 29th June 2020. During this period, all active farms were required to self-report sea lice level data from their sites to the Marine Institute on a fortnightly basis from 24th March 2020 to 31st May 2020 and monthly for June 2020.

2.2.12.4. Treatments

There is a significant secondary advantage to the use of freshwater bathing of the fish (other than the treatment of amoebic gill disease AGD) is that it removes 95% of the sea lice. The primary methods for the control of sea lice going forward will be the use of nano-filtered desalinated water baths and the supplement use of 'cleaner' fish; wrasse during the summer months and 'lump fish during the winter months.

In Ireland now it is expected that each farm will have to fresh water bathe the fish three times over the summer period to ameliorate the effect of AGD. When combined with the use of cleaner fish the reliance on other methods previously employed is greatly reduced.

Treatment with Nano-filtered water treatment

Mannin Salmon Co. Ltd have been instrumental in the development of methods for the use of nano-filtered water in the successful treatment of sea lice and Amoebic Gill Disease (AGD).

At an investment of €820,000, the nano-filtration unit has negated issues of access to freshwater and has enhanced management strategies for the treatment of both AGD and sea lice, promoting best practices in fish and welfare and reducing the need for chemical therapeutants.

When commissioned, the unit is deployed on a boat or barge which is then transported to the site of use. Methods developed by for this treatment system involve a tarpaulin treatment baths (70 metres circumference, 2 metres deep and or 90 metres circumference) for up to 4.0 hours immersion in nano-filtered water.

The fish are pumped from one of the pens into an empty pen that has a net (for security) and tarpaulin mounted into which the nano filtered water has been pumped. Upon completion of the treatment the tarpaulin is dropped allowing the fish to occupy the new pen and net.

Research to date has shown that sea lice removed during the treatment are not viable once they have been removed from the host.

A measure of its success is demonstrated in the Figure 2-20 which shows the lice levels for 2020 at the Mannin Salmon site in Clifden Bay following 3 successive treatments with nano-filtered water. A more detailed study has been conducted by the Marine Institute, Oranmore, and the subsequent paper, "Novel use of nano-filtered hyposaline water to control sea lice (*Lepeophtheirus salmonis* and *Caligus elongatus*) and amoebic gill disease, on a commercial Atlantic salmon (*Salmo salar*) farm" has been published in Aquaculture Reports (Mc Dermott *et al.*, 2021).

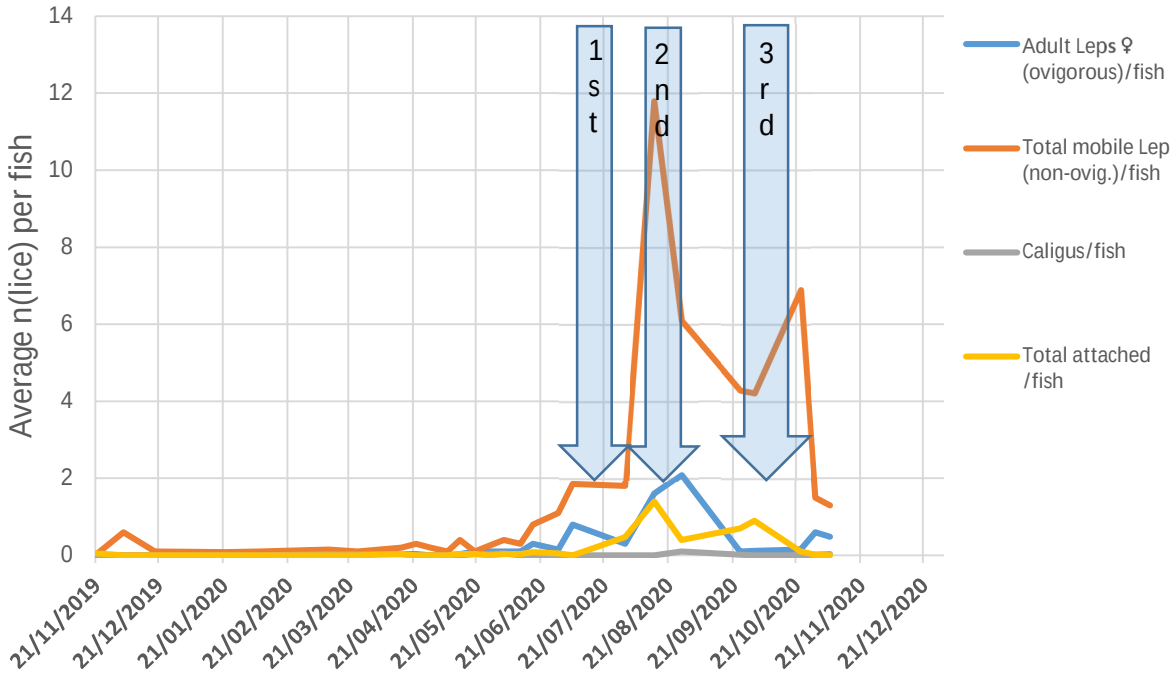

Figure 2-20: G2020A Clifden Bay: Average lice counts (site total) per sample date with 1st, 2nd and 3rd nano-filtration treatment rounds.

Other Treatments

Cleaner fish

In recent years, the industry has developed a new non-medicinal strategy to control sea lice involving the use of cleaner fish. Cleaner fish are a species which display a natural behaviour of removing parasites and dead skin from other fish species in the wild by feeding on them.

The main interest is in wrasse of the genus Labroides, of which there are several species indigenous to European waters. The supply of wrasse comes from commercial fishermen that operate in the bay. Their fishing and supply to the farm is regulated by licence/registration issued by the Sea Fisheries Protection Agency. Wrasses are primarily used between June and November. For the winter months the lumpsucker, *Cyclopterus lumpus,* is used. The source of the 'lump fish' is from a commercial hatchery. The stocking rate for lumpsuckers is at a rate of 10% of the salmon pen population. Cleaner fish are already deployed in Ireland with good success. At the sites, hatchery reared lumpsucker (*Cyclopterus lumpus*) fish will be deployed at the time of salmon transfer (October) to a ratio of 10 cleaner fish per 100 salmon. These will be supplemented/ replaced with locally caught wrasse during summer months stocked at a ratio of 7 wrasse per 100 salmon. Cleaner fish can be re-captured using

baited lobster pots or creels. As a precaution, cleaner fish are removed from the pens before size-grading of salmon, bath treatments and when fasting salmon prior to harvest.

The Annex III of 'The Farmed Salmonid Handbook' developed by the Aquaplan project (IFA Aquaculture, the Marine Institute, Vet Aqua International, Global Trust and the DAFM) first published in 2011 and updated regularly, provides a Risk analysis for the Movement of Wild Caught Wrasse in Ireland.

As already noted above the sale and purchasing of wild caught wrasse is regulated and licences by the Sea Fisheries Protection Agency (SFPA).

Use of SLICE

'Slice' is an infeed therapeutant which will remove or prevent the growing of all settled lice.

It is particularly beneficial for keeping young fish free of lice in the first year. It is only allowed to be used on a restricted basis by the 'organic agencies' and so cannot be used in the second year of the growing cycle. Slice is used in the springtime when wrasse may not be available in sufficient time. A detailed description is presented in Appendix 8.

2.2.13. Predator Control

Predator control includes bird netting to prevent bird predation on salmon. Pen netting is weighted to prevent seal predation. Obviously, these preventative measures are working as seal predation has not been an issue at these locations. No acoustic deterrents have been used or are planned for the sites in the Hawk's Nest, Curhownagh, or Ardbear sites.

2.2.14. Accidents and Emergencies

Emergency plans apply to eventualities, which, as a result of circumstance or unforeseen occurrence, may fall temporarily out of the control of the operator. It must be emphasised at the outset that such eventualities are extremely rare; none of those listed has occurred on Mannin Salmon Co. Ltd. or Ardbear Seafarms Ltd. sites to date and are not known to have occurred on any other local aquaculture installation. That said that such hazards exist cannot be ignored. In many cases it is their infrequency and lack of familiarity, which are the primary causes of loss of control. Consequently, adequate emergency plans must be in place to deal with such eventualities. Insofar as is possible, the risk of hazard or consequential event is mitigated or reduced by:

- Site selection.
- Use of adequately specified equipment and structures.

- Installation of appropriate management systems.
- Standard registration of all farm operational data.
- Employment of staff suitably qualified for job specified.
- Diver qualification to a minimum of HSE Part 4 diver's certificate; all divers to be accompanied underwater.
- Regular equipment inspection.
- Regular servicing of vessels, vehicles and other moving plant.
- Regular inspection of safety aids (life rafts, fire extinguishers, life jackets, navigation lights, winkies).
- Regular inspection and testing of diving equipment.
- Provision of guards over moving plant.
- Marine safety and rescue training.
- Wearing of lifejackets for all staff at sea.
- First aid training and availability of first aid kits.
- Availability of emergency flare kits.
- Fitting of life rafts to all main vessels.
- Disciplinary procedures.
- Ready availability of radios, telephones and emergency numbers lists.
- Protective clothing where necessary.
- Prohibition of unaccompanied access to company equipment and vessels by contractors, representatives, public servants and private individuals, who must be also provided with waterproofs and safety equipment as necessary when on company property.

Much of this information is enshrined, as required, in the Company's SOPs relating to health and safety (see Appendix 2) which set out the lines of responsibility for overseeing all operational health and safety systems and procedures.

In salmonid farming, the list of potential hazards, or circumstances which may lead to consequential hazardous events or loss can be summarised as follows:

- Staff: Injury, man overboard, illness at work, poisoning, fire.
- Vehicles: Breakdown, collision, fire.
- Vessels: Loss of power, capsize, collision, grounding, fouling, loss of radio contact, fire.
- Fish farm installations:
    - Fish mass mortality: May result from asphyxiation, disease, predator attack, poisonous blooms, oil leakage or other contamination.

- Mass fish escape: May result from loss of net integrity (predator attach), wear and tear, storm damage or collision.
- Normal weather eventualities: Collision with vessel, loss of net integrity, fish escape, net fouling, poisonous blooms, predator attack, contamination or oil leakage.
- Storm weather eventualities: Structural or net damage, loss of moorings, fish escape, pen adrift.

2.2.14.1. Staff

All staff are instructed to always wear life jackets or floatation suits when at sea. All vessels will carry first aid kits, radios or mobile telephones and flare kits. All vessels will carry first aid kits, radios or mobile telephones and flare kits. Staff will undergo routine training in first aid and rescue, including BIM courses in marine safety, first aid and radio use. In the event of an emergency, the attending personnel must contact the relevant base station, stating the nature of the event, position and other relevant details. The base station will then contact any required emergency service. In the case of staff at sea, nearby vessels must also be contacted, as required. In the event of accident at work, a report must be submitted to the local Health and Safety Authority Office.

2.2.14.2. Vehicles

Any event involving vehicles, which is hazardous or may lead to a hazard, is dealt with following a similar procedure as to what is stated in above. Radio or telephone contact to the relevant base station must be used to raise in-house support or emergency services as required.

2.2.14.3. Vessels

Vessels carry first aid kits, radios or mobile telephones and flare kits. Larger inboard vessels must carry radios, fire extinguishers, asbestos blankets and life rafts/ lifebelts. Any injury arising must be dealt with using standard first aid procedures, involving contact to shore base, and onward to emergency service as required. In the event of vessel damage, capsize or loss of power, contact is made to the base station with position and nature of event, with a request for assistance. Further actions are taken as necessary to ensure staff and public safety and minimise the risk of loss of vessel or consequential loss. In the case of events involving vessels, depending on the seriousness of the incident, a report must also be submitted to the Department of Transport, Marine Safety Directorate, Marine Survey Office. Contingency plans for major incidentss are detailed in SOP #10 in the Company Management Plan in Appendix 2). Fuel oils are the principal hazardous chemicals associated with an aquaculture site. All fuel oils are stored in bunded tanks to prevent pollution. The Company Management Plan

details preventative maintenance programme to ensure regular servicing of machinery and equipment ensuring breakdowns and spills are avoided (see Appendix 2).

2.2.14.4. Fish Farm Installations

Barring serious human accidents on or around farm installations, the main, albeit rare, hazards associated with salmon farm units are:

- Mass fish mortality may occur as a result of collision/net collapse, disease, asphyxiation, storm damage, poisonous phytoplankton, jellyfish caused mortality, predator attack, oil leakage and other contamination.
- Mass fish escape, which may follow as a loss of net integrity in storm or even normal weather conditions or follow other structural damage to the pen structures (for example by collision).

These are considered the main hazards because they carry the greatest risk of widespread consequences. Other possible hazards are those involving collision between moving vessels and pen structures, loss of moorings and drifting of pens. These eventualities are dealt with separately below.

2.2.14.5. Mass fish mortality

Mass mortality events have greatly reduced in number with the maturation and increased experience base of the industry. The most predictable causes of mass mortality are associated with disease and asphyxiation.

Mass mortality can often be brought on by stress, associated with high stocking density, fouled nets and warm weather, also the primary cause of asphyxiation. The most effective strategies for the avoidance of a mass mortality are low stocking densities required for organic farming, the experience of the staff along with day-to-day monitoring of plankton and jellyfish.

Appropriate site selection, regular net inspection, and cleaning will also all assist in avoiding these problems. Regular veterinary inspection and appropriate action on the first signs of stock distress can greatly reduce the risks of disease outbreak. Whatever the cause, the primary risks in a fish mortality event are disease transmission to other pens (in a disease-based event) and pollution. Once the mortality has been registered, the company plan comprises the use of divers to remove the mortalities, with counting, into harvest bins as quickly as possible.

Following mortality removal, diver must check the fish remaining in the pen on ensuing days to remove any additional mortalities. Once the event has passed, the fish remaining in the pen must be moved and counted into new accommodation, in order to determine the total number of fish in the pen and to confirm the level of the mortality. The quicker the mortalities and moribund fish are removed, the

lower the chance of disease hazard. The Fish Health Unit of the Marine Institute must also be notified. Protocol to be following is sudden heavy mortality occurs is detailed in SOP #10 in the company's management plan in Appendix 2.

2.2.14.6. Fish escapes

No farmed escapes have been reported at sites. Mannin Salmon Co. Ltd. and Ardbear Seafarms Ltd. have in place fish escape prevention protocols (see Appendix 3).

As well as being fully aware of the potential impact risks of escapees on local wild fisheries (subject to species in question and season), it is essential to the company's commercial viability to contain its fish. Thus, the guidelines set out below to avoid fish escapes are adhered to as a matter of commercial necessity as well as in the interests of the environment. With respect of fish farm escapes, Mannin Salmon Co. Ltd. and Ardbear Seafarms Ltd. will follow the guidelines on containment of farmed salmonids, drawn up between the North Atlantic Salmon Organisation (NASCO) and the International Salmon Farmers Association (ISFA) (NASCO, 2010).

These guidelines first set out preventative measures, which are observed by the company, in respect of:

- Site selection.
- Equipment and structural specification.
- Preventative strategies, inspection and maintenance.
- Staff training.

Under these guidelines, the selection of the sites has considered fish escape risk, which increases, for example, in areas exposed to excessively heavy seas or heavy boat traffic. All floating pen equipment, nets and associated structures will be specified to withstand local current and wave climate conditions. Mooring systems will be designed to withstand predicted 50-year local wave climate conditions and thus to protect the integrity of the pens. Preventative strategies include guidelines for the use of vessels around pens and the provision of adequate navigational lighting and radar reflectors to prevent damage arising due to navigational errors by non-company vessels.

Nets are cleaned and dried prior to storage and are stored off the ground in vermin-free conditions. Nets are inspected before use and regularly renewed. Spare nets are always available. Members of staff are trained in preventative net inspection and maintenance. All farm activities which may increase the risk of fish escape are carried out by staff aware of the risks and trained for the task in hand. The majority are also covered by SOPs found in the Company Management Plan, these include:

- Net changing
- Pen towing
- Bath treatments
- Fish sampling and health monitoring.

In readiness for any escape event, the company has a contingency plan and a registration and verification procedure. Any indication of escape, such as loss of net integrity, will be immediately followed up by repair or net change, as required, subject to weather conditions. Once an escape has been confirmed, the event must be reported to the AFMD in Clonakilty and to IFI and the Marine Institute. The fish remaining in the pen must be transferred and counted into a new enclosure and the extent of the escape verified. The event is then fully reported, stating species, strain, hatchery of origin, age, mean weight and length of stock, escape number and likely level of maturation in the year of escape. This information must be provided to the AFMD, IFI and DAFM within 24 hours of the incident. The company will co-operate with any program attempting to recapture the stock, which may be mounted or ordered by the relevant authorities.

A similar verification and reporting procedure must be also undertaken in the event of unexplainable reductions in stock numbers discovered, for example, during normal transfer or grading procedures. Under these circumstances, the pen structures occupied by the stock in question must be fully inspected following discovery of the shortfall.

2.2.15. Single Bay Management

Single Bay Management arrangements for fin-fish farms are designed to co-ordinate husbandry practices in such a way that best practice is followed and that stocking, fallowing and treatment regimens on individual farms are appropriately coordinated with the neighbouring farms. The goal is to ensure that practices on individual farms act synergistically to enhance the beneficial effects to the bay as a whole. An important component in this process is establishing effective lines of communication between the operators. The non-confrontational environment of Single Bay Management meetings between licensed operators has proved a valuable forum in the process of conflict resolution and avoidance both within the industry and between the industry and its neighbours.

The Single Bay Management process has proved very effective in enhancing the efficacy of lice control and in reducing the overall incidence of disease in the stocks. Single Bay Management plans are subject to revision for each production cycle. This arises out of changes in production plans related to:

- New Licence applications,

- In response to changing markets,
- New husbandry requirements, and
- Both internal company restructuring and inter-company agreement.

Crucial elements in the success of this plan are identified as:

- separation of generations,
- annual fallowing of sites,
- strategic application of chemotherapeutants,
- good fish health management, and
- close co-operation between farms.

Appendix 4 contains the Mannin Bay and Clifden Bay Single Bay Management Plan as well as the Ardbear Single Bay Management Plan. The synchronised production and fallowing in single bay areas is essential to ensure the breaking of disease and parasite life cycles. This requires the use of single year classes in each bay area.

Treatments will be undertaken appropriate to reduce lice numbers to a minimum by the autumn on all fish which are to be over-wintered. During the months of January to May, numbers of ovigerous female and total *L. salmonis* will be maintained as close to zero as possible using cleaner fish and freshwater baths to remove sea lice but other appropriate treatment may also be used as necessary.

2.2.16. Decommissioning

At the end of their lifespan or during certain maintenance tasks, fish pens have to be dismantled. This task is only carried out after the fish pen has been taken ashore. The pen must be beached on a hard surface out of water and away from rising/falling tide. When a decision is taken to decommission a floating farm site and all related equipment, a precise method of steps must be followed. These include removal of netting, ropes, chain mooring bridles; transport of the pens ashore; dismantling and recycling of pens; removal of moorings and buoys and the removal of anchors.

2.2.17. Consideration of Alternatives

The project area was identified as a suitable location for the proposed salmon farming for the following reasons:

- Hawk's Nest, Curhownagh and Ardbear sites are existing sites where aquaculture production occurs.
- Aquaculture production has been carried out at the sites and the bay successfully for almost 40 years.

- Production at the sites has no long-term significant effects on the environment.

2.3. Screening Exercise

2.3.1. Source-Pathway-Receptor and Impact Assessment

2.3.1.1. Overview

A key factor in the consideration as to whether or not a QI of a SAC or a SCI of a SPA is likely to be affected by a proposed project is the existence of connectivity (or interaction/or impact pathway) between the designated feature and the impact mechanisms associated with the project. National guidance (DEHLG, 2009) states that screening for AA should be carried out for any European Site within the likely 'Zone of Impact' of a plan or project.

For projects, the guidance outlines that the Zone of Impact (ZoI) must be evaluated on a case-by-case basis with reference to the nature, size and location of the project, the sensitivities of the ecological receptors, and the potential for in combination effects. Section 2.3.1.3 and Section 2.3.1.6 considers the potential effects due to the proposed project, while Section 2.4 considers potential in combination effects with other plans and projects.

2.3.1.2. Methodology

As outlined in Section 2.2 above, this *Screening for AA and NIS* focuses on the potential effect to European sites associated with the proposed project.

In order to establish the ZoI of the proposed project, the assessment of connectivity between project impact mechanisms (or source) and designated features considers the location of the project relative to habitats and non-mobile species, species foraging distances and migration routes, and the proximity of the project to foraging and breeding areas, and potential changes in species behaviour, effects on prey species resulting in alteration in interactions and associated impacts.

To inform the assessment, nationally available data on protected habitats and species was mapped using a Geographic Information System (GIS) and interrogated to identify for source-pathway-receptor connectivity. The source (potential project impact mechanisms), pathways (hydrological, physical or ecological connectivity) and receptors (QIs and SCIs of the European sites) were identified using GIS software, and through the examination of aerial photography and review of ecological survey undertaken in the area. Any European sites identified to have a viable source pathway-receptor link to the proposed project were then examined further to determine the potential for significant effects.

To ensure that all potential receptors that may be affected by the project impact mechanisms are considered in the Screening for AA the assessment considers:

1. QIs of SACs and SCIs of SPAs located within 15 km of the sites (see Section 2.3.1.3), and
2. Wide ranging QIs and SCIs that may be found at the project area (see Section 2.3.1.6).

Given the nature of the proposed activities and the potential QIs and SCIs (receptors) in the area, the potential project impact mechanisms are:

1. Nutrient enrichment/sedimentation.
2. Underwater noise.
3. Physical disturbance and collision risk.
4. Entanglement on nets from the site.
5. Pest and disease risk.
6. Genetic impacts.
7. Introduction of therapeutants.

The assessment of significant effects is detailed in Section 2.3.1.4 and Section 2.3.1.5.

2.3.1.3. SACs and SPAs within 15 km of the aquaculture sites

The SACs and SPAs within 15 km[8] of the Hawk's Nest, Curhownagh, and Ardbear sites are shown in Figure 2-21 and Figure 2-22. The SACs and SPAs are also listed in Table 2-7 and Table 2-8 alongside QIs and SCIs for which the sites are designated. Table 2-7 and Table 2-8 also lists the conservation objectives set for the QIs and SCIs and presents the distance of the SACs and SPAs to the Hawk's Nest, Curhownagh, and Ardbear sites. All site synopsis and conservation objectives for the European sites can be accessed through the NPWS website[9].

Table 2-7 and Table 2-8 also outline the broad ecological group to which the QIs and SCIs can be assigned:

- Qualifying Interests
    - Annex I Habitats
        - marine habitats
        - terrestrial/ coastal habitats
        - terrestrial habitats
        - terrestrial/ freshwater aquatic habitats
    - Annex II Species
        - mammal species

[8] Shortest linear distances are the shortest straight-line distance *(i.e.,* as the 'crow flies').

[9] Protected Sites in Ireland | National Parks & Wildlife Service (npws.ie)

- terrestrial/coastal species
- terrestrial species
- diadromous fish species
- freshwater aquatic plant species
- freshwater aquatic invertebrate species

- Special Conservation Interests
  - Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour.
  - Species mainly foraging in intertidal and coastal areas with limited diving behaviour. Dabbler birds
  - Species typically associated with terrestrial habitats. Rarely found foraging outside of terrestrial habitats.

Section 2.3.1.4 and Section 2.3.1.5 present the screening assessments of the potential effects (direct or indirect) of project impact mechanisms (identified in Section 2.3.1.2 above) to QIs of SACs and SCIs of SPAs within 15 km of the Hawk's Nest, Curhownagh, and Ardbear sites.

In the screening assessments, where a potential significant effect to a QI and/or SCI from an impact mechanism is deemed likely, the designated feature and impact mechanism combination is bought forward in the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS). In contrast, where a significant effect to a designated feature from an impact mechanism is deemed unlikely to occur, the designated feature and impact mechanism combination is screened out of further assessment. The NIS that has been prepared to provide the relevant scientific information to enable the competent authority to carry out its AA to determine whether or not the proposed project would adversely affect the integrity of a SAC or SPA.

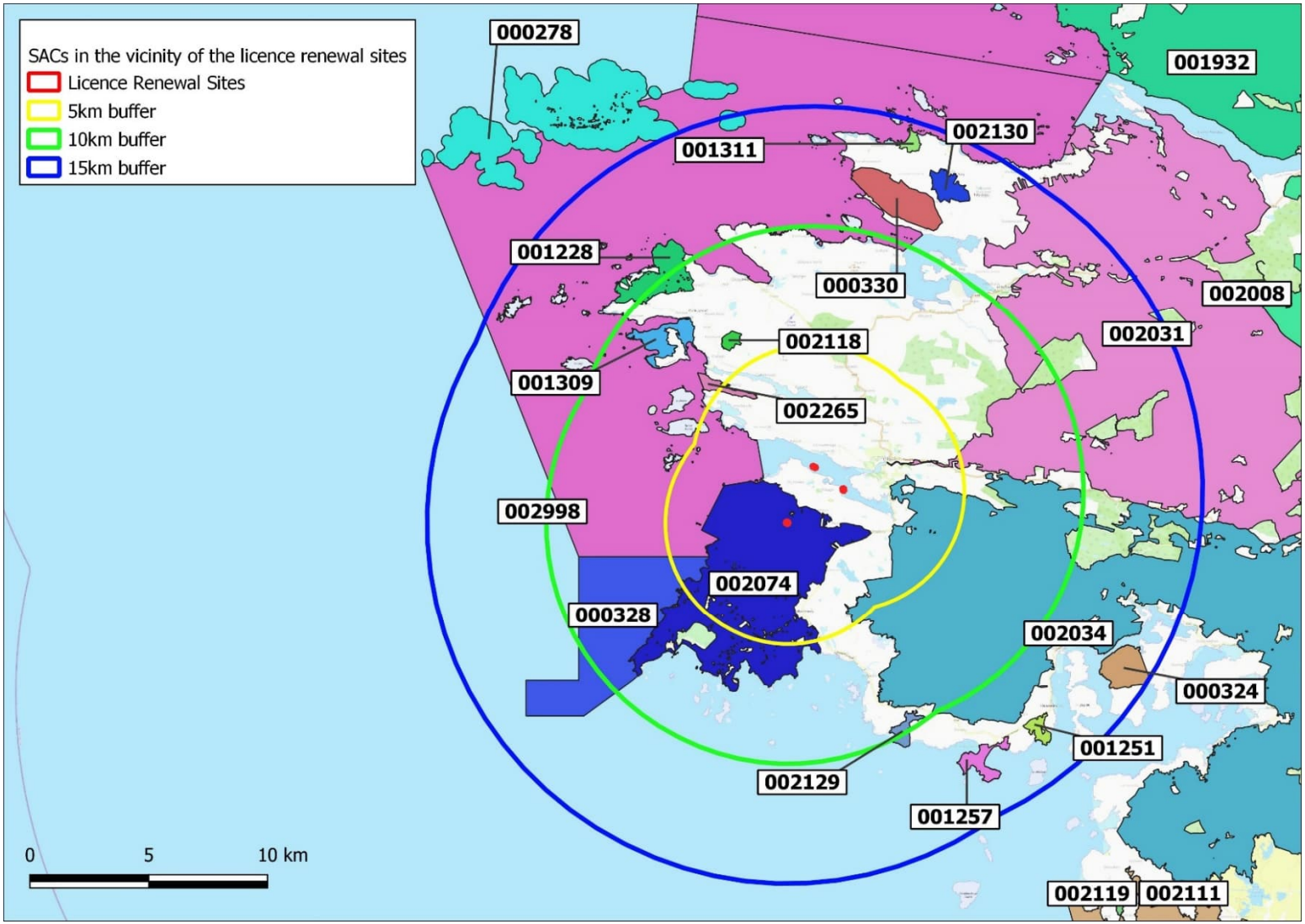

Figure 2-21: SACs with 15 km of the sites.

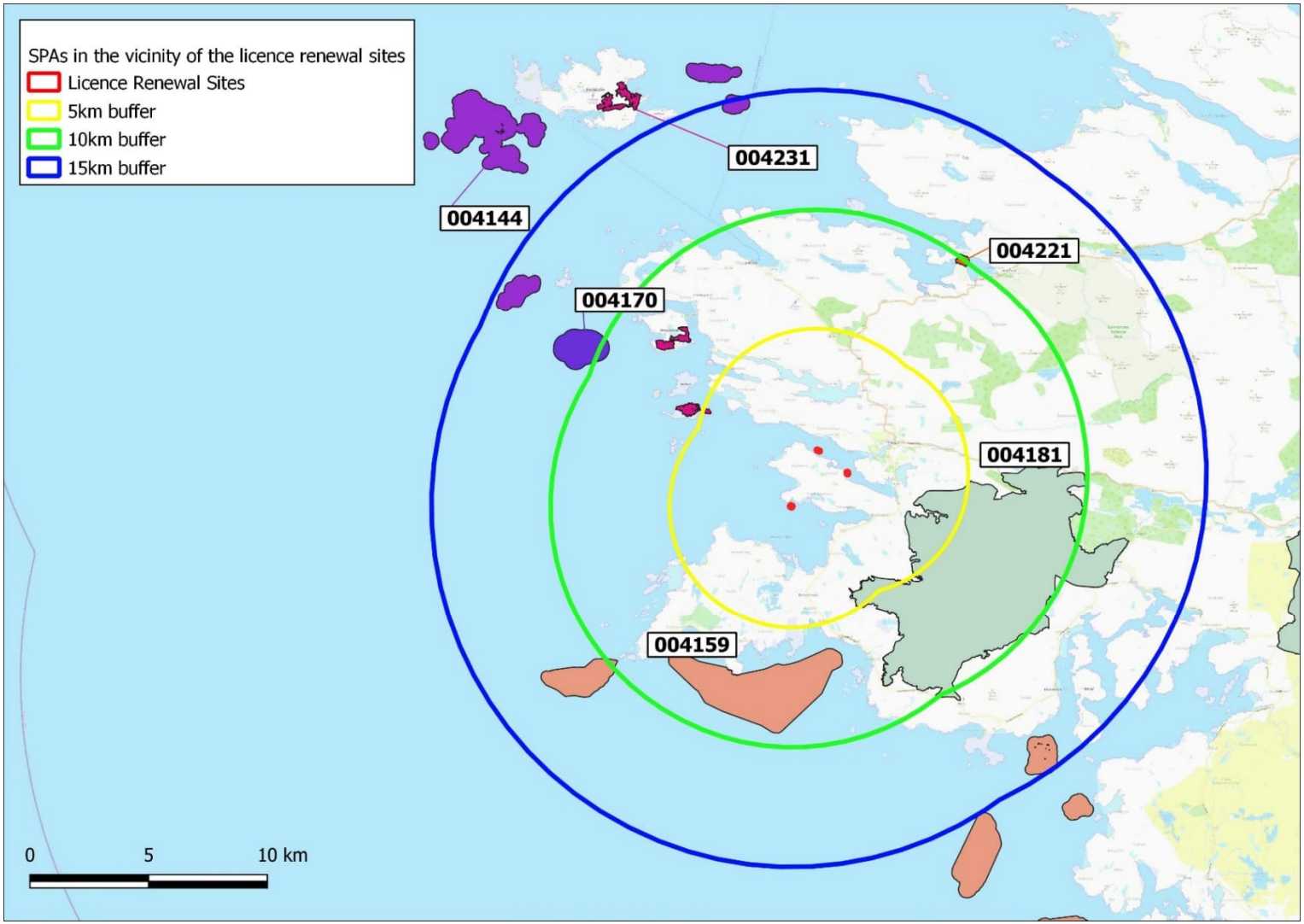

Figure 2-22: SPAs within 15 km of the Hawk's Nest, Ardbear and Curhownagh sites.

Table 2-7: SAC within 15 km of Hawk's Nest, Curhownagh and Ardbear sites.

Site (code)	Distance to proposed sites (km)	Ecological Group	QIs	Conservation Objective
Slyne Head Peninsula SAC (002074)	Hawk's Nest – 1.4 Ardbear – 1.1 Curhownagh - 0	Annex I - coastal habitats	Annual vegetation of drift lines (1210)	To maintain the favourable conservation condition
			Atlantic salt meadows (*Glauco-Puccinellietalia maritima*e) (1330)	To restore the favourable conservation condition
			Embryonic shifting dunes (2110)	To restore the favourable conservation condition
			Machairs (* in Ireland) (21A0)	To restore the favourable conservation condition
			Mediterranean salt meadows (*Juncetalia maritimi*) (1410)	To restore the favourable conservation condition
			Perennial vegetation of stony banks (1220)	To maintain the favourable conservation condition
			Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (2120)	To restore the favourable conservation condition
		Annex I - coastal/ terrestrial habitats	Molinia meadows on calcareous, peaty or clayey-silt laden soils (*Molinia caeruleae*) (6410)	To maintain the favourable conservation condition
		Annex I - marine habitats	* Coastal lagoons (1150)	To restore the favourable conservation condition
			Large shallow inlets and bays (1160)	To maintain the favourable conservation condition
			Reefs (1170)	To maintain the favourable conservation condition
		Annex I - terrestrial/ freshwater aquatic habitats	Alkaline fens (7230)	To maintain the favourable conservation condition
			European dry heaths (4030)	To maintain the favourable conservation condition
			Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (3140)	To maintain the favourable conservation condition
			Juniperus communis formations on heaths or calcareous grasslands (5130)	To maintain the favourable conservation condition

Site (code)	Distance to proposed sites (km)	Ecological Group	QIs	Conservation Objective
			Lowland hay meadows *(Alopecurus pratensis, Sanguisorba officinalis*) (6510)	To maintain the favourable conservation condition
			Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) (3110)	To maintain the favourable conservation condition
			Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) (6210)	To maintain the favourable conservation condition
		Annex II - coastal species	Petalwort (*Petalophyllum ralfsii*) (1395)	To maintain the favourable conservation condition
		Annex II - freshwater aquatic plant species	Slender Naiad (*Najas flexilis*) (1833)	To maintain the favourable conservation condition
West Connacht Coast SAC (002998)	Hawk's Nest – 2.0 Ardbear – 3.3 Curhownagh – 1.9	Annex II – mammal species	Bottlenose dolphin (*Tursiops truncatus*) (1349)	To maintain or restore the favourable conservation condition
The Twelve Bens/Garraun Complex SAC (002031)	Hawk's Nest – 2.8 Ardbear – 2.1 Curhownagh – 4.8	Annex I - diadromous fish species	Atlantic salmon (*Salmo salar*) (only in fresh water) (1106)	To maintain the favourable conservation condition
		Annex I - terrestrial habitat	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles (91A0)	To maintain the favourable conservation condition
		Annex I - terrestrial/ freshwater aquatic habitats	Alpine and Boreal heaths (4060)	To restore the favourable conservation condition
			Blanket bogs (* if active bog) (7130)	To restore the favourable conservation condition
			Calcareous rocky slopes with chasmophytic vegetation (8210)	To restore the favourable conservation condition
			Depressions on peat substrates of the *Rhynchosporion* (7150)	To restore the favourable conservation condition

Site (code)	Distance to proposed sites (km)	Ecological Group	QIs	Conservation Objective
			Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto- Nanojuncetea* (3130)	To maintain the favourable conservation condition
			Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) (3110)	To maintain the favourable conservation condition
			Siliceous rocky slopes with chasmophytic vegetation (8220)	To restore the favourable conservation condition
			Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsetalia ladani*) (8110)	To restore the favourable conservation condition
		Annex II - freshwater aquatic invertebrate species	Freshwater pearl mussel (*Margaritifera margaritifera*) (1029)	To restore the favourable conservation condition
		Annex II - freshwater aquatic plant species	Slender Naiad (*Najas flexilis*) (1833)	To maintain the favourable conservation condition
		Annex II – mammal species	Otter (*Lutra lutra*) (1355)	To maintain the favourable conservation condition
Connemara Bog Complex SAC (002034)	Hawk's Nest – 3.1 Ardbear – 1.9 Curhownagh – 3.9	Annex II - diadromous fish species	Atlantic salmon (*Salmo salar*) (only in fresh water) (1106)	To restore the favourable conservation condition
		Annex I - marine habitats	* Coastal lagoons (1150)	To maintain the favourable conservation condition
			Reefs (1170)	To maintain the favourable conservation condition
		Annex I - terrestrial habitat	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles (91A0)	To maintain the favourable conservation condition
			Molinia meadows on calcareous, peaty or clayey-slit laden soils	To maintain the favourable conservation condition

Site (code)	Distance to proposed sites (km)	Ecological Group	QIs	Conservation Objective
		Annex I - terrestrial/ freshwater aquatic habitats	Alkaline fens (7230)	To restore the favourable conservation condition
			Blanket bogs (* if active bog) (7130)	To restore the favourable conservation condition
			Depressions on peat substrates of the *Rhynchosporion* (7150)	To restore the favourable conservation condition
			European dry heaths (4030)	To restore the favourable conservation condition
			Natural dystrophic lakes and ponds (3160)	To maintain the favourable conservation condition
			Northern Atlantic wet heaths with *Erica tetralix* (4010)	To restore the favourable conservation condition
			Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto- Nanojuncetea* (3130)	To maintain the favourable conservation condition
			Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) (3110)	To maintain the favourable conservation condition
			Transition mires and quaking bogs (7140)	To restore the favourable conservation condition
			Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260)	To maintain the favourable conservation condition
		Annex II - freshwater aquatic plant species	Slender Naiad (*Najas flexilis*) (1833)	To maintain the favourable conservation condition
		Annex II - mammal species	Otter (*Lutra lutra*) (1355)	To maintain the favourable conservation condition
		Annex II - terrestrial species	Marsh Fritillary (*Euphydryas aurinia*) (1065)	To maintain the favourable conservation condition

Site (code)	Distance to proposed sites (km)	Ecological Group	QIs	Conservation Objective
Kingstown Bay SAC (002265)	Hawk's Nest – 3.6 Ardbear – 5.2 Curhownagh - 5.2	Annex I – Marine habitats	Large shallow inlets and bays (1160)	To maintain the favourable conservation condition
Slyne Head Islands SAC (000328)	Hawk's Nest – 5.7 Ardbear – 6.2 Curhownagh – 3.4	Annex I – marine habitats	Reefs (1170)	To maintain or restore the favourable conservation condition
		Annex II – mammal species	Grey seal (*Halichoerus grypus*) (1364)	To maintain or restore the favourable conservation condition
			Bottlenose dolphin (*Tursiops truncates*) (1349)	To maintain or restore the favourable conservation condition
Barnahallia Lough SAC (002118)	Hawk's Nest – 5.8 Ardbear – 7.3 Curhownagh - 7.4	Annex II – freshwater aquatic plant species	Slender Naiad (*Najas flexilis*) (1833)	To maintain or restore the favourable conservation condition
		Annex I – freshwater habitats	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalis uniflorae*) (3110)	To maintain or restore the favourable conservation condition
Omey Island Machair SAC (001309)	Hawk's Nest – 6.8 Ardbear – 8.4 Curhownagh – 8.0	Annex I – coastal habitat	Machairs (* in Ireland (21A0)	To restore the favourable conservation condition
		Annex I – terrestrial/ freshwater aquatic habitats	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (3140)	To maintain the favourable conservation condition
		Annex II – coastal species	Petalwort (*Petalopyllum ralfsii*) (1395)	To maintain the favourable conservation condition
Aughrusbeg Machair and Lake SAC (001228)	Hawk's Nest – 8.9 Ardbear – 10.4 Curhownagh – 10.4	Annex I - freshwater habitats	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) (3110)	To maintain or restore the favourable conservation condition
		Annex I terrestrial habitats	Northern Atlantic wet heaths with *Erica tetralix* (4010)	To maintain or restore the favourable conservation condition
	Hawk's Nest – 10.7	Annex I – coastal habitat	Machairs (* in Ireland) (21A0)	To restore the favourable conservation condition

Site (code)	Distance to proposed sites (km)	Ecological Group	QIs	Conservation Objective
Murvey Machair SAC (002129)	Ardbear – 9.6 Curhownagh – 9.3	Annex II – coastal species	Petalwort (*Petalopyllum ralfsii*) (1395)	To maintain the favourable conservation condition
Tully Mountain SAC (000330)	Hawk's Nest – 10.9 Ardbear – 11.4 Curhownagh – 13.4	Annex I - terrestrial habitats	European dry heaths (4030)	To maintain or restore the favourable conservation condition
Tully Lough SAC (002130)	Hawk's Nest – 12.2 Ardbear – 12.6 Curhownagh – 14.8	Annex I – terrestrial/ freshwater aquatic habitats	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) (3110)	To maintain or restore the favourable conservation condition
		Annex II – freshwater aquatic plant species	Slender Naiad (*Najas flexilis*) (1833)	To maintain or restore the favourable conservation condition
Dog's Bay SAC (001257)	Hawk's Nest – 13.3 Ardbear – 12.0 Curhownagh – 12.1	Annex I - coastal habitats	*Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130)	To restore the favourable conservation condition
			Annual vegetation of drift lines (1210)	To restore the favourable conservation condition
			Embryonic shifting dunes (2110)	To maintain the favourable conservation condition
			Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (2120)	To restore the favourable conservation condition
		Annex I - terrestrial/ habitats	European dry heaths (4030)	To maintain the favourable conservation condition
Cregduff Lough SAC (001251)	Hawk's Nest – 13.7 Ardbear – 12.3 Curhownagh – 13	Annex I - terrestrial/ freshwater aquatic habitats	Transition mires and quaking bogs (7140)	To maintain or restore the favourable conservation condition**
		Annex II - freshwater aquatic plant species	Slender Naiad (*Najas flexilis*) (1833)	To maintain or restore the favourable conservation condition**
	Hawk's Nest – 14.3		Blanket bogs (* if active bog) (7130)	To restore the favourable conservation condition

Site (code)	Distance to proposed sites (km)	Ecological Group	QIs	Conservation Objective
Rosroe Bog SAC (000324)	Ardbear – 12.9 Curhownagh – 14.3	Annex I - terrestrial/ freshwater aquatic habitats	Depressions on peat substrates of the *Rhynchosporion* (7150)	To restore the favourable conservation condition
Rusheenduff Lough SAC (001311)	Hawk's Nest – 13.7 Ardbear – 14.3 Curhownagh – 16.2	Annex I – terrestrial/ freshwater aquatic habitats	Ologotrophic waters containing very few minerals of sandy plains (*Littorelletalis uniflorae*) (3110)	To maintain or restore the favourable conservation condition
		Annex II – freshwater aquatic plants species	Slender naiad (*Najas flexilis*) (1833)	To maintain or restore the favourable conservation condition
Inishbofin and Inishshark SAC (000278)	Hawk's Nest – 14.3 Ardbear – 15.6 Curhownagh – 16.4	Annex I – marine habitats	*Coastal lagoons (1150)	To restore the favourable conservation condition
		Annex I - terrestrial/ freshwater aquatic habitats	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) (3110)	To maintain the favourable conservation condition
			European dry heaths (4030)	To restore the favourable conservation condition
			Northern Atlantic wet heaths with *Erica tetralix* (4010)	To restore the favourable conservation condition
		Annex II – coastal species	Petalwort (*Petalophyllum ralfsii*) (1395)	To maintain the favourable conservation condition
		Annex II – marine mammal	Grey seal (*Halichoerus grypus*) (1364)	To maintain or restore the favourable conservation condition

Table 2-8: SPAs within 15 km of the Hawk's Nest, Curhownagh and Ardbear sites.

Site (code)	Distance to proposed sites	Ecological Group	SCIs	Conservation Objective
Connemara Bog Complex SPA (004181)	Hawk's Nest – 4.3 Ardbear – 2.9 Curhownagh – 4.1	Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour	Cormorant (*Phalacrocorax carbo*) [A017]	To maintain or restore the favourable conservation condition*
		Species foraging in intertidal and coastal areas with limited diving behaviour. Dabbler birds	Common Gull (*Larus canus*) [A182]	To maintain or restore the favourable conservation condition*
			Golden Plover (*Pluvialis apricaria*) [A140]	To maintain or restore the favourable conservation condition*
		Species typically associated with terrestrial habitats. Rarely found foraging outside of terrestrial habitats. Non-diving birds.	Merlin (*Falco columbarius*) [A098]	To maintain or restore the favourable conservation condition*
Inishbofin, Omey Island and Turbot Island SPA (004231)	Hawk's Nest – 4.6 Ardbear – 6.2 Curhownagh – 5.0	Species typically associated with terrestrial habitats. Rarely found foraging outside of terrestrial habitats. Non-diving birds.	Corncrake (*Crex crex*) [A122]	To maintain or restore the favourable conservation condition*
Slyne Head to Ardmore Point Islands SPA (004159)	Hawk's Nest – 8.2 Ardbear – 7.3 Curhownagh – 6.1	Species foraging in marine waters and coastal waters/ areas. Shallow diving behaviour.	Arctic Tern (*Sterna paradisaea*) [A194]	To maintain or restore the favourable conservation condition*
			Little Tern (*Sternula albifrons*) [A195]	To maintain or restore the favourable conservation condition*
			Sandwich Tern (*Sterna sandvicensis*) [A191]	To maintain or restore the favourable conservation condition*
		Species foraging in intertidal and coastal areas with limited diving behaviour. Dabbler birds	Barnacle Goose (*Branta leucopsis) [A045]*	To maintain or restore the favourable conservation condition*

Site (code)	Distance to proposed sites	Ecological Group	SCIs	Conservation Objective
Illaunnanoon SPA (004221)	Hawk's Nest – 9.6 Ardbear – 9.8 Curhownagh – 12.2	Species foraging in marine waters and coastal waters/areas. Shallow diving behaviour.	Sandwich Tern (*Sterna sandvicensis*) [A191]	To maintain or restore the favourable conservation condition*
Cruagh Islands SPA (004170)	Hawk's Nest – 9.6 Ardbear – 11.1 Curhownagh – 9.8	Species foraging in intertidal and coastal areas with limited diving behaviour. Dabbler birds.	Barnacle Goose (*Branta leucopsis*) [A045]	To maintain or restore the favourable conservation condition*
		Species foraging in intertidal and coastal areas. Shallow diving behaviour.	Manx Shearwater (*Puffinus puffinus*) [A045]	To maintain or restore the favourable conservation condition*
High Island, Inishshark and Davillaun SPA (004144)	Hawk's Nest – 13.4 Ardbear – 14.9 Curhownagh – 13.8	Species foraging in marine waters and coastal waters/areas. Shallow diving behaviour	Arctic Tern (*Sterna paradisaea*) [A194]	To maintain or restore the favourable conservation condition*
		Species foraging in intertidal and coastal areas with limited diving behaviour. Dabbler birds	Barnacle Goose (*Branta leucopsis*) [A045]	To maintain or restore the favourable conservation condition*
		Species foraging in marine and coastal areas exhibiting significant dive foraging diving behaviour	Fulmar (*Fulmarus glacialis*) [A009]	To maintain or restore the favourable conservation condition*
* Generic Conservation Objectives				

2.3.1.4. Screening Assessment of SACs within 15 km of aquaculture sites

Potential significant effects to the following Qualifying Features (habitats and species) of SACs are excluded, as based on the ZoI of the proposed project and the distance from the proposed project from the SAC, no potential pathway for interaction exists between project impact mechanisms and the Qualifying Features (*i.e.,* no connectivity exists):

- Slyne Head Peninsula SAC
    - Annex I coastal habitats
    - Annex I coastal/ terrestrial habitats
    - Annex I terrestrial/ freshwater aquatic habitats
    - Annex II coastal species
    - Annex II freshwater aquatic plant species
- The Twelve Bens/Garraun Complex SAC
    - Annex I terrestrial habitat
    - Annex I terrestrial/ freshwater aquatic habitats
    - Annex II freshwater aquatic plant species
- Connemara Bog Complex SAC
    - Annex I coastal/ terrestrial habitats
    - Annex I terrestrial habitat
    - Annex I terrestrial/ freshwater aquatic habitats
    - Annex II terrestrial species
- Kingstown Bay SAC
    - Annex I marine habitats
- Barnahallia Lough SAC
    - Annex I freshwater habitats
    - Annex II freshwater aquatic plant species
- Omey Island Machair SAC
    - Annex I coastal habitats
    - Annex I terrestrial/ freshwater aquatic habitats
- Aughrusbeg Machair and Lake SAC
    - Annex I terrestrial/freshwater habitats
- Murvey Machair SAC
    - Annex I coastal habitats
    - Annex II coastal species

- Tully Mountain SAC
    - Annex I terrestrial habitats
- Tully Lough SAC
    - Annex I terrestrial habitats
    - Annex II freshwater aquatic plant species
- Dog's Bay SAC
    - Annex I coastal habitats
    - Annex I terrestrial/ freshwater plant aquatic habitats
- Cregduff Lough SAC
    - Annex I terrestrial habitats
    - Annex II freshwater aquatic plant species
- Rosroe Bog SAC
    - Annex I terrestrial/ freshwater aquatic habitats
- Inishbofin and Inishshark SAC
    - Annex I marine habitats
    - Annex I terrestrial/ freshwater aquatic habitats
- Tully Lough SAC
    - Annex I terrestrial/ freshwater habitats
    - Annex II freshwater aquatic plant species
    - Annex II coastal species

In contrast, there is potential for significant effects to the following:

- Slyne Head Peninsula SAC
    - Annex I marine habitats
- West Connacht Coast SAC
    - Annex II mammal species
- The Twelve Bens/Garraun Complex SAC
    - Annex II diadromous fish species
    - Annex II mammal species
    - Annex II freshwater aquatic invertebrate species
- Connemara Bog Complex SAC
    - Annex I marine habitats
    - Annex II mammal species
    - Annex II diadromous fish species

- Slyne Head Islands SAC
    - Annex I marine habitats
    - Annex II marine mammals
- Inishbofin and Inishshark SAC
    - Annex II mammal species

Table 2-9 below summarise the findings of the assessments to the above QI for which there are potential likely significant effects. Potential likely significant effect to QI from impact mechanism are highlighted in bold.

Table 2-9: Annex I habitats and Annex II species – S-P-R assessment of potential significant effects. Potential significant effects to QIs are highlighted in bold.

Slyne Head Peninsula SAC					
Ecological Group	QI	Impact Mechanism	Potential Effects	S-P-R Assessment	Potential for Significant Effects
Annex I - marine habitats	* Coastal lagoons (1150) Large shallow inlets and bays (1160) Reefs (1170)	1. Nutrient enrichment	Yes	Habitats fall within the project ZoI - potential direct connectivity.	Likely significant effects cannot be excluded at the Stage 1 Screening for AA stage. QIs brought forward to Stage 2 AA.
Annex I - marine habitats	* Coastal lagoons (1150) Large shallow inlets and bays (1160) Reefs (1170)	2. Underwater noise 3. Disturbance 4. Entanglement 5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	No effect	No viable pathway for significant effect exists between the impact mechanisms and the QIs (*i.e.,* no connectivity exists).	Given that there is no potential significant effects, the QI and impact mechanism combinations are screened out of further assessment.
West Connacht Coast SAC					
Ecological Group	QI	Impact Mechanism	Potential Effects	S-P-R Assessment	Potential for Significant Effects
Annex II - marine mammal species	Common bottlenose dolphin (*Tursiops truncates*) (1349)	1. Nutrient enrichment	No effect	No viable pathway for significant effect exists between the impact mechanisms and the QIs (*i.e.,* no connectivity exists).	Given that there is no potential significant effects, the QI and impact mechanism combinations are screened out of further assessment.
Annex II - marine mammal species	Common bottlenose dolphin (*Tursiops truncatus*) (1349)	2. Underwater noise 3. Disturbance 4. Entanglement	Yes – potential direct effects	Species may occur within or adjacent to the project area and be affected by the impact mechanisms.	There is potential for significant effects. The QI and impact mechanism combinations are bought forward in

Annex II - marine mammal species	Common bottlenose dolphin (*Tursiops truncatus*) (1349)	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	Yes – potential indirect effect	Potential direct effects of the project to salmon may indirectly affect foraging success.	the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS).
The Twelve Bens/Garraun Complex SAC Kilkieran Bay and Islands SAC Connemara Bog Complex SAC					
Ecological Group	QI	Impact Mechanism	Potential Effects	S-P-R Assessment	Potential for Significant Effects
Annex II - diadromous fish species	Atlantic salmon (*Salmo salar*) (only in fresh water) (1106)	1. Nutrient enrichment 2. Underwater noise 3. Disturbance 4. Entanglement	No effect	No viable pathway for significant effect exists between the impact mechanisms and the QIs (*i.e.,* no connectivity exists).	Given that there is no potential significant effects, the QI and impact mechanism combinations are screened out of further assessment.
Annex II - diadromous fish species	Atlantic salmon (*Salmo salar*) (only in fresh water) (1106)	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	Yes – potential direct effect	Given the nature of salmon farming there is potential that operations may directly impact wild salmon populations: • increasing lice infection rate in wild salmon; • disease spread; • the introduction of therapeutants; and • genetic interaction between farmed and wild Atlantic salmon.	There is potential for significant effects on diadromous fish species. The QI and impact mechanism combinations are bought forward in the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS).
Annex II - freshwater aquatic invertebrate species	Freshwater pearl mussel (*Margaritifera margaritifera*) (1029)	1. Nutrient enrichment 2. Underwater noise 3. Disturbance 4. Entanglement	No effect	No viable pathway for significant effect exists between the impact mechanisms and the QIs (*i.e.,* no connectivity exists).	Given that there is no potential significant effects, the QI and impact mechanism combinations are screened out of further assessment.

Annex II - freshwater aquatic invertebrate species	Freshwater pearl mussel (*Margaritifera margaritifera*) (1029)	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	Yes – potential direct effect	Project may affect salmon, an obligate host of *Margaritifera margaritifera* larvae (*i.e.,* indirect effect).	There is potential for significant indirect effects on *Margaritifera margaritifera* larvae. Potential indirect effect to the QI are further assessed in Section 3 NIS.
Annex II – marine mammal species	Otter (*Lutra lutra*) (1355)	1. Nutrient enrichment	No effect	No viable pathway for significant effect exists between the impact mechanisms and the QI (*i.e.,* no connectivity exists).	Given that there is no potential significant effects, the QI and impact mechanism combinations are screened out of further assessment.
Annex II – marine mammal species	Otter (*Lutra lutra*) (1355)	2. Underwater noise 3. Disturbance 4. Entanglement	Yes – potential direct effect	Species may occur within or adjacent to the project area and be affected by the impact mechanisms.	There is potential for significant indirect effects on otter. Potential effect to the QI are further assessed in Section 3 NIS.
Annex II – marine mammal species	Otter (*Lutra lutra*) (1355)	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	Yes – potential indirect effect	Potential direct effects of the project to salmon may indirectly affect otter foraging success.	
Connemara Bog Complex SAC					
Ecological Group	QI	Impact Mechanism	Potential Effects	S-P-R Assessment	Potential for Significant Effects
Annex I - marine habitats	* Coastal lagoons (1150) Reefs (1170)	1. Nutrient enrichment	Yes – potential direct effect	Habitats fall with the project ZoI - potential direct connectivity.	Likely significant effects cannot be excluded at the Stage 1 Screening for AA stage.

Annex I - marine habitats	* Coastal lagoons (1150) Reefs (1170)	2. Underwater noise 3. Disturbance 4. Entanglement 5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	No effect	No viable pathway for significant effect exists between the impact mechanisms and the QI (*i.e.,* no connectivity exists).	Given that there is no potential significant effects, the QI and impact mechanism combinations are screened out of further assessment.
Annex II - diadromous fish species	Atlantic salmon (*Salmo salar*) (only in fresh water) (1106)	1. Nutrient enrichment 2. Underwater noise 3. Disturbance 4. Entanglement	No effect	No viable pathway for significant effect exists between the impact mechanisms and the QI (*i.e.,* no connectivity exists).	Given that there is no potential significant effects, the QI and impact mechanism combinations are screened out of further assessment.
Annex II - diadromous fish species	Atlantic salmon (*Salmo salar*) (only in fresh water) (1106)	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	Yes – potential direct effect	Given the nature of salmon farming there is potential that operations may directly impact wild salmon populations: • increasing lice infection rate in wild salmon; • disease spread; • the introduction of therapeutants; and • genetic interaction between farmed and wild Atlantic salmon.	There is potential for significant effects on diadromous fish species. The QI and impact mechanism combinations are bought forward in the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS).
Annex II – marine mammal species	Otter (*Lutra lutra*) (1355)	1. Nutrient enrichment	No effect	No viable pathway for significant effect exists between the impact mechanisms and the QIs (*i.e.,* no connectivity exists).	Given that there is no potential significant effects, the QI and impact mechanism combinations are screened out of further assessment.
Annex II – marine mammal species	Otter (*Lutra lutra*) (1355)	2. Underwater noise 3. Disturbance 4. Entanglement	Yes – potential direct effect	Species may occur within or adjacent to the project area and be affected by the impact mechanisms.	There is potential for significant effects on otter. The QI and impact mechanism combinations are bought forward in

Annex II – marine mammal species	Otter (*Lutra lutra*) (1355)	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	Yes – potential indirect effect	Potential direct effects of the project to salmon may indirectly affect otter foraging success.	the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS).
Slyne Head Islands SAC					
Ecological Group	QI	Impact Mechanism	Potential Effects	S-P-R Assessment	Potential for Significant Effects
Annex I - marine habitats	Reefs (1170)	1. Nutrient enrichment	Yes	Habitats fall with the project ZoI - potential direct connectivity.	Likely significant effects cannot be excluded at the Stage 1 Screening for AA stage. QI brought forward to Stage 2 AA.
Annex I - marine habitats	Reefs (1170)	2. Underwater noise 3. Disturbance 4. Entanglement 5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	No effect	No viable pathway for significant effect exists between the impact mechanisms and the QI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects the QI and impact mechanism combinations are screened out of further assessment.
Annex II – marine mammal species	Grey seal (*Halichoerus grypus*) (1364) Common bottlenose dolphin (*Tursiops truncatus*) (1349)	1. Nutrient enrichment	No effect	No viable pathway for significant effect exists between the impact mechanisms and the QI (*i.e.*, no connectivity exists).	Given that there are no potential significant effects the QI and impact mechanism combinations are screened out of further assessment
Annex II - marine mammal species	Grey seal (*Halichoerus grypus*) (1364) Common bottlenose dolphin (*Tursiops truncatus*) (1349)	2. Underwater noise 3. Disturbance 4. Entanglement	Yes – potential direct effects	Species may occur within or adjacent to the project area and be affected by the impact mechanisms.	There is potential for significant effects. The QI and impact mechanism combinations are bought forward in the assessment for a detailed

Annex II - marine mammal species	Grey seal (*Halichoerus grypus*) (1364) Common bottlenose dolphin (*Tursiops truncatus*) (1349)	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	Yes – potential indirect effect	Potential direct effects of the project to salmon may indirectly affect otter foraging success.	consideration of the potential for adverse effects (see Section 3 NIS).
Inishbofin and Inishshark SAC					
Ecological Group	QI	Impact Mechanism	Potential Effects	S-P-R Assessment	Potential for Significant Effects
Annex II - marine mammal species	Grey seal (*Halichoerus grypus*) (1364)	1. Nutrient enrichment	No effect	No viable pathway for significant effect exists between the impact mechanisms and the QIs (*i.e.,* no connectivity exists).	Given that there are no potential significant effects the QI and impact mechanism combinations are screened out of further assessment.
Annex II - marine mammal species	Grey seal (*Halichoerus grypus*) (1364)	2. Underwater noise 3. Disturbance 4. Entanglement	Yes – potential direct effects	Species may occur within or adjacent to the project area and be affected by the impact mechanisms.	There is potential for significant effects on otter. The QI and impact mechanism combinations are bought forward in the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS).
Annex II - marine mammal species	Grey seal (*Halichoerus grypus*) (1364)	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	Yes – potential indirect effect	Potential direct effects of the project to salmon may indirectly affect otter foraging success.	

2.3.1.5. Screening Assessment of SPAs within 15km of aquaculture sites

Potential significant effects to the following SCIs of SPAs are excluded, as based on the ZoI of the proposed project, the distance from the proposed project from the SPA and the typical foraging behaviour of the species, no potential pathway for interaction exists between project impact mechanisms and the SCIs *(i.e.,* no connectivity exists):

- Connemara Bog Complex SPA
    - SCI species typically associated with terrestrial habitats. Rarely found foraging outside of terrestrial habitats. Non-diving birds (*i.e.,* Merlin (*Falco columbarius*) [A098])
- Inishbofin, Omey Island and Turbot Island SPA
    - SCI species corncrake (*Crex crex*) [A122] associated with terrestrial habitats. Rarely found foraging outside of terrestrial habitats.

In contrast, potential there is potential for significant effects to the following:

- Connemara Bog Complex SPA
    - species foraging in marine and coastal areas exhibiting significant dive foraging behaviour,
    - species foraging in intertidal and coastal areas with limited diving behaviour. Dabbler birds.
- Slyne Head to Ardmore Point Islands SPA
    - Species foraging in marine waters and coastal waters/areas. Shallow diving behaviour,
    - Species foraging in intertidal and coastal areas with limited diving behaviour. Dabbler birds.
- Illaunnanoon SPA
    - species foraging in marine and coastal areas exhibiting significant dive foraging behaviour.
- Cruagh Island SPA
    - Species foraging in intertidal and coastal areas with limited diving behaviour. Dabbler birds,
    - Species foraging in intertidal and coastal areas. Shallow diving behaviour.
- High Island, Inishshark and Davillaun SPA
    - Species foraging in marine waters and coastal waters/areas. Shallow diving behaviour,
    - Species foraging in intertidal and coastal areas with limited diving behaviour. Dabbler birds.

Table 2-10 below summarise the findings of the assessments to the above SCIs for which there are potential likely significant effects; potential likely significant effects are highlighted in bold.

Table 2-10: SCI species – S-P-R assessment of potential significant effects. Potential significant effects to SCIs are highlighted in bold.

Connemara Bog Complex SPA					
Ecological Group	SCI	Impact Mechanism	Potential Effects	S-P-R Assessment	Potential for Significant Effects
Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour	Cormorant (*Phalacrocorax carbo*) [A017]	1. Nutrient enrichment 2. Underwater noise	No effect	No viable pathway for significant effect exists between the impact mechanisms and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out of further assessment.
Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour	Cormorant (*Phalacrocorax carbo*) [A017]	3. Disturbance 4. Entanglement	Yes – potential effect	Species may occur within or adjacent to the project area and be affected by the impact mechanisms.	There is potential for significant effects. The SCI and impact mechanism combinations are bought forward in the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS).
Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour	Cormorant (*Phalacrocorax carbo*) [A017]	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	No effect	No viable pathway for significant effect exists between the impact mechanisms and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out of further assessment.
Species foraging in intertidal and coastal areas with limited diving behaviour. Dabbler birds	Common Gull (*Larus canus*) [A182] Golden Plover (*Pluvialis apricaria*) [A140]	1. Nutrient enrichment 2. underwater noise	No effect	No viable pathway for significant effect exists between the impact mechanisms and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects the SCI and impact mechanism combinations are screened out of further assessment.

Species foraging in marine waters and coastal waters/ areas. Shallow diving behaviour.	Common Gull (*Larus canus*) [A182] Golden Plover (*Pluvialis apricaria*) [A140]	3. Disturbance 4. Entanglement	Yes – potential effect	Species may occur within or adjacent to the project area and be affected by the impact mechanisms.	There is potential for significant effects. The SCI and impact mechanism combinations are bought forward in the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS).
Species foraging in intertidal and coastal areas with limited diving behaviour. Dabbler birds	Common Gull (*Larus canus*) [A182] Golden Plover (*Pluvialis apricaria*) [A140]	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	No effect	No viable pathway for significant effect exists between the impact mechanisms and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out of further assessment.
Slyne Head to Ardmore Point Islands SPA					
Ecological Group	SCI	Impact Mechanism	Potential Effects	S-P-R Assessment	Potential for Significant Effects
Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour	Arctic Tern (*Sterna paradisaea*) [A194] Little Tern (*Sterna albifrons*) [A195] Sandwich Tern (*Sterna sandvicensis*) [A191]	1. Nutrient enrichment 2. Underwater noise	No effect	No viable pathway for significant effect exists between the impact mechanisms and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out of further assessment.
Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour	Arctic Tern (*Sterna paradisaea*) [A194] Little Tern (*Sterna albifrons*) [A195] Sandwich Tern (*Sterna sandvicensis*) [A191]	3. Disturbance 4. Entanglement	Yes – potential effect	Species may occur within or adjacent to the project area and be affected by the impact mechanisms.	There is potential for significant effects. The SCI and impact mechanism combinations are bought forward in the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS).
Species foraging in marine and coastal	Arctic Tern (*Sterna paradisaea*) [A194]	5. Pest and disease risk	No effect	No viable pathway for significant effect exists	Given that there is no potential significant effects, the SCI and

areas exhibiting significant dive foraging behaviour	Little Tern (*Sterna albifrons*) [A195] Sandwich Tern (*Sterna sandvicensis*) [A191]	6. Genetic impacts 7. Introduction of therapeutants		between the impact mechanisms and the SCI (*i.e.*, no connectivity exists).	impact mechanism combinations are screened out of further assessment
Species foraging in intertidal and terrestrial areas. Dabbler birds	Barnacle Goose (*Branta leucopsis*) [A045]	1. Nutrient enrichment 2. Underwater noise 3. Disturbance 4. Entanglement 5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	No effect	No viable pathway for significant effect exists between the impact mechanisms and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out of further assessment.
Illaunnanoon SPA					
Ecological Group	SCI	Impact Mechanism	Potential Effects	S-P-R Assessment	Potential for Significant Effects
Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour	Sandwich Tern (*Sterna sandvicensis*) [A191]	1. Nutrient enrichment 2. Underwater noise	No effect	No viable pathway for significant effect exists between the impact mechanisms and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out of further assessment.
Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour	Sandwich Tern (*Sterna sandvicensis*) [A191]	3. Disturbance 4. Entanglement	Yes – potential effect	Species may occur within or adjacent to the project area and be affected by the impact mechanisms.	There is potential for significant effects. The SCI and impact mechanism combinations are bought forward in the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS).
Species foraging in marine and coastal areas exhibiting	Sandwich Tern (*Sterna sandvicensis*) [A191]	5. Pest and disease risk 6. Genetic impacts	No effect	No viable pathway for significant effect exists between the impact	Given that there is no potential significant effects, the SCI and

significant dive foraging behaviour		7. Introduction of therapeutants		mechanisms and the SCI (*i.e.*, no connectivity exists).	impact mechanism combinations are screened out of further assessment.
Cruagh Island SPA					
Ecological Group	SCI	Impact Mechanism	Potential Effects	S-P-R Assessment	Potential for Significant Effects
Species foraging in intertidal and terrestrial areas. Dabbler birds.	Barnacle Goose (*Branta leucopsis*) [A045]	1. Nutrient enrichment 2. Underwater noise 3. Disturbance 4. Entanglement 5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	No effect	No viable pathway for significant effect exists between the impact mechanisms and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out of further assessment.
Species foraging in marine waters coastal waters/areas. Shallow diving behaviour	Manx Shearwater (*Puffinus puffinus*) [A013]	1. Nutrient enrichment 2. Underwater noise	No effect	No viable pathway for significant effect exists between the impact mechanisms and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out.
Species foraging in marine waters coastal waters/areas. Shallow diving behaviour	Manx Shearwater (*Puffinus puffinus*) [A013]	3. Disturbance 4. Entanglement	Yes – potential effect	Species may occur within or adjacent to the project area and be affected by the impact mechanisms.	There is potential for significant effects. The SCI and impact mechanism combinations are bought forward in the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS).

Species foraging in marine waters coastal waters/areas. Shallow diving behaviour	Manx Shearwater (*Puffinus puffinus*) [A013]	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	No effect	No viable pathway for significant effect exists between the impact mechanism and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out.
High Island, Inishshark and Davillaun SPA					
Ecological Group	SCI	Impact Mechanism	Potential Effects	S-P-R Assessment	Potential for Significant Effects
Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour	Arctic Tern (Sterna paradisaea) [A194] Fulmar (*Fulmarus glacialis*) [A009]	1. Nutrient enrichment 2. Underwater noise	No effect	No viable pathway for significant effect exists between the impact mechanism and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out of further assessment
Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour	Arctic Tern (Sterna paradisaea) [A194] Fulmar (*Fulmarus glacialis*) [A009]	3. Disturbance 4. Entanglement	Yes – potential effect	Species may occur within or adjacent to the project area and be affected by the impact mechanisms.	There is potential for significant effects. The SCI and impact mechanism combinations are bought forward in the assessment for a detailed consideration of the potential for adverse effects (see Section 3 NIS).
Species foraging in marine and coastal areas exhibiting significant dive foraging behaviour	Arctic Tern (*Sterna paradisaea*) [A194] Fulmar (*Fulmarus glacialis*) [A009]	5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants	No effect	No viable pathway for significant effect exists between the impact mechanism and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out of further assessment.
Species foraging in intertidal and terrestrial areas. Dabbler birds	Barnacle Goose (*Branta leucopsis*) [A045]	1. Nutrient enrichment 2. Underwater noise 3. Disturbance 4. Entanglement	No effect	No viable pathway for significant effect exists between the impact mechanism and the SCI (*i.e.*, no connectivity exists).	Given that there is no potential significant effects, the SCI and impact mechanism combinations are screened out of further assessment.

		5. Pest and disease risk 6. Genetic impacts 7. Introduction of therapeutants			

2.3.1.6. Wide Ranging QIs and SCIs

2.3.1.7. Overview

There is potential that wide-ranging species that are QIs and SCIs of SACs and SPAs greater than 15 km from the project could be present in the vicinity of the sites in Clifden Bay, Mannin Bay, Ardbear Bay or within the project zone of potential disturbance and thereby, be affected by the proposed operations. The relevant QIs and SCIs are identified in Section 2.3.1.8 and Section 2.3.1.9. The relevant wide-ranging species of SACs and SPAs are marine mammals and seabird species. The potential project impact mechanisms relevant are:

- Impact mechanism 2. Underwater noise.
- Impact mechanism 3. Physical disturbance and collision risk.
- Impact mechanism 4. Entanglement on nets from the site.

Significant effects to the QIs and SCIs cannot be screened out and are therefore brought forward to the NIS (Section 3).

2.3.1.8. QIs of SACs Brought Forward to Stage 2 Appropriate Assessment

Pinniped species:

- Harbour seal (*Phoca vitulina*): The furthest foraging trip for harbour seal reported by Sharples *et al*. (2012) was 220 km. A total of 11 SACs in Irish waters designated for harbour seal are located within 220 km of the Clifden and Mannin Bay; these SACs are brought forward to the NIS.
- Grey seal (*Halichoerus grypus*): Cronin *et al.* (2011) investigated grey seal movement on Irelands' continental shelf. A total of 529 foraging trips recorded with the furthest trip measuring 511 km; given this wide range all SACs designated for the species are brought forward to the NIS.

Cetacean species:

- Harbour porpoise (*Phocoena phocoena*): The 3 SACs in Irish waters designated for the wide-ranging species are brought forward to the NIS.
- Bottlenose dolphin (*Tursiops truncatus*): The 5 SACs in Irish waters designated for the species are brought forward to the NIS.

SACs designated for Annex II marine mammal species are listed in Table 2-11 and the QIs brought to the Section 3 NIS are marked with asterisk (*).

Table 2-11: SACs designated for Annex II marine mammal species.

SAC (Site code)	QI (Code)			
	Harbour seal (*Phoca vitulina*) (1365)	Grey seal (*Halichoerus grypus*) (1364)	Harbour porpoise (*Phocoena phocoena*) (1351)	Bottlenose dolphin (*Tursiops truncatus*) (1349)
Slyne Head Peninsula SAC (002074)				✓*
West Connacht Coast SAC (002998)				✓*
Slyne Head Islands SAC (000328)		✓*		✓*
Inishbofin and Inishshark SAC (000278)		✓*		
Kilkieran Bay and Islands SAC (002111)	✓*			
Clew Bay Complex SAC (001482)	✓*			
Duvillaun Islands SAC (000495)		✓*		✓*
Galway Bay Complex SAC (000268)	✓*			
Inishkea Islands SAC (000507)		✓*		
Killala Bay/Moy Estuary SAC (000458)	✓*			
Lower River Shannon SAC (002165)				✓*
Ballysadare Bay SAC (000622)	✓*			
Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (000627)	✓*			

SAC (Site code)	QI (Code)			
	Harbour seal (*Phoca vitulina*) (1365)	Grey seal (*Halichoerus grypus*) (1364)	Harbour porpoise (*Phocoena phocoena*) (1351)	Bottlenose dolphin (*Tursiops truncatus*) (1349)
Blasket Islands SAC (002172)		✓*	✓*	
Slieve Tooey/Tormore Island/Loughros Beg Bay SAC (000190)		✓*		
Donegal Bay (Murvagh) SAC (000133)	✓*			
West of Ardara/Maas Road SAC (000197)	✓*			
Kenmare River SAC (002158)	✓*			
Rutland Island and Sound SA (002283)	✓*			
Glengarriff Harbour and Woodland SAC (000090)	✓*			
Roaringwater Bay and Islands SAC (000101)		✓*	✓*	
Horn Head and Rinclevan SAC (000147)		✓*		
Slaney River Valley SAC (000781)	✓			
Rockabill to Dalkey Island SAC (003000)			✓*	
Lambay Island SAC (000204)	✓	✓*		
Saltee Islands SAC (000707)		✓*		

2.3.1.9. SCIs of SPAs Brought Forward to Stage 2 Appropriate Assessment

The mobile wide ranging seabird species considered are those for which species-specific foraging ranges are identified in Thaxter *et al.* (2012), Jovani *et al*. (2016) and Wakefield *et al.* (2017). The species considered are listed in Table 2-12 below alongside maximum foraging ranges[10] identified for the species. Distances used in this assessment are indicated in bold. In order to establish the sites that lay within the foraging ranges specified, measures of the shortest distance between the sites and the project were used[8]. SPAs designated for bird species with maximum foraging ranges overlapping the project are listed in Table 2-13.

It should be noted, that given the nature of the proposed development it is considered that bird species that exhibit coastline or inland habitat and do not utilise the marine environment are unlikely to be present in the project area and so can be excluded from further consideration (*i.e.,* significant effects to the species are unlikely to occur and the species can be screened out). For instance, impact can be excluded for intertidal, coastal and inland species, such as oystercatcher, chough, swans *etc*.

[10] Mean foraging range (taken from Thaxter *et al*., 2012), maximum foraging range (from Jovani *et al*., 2016) or mean foraging range (from Wakefield *et al*., 2017) was chosen according to the highest value.

Table 2-12: Seabird foraging ranges.

Species	Thaxter *et al*., 2012		Jovani *et al*., 2016		Wakefield *et al*., 2017
	Maximum foraging range	Mean foraging range	Foraging range	Maximum foraging range	Mean foraging range
Arctic tern (*Sterna paradisaea*)	30	7.1			
Black-headed Gull (*Larus ridibundus*)	40	11.4			
Black Guillemot (*Cepphus grylle*)			7		
Common Gull (*Larus canus*)	50	25			
Common Tern (*Sterna hirundo*)	30	7.1			
Cormorant (*Phalacrocorax carbo*)	35	5.2			
Eider (*Somateria mollissima*)	80	2.4			
Fulmar (*Fulmarus glacialis*)	580	47.5			
Gannet (*Morus bassanus*)	590	92.5	709		
Great Black-backed Gull (*Larus marinus*)			60		
Guillemot (*Uria aalge*)	135	37.8		340	10.5
Herring Gull (*Larus argentatus*)	92	10.5			
Kittiwake (*Rissa tridactyla*)	120	24.8	231	300	11.9
Leach's Storm Petrel (*Hydrobates leucorhous*)	120				
Lesser Black-backed Gull (*Larus fuscus*)	181	71.9			
Little Tern (*Sterna albifrons*)	11	2.1			
Manx Shearwater (*Puffinus puffinus*)	330	2.3			
Mediterranean Gull (*Larus melanocephalus*)	20	11.5			
Puffin (*Fratercula arctica*)	200	4			

Razorbill (*Alca torda*)	95	23.7	312	340	10.5
Red-throated Diver (*Gavia stellata*)	9	4.5			
Roseate Tern (*Sterna dougallii*)	30	12.2			
Sandwich Tern (*Sterna sandvicensis*)	54	11.5			
Shag (*Phalacrocorax aristotelis*)	17	5.9		35	3.4
Storm-petrel (*Hydrobates pelagicus*)	65				

Table 2-13: SCIs of SPAs with foraging ranges overlapping the project area. Maximum foraging ranges used.

SCI (code)	Species Foraging Distance (km)	SPA (code)	Shortest linear distance from project (km)
Arctic tern (*Sterna paradisaea*) (A194)	30	High Island, Inishshark and Davillaun SPA (004144)	13.5 km
		Slyne Head To Ardmore Point Islands SPA (004159)	6.2 km
Black-headed Gull (*Chroicocephalus ridibundus*) [A179]	40	Lough Corrib SPA (004042)	34.0 km
		Lough Mask SPA (004062)	36.2 km
Common Gull (*Larus canus*) [A182]	50	Clare Island SPA (004136)	33.4 km
		Connemara Bog Complex SPA (004181)	2.9 km
		Lough Corrib SPA (004042)	34.0 km
		Lough Mask SPA (004062)	36.2 km
Cormorant (*Phalacrocorax carbo*) (A017)	35	Connemara Bog Complex SPA (004181)	2.9 km
Fulmar (*Fulmarus glacialis*) [A009]	580	Beara Peninsula SPA (004155)	198.8 km
		Blasket Islands SPA (004008)	150.8 km
		Clare Island SPA (004136)	33.4 km
		Cliffs of Moher SPA (004005)	68.0km
		Deenish Island and Scariff Island SPA (004175)	191.3km
		Dingle Peninsula SPA (004153)	129.1 km
		Duvillaun Islands SPA (004111)	65.1 km
		High Island, Inishshark and Davillaun SPA (004144)	13.5 km
		Horn Head to Fanad Head SPA (004194)	229.0 km
		Inishkea Islands SPA (004004)	68.5 km
		Iveragh Peninsula SPA (004154)	157.5 km

		Kerry Head SPA (004189)	112.7 km
		Lambay Island SPA (004069)	266.4 km
		Puffin Island SPA (004003)	181.3 km
		Saltee Islands SPA (004002)	275.5 km
		Skelligs SPA (004007)	188.8 km
		Tory Island SPA (004073)	230.4 km
		West Donegal Coast SPA (004150)	155.2 km
Gannet (*Morus bassanus*) (A016)	709	Saltee Islands SPA (004002)	275.5 km
		Skelligs SPA (004007)	188.8 km
		The Bull and the Cow Rocks SPA (004066)	208.4 km
Guillemot (*Uria aalge*) (A199)	340	Clare Island SPA (004136)	33.4 km
		Cliffs of Moher SPA (004005)	68.0 km
		Horn Head to Fanad Head SPA (004194)	229.0 km
		Inishmore SPA (004152)	37.5 km
		Ireland's Eye SPA (004117)	264.2 km
		Iveragh Peninsula SPA (004154)	157.5km
		Lambay Island SPA (004069)	266.4km
		Loop Head SPA (004119)	98.8 km
		Mid-Waterford Coast SPA (004193)	229.2 km
		Old Head of Kinsale (004021)	230.2 km
		Saltee Islands SPA (004002)	275.5 km
		Skelligs SPA (004007)	188.8 km
Herring Gull (*Larus argentatus*) [A184]	92	Inishglora and Inishkeeragh SPA (004084)	79.0 km

		Inishkea Islands SPA (004004)	68.5 km
Kittiwake (*Rissa tridactyla*) [A188]	300	Aughris Head SPA	121.8 km
		Blasket Islands SPA	150.8 km
		Clare Island SPA (004136)	33.4 km
		Cliffs of Moher SPA (004005)	68.0 km
		Helvick Head to Ballyquin SPA (004192)	230.7 km
		Horn Head to Fanad Head SPA (004194)	229.0 km
		Howth Head Coast SPA ((004113)	265.6 km
		Inishmore SPA (004152)	37.5 km
		Ireland's Eye SPA (004117)	264.2 km
		Iveragh Peninsula SPA (004154)	157.5 km
		Lambay Island SPA (004069)	266.4 km
		Loop Head SPA (004119)	98.8 km
		Old Head of Kinsale (004021)	230.2 km
		Puffin Island SPA (004003)	181.3km
		Rockabill SPA (004014)	264.8 km
		Saltee Islands SPA (004002)	275.5 km
		Skelligs SPA (004007)	188.8 km
		West Donegal Coast SPA (004150)	155.2 km
		Wicklow Head SPA (004127)	274.7 km
Leach's Storm-petrel (*Hydrobates leucorhous*) [A015]	120	Stags of Broad Haven SPA (004072)	99.0 km
Lesser Black-backed Gull (*Larus fuscus*) [A183]	181	Blasket Islands SPA (004008)	150.8 km
		Inishglora and Inishkeeragh SPA (004084)	79.0 km

		Lough Mask SPA (004062)	36.2 km
Manx Shearwater (*Puffinus puffinus*) [A013]	330	Blasket Islands SPA (004008)	150.8 km
		Cruagh Island SPA (004170)	9.6 km
		Deenish Island and Scariff Island SPA (004175)	191.3 km
		Puffin Island SPA (004003)	181.3 km
		Skelligs SPA (004007)	188.8 km
Puffin (*Fratercula arctica*) [A204]	200	Bills Rocks SPA (004177)	43.5 km
		Blasket Islands SPA (004008)	150.8 km
		Cliffs of Moher SPA (004005)	68.0 km
		Puffin Island SPA (004003)	181.3 km
		Skelligs SPA (004007)	188.8 km
		Stags of Broad haven SPA (004072)	99.0 km
Razorbill (*Alca torda*) [A200]	340	Blasket Islands SPA (004008)	150.8 km
		Clare Island SPA (004136)	33.4 km
		Cliffs of Moher SPA (004005)	68.0 km
		Horn Head to Fanad Head SPA (004194)	229.0 km
		Ireland's Eye SPA (004117)	264.2 km
		Lambay Island SPA (004069)	266.4 km
		Puffin Island SPA (004003)	181.3 km
		Saltee Islands SPA (004002)	275.5 km
		Tory Island SPA (004073)	230.4 km
		West Donegal Coast SPA (004150)	155.2 km
Sandwich Tern (*Sterna sandvicensis*) [A191]	54	Cross Lough (Killadoon) SPA (004212)	26.6 km

		Illaunnanoon SPA (004221)	9.7 km
		Slyne Head to Ardmore Point Islands SPA (004159)	6.2 km
Shag *(Phalacrocorax aristotelis)* [A018]	35	Clare Island SPA (004136)	33.4 km
Storm Petrel (*Hydrobates pelagicus*) [A014]	65	Bills Rocks SPA (004177)	43.5 km

2.4. Plans or Projects That Might Act In Combination

Regulation 42 (1) of the 2011 Regulations requires that:

> *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 on the European site*.

It is therefore required that the potential impacts of the proposed project are considered in combination with other relevant plans or projects.

Following a review of existing or permitted projects in the Clifden and Mannin Bay area including Ardbear Bay, it was concluded that discharges from the Hawk's Nest (T09/127A) and Curhownagh (T09/140A) sites have the potential to give rise to cumulative impacts. A third site, located in Ardbear Bay (T09/96B), is also licensed. An assessment of potential in-combination effect is presented in Section 3.8.

2.5. Screening Outcome

Potential significant effects to the following QIs (habitats and species) of SACs are excluded, as based on distance from the proposed project, no potential pathway for interaction exists between project impact mechanisms and the QIs (*i.e.,* no connectivity exists):

- Habitats Directive Annex I terrestrial habitats – grassland formations, forests, heath and scrub, bogs, mires and fens, rivers, rocky habitats and caves,
- Habitats Directive Annex II terrestrial and aquatic species – molluscs, non-migratory freshwater fish species, insects, higher and lower species of plant and vertebrates (*i.e.,* bats),
- Habitats Directive Annex I coastal and marine habitats – reefs (geogenic and biogenic), cliffs, caves, offshore islands, sand dunes, salt marsh, beaches and river estuaries.

In contrast, potential connectivity exists between the project and the following QIs (habitats and species) of SACs.

- Habitats Directive Annex I habitats: Lagoons, Large shallow inlets and bays, Reefs,

- Habitats Directive Annex II marine mammals: Harbour porpoise (*Phocoena phocoena*), Grey seal (*Halichoerus grypus*), Harbour seal (*Phoca vitulina*), Bottlenose dolphin (*Tursiops truncatus*),
- Habitats Directive Annex II aquatic mammal: Otter (*Lutra lutra*),
- Habitats Directive Annex II migratory fish species: Atlantic salmon (*Salmo salar*),
- Habitats Directive Annex II aquatic mollusc species: Freshwater Pearl Mussel (*Margaritifera margaritifera*).

Potential connectivity exists between the project and the following SCIs and notable species of SPAs; consequently, effects could not be excluded. Arctic tern (*Sterna paradisaea*), Black-headed Gull (*Larus ridibundus*), Common Gull (*Larus canus*), Cormorant (*Phalacrocorax carbo*), Fulmar (*Fulmarus glacialis*), Gannet (*Morus bassanus*), Golden Plover (*Pluvialis apricaria*), Guillemot (*Uria aalge*), Herring Gull (*Larus argentatus*), Kittiwake (*Rissa tridactyla*), Leach's storm-petrel (*Hydrobates leucorhous*), Lesser Black-backed Gull (*Larus fuscus*), Little Tern (*Sternula albifrons*), Manx Shearwater (*Puffinus puffinus*), Puffin (*Fratercula arctica*), Razorbill (*Alca torda*), Sandwich Tern (*Sterna sandvicensis*), Shag (*Phalacrocorax aristotelis*), Storm Petrel (*Hydrobates pelagicus*)

Significant effects to the above habitats and species are uncertain and are brought forward to Stage II AA for assessment of significance of effects (Section 3).

3. Natura Impact Statement

3.1. Summary of Screening Outcome

The QIs of SACs within 15 km of the aquaculture sites for which there is potential for significant effects are:

- Grey seal (*Halichoerus grypus*) [1364]
- Bottlenose dolphin (*Tursiops truncatus*) [1349]
- Atlantic salmon (*Salmo salar*) [1106]
- Otter (*Lutra lutra*) [1355]
- Freshwater pearl mussel (*Margaritifera margaritifera*) [1029]

SCIs within 15 km of the aquaculture sites for which there is potential for significant effects are:

- Cormorant (*Phalacrocorax carbo*) [A017]
- Common Gull (*Larus canus*) [A182]
- Golden Plover (*Pluvialis apricaria*) [A140]
- Arctic Tern (*Sterna paradisaea*) [A194]
- Fulmar (*Fulmarus glacialis*) [A009]
- Little Tern (*Sternula albifrons*) [A195]
- Sandwich Tern (*Sterna sandvicensis*) [A191]
- Manx Shearwater (*Puffinus puffinus*) [A013]

The QIs of SACs located more than 15 km from the aquaculture sites for which there is potential for significant effects are:

- Harbour Seal (*Phoca vitulina*) [1365]
- Harbour Porpoise (*Phocoena phocoena*) [1351]
- Grey Seal (*Halichoerus grypus*) [1364]
- Bottlenose dolphin (*Tursiops truncatus*) [1349]

SCI located more than 15 km from the aquaculture sites for which there is potential for significant effects are:

- Arctic tern (*Sterna paradisaea*) [A194]
- Common Gull (*Larus canus*) [A182]
- Cormorant (*Phalacrocorax carbo*) [A017]
- Fulmar (*Fulmarus glacialis*) [A009]
- Gannet (*Morus bassanus*) [A016]
- Guillemot (*Uria aalge*) [A199]
- Herring Gull (*Larus argentatus*) [A184]
- Kittiwake (*Rissa tridactyla*) [A188]
- Leach's Storm-petrel (*Oceanodroma leucorhoa*) [A015]
- Black-headed Gull (*Chroicocephalus ridibundus*)
- Lesser Black-backed Gull (*Larus fuscus*) [A183]
- Little Tern (*Sternula albifrons*) [A195]
- Manx Shearwater (*Puffinus puffinus*) [A013]
- Puffin (*Fratercula arctica*) [A204]
- Razorbill (*Alca torda*) [A200]
- Sandwich Tern (*Sterna sandvicensis*) [A191]
- Shag (*Phalacrocorax aristotelis*) [A018]
- Storm Petrel (*Hydrobates pelagicus*) [A014]

3.2. Aim of NIS

This Natura Impact Statement (NIS) has been prepared to provide the relevant scientific information to enable the competent authority to carry out its AA to determine whether or not the proposed project would adversely affect the integrity of a SAC or SPA. Specifically, the NIS considers in greater detail the aspects of the proposed project with potential for significant effects to QIs and SCIs. The NIS examines the impacts that the project might have on its own or in combination with other plans and projects. Where potential significant adverse effects are identified, mitigation measures are identified to prevent adverse effects.

For the current project, the potential impact mechanisms (sources of impact) include:

1. Nutrient enrichment/sedimentation.
2. Underwater noise.
3. Physical disturbance and collision risk.
4. Entanglement on nets from the site.
5. Pest and disease risk.
6. Genetic impacts.
7. Introduction of therapeutants.

3.3. Description of the Proposed Project

Mannin Salmon Co. Ltd. is currently operating salmon farms at the Curhownagh site (T09/140A) in Mannin Bay while Ardbear Seafarms Ltd is the licensee for the Hawk's Nest site (T09/127A) in Clifden Bay and a third site, located in Ardbear Bay (T09/96B), is also licensed by the company but is currently not in use. The conditions of the current licences for the Hawk's Nest site and the Curhownagh site allow the harvest of 100 t and 200 t of salmon (dead weight) per calendar year, respectively (as written in the licences – Appendix 1). The fish culture licence for the Ardbear site states that the quantity of fish will be determined by the Minister of the DAFM (Appendix 1).

The application for review and renewal of the licence requests the operating conditions attached to the licences be amended to allow:

- Hawk's Nest (AQ180 - T09/127A)
    - Harvest 200 tonnes from a net production of 625 tonnes of salmon every 21 months.
- Ardbear (FCL591 - T09/96B)
    - Harvest 182 tonnes from a net production of 86 tonnes of salmon every 21 months.

- Curhownagh (AQ122 - T09/140A)
    - Harvest 380 tonnes from a net production of 110 tonnes of salmon every 21 months.

Descriptions of the proposed project are presented in Section 2.2.

3.4. Description of Aspect of SACs and SPAs brought forward to NIS

3.4.1. Special Areas of Conservation

3.4.1.1. QI Annex I Habitats

The QI habitats of SACs for which potential significant effects were identified in the screening assessment are listed below (see Section 3.1 for summary):

- Slyne Head Peninsula SAC
    - Annex I marine habitats
        - * Coastal lagoons (1150)
        - Large shallow inlets and bays (1160)
        - Reefs (1170)
- Connemara Bog Complex SAC
    - Annex I marine habitats
        - * Coastal lagoons (1150)
        - Reefs (1170)
- Slyne Head Islands SAC
    - Annex I marine habitats
        - Reefs (1170)

3.4.1.2. QI Annex II Species

Table 3-2 lists the QI species of SACs for which potential significant effects were identified in the screening assessment (see Section 3.1 for summary); the Annex II species are:

- Harbour seal (*Phoca vitulina*) [1365]
- Grey seal (*Halichoerus grypus*) [1364]
- Harbour porpoise (*Phocoena phocoena*) [1351]
- Bottlenose dolphin (*Tursiops truncatus*) [1349]
- Otter (*Lutra lutra*) [1355]
- Atlantic salmon (*Salmo salar*) [1106]

- Freshwater pearl mussel (*Margaritifera margaritifera*) [1029]

Marine and Freshwater Mammals

Data available from the National Biodiversity Data Centre (NBDC) online database[11] have shown a diverse number of cetacean and pinniped species sightings and strandings around Clifden and Mannin Bay, which can be seen in Table 3-1. Note that some of these records originate from citizen science schemes and the area covered for these recordings extended further than Clifden and Mannin Bay.

Table 3-1: Annex II Marine mammal records in the vicinity of Clifden and Mannin Bay from the NBDC database.

Pinnipeds	Record type
Common (Harbour) Seal (*Phoca vitulina*) *	Sightings
Grey Seal (*Halichoerus grypus*) *	Sightings
Odontocetes (Toothed whales)	
Harbour porpoise (*Phocoena phocoena*)	Sightings and Strandings
Common Bottlenose Dolphin (*Tursiops truncatus*) *	Sightings

Pinniped species

Common seals and grey seals are resident species commonly found throughout Irish waters (Wall *et al.* 2013). Common seals and grey seals have terrestrial colonies (haul-out sites) along all coastlines of Ireland, which they use to return to rest ashore, rear young, engage in social activity, *etc* (Cronin *et al.* 2004b).

Common (harbour) seal (*Phoca vitulina*)

Harbour seals are one of two seal species that inhabit Irish waters, predominantly on the west side coast of Ireland. This species is included under Annex II of the Habitats Directive, thus requires Member States to designate SACs for their protection. There are 13 SACs designated for this species in Ireland which are listed in Table 3-2.

Cronin *et al.* (2007) carried out aerial and ground surveys on the coast of Ireland in August 2003 in order to assess the population estimates of harbour seals in the Republic of Ireland. One of the ground-truthing sites was in Mannin Bay which recorded a total of 13 individuals during the aerial survey. Morris & Duck (2019) carried out thermal-imaging surveys along the coastline of Ireland in August 2017 and August 2018, which calculated a total of 134 counts of harbour seals between south of Roonah Point to Mannin Bay in 2017/2018. Morris & Duck (2019) also compared these results to other

[11] Biodiversity Ireland - https://maps.biodiversityireland.ie/Map (accessed 21/11/2022).

surveys carried out in the same area in 2003 (Cronin *et al.* 2004b; 2007) and in 2011/2012 (Duck & Morris, 2012; 2013), which recorded a total of 36 and 106 counts, respectively.

Additionally, Sharples *et al.*, (2012) assessed the foraging behaviour of harbour seals at seven locations around the coast of Britain and stated a large degree of variation in seal movements with the longest foraging trip reaching 200 km of distance.

The closest SAC designated for this species is the Kilkieran Bay and Islands SAC (002111), at 19.3 km of the closest site (Ardbear site) which holds an important population of harbour seals. Given their wide-ranging behaviour, there is potential for this species to occur in the proposed project area.

Grey seal (*Halichoerus grypus*)

Grey seals are the other seal species to inhabit the coast of Ireland, with greatest numbers around the western coast (Morris and Duck, 2019). This species is included under Annex II of the Habitats Directive, thus requires Member States to designate SACs for their protection. There are 10 SACs designated for this species in Ireland which are listed in Table 3-2.

Simultaneously to the harbour seals, Cronin *et al.* (2007) carried out aerial and ground surveys on the coast of Ireland in August 2003 in order to assess the population estimates of grey seals in the Republic of Ireland. One of the ground-truthing sites was in Mannin Bay which recorded a total of 45 individuals. Morris and Duck (2019) carried out thermal-imaging surveys along the coastline of Ireland in August 2017 and August 2018, which calculated a total of 107 counts of grey seals between south of Roonah Point to Mannin Bay in 2017/2018. Morris & Duck (2019) also compared these results to other surveys carried out in the same area in 2003 (Cronin *et al.* 2004b; 2007) and in 2011/2012 (Duck & Morris, 2012; 2013), which recorded a total of 61 and 100 counts, respectively.

The closest SAC designated for this species is Slyne Head Islands SAC (000328) at 3.4 km of the closest site (Curhownagh site). In 2005, the grey seal population was estimated at 238-306 individuals (Ó Cadhla *et al*., 2007), and later in 2011 the population was estimated between 364-468 seals (Ó Cadhla *et al*., 2013). Given their wide-ranging behaviour, there is potential for this species to occur in the Proposed Project area.

Cetaceans

Common (or Harbour) porpoise (*Phocoena Phocoena*)

Harbour Porpoises are one of the most widely distributed and observed cetacean species in European waters (Hammond *et al.,* 2002), inhabiting shallow waters around the north hemisphere (Todd *et al.,* 2020). This species is strictly protected under Annex II of the Habitats Directive, thus requires Member

States to designate SACs for their protection, with three SACs designated for this QI in Ireland (Table 3-2).

Broadhaven Bay located in the northwest of Ireland, was also identified has a site of high diversity for cetacean species, including harbour porpoises, with the longest marine mammal monitoring programme in Ireland (Anderwald *et al.*, 2012; Todd *et al.,* 2020). Previous studies have assessed the density and abundance of harbour porpoises in Irish waters. Berrow *et al.* (2014) surveyed eight sites around the east, south and west coast of Ireland, and calculated density, abundance and group size for this species. One of the sites was located in Galway Bay which recorded a total of 402 (297-605) of abundance and a total of 2.15 (1.63-3.53) of mean group size. The NBDC database has records of two stranding events of the species: one near Omey Island in 2004 and the other in Mannin Bay Blueway in 2019. There was only one sighting record during the ObSERVE Aerial Survey to the west of Mannin Bay in 2016.

The closest SAC designated for this species is the Blasket Islands SAC (002172) at a distance of 148.6 km to the nearest site (Curhownagh site). Given their wide-ranging behaviour, there is potential for this species to occur in the Proposed Project area.

Common bottlenose dolphin (*Tursiops truncatus*)

Bottlenose dolphins are one of the most studied delphinid species and are widely distributed around the Irish coastline and between the UK and Ireland (Wall *et al.,* 2013). This species is strictly protected under Annex II and IV of the Habitats Directive, thus requires Member States to designate SACs for their protection, with five SACs designated for this QI in Ireland (Table 3-2).

In the NBDC database one stranding and 9 sighting records around Mannin and Clifden Bays, with group sizes ranging between 5 to 25 individuals. The closest sighting to one of the proposed sites was a sighting with 7 individuals close to the proposed location to the Curhownagh site in 2012.

In 2005, Small Cetaceans in the European Atlantic and North Sea project (SCANS-II) carried out shipboard and aerial surveys to estimate cetacean abundance in the continental shelf waters in the Northeast Atlantic. A total abundance of 313 individuals (CV = 0.81) was calculated around the coast of Ireland (Hammond *et al.*, 2013). The first attempt to assess the abundance estimates of bottlenose dolphins in the north-west coast of Ireland was by Ingram *et al.* (2009) which estimated a total of 171 ± 48 (CV = 0.28, 95% CI = 100 - 294), however surveys were restricted to north of Slyne Head, Connemara. Ingram *et al.* (2009) also stated that animals recorded in this study were present beyond the survey area, with sightings around Youghal, Co. Cork and in Co. Donegal. Local abundance

estimates calculated a total of 56 for bottlenose dolphins in Connemara during the summer months of 2013 and 86 for the summer months in 2014 (Nykänen *et al.*, 2015).

The closest SAC designated to this species is the Slyne Head Peninsula SAC (002074) which supports one or more groups of a bottlenose dolphin population of at least 177-337 individuals, that inhabits the north and west coast of Connacht (NPWS, 2019). The boundaries of the Curhownagh site are located completely within this SAC.

Aquatic mammals

Otter (*Lutra lutra*)

The Eurasian otter is a top predator in freshwater systems, thus its presence has a significant role in the wellbeing of these ecosystems (Reid *et al.*, 2013). Aquatic prey and shelter availability are two basic requirements in the growth of otter populations. This species is strictly protected under Annex II and IV of the Habitats Directive, thus requires Member States to designate SACs for their protection. There are 45 SACs designated for this species in Ireland (Table 3-2), with the Connemara Bog Complex SAC at a distance of 1.9 km of the nearest proposed site (Ardbear site).

This species forage and feed within 80 m to 100 m of the coastline (Kruuk & Moorhouse, 1991; De Jongh & O'Neill, 2010) and can travel distances up to 500 m across estuaries or between islands (De Jongh & O'Neill, 2010). The diving depth of otters typically ranges from 10-12 m with the majority of dives being less than 3 m and lasting less than 20 seconds (Kruuk *et al.*, 1985). Kruuk & Moorhouse (1991) reported that small benthic fish, eels and crustaceans are common prey items for otters, and they appear to have a strong preference for hunting in areas with dense seaweed cover in shallow, rocky environments. Reid *et al.*, (2013) also estimated the population estimates for the different River Basin Districts in Ireland in the National Otter Survey of Ireland 2010/2012. The proposed aquaculture sites are located in the Western River Basin District which also recorded the highest population estimates with a total of 411 (379-545) within the 45 SACs where otters were a designated feature and, 1,809 (1,671-2,401) in total for the western river basin (Reid *et al.*, 2013).

Given their wide-ranging behaviour and the close distance to the proposed aquaculture sites, there is potential for this species to occur in the Proposed Project area.

Freshwater aquatic invertebrate species

Freshwater Pearl Mussel

The freshwater pearl mussel (*Margaritifera margaritifera*) is one of the most endangered species in Europe (Geist, 2010; Taeubert & Geist, 2017) and it is listed on Annex II and V of the Habitats Directive. There are 19 SACs designated for this species in Ireland (Table 3-2), with the Twelve Bens/Garraun Complex SAC at a distance of 2.1 km of the nearest proposed site (Ardbear site).

This species has a complex life cycle which requires a parasitic phase on a suitable fish host (Taeubert & Geist, 2017). During this phase, females will release a high amount glochidia larvae, which will then reach their fish host through the water current. When inhaled by the fish host, the larvae will attach to the gills and become encapsulated by epithelial cells of the host where it grows for a period up to 11 months, and metamorphose into juvenile mussels (Ziuganov *et al.*, 1994). After excystment from the fish host, juvenile pearl mussels burrow into the river substratum where they stay for a period of five years until they emerge from the substratum and begin to filter-feed (Ziuganov *et al.*, 1994).

The interaction between *Margaritifera margaritifera* and its hosts has highlighted both positive and negative effects (Taeubert & Geist, 2017). Previous studies supporting the positive effects of this interaction classified the pearl mussel-fish host relationship as a variety of symbiosis (Geist, 2010), which is supported by the fact that the fish host would benefit from the filtering process of particulate matter and nutrients of rivers by adult pearl mussels, in addition to the creation of microhabitats for juvenile fishes (Ziuganov *et al.*, 1994). Another indirect positive effect from the larvae infestation would be a decrease in the accelerated senescence in salmon, which would result in an increase of this species' life span (Ziuganov, 2005). Previous studies where this interaction was considered to have negative effects on the fish host, *i.e.,* a parasitic relationship where this interaction is only beneficial to the mussel (Taeubert & Geist, 2017). This statement is supported by the release of large number of larvae at the beginning of the host-dependent phase and the ability of acquiring immunity after multiple infections (Taeubert *et al.*, 2013). Furthermore, highly infested hosts showed weakened swimming capabilities and an increase in mortality rates (Taeubert & Geist, 2017).

Some of the threats to freshwater pearl mussel include poaching for pearls and siltation of streams, however, this species is indirectly susceptible to any factors that reduce the abundance and distribution of its fish hosts (Cosgrove *et al.*, 2000; Taeubert & Geist, 2017).

In Ireland, the distribution of the freshwater pearl mussel has been divided in three catchment categories. The closest catchment is located to the east of the proposed project, namely the Ballynahinch catchment, which has records of the freshwater pearl mussel however the current status of this species is classified as unknown (Figure 3-1).

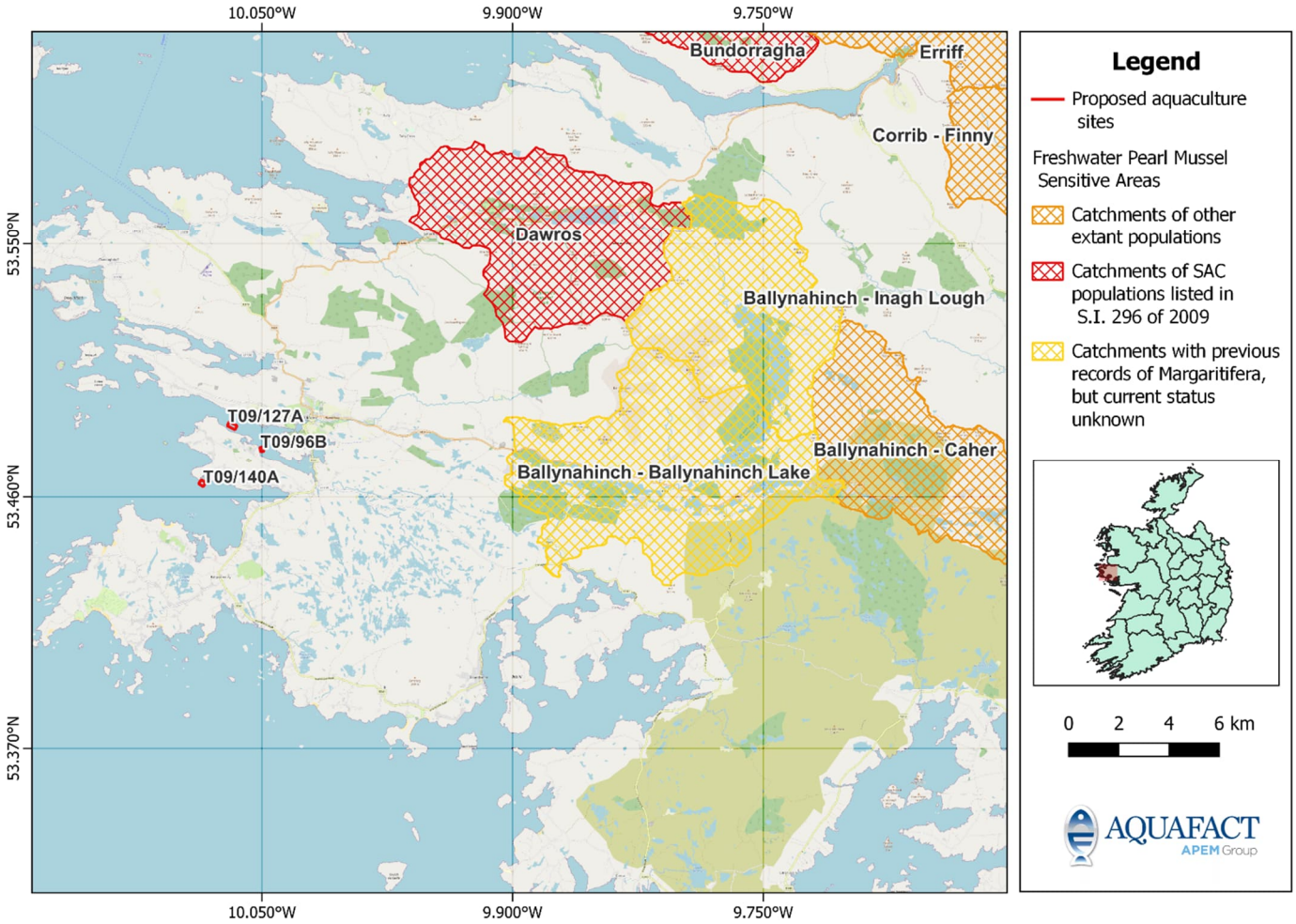

Figure 3-1: Freshwater pearl mussel catchments in the vicinity of Clifden and Mannin Bay, Co. Galway.

The potential impacts to the QIs are discussed in Section 3.5.1 through Section 3.5.4 below. The national conservation status of the QIs Annex II Species are presented in Table 3-3.

Table 3-2: SACs designated for the QIs Annex II Species.

SAC (Site code)	Harbour seal (*Phoca vitulina*)	Grey seal (*Halichoerus grypus*)	Harbour porpoise (*Phocoena phocoena*)	Bottlenose dolphin (*Tursiops truncatus*)	Otter (*Lutra lutra*)	Atlantic salmon (*Salmo salar*)	Freshwater pearl mussel (*Margaritifera margaritifera*)
Ballysadare Bay SAC (000622)	✓						
Bandon River SAC (002171)							✓
Ben Bulben, Gleniff and Glenade Complex SAC (000623)					✓		
Blackwater River (Cork/Waterford) SAC (002170)					✓	✓	✓
Blackwater River (Kerry) SAC (002173)					✓	✓	✓
Blasket Islands SAC (002172)		✓	✓				
Castlemaine Harbour SAC (000343)					✓	✓	
Clew Bay Complex SAC (001482)	✓				✓		
Cloghernagore Bog and Glenveagh National Park SAC (002047)					✓	✓	✓
Connemara Bog Complex SAC (002034)					✓	✓	
Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (000627)	✓						
Donegal Bay (Murvagh) SAC (000133)	✓						
Dromore Woods and Loughs SAC (000032)					✓		
Duvillaun Islands SAC (000495)		✓		✓			
East Burren Complex SAC (001926)					✓		
Fawnboy Bog/Lough Nacung SAC (000140)							✓
Galway Bay Complex SAC (000268)	✓				✓		
Glanmore Bog SAC (001879)							✓

SAC (Site code)	Harbour seal (*Phoca vitulina*)	Grey seal (*Halichoerus grypus*)	Harbour porpoise (*Phocoena phocoena*)	Bottlenose dolphin (*Tursiops truncatus*)	Otter (*Lutra lutra*)	Atlantic salmon (*Salmo salar*)	Freshwater pearl mussel (*Margaritifera margaritifera*)
Glenamoy Bog Complex SAC (000500)						✓	
Glengariff Harbour and Woodland SAC (000090)	✓				✓		
Gweedore Bay and Islands SAC (001141)					✓		
Horn Head and Rinclevan SAC (000147)		✓					
Inishbofin and Inishshark SAC (000278)		✓					
Inishkea Islands SAC (000507)		✓					
Kenmare River SAC (002158)	✓				✓		
Kilkieran Bay and Islands SAC (002111)	✓				✓		
Killala Bay/Moy Estuary SAC (000458)	✓						
Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC (000365)					✓	✓	✓
Lambay Island SAC (000204)	✓	✓					
Leannan River SAC (002176)					✓	✓	✓
Lough Carra/Mask Complex SAC (001774)					✓		
Lough Corrib SAC (00297)					✓	✓	✓
Lough Eske and Ardnamona Wood SAC (00163)						✓	✓
Lough Gill SAC (001976)					✓	✓	
Lough Melvin SAC (00428)					✓	✓	
Lough Oughter and Associated Loughs SAC (000007)					✓		
Lough Ree SAC (00440)					✓		
Lough Swilly SAC (002287)					✓		

SAC (Site code)	Harbour seal (*Phoca vitulina*)	Grey seal (*Halichoerus grypus*)	Harbour porpoise (*Phocoena phocoena*)	Bottlenose dolphin (*Tursiops truncatus*)	Otter (*Lutra lutra*)	Atlantic salmon (*Salmo salar*)	Freshwater pearl mussel (*Margaritifera margaritifera*)
Lower River Shannon SAC (002165)				✓	✓	✓	✓
Lower River Suir SAC (002137)					✓	✓	✓
Maumturk Mountains SAC (002008)						✓	
Mount Brandon SAC (000375)							✓
Moyree River System SAC (000057)					✓		
Mullet/Blacksod Bay Complex SAC (000470)					✓		
Mulroy Bay SAC (002159)					✓		
Mweelrea/Sheeffry/Erriff Complex SAC (001932)					✓	✓	✓
Newport River SAC (002144)						✓	✓
North Inishowen Coast SAC (002012)					✓		
Owenduff/Nephin Complex SAC (000534)					✓	✓	
River Barrow and River Nore SAC (002162)					✓	✓	✓
River Boyne and River Blackwater SAC (002299)					✓	✓	
River Finn SAC (002301)					✓	✓	
River Moy SAC (002298)					✓	✓	
River Shannon Callows SAC (000216)					✓		
Roaringwater Bay and Islands SAC (000101)		✓	✓		✓		
Rockabill to Dalkey Island SAC (003000)			✓				
Rutland Island and Sound SA (002283)	✓						
Saltee Islands SAC (000707)		✓					

SAC (Site code)	Harbour seal (*Phoca vitulina*)	Grey seal (*Halichoerus grypus*)	Harbour porpoise (*Phocoena phocoena*)	Bottlenose dolphin (*Tursiops truncatus*)	Otter (*Lutra lutra*)	Atlantic salmon (*Salmo salar*)	Freshwater pearl mussel (*Margaritifera margaritifera*)
Slaney River Valley SAC (000781)	✓				✓	✓	✓
Slieve Tooey/Tormore Island/Loughros Beg Bay SAC (000190)		✓			✓		
Slyne Head Islands SAC (000328)		✓		✓			
Slyne Head Peninsula SAC (002074)				✓			
The Gearagh SAC (000108)					✓		
The Twelve Bens/Garraun Complex SAC (002031)					✓	✓	✓
Tralee Bay and Magharees Peninsula, West to Cloghane SAC (002070)					✓		
Unshin River SAC (001898)					✓	✓	
West Connacht Coast SAC (002998)				✓			
West of Ardara/Maas Road SAC (000197)	✓				✓	✓	✓
Wicklow Mountains SAC (002122)					✓		

Table 3-3: National Status of QIs Annex II Species.

QI	National Status [2]
Harbour seal (*Phoca vitulina*)	Overall Status is assessed as Favourable. Overall Trend in Conservation Status is assessed as Stable.
Grey seal (*Halichoerus grypus*)	Overall Status is assessed as Favourable. Overall Trend in Conservation Status is assessed as Improving.
Harbour porpoise (*Phocoena phocoena*)	Overall Status is assessed as Favourable. Overall Trend in Conservation Status is assessed as Stable.
Bottlenose dolphin (*Tursiops truncatus*)	Overall Status is assessed as Favourable. Overall Trend in Conservation Status is assessed as Stable.
Otter (*Lutra lutra*)	Overall Status is assessed as Favourable. Overall Trend in Conservation Status is assessed as Improving.
Atlantic salmon (*Salmo salar*)	Overall Status is assessed as Inadequate. Overall Trend in Conservation Status is assessed as Stable.
Freshwater pearl mussel (*Margaritifera margaritifera*)	Overall Status is assessed as Bad. Overall Trend in Conservation Status is assessed as Deteriorating.

3.4.2. Special Protection Areas

Potential likely significant effects to the following SCIs of SPAs within 15 km of the proposed project could not be screened:

- Connemara Bog Complex SPA
  - Common Gull (*Larus canus*) [A182]
  - Cormorant (*Phalacrocorax carbo*) [A017]
  - Golden Plover (*Pluvialis apricaria*) [A140]
- Cruagh Island SPA
  - Manx Shearwater (*Puffinus puffinus*) [A013]
- High Island, Inishshark and Davillaun SPA
  - Arctic Tern (*Sterna paradisaea*) [A194]
  - Fulmar (*Fulmarus glacialis*) [A009]
- Illaunnanoon SPA
  - Sandwich Tern (*Sterna sandvicensis*) [A191]
- Slyne Head to Ardmore Point Islands SPA
  - Arctic Tern (*Sterna paradisaea*) [A194]
  - Little Tern (*Sternula albifrons*) [A195]
  - Sandwich Tern (*Sterna sandvicensis*) [A191]

In addition, based on the species specific foraging ranges, potential likely significant effects of the proposed project could not be screened out for the SCIs of SPAs listed in Table 3-4 (see Section 3.1 for summary). Table 3-4 also presents the conservation status of these species from the fourth assessment of Birds of Conservation Concern in Ireland (BoCCI4) (Gilbert *et al.*, 2021).

Table 3-4: SCIs of SPAs with foraging ranges overlapping the project area. Maximum foraging ranges used.

SCI (foraging range)	BoCCI4	SPA
Arctic tern (*Sterna paradisaea*) (30 km)	Amber	High Island, Inishshark and Davillaun SPA (004144)
		Slyne Head To Ardmore Point Islands SPA (004159)
Black-headed Gull (*Larus ridibundus*) (40 km)	Amber	Lough Corrib SPA (004042)
		Lough Mask SPA (004062)
Common Gull (*Larus canus*) (50 km)	Amber	Clare Island SPA (004136)
		Connemara Bog Complex SPA (004181)
		Lough Corrib SPA (004042)
		Lough Mask SPA (004062)

Cormorant (*Phalacrocorax carbo*) (35 km)	Amber	Connemara Bog Complex SPA (004181)
Fulmar (*Fulmarus glacialis*) (580 km)	Amber	Beara Peninsula SPA (004155)
		Blasket Islands SPA (004008)
		Clare Island SPA (004136)
		Cliffs of Moher SPA (004005)
		Deenish Island and Scariff Island SPA (004175)
		Dingle Peninsula SPA (004153)
		Duvillaun Islands SPA (004111)
		High Island, Inishshark and Davillaun SPA (004144)
		Horn Head to Fanad Head SPA (004194)
		Iveragh Peninsula SPA (004154)
		Kerry Head SPA (004189)
		Lambay Island SPA (004069)
		Puffin Island SPA (004003)
		Saltee Islands SPA (004002)
		Skelligs SPA (004007)
		Tory Island SPA (004073)
		West Donegal Coast SPA (004150)
Gannet (*Morus bassanus*) (709 km)	Amber	Saltee Islands SPA (004002)
		Skelligs SPA (004007)
		The Bull and the Cow Rocks SPA (004066)
Guillemot (*Uria aalge*) (340 km)	Amber	Clare Island SPA (004136)
		Cliffs of Moher SPA (004005)
		Horn Head to Fanad Head SPA (004194)
		Inishmore SPA (004152)
		Ireland's Eye SPA (004117)
		Iveragh Peninsula SPA (004154)
		Lambay Island SPA (004069)
		Loop Head SPA (004119)
		Mid-Waterford Coast SPA (004193)
		Old Head of Kinsale (004021)
		Saltee Islands SPA (004002)
		Skelligs SPA (004007)
Herring Gull (*Larus argentatus*) (92 km)	Amber	Inishglora and Inishkeeragh SPA (004084)
		Inishkea Islands (004004)
Kittiwake (*Rissa tridactyla*) (300 km)	Red	Aughris Head SPA (004133)

		Blasket Islands SPA (004008)
		Clare Island SPA ((004136)
		Cliffs of Moher SPA (004005)
		Helvick Head to Ballyquin SPA (004192)
		Horn Head to Fanad Head SPA (004194)
		Howth Head Coast SPA (004113)
		Inishmore SPA (004152)
		Ireland's Eye SPA (004117)
		Iveragh Peninsula SPA (004154)
		Lambay Island SPA (004069)
		Loop Head SPA (004119)
		Old Head of Kinsale (004021)
		Puffin Island SPA (004003)
		Rockabill SPA (004014)
		Saltee Islands SPA (004002)
		Skelligs SPA (004007)
		West Donegal Coast SPA (004150)
		Wicklow Head SPA (004127)
Leach's Storm-petrel (*Hydrobates leucorhous*) (120 km)	Red	Stags of Broad Haven SPA (004072)
Lesser Black-backed Gull (*Larus fuscus*) (181 km)	Amber	Blasket Islands SPA (004008)
		Inishglora and Inishkeeragh SPA (004084)
		Lough Mask SPA (004062)
Manx Shearwater (*Puffinus puffinus*) (330 km)	Amber	Blasket Islands SPA (004008)
		Cruagh Island SPA (004170)
		Deenish Island and Scariff Island SPA (004175)
		Puffin Island SPA (004003)
		Skelligs SPA (004007)
Puffin (*Fratercula arctica*) (200 km)	Red	Bills Rocks SPA (004177)
		Blasket Islands SPA (004008)
		Cliffs of Moher SPA (004005)
		Puffin Island SPA (004003)
		Skelligs SPA (004007)
		Stags of Broad Haven SPA (004072)
Razorbill (*Alca torda*) (340 km)	Red	Blasket Islands SPA (004008)
		Clare Island SPA (004136)

		Cliffs of Moher SPA (004005)
		Horn Head to Fanad Head SPA (004194)
		Ireland's Eye SPA (004117)
		Lambay Island SPA (004069)
		Puffin Island SPA (004003)
		Saltee Islands SPA (004002)
		Tory Island SPA (004073)
		West Donegal Coast SPA (004150)
Sandwich Tern (*Sterna sandvicensis*) (54 km)	Amber	Cross Lough (Killadoon) SPA (004212)
		Illaunnanoon SPA (004221)
		Slyne Head to Ardmore Point Islands SPA (004159)
Shag *(Gulosus aristotelis)* (35 km)	Amber	Clare Island SPA (004136)
Storm Petrel (*Hydrobates pelagicus*) (65 km)	Amber	Bills Rocks SPA (004177)

3.5. Impact Prediction

Table 3-5 presents a quick reference summary of the project impact mechanisms of concern with regards to the QIs and SCIs.

Sections 3.5.1 through Section 3.5.4 assesses the risk of potential effects to the QIs while Sections 3.5.5 assesses the risk to SCIs.

The assessment of risk of potential effects to QIs and SCIs considered the *negative impacting threats and pressures* and *positive impacting activities/management* affecting the sites as listed in Natura 2000 Forms compiled for the sites.

Table 3-5: Impact mechanisms relevant to QIs and SCIs.

Ecological Group	QI	Impact Mechanism						
		1. Nutrient enrichment	2. Underwater noise	3. Disturbance	4. Entanglement	5. Pest and disease risk	6. Genetic impacts	7. Introduction of therapeutants
Annex I - habitats	* Coastal lagoons (1150) Large shallow inlets and bays (1160) Reefs (1170)	Potential Direct Effect						
Annex II – marine mammal species	Harbour seal (*Phoca vitulina*) (1365) Grey seal (*Halichoerus grypus*) (1364) Harbour porpoise (*Phocoena phocoena*) (1351) Bottlenose dolphin (*Tursiops truncatus*) (1349)		Potential Direct Effect	Potential Direct Effect	Potential Direct Effect			
	Otter (*Lutra lutra*) (1355)		Potential Direct Effect	Potential Direct Effect	Potential Direct Effect	Potential Indirect Effect	Potential Indirect Effect	Potential Indirect Effect
Annex II - diadromous fish species	Atlantic salmon (*Salmo salar*) [1106]					Potential Direct Effect	Potential Direct Effect	Potential Direct Effect
Annex II – freshwater aquatic invertebrate	Freshwater pearl mussel (*Margaritifera margaritifera*) (1029)					Potential Indirect Effect	Potential Indirect Effect	Potential Indirect Effect
*priority habitat under the Habitats Directive								

Ecological Group	QI	Impact Mechanism						
		1. Nutrient enrichment	2. Underwater noise	3. Disturbance	4. Entanglement	5. Pest and disease risk	6. Genetic impacts	7. Introduction of therapeutants
Seabird Species	Arctic Tern (*Sterna paradisaea*) [A194] Black-headed Gull (*Chroicocephalus ridibundus*) [A179] Common Gull (*Larus canus*) [A182] Cormorant (*Phalacrocorax carbo*) (A017) Fulmar (*Fulmarus glacialis*) [A009] Gannet (*Morus bassanus*) (A016) Golden Plover (*Pluvialis apricaria*) [A140] Guillemot (*Uria aalge*) (A199) Herring Gull (*Larus argentatus*) [A184] Kittiwake (*Rissa tridactyla*) [A188] Leach's Storm-petrel (*Hydrobates leucorhous*) [A015] Lesser Black-backed Gull (*Larus fuscus*) [A183] Little Tern (*Sterna albifrons*) [A195] Manx Shearwater (*Puffinus puffinus*) [A013] Puffin (*Fratercula arctica*) [A204] Razorbill (*Alca torda*) [A200] Sandwich Tern (*Sterna sandvicensis*) [A191] Shag (*Gulosus aristotelis*) [A018] Storm Petrel (*Hydrobates pelagicus*) [A014]			Potential Direct Effect	Potential Direct Effect			

3.5.1. Impact Mechanism 1 – SAC QI Annex I Habitats

3.5.1.1. Potential Impacts

The potential source of impact to Annex I marine habitats of Slyne Head Peninsula SAC, Connemara Bog Complex SAC and Slyne Head Islands SAC from operations at the sites is organic enrichment due to settleable solids discharged from the fish sites which comprises fish faeces and feed waste. Solid wastes arising from the culture of fish can impact the seabed and associated benthic communities.

3.5.1.2. Modelling and Assessment of the Potential Impacts to Annex I Habitats

For the proposed salmon production operations at the Clifden Bay and Mannin Bay sites, three-dimensional hydrodynamic simulation modelling was undertaken to determine the transport and dispersion of settleable solids surrounding the site. Details of the model are presented in full in Appendix 6.

To note that, the coordinates (areas) of the proposed aquaculture sites presented in Figure 2-1 and Figure 2-3 are different from the boundaries of the site's coordinates used in the modelling report (Table 2 of the modelling report – Appendix 6). However, the centre point coordinates of each pen are used as discharge centre points for each pen and still fall within the boundary of the sites and the model output remains valid for the pollutant's dispersion models output.

The settleable solids loads used in the modelling exercise (Table 3-6) are higher than the settleable solids loads shown in Table 2-5 as the original model inputs were based on slightly higher biomass levels and associated feed requirements compared to the current production cycle (Table 2-1). Therefore, the settlement solids load used in the model remains valid for the purpose of assessing the worst-case scenario of sediment loading impact at the farm sites.

Table 3-6: Settleable solids loadings used in the hydrodynamics modelling study (see Table 3 Appendix 6)

Site	Month	Settleable solids
Hawk's Nest	14	15.745
Ardbear	14	3.374
Curhownagh	18	9.276

The fate, dispersion and transport of solids were modelled following discharge into the water column at mid water depth at the fish pens (*i.e.,* approximately 3 m below surface). The settleable solids discharged from the fish sites comprised two sources of organic particulate matter: fish faeces and feed waste. Of the feed supplied to a fish farm an estimated 97% is consumed by the fish stock while the remaining 3% is uneaten and settles to the bottom. The simulations show localised deposition

immediately beneath the farm cages and within the proposed licensed site area. The modelled total solids deposition depth in mm over full production cycles at Hawk's Nest, Ardbear and Curhownagh are shown respectively in Figure 3-2, Figure 3-3 and Figure 3-4. The predicted maximum accumulation rate at the Hawk's Nest site is 17 g/day per m^2, at the Ardbear site is 25 g/day per m^2 and at the Curhownagh site is 5.5 g/day per m^2, however it should be noted that these values represent a single point of deposition whereas in reality the accumulation rates decrease dramatically with distance from the pens. Total accumulated depth of deposition under the Hawk's Nest, Ardbear and Curhownagh sites over the production cycle were estimated at 2.2 mm, 2.6 mm and 0.6 mm, respectively As effect from deposition is likely to only occur within the immediate area of the pens, it is unlikely that an effect beyond the immediate area of the sites will occur.

Due to the distance of Annex I habitats Reefs within the Slyne Head Islands SAC and Coastal lagoons within the Connemara Bog Complex SAC, as well as the highly localised sedimentation at the sites in Hawk's Nest, Ardbear, and Curhownagh; there is no likely potential significant effect to the Annex I habitats within these SACs.

The modelled sediment plume predicted for the Curhownagh site overlaps the following Annex I Habitats within the Slyne Head Peninsula SAC:

- Large shallow inlets and bays, and
- Reefs.

The modelled sediment plume predicted for the Curhownagh site also overlaps with the following Marine Community Types:

- Subtidal sand with *Kurtiella bidentata* community complex, and
- *Laminaria* dominated community complex.

Though the sediment dispersal overlaps with conservation objectives of the Slyne Head Peninsula SAC [002074], the daily rate of deposition at the Curhownagh site was modelled at 5.5 g/day per m^2 with the majority of the sediments settling directly within the footprint of the Curhownagh site with deposition decreasing dramatically and returning to reference conditions with increasing distance from the pens. Annex I habitats in the Slyne Head Peninsula SAC [002074] are extensive within the area, with those designated for Coastal lagoons [1150] having been calculated at 22.3 ha, those designated for Large shallow inlets and bays [1160] having been calculated as 1540 ha, the area designated for Reefs [1170] has been calculated at 571 ha (NPWS, 2015).

Though coastal lagoons do not overlap with the any of the sites within Clifden or Mannin bays, the lagoon at Athola lough is located particularly close to the Curhownagh site, warranting further investigation. Two lagoons are located within the Slyne Head Peninsula SAC: Ballyconneely Lake is located approximately southeast of the Curhownagh site; 0.5 km south of Ballyconneely, Co. Galway and was assessed by Oliver, 2007, as being of Unfavourable-Inadequate conservation status. However, due to the distance of this site from the aquaculture sites there is likely no significant effects.

The second lagoon in the Slyne Head Peninsula SAC is Lough Athola, located approximately 1 km northeast of the Curhownagh site. The conservation of this lagoon was assessed to be favourable in Oliver, 2007, however its proximity to the Curhownagh site warrants further investigation. Modelling of the dispersal of nitrogen and phosphorous was carried out to determine the influence of the Curhownagh site to surrounding area which includes the waters on approach to the Athola lough lagoon. Targets for water quality with regard to ambient levels of phosphorus (MRP) and nitrogen (DIN) in lagoons have been set out in Roden and Oliver, 2013. The annual median for MRP ranges in lagoons and is typically less than 0.1 mg/l whilst the median DIN is typically less than 0.15 mg/l. The modelling has predicted that the maximum computed nitrogen concentration in waters on approach to Lough Athola will be 0.02 – 0.04 mg/l N which corresponds with natural levels of nitrogen set for the lagoons (less than 0.15 mg/l N). With regard to modelled phosphorus, the maximum computed phosphorus levels in waters closest to Lough Athola lagoon was predicted to contain 0.003 – 0.004 mg/l which is well below the target of <0.1 mg/l based on Roden and Oliver, 2013. Settleable solids from Curhownagh were modelled to drift and settle relatively west of the site and was determined to not pose an impact to the coastal lagoon at Lough Athola.

Marine Community Types including subtidal sand with *Kurtiella bidentata* community complex and *Laminaria*-dominated community complex coincides with the site at Curhownagh. Both community types are found throughout the bay and cover large areas, 574 ha and 234 ha respectively. Based on the results of the hydrodynamic modelling, it is unlikely that Annex I habitats and associated marine community types will be negatively impacted by the proposed aquaculture at Curhownagh.

3.5.1.3. Conclusion

The dispersion simulations show that all three sites produce low accumulated deposition depths over the production cycle with Hawk's Nest site having an accumulated depth beneath the cages of 2.2 mm and at Ardbear it is 2.6 mm and at Curhownagh it is only 0.6 mm. The maximum deposition rates at the sites are 17 g/day per m^2 for Hawk's, 25 g/day per m^2 at Ardbear and 5.5 g/day per m^2 at Curhownagh. However, these maximum deposition rates represent a very specific moment in space

and time with the deposition varying spatio-temporally; with deposition rates decreasing dramatically with increasing distances from the pen areas. Levels of deposition at the pens where deposition rates are highest are capable of being absorbed by the benthic community of microbenthic fauna below pens at the Hawk's Nest, Ardbear, and Curhownagh sites as evidenced by benthic audits carried out in recent years where no evidence of impact from the overlying aquaculture activities was found (see Appendix 7).

In conclusion, these deposition depths and rate are not significant and will not result in a smothering of the seabed or in any significant enrichment of the sea floor within or outside of the licensed sites.

The renewal application requests change to the boundaries of the existing site and to the operating conditions attached to the licences.

As shown above, the proposed operations will not give rise to long term negative effects on local sediment; it is concluded that there will be no significant effects to Annex I habitats.

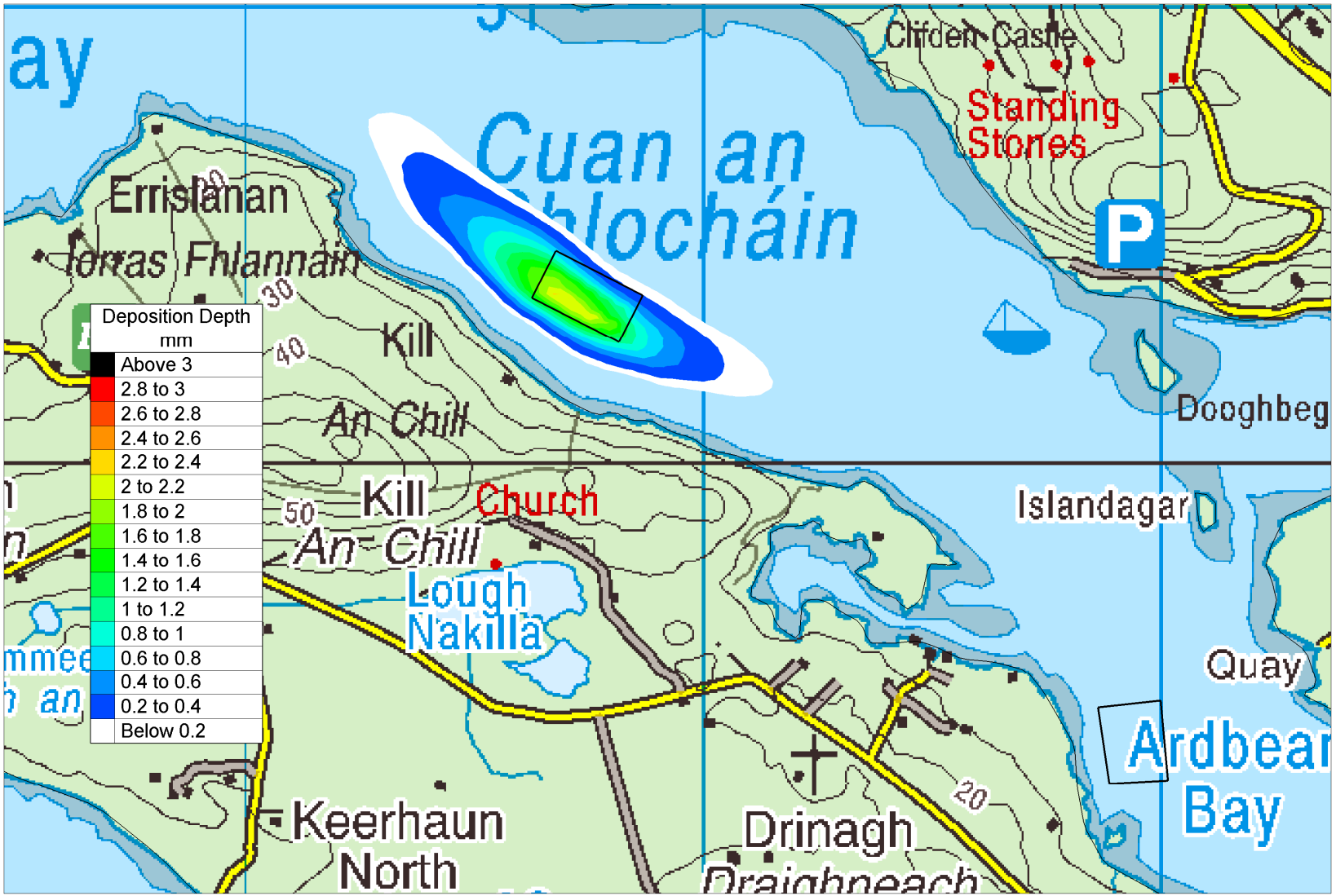

Figure 3-2: Predicted total solids deposition depth (in mm) over full production cycle at Hawk's Nest site.

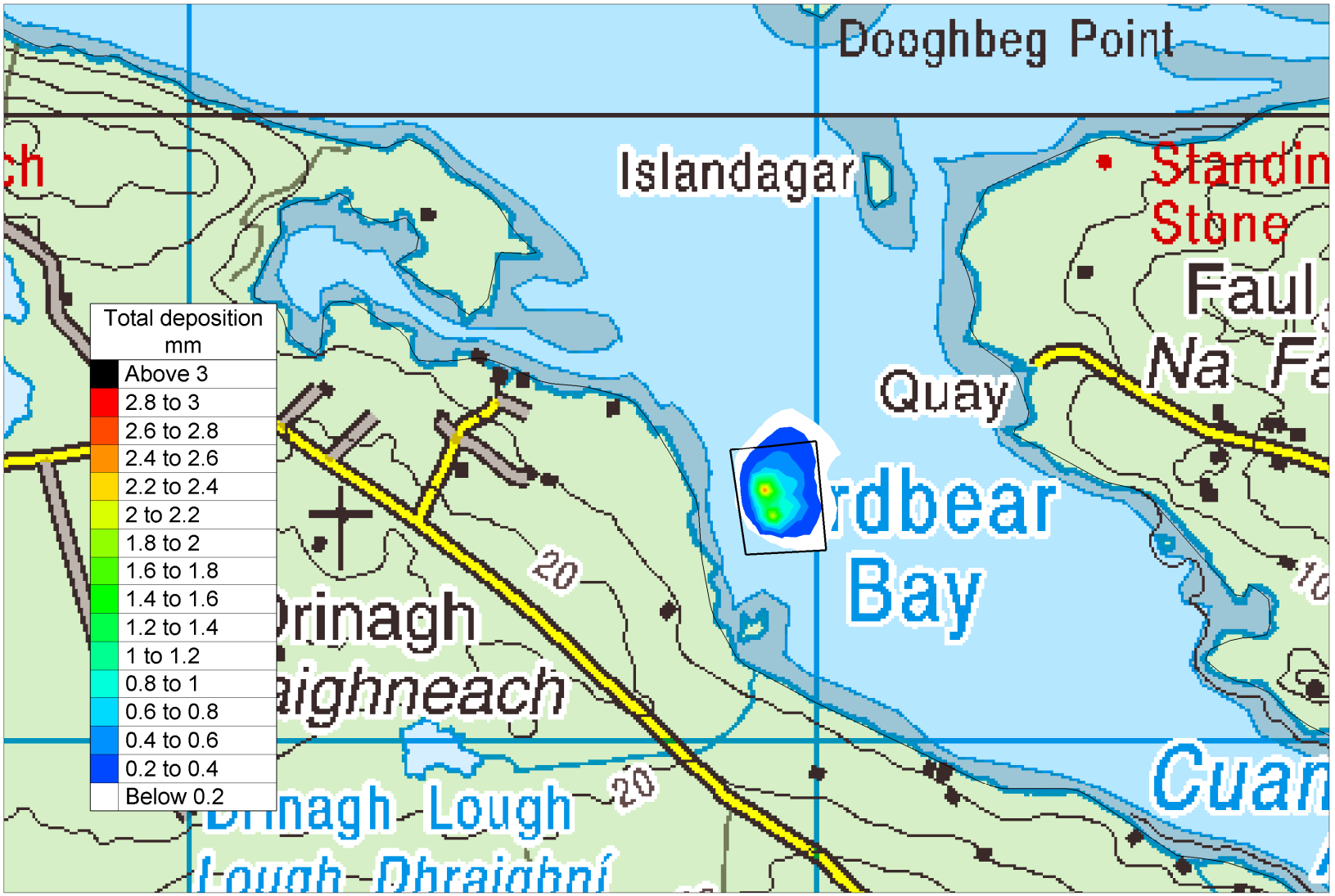

Figure 3-3: Predicted total solids deposition depth (in mm) over full production cycle at Ardbear Site

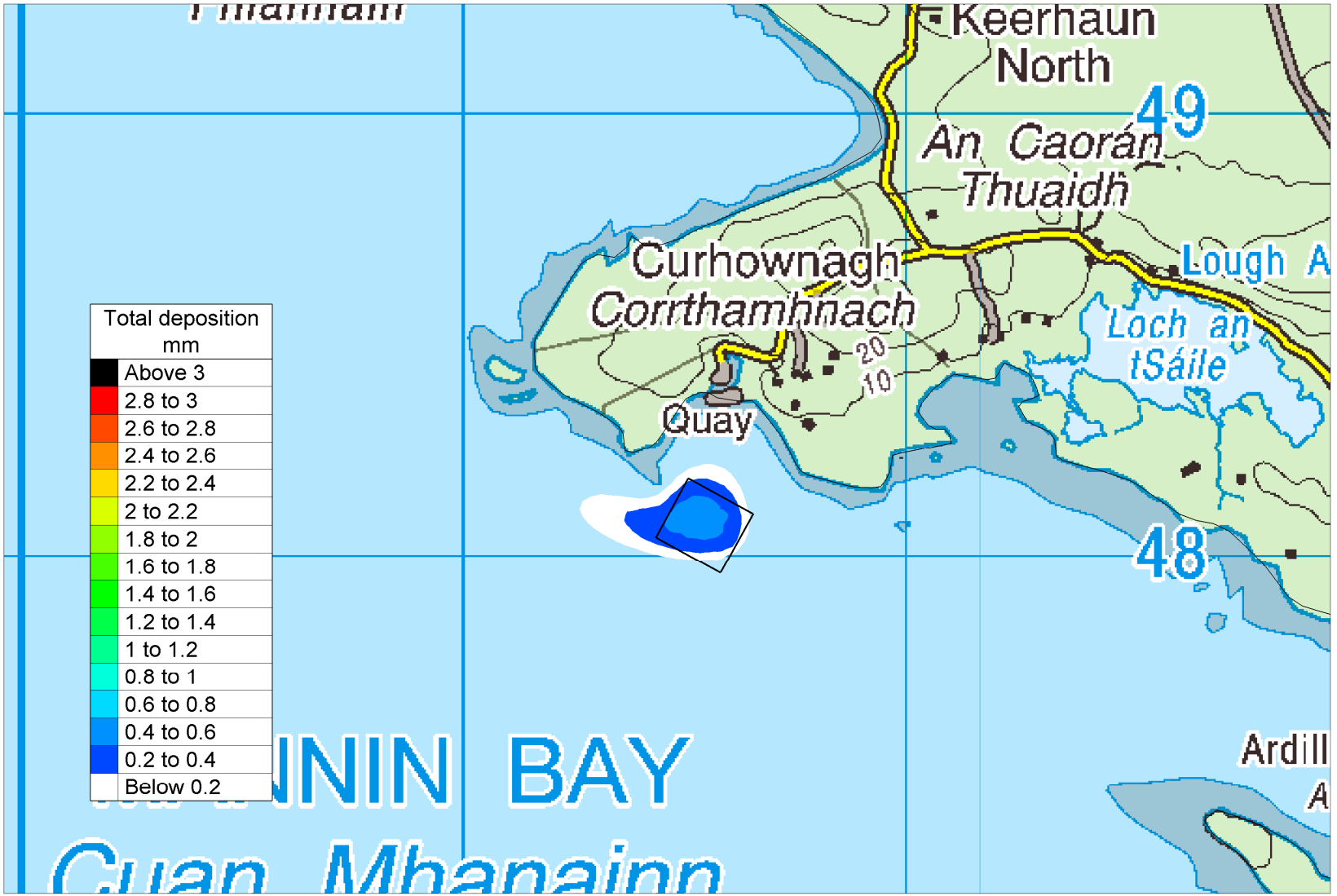

Figure 3-4: Predicted total solids deposition depth (in mm) over full production cycle at Curhownagh Site..

3.5.2. Impact Mechanism 2, 3 and 4 - SAC QI Annex II Species – Mammals

3.5.2.1. Potential Impacts

Operations may result in underwater noise pollution from the boats, physical disturbance and collision risk and entanglement on nets from the sites to the following Annex II species:

- Harbour seal (*Phoca vitulina*) (1365)
- Grey seal (*Halichoerus grypus*) (1364)
- Harbour porpoise (*Phocoena phocoena*) (1351)
- Bottlenose dolphin (*Tursiops truncatus*) (1349)
- Otter (*Lutra lutra*) (1355)

3.5.2.2. Impact Assessment

Impact Mechanism 2 – Underwater noise

Marine mammals use echolocation as their primary means of communication, foraging, navigation and predator avoidance. Previous studies have assessed the potential impacts of noise on marine mammals (Buckstaff, 2004; Weilgart, 2007; Roberts *et al.*, 2019). Acoustic masking is the term used when a frequency of anthropogenic noise overlaps with the frequencies used by marine mammals, which reduces their ability to detect important sounds for communication, navigation and prey detection (Weilgart, 2007). Acoustic Masking can occur anywhere within an organism's auditory range (Wright *et al.*, 2007), and can result in increased information ambiguity and, in extreme circumstances, inability for cetaceans to orientate themselves, hunt or evade predation in the marine environment (Wright *et al.*, 2007). Potential effects of noise disturbance on marine mammals can result in lethal effects, physical injury, auditory injury and behavioural response.

As there is potential that both seal species and some dolphin species may in the vicinity of the sites in Clifden and Mannin Bay, effects from underwater noise and vibrations generated by the service vessels, well-boat and feed barges must be considered. As is standard practice in marine vessel construction the engines will be on flexible sound dampening mounts. This effectively reduces the vibrations and the transfer of noise into the aquatic environment. Farmed salmon stock generally show no negative response or stress to the low-level noise generated during normal farm activities (BIM, 2012). It should be noted that the underwater noise generated by the farm vessels will not be any more significant than normal fishing/recreational activities. Small fish are known to shoal around the pens of salmon farms as structures themselves can act as artificial reefs, an act that is unlikely to occur if there were any serious noise issues associated with the farm. Consequently, it is unlikely that

operations at the site will result in disturbance effects on pinniped and cetacean species, and the likelihood of an impact occurring is remote; it is concluded that there will be no likely significant effects.

There is a possibility it may be necessary to use anti-predator nets and or Acoustic Deterrent Devices (ADDs) to protect the stock from seal depredation. As ADDs have never been required at the licensed sites, it is extremely unlikely that they will be required if the licence is renewed.

Impact Mechanism 3 - Physical disturbance and collision risk

Collision risks due to increased vessel traffic include a range of injuries for marine mammals, which in extreme cases can cause mortality (Laist *et al.*, 2001, Van Waerebeek *et al.*, 2007). Non-lethal collisions can be divided in two main categories: blunt trauma from impact, and lacerations from propellers (Van Waerebeek *et al.*, 2007). Consequently, these types of injuries can trigger a second type of impacts as they can potentially put species in a vulnerable state for infections and predation. Previous literature has assessed that cetaceans adopt avoidance behaviours determined on the type of vessel/boat characteristics. Boats with fast and unpredictable movements (speedboats and jet skis) are more likely to initiate avoidance behaviours in marine mammals (Leung & Leung, 2003, Buckstaff, 2004), than vessels that are larger in size with slower speed which makes their trajectory predictable (cargo ships) (Leung & Leung, 2003; Sini *et al.*, 2005). Seal responses to disturbance can vary widely depending on the location and nature of the disturbance from increased alertness to movement towards the water and entering the water. A considerable body of research has focussed on short-term responses of seal to recreational boaters (Paterson *et al.*, 2019; Johnson & Acevedo-Gutierrez, 2007; Henry & Hammill, 2001), commercial ships (Jansen *et al.*, 2010; Mathews *et al.*, 2016). Disturbance by small boats and people have been reported to result in flushing responses in seals at distances of between 80m and 1km (Johnson & Acevedo-Gutierrez, 2007; Jansen *et al.*, 2010). Moreover, Jansen *et al.* (2010) showed the need to update regulations to maintain a 500 m distance between cruise ships and seals.

Impact Mechanism 4 - Entanglement on nets from the site

The fish pens and associated infrastructure (nets, ropes, anchor lines etc.) pose an entanglement risk to some marine mammal species foraging in the site areas, however, in contrast to fishing gear, there are far fewer documented entanglement cases in salmon aquaculture gear. Some cetacean species such as harbour porpoise and the bottlenose dolphin have been reported in Clifden and Mannin Bays, therefore, there is potential that the species may occur near the aquaculture sites during operations. However, cetaceans rarely interact with marine farm sites and so disturbance and entanglement impact can be excluded. For pinniped species, the harbour seal feeds primarily on fish and may

occasionally predate on salmon farmed in pens. Although entanglement incident would most likely result in the fatality of the individual, it is unlikely to be more than an isolated incident and the impact on the population would be similar in magnitude to natural variation. Consequently, it is concluded that there will be no likely significant effects.

Otters are known to cause loss/damage to stock in marine farms (Sales-Luis *et al.*, 2009), although they are, in general, considerably less problematic than seals, and probably as much of a nuisance as some bird species such as cormorant, shag, heron and gulls (Quick *et al.*, 2002). Previous studies have also stated a wide range and shift in otters dietary with preferences in brown trout and cyprinids, such as carp, roach, rudd and tench, resulting in conflict with freshwater fish farms (Freitas, 2007; Jacobsen, 2005), fisheries and recreational anglers (Almeida *et al.*, 2012). The high diversity in otter's diet seems to depend on availability, as well as on a seasonal basis, consequently indicating that food preferences are a response to availability instead to a dietary necessity.

While there is potential that otter may be found along the coast of Clifden and Mannin Bays, the distance of the proposed aquaculture sites from the coastline is too significant for the species to be found at the site. All proposed sites are located at a water depth that falls outside the diving range of otters. Furthermore, the habitat type at the aquaculture sites is not conducive to foraging, therefore it is extremely unlikely that otters will come into contact with the aquaculture pens or be impacted by the aquaculture activity.

The likelihood of an impact occurring on otters is remote, the consequence of an impact if realised is negligible; it is concluded that there will be no likely significant effects to otter.

3.5.2.3. Conclusion

It can be concluded that operations will not significantly affect Annex II species mammal species.

3.5.3. Impact Mechanism 5, 6 and 7 - SAC QI Annex II Species – Atlantic salmon and Freshwater Pearl Mussel

3.5.3.1. Potential Impacts

Given the nature of salmon farming there is potential that operations may directly impact wild salmon populations:

- increasing lice infection rate in wild salmon,
- disease spread,
- the introduction of therapeutants, and

- genetic interaction between farmed and wild Atlantic salmon.

A comparison of trout versus salmon dominated rivers of Ireland shows that all identified pearl mussel rivers are associated with salmon and sea trout. Salmon and freshwater pearl mussel have been cited as symbiotic in their relationship, with both species providing a beneficial role for the other (Ziuganov & Nezlin 1988, Ziuganov *et al*., 1994) with salmon gills hosting mussels during their glochidial stage and pearl mussels preventing early senility in salmon (Ziuganov, 2005).

Potential loss of host fish has been cited as a potential reason for pearl mussel decline (Araujo & Ramos, 2000, Geist, 2010); consequently, there is potential that the proposed project may affect wild salmon, an obligate host for pearl mussel larvae.

3.5.3.2. Sea Lice

Background

Sea lice are natural parasites of both wild and farmed fish. There two main species found in Ireland; *Lepeophtheirus salmonis* which infests only salmonids and while *Caligus elongatus* which is known to parasitise over 80 different species of marine fish (O'Donohoe *et al.,* 2017). *Lepeophtheirus salmonis* is the larger of the two species and is regarded as the more damaging parasite. It is endemic at a high prevalence (>90%) within wild populations (Jackson *et al.,* 2013), and occurring frequently on farmed salmonids (Jackson & Minchin, 1992; Jackson *et al.,* 2005).

Lepeophtheirus salmonis is an obligate parasite with a direct lifecycle with 8 stages (comprising of nauplius 1, nauplius 2, copepodid, chalimus 1, chalimus 2, pre-adult 1, pre-adult 2 and the adult stages (O'Donohoe *et al.,* 2017). The life cycle is shown in Figure 3-5. The nauplius 1 stage hatches from paired egg-strings and is dispersed in the plankton. It moults to nauplius 2, also planktonic, which is followed by a copepodid, the infective stage where attachment to the host takes place. The copepodid then moults through the attached chalimus stages before becoming a mobile pre-adult. There are two pre-adult stages before maturing to the adult phase. The adult female can produce several batches of paired egg-strings, which in turn hatch into the water column to give rise to the next generation (Hamre, 2013; Kabata, 1979; Schram, 1993). Hatch rate is variable according to season, host and other factors but peaks at about 400 Nauplii per clutch. The copepodid attaches to its target host through the development of a frontal filament.

Copepodids have limited strategies to assist in seeking out hosts. They can dart by up to 10 cm on sensing a passing host fish. They may also be able to adjust their position in the water column, sinking towards the seabed in response to the ebbing tide (geotaxis), to assist in maintaining their position

and population density, close to estuaries and inshore margins, through which their target hosts migrate. Once attached, to the host, the louse feeds on blood and tissue. It develops through four chalimus larval stages and two pre-adult stages before maturing. The time taken between metamorphoses for this cycle to complete, and the next generation of eggs to be produced, is temperature-dependant.

A paper by Shepard and Gargan (2017) explores the topic of the contribution of sea lice from aquaculture to declining annual returns in a wild Atlantic salmon population. They use a 26 year data set of 1 sea-winter (1SW) salmon from the Erriff River which flows into Killary Harbour at its eastern end. There is another salmonid river in the area, the Bundorragha, which also flows into Killary Harbour. A salmon farm is located at the western end of Killary on its southern shore and has been operating since the mid-1980s and as is typical for any marine-based salmon farm anywhere in the world, the farmed fish are infected by the sea louse, *L. salmonis*. The authors use a suite of statistical tests to show a correlation between high numbers of lice on the farmed fish and declines in numbers of 1SW fish.

However, these authors do not make any reference at all to the oceanographic characteristics of Killary in their paper nor do they reference any of the findings of the planktonic larval sea lice studies that were carried out in the harbour and they do not discuss possible migration smolt behaviour patterns. Rather than considering the possible contribution that physical oceanography might have on dispersing and diluting larvae in the harbour nor discussing the likely outward migratory routes that smolts may take, these authors depend solely on using statistics to demonstrate a correlation between lice numbers and numbers of 1SW fish.

In terms of physical oceanography, Killary has been the subject of many, many detailed oceanographic investigations since the first multidisciplinary study was carried out in 1974 by a joint Irish/French group of scientists (see Keegan and Mercer, 1986). This was followed up by a series of papers from University College of Galway's Shellfish Research Laboratory in Carna (see *inter alia* Rodhouse *et al.,* 1984 and 1985, Rodhouse and Roden, 1987 and Roden *et al.,* 1987). Costelloe *et al.* (1995) and Costelloe *et al.* (1998b) present findings of a number of drogue surveys of Killary and some water column data. Bord Iascaigh Mhara (2007), as part of its UISCE initiative, carried out hydrographic surveys of the harbour and developed a hydrographic model for it also.

Based on all these data sets, Killary can be described as a layered system with a lower salinity, outflowing (westerly) body of water that overlies a higher salinity inflowing (easterly) current. This becomes most pronounced during periods of high rainfall. Wind can have a strong effect on the flow direction of surface waters *i.e.,* the top 2m. Current velocities are generally less than 20 cms^{-1} sec.

Drogue track results presented in Costelloe *et al.,* (1995), Costelloe *et al.,* (1998b) for drogues released close to the farm site at the western end of Killary at low water reflect these low velocities as they show a very slow inward progression with the drogues travelling *ca* 2 km over a deployment period of *c.* 5 hr. (up to high water) which equals a mean speed of *ca* 10 cms^{-1}. The drogues were not followed on the ebbing tide but it is clear that they would have travelled westwards.

These results are also in line with data presented in Costelloe *et al.* (1995, 1996a, 1996b, 1988a, 1998b) who show that, due to dilution and dispersion, larval lice numbers decrease rapidly with distance away from the salmon farms. Another reason why larval densities outside pens may be low is that once the copepodids had been reached (which is the first potentially infective stage (Hamre *et al.,* 2013), the larvae can then metamorphose directly into the adult stage and infect the fish in the pens. They do not therefore have to go through the other larval stages.

Pycnoclines (vertical density gradients) are associated with stratified water columns (Arellano *et al*., 2012, *inter alia*) of planktonic (both mero and holoplanktonic) species. Included in these taxa are naupliar stages of *L. salmonis.* This is because the early-stage larvae do not have enough swimming power to allow the larvae to swim through these discontinuities. The pycnoclines are located in parts of bays where rivers enter them and, depending on the number of rivers entering these systems, there will be more than one location where such discontinuities are present. Furthermore, the spatial extent of the pycnocline will be directly related to the amount and temporal extent of rainfall events.

Crosbie *et al.* (2019) recorded that, under laboratory-based experiments on the effect of salinity on salmon lice larvae (*L. salmonis*), both nauplii and copepodids aggregated at or just under the halocline and that for nauplii, clustering within the halocline was particularly strong. Such barriers to larval movements were never considered in a paper by Shepard and Gargan (2017) that looked at possible interactions between fish farms and wild salmonid populations.

Larval *Lepeophtheirus* densities recorded by Costelloe *et al.* (1988) are similar to those recorded more recently by á Norði (2015), Nelson *et al.,* (2017), Byrne *et al.,* (2018) and Adams *et al.* (2021).

Hydrodynamic models are routinely used to predict the fate and concentration of different types of materials that are disposed of to the aquatic environments and in relation to salmon farms, these include Biological Oxygen Demand (BOD), dissolved inorganic nitrogen (DIN), molybdate reactive phosphorus (MRP), ammonia (NH_4), suspended solids (SS), antibiotics (AB) and sea lice larvae.

The model is initially constructed to ensure that its physical attributes *e.g.,* tidal heights, current velocities and directions, accurately reflect these variables as they occur at the site being modelled and this is achieved by placing recording sensors *e.g.,* tide gauges and current meters, in the area to

be modelled for at least one lunar cycle. The model is then run and the predicted tidal heights and current velocities and directions are statistically compared to the empirical data and depending on the closeness of the fit, the model is refined to make the output reflect the measured data more accurately. As the tidal cycle is well understood on a global basis and the area of fluid dynamics has been studied for many decades, the modelled output for the tidal heights and current flows and directions normally fit the empirical data well.

For the solute modelling *i.e.,* BOD, DIN, MRP, NH_4, SS and AB, water samples are collected over different parts of the tidal cycle within the model domain and, as for the tidal height, and current and direction simulations, the modelled data are statistically compared to the empirical data and the model can be refined to make a better fit between the empirical, measured data and the modelled data. Similar to the tidal and current modelled data, as water solutes have been well studied over a long time period, modelled output for these variables normally fit the empirical data well.

With regard to the densities of larval lice (*L. salmonis*) in the marine environment, Costelloe *et al.*(1996; 1998) were the first to publish data on this topic and they recorded densities ranging from *c.* 70 larvae/m³ within the pens, to *c.* 3 larvae/m³ outside the pens, to *c.* 1 larva/m³ 100 m away from the pens and less than 1 larva/m³ 1 km away from the farm. Morton *et al.* (2011) report larval lice densities from the west coast of Canada (Broughton Archipelago) as ranging from < 0.1 m³ - < 0.4 m³ and state that there were no lice in samples from control sites or sites with pens but no fish. á Norði *et al.* (2015) present abundance data on planktonic stages of *L. salmonis* in a salmon farming region in the Faroe Islands and record densities of 0 m³ for nauplii and 0 – 0.21 m³ for copepodids. Nelson *et al.* (2017) studies the distribution of *L. salmonis* around salmon farms in the Bay of Fundy, Canada and recorded larval densities of 1.5 m³ at the edge of the farm and 0.4 m³ 100 m away from the farm. They also recorded densities of 0.05 m³ at a reference site. Byrne *et al.* (2018) examined larval densities of *L. salmonis* at a salmon farm in British Columbia, Canada and record densities of *c.* 1 m³ both in the farm at a reference site. Adams *et al.* (2021) worked on *L. salmonis* abundances in a bay with salmon farms in the northwest coast of Scotland and recorded naupliar densities ranging from 0 – *c.* 0.6 m³ and copepodid densities from 0 – *c.* 3.5 m³.

These values are relatively similar to one another, and they also cover a broad geographical extent ranging from the northeast to the northwest Atlantic and further west to the northeast Pacific, all these data show that outside the farm area, larval densities are low. This very much follows a simple dilution model with increased distance from the source. It is considered that because these data are so similar to one another and cover such a broad geographic extent, they are suitable to be used as model validation data.

As the output data of the hydrodynamic model with regard to predicted larval densities fall within the range of the empirical data, it is clear therefore that the model is generating valid data.

Lice fecundity peaks in spring, when infective copepodid stages appear to congregate near the river mouths, from which smolts emerge. The precise mechanism behind this phenomenon is not clear but it is likely that ovigerous female lice are carried into the inshore margins near estuaries on wild adult salmon, returning to their native rivers to spawn. By this means, a critical mass of descending smolts is met by a critical mass of waiting copepodids, such that a successful infestation ensues.

Lepeophtheirus salmonis evolved this strategy of infesting salmonid smolt during their migration, countless millennia ago, long before the advent of salmon farming. In fact, *L. salmonis* must be very successful at host targeting because the clutch size of lice juveniles is quite small for a parasite that releases its young into open waters to complete its life cycle rather than directly onto a host species.

Copepodids cannot feed and only survive as long as their internal yolk supplies last. Any that fail to find wild hosts drift seawards and die, within ten days or so, dependant on temperature, as their yolk supplies run out. Inadvertently, salmon farms offer a new, alternative host source since they are situated at fixed locations downstream of river mouths and their relatively high stocking density mirrors the natural shoaling of their wild cousins, prior to their migration dispersal.

However, while wild fish disperse seawards from their native estuaries, effectively ending their exposure to the parasite, farmed salmon remain at high densities, within the confines of their pens. This makes it easy for chance encounters with small numbers of drifting wild copepodids to result in widespread infestation of farm stocks within one or two lice generations if the infestation if not treated. This is the primary means of lice infestation of well-managed salmon farms, their secondary route being infestation by copepodid drift from one farm site to others, downstream of it. Another reason why larval densities outside pens may be low is that once the copepodid had been reached (which is the first potentially infective stage0 (Hamre *et al.,* 2013), the larvae can then metamorphose directly into the adult stage and infect the fish in the pens. They do not therefore have to go through the other larval stages.

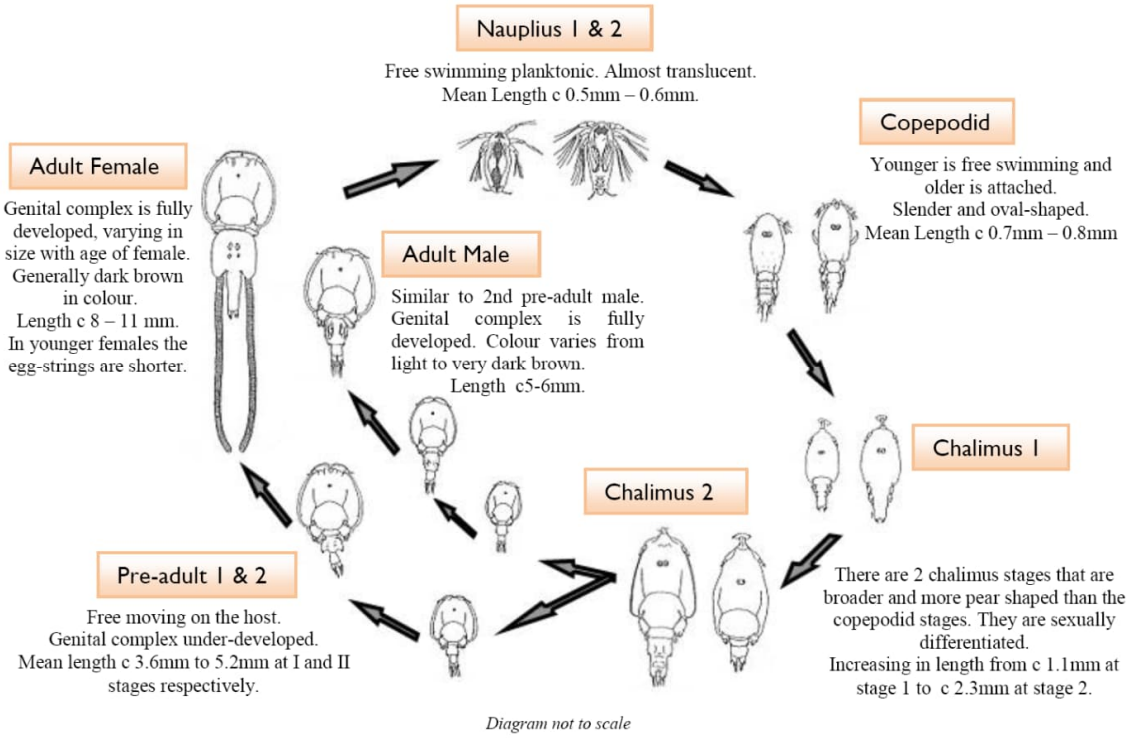

Figure 3-5 Life cycle of *Lepeophtheirus salmonis* (O'Donohoe *et al*., 2017 after Schram, 1993 & Hamre, 2013).

Research by Jaffa (2016; 2019, 2021) on declining stocks of salmonids in Scottish waters provides some interesting insights into the lack of correlation between declines in salmonid stocks and salmon farms in Scottish waters (Appendix 5 – Summary of Jaffa Papers 2016; 2019 & 2021). Although, it is worth acknowledging other research views pointing towards salmon farms being a major contributor to wild salmon population declines (Tully & Whelan, 1993; Costello, 2009; Forseth *et al.,* 2017; Shephard and Gargan, 2017; 2021).

3.5.3.3. Modelling Potential Impact

The critical period for sea lice infestations and impact on wild fish is during spring season. The proposed production plan shows that the Hawk's Nest site is a potential source of sea lice infestation during the first spring period.

To note that, the coordinates (areas) of the proposed aquaculture sites presented in Figure 2-1 and Figure 2-3 are different from the boundaries of the site's coordinates used in the modelling report (Table 2 of the modelling report – Appendix 6). However, the centre point coordinates of each pen are used as discharge centre points and still fall within the boundary of the sites and the model output remains valid for the sea lice dispersion model's output.

The production plan shows that Ardbear is unlikely to be a source of sea lice larvae dispersion as it is harvesting the fish in March and April of Year 2. Curhownagh is also only in use in Year 2 but has a

standing stock during March and April before harvesting in May and June and therefore, is a potential source for sea lice infestation. It was considered that Ardbear was an unlikely sources of sea lice larvae and was not included in the three-dimensional modelling (see Appendix 6).

Three-dimensional hydrodynamic simulations of the transport and dispersion of sea lice (*L. salmonis*) larvae from the proposed salmon farm production at Hawk's Nest site was performed using a five vertical layer model, in sigma coordinates and a variable horizontal mesh as described earlier. The lice larvae loading was released as a continuous discharge into the water column at mid-cage depth and its subsequent advection and dispersion modelled both horizontally and vertically.

The simulation output is presented both as the computed maximum plume concentration envelope and also the mean plume concentration envelope, refer to Figure 3-6 and Figure 3-7 for the Hawk's Nest site and Figure 3-8 and Figure 3-9 for the Curhownagh site. The maximum plume concentration envelope plot represents the instantaneous maximum concentration both in the water column and over time with the maximum concentration outputted spatially over the model domain. It should be noted that such maximum concentrations, spatially, do not occur simultaneously in time and that the frequency and duration of such occurrence is relatively low.

The average larvae plume concentration (Nauplius and Copepodid stages) envelope represents the average concentration plume in the water column and over time and is reasonably similar in magnitude (generally higher) to the statistical median (50-percentile) concentration, particularly over a 29-day simulation period. For the ten selected reference sites presented in Figure 3-10 and Figure 3-11 the statistical quantities for the average, 90, 95, 98 and 99 percentiles and the instantaneous maximum concentrations are presented in below for Hawk's Nest and Curhownagh sea lice larvae dispersal simulations.

For the Hawk's Nest site (average of 190,200 fish in Spring Year 1), the maximum larvae concentration occurs at the cage sources with a predicted maximum within the farm site of 2.91 no./m^3 and a tidal mean of 1.02 no./m^3. Outside of the site boundary this maximum concentration reduces to *c.* 1.33 no./m^3 and in the inner bay area at Ardbear the maximum predicted concentration is less than 0.6 no./m^3 and with a tidal average of less than 0.3 no./m^3. The impact outside in the approaches to Clifden Bay and on the adjoining Mannin Bay is small with concentrations below 0.1 no./m^3 including its impact at the Curhownagh site.

For the Curhownagh simulation the fish number (average of 78,000 fish March to April Year 2) and thus the potential larval load is only 40% of Hawk's Nest. The simulation shows the maximum larvae concentration occurring at the cage sources with a predicted maximum within the farm site of 1.62

no./m^3 and a tidal mean of 0.6 no./m^3. Outside of the site surrounding the boundary, this maximum number reduces between 0.2 and 0.55 no./m^3 and a tidal mean between and in the inner bay area at Ardbear the maximum predicted is less than 0.6 no./m^3 and the tidal mean is 0.3 no./m^3. In the wider bay area, the larval concentrations are predicted to be less than 0.1 no./m^3. There is no impact from the Curhownagh site on the Clifden Bay sites and therefore no potential for a combined impact and cross contamination of sites through advection and dispersion.

Table 3-7: Predicted Sea Lice Nauplius I Larvae Concentration statistics (No./m^3) at reference sites for Spring Average Fish Numbers Year 1 at the Hawk's Nest Production Site.

Reference Sites	Solute Concentrations						
	Mean	Median	90	95	98	99	Maximum
A1	1.02	0.87	1.80	2.16	2.40	2.52	2.91
A2	0.51	0.51	0.77	0.82	0.92	1.02	1.18
A3	0.47	0.29	1.06	1.14	1.20	1.23	1.33
A4	0.27	0.24	0.42	0.48	0.56	0.60	0.68
A5	0.26	0.26	0.39	0.43	0.50	0.57	0.66
A6	0.24	0.23	0.33	0.37	0.44	0.46	0.51
A7	0.09	0.07	0.19	0.21	0.22	0.23	0.26
A8	0.30	0.27	0.46	0.50	0.53	0.54	0.57
A9	0.21	0.21	0.27	0.29	0.30	0.31	0.33
A10	0.19	0.18	0.22	0.23	0.23	0.23	0.24

Table 3-8: Predicted Sea Lice Nauplius I Larvae Concentration statistics (No./m3) at reference sites for Spring Average Fish Numbers Year 1 at the Curhownagh Production Site.

Reference Sites	Solute Concentrations						
	Mean	Median	90	95	98	99	Maximum
C1	0.60	0.53	1.23	1.33	1.41	1.47	1.62
C2	0.29	0.34	0.51	0.52	0.53	0.54	0.55
C3	0.20	0.21	0.29	0.31	0.33	0.34	0.37
C4	0.19	0.20	0.08	0.12	0.15	0.17	0.26
C5	0.03	0.01	0.08	0.12	0.15	0.17	0.23
C6	0.16	0.16	0.29	0.33	0.37	0.39	0.40
C7	0.18	0.17	0.22	0.24	0.26	0.27	0.29
C8	0.08	0.09	0.13	0.14	0.15	0.15	0.15
C9	0.04	0.03	0.06	0.06	0.07	0.07	0.08
C10	0.07	0.07	0.09	0.09	0.10	0.10	0.11

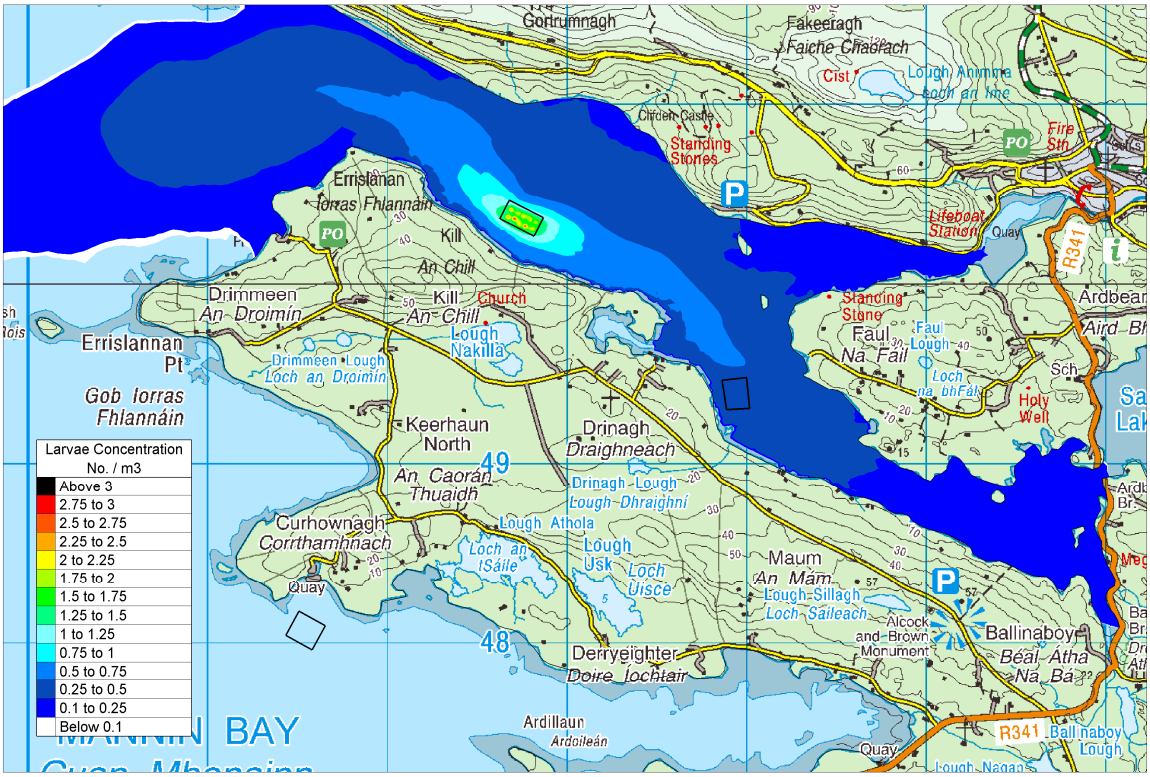

Figure 3-6: Predicted tidal maximum Nauplius I larvae numbers (No./m^3) from the Hawk's Nest site.

Figure 3-7: Predicted tidal mean Nauplius I larvae numbers (No./m^3) from the Hawk's Nest site.

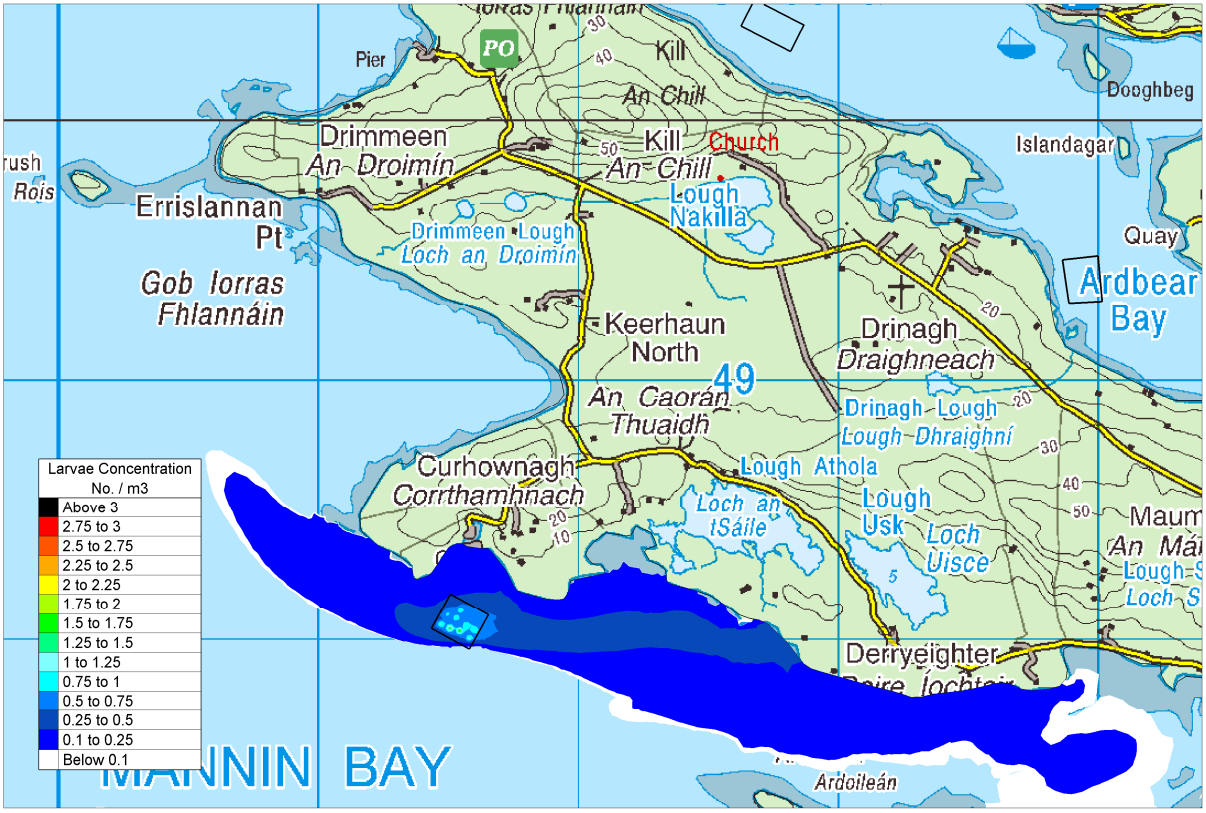

Figure 3-8: Predicted tidal maximum Nauplius I larvae numbers (No./m^3) from the Curhownagh site.

Figure 3-9: Predicted tidal mean Nauplius I larvae numbers (No./m^3) from the Curhownagh site.

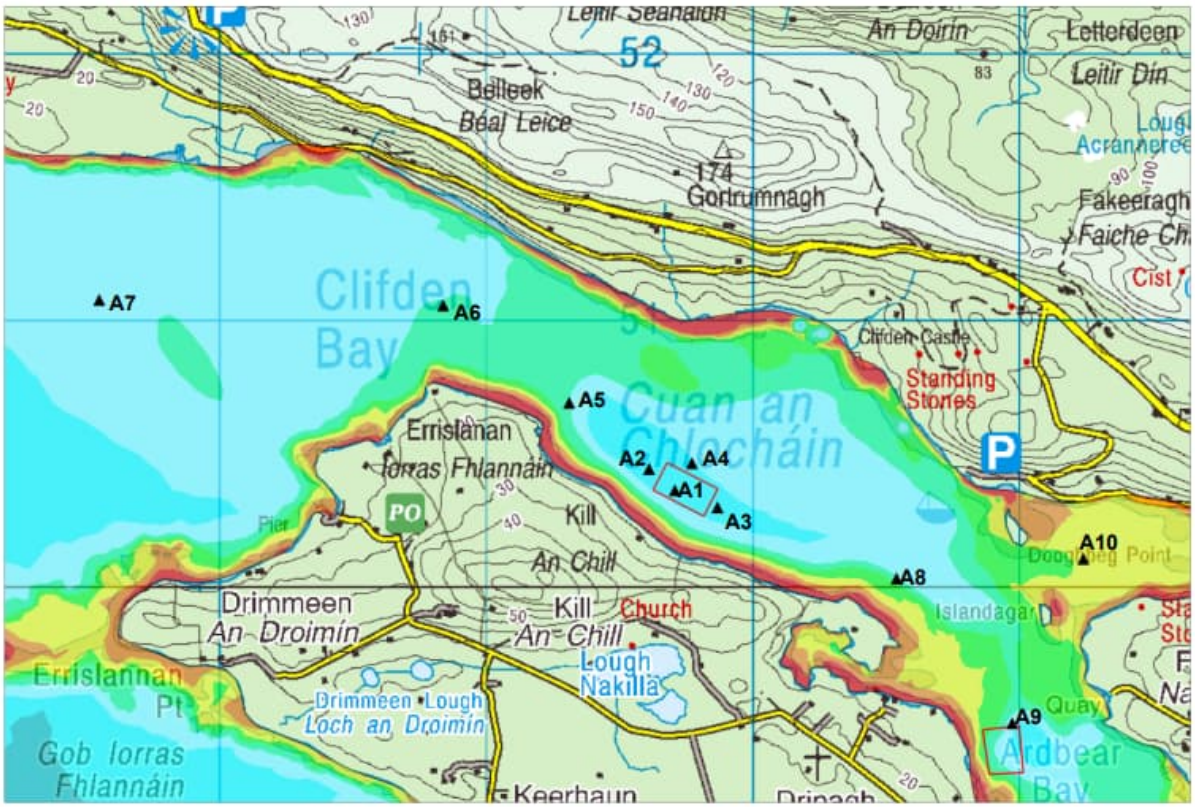

Figure 3-10: Time Series Reference Sites for Hawk's Nest site.

Figure 3-11: Time Series Reference Sites for the Curhownagh site.

3.5.3.4. Assessment

The effects of lice infestation on the physiology of Atlantic salmon, sea trout and Arctic charr smolts has been reviewed by several studies (Finstad & Bjørn, 2011; Thorstad *et al*., 2015; ICES, 2016). Major primary (nervous, hormonal), secondary (blood parameters), and tertiary (whole body response) physiological effects (*e.g.,* high levels of plasma cortisol and glucose, reduced osmoregulatory ability, and reduced non-specific immunity) occur when the lice develop from the sessile chalimus second stage to the mobile first pre-adult stage. Reduced growth, reproduction, swimming performance, and impaired immune defence have also been reported as effects of sea lice infestations on salmonid species. (Finstad & Bjørn, 2011; ICES, 2016).

The susceptibility and response to louse infection varies among individuals, populations, and species of salmonid. Laboratory studies have showed that 0.04–0.15 lice per gram fish weight can increase stress levels and that infections of 0.75 lice per gram fish weight (equivalent of 11 lice per smolt) can kill hatchery-reared smolts if all the lice develop into pre-adult and adult stages (Finstad *et al.*, 2000; ICES, 2016).

Evidence suggests that sea lice induced mortality has an impact on Atlantic salmon returns, which may impact the achievement of conservation limits in salmon rivers (Gargan *et al.*, 2012; ICES, 2016). In recent years, research studies have been based on a variety of statistical analyses of differential survival to adults among release groups (Jackson *et al.,* 2011a, b; Gargan *et al.,* 2012) including odds ratios (Jackson *et al.,* 2013; Krkošek *et al.,* 2014; Vollset *et al.,* 2016). The odds ratio was represented as the probability of being recaptured in the treated group divided by the probability of being recaptured in the control group. All studies reported an overall improved return rate for treated *vs.* control salmon, however these studies also showed significant spatial and temporal variability in the magnitude of the treatment effect (ICES, 2016).

Furthermore, the studies were not designed to discriminate between lice from farm and non-farm sources. In addition, the baseline marine survival from untreated groups, which is used as a comparator for treated groups, is itself likely to be affected by louse abundance, introducing an element of circularity that leaves the interactive effects between lice and other factors on salmon survival poorly characterized (ICES, 2016).

Nutrient enrichment due to settleable solids discharged from the fish site is the main source of degradation of freshwater pearl mussel, due to the deoxygenation of the substratum, as well as creating a physical barrier of fungal and bacterial biomass. The species is extremely sensitive to environmental perturbations, owing to its complex life cycle, especially for juvenile individuals which

spend a minimum of five years living in the substratum. Consequently, this species can be indirectly affected by impacts on benthic habitats.

3.5.3.5. Conclusions

Sea lice larvae infestation simulations were carried out for Hawk's Nest and Curhownagh sites. The modelling used 1 Louse per Adult Fish producing 250 eggs per louse gives the following average combined input rate of 60.4 larvae/second.

Modelling of sea lice concentrations at Hawk's Nest and Curhownagh concluded that sea lice concentrations are elevated at sites which decrease to less than 0.1 no./m^3 on approach to Clifden and Mannin bays, respectively. The impact of sea lice is localised to the farms and there is no impact of the Hawk's Nest site on the Curhownagh site and vice versa through advection and dispersion. On average, elevated sea lice will be found directly within the pen areas itself with maximum predicted larvae numbers at Hawk's Nest suggest some dispersal into the larger area of Clifden Bay, this increase will be temporary with exposure being relatively limited to the northern shore of the Errislannan peninsula. As sea lice are also a naturally occurring parasite in Irish waters, it can be concluded that there will be no likely significant effect to Annex II species Atlantic salmon and freshwater pearl mussel.

3.5.3.6. Disease spread

3.5.3.7. Background

Disease occurrence in organic farming in covered in Section 0. Diseases contracted by farmed salmon mainly arise in the first instance from local wild stocks. Regulation of farmed stock movements is such that the introduction of diseased farmed fish from other regions is unlikely.

3.5.3.8. Assessment and Conclusions

The use of vaccines and effective veterinary supervision have brought the eradication and control of diseases on salmon farms to a level that surpasses accepted levels for other livestock. Given the control of diseases on the farm, it is highly unlikely that the farm act as a significant source of disease; consequently, it is concluded that there will be no likely significant direct effects to the Atlantic salmon and no likely significant indirect effect to the freshwater pearl mussel.

3.5.3.9. Therapeutants

3.5.3.10. Background

The use of chemicals, including antibiotics, has been reduced with the introduction of vaccines and the application of organic standards. In-feed antibiotic treatments are never used prophylactically for farmed salmon.

3.5.3.11. Assessment and Conclusions

Modern treatments, in particular for lice, break down and disperse rapidly post-treatment, with no prospect of deleterious impact on wild salmonid stocks. For example, Slice® a licensed in–feed treatment for sea lice which, where hydrographic conditions suit its application, is commonly chosen in preference to bath treatments as it is considered more effective, in that it kills all lice stages and is more environmentally benign. Slice® is a proprietary pre-mix containing 0.2% Emamectin Benzoate (EmBZ), for surface coating onto salmon feed, at a rate of 5 kg Slice® tonne of feed (that is 10 g EmBZ/ tonne of feed). It is manufactured by Merck Animal Health Inc. The treatment is applied, on veterinary prescription, as a surface dressing to salmon feed, prior to use and the course of treatment lasts 7 days. It has been determined that 10% of the EmBZ dose ingested is excreted during this treatment period (SEPA, 2005). Of the remaining 90% of the chemical, approximately 99% is excreted over the subsequent 216 days. This excretion has an exponential decay profile such that 50% of the chemical remaining in the fish is released, on average, over each ensuing 36 – 37-day period. It has also been determined that EmBZ breaks down into “non-toxic” sub-compounds with a half-life period of 250 days.

The three-dimensional model simulations for the dispersal of Slice® in-feed treatment was carried out for 7-day treatments coinciding with both spring and neap tides and the results show that the predicted concentrations at 100 m from the site is 0.0011 µg/l of EmBz on neap tides and 0.00098 µg/l of EmBz on spring tides. The simulations results show that it exceeds the SI No. 466 of 2008 acceptable maximum concentration standard of 0.00022 µg/l for EmBz concentration in the water column at 100 m from the licensed site, but this environmental standard has not been revised since 2008. Currently, the latest revised recommendation from WFD-UKTAG is based on an acceptable maximum concentration of 0.0012 µg/l of EmBz at 100 m from the licensed area (WFD-UKTAG, 2022). It should be noted that this is the worst-case scenario that is being presented in the model predictions for Slice® pollutant plume in Appendix 6 and the use of Slice® would only be applied when and if the trigger level for sea lice will be exceeded in the most sensitive spring period (May Year 1). The use of cleaner fish

and freshwater bath treatments will be prioritised as main treatment methods for sea lice prior to considering the use of Slice®.

Given the limited potential for the introduction and persistence of therapeutants in the environment its can be concluded that there will be no likely significant direct effects to the Atlantic salmon and no likely significant indirect effect to the freshwater pearl mussel.

3.5.3.12. Escapees

3.5.3.13. Background

Glover *et al.* (2017) reviewed the current status of knowledge on half a century of genetic interaction between famed and wild Atlantic salmon. Impact risk depends on the maturity of the escapees and farmed fish are harvested before they fully mature. By and large, escapees are more likely to die or be preyed upon at sea than to enter a river system, in particular if they are immature, which is the most likely prospect (Hansen, 2006; Skilbrei, 2010; Whoriskey *et al.*, 2006). Fish will only enter a river system if they escape close to maturation and survive to mature. Further, overrunning of redds or interbreeding with wild fish also only becomes a risk if escapees are mature. Overrunning and displacement of wild salmon eggs is an impact risk because farmed fish tend to mature later than wild stock. However, later maturation would limit interbreeding risks. While the evidence indicates that survival to sexual maturity of escapees is very low, and only a small proportion manages to survive and enter rivers, the number is often numerically high due simply to the high numbers involved in escape events (Glover *et al.*, 2017). The actual numbers, however, can be expected to be dependent on both the stage of the life cycle and the time of the year at which they escape (Skilbrei *et al.*, 2015).

Fears of interactions between farmed and wild salmon stocks were expressed by McGinnity *et al.* (2003). However, the scenario that the authors depict could only result from significant, persistent or annual escapes surviving to enter single rivers. Nevertheless, farmed escapees have been documented in rivers in most regions where there is commercial aquaculture. In addition, escapees have been reported in oceanic feeding areas as well as in rivers far away from major farming regions (Glover *et. al.*, 2017). While escapees display considerable potential for long-distance dispersal/migration the incidence of farmed escaped salmon in rivers is correlated with the volume of farming within that region (Fiske *et al.,* 2006; Green *et al.,* 2012; Youngson *et al.,* 1997; Clifford *et al.,* 1998).

Experiments have shown that adult escapees have reduced spawning success compared to wild salmon that depends on the life stage at which they escape into the wild, mature and attempt to spawn with wild fish, and the level of competition with wild fish in the spawning grounds. Farmed females display

a greater relative spawning success than farmed males which will increase the relative frequency of hybrid as opposed to pure farmed offspring. Wild populations that are already experiencing natural declines in adult abundance will be more vulnerable to introgression of farmed salmon due to the reduced level of competition faced by escapees once on the spawning grounds. The offspring of farmed and hybrid salmon will also compete with wild salmon for both territory and resources. (Glover *et al.* 2017). There is unequivocal evidence of the introgression of farmed salmon into *ca.* 150 native Norwegian populations (ranging from 0% to 47%) (Glover *et al.,* 2013; Karlsson *et al.,* 2016). Reduced genetic variability will affect a species' ability to cope with a changing environment. One-way gene flow, as occurs through successful spawning of farmed escapees, potentially represents a powerful evolutionary force. It erodes genetic variation among wild populations (Glover *et al.*, 2012). Many wild salmon populations are already under evolutionary strain from a wide variety of anthropogenic challenges (Lenders *et al.,* 2016; Parrish *et al.,* 1998) and such populations are more likely to be vulnerable to the potential negative effects of introgression. The long-term consequences of introgression on native populations can be expected to lead to changes in life-history traits, reduced population productivity and decreased resilience to future impacts such as climate change. Only a substantial or complete reduction in the number or escapees in rivers, and/or creating a reproductive barrier through sterilization of farmed salmon can eliminate these impacts (Glover *et al.* 2017).

3.5.3.14. Assessment and Conclusions

In the event of an escape incident occurring the magnitude of impact depends on the number of escapees, their level of maturity and the time of year of the event. Large escapes (tens of thousands of individuals) of mature fish in the spawning season have a greater potential for impact significance than small escapes of smolts. Large escape events have the potential to have a significant effect on wild salmon populations in the area especially considering the low returns within many salmon rivers. However, the likelihood of an escape event occurring is remote and measures have been adopted to prevent such an occurrence; consequently, significant direct effects to the Atlantic salmon and indirect effects to the freshwater pearl mussel can be excluded.

3.5.4. Impact Mechanism 5, 6 and 7 – SAC QI Annex II Species – Otter

3.5.4.1. Potential Impact

There is potential that direct impact on wild salmon population could indirectly effect prey availability and thus otter foraging success.

3.5.4.2. Assessment and Conclusion

With regards to any indirect (knock-on) effect that a theoretical decline in wild salmon populations would have on otter populations, Saunders (2017) in a report specifically focused on this concern concluded that as otters are omnivorous generalists with an ability to utilise a wide variety of species as food, adapting to whatever is available (which tends to vary seasonally), it would be logical to expect that during a theoretical scenario in which there is a fish farm-linked decline in wild salmonids, otters, either in freshwater or marine locations, would be unlikely to be significantly affected. In addition, Saunders (2017) notes that throughout the period when wild salmonid populations were declining, survey data for Irish otter populations indicated either a stable or increasing trend, resulting in the currently "Favourable" status under the Habitats Directive. Reid et *al.* (2013) in their evaluation of pressures on Irish otter populations conclude:

"None of the factors that significantly influenced otter occurrence (river size, substrate *type, bank elevation and slope or salmonid biomass) are likely to be limiting or impacted detrimentally by human activities".*

The likelihood of an impact occurring on otters is remote, the consequence of an impact if realised is negligible; it is concluded that there will be no likely significant effects to otter.

3.5.5. Impact Mechanism 3 and 4 – SPA SCI – Bird species

3.5.5.1. Potential Impacts

Operations at the Clifden Bay and Mannin Bay sites may result in disturbance and entanglement impacts to the following bird species listed in Table 3-4.

3.5.5.2. Entanglement/Mortality Risk

There is potential that bird species may predate on farmed fish and thereby become entangle in farm pens and nets. However, if reasonable mitigation measures are taken against predation, such as the correct installation and fixing of bird nets, most species will do nothing more than perch until disturbed. The measures that will be employed include correct installation and fixing of bird nets. Entanglement of birds in nets is also less likely when nets are correctly installed and kept taut. Gulls are also habitual followers of fish farm vessels as they are with fishery vessels. Cormorants are the most persistent avian predators of farmed fish. They are capable of breaching the pen nets underwater and on occasions can also breach bird nets, to predate on the salmon stock. However, mitigating measures can deter such activities. Experience suggests that cormorants should not prove problematic

at this site as long as the stock is adequately protected. No direct predator control will be employed at the licence renewal site.

3.5.5.3. Conclusions

The likelihood of disturbance impacts occurring is remote; it is concluded that there will be no likely significant effects.

3.5.5.4. Disturbance Risk

Potential disturbance effects to bird species could arise in the following ways:

- from avoidance of the farm structures,
- from avoidance of activity associated with the salmon farm, and
- from impacts on foraging.

In general, birds seem to use artificial structures as roosting sites when they prove suitable. Birds will avoid artificial structures when they interfere with specific habitat requirements such as flight paths or maintaining open views to detect predators. Considering the scale of the pens in the proposed renewal sites, this is unlikely to be an issue.

There will be daily human activity at the licence renewal sites while the site is stocked with fish. This activity will include work boat transport to and from the site as well as daily activity relating to feeding, health and quality checks, sampling and removal of mortalities. These activities would be low level with a limited number of people on site. Larger scale activities will include net pen maintenance, including net exchange for the purpose of net cleaning, stock treatment and harvesting. These activities will require a larger human presence and the use of more equipment on site including a well boat.

If the licensed area coincides with suitable foraging areas, the farming operation may directly and indirectly effect bird foraging success. For instance, the farm structures may act as a fish aggregation device or artificial reef thereby increasing bird prey availability. Bird foraging success may also be positively affected through the provision of resting/roosting locations and/or the creation of sheltered waters in the lee of structures.

In addition, there is potential that organic enrichment of benthic habitats at the site may indirectly affect the foraging behaviour of bird species by effecting benthic and demersal prey. There is also potential that bird species may supplement natural foraging and diet by directly predating on farmed salmon.

3.5.5.5. Impact Assessment Methodology

A risk assessment[12] to examine the potential impacts on SCIs of SPAs has been carried using criteria for the following:

- species risk of disturbance (as detailed in Table 3-9),
- species population sensitivity (Table 3-10),
- licenced area habitat suitability (Table 3-11), and
- species habitat flexibility (Table 3-12),
- The significance of risk is presented in Table 3-14.

3.5.5.6. Disturbance Risk

The greatest potential impact from human activity will be associated with boat movements around the site. The sensitivity of various high conservation value species to such impacts will vary. Species that regularly follow fishing trawlers and larger boats (*i.e.,* the gulls and Fulmars) are unlikely to be significantly displaced by boat movements.

A disturbance scale developed by Garthe & Hüppop (2004), and Furness *et al.* (2012, 2013) rated the potential vulnerability of seabirds to disturbance on a scale of 1–5, with 1 representing hardly any escape/avoidance behaviour and/or non/very low fleeing distance and 5 representing strong escape/ avoidance behaviour and/or large fleeing distance.

Using the disturbance scale, relevant bird species (presented in Table 3-4) are assigned to disturbance categories in Table 3-9.

[12] The methods of impact assessment have been adapted from Atkins (2012).

Table 3-9: Disturbance risk categories of SCIs of SPAs (*sensu* Furness *et al*., 2013).

SCIs	Disturbance Category
Arctic tern (*Sterna paradisaea*)	2
Black-headed Gull (*Larus ridibundus*)	2
Common Gull (*Larus canus*)	2
Cormorant (*Phalacrocorax carbo*)	4
Fulmar (*Fulmarus glacialis*)	1
Gannet (*Morus bassanus*)	2
Golden Plover (*Pluvialis apricaria*)[13]	5
Guillemot (*Uria aalge*)	3
Herring Gull (*Larus argentatus*)	2
Kittiwake (*Rissa tridactyla*)	2
Leach's Storm-petrel (*Hydrobates leucorhous*)	1
Lesser Black-backed Gull (*Larus fuscus*)	2
Little Tern (*Sternula albifrons*)	2
Manx Shearwater (*Puffinus puffinus*)	1
Puffin (*Fratercula arctica*)	2
Razorbill (*Alca torda*)	3
Sandwich Tern (*Sterna sandvicensis*)	2
Shag (*Phalacrocorax aristotelis*)	3
Storm Petrel (*Hydrobates pelagicus*)	1

3.5.5.7. Species Population Sensitivity

The determination of the sensitivity of species population takes into account the following:

- Tolerance to change: the species' ability to accommodate temporary and permanent change.
- Recoverability: the ability of the receptor to return to its natural state following cessation of an effect.
- Adaptability: the ability of a receptor to avoid or adapt to an effect
- Value: a measure of the receptor's importance, rarity and worth.

[13] Golden Plover is not assessed in in Furness *et al.*, 2013. A conservative (precautionary) score of 5 is assigned to the species.

In general, populations with very poor conservation status including species on the BoCCI red list have little capacity to tolerate change and recover following an impact. In contrast, populations that are not of conservation concern typically exhibit capacity to absorb impacts.

Table 3-10: Sensitivity criteria.

Sensitivity	Definition
Very High	Receptor population has no tolerance of effect. *e.g.,* no capacity to absorb change, a population level effect very likely to occur. Likely to be limited to populations with very poor conservation status - BoCCI Red List
High	Receptor population has a very limited tolerance of effect. *e.g.,* likely to have no capacity to absorb change, so a population level effect likely. Likely to be limited to populations with poor existing conservation status - BoCCI Amber List
Medium	Receptor population has limited tolerance of effect. *e.g.,* very minor capacity to absorb change, so a population effect possible. Likely to include but not be limited to populations with poor existing conservation status - BoCCI Green List
Low	Receptor population has some tolerance of effect. *e.g.,* likely to have minor capacity to absorb additional mortality or reduction in productivity or habitat loss, so a population level effect unlikely.
Negligible	Receptor population generally tolerant of effect. *e.g.*, likely to have moderate capacity to absorb additional mortality or reduction in productivity or habitat loss, so a population effect very unlikely.

3.5.5.8. Licenced Area Habitat Suitability

The habitat suitability of the licence renewal site is coded as follows:

1. habitat conditions include specific features (substrate type, upwellings, *etc.*) identified as being important for the species,
2. habitat conditions generally suitable (*e.g.,* within depth range) but lack specific features identified as being important for the species,
3. habitat conditions include some features identified as unsuitable in some studies, and
4. habitat conditions generally unsuitable.

Habitat preference follows that identified for the species in Furness *et al.* (2012, 2013).

Table 3-11: Habitat Suitability.

SCIs	Species Habitat Preference	Suitability Score
Arctic tern (*Sterna paradisaea*)	Found in a range of habitats in coastal areas where it preys on small fish or marine crustaceans. Arctic terns sometimes dip down to the surface of the water to catch prey close to the surface.	2
Black-headed Gull (*Chroicocephalus ridibundus*)	Coastal and inland in winter, including beaches, estuarine mudflats, inland on grass and freshly ploughed land, refuse tips, lochs and estuaries.	2
Common Gull (*Larus canus*)	Like most gulls, they are omnivores and will scavenge as well as hunt small prey. Frequently found around ships in inshore areas. Feeds on shoaling fish, in the intertidal.	2
Cormorant (*Phalacrocorax carbo*)	Feeds in coastal waters on fish caught through diving.	2
Fulmar (*Fulmarus glacialis*)	Oceanic and shelf break although large number can occur near trawlers on continental shelf	4
Gannet (*Morus bassanus*)	Oceanic, pelagic but mainly offshore over continental shelf.	4
Golden Plover (*Pluvialis apricaria*)	Tends to gather in large flocks and winter in open areas, agricultural plains, ploughed land, and short meadow. Birds forage on fields, beaches and tidal flats. Diet predominately consists of insects and crustaceans.	4
Guillemot (*Uria aalge*)	Typically feeds offshore with inshore and pelagic feeding less common.	3
Herring Gull (*Larus argentatus*)	Forages around ships in inshore areas, on shoaling fish, in the intertidal, in agricultural areas, on refuse and in streets.	2
Kittiwake (*Rissa tridactyla*)	Birds forage over continental shelf within the 200m contour.	2
Leach's storm-petrel (*Hydrobates leucorhous*)	Oceanic, found above and beyond the shelf break over deep water.	4
Lesser Black-backed Gull (*Larus fuscus*)	Feed in a range of habitats in coastal areas, and in agricultural areas, and extensive use is made of refuse tips and other sources of human waste.	2
Little Tern (*Sternula albifrons*)	Coastal and near shore species feed by plunge-diving for fish. Occurs is very dense colonies on coasts and islands	3
Manx Shearwater (*Puffinus puffinus*)	Pelagic although mainly over continental shelf	4
Puffin (*Fratercula arctica*)	Feed far from the coast and is pelagic in winter.	4

Razorbill (*Alca torda*)	Found in a range of marine habitats but generally in shallow sea.	3
Sandwich Tern (*Sterna sandvicensis*)	Coastal and near shore species feed by plunge-diving for fish. Occurs in very dense colonies on coasts and islands	3
Shag (*Phalacrocorax aristotelis*)	Found in coastal waters feeding predominately on prey on the sea bottom. They will eat a wide range of fish however their most common prey is the sand eel. Shag is one of the deepest divers among the cormorant family.	1
Storm Petrel (*Hydrobates pelagicus*)	Pelagic, generally found over continental shelf.	4

3.5.5.9. Species Habitat Flexibility

The habitat use flexibility scores are based on Garthe & Hüppop (2004) and Furness *et al.* (2012, 2013). The score value ranges from 1 to 5 with 1 indicating species is very flexible in habitat use and to 5 indicating the species is reliant on specific habitat characteristics. Species that are coded low occupy large sea areas with no specific habitat preferences while species that are coded high rely on specific habitat features.

Table 3-12: Habitat Flexibility Scores (*sensu* Furness *et al*., 2013).

SCIs	Flexibility Scores
Arctic tern (*Sterna paradisaea*)	3
Black-headed Gull (*Chroicocephalus ridibundus*)	2
Common Gull (*Larus canus*)	2
Cormorant (*Phalacrocorax carbo*)	3
Fulmar (*Fulmarus glacialis*)	1
Gannet (*Morus bassanus*)	2
Golden Plover (*Pluvialis apricaria*) [14]	3
Guillemot (*Uria aalge*)	3
Herring Gull (*Larus argentatus*)	1
Kittiwake (*Rissa tridactyla*)	2
Leach's storm petrel (*Hydrobates leucorhous*)	1
Lesser Black-backed Gull (*Larus fuscus*)	2
Little Tern (*Sternula albifrons*)	3
Manx Shearwater (*Puffinus puffinus*)	1
Puffin (*Fratercula arctica*)	3
Razorbill (*Alca torda*)	3
Sandwich Tern (*Sterna sandvicensis*)	3
Shag (*Phalacrocorax aristotelis*)	3
Storm Petrel (*Hydrobates pelagicus*)	1

[14] Golden Plover is not assessed in in Furness *et al*., 2013. The species forages in a variety of habitats; intertidal mud/ sand flats, agricultural plains, ploughed land, and short meadow. Diet predominately consists of insects and crustaceans. A conservative (precautionary) score of 3 is assigned.

3.5.5.10. Assessment of Impact Significance

The significance of effects is determined by combining assessments of 1) Disturbance, 2) Population Sensitivity, 3) Licensed Area Habitat Suitability and 4) Habitat Flexibility Scores. The significance of the effect is described in The overall effect for the selected bird species was negligible, with the exception of the common gull, herring gull, kittiwake and shag which scored a low effect. The description of effects has shown to be imperceptible or to potentially have a low effect for some bird species. Consequently, the effects are considered not to be significant for all bird species.

Table 3-13, based on the sensitivity/value of the receptor, the magnitude of effects and the likelihood of occurrence, determines the significance of the effect.

The significance of effects to the selected bird species is detailed in Table 3-14. The overall effect for the selected bird species was negligible, with the exception of the common gull, herring gull, kittiwake and shag which scored a low effect. The description of effects has shown to be imperceptible or to potentially have a low effect for some bird species. Consequently, the effects are considered not to be significant for all bird species.

Table 3-13: Significance of Effects

Significance of effects	Definition
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant effects	An effect which, by its character, magnitude, duration or intensity, alters a sensitive aspect of the environment.
Very significant	An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Profound effects	An impact which obliterates sensitive characters.

3.5.5.11. Conclusions

The significance of the effects for the SCIs are considered to be having Imperceptible to not significant or slight effects even for those sensitive species populations such as Golder Plover (*Pluvialis apricaria*), Kittiwake (*Rissa tridactyla*) and Leach's storm petrel (*Hydrobates leucorhous*). The habitat flexibility scores for the identified species range from low to medium reliance on specific marine habitat areas. This means

that these species can occur and utilise a wider range of marine areas without being significantly impacted by the proposed operations at the farm. The likelihood of disturbance effects occurring is remote Consequently, it is concluded that there will be no likely significant effects on bird species by the proposed project.

Table 3-14: Potential impacts on bird populations.

SCIs	Disturbance	Population Sensitivity BoCCI	Licensed Areas Habitat Suitability	Habitat Flexibility Scores	Description of effects	Significance of effects
Arctic tern (*Sterna paradisaea*)	2	High – BoCCI Amber List	2	3	Negligible	Potential Imperceptible Effect (NOT SIGNIFICANT)
Black-headed Gull (*Larus ridibundus*)	2	High – BoCCI Amber List	2	2	Minor	Potential Slight Effect (NOT SIGNIFICANT)
Common Gull (*Larus canus*)	2	High – BoCCI Amber List	2	2	Minor	Potential Imperceptible Effect (NOT SIGNIFICANT)
Cormorant (*Phalacrocorax carbo*)	4	High – BoCCI Amber List	2	3	Minor	Potential Slight Effect (NOT SIGNIFICANT)
Fulmar (*Fulmarus glacialis*)	1	High – BoCCI Amber List	4	1	Negligible	No change (NOT SIGNIFICANT)
Gannet (*Morus bassanus*)	2	High – BoCCI Amber List	4	2	Negligible	Potential Imperceptible Effect (NOT SIGNIFICANT)
Golden Plover (*Pluvialis apricaria*)	5	Very High BoCCI Red List	3	3	Negligible	Potential Slight Effect (NOT SIGNIFICANT)
Guillemot (*Uria aalge*)	3	High – BoCCI Amber List	3	3	Negligible	Potential Imperceptible Effect (NOT SIGNIFICANT)
Herring Gull (*Larus argentatus*)	2	High – BoCCI Amber List	2	1	Minor	Potential Slight Effect (NOT SIGNIFICANT)
Kittiwake (*Rissa tridactyla*)	2	Very High BoCCI Red List	2	2	Negligible	Potential Imperceptible Effect (NOT SIGNIFICANT)
Leach's storm petrel (*Hydrobates leucorhous*)	1	Very High BoCCI Red List	4	1	Negligible	No change (NOT SIGNIFICANT)

SCIs	Disturbance	Population Sensitivity BoCCI	Licensed Areas Habitat Suitability	Habitat Flexibility Scores	Description of effects	Significance of effects
Lesser Black-backed Gull (*Larus fuscus*)	2	High – BoCCI Amber List	2	2	Negligible	Potential Imperceptible Effect (NOT SIGNIFICANT)
Little Tern (*Sternula albifrons*)	2	High – BoCCI Amber List	3	3	Negligible	Potential Imperceptible Effect (NOT SIGNIFICANT)
Manx Shearwater (*Puffinus puffinus*)	1	High – BoCCI Amber List	4	1	Negligible	Potential Imperceptible Effect (NOT SIGNIFICANT)
Puffin (*Fratercula arctica*)	2	High – BoCCI Amber List	4	3	Negligible	Potential Imperceptible Effect (NOT SIGNIFICANT)
Razorbill (*Alca torda*)	3	High – BoCCI Amber List	3	3	Negligible	Potential Imperceptible Effect (NOT SIGNIFICANT)
Sandwich Tern (*Sterna sandvicensis*)	2	High – BoCCI Amber List	3	3	Negligible	No Change (NOT SIGNIFICANT)
Shag (*Phalacrocorax aristotelis*)	3	High – BoCCI Amber List	1	3	Minor	Potential Slight Effect (NOT SIGNIFICANT)
Storm Petrel (*Hydrobates pelagicus*)	1	High – BoCCI Amber List	4	1	Negligible	Potential Imperceptible Effect (NOT SIGNIFICANT)

3.6. Mitigation Measures

There is potential that Habitats Directive Annex II species salmon and freshwater pearl mussel maybe affected by the proposed farm (*e.g.,* through lice infestation, disease spread and the introduction of therapeutants). Details of the farm management schemes (*i.e.,* Single Bay Management, CLAMS) designed to co-ordinate husbandry practices are detailed in Section 2.2.15. These schemes ensure the breaking of disease and parasite life cycles with the effect of enhancing the efficacy of lice control and reducing the overall incidence of disease in the stocks and the use of therapeutants, thereby reducing risks to wild population of salmon. Wilds populations of salmon are also at risk from genetic interaction with escapees from fish farms. Section 2.2.14.6 outlines measures in place to reduce the risk of escapees occurring. Risk of potential entanglement of Birds Directive species will be mitigated by the uses of top (bird) nets on the pens to prevent entanglement of birds with farm pens.

3.7. Monitoring

Parasite monitoring in place at the farm is described in Section 0.

3.8. In-combination Effects

Following a review of existing or permitted projects in the Clifden and Mannin Bay area it was concluded that discharges from the Hawk's Nest (T09/127A), Curhownagh (T09/140A) and Ardbear (T09/96B) sites have the potential to give rise to cumulative impacts.

It is to be noted that BOD, nitrogen and phosphorus solute loadings of solid discharges from the farm were calculated based on production and pollutant loads derived from a previous production model and feeding requirements different from the ones presented in Section 2.2.8 and Section 2.2.9. However, the values derived for the pollutant loadings used in the model (see Table 3-15 below) are higher than the values derived from the actual production model (Table 2-1) and projected soluble pollutants budget (Table 2-5), which still represent the worst-case scenario of pollutant loadings at the three sites. Therefore, the output of the model remains valid and can be used to assess the impact of pollutants loadings at the sites.

Table 3-15: Pollutants loadings used in the hydrodynamics modelling study (see Appendix 6)

Site names	Month	Maximum feed input (Tonnes/month)	Pollutants load (Tonnes/month)			
			Nitrogen	Phosphorus	BOD	Settleable solids
Hawk's Nest	14	142.23	4.552	0.469	105.208	15.745
Ardbear	14	30.48	0.975	0.101	22.546	3.374
Curhownagh	18	83.794	2.681	0.277	61.982	9.276

Settleable Solids

Three-dimensional modelling of settleable solids at Hawk's Nest, Ardbear and Curhownagh showed only localised deposition from farming activities and no likely overlap of deposition between sites therefore no significant in-combination effects.

Sea lice larvae

Extensive experimental work has been undertaken on the distribution and density of *L. salmonis* larvae in salmon aquaculture bays on the west coast of Ireland (*e.g.,* Costelloe *et al*., 1995; 1996; 1998a, b). In experiments at Killary Harbour, Costelloe *et al*. (1995; 1998b) demonstrated that the infectivity and viability of the infective stages of sea lice falls off very sharply with time and distance from the source of the larvae. Costelloe *et al*. (1996) reported sea lice larvae occurred consistently at a station close to a salmon farm but only sporadically close to a river mouth indicting a very high retention of sea lice within fish farms and that sea lice found at river mouths were likely to come from wild salmon and sea trout. In the study highest larvae densities were found in samples taken in the vicinity of the farm in comparison to those samples taken further away from it. Respectively, the maximum larvae density at 10 m and 1 km from the farm boundary was 4.8 and 0.4 no. per m^3. The findings of Costelloe *et al*. (1996) also suggested that few larvae would be found 2 km from the farm boundary. The findings presented in Costelloe *et al*. (1996) were supported by experiments undertaken at three bays in Co Galway (Killary Harbour, Casla Bay, Dunkellin Bay) which showed larvae occurring consistently at a station close to a salmon farm at the mouth of Killary Harbour and occurring sporadically at stations distant from the farm in inner Killary Harbour close to the mouths of two rivers, and at stations at Casla Bay and Dunkellin Bay which had no salmon aquaculture farms (Costelloe *et al*., 1998a).

For the Curhownagh simulation the fish numbers (average fish number of 78,000) and thus the potential larval load is only 40% of Hawk's Nest. The simulation shows the maximum larvae concentration occurring at the cage sources with a predicted maximum within the farm site of 1.62 no./m^3 and a tidal mean of 0.6 no./m^3. Outside of the site surrounding the boundary this maximum number reduces between 0.2 and 0.55 no./m^3 and a tidal mean between and in the inner bay area at

Ardbear the maximum predicted is less than 0.6 no./m^3 and the tidal mean is 0.33 no./m^3. In the wider bay area, the larval concentrations are predicted to be less than 0.1 no./m^3. There is no impact from the Curhownagh site on the Clifden Bay sites and therefore no potential for a combined impact and cross contamination of sites through advection and dispersion. Therefore, there will be no significant in-combination effects.

Sea lice treatment

The impact on water quality from sea lice treatment at the Hawk's Nest site which is proposed prior to the end of May in Year 1 was examined. This treatment option only applies the Hawk's Nest site as the other two sites are transfer sites and are only proposed to be stocked for a limited period in Year 2. Therefore, there is unlikely to be significant effect arising from in-combination effects as a result of sea lice treatment. The use of cleaner fish and freshwater bath treatments will be prioritised as main treatment methods for sea lice prior to considering the use of Slice®.

BOD

A combined BOD analysis was performed between the combined production at Hawk's Nest and Ardbear using the maximum production month just after transfer between the sites. This analysis showed that the combined production in month 14/15 produced slightly higher BOD concentration at Ardbear (3.70 mg/l), however, it also showed a lower concentration at Hawk's Nest (3.38 mg/l) over the individual site production simulations. At no stage combined or otherwise is the BOD EQS of 4 mg/l limit set for transitional waters and adopted for coastal waters exceeded. Therefore, there will be no significant in-combination effects as a result of the proposed operations at the site.

Nitrogen

The predicted median nitrogen concentration from the individual farm dispersion simulations gives a maximum median concentration throughout the bay of 0.086 mg/l N at Hawk's Nest, 0.06 mg/l N at Ardbear and 0.038 mg/l N at Curhownagh. The combined production simulation between Hawk's Nest and Ardbear produces a maximum median concentration of 0.11 mg/l N occurring at Ardbear. At no stage combined or otherwise is the nitrogen EQS median concentration limit of 0.17 mg/l exceeded at any tidal stage or location within the bays by the proposed production. There are no significant combined effects on nitrogen concentration in receiving waters from proposed operations at the three farms.

Given the above, there will be no significant in-combination effects as a result of the proposed operations at the sites.

Phosphorus

The individual phosphorus dispersion simulation results show that the predicted total phosphorus concentrations both nearfield and far field are very small and fall well within the EQS median limit of 0.04 mg P/l set for transitional waters. In respect to the Curhownagh site located in coastal waters does not have any EQS limit for phosphorus (not considered to be the limiting nutrient).

The simulation results show that the median concentration is 0.0089 mg/l P at the Hawk's Nest site. The median concentration outside of the proposed licensed area easily meets this EQS MRP standard (Transitional waters) of 0.04 mg/l P being typically less than 0.007 mg/l P at the site boundary.

The simulation results show that a median concentration of 0.006 mg/l P occurs at the Ardbear farm site which is well within the 0.04 mg/l EQS limit for good status transitional waters.

The predicted combined phosphorus concentrations at the Hawk's Nest and Ardbear sites has a median concentration of 0.011 mg/l P which is well within the 0.04 mg/l EQS limit for good status transitional waters.

At Curhownagh site, the median concentration is 0.0039 mg/l P. The median concentration both inside and outside of the proposed licensed area easily meets this EQS MRP standard (for transitional waters) of 0.03 mg/l P being typically less than 0.004 mg/l P at median concentration.

It should be noted that this water is coastal, and no limits are applicable. There is no predicted impact on the adjoining Clifden Bay and its transitional water with median concentrations less than 0.0001 mg/l P. Therefore, there is no cumulative impact between Curhownagh site and the proposed production activities at Hawk's Nest and Ardbear sites within Clifden Bay.

Given the above, there will be no significant in-combination effects as a result of the proposed operations at the sites.

3.9. Outcomes

This report has been prepared with regard to the relevant provisions of the EU Council Directive 92/43/EEC and Ireland's EU (Birds and Natural Habitats) Regulations 2011 (as amended).

This NIS has been prepared as it was not possible in the Screening for AA to rule out, as a matter of scientific certainty, that the proposed operation at the Clifden Bay and Mannin Bay sites will not have a likely significant effect on SACs and SPAs.

The NIS has examined and analysed, in light of the best scientific knowledge, how the proposed operations could impact on the Qualifying Interests of SACs and Special Conservation Interests of SPAs and whether the predicted impacts would adversely affect the integrity of protected sites.

Mitigation measures have been identified which ensure that any impacts on the Conservation Objectives of the Conservation Features for which SACs and SPAs are designated will be avoided such that there will be no risk of adverse effects to the protected sites.

It has been objectively concluded following an examination, analysis and evaluation of the relevant information, including in particular the nature of the predicted impacts from the proposed operations together with the mitigation measures proposed, that the proposed operations will not pose a risk of adversely affecting (either directly or indirectly) the integrity of SACs or SPAs, either alone or in combination with other plans and projects, and that there is no reasonable scientific doubt in relation to this conclusion.

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