Environmental Impact Assessment

Volume 3 – Appendices

Renewal of Marine Finfish Aquaculture Licence at Deenish Island, Co. Kerry

Licence Site Ref: T6/202

Produced by

AQUAFACT International Services Ltd

On behalf of

MOWI Ireland

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Report Approval Sheet

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AQUAFACT

List of Appendices

Appendix 1 Licence AQ199 Cover Page

Appendix 2 MOWI Standard Operating Procedures I

- Appendix 2.1 Pen Moorings and Decommissioning
- Appendix 2.2 Nets
- Appendix 2.3 Fish Movements and Husbandry
- Appendix 2.4 Waste Management and Biosecurity

Appendix 3 MOWI Standard Operating Procedures II

- Appendix 3.1 Fish Health Management
- Appendix 3.2 Material Safety Data Sheets for Positive List of Medicines
- Appendix 3.3 Sea Lice and Sea Lice Treatment
- Appendix 3.4 Predator Control
- Appendix 3.5 Environmental Management Policy
- Appendix 3.6 Organic Policy
- Appendix 3.7 QMS Policy
- Appendix 3.8 Training and Development

Appendix 4 MOWI Standard Operating Procedures III Emergency Plans

Appendix 5 MOWI Standard Operating Procedures IV Single Bay Management Plans

Appendix 6 Benthic Audits

Appendix 7 Hydrodynamic Modelling

Appendix 8 AA Conclusion Statement by Licensing Authority for Kenmare River SAC

Appendix 9 Special Areas of Conservation and Special Protection Areas

Appendix 10 Archaeological Assessment

Appendix 11 Water Quality Monitoring

Appendix 12 Schematics

Appendix 1

Licence AQ199 Cover Page

AQ.199.

T6/202

CERTIFICATION OF AMENDMENT
OF
AQUACULTURE LICENCE No. 199
AND
FORESHORE LICENCE No. 199

Dated the 31st of October, 2012

This is to certify that the above-mentioned licences referred to as "Deenish T6/202 AQ199" have been amended subject to the modification of the Aquaculture Licence specified in the Certification of Renewal dated the 4th of August 2004, with the approval of the Minister for Agriculture, Food and the Marine for the period up to and including the 31st of March 2015 subject to the special conditions thereof and subject to the provisions of the Fisheries (Amendment) Act 1997 (No 23) as amended.

The special conditions are set out in a letter from the Department of Agriculture, Fisheries and Food to Mr Jan Feenstra, Marine Harvest Ireland dated 1st April 2011 and is attached hereto.

Signed

Mark O'Connell,
Chairman,
Aquaculture Licence Appeals Board

Mr Jan Feenstra
Marine Harvest Ireland
Rinmore
Ballylar
Letterkenny
Co Donegal

Our Ref: - Deenish T6/202 AQ199

1 April 2011

Dear Mr Feenstra,

I refer to your letter of 7th February 2011 requesting the Department to approve the company's request to change the permitted stocking arrangements at the Deenish site.

The Minister approved the amendment of the licence on 22 March, 2011, subject to the following "special conditions".

- That MHI only introduce smolts into Deenish and do not introduce any smolts into any of the other sites in their Southwest portfolio in 2011.
- In particular, that the Travara site, which may be defunct in any case, be kept on an extended fallow arrangement for the full duration of this pilot action (*i.e.* until 2013).
- That MHI carry out an additional benthic impact monitoring study to the usual pattern (in accordance with the protocol methodology), at their own expense, to check that the predictive model is correct at the mid point in the cycle.
- That MHI submit monthly stock reports, including all fish movements both within and to and from the site, of a standard and format agreed and determined by the agencies and DAFF Engineering Division to the Department to ensure that the pilot operation is proceeding as anticipated.
- That the company shall have available on demand by the Department, or its agents, records of all key site activities including; net inspections, preventative maintenance actions and that all required navigation marks are maintained in a good state of repair.
- That it be made clear to the company that this arrangement, if permitted, is strictly a once off pilot for this site only and that any repeat of the stocking pattern would have to be considered, inter alia, in light of the outcome of the monitoring and the progress of the implementation of overall licensing policy towards the use of 'maximum standing stock biomass' as a control point in licence terms and conditions
- That this pilot shall not be considered as a precedent in the context of the licence conditions attaching to any other site.

An Roinn
Talmhaíochta,
Iascaigh agus B
Department of
Agriculture,
Fisheries and Fo

The Notice of Decision is attached.

Please be aware, however, that in accordance with Regulation 19 of S.I. No. 236/1998 – Aquaculture (Licence Applications) Regulations, 1998, the Minister is required to publish a notice of his decision "within 2 weeks after making the decision, in a newspaper circulating in the vicinity of the location of the proposed aquaculture". Any person aggrieved by the decision may, in accordance with Section 41 of the Fisheries (Amendment) Act, 1997, appeal against it in writing to the Aquaculture Licences Appeals Board, by completing the Notice of Appeal Application Form available from the Board. This appeal must be lodged within one month beginning on the date of the publication of the decision.

In the case that there is no appeal the licence will be issued to you as soon as practicable after the end of the appeal period.

Yours sincerely,

John A Kelly
AFMD

Appendix 2

MOWI Standard Operating Procedures I
Farm Installations and Operations

Appendix 2.1

Pen Moorings and Decommissioning

Pen Mooring **Mowi Ireland**

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	09/05/2017 (Joseph Gibbons)	**Last revision date**	17/08/2018
Date changed	08/05/2017 (Michelle Hay)	**Next revision date**	15/08/2023

Pen Mooring:

1. Scope:

Depending on sea site characteristics, mooring system and individual pen specifications may vary. This procedure outlines mooring methods for a range of pen types.

2. Pen Type 1 – Turmec/Steel:

Once pen assembly is completed and the basic moorings have been laid, a group of pens are towed to their sea site destination.
At every mooring, attach a cubic meter or 2T concrete clump anchor followed by 4 to 5 meters of 2/4 inch chain shackled with a 6.5 tonne commercial shackle to the anchor. Shackle the other end of the chain to a 28 mm or No. 3.5 polypropylene rope with a 16 inch thimble spliced into one end. The length of rope depends on depth of water and for the lateral anchors; three times the depth of rope is used. For the leading anchors, 4 times the depth is used.
At approximately 12 meters from the pens on the lateral side, splice a 1.5m length of 16 mm rope into the anchor rope. Tie the rope onto the pen with two turns and two half hitches.
Tie a 90 kg concrete weight onto the length of 16 mm rope with two turns of rope and two half hitches to act as a damper weight to allow for stormy conditions.
On the leading end moorings attach a 300 litre block surface buoy to the rope via a 3/4 inch shackle and 5 inch thimble spliced into the rope. On the other end of the surface buoy tie a 5 meter length of 28 mm polypropylene rope onto the pens with one turn of rope and two half hitches.
All shackles under water must be spot welded.
Always observe pen surroundings to make note of the presence or absence of individual pen block moorings.

3. Pen Type 2 – Polar Cirkle, Aqualine plastic:

Construct an outer square of rope 5 -6 metres under the water surface. This is kept afloat by means of 14 mooring buoys which are moored with 4 or 5.5 x 60m/65m/70m or 75m ropes.
These ropes are attached to 15-25m of heavy stud link chain which is attached to 1000kg or 1500kg anchors, north and south of the mooring buoy.
Each pen is placed inside the rope frame square and bridles are attached to the special mooring plates at a point on the chain underneath the mooring buoy.
All shackles under water must be spot welded, except for bridle shackles which are sometimes split-pinned.
If necessary, adjust lateral anchors to align grid.

4. Pen Type 3 – Bridgestone Dunlop:

All are individually moored with 7.5m split bridles attached to an anchor hitch onto a pen corner with 85mm nylon octoplait rope.
A G-link is connected to the bridle, which is connected to a masterlink and 75m length of 85mm nylon mooring rope.
This mooring rope is then connected to 20m heavy stud link chain attached to a 750kg plough anchor.
All connections are connected using 12T green pin shackles and spot welded.

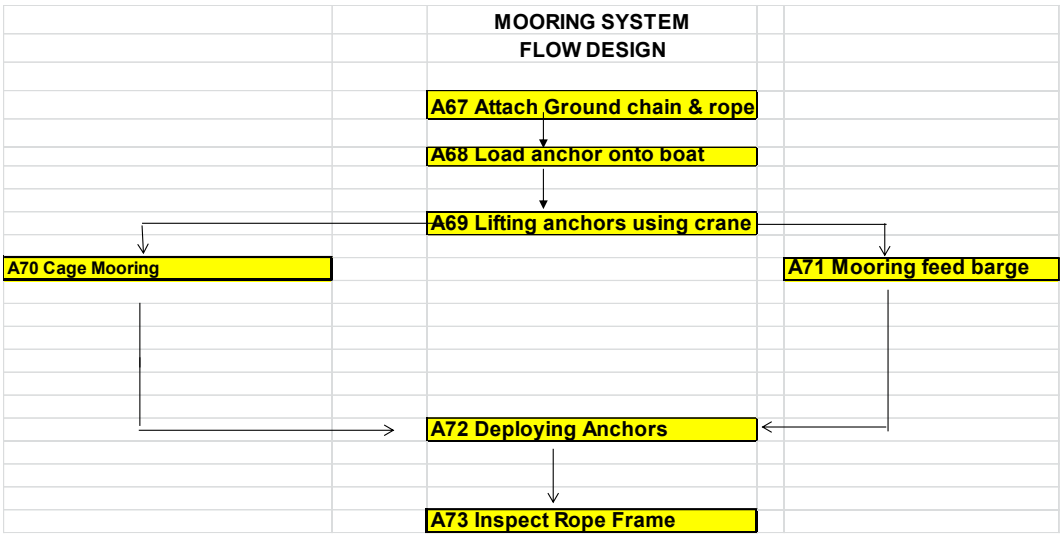
5. HES Precautions:

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	09/05/2017 (Joseph Gibbons)	**Last revision date**	17/08/2018
Date changed	08/05/2017 (Michelle Hay)	**Next revision date**	15/08/2023

Operate in favourable weather and tidal conditions. Observe manual handling procedures. Wear appropriate PPE, lifejackets and hard hats. Use necessary and appropriate lifting equipment. Only competent persons should undertake this task.

5. Safety risk assessment & process flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Deploying & Recovery of Anchors **Mowi Ireland**

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	14/07/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	13/07/2017 (Michelle Hay)	**Next revision date**	12/11/2023

Deploying and Recovery of Anchors:

1. Scope:

Anchors are used to secure grid frames and individually moored pens. They are deployed following pen maintenance or installation of new pen/grid, or sometimes in the case of mooring a feed bage. Anchors are recovered if one is loosened/breaks away following a storm, or when moving a pen or grid.

2. Deploying anchor on grid:

Select location and grey buoy on grid from which anchor is to be deployed. Lift grey float using crane/winch, until the plate is exposed and accessible. Attach the safety chain in case hook on buoy breaks. **Secure plate to the vessel**. The anchor is then shackled/welded or chained into the plate. Lower the plate slowly until the float is at water level, then disconnect from crane/hauler.
Allow boat to slowly drift from the float as rope escapes out into water.
Lift chain out of boat into water and tie to winch using a heel rope.
When rope is fully out, allow the chain to release slowly and the anchor to drop using winch, until it has reached the sea bed.
Pull the anchor using the heel rope on winch until the required tension is achieved on grid/pens.

3. Deploying anchor on individually moored pen:

Select location on pen from which anchor is to be deployed. Lift bridle and attach flat link of mooring rope into the G link of the bridle. Allow boat to slowly drift from the bridle as rope escapes out into water.
Lift chain out of boat into water and tie to winch using a heel rope.
When rope is fully out, allow the chain to release slowly and the anchor to drop using winch, until it has reached the sea bed via heel rope.
Pull the anchor using boat until the required tension is achieved on the selected pen.

4. Recovery of anchor from grid or pen:

A dive team must be present to carry out this task, depending on the site or conditions. Diver enters the water and connects a heel rope (32mm plus) to the heel or chain of the anchor (whichever is visible at the time). Once the diver has surfaced and is safely back on board, the anchor is lifted to the surface using crane/winch.

5. HES:

Ensure appropriate PPE is worn. Observe manual handling procedures. Minimum staff required 3 (excluding dive team).

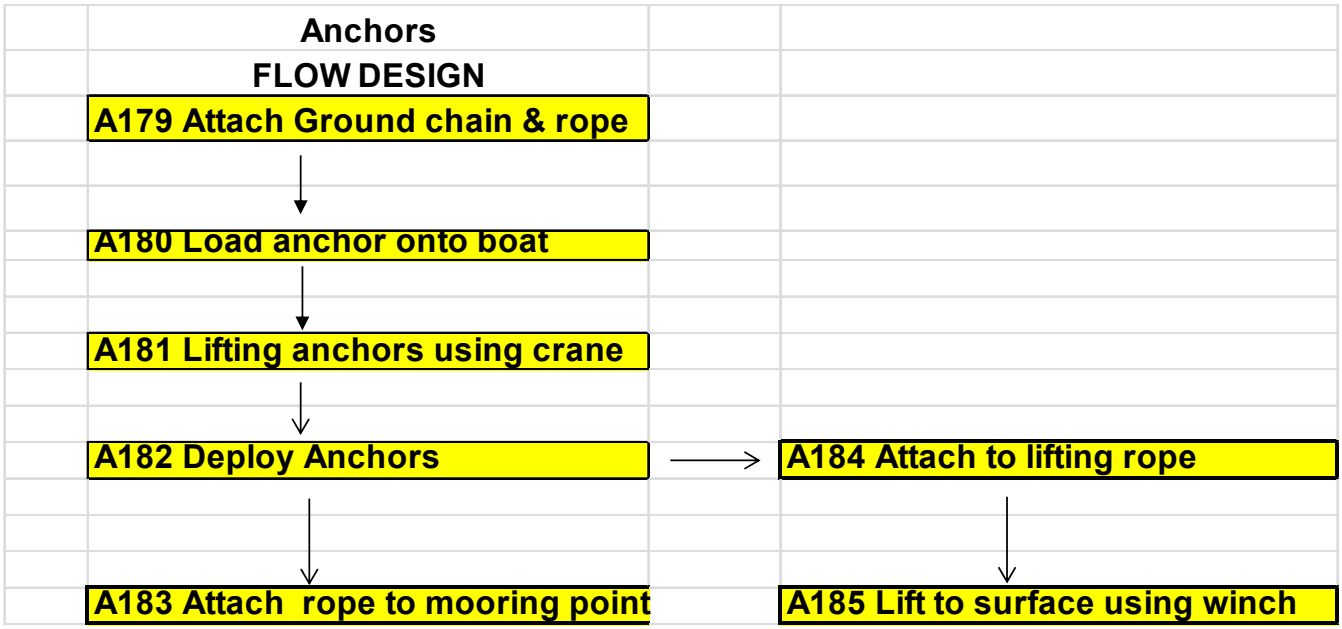
6. Safety risk assessment and process flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.

Deploying & Recovery of Anchors

Mowi Ireland

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	14/07/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	13/07/2017 (Michelle Hay)	**Next revision date**	12/11/2023



Location and process	Ireland / Diving / Diving Operations	**Document category**	
Last approved date	17/11/2020 (Joseph Gibbons)	**Last revision date**	14/09/2021
Date changed	02/11/2020 (Patrick Shovelin)	**Next revision date**	31/05/2023

Fish Pen Grid Check

1. Purpose

All Grid frames must be checked twice a year in Feb/Mar (video/photo) and in Aug/Sept (cleaned and video/Photo) in addition to checking ropes for wear and the condition of the plates and shackles.

2. Procedure

2.1 Have a plan of the site grid system with each mooring plate marked with its own number for cross reference.

2.2 Underwater work is carry out by Diver or a ROV.

2.3 Label each mooring plate with it number.

2.4 Check all shackles are tight and no wear is taking place.

2.5 Check ropes at thimbles and along the rope frame.

2.6 Check the bridles from the mooring plates to the cage.

2.7 Check shackles which attach bridles to cages.

2.8 Check the anchor rope from the mooring plate to the anchor.

2.9 Check the chain mooring plate to the buoy.

2.10 Video or photograph the frame at each point clearly showing the plate, shackles and thimbles.

2.11 Record what is inspected on site grid sheet by highlighting the area checked

2.12 Record any faults in the grid and report to the dive supervisor and site supervisor.

2.13 Any non-routine checks should also be recorded on the cage mooring survey sheet.

Fish Pen Grid Check

Mowi Ireland

Location and process	Ireland / Diving / Diving Operations	**Document category**	
Last approved date	17/11/2020 (Joseph Gibbons)	**Last revision date**	14/09/2021
Date changed	02/11/2020 (Patrick Shovelin)	**Next revision date**	31/05/2023

3. H&S Risk Assessment

Process Flow:

D36 Anchor Work
D37 Net Checks

Nitrox blending system

Total Assessed Risk = Likelihood x Severity

Likelihood	Severity
1 = Unlikely event: Once every year	1 = Negligible. No Impact or not detectable
2 = Occasional event: Once per month	2 = Significant: impact on critical limits
3 = Frequent event: Once per day	3 = Critical: public health risk, public product recall.

Likelihood	Severity		
	1	2	3
1	1	2	3
2	2	4	6
3	3	6	9

Low Risk = 1 - 3
Medium Risk = 4
High Risk = 6 - 9

Low Risk - These risks are considered acceptable. No further action is necessary other than to ensure that the controls are maintained.

Medium Risk - Consideration should be as to whether the risks can be lowered, where applicable, to a tolerable level and preferably to an acceptable level, but the costs of additional risk reduction measures should be taken into account. The risk reduction measures should be implemented within a time period.

High Risk - Substantial efforts should be made to reduce the risk. Risk reduction measures should be implemented urgently within a defined time period and it might be necessary to consider suspending or restricting the activity, or to apply interim risk control measures, until this has been completed. Considerable resources might have to be allocated to additional control measures.

Location and process	Ireland / Marine Production / Maintenance	**Document category**	Procedures
Last approved date	09/11/2022 (Joseph Gibbons)	**Last revision date**	09/11/2022
Date changed	09/11/2022 (Patrick Shovelin)	**Next revision date**	20/09/2024

Decommissioning Floating Farm Installations

1. Scope:

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, the following steps must be followed.

2. Related reference documentation:

- List of approved waste transport and recycling companies (TQM Database)
- Waste management permits. (TQM Database)

3. Preliminary preparation:

3.1. Remove all bird and fish containment netting. Remove all ropes. Subject to inspection and testing, nets and ropes may be reused. Otherwise unwanted nets and ropes may be delivered to an approved recycling company.

3.2. Decouple the fish pen chain mooring bridles from the mooring sub-surface mooring grid connector plates. Coil and secure the chains on the fish pens for removal later when onshore.

3.3. Tow the fish pens to the decommissioning site for cutting up.

4. Procedure for dismantling Aqualine/Plastic Pens:

4.1. Remove hand rails and cut into suitable lengths to allow safe transport to storage or disposal.

4.2. Optional – disconnect chains/bars using appropriate equipment

4.3. Remove all other stanchions by loosening nuts & bolts with spanner and/or air gun.

4.4. Cut pen pontoons into suitable lengths to allow safe transport to storage area or for disposal/recycling. The polystyrene is removed from pontoons using a piece of handrail to push it out. The polystyrene is stored and removed from site for recycling by an approved waste contractor.

4.5. Store other parts for future use or recycle/dispose with an approved recycling company.

5. Removal of Moorings:

5.1. De-couple the mooring anchors from the Mooring grid one at a time. Coil and store for re-use leaving just four corner anchors to secure the grid while it is being dismantled.

5.2. Decouple the grid ropes from the mooring grid connector plates one by one. Clean and coil for recycling.

5.3. All buoys and their associated chains and grid connector plates are also removed as the grid ropes are removed for reuse or recycling.

5.4. When all the grid and associated components buoy chains and grid connector plates are removed, then the remaining corner anchors are removed from the seabed. The anchors may be reused at other sites.

6. HES:

Ensure appropriate PPE is worn, including eye protection, ear protection and steel toe capped boots. Do not stand under suspended loads on forklift.

7. Safety Risk Assessment:

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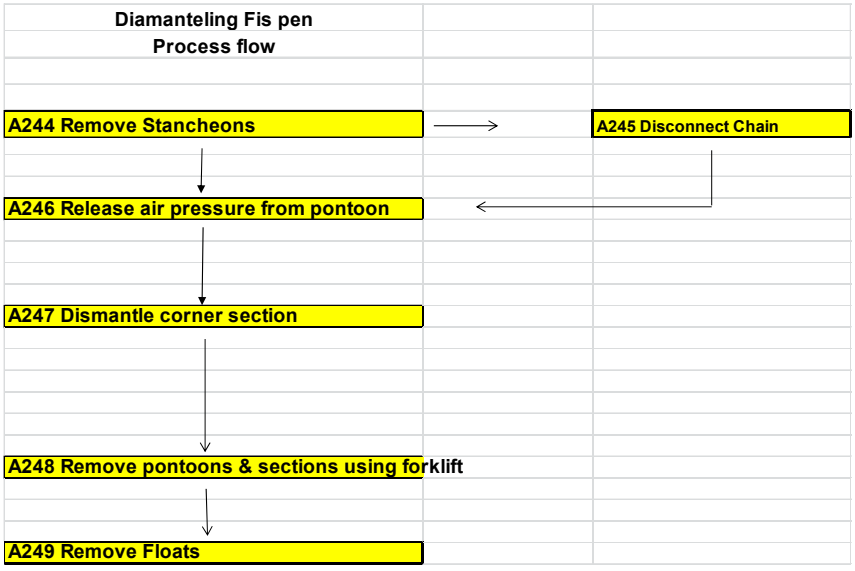

Deploying Pen weights

Mowi Ireland

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
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Date changed	12/11/2020 (Michelle Hay)	**Next revision date**	12/11/2023

Deploying Pen Weights:

1. Scope:

Weights are used to keep the net in shape where currents and strong tides exist. Weights are deployed just prior to the net being placed in the pen.

2. Procedure:

Ensure that the tide/current is appropriate to complete this task for each site.

Tie approximately 20m of 18mm rope onto selected weight using an anchor hitch, or an appropriate length depending on the net depth. The other end of this rope is tied to the corners of the pen using a round turn and two half hitches and the tail end is tucked in to the rope.
This weight is then safely suspended from a crane and lowered in to the water until it can be released slowly.
Recovery of weights is carried out by divers, see procedure.
In Donegal sites the weight is attached at the surface and is lowered along with the net. In Mulroy sites slider weights are attached to the chain going to the sinker tubes and is released along with the net. As a final check, ensure all slider nets are dropped.

3. HES:

Wear appropriate PPE. Ensure area around rope is clear and there are no entanglements before the weight is released.

4. Safety risk assessment and process flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.

Deploying Pen weights

Mowi Ireland

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	17/11/2020 (Joseph Gibbons)	**Last revision date**	12/11/2020
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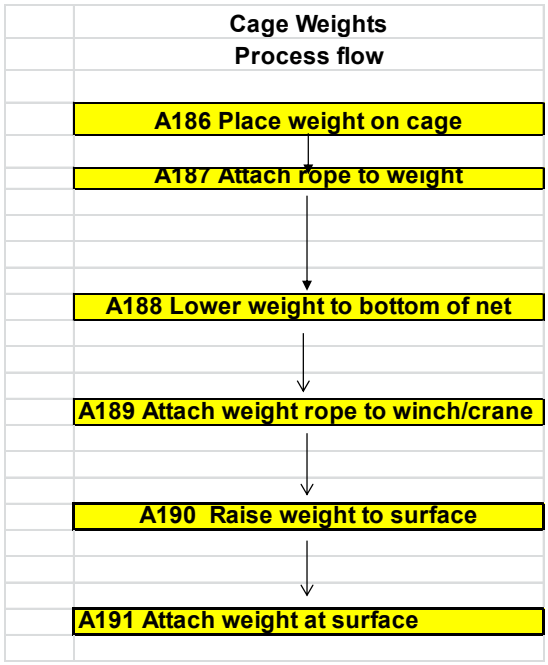


Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	26/07/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	09/05/2017 (Michelle Hay)	**Next revision date**	12/11/2023

Towing Fish Pens Ashore

1. Scope:

In order to complete routine maintenance or dismantling, fish pens have to be towed ashore. This is done at high tide.

2. Procedure:

2.1 Staff on vessel at site removes bird net, pen weights, net and camera/solar panel.

2.2 Attach 40mm power flex rope across diameter of the fish pen to be moved, placing the rope through the mooring points.

2.3 Where fish pens have a froya ring, before towing, the ring must be pulled up as tight as possible under the pen and tied with the chains.

2.4 Place two similar cross ropes paralell to the centre rope (equal distances apart). Wrap the ropes around both pipes at each side.

2.5 From positions at the end of the two cross ropes make a V bridle going from the ends of the outside cross ropes to a centre point. The centre point will be at least 1.5 times the measurement between the two outside cross ropes.

2.6 Make eye at the centre of this bridle and attach the towing rope to this point with a suitable shackle.

2.7 The tow rope from the bridle to the boat should be a least double the bollard pull of the towing vessel

2.8 Ensure the tow rope is long enough so that the wash from the propellor does not reduce the towing capability of the boat.

2.9 If the tow is over a long distance a longer rope should be used.

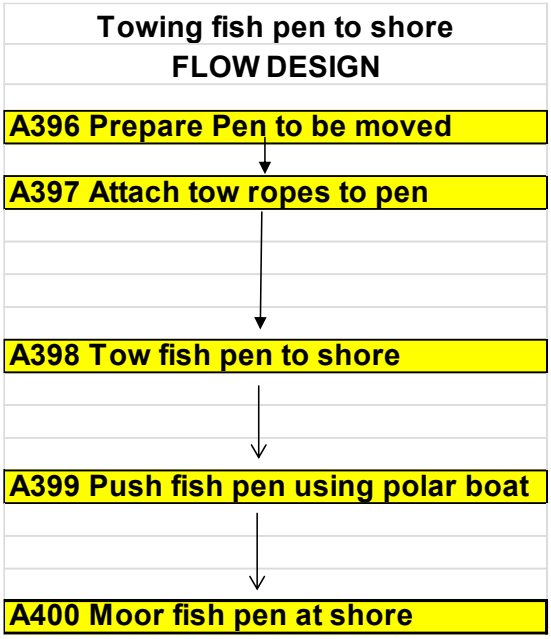
2.10 When the fish pen is near the shore, remove the tow ropes and push the pen ashore using the polar boat.

2.11 Secure the fish pen in place to anchors that had been pre positioned.

2.12 Ensure a light and radar reflector are on the pen if towing at night.

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	26/07/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	09/05/2017 (Michelle Hay)	**Next revision date**	12/11/2023

3. Process Flow:



4. Risk Assessment:

All marine risk assessments are available on TQM 42229. The numbers listed above in the process flow are related to this procedure.

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	06/11/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	04/10/2017 (Patrick Shovelin)	**Next revision date**	12/11/2023

Towing Vessels at Sea

1. Scope:

Due to the nature of the business, feed barges, fish pens and other vessels need to be moved between sites. This is done by towing using a workboat or tug.

2. Preparations before commencing towing operations

In preparing to carry out towing operations, fundamental checks should be completed onboard both the workboat and fish pen/vessel to be towed.

Preparations onboard the Work boat:

To ensure that the workboat is suitably prepared for towing operations the following items should be checked prior to commencing a tow:

2.1 All Life Saving Equipment: fire fighting and navigation equipment on board should be in good working order and should be checked regularly as part of the vessels daily, weekly and monthly checks.

2.2 Boat Engines: Prior to commencing a towing operation, proper checks should be made of the main engine and steering gear. These checks should include such items as oil/coolant levels, operation of main engine, gearbox and steering gear and sea inlet/outlet flow. In addition, during towing operations when the main engines are under heavy load, regular checks should be made of the engines temperatures. Details of the engine room checks should be noted and should be kept for future reference.

2.3 Water/Weathertight Integrity: The vessel to be towed should be checked to ensure that all cargo hatches and buoyancy spaces are secured prior to the beginning of a towing operation. In addition the vessel should be checked for any obvious damage, especially in the case of a feed barge, as frequent damage can occur in the way of splits in the shell plating, especially on the deck joint. Decks need to be cleared of loose rope before towing.

2.4 Towing Equipment: The section below details the checks to be made on towing equipment prior to commencing a tow.

3. Testing, inspection & maintenance of towing equipment

Before and after the completion of any tow, it is recommended that all towing equipment is thoroughly checked for defects and general wear. This should include both the towing equipment aboard the workboat/ tug and also the towing equipment aboard the vessel/fish pen to be towed. The following general guidance should be adhered to:

3.1 Towing Hook

- Monitor the condition of the gear on a regular basis, especially wear and tear at the fulcrum pin and where the hook interacts with the guide track;
- Look out for stress fractures in the key stress areas i.e. the fulcrum pin and supporting structure;
- The smooth and efficient action of the quick release system (if applicable); and
- An axe should be provided and be readily available for use.

3.2 Towing Winches

- Check the effective operation of the winch including braking mechanism and 'in gear' operation;
- Ensure the pawls on winches are effective and free to arrest the tension on the towing wire and are able to release with ease
- Look for excessive corrosion or fracturing of the winch hold.

3.3 Bollards, Fairleads and Sheaves

- Check for excessive corrosion leading to the wasting of the bollard/fairleads and supporting structure;
- Look closely for fractures in both the bollard support structure especially around bollard pins; and
- Proper rotation of sheaves or other pulley devices such as snatch blocks, and secure connection to deck or other tug structure.

3.4 Ropes & Wires

- Undertake regular visual inspections of all ropes and wires, identifying frayed strands, distortion of wire/rope and condition of splices/mechanical wire splices, knots & shackles.

4. Formal Testing and Maintenance of Towing Equipment

Towing equipment, such as hooks, winches and ropes should be provided with test certificates when new and should be tested and certified by an approved contractor. Test certificates should be kept for future record. Towing ropes should also be provided with test certificates.

5. Safety Factors for Towing Equipment

As a general rule it is recommended that steel wire and fibre rope towlines and towing springs have a Safe Working Load of at least 2 times the bollard pull of the workboat/tug involved in the towing operation. This also applies to towing hooks. A lesser safety factor can have a detrimental effect on the towlines lifespan, which may lead to failure of the towline during towing operations.

6. Safety of Crew/Personnel:

All those with a responsibility for personnel or equipment involved in craft towage operations have a duty to ensure that safe working practices are followed, and that associated equipment is fit for purpose. They should also ensure that those involved in craft towage operations are properly equipped and trained to undertake the work.

They should never:

- Stand in the bight or eye of a towing or mooring rope at any time.
- Walk over slack towing or mooring ropes.
- Stand astride, stand on or walk over taut towing or mooring ropes.
- Let a wire rope slip through the hands or slide a hand along a wire.
- Wear rings.
- Stand in a “DANGER ZONE”, i.e. in the area into which a tow line under tension could recoil. In this instance it is recommended that the “DANGER ZONE” is clearly indicated on each tug, this may be completed by highlighting the relevant deck.

7. Towing:

Tow ropes should be secured from the workboat/tug to the barge/fish pen in equal lengths and with the same number of turns and identical knots to ensure that the same amount of rendering of the tow rope when power is applied.

Once the towing gear is connected, the crew should indicate this to the Skipper, if required to remain on deck, but stand in a safe position. If the crew are required to attend the towing gear during a towing operation, the length of time exposed should be kept to a minimum and the skipper should be aware.

During towing operations the towing gear, equipment and personnel should be continuously monitored and any change in circumstances immediately relayed to the Skipper. **Crew should be aware that the tow may have to be released in an emergency situation, and that this may occur without warning.** The Skipper and crew need to remain vigilant when tow ropes become slack during the towage operations. When speed is increased, weight can unexpectedly come back on the ropes, which can be a danger to crew on deck. In other circumstances, whilst the weight may come back on the ropes in a controlled manner, the tow ropes may become caught under an obstruction on the deck, and may suddenly recoil as the weight becomes excessive. When toe ropes are slack they should be controlled by a member of the crew to ensure that they do not enter the water or become fouled on any obstructions.

8. Craft Tug Towing Limitations

Before carrying out a towing operation, consideration should be given to the size of the tow and the tug being considered for use in the towing operation. A tug is considered powerful enough to tow a barge if it can at least stem the tide with a tow.

9. Effects of Rough Weather

The effects of rough sea on a workboat/tug and tow can be significant and may include the following:

- The effect on the workboat or towed vessel's stability due to surface water and spray on deck.
- The workboat and barge/fish pen being moved on the vertical plain at different times to each other, thus placing extra strain on the towing and mooring lines.
- Damage caused to the work boat and barge as they are forced against each other by rising swells.

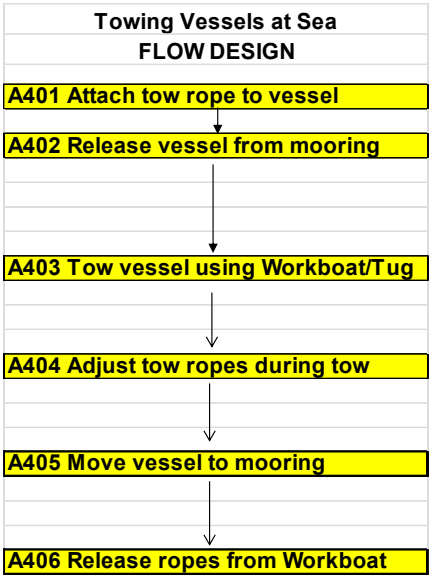
Actions to minimize or avoid Damage in Rough Weather

In order to reduce the risk to safety and potential damage when towing in rough or inclement weather, the following precautions should be taken:

- Delay departure until the wind decreases or changes direction or depart at a different state of tide.
- Checking the local weather forecast regularly prior to departure.
- Reduce power/speed during the tow this will aid in reducing the amount of movement in the tow.
- If towing, lengthen the tow ropes to compensate for the tug power surge caused by the swell.
- Securely stow all moveable objects on deck and below deck.
- Closing down all external hatchs, doors and windows and vulnerable ventilators.
- Closely inspecting all towlines to ensure they are sound and undamaged, secure the barges to the workboat/tug and to each other with extra lines to compensate for their random movement in rough weather.
- Sheeting up the forward end of the main hatch coaming to reduce the amount of spray entering the hold where applicable.

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	06/11/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	04/10/2017 (Patrick Shovelin)	**Next revision date**	12/11/2023

10. Process Flow



Towing Vessels at Sea

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	06/11/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	04/10/2017 (Patrick Shovelin)	**Next revision date**	12/11/2023

Location and process	Ireland / Marine Production / Maintenance	**Document category**	Procedures
Last approved date	10/05/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	08/05/2017 (Michelle Hay)	**Next revision date**	12/11/2023

Procedure for Washing Pontoons and Walkways of Pens at Sea

1. Scope:

Pontoons of pens are washed and maintained at sea to remove growth and clean surfaces, in order to prevent slips/falls by staff walking on them.

2. Precautions:

Ensure a good calm working day before carrying out this task. Ensure power washer is free from all detergents before use.

3. Procedure:

Select a suitable vessel from which to wash pontoons. Moor boat to chosen pen to be cleaned, and set up power washer.

Lift the area of pontoon to be washed with crane.

If surface of pontoon is particularly fouled, use a garden hoe to remove excess growth before power washing.

Apply water from power washer to pontoons, washing back and forth, until all growth and fouling has been removed and the surface is clean.

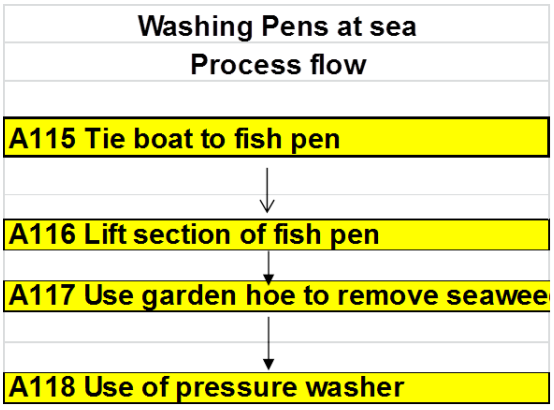
.

4. HES:

Operate in favourable weather and tidal conditions. Observe manual handling procedures. Wear appropriate PPE including lifejackets, ear protection and goggles. Use necessary and appropriate lifting equipment.

5. Safety risk assessment & Process flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Guidelines
Last approved date	21/01/2022 (Patrick Shovelin)	**Last revision date**	21/01/2022
Date changed	21/01/2022 (Patrick Shovelin)	**Next revision date**	06/12/2023

WORK AT SEA - FLOATING FISH FARM INSTALLATIONS

All parts of Mowi Ireland floating pen units are designed and constructed to provide suitable anchorage, buoyancy, strength and stability to ensure the installations safety. When deciding on the adequacy of these features it was taken into account the likely loads imposed by equipment and fish feed etc, and the effects of waves, current and wind. Mowi Ireland ensures continued safety of the installation by carrying out regular routine inspections combined with a maintenance inspection, normally at least once a year and after storms.
Easily understood written instructions on the operation and maintenance of the installations are available on each site. When working over water on any site, at least two people need to remain within sight and sound of each other at all times. Young workers (under 18 years) will not be permitted to work at sea in poor weather conditions. The Site Manager/Supervisor will have the responsibility to ensure young workers are not exposed to hazards or perform hazardous work.

Boats:

Only trained and properly qualified staff are permitted to operate boats on Mowi Ireland sites. Untrained staff are only permitted to operate boats as part of their training provided they are always supervised and are always accompanied until they have the appropriate training completed. All on board the boat shall be wearing a lifejacket as per the Mowi Lifejacket Policy. All boats owned or hired by Mowi Ireland must be certified to Department of Marine standard, to include Load Line or Passenger Cert. Cranes, winches and other lifting equipment should be inspected at least annually by a competent authority.
There must be at least two people on board boats at all times except using plastic boats in the following circumstances:

- When there are other crewed Mowi Ireland vessels on the site, in the immediate area and capable of verbal communication with each other via radio.
- When the boat is moored and the personnel are within visual range and capable of verbal communication with the person on shore or work platform.
- If the person on board carries a personal radio, which has been charged and checked prior to departure and keeps in regular contact with his base.

Feed Barges:

The size of feed barge on Mowi Ireland sites varies from 50 ton capacity to 200ton capacity and are situated adjacent to the fish pens. Apart from holding feed, these feed barges contain the feeding system, canteen, toilet/hygiene facilities and office from where feeding is monitored via underwater camera. All equipment on the feed barge is powered from an onboard generator. Routine tasks onboard the feed barge includes feed monitoring, loading feed, housekeeping and basic maintenance. As there are areas on the feed barge that are designated as confined spaces, all staff have completed confined space training and equipment has been provided.
Under no circumstances should anyone enter the feed silos without completing a confined space permit.
There must be at least two people on board the feed barge at all times except when there are other crewed Mowi Ireland vessels on the site, in the immediate area and capable of verbal communication with each other via radio.

Safety and rescue equipment:

When working over water at any location, at least two people will remain within sight and sound of each other at all times. They will have constant access to a moored boat or life raft. Life rings with a suitable buoyant lifeline of adequate length attached are available where a person could fall into the water, (life rings are not necessary where they are provided on a work boat at a small or single cage installation).

Suitable personal buoyancy equipment, such as lifejackets are provided to all staff and it is company policy to wear them at all times when working over water. Mowi Ireland provides training on the procedures for rescuing people from the water (including rescue into a boat) and also the correct fitting, maintenance and use of lifejackets.

Clothing for wet and cold weather:

There is always a risk of rhematic complaints due to a combination of cold, damp repetitive strain. To minimise such risk, Mowi Ireland provide protective/warm clothing. Where there is a risk of staff falling into the water during the winter when water temperatures are 10^0 C or less flotation suits are provided to reduce the risk of cold shock or hypothermia.

Communication:

All work boats in accordance with Dept. of Marine regulations are fitted with VHF radio, flares and navigational lights.

Dust:

Workers handling feedstuffs can be exposed to dust and can be at risk from irritation to eyes, nose and the respiratory system. Where dusts cannot be prevented or controlled by engineering methods, respiratory protective equipment is provided.

Process Flow:

Working on floating fishfarm installations

Mowi Ireland

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Guidelines
Last approved date	21/01/2022 (Patrick Shovelin)	**Last revision date**	21/01/2022
Date changed	21/01/2022 (Patrick Shovelin)	**Next revision date**	06/12/2023

Floating Fishfarm Installations	
A413	Boat from Mooring
A414	Loading feed onto boat
A415	Loading feed Barge
A416	Loading C-Cap Barge
A417	Access to Feed Barge
A418	Feeding of fish
A419 **A420**	Petrol Fish Feed
A421	Canteen
A422	Toilets
A423	Weather Conditions
A424	Rodents
A425	Insects
A426	Birds
A427	Feed Barge
A428	Access to drinking water
A429	Storms at sea

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	05/06/2020 (Joseph Gibbons)	**Last revision date**	13/05/2020
Date changed	13/05/2020 (McManus, Catherine)	**Next revision date**	28/02/2023

Procedure for Installing Graphite Pole Supports for predator nets:

1. Scope:

Top nets are fitted to all Mowi Ireland pens to prevent entry of predators. The top nets are held in position using 21 graphite poles secured to the stanchion. The poles that are fitted around the perimeter of the fish pen provide more flexibility and will reduce the amount of damage to the fish as there is no structure within the pen.

2. Procedure for installation:

Step 1

The steel pole holder is manually attached to the stanchion to secure the pole upright in all weather conditions.

The 430mm tube at the bottom of the holder slots into the base of the stanchion.

The top of the holder is secured to the stanchion by a steel bracket.

Step 2

Lift the holder into position and slot the 430mm tube into the existing hole at the base of the stanchion.

Poles for bird nets

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	05/06/2020 (Joseph Gibbons)	**Last revision date**	13/05/2020
Date changed	13/05/2020 (McManus, Catherine)	**Next revision date**	28/02/2023

Step 3

Secure the top of the holder to the stanchion using the steel bracket. This is tightened in place using a 90mm x 12mm galvanised bolt.

Step 4

At eight points around the fish pen the 19mm chain from the mooring bridle is attached using a lifting sling to pull the 19mm chain from the mooring bridle up through the tube and attach to the holding eye using a steel pin. This can be done using the crane.

Step 5

Attach two 12m lengths of 10mm rope to the top of the pole. One rope to hold the top of the predator net in place and the second rope for lifting the side of the net when inspecting fish stocks.

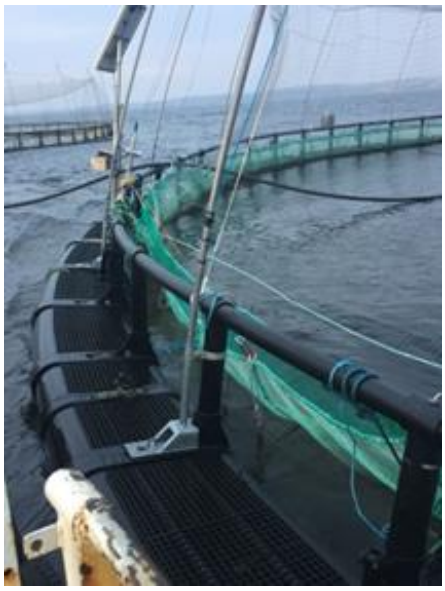
Only reattach the ropes by removing the poles from the holder. Do not attempt to pull the top of the pole downwards with excessive force.

Step 6

The task of slotting the pole into the holder will require at least two staff as the pole will be top heavy and the movement of the fish pen will be increased at the top of the pole. Ensure all staff are wearing hard hats.

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	05/06/2020 (Joseph Gibbons)	**Last revision date**	13/05/2020
Date changed	13/05/2020 (McManus, Catherine)	**Next revision date**	28/02/2023

Step 7



The predator net is then be put into the fish pen and pulled into position on the surface of the water using ropes across the fish pen.

When the net is in position on the surface of the water all the ropes are attached.

One end of a rope from the top of the poles are then attached to the predator net and the net can then be pulled tight into position.

The net must be tightened into position simultaneously by at least two staff, one at each side of the pen, otherwise the net will not tighten evenly and put too much stress on the poles.

Once in position, the rope can be secured to the handrail. One end of the second rope is attached to the bottom of the predator net and again the other secured to the handrail

4. HES:

Ensure appropriate PPE is worn. Observe manual handling procedures.

5. Safety Risk Assessment and Process Flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.

Install Net Poles

A155 Attach pole holder
A156 Attach chain & bracket
A157 Insert pole into holder
A157(a) Attach & adjust top net

Appendix 2.2

Nets

IDEMA Netwasher Daily Checklist

Mowi Ireland

Location and process	Ireland / Marine Production / Maintenance	**Document category**	Record Sheets
Last approved date	13/01/2023 (Michelle Hay)	**Last revision date**	12/01/2023
Date changed	12/01/2023 (Michelle Hay)	**Next revision date**	12/01/2024

IDEMA NETWASHER DAILY CHECKLIST

Date
Hours reading
Operator
Site

DAILY CHECK—Items to be checked before use

NO	Checklist	Yes	No	Ok
1	Check engine oil level (dip)			
2	Check engine for oil leaks			
3	Check gearbox oil level (dip)			
4	Check gearbox for oil leaks			
5	Check pump oil level (glass on both sides ½ way up)			
6	Check Radiator			
7	Diesel level			
8	Water intake filters			
	Start up procedures.			
1	Put Intake pipe in water (NEVER RUN WITHOUT WATER)			
2	Switch on key			
3	If red light comes on switch off and press override. Keep override pressed switch on.			
4	Press green button to start.			
5	Keep override pressed till tank over flows then release override.			
6	Check for oil & water leaks			
7	Set up head and hoses.			
8	Check camera's			

REPORT ANY DEFECTS
Operator signature_____
Supervisor's signature_____

Allow engine to heat up before engaging pump (5-10 min).
When stopping disengage pump and allow engine to cool down (5-10 min) before turning off.
When using net washer let out all the hoses on the deck.

Location and process	Ireland / Marine Production / Maintenance	**Document category**	Procedures
Last approved date	06/11/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	26/09/2017 (Michelle Hay)	**Next revision date**	12/11/2023

IDEMA Net Washer

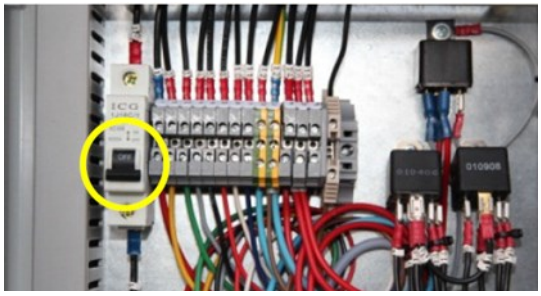
1. Scope:
The IDEMA net washer is a high pressure net cleaning system used for all nets.

2. Precautions:
Everyone that uses the equipment, all that perform any type of repairs, service or other maintenance to the product, and all that work in areas where the washer is installed must read the entire user and maintenance manual (TQM 41840). Caution must be taken when using high pressure equipment; this equipment generates a large amount of force and may cause damage to personnel or equipment if used incorrectly. Operators must always be conscious of personal safety, general safety and equipment safety.

3. Procedure:
3.1. Pre Check
Daily Pre-check record must be filled out (TQM 41856) which will include oil pressure and water pressure checks.

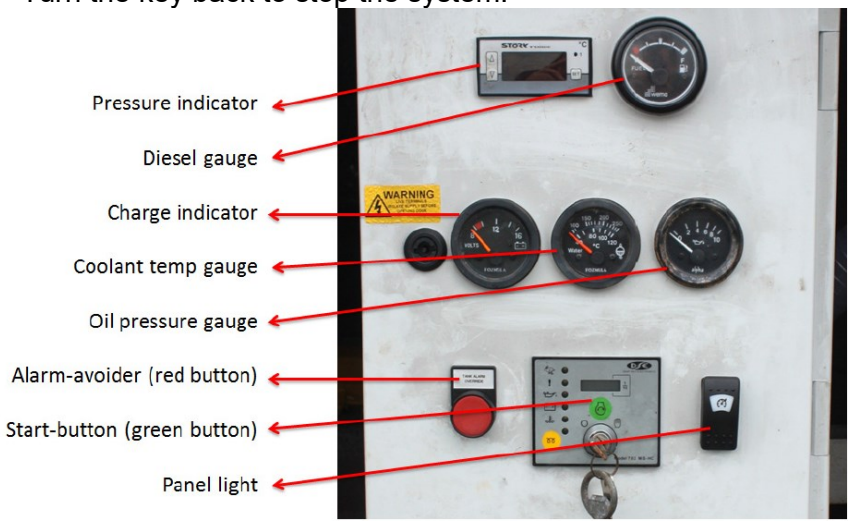
3.2. Set Up
Connect water hose to the high pressure hose coming from the pump. Ensure that the washer is appropriately secured to the deck of the boat to avoid movement at sea. Make sure that the suction hose is well attached to the feed pump. It is also important that the entire suction filter is below water during the running of the net cleaner. Check the hoses on the frames for bends, these must be not be flattened. Also check for tears and other damage. Any damages must be repaired or the hoses replaced before use. Check the hose couplings, and tighten if necessary. Run the system with feed pressure to check the conditions of all the nozzles.

3.3. Starting and stopping the machinery
After going through, and preparing all of the inspection instructions, it is safe to start the system like this:



3.3.1. Set the main switch (marked with a yellow ring) to “ON”
3.3.2. Press and hold the red button in the control panel
3.3.3. Turn the key
3.3.4. Press the green start button until the machinery starts (this normally takes about 2 seconds)
3.3.5. Release the red button
3.3.6. Open the cabinet door and engage the pump by moving the throttle forwards until it slows down. Leave the throttle in this position for about ten seconds, so that the pump can build up pressure before increasing rpm
3.3.7. After 10 seconds, exceed the power as much as needed
3.3.8. To stop, pull the throttle directly back to the starting position, and leave the motor running without load for 3-5 minutes to cool down the system and prevent potential destructions caused by a hard stop (may cause destructions to the turbo and the bearings)

3.3.9. Turn the key back to stop the system.



3.4. Training & PPE

Operators must be over 18 years of age to operate this machine. Operators must have received specific training on this piece of equipment to be allowed to operate the machine. Wear appropriate PPE. Use necessary and appropriate lifting equipment and observe manual handling procedures.

4. Maintenance

4.1. Oil Overview

Oil for motor: 10W-40
Amount of oil in motor: 20L
Oil for pump: SAE 220
Amount of oil in pump: 7L
Oil for gear: SAE 30
Amount of oil in gear: 9L (K-136-300-SD) or 14L (other)
Use dipsticks to make sure that the oil amounts are correct.

4.2. Motor

External cleaning: once a week
Oil check: every day
Oil change: First time after 25h use, thereafter every 250h
Change oil filter: First time after 25h use, thereafter every 250h
Air filter: change oil after 250h, check oil every day

4.3. Motor filters

4.3.1. Diesel filter

Open the filter cup, check filter for impurities and change if it is clogged

4.3.2. Oil filter

Use filter forceps to remove the motor oil filter. Place the forceps around the filter cup, turn to the left and release the filter. Take out the old one, clean the holder with a clean cloth, and put in the new filter. Replace the filter cup and fasten it using hand power.

4.3.3. Air filter

This filter has its own indicator placed on top of the motor, when it turns red, it needs to be replaced. To replace the filter:

- Release the cover by loosening the clamps
- Take the filter out
- Check for filth and replace filter if clogged.


4.4. Coolant

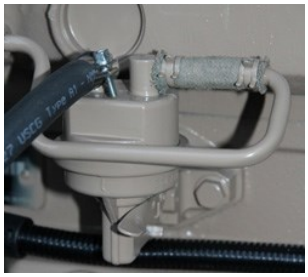
The coolant must be changed every other year. Drain the coolant by opening the draining valve placed in the bottom of the radiator**.** Refill with fresh coolant**.** Check the coolant level after refill. If the level is too low, more coolant must be added.

4.5. Ventilating the diesel system

When air appears in the diesel system, it needs to be ventilated out of the system. Air can appear in the system after:

- running out of diesel
- changing diesel filter
- any work is done with the system.

The ventilation handle is placed on the right side of the diesel filter. When ventilating, push the handle upwards several times, until a smooth resistance is felt.



4.6. Pump Overview

Cleaning: once a week
Oil check: every day
Oil change: first time after 50h use, thereafter every 500h
Inspection, function test: when required
Vents: when required
Pressure gaskets: when required
Pistons: when required

4.7. Gear Overview

Cleaning: once a week
Oil level: once a day

Oil change and sieve cleaning: first time after 50h use, thereafter every 500h use or once a year.

Oil cooler, cleaning and if necessary, change of zinc anode: every six months. The oil cooler is inspected by removing the end lid. Take the insides out for cleaning. Stake the insides, clean and blow away any contaminations. Replace the insides, and put the lid back on place.

The zinc anode is placed inside the nut marked with a yellow ring. This needs to be replaced every sixth month. Release the nut and remove the anode, place a new one in and screw the nut back in its place.

When the gear oil is changed, the coarse strainer must also be changed. Release the plug, remove the filter and clean it. The two screws must be fastened with 18 Nm torque.

4.8. Feed pump

Impeller inspection: when required, but at least once a year
Impeller change: when required
Change ball bearings and gaskets: when required
Remove cover and look inside to control the impeller visually.

4.9. Sea water filter

Since this net cleaner has a dual-pump, it also has two sea water filters. These are attached above the pump in the cabinet. The filter must be checked every 100h. Unscrew the glass cylinders and take the filter out of its container for inspection. Clean or replace the filters when required.

4.10. Net Cleaner Frame

Change ball-bearing when required. Spin the discs manually one by one and listen for rumbling sounds. When the bearings are ok, no sounds will be heard. Run the system with feed pressure to

check the condition of the nozzles on the net cleaner. Make sure to check each one of the nozzles, and clean them if necessary. Hoses and hose couplings must be checked every six months.

4.11. Battery

Battery level and poles checked every six months. When the poles become dirty, this may lead to quick discharging of the battery because of power leakages. Clean battery poles are therefore important for optimized charge. Before the cleaning, remove the poles from the battery. **Use protection gloves and goggles to avoid being hurt by the very corrosive battery acid.** Use a steel brush to clean the poles. Brush and clean the poles until they are shiny and clean. Blow off any scrapings. The negative pole may be harder to reach, so use a screw driver or something similar to scrape off filth and rust. Blow at the poles to remove loose bits and to see that they are clean.

5. Cleaning & Disinfection

At the end of each day, the equipment must receive a fresh water rinse and any organic matter removed. At the end of each site, a full disinfection of the system must be completed. Regular service and good maintenance are factors which will prolong the equipment's lifetime and functions. It is recommended that all of the items in the maintenance plans from chapter 13 of the user manual are checked according to plan, and also after long lasting cleaning processes. This way, the equipment will always be ready for use, and this will also reduce service costs.

6. Post Use Check

After use, the net washer must be rinsed out with fresh water.

7. Maintenance Plan

The maintenance plan is to be completed as directed in the user manual and depicted below.

Motor:

Task	Service interval					
	Hours	Day	Week	Monts	Year	Comments
Cleaning			1			
Check motor oil		1				
Change motor oil	500					First time after 100h
Change oil filter	500					First time after 100h
Change air filter					1	Control the indicator
Change diesel filter	500					
Inspect coolant level		1				
Change coolant					0,5	Every other year

Pump:

Task	Service interval					
	Hours	Day	Week	Monts	Year	Comments
Cleaning			1			
Check oil						
Change oil		1			1	First change after 50h
Function test					1	
Clean salt water filter	100					

Gear:

Task	Service interval					
	Hours	Day	Week	Monts	Year	Comments
Cleaning			1			
Change oil, clean sieve	500					First time after 50h
Check oil		1				
Check oil cooler, change sink anode					1	

Feeding pump:

Task	Service interval					
	Hours	Day	Week	Monts	Year	Comments
Cleaning					1	

Battery (if installed):

Task	Service interval					
	Hours	Day	Week	Monts	Year	Comments
Cleaning				6		

8. Storage

8.1. Always run fresh water through the system after use

8.2. Mix 80% water and 20% antifreeze solution and run this through the system to conserve the system, to lubricate the seals and to reduce the danger of frost damages in case of storing in a below 0°C environment. If storing in colder environments, increase the amount of antifreeze solution. Check instructions on the solution bottle

8.3. If the system can be exposed to frost, it is important that the amount of water inside is as low as possible, but more importantly, there has to be antifreeze solution in the water. The components can burst if a large amounts of water freezes inside

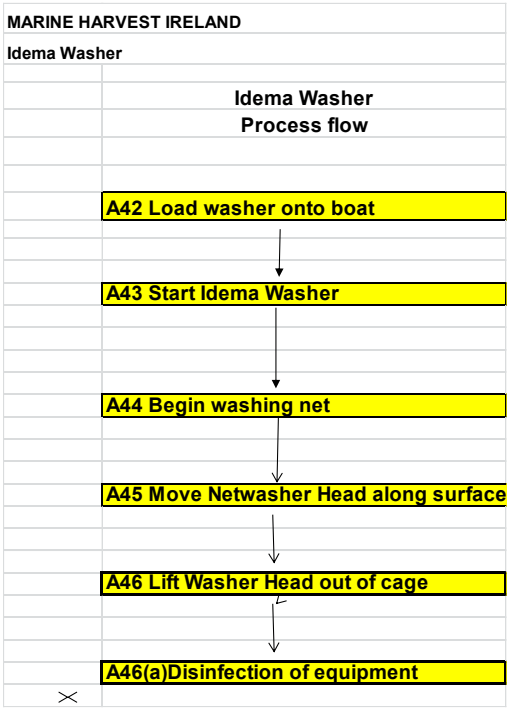
8.4. Empty the pressure hose and coil it up.

9. HES Precautions

9.1. Operate in favourable weather and tidal conditions.
9.2. Observe manual handling procedures.
9.3. Wear appropriate PPE, lifejackets and hard hats.
9.4. Use necessary and appropriate lifting equipment.
9.5. Observe SDS sheets for disinfectants used.
9.6. Do not operate net washer if divers are in the immediate area of net to be washed.
9.7. Never handle net washer heads whilst in use.

10. Risk Assessment

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Location and process	Ireland / Diving / Diving Operations	**Document category**	
Last approved date	17/11/2020 (Joseph Gibbons)	**Last revision date**	14/09/2021
Date changed	02/11/2020 (Patrick Shovelin)	**Next revision date**	31/05/2023

Fish Pen Net check

1. Purpose:

Nets must be checked regularly by divers to insure no damage or wear has taken place, or that extreme weather conditions has caused damage.

2. Procedure:

2.1 Enter the net and make your way to the centre of the net floor.

2.2 Start checking net from the centre outwards in a circle and at a distance that visibility allows.

2.3 Place a tag at the starting point.

2.4 Each time you do a full circle move out the tag and do the circle again till you reach the wall of the net.

2.5 Move the tag from the floor to the wall and then swim around the wall until you reach the tag. Move it up the wall a distance that visibility allows.

2.6 Continued the inspection until you reach the surface.

2.7 Report any defects on the net.

2.8 If any holes are found, repair immediately and inform supervisor and site manger so the net can be changed if necessary.

2.9 Record all net checks and repairs that are carried out.

3. H&S Risk assessment:

Process Flow:

D37 Net Checks

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	05/06/2020 (Joseph Gibbons)	**Last revision date**	06/02/2019
Date changed	06/02/2019 (Patrick Shovelin)	**Next revision date**	24/06/2023

Procedure for Net Changing:

1. Scope:

Good net hygiene is necessary in order to optimize environmental conditions for fish, to ensure a good flow of clean, well oxygenated water through the pens. In addition, keeping the nets free from substantial fouling will help prolong the life of the net.

No antifoulants are used on the nets of Mowi Ireland. Subsequently, fouling of these nets is much more rapid than on antifouled nets. This warrants more frequent net changing than other sites. However, since the introduction of the net washer in all regions, reliance on net changing has been much reduced.

Net changing should take place during appropriate tidal conditions for the site.

2. Net Changing on Turmec/Steel Pens:

- Untie the waterline ties and remove any hanging weights. Use winch etc. to lift the dirty net 8-9 m out of the water until the bottom lead line rope is hanging along the handrails of the pen.
- Choose the side of the clean net which is roped to the outside. Hang it up on the handrails and then push the rest of the clean net into the water.
- Using the 2 relevant corner ropes, guide the clean net under the dirty net and up along both sides. Starting at the opposite end to which the net is being pulled out, drop three sides of the dirty net into water & allow them to sink.
- Pull out dirty net with crane, allowing fish to swim from dirty net to clean net.
- Replace bird net, weights and tie back waterline ties.

3. Net Changing on Aqualine/Polar Cirkel pens:

- Pull up net weights and secure to pen, or disconnect via divers. Free bird net from stanchions
- Pull up the net to approximately 2 meters (or to a point where fish are not stressed) around the pen by means of crane/hauler on boat and tie to corner stanchions. The slack net is lifted by the net changing crew to stop fish becoming trapped.
- Remove new clean net from bag and attach net-pulling ropes (20mm) to top loops or corner water level ties. These net pulling ropes are then fed under the dirty net to each corner. In Mulroy & Swilly the net is fed in top first underneath the old net using the lead rope, the 4 corners are tied every 10 stanchions, the stanchions are marked accordingly.
- Working from the boat side of the pen, the new net is pulled at each corner to ensure the 4 or 8 corners of the new net are secured. Water level ties are then pulled to each stanchion and tied off. Lift the mouth of the new net and hook onto stanchions. Net weights are then attached to the new net.
- The fouled net is slowly pulled out, making sure that the fish are not trapped or damaged in the process via down ropes.
- A final check is carried out on the newly fitted net to make sure that all the water-level ties are in place and properly secured. An underwater diving inspection of the newly placed must be carried out to ensure net integrity.

4. Records:

Following net change, please record all details on net changing record sheet attached to this procedure.

5. HES Precautions:

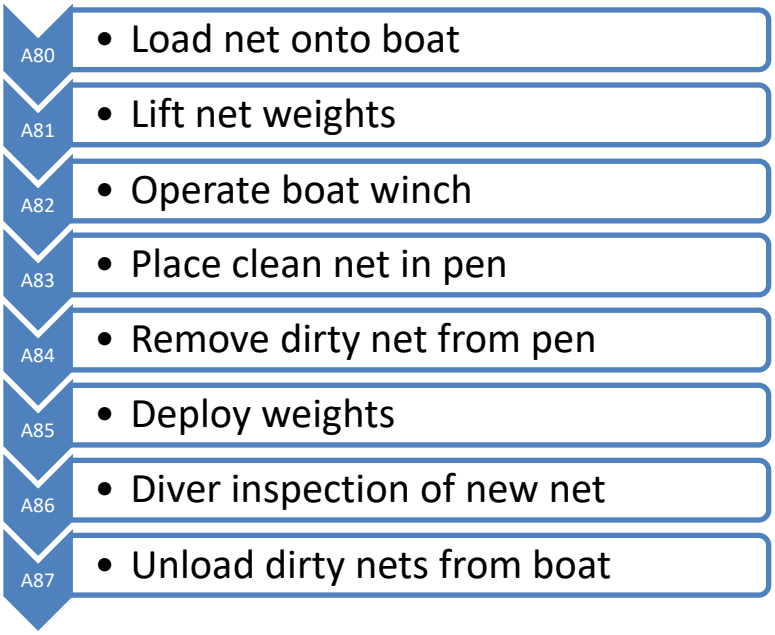
Observe manual handling procedures. Wear life jackets, hard hats and other appropriate PPE. Slings must be used for lifting nets.

Never lift the dirty net too high, thus crowding and stressing the fish. Take care not to trap fish in folds by dirty net being lifted out and clean net being tied in.

Ensure a final net check is carried out by divers when net weights are tied back in to new net.

6. Safety Risk Assessment & Process Flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Net Mending **Mowi Ireland**

Location and process	Ireland / Net Management / Net Mending	**Document category**	Procedures
Last approved date	26/01/2022 (Patrick Shovelin)	**Last revision date**	26/01/2022
Date changed	25/01/2022 (Patrick Shovelin)	**Next revision date**	06/07/2023

Net Mending:

1. Scope:

After nets have been washed and disinfected, each net must be inspected and fully repaired before it can be used again.

2. Procedure:

2.1 Any areas requiring patching are marked with a red or yellow tag.

2.2 A single tear to one mesh can be repaired by starting one square above the tear, and finishing one square below locked at both ends.

2.3 Damage to a 3x3 mesh area or more, can be repaired with a patch of 7x7 mesh.

2.4 An area or more with 2 lines of stitching, one within the other e.g. 4x4 mesh, needs a 8x8 mesh patch, all stitching must be locked at each point in such a way that if one should break the remaining sewing will not unravel.

2.5 Any holes cut out when the net is checked will be marked with a plastic tag (numbered 1 – 10). Tags will remain on the net until the patch is completed.

2.6 When patching & repairing is completed, the tag is handed back to the net supervisor, who has responsibility to ensure all tags are accounted for before net is passed fit for use.

2.7 Nets are tested with a hydraulic strength tester 3 times on floor and 3 times on each side. Results are recorded on Net Mending Record.

2.8 Any net deemed to be too worn or not safe for reuse must be discarded.

3. Records:

All nets are marked with year of manufacture and number of net. Record all mending details on Net Mending Record on Aquacom.

4. Storage:

Nets must be rolled up properly or put into net bag to ensure easy changing on site. A red tag to show that the net has been fixed will be attached to identify it.

5. HES:

Wear appropriate PPE, steel gloves are provided and must be worn when handling knives. Manual handling procedures must be observed at all times.

6. Safety Risk Assessment & Process Flow:

Net Mending

Mowi Ireland

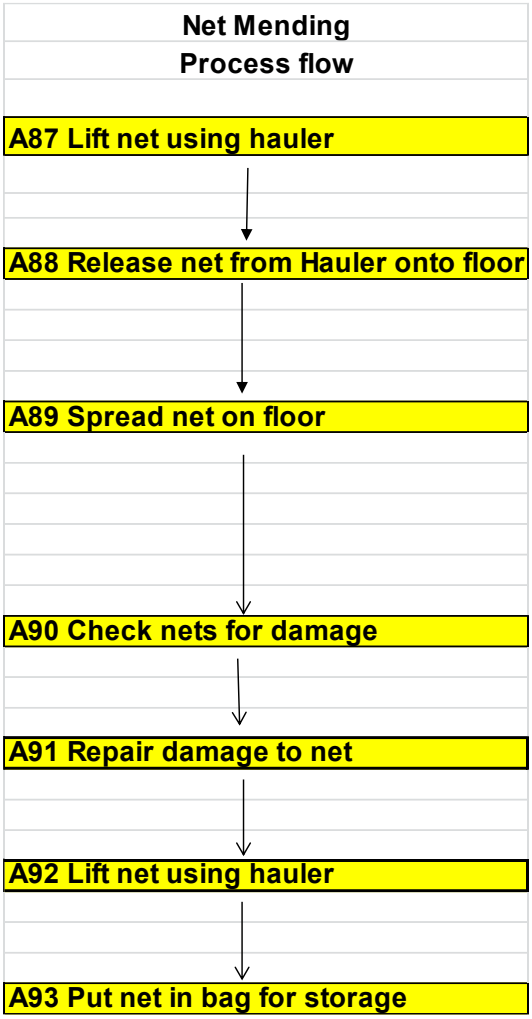
Location and process	Ireland / Net Management / Net Mending	**Document category**	Procedures
Last approved date	26/01/2022 (Patrick Shovelin)	**Last revision date**	26/01/2022
Date changed	25/01/2022 (Patrick Shovelin)	**Next revision date**	06/07/2023

Net Mending				***Probability/Severity score***			***Risk Score***	
	People at risk:	Net maintenance staff		**Low = 1**			**Low = 1 - 3**	
				Medium = 2			**Medium = 4**	
				High = 3			**High = 6 - 9**	
NO.	**PROCESS STEP**	**HAZARD**	**Adverse Effects**	**Probability of Occurance**	**Severity**	**Risk Score**	**CONTROL MEASURE** (all competent staff)	**FURTHER CORRECTIVE ACTION**
A87	Lift net using Crane	Raised loads	Crush injury	1	3	3	Supervision, hard hats, signs	
		Falling objects	Crush injury/knock to head	1	3	3	Hard hat, signs, supervision, training	
		Moving parts	Hand trap	1	2	2	enclosed parts, guards, PPE	
		Slippery surface	Bruising to limbs	1	2	2	Safety boots, housekeeping, Signs	
A88	Lower net into netwashe	Crane	Crush injury	1	3	3	Alarm, trained staff, supervision	
		Raised load	Crush injury/knock to head	1	3	3	SWL, Hard hats, Guards, supervision, signs	
		Falling materials	Crush/knock to haed	1	3	3	Hard hats, supervision, signs, inspections	
		Moving parts	Hand trap	1	2	2	guards, enclosed parts	
A89	Spread net on floor	Manual handling	manual handling injury	1	2	2	manual handling training, winch, painted floor	
		Slippery floor	slip/fall	1	2	2	Safety boots, housekeeping, supervision, signs	
		Winch	Hand trap	1	2	2	Supervision, sign, foot operation, training	
		ropes/net on floor	trip/fall	1	2	2	Housekeeping, supervision, safety boots	
A90	Check nets for damage	Manual handling	Manual handling injuries	1	2	2	Three staff doing task, rotation, inside work	
		Weather conditions	sun burn / cold	1	2	2	Most work carried out inside, PPE, suncream	
		net and ropes on floor	Trip/fall	1	3	3	Housekeeping, supervision, safety boots	
		Dust from net	respiratory irritation	1	2	2	Housekeeping, face masks if required, supervision	
A91	Repair damag to nets	Knife	cuts to limbs	1	2	2	Knife handling training, supervision, First aid	
		Ropes/net on floor	trip/fall	1	2	2	Housekeeping, supervision, safety boots	
		Manual handling	manual handling injury	1	2	2	Table for net, winch, help on site, PPE	
		Needle slipping when tighteni	Stabbing	1	3	3	Pull needle away from body, proper knot	
		Dust from net	respiratory irritation	1	2	2	Dust Masks, Ventilation (Doors)	
A92	Lift net using hauler	Raised loads	Crush injury	1	3	3	SWL, Inspections, Trained staff, Hard hats	
		Falling objects	Crush injury/knock to head	1	3	3	SWL, Hard hats, supervision, signs	
		Moving parts	Hand trap	1	3	3	Guards, rails, PPE, supervision	
		Slippery surface	Bruising to limbs	1	2	2	Safety boots, housekeeping, signs	
A93	Put net in bag for storage	Raised load	Crush/knock to head	1	3	3	SWL, Inspections, Trained staff, Hard hats	
		Falling materials	Crush/knock to head	1	3	3	SWL, Inspections, Trained staff, Hard hats	
		Moving parts	hand trap	1	3	3	Guards, rails, PPE, supervision	
		Ropes	Trip/fall	1	2	2	Housekeeping, safety boots	

Net Mending

Mowi Ireland

Location and process	Ireland / Net Management / Net Mending	**Document category**	Procedures
Last approved date	26/01/2022 (Patrick Shovelin)	**Last revision date**	26/01/2022
Date changed	25/01/2022 (Patrick Shovelin)	**Next revision date**	06/07/2023



Total Assessed Risk = Likelihood x Severity

Likelihood	Severity
1 = Unlikely event: Once every year	1 = Negligible. No Impact or not detectable
2 = Occasional event: Once per month	2 = Significant: impact on critical limits
3 = Frequent event: Once per day	3 = Critical: public health risk, public product recall.

Likelihood	Severity		
	1	2	3
1	1	2	3
2	2	4	6
3	3	6	9

Low Risk = 1 - 3
Medium Risk = 4
High Risk = 6 - 9

Low Risk - These risks are considered acceptable. No further action is necessary other than to ensure that the controls are maintained.

Medium Risk - Consideration should be as to whether the risks can be lowered, where applicable, to a tolerable level and preferably to an acceptable level, but the costs of additional risk reduction measures should be taken into account. The risk reduction measures should be implemented within a time period.

High Risk - Substantial efforts should be made to reduce the risk. Risk reduction measures should be implemented urgently within a defined time period and it might be necessary to consider suspending or restricting the activity, or to apply interim risk control measures, until this has been completed. Considerable resources might have to be allocated to additional control measures.

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	17/11/2020 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	12/11/2020 (Michelle Hay)	**Next revision date**	12/01/2023

Procedure for Installing Bird Nets & Supports on Fish Pens:

1. Scope:

Top nets are fitted to all MOWI Ireland pens, to prevent entry of predators. In most cases, each net is supported by a 'Pepper Pot' (example fig 1) a 'Hamster Wheel' (example fig. 2) or net poles (Fig 3).


Fig 1


Fig 2


Fig 3

2. Procedure for installation and preparing on shore:

i. **Pepper Pot**
Ensure all required ropes on net are secured to frame. The number of ropes required is dependent on pen type and size of pen. The frame is now ready to be transported to site.

ii. **Hamster Wheel**
Place frame on its side with a teleporter. Secure the bird net to the top, and stretch out the net with the centre fixed to the top. Gradually cloak the bird net over the frame and stand the frame upright. Gather the slack and hitch bundles around the outside of the frame. The completed unit is now ready to be moved to site.

iii. **Net poles**
No shore based preparation is required; all components are prepared at sea.

3. Procedure for installation at sea:

i. **Pepper Pot**
Firstly, remove old net if required. Lift pepper pot into pen with crane, ensuring required number of ropes are secured to the frame. Topple the frame with ropes attached on its side inside the pen. Drape the bird net over the toppled frame, and secure at the top. Lift the frame upright, and move into position in centre of pen. Secure bird net to hand rails and stanchions.

ii. **Hamster Wheel**
Lift the prepared support and net into the pen. Once in centre, a diver swims out to detach ropes holding slack, and staff on walkways pull net, securing it to the handrails.
If a net requires replacing at sea, ropes are detached from handrails and old net is lifted into boat. The new net is then lifted in, and gently draped over the frame with suitable ropes. Staff at either end of pen pull the new net across at a 180 degree angle to each other. The new net is then secured to the hand rail and stanchions.

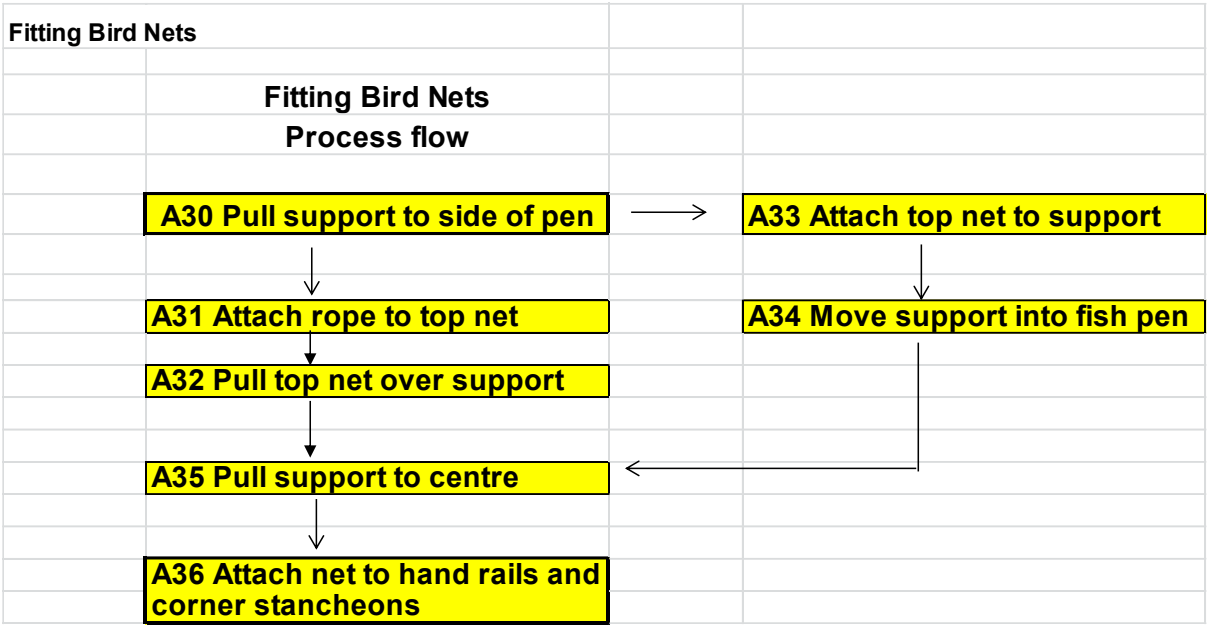
iii. **Net poles**
Using the appropriate brackets fit the flexible poles to the pen stanchions. The number of poles used is relevant to the size of the pen (16-22). The pre-prepared net and associated net will then be installed over the pen and the pole ropes attached to the net. When all the ropes are connected, tighten to the appropriate strain, ensuring the top net is taught and clear of the water.

4. HES:

Ensure appropriate PPE is worn. Observe manual handling procedures. Follow working at height procedures.

5. Safety Risk Assessment and Process Flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Location and process	Ireland / Net Management / Net Handling	**Document category**	Procedures
Last approved date	08/10/2012 (Harry Boyce)	**Last revision date**	19/02/2019
Date changed	04/10/2012 (McManus, Catherine)	**Next revision date**	20/06/2023

Net Strength Test Procedure:

1. Scope:

All Pen nets destined for Sea deployment must have the strength of mesh twine tested after purchase and after each net wash, at Scraggy Net Maintenance Station.

2. Equipment:

Dynafor /Model LLX L.C.D load indicator.

3. Procedure:

3.1 Switch on the Dynafor load indicator computer. Display should read “0.0”. Press right hand button and display should read “Max”.

3.2 Open the release valve and push the cylinder to button

3.3 Loop the net mesh on the hooks allowing one net strand per hook.

3.4 Tighten the release valve

3.5 Proceed to pump until the mesh breaks

3.6 Read the digital output in Kg and refer to the machine manual to convert to Bar pressure. Refer to attached conversion graph supplied with the net test machine.

4. Net test points:

Carry out the test one each net in the following areas;

- Above water line
- Net middle
- Net bottom

5. Pass/Fail Criteria:

Nets are removed from use if the average net break pressure is </=40% of the original break point on the new net.

6. Records:

All readings are recorded on each net file with the average breaking strength calculated and compared to the new net breaking point. The results of all tests are filed in the Net Maintenance station and reported to the Marine Services Manager.

Records of failed net disposal and/or recycling are maintained by the Marine Services Manager.

7. Safety Risk Assessment:

Net Strength Test Procedure

Mowi Ireland

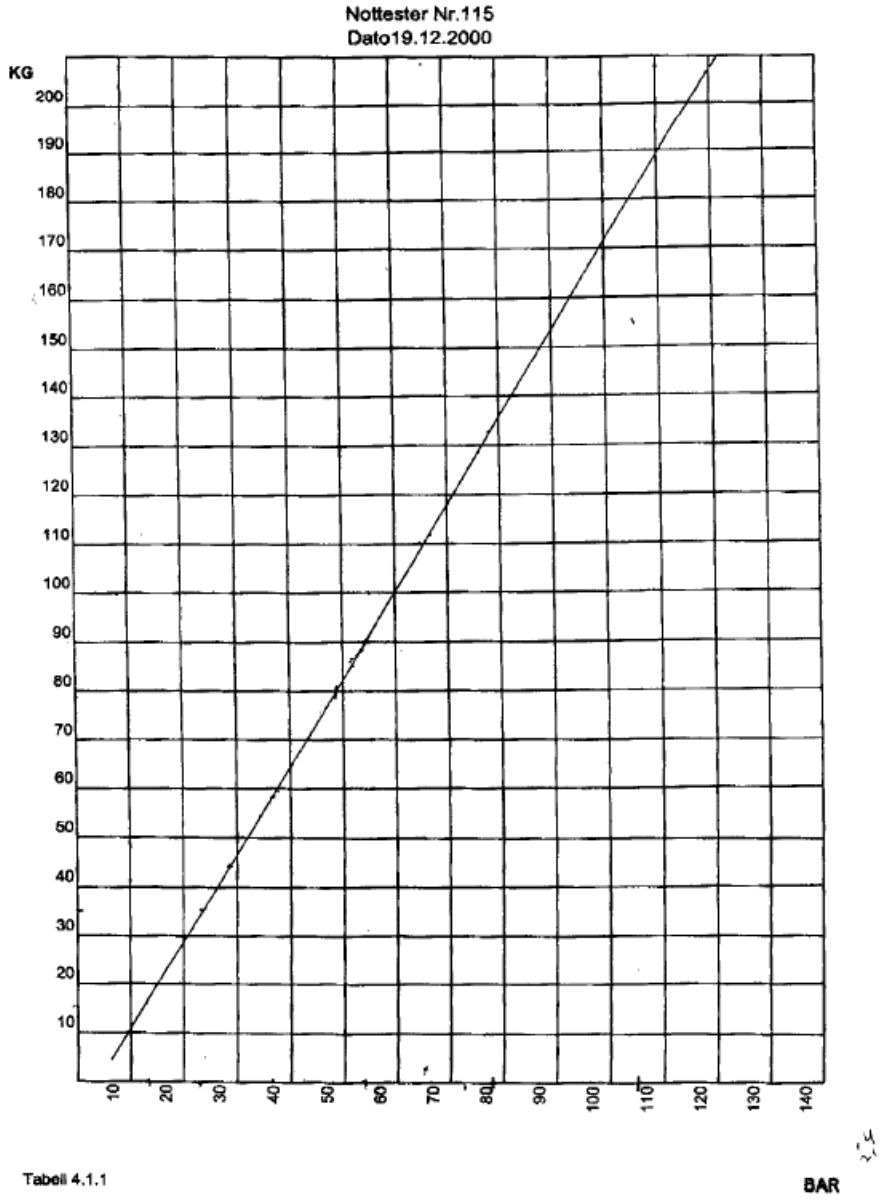
Location and process	Ireland / Net Management / Net Handling	**Document category**	Procedures
Last approved date	08/10/2012 (Harry Boyce)	**Last revision date**	19/02/2019
Date changed	04/10/2012 (McManus, Catherine)	**Next revision date**	20/06/2023

MARINE HARVEST IRELAND							**Revision Date: 2/10/12**	
Net testing				*Probability/Severity score*			*Risk Score*	
	People at Risk:	Net mending staff		Low = 1			Low = 1 - 3	
				Medium = 2			Medium = 4	
				High = 3			High = 6 - 9	
NO.	**PROCESS STEP**	**HAZARD**	**Adverse Effects**	**Probability of Occurrence**	**Severity**	**Risk Score**	**CONTROL MEASURE** (all competent staff)	**FURTHER CORRECTIVE ACTION**
1	Open valve & push cylinder to bottom	Manual handling Hand trap sharp edges Posture	Back/shoulder injury Crush injury Cuts to limbs Back strain	1 1 1 1	2 2 2 2	2 2 2 2	Manual handling training Manually operated, gloves Inspections, gloves, first Aid, maintenance Manual handling training, light weight equipment	None required
2	Attach mesh to hooks	Dirty net Sharp edges Ropes on floor	Infection Cuts to limbs trip/fall	1 1 1	2 2 2	2 2 2	Disinfection, gloves, first aid Housekeeping, supervision Housekeeping, supervision	None required
3	Pump cylinder till mesh breaks	Hand trap sharp edges Manual handling Ropes	Crush cuts to limbs Back/shoulder injury trip/Fall	1 1 1 1	2 2 2 2	2 2 2 2	Manually operated, gloves Inspections, Gloves, maintenance, First Aid Manual handling training Housekeeping, supervision	None required
4	Remove mesh and store equipment	Manual handling Sharp edges Ropes on floor	Back/shoulder injury cuts to limbs trip fall	1 1 1	2 2 2	2 2 2	Manual handling training Inspections, Gloves, maintenance, First Aid Housekeeping, supervision	None required

Net Strength Test Procedure

Mowi Ireland

Location and process	Ireland / Net Management / Net Handling	**Document category**	Procedures
Last approved date	08/10/2012 (Harry Boyce)	**Last revision date**	19/02/2019
Date changed	04/10/2012 (McManus, Catherine)	**Next revision date**	20/06/2023



Tabell 4.1.1

Location and process	Ireland / Net Management / Net Washing and Disinfection	**Document category**	Procedures
Last approved date	26/01/2022 (Patrick Shovelin)	**Last revision date**	26/01/2022
Date changed	25/01/2022 (Patrick Shovelin)	**Next revision date**	08/06/2023

Net Washing and Disinfection:

1. Scope:

After nets have been removed from a pen and taken in from sea, the dirty net must be washed and disinfected before repair and before it can be used at sea again. Donegal nets are washed at Scraggy Bay; Clare Island & OBB nets at Cloughmore; and South West nets at Dinish Yard. No antifoulants are used on any nets owned by Mowi Ireland.

2. Procedure:

2.1 Nets shall be lifted from the lorry/trailer using a crane or a hydraulic powered hauler fitted to a forklift. Please refer to the handling nets procedure and procedure for fitting hauler to fork-lift.

2.2 Place the net in selected net washer using the crane/hauler and approved slings.

2.3 To transfer a net to a washing drum, open net washer door and safety gate. Move the forklift/crane next to the net washer then lift net above net washer. Unwind the net into drum and close safety gate and lids.

2.4 For all large net washing drum, lift the net above the drum with crane/forklift. Unwind/lower the net into washer. Close net washer door, close gate, remove sign from controls and select washing cycle.

2.5 Depending on fouling, the net is washed for 1 hour minimum and 2 hours maximum. Disinfectant is added to the net washing drum for the final 15 minutes of the net washing cycle.

2.6 Remove the net from the net washer and untangle the net. Record the net number on the net files and add a white tag to identify each individual net.

3. Records:

Please record all details on Net Washing & Disinfection Record.

4. Storage:

Nets must be rolled up properly or put into net bag to ensure easy changing on site. The white tag attached to net must state net number.

5. Washer Maintenance:

Washing machines must have the nipples greased monthly. Checks of net washing drums must be recorded on the attached record ‘Net Washing Machine Checklist’.

6. HES:

Wear appropriate PPE. Manual handling procedures must be observed at all times. Observe SDS precautions when handling disinfectant.

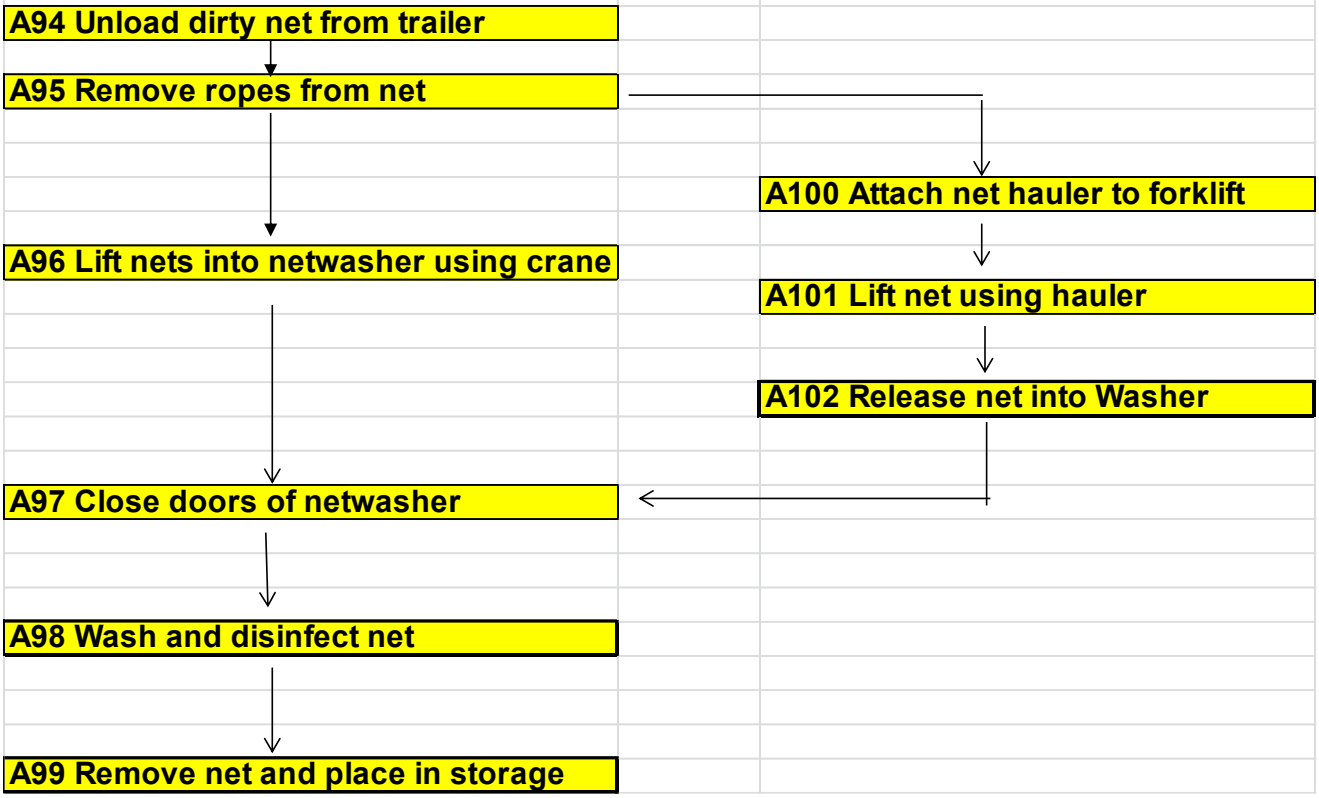
7. Safety risk assessment:

Net Washing and Disinfection

Mowi Ireland

Location and process	Ireland / Net Management / Net Washing and Disinfection	**Document category**	Procedures
Last approved date	26/01/2022 (Patrick Shovelin)	**Last revision date**	26/01/2022
Date changed	25/01/2022 (Patrick Shovelin)	**Next revision date**	08/06/2023

Net Washing & Disinfection
FLOW DESIGN



Net Washing and Disinfection

Mowi Ireland

Location and process	Ireland / Net Management / Net Washing and Disinfection	**Document category**	Procedures
Last approved date	26/01/2022 (Patrick Shovelin)	**Last revision date**	26/01/2022
Date changed	25/01/2022 (Patrick Shovelin)	**Next revision date**	08/06/2023

Marine - Net Washing				***Probability/Severity score***			***Risk Score***	
	People at Risk:			**Low = 1**			**Low = 1 - 3**	
		Marine staff	Crane Driver	**Medium = 2**			**Medium = 4**	
		Net Maintenance staff	Truck driver	**High = 3**			**High = 6 - 9**	
NO.	**PROCESS STEP**	**HAZARD**	**Adverse Effects**	**Probability of Occurance**	**Severity**	**Risk Score**	**CONTROL MEASURE**	**FURTHER CORRECTIVE ACTION**
							(all competent staff)	
A94	Unload dirty net from trailer	Manual handling	Manual handling injury	1	2	2	Manual handling training, crane, two staff	No further action required
		Work at height (trailer)	Fall from height	2	2	4	Safety training, supervision	Rails and steps required
		Slippery work surface	Slip/Fall	1	3	3	Protective foot wear, housekeeping	No further action required
		Uneven work surface (ropes)	Trip/fall	1	3	3	Housekeeping	Rails and steps required
								Work from ground level
A95	Remove ropes from nets	Manual handling	Manual handling injury	1	2	2	Manual handling training, Two staff	No further action required
		Weather conditions	Crush injury	1	3	3	Carry out task in good weather conditions	No further action required
		Raised loads	Knock to head/Crush injury	1	3	3	Hard hats, housekeeping, training in task, SWL	No further action required
		Falling objects	Knock to head/Crush injury	1	3	3	Hard hats, housekeeping, training in task, signs	No further action required
A96	Lift nets into netwasher using crane	Raised loads	Crush injury	1	3	3	SWL, Hard hats, Guards, supervision, signs	No further action required
		Falling objects	Knock to head/Crush injury	1	3	3	Hard hats, Housekeeping, training in task, signs	No further action required
		Weather conditions	Vehicle overturn	1	3	3	Carry out task in good weather conditions	No further action required
		Door on netwasher	Manual handling injury	1	2	2	Small hand winch, training in task, supervision	No further action required
A97	Close doors of netwasher	Manual handling	Crush injury	1	2	3	Manual handling training, small winch, crane	No further action required
		Moving parts	hand trap	1	3	3	Signs, guards, training in task	No further action required
		Slip/trip/fall	Bruising	1	3	3	Signs, supervision, rains, gantry, harness	No further action required
		Work at height (Open door)	Fall	1	3	3	Gantry, rails, harness	No further action required
A98	Wash and disinfect net	Rotating Drum	Crush/fall overboard	1	3	3	Signs, supervision, suards on hand trap, alarm	
		Spillages - Slip/fall	Bruised limbs	1	3	3	Housekeeping, containment area	No further action required
		Weight of net	Crush injury	1	3	3	Enclosed drum, trained staff, supervision	No further action required
		Manual handling of detergent	Back strain	1	3	3	Manual handling training, pump, container	No further action required
		Electricity	Electric shock/burn	1	3	3	MCB, Trip switch, insulation, inspections	No further action required
		Dilutuion of detergent- splash	Skin/eye irritation	1	3	3	Gloves,goggles, supervision	No further action required
		Moving parts	Hand trap	1	2	2	Guards, rails, signs, gantry, alarm	No further action required
		Disinfectant splash	Skin/eye irritation	1	3	3	PPE, Supervision. Chemical training	No further action required
		Disinfectsnt spill	Skin/eye irritation	1	3	3	PPE, Supervision. Chemical training, spill kit	No further action required
		Fumes from disinfectant	Inhalation	1	2	2	Well ventilated area, PPE, supervision	No further action required
A99	Remove net and place in storage	Moving machinery	Crush injury	1	3	3	Alarm, flashing light, trained staff, supervision	No further action required
		Raised load	Crush injury	1	3	3	SWL, Hard hats, Guards, supervision, signs	No further action required
		Strap breaking	Crush injury	1	3	3	Tested straps, inspections, hard hats	No further action required
								No further action required
A100	Attach net hauler to forklift	Moving parts	Hand trap	1	2	2	guards, enclosed parts	No further action required
		Oil leaks	skin irritation/dermatitus	1	2	2	Inspections, spill kit, oil spill training	No further action required
		Equipment falling from stand	Crush injury	1	3	3	Supervision, trained drivers, signs	No further action required
		Moving machinery(forklift)	Crush injury	2	2	4	Alarm, flashing light, trained staff, supervision	Hauler not big enough
A101	Lift net using hauler	Moving machinery(forklift)	Crush injury	1	3	3	Alarm, flashing light, trained staff, supervision	No further action required
		Raised load	Crush injury/knock to head	1	3	3	SWL, Hard hats, Guards, supervision, signs	No further action required
		Falling materials	Knock to head	1	3	3	Hard hats, supervision, signs, inspections	No further action required
		Oil leak	Skin irritation/dermatitus	1	2	2	Inspections, spill kit, oil spill training	No further action required
		Moving parts	Hand trap	1	2	2	guards, enclosed parts	No further action required
A102	Release net from hauler into netwashe	Moving machinery(Forklift)	Crush injury	1	3	3	Alarm, flashing light, trained staff, supervision	No further action required
		Raised load	Crush injury/knock to head	1	3	3	SWL, Hard hats, Guards, supervision, signs	No further action required
		Falling materials	Crush/knock to haed	1	3	3	Hard hats, supervision, signs, inspections	No further action required
		Moving parts	Hand trap	1	2	2	guards, enclosed parts	No further action required

Net Washing and Disinfection

Mowi Ireland

Location and process	Ireland / Net Management / Net Washing and Disinfection	**Document category**	Procedures
Last approved date	26/01/2022 (Patrick Shovelin)	**Last revision date**	26/01/2022
Date changed	25/01/2022 (Patrick Shovelin)	**Next revision date**	08/06/2023

Total Assessed Risk = Likelihood x Severity

Likelihood	Severity
1 = Unlikely event: Once every year	1 = Negligible. No Impact or not detectable
2 = Occasional event: Once per month	2 = Significant: impact on critical limits
3 = Frequent event: Once per day	3 = Critical: public health risk, public product recall.

	Severity		
Likelihood	1	2	3
1	1	2	3
2	2	4	6
3	3	6	9

Low Risk = 1 - 3
Medium Risk = 4
High Risk = 6 - 9

Low Risk - These risks are considered acceptable. No further action is necessary other than to ensure that the controls are maintained.

Medium Risk - Consideration should be as to whether the risks can be lowered, where applicable, to a tolerable level and preferably to an acceptable level, but the costs of additional risk reduction measures should be taken into account. The risk reduction measures should be implemented within a time period.

High Risk - Substantial efforts should be made to reduce the risk. Risk reduction measures should be implemented urgently within a defined time period and it might be necessary to consider suspending or restricting the activity, or to apply interim risk control measures, until this has been completed. Considerable resources might have to be allocated to additional control measures.

Appendix 2.3

Fish Movements & Husbandry

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	14/07/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	13/07/2017 (Michelle Hay)	**Next revision date**	12/11/2023

Smolt Transfer to Sea:

1. Scope:

S1 smolts are transferred from freshwater units to sea sites during January/February/March/April of each year, while S0 smolts are transferred during September/October/November. Smolts may be transferred by means of truck and boat, helicopter or live fish carrier (wellboat).

2. Records:

All details are recorded on the attached ‘Smolt Transfer Sheet’ by freshwater staff. Checks are also carried out during loading in the relevant freshwater unit and again at the pier where unloading to a wellboat or tanks take place. Details are filled in on the attached ‘Smolt Transfer Checklists’. Copies of these documents are kept at the relevant technical offices.
It is the responsibility of the marine manager to ensure completion of checklists.
Certificates of cleaning and disinfection for any method of transport must be obtained from the freshwater manager or hauler/skipper prior to movements.

3. Truck/Boat Transfer Method:

Smolts are delivered from the freshwater unit in an oxygenated road tanker.
Fit transport tank onto raft or boat. Half fill tank with fresh sea water and oxygenate. Prepare the smolt pen by fitting it with appropriate sized net, bird net and supporting frames.
Position the end of a 6inch hose pipe close to the centre of the pen, with an angle to water surface of less than 45 degrees. Attach pipe to fish pump (if necessary). Transfer the smolts via the hose from the road tanker to the seawater tank on board the raft/boat. Place a top net on the destination pen in order to protect the smolts from bird predation.

4. Helicopter Transfer Method:

Prepare receiving pen as above. The smolts are loaded from freshwater tanks on trucks into a bucket of fresh oxygenated seawater, attached to helicopter.
On arrival at the sea site the helicopter positions itself above the recipient pen. The pilot then lowers the bucket to the water surface allowing it to touch the water. This triggers an automatic release mechanism which tilts the bucket allowing the fish to spill into the pen. During the helicopter’s trip to the destination pen, another bucket is filled on shore and prepared for the return of the helicopter.
Place a top net on the destination pen in order to protect the smolts from bird predation.

5. Wellboat Transfer Method:

Prior to loading, a disinfection certificate must be obtained from the wellboat operator/skipper and water quality must be sampled/checked. Smolts are delivered to pier/moored location of wellboat by trucks. Attach a discharge hose from the freshwater tanker to the wellboat and empty contents of the tanker.
When the wellboat is loaded, travel to destination site and moor alongside prepared pen. Lower in the discharge hose and unload smolts. Count if weather conditions permit.
Place a top net on the destination pen in order to protect the smolts from bird predation.

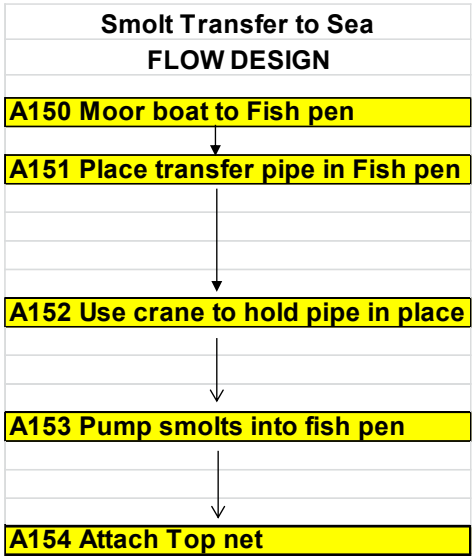
Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	14/07/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	13/07/2017 (Michelle Hay)	**Next revision date**	12/11/2023

6. HES:

Ensure appropriate PPE is worn. Observe working at heights and manual handling procedures.

7. Safety risk assessment and process flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	17/11/2020 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	12/11/2020 (Michelle Hay)	**Next revision date**	12/11/2023

Fish Sample Weighing & Biomass Estimation:

1. Scope:

In order to monitor stock development, pens are sample weighed to view their progress and advise on feed size changes etc. One of two methods may be employed to estimate the average weight of a batch or pen of fish. Ideally one of these methods should be employed at least monthly on each generation of fish. Where high water temperatures or health problems exist, the average weight will be estimated by Aquafarmer growth model, using weekly feed data.

2. Sample Frequency:

All site pens should be manually / individually sampled weighed at least five times in their life cycle.

3. Records & reporting:

Record results on the attached sample weighing sheet and save in V:\Region\Sitename\crop and mail to the Marine Operations manager and Sean Begley & Sales Office.

4. Materials required:

- Box net, sweep net
- Safety Net between boat and fish pen
- 10” delivery pipe for fish
- Ocean compensating scales
- Hand net
- Tricaine solution
- Large sampling bin

5. Individual Weighing Procedure:

5.1. Drop sample net into selected pen whilst securing all 4 corners. Allow net to settle.
5.2. Attach safety net between the boat and the fish pen.
5.3. Attach delivery pipe between fish pen and sample bin.
5.4. Scatter some feed pellets over the net to draw fish in. Quickly draw up the net through the pen to the surface. Secure net to hand rails.
5.5. Using a hand net, sweep out a small batch of fish into the Tricaine bath, ensuring the bath is not overcrowded. Allow fish to quieten before handling. Do not leave fish in the bath for longer than 5 minutes. A minimum of 60 fish should be sampled per pen, depending on the grade.
5.6. Place individual fish in cradle on scales and allow to settle. Record weight on the sample weighing sheet. Results are processed on computer in the marine office and notified as above.

6. Batch Weighing Method:

6.1. Weigh a sample bucket/bin containing a Tricaine bath and tare.
6.2. Hand net a number of fish into the bath and re-weigh = W.
6.3. Count fish as they are returned directly to the pen = N.

Average Weight = W/N.

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	17/11/2020 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	12/11/2020 (Michelle Hay)	**Next revision date**	12/11/2023

7. HES Precautions:

Wear appropriate PPE, including gloves when handling anesthetised fish. Observe manual handling procedures. Consult SDS sheet for Tricaine handling. **Observe withdrawal for Tricaine.**

8. Safety risk assessment & Process Flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.

Sample weighing flow design

A25 Use sweep net or Box net to catch fish for sampling
A26 Set up safety net between Pen and sample boat
A27 Weigh a minimum of 50 individual fish from each Pen
A28 Return fish to Pen in a safe manner
A29 Remove sweep net from pen

Passive Grading **Mowi Ireland**

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	09/05/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	08/05/2017 (Michelle Hay)	**Next revision date**	12/11/2023

Passive Grading:

1. Scope:

Passive grading is carried out on site to ensure larger fish are selected for harvest and to therefore optimize growth of smaller fish in the selected pen. The size of panel/grader is selected dependent of fish size and sales requirements.
Fish should not be fed on the day of grading.

2. Deploying grader/panel into pen:

Moor boat up to the selected pen, in the ‘up current’ position. Lift grader from boat into pen with crane/winch. Hook onto handrail/stanchions and temporarily secure. Move boat to opposite side of pen.
Lift main net in pen with crane/winch, by means of down ropes. Lift net so that floor is sloping on the side to which the boat is tied. Ensure that divers monitor the grading net as it’s coming across.

3. Grading fish:

Unhook the panel/grader, and with 2 ropes attached to each side of panel, and 1 in the centre, gently pull towards the boat using winch/crane in the down current direction, regularly slackening temporarily. When the required tonnes/fish have swam through the grader, insert float line around the grading net (See TQM Doc 31024), load fish and move to another pen or load onto wellboat.

4. Removing grader/panel:

Unhook/ remove grading panel from pen, onto deck of boat and pack away for storage on shore.

5. Records:

Record all details of grading and any further movements on the ‘Marine Movements and Grading Log’. This is then sent to relevant marine office for filing.

6. HES:

Ensure appropriate PPE is worn. Observe manual handling procedures.

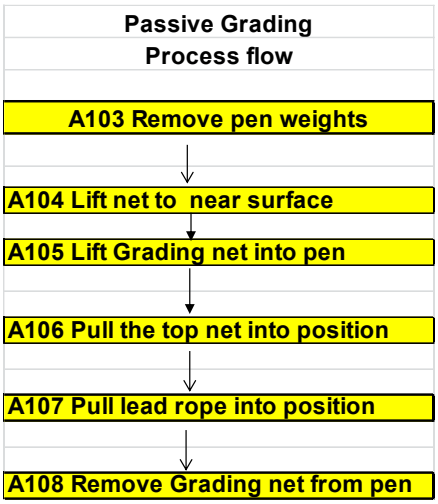
7. Safety risk assessment:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.

Passive Grading

Mowi Ireland

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	09/05/2017 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	08/05/2017 (Michelle Hay)	**Next revision date**	12/11/2023



Location and process	Ireland / Marine Production / Feeding	**Document category**	Procedures
Last approved date	09/11/2022 (Joseph Gibbons)	**Last revision date**	09/11/2022
Date changed	09/11/2022 (Patrick Shovelin)	**Next revision date**	03/11/2023

Feeding of Fish

1. Scope:

This procedure outlines a number of feeding methods for fish in seawater. Choice of method will depend upon site location and feeding equipment available. The principal feeding methods are automatic feeding by means GMT, Akva and Stenvik feeding systems.

2. Records:

Daily feed amounts are recorded on the attached daily feed sheet. Where an automatic feeding system is in use, the auto feeder correction and adjustment sheet must be used to account for any errors. Feed sheets and associated records should be returned to the relevant marine/technical offices by Thursday evening/Friday morning of each week.

3. Responsibility:

The feed monitor is responsible for all aspects of feeding, records, stock taking and reporting of feed or feeding problems. In their absence, the site manager must appoint a suitably trained staff member.

4. Automatic Feeding Systems:

- Loading of feed silos:
  Bulk (1000Kg or 500Kg) bags are loaded into the feed silos by means of a crane. Bags are lifted using the attached lifting straps. Suspend bags over blower hopper. Lower bulk bag onto the bag cutter and allow feed to spill into hopper.
  25Kg bags are manually poured into the hopper.
- Operation of Automatic Feeding System:
  Switch on feeding system computer. For each new pen, input total fish number, average weight, sea water temperature and expected feed rates based on appetite.
  Input daily seawater temperatures and deduct mortality and harvest numbers where applicable.
  Visual feed observations should be monitored closely at each meal, or with cameras. Please refer to procedure for operating cameras.
- Check spinners to ensure an even distribution of feed into the pen.
- To calibrate a feeding system, calculate a feed correction value using the auto feeder correction sheet (attached).

5. Air/Cyclone Feeding Systems:

Load 25Kg/500Kg/1000Kg bags onto boat housing the cyclone system by means of crane or forklift. Moor the prepared boat at the required pen. Empty required feed into the cyclone hopper. The hopper is marked at intervals inside, in order to gauge the quantity of feed fed.
Switch on feeder to create an air flow throughout the hopper to blow feed out through a pipe into the recipient pen.

6. Hand Feeding:

Hand feeding is used under the following circumstances:

- Smolts, depending on appetite, up to 2 months after transfer to sea
- Small amounts of Medicated feed.
- Low appetite fish such as Broodstock, grilse and recovering grilse
- To spot check pens for appetite
- To supplement automatic feeding under unfavourable wind or current conditions

In order to ensure an even distribution of feed in a pen, scoop feed towards the up-current and upwind end of the pen. Record quantity of feed used.

7. Waste Feed:

As waste feed/out of date feed is classified as Category 2 waste under the animal by-product regulations, it can be sent to an approved rendering facility for disposal.

Any waste medicated feed is classified as Category 1 waste under the animal by-products regulations, it can be sent to an approved rendering facility for disposal.

8. HES:

When loading bulk bags into hoppers, hard hats must be worn. Opening of bulk bags must be carried out by remote means. Where this is not available, cut bag with long shafted knife. **Never reach under bags to open.** Manual handling procedures must be observed at all times. Wear appropriate PPE, including ear protection when necessary.
Follow confined space guidelines if entering feed silos.

9. Safety risk assessment & Process Flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.

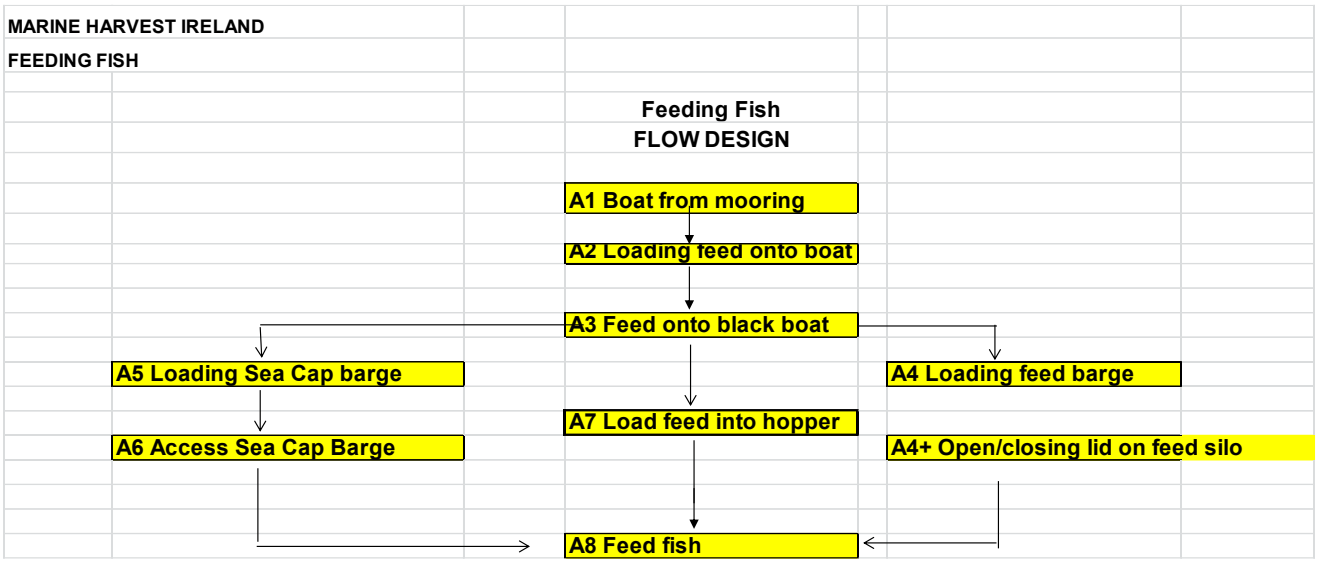
Feeding of Fish (2)

Mowi Ireland

Location and process	Ireland / Marine Production / Feeding	**Document category**	Procedures
Last approved date	09/11/2022 (Joseph Gibbons)	**Last revision date**	09/11/2022
Date changed	09/11/2022 (Patrick Shovelin)	**Next revision date**	03/11/2023

MARINE HARVEST IRELAND

FEEDING FISH



Location and process	Ireland / Marine Production / Wellboat Operations	**Document category**	Procedures
Last approved date	17/11/2020 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	06/02/2019 (Patrick Shovelin)	**Next revision date**	12/11/2023

Fish Grading using a Well boat:

1. Scope:

At Mowi Ireland fish stocks are usually graded at 6 to 14 months after transfer to sea. The objective of fish grading is to produce pen populations of large and small grades and in some cases to reduce stocking density. Fish may be counted during grading if required.

2. Records:

Record all details on the 'Marine Movements and Grading Log' attached to this procedure – document no. 23010. It is the responsibility of the Site Manager to ensure that grading records are completed and signed. Ensure a record of cleaning and disinfection is obtained from the wellboat skipper upon arrival at site.

3. Precautions:

Fish must be starved a minimum of 3 days prior to any well boat handling.

4. Method of Operation:

The percentage breakdown of size grades can be manipulated by slight adjustment of the bar spacing through which the smaller fish fall. At the time of grading the numbers of fish in each pen and thus the stocking density can be adjusted using the bar spacing.

Use a sweep net or a float line to crowd fish close to the side of the pen to which the well boat is tied. Please refer to procedure for crowding fish (TQM 31024).

- When using a sweep net, lift a full pen net to a depth which allows crowding of fish without obvious signs of stress. Lower the sweep net into the water on the opposite side of the pen to the pump/siphon. Haul the sweep net slowly across the pen, gently crowding fish. Secure sweep net to pen rail and reduce volume to a safe working load.
- If using float line, introduce one end of the float line on the outside of the net until it surrounds the net at water level. Gradually pull the line towards the pump/siphon, allowing excess net to fall back over the float line. The fish are finally crowded into a narrow but deep pocket, avoiding entanglement in the net.

The crowded fish are brailed or pumped/siphoned into the hopper of the grader where they are graded into large and small grades. At broodstock grading, mature fish are removed manually via a fibre glass hopper branching into a suitable pen or transporter pen.

Dissolved oxygen levels must be monitored during this procedure. If any bath disinfection or treatments have been carried out in the wells, observe the relevant procedures and complete accompanying records.

5. HES:

Wear hardhats, gloves, and all other appropriate PPE. Observe manual handling and working at height procedures. Be aware of weather forecast prior to carrying out task.

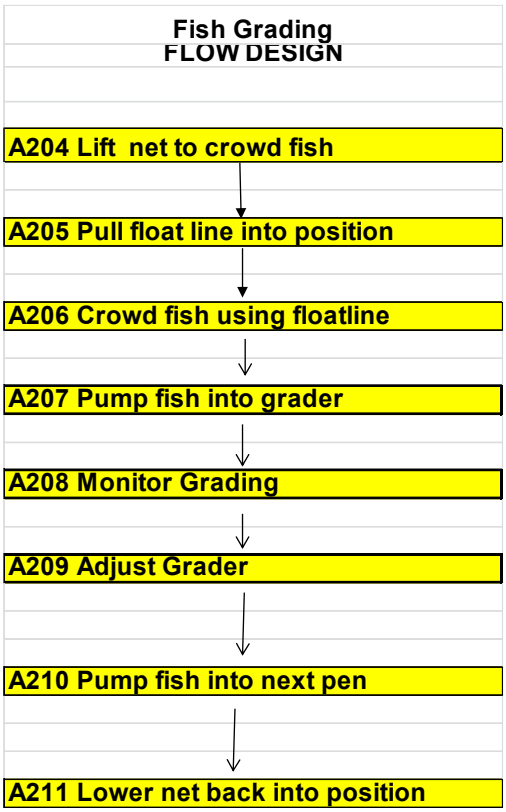
Fish Grading Using Wellboat

Mowi Ireland

Location and process	Ireland / Marine Production / Wellboat Operations	**Document category**	Procedures
Last approved date	17/11/2020 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	06/02/2019 (Patrick Shovelin)	**Next revision date**	12/11/2023

6. Safety risk assessment & process flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Location and process	Ireland / Harvesting / Operational Procedures	**Document category**	Procedures
Last approved date	10/11/2022 (Joseph Gibbons)	**Last revision date**	26/10/2022
Date changed	26/10/2022 (Patrick Shovelin)	**Next revision date**	27/10/2023

Harvesting Fish at Sea

1. Scope:

The following SOP details the methods used by Mowi Ireland for harvesting fish at sea. Fish are crowded and pumped live onto a harvest vessel. The fish are percussion stunned and bled on board. All fish are transported in the hold with slush ice in order to facilitate cooling. Fish are pumped into tankers at the pier and are dead hauled to the processing plant.

2. Records:

Record all details on the 'Daily Harvest Record' sheet (organic TQM 29248 or premium TQM 38836), which accompanies each batch of fish from the harvest site to the processing plant.

3. Precautions:

Fish must be starved a minimum of 3 days prior to harvest. Fish must only be harvested from one site at a time.

4. Harvesting Procedure:

4.1. Fish are crowded as directed in TQM 31024 Procedure for Crowding Fish. Fish are taken onboard through the fish suction pipe.

4.2. Fish are pumped out of the pipe over a dewatering unit, where the fish slide into the orientation tank and excess water is diverted back into the sea.

4.3. The amount of fish in the orientation tank is controlled by the operator managing the pump adjacent to the harvest line. A current of water pumped from the stunners entices the fish to swim into the stunner. Harvest staff also help to orient the fish so that they enter the v channel of the chutes correctly.

4.4. From the channel the fish are stunned and bled automatically. This is a pneumatic system where the fish swim into the SI7 stunner, the fish are stunned by a pneumatic blow to the head and are bled by a pneumatic knife which is attached below the stunner.

4.5. Post stunning and bleeding, the fish can be inspected on a stainless-steel tray/table. If a fish has not been stunned, the procedure for Ineffective Stunning (TQM 41692) must be followed. The first 100 fish when starting harvesting and after each break in harvesting must be checked as per Stun and Bleed Procedure for Sea Site Harvesting Unit (TQM 40958) to ensure effective stunning occurs.

4.6. Stunned and bled fish are moved along the table and drop down a chute into the holding tank.

4.7. Once the harvest volume is reached, the sweep is released and the pipe is removed from the pen.

5. Loading Tanker:

5.1. Fish are pumped from the hold to a tanker. Fish cross over a dewatering unit which returns the blood water to the vessel's hold and the fish slide down a chute into the tanker which already contains a mix of water and ice.

5.2. A staff member monitors the operation from the top of the gantry/tanker and signals to the boat pump operator when to stop loading.

5.3. After loading the fish the tanker is filled to the top with salt water, this ensures the tanker is stable and prevents the load from splashing around inside the tanker during transport.

5.4. The load details are completed in duplicate to send one copy with the tanker and one copy is retained in the office.

5.5. The tankers are sealed, and security tagged before departure from the pier.

6. Health and Safety:

6.1. Wear appropriate PPE, lifejacket, and ear protection while harvesting.
6.2. Follow working at height policy for loading tankers.

7. Risk Assessment Process Flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.

Process Flow

Harvesting Fish

A348 Pump Fish From Pen
A349 Orientation
A350 Stun & Bleed
A351 Visual Inspection **Back-up Stunner**
A352 Pump Fish To Road Tanker
A353 Top-Up & Close Tanker

Mooring Feed Barge **Mowi Ireland**

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	17/11/2020 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	12/11/2020 (Michelle Hay)	**Next revision date**	12/11/2023

Mooring a Feed Barge:

1. Scope:

Feed barges are used to store feed, house automatic feeding systems and in some cases staff facilities. Depending on the site characteristics the number of anchors required and specifications may vary.

2. Procedure:

2.1 Ensure feed barge is towed into the appropriate selected position; a position is selected according to pen layout, prevailing winds and site characteristics and in accordance with site technical drawings.

2.2 Shackle chain on to mooring points of bollards on barge by constructing a figure of eight from the chain and connect back in to the chain with suitable shackle. Otherwise shackle the chain in to the mooring eye on the corner of the barge, secure to bollards.

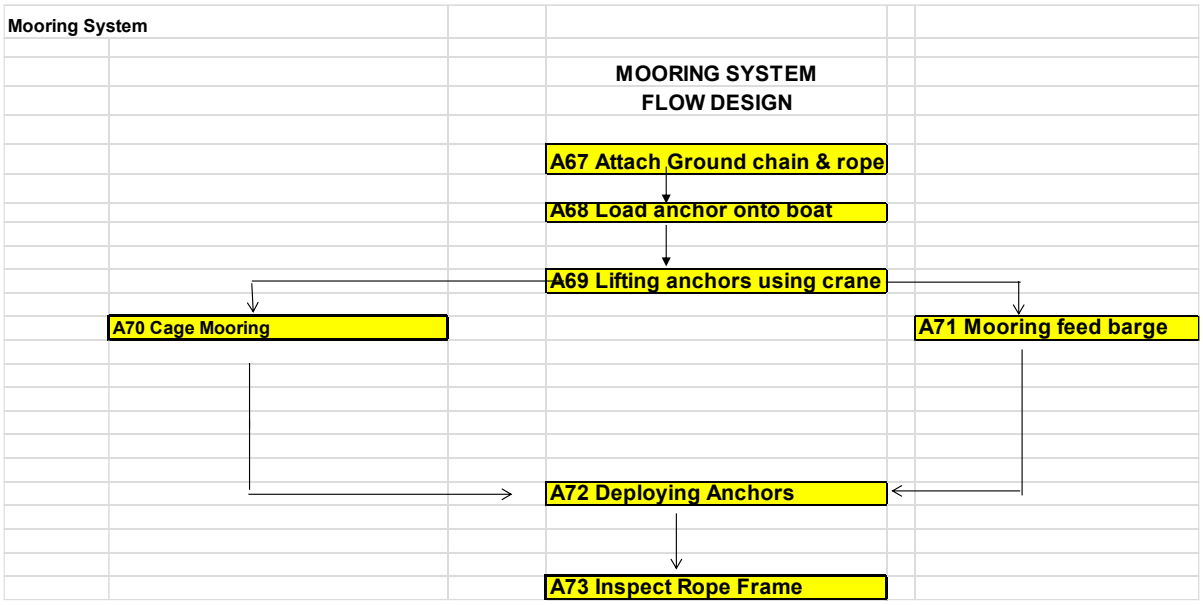
2.3 Deploy required number of anchors attached to chain, usually four or more anchors needed depending on site, location and seabed. Allow the chain to release slowly and the anchor to drop using winch, until it has reached the sea bed.

3. HES:

Wear appropriate PPE. Slings are used to lift chain. Operate in favourable weather and tidal conditions. Observe manual handling procedures.

4. Safety risk assessment & process flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Location and process	Ireland / Policies / Feed Sustainability	**Document category**	
Last approved date	02/01/2019 (McManus, Catherine)	**Last revision date**	15/08/2019
Date changed	02/01/2019 (McManus, Catherine)	**Next revision date**	31/01/2023

Mowi Ireland Policy on Sustainable Salmon Feed

When considering the Life Cycle Assessment of salmon farming, feed remains the largest contributor to environmental footprint. Sourcing sustainable feed ingredients is therefore a top priority to Mowi to be a front runner in environmental responsibility. Over the last 10 years the salmon industry and Mowi has been able to reduce the dependency of marine raw materials (fish meal and fish oil) in salmon feeds by ca 50%. This was possible due to a significant replacement of marine raw materials with vegetable sources in the salmon diets. Such improvement brings new challenges such as the use of sustainably sourced vegetable ingredients and a continuous effort to source marine ingredients from sustainable fisheries.

Mowi's policy regarding sustainable salmon feed applies to both external feed suppliers and to our own internal production (Mowi Fish Feed):

1. All ingredients used in salmon feed (marine and non-marine) should have a traceability system in place. This should include as a minimum the volumes per species, country of origin and fishery for marine ingredients including those originated from trimmings and volumes per species and region grown for vegetable ingredients;

2. Marine raw materials should not origin from IUU (Illegal, Unregulated and Unreported) catch or from fish species classified as endangered by the International Union for the Conservation of Nature (IUCN) red list;

3. Marine raw materials should be sourced from suppliers who adhere to responsible environmental management of pelagic fisheries. This means sourcing fish meal and fish oil from certified sources such as IFFO RS approved fisheries, MSC or equivalent recognized standards. In addition, the Fish Source Score for each individual fishery providing the marine raw materials should be ≥6;

4. Mowi supports efforts to increase purchases of sustainably sourced vegetable raw materials, e.g. soymeal certified under the Roundtable for Responsible Soy (RTRS) or equivalent. Feed suppliers should therefore be a member of the RTRS and be able to supply increasing volumes of certified soy;

5. In the future, when expanding the portfolio of non-marine raw materials used in our feed we will continue to support the inclusion of ingredients that originate from verified sustainable sources. If palm products are used they should come from certified sources such as the Roundtable on Sustainable Palm Oil (RSPO) and Green Palm;

6. Feed suppliers should be as a minimum Global GAP certified by an accredited certification body (CB).

7. Organic feeds must conform and be certified to the animal feed requirements of EU Organic regulations 834/2007, 889/2008 and 710/2009.

Use of Fish Transporter (1) **Mowi Ireland**

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	09/11/2022 (Joseph Gibbons)	**Last revision date**	09/11/2022
Date changed	09/11/2022 (Patrick Shovelin)	**Next revision date**	03/11/2023

Use of Fish Transporter:

1. Scope:

The following SOP details the steps in using the transporter to transfer fish between pens on site, usually at Millstone or Broodstock.

2. Preparation of Donor Pen:

All weights must be lifted and the net secured up in position. The net is ‘V’d’ into one point, to allow enough slack for the net to move underneath pen rings/walkway.

Tow the transporter into place using boat and secure to donor pen. The slack of the net is fitted into the loading door of the transporter and dropped into the channel.

The remaining slack/surplus net must be secured to handrail or walkway to prevent fish escapes during loading.

3. Loading Transporter:

The transporter net is tightened down into place using a closed-loop rope. Using the floatline, gently pull fish forward (using crane or winch) towards the loading point of the transporter.

Allow the fish to swim through, taking care not to overcrowd. Once the required volume of fish is in the transporter, slowly lower the closing gate, eventually closing the channel. Secure with rope.

The loading door of the transporter is then raised, taking care not to release the slack net. The donor net is removed from the door and is secured back to the donor pen.
Tow transporter to receiving pen.

4. Discharge at Receiving Pen:

The net of the receiving pen is ‘V’d’ into a point, and slack is taken underneath walkway. Repeat the above process as with preparation of donor pen.

Once the gate has been opened, allow fish to swim to receiving pen. The net on the transporter is lifted using a closed loop rope from front to back to ensure all fish swim through and are not trapped. Once fish have been received to pen, secure net back to pen, remove transporter and moor whilst not in use.

5. Precautions and HES:

Take care that fish are not stressed during loading, unloading and movement. Observe manual handing procedures, wear appropriate PPE.

6. Records:

All records are stored on movement logs in V drive.

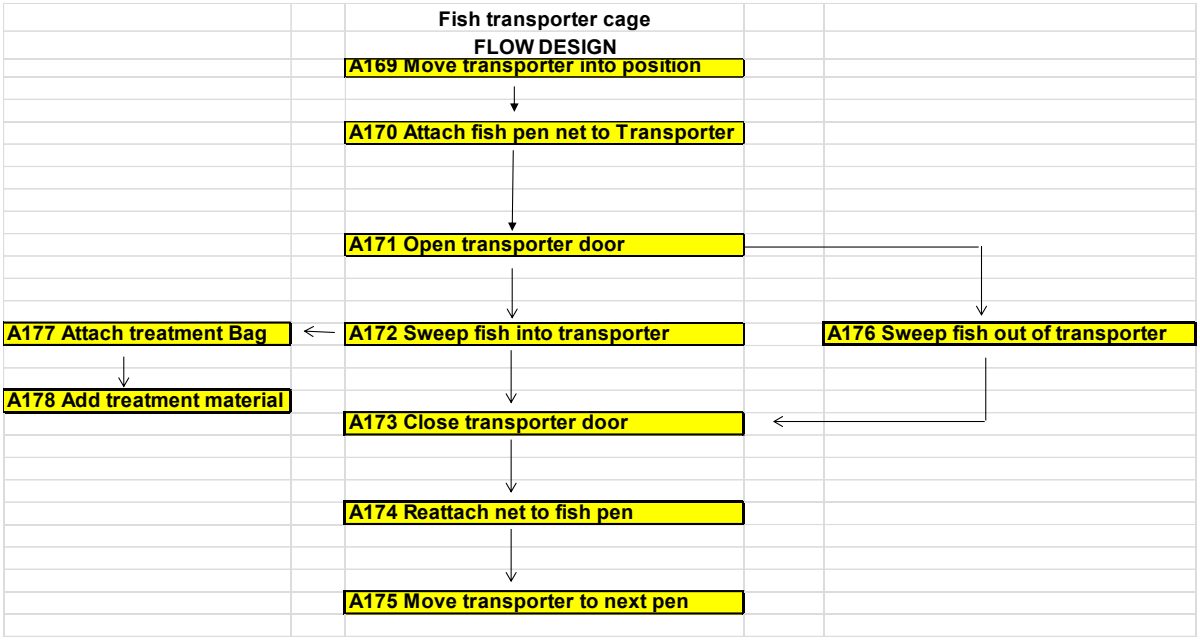
Use of Fish Transporter (1)

Mowi Ireland

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	09/11/2022 (Joseph Gibbons)	**Last revision date**	09/11/2022
Date changed	09/11/2022 (Patrick Shovelin)	**Next revision date**	03/11/2023

7. Safety Risk Assessment & Process Flow:

All marine risk assessments are available on TQM 42229. The numbers listed above in the process flow are related to this procedure.



Location and process	Ireland / Waste Management / Waste Management	**Document category**	Procedures
Last approved date	11/08/2021 (Laura Hegarty)	**Last revision date**	09/07/2022
Date changed	22/07/2021 (McManus, Catherine)	**Next revision date**	22/07/2023

Waste Monitoring & Management

1. PURPOSE

To describe the procedures for monitoring and disposal of hazardous and non-hazardous wastes produced during routine operations of Mowi Ireland (MI). Only approved waste management facilities which hold waste management and/or collection permits must be used for waste collection and disposal.

Mowi Ireland does not dump non-biological waste into the ocean.

2. RECORDS & RESPONSIBILITY:

Details of waste disposal are recorded on the Waste Movement record (Duty of Care Document). Copy attached. All site Managers must record waste moved off site on this document.

The Safety Coordinator is responsible for collating annual waste returns for submission to the Technical Manager. All waste data is collated and reported to Mowi ASA sustainability database for each quarter.

For details of approved waste contractors/recycling companies used by MI please contact the Technical Manager, the Technical Supervisor or the Marine Support Manager/Safety coordinator.

A list of approved waste handlers can be located in the TQM document database.

3. METHOD OF OPERATION

3.1 Freshwater Effluent:

All freshwater utilised in smolt production units is treated by means of drum filters. Effluent and river quality is monitored by Mowi Ireland in accordance with Donegal Co. Council requirements. Records of water/waste water production are maintained by the Site Manager.

Sludge produced during water filtration are removed periodically by a licensed waste disposal contractor for licenced land spread or anaerobic digestion.

Periodically, benthic surveys are carried up and down stream of freshwater discharge points in order to ascertain the impact of the effluent on the benthos.

3.2 Seawater Production Waste:

Key Performance Indicators for feed conversion ratios (FCR) are established for all marine production sites in order to minimise the volume of waste feed and faeces discharged to the sea and benthos. FCR records are maintained in the Mercatus Farming database.

Annual benthic surveys are carried out on all marine production sites in order to determine the extent of environmental impact and to help formulate fallowing plans. Such surveys follow at minimum the requirements of the Department of Agriculture, Food and Marine, Monitoring Protocol No. 1 for Offshore Finfish farms – Benthic Monitoring.

3.3 Domestic Sewage:

Domestic sewage produced on land-based sites is treated by means of septic tanks and/or Biocycle© systems. Floating marine staff platforms have chemical toilets. If there is a requirement to clean a septic tank or chemical toilet, the resultant sludge is removed by a licensed waste disposal contractor and licensed waste management facility. Records of sludge disposal are maintained by the appropriate site Manager.

3.4 Rinmore Effluent:

Refer to Rinmore Effluent Treatment Plant operational procedures for the treatment of blood and process wash water.

3.5 Dead Fish/Offal:

Dead fish is removed from site in accordance with Marine & Freshwater SOP's. Unless deliberately culled, routine site mortality must be sent to an approved Animal By-Product rendering plant for incineration or anaerobic digestion. Similarly, Offal and VAP waste is sent to an approved ABP facility. Offal and other Rest Raw Material (RRM) may also be sold to approved facilities for recovery of oil and protein. Records of dead fish, offal and RRM are maintained by the site Managers.

3.6 Plastics:

All production sites are required to segregate plastic waste (bags, totes, wrapping, clean ropes, pen piping) from other wastes and return to the designated waste areas for bailing/segregation. Bailed plastics are sent to approved recycling contractors who hold an up to date waste permit. Records of all such waste must be maintained.

Where possible, plastic HDPE piping is reused for repair and maintenance of pens otherwise it must be delivered to a recycling waste management facility.

3.7 Paper Waste:

Waste paper and cardboard must be segregated into bins provided on site and the contents returned to the designated Mowi waste management areas for bailing. All bailed card and paper are sent to a third party contractor for recycling. All such contractors must have a waste transport and handling permit.

3.8 Wood/Pallets:

Used pallets are returned to pallet suppliers for reuse/recycling. All pallet waste subcontractors must have a waste permit an records are maintained by the Processing Site Manager.

3.9 Pen Nets:

Pen nets which are no longer suitable for use by MI may be sold to fishermen/aqua culturists for reuse or may be donated for coastal erosion projects, woodland path maintenance etc. or for recycling through NOFIR, Norway. Evidence of such sales, donations and recycling must be maintained by the Marine Support Manager.

3.10 Metals:

Where possible, waste steel is used for in-house repair and maintenance work. Otherwise all scrap metal is collected in a skip provided by metal recycling contractors, for recycling. All contractors must hold a current waste permit.

3.11 General Waste:

Non-hazardous waste that cannot be segregated for reuse or recycling is collected at the principal production land bases. Only approved waste hauliers and handlers may transport and segregate such waste and must hold a current waste permit. Records of such waste moved off site are maintained by the appropriate Managers.

3.12 Batteries:

Waste batteries are returned to the maintenance workshops in Donegal, Mayo and Cork and stored in designated bunded areas. These are collected by an approved battery recycling company who hold a current waste permit. Records are maintained by the Maintenance Manager.

3.13 Waste oils & Oily rags/paper:

Waste oils and oily paper/rags are segregated at source and returned to regional maintenance workshops. These are collected by an approved oil recycling company who hold a current waste permit. Records are maintained by the Maintenance Manager.

3.14 Fluorescent Lights:

While the fluorescent light replacement programme is underway, all decommissioned lights are collected in a "light coffin" at the local Mowi maintenance support base, in designated waste collection areas. All waste lights are collected by an approved recycling company who hold a current waste permit. Records are maintained by the area Marine or Freshwater Manager.

3.15 Waste Electrical Equipment:

All waste electrical items must be returned to retailers/wholesalers when purchasing similar items. This is in accordance with the WEE directive.

3.16 Hazardous laboratory waste:

Refer to the “Laboratory Chemical & Disposal” Procedure in the TQM Publishing Database.

3.17 Waste mobile phones & printer Cartridge:

All waste mobile phones and printer ink cartridges are collected at MI regional Offices and forwarded to selected charities for recycling.

3.18 Bund Waste:

Containment bunds are inspected routinely for waste build up. Where chemical/oils have collected in the bund, these must be removed and disposed of in accordance with Hazardous Lab waste and Waste Oil procedures.

Where uncontaminated rainwater builds up in bunds, this must be released routinely.

Bund inspections must be recorded on the Bund inspection checklist located in the TQM document database.

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	06/10/2020 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	24/09/2020 (Michelle Hay)	**Next revision date**	12/11/2023

Procedure for Crowding Fish

1. Scope:

Fish are crowded for the purposes of harvesting, grading, lice treatments, swim through transfer, net changing etc. There are 2 ways in which fish can be crowded, the first with a float line (most widely used) and the second, with a seine net.

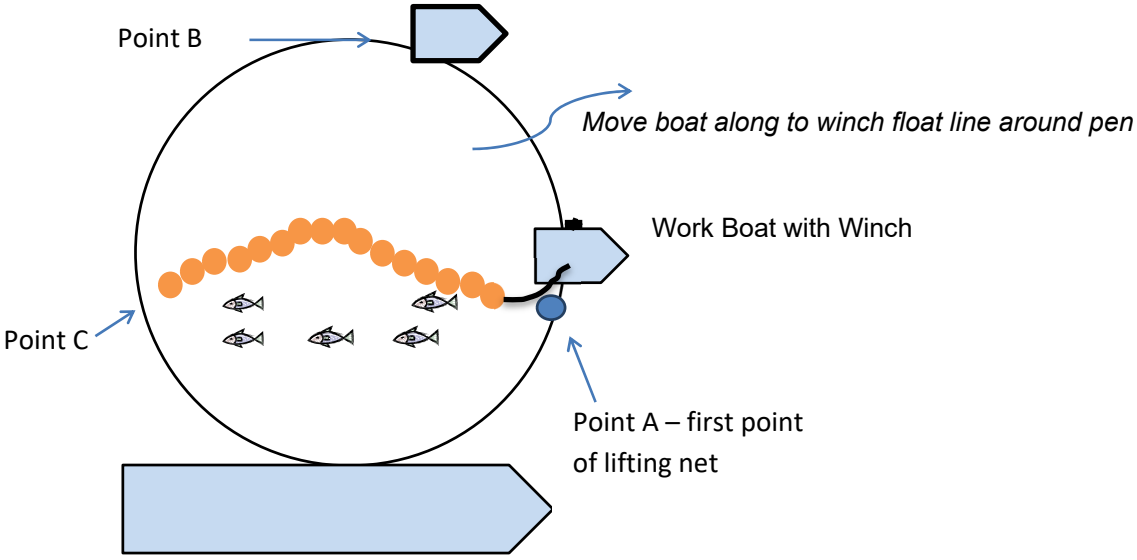
2. Float Line:

2.1 **Check the float line before use. Any broken floats must be removed before use.**

2.2 Weights and/or centre weights are first loosened or tied up to pen. The net is lifted at 6 - 7 out of 8 points along the pen. The float line is put into place at point A, opposite to well boat or receiving pen, between net and inside the pontoons. This can be done prior to lifting net (*Point A*)

2.3 Slack netting between lifting eyes is gathered up immediately taking out any pockets of fish and removing slack netting from hindering float line

2.4 When all of the net is lifted and the float line is in place, winch the float line through the stanchions the opposite end of the float line tied to *Point B.*



2.5 Move work boat to other side of float line and pull float line through *Point B*

2.6 Keep pulling float line around pen to *Point C* using the Work Boat crane/winch, Well Boat crane or capstan winch.

2.7 Keep the number of fish in the crowd to around or below what can be harvested within 2 hours (approx. 7000-8000 fish)

2.8 Prepare a second float line along the pen to start another sweep when the first crowd is harvested.

2.9 If further sweeps are necessary, prepare a float line for subsequent sweeps.

2.10 When finished release float line at one end, pull float line using the crane, winch or small boat making sure that the net does not become trapped between the floats, and release any remaining fish back into the pen.

Precaution: When the fish are crowded towards the Well Boat, there is a risk that the netting can continue to roll over the float line which can over crowd the fish to a dangerous degree. To mitigate against this, a diver in a dry suit can tie the net to the float line and in addition bag weights or lead rope weights can be deployed into the net at points.

Any broken/damaged/waterlogged floats should be removed from the float line immediately.

3 Seine Net:

3.1 A seine net is used to take a sweep of fish from a pen, where smaller volumes of fish are required. Again, lift the net to a depth (6/7 out of 8 points) which allows crowding of the fish without obvious signs of stress.

3.2 Lower the seine net into the water on the opposite side of the pen to the pump/siphon. The seine net is gradually dropped and both ends are pulled simultaneously towards wellboat etc.

3.3 Haul the sweep net gently across the pen, crowding the fish slowly and safely.

3.4 Secure the net to the pen rail and reduce volume to a safe working load.

4 Fish Welfare:

Ensure nets are free of fouling before commencing any crowding procedures. Care should be taken to avoid excessive crowding. Oxygen levels within the crowd should be monitored regularly and recorded on the relevant document (net change, treatment, etc.). Oxygen is deployed any time fish are crowded. If more than some dorsal fins are observed above the surface, or if any thrashing begins, drop the net (and/or tarpaulin) immediately.

5 HES:

Wear appropriate PPE. Ensure fish are monitored at all times, releasing net/float line if fish become unnecessarily stressed.

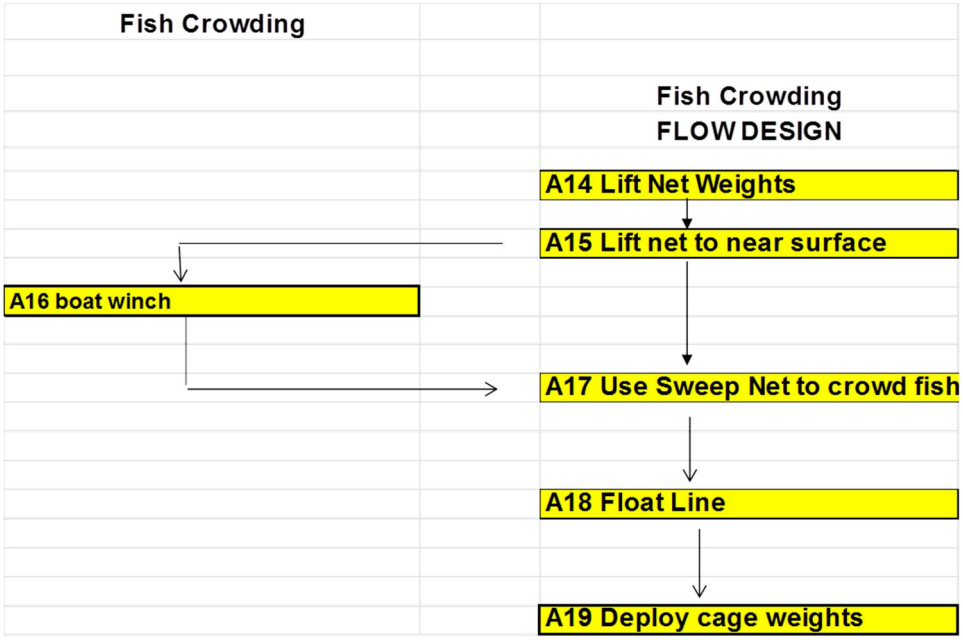
6 Risk Assessment & Process Flow:

Crowding Fish

Mowi Ireland

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	06/10/2020 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	24/09/2020 (Michelle Hay)	**Next revision date**	12/11/2023

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Location and process	Ireland / Quality Management / Planning	**Document category**	Guidelines
Last approved date	14/01/2022 (Sandra Vesanto)	**Last revision date**	14/01/2022
Date changed	14/01/2022 (Sandra Vesanto)	**Next revision date**	02/01/2023

Risk analysis for the stocking of farmed Atlantic salmon (*Salmo salar*) into sea pens

1. Identification of hazards: identification of pathogens that: (a) are notifiable and/or (b) could cause disease in farmed Atlantic salmon (*Salmo salar)*.

Potential hazards:

1.1. Viruses:

1.1.1. Viral haemorrhagic septicaemia virus (VHSV)
1.1.2. Epizootic haematopoetic necrosis virus (EHNV)
1.1.3. Infectious salmon anaemia virus HPR deleted (ISAV-HPR deleted)
1.1.4. Infectious haematopoetic necrosis virus (IHNV)
1.1.5. Salmonid alphavirus (SAV)
1.1.6. Infectious pancreatic necrosis virus (IPNV)
1.1.7. Piscine Orthoreovirus (PRV)
1.1.8. Piscine myocarditis virus (PMCV)
1.1.9. Viral nervous necrosis virus (VNNV)
1.1.10 Iridovirus (Ranavirus)
1.1.11. Salmon Gill Pox Virus (SGPV)
1.1.12. Novel viral infections of Atlantic salmon

1.2. Bacteria:

1.2.1. *Renibacterium salmoninarum*
1.2.2. *Aeromonas salmonicida* (atypical subspecies)
1.2.3. *Aeromonas salmonicida* (subspecies *salmonicida)*
1.2.4. *Vibrio anguillarum*
1.2.5. *Vibrio splendidus*
1.2.6. *Vibrio tapetis*
1.2.7. *Vibrio salmonicida*
1.2.8. *Moritella viscosa*
1.2.9. *Pasteurella skyensis*
1.2.10. *Piscirickettsia salmonis*
1.2.11. *Francisella spp.*
1.2.12. *Mycobacterium* spp.
1.2.13. *Tenacibaculum* spp.
1.2.14. Novel bacterial infections of Atlantic salmon

1.3. Parasites

1.3.1. *Gyrodactylus salaris*
1.3.2. *Neoparamoeba perurans*
1.3.3. *Lepeophtherius salmonis*
1.3.4. *Caligus elongatus*
1.3.5. Novel parasitic infections of Atlantic salmon

1.4. Fungi:

1.4.1. Novel fungal infections of Atlantic salmon

2. Risk assessment: the risk assessment for every hazard is made using the 5 components outlined below.

2.1 Release assessment (R): an estimation of the probability (i.e. likelihood) of fish movement resulting in hazard introduction. Biological risk factors, source risk factors and item risk factors are considered. See table 1 for definition of terms. **If the risk is considered negligible the assessment is ended at this point.**

2.2. Exposure assessment (E): the probability of a pathogen release resulting in infection of Atlantic salmon. Biological risk factors, destination risk factors and item risk factors are considered. See table 1 for definition of terms. **If the risk is considered negligible the assessment is ended at this point.**

2.3. Probability of establishment (PE): the risk of a disease being introduced, calculated through a conversion chart using the release assessment and the exposure assessment (table 2). See table 1 for definition of terms.

2.4. Consequence assessment (C): an evaluation of the consequences of introduction considering potential hazards to human health, fish health and the environment. See table 3 for definition of terms.

***Table 1**: terms used to quantify risk in 2.1, 2.2 and 2.3.*

Scale for release assessment, exposure assessment and the probability of establishment	
High (H)	Event would be expected to occur
Moderate (M)	There is a less than even chance of the event occurring
Low (L)	Event would occur occasionally
Very low (VL)	Event would occur very rarely
Negligible (N)	Chance of event occurring is so small it can be ignored.

***Table 2**: conversion chart used to calculate the probability of establishment.*

		Exposure assessment (E) →				
		Negligible (N)	Very Low (VL)	Low (L)	Moderate (M)	High (H)
Release assessment (R) ↑	High (H)	N	VL	L	M	H
	Moderate (M)	N	VL	L	M	M
	Low (L)	N	N	VL	L	L
	Very Low (VL)	N	N	N	VL	VL
	Negligible (N)	N	N	N	N	N

Table 3: *terms used to describe the significance of consequences.*

Scale for significance of consequences	
High	Associated with diseases that would have serious biological effects (e.g. high mortality or morbidity). Such effects would be expected to be felt for a prolonged period and would not be amenable to control measures. Such diseases would be expected to result in significant economic losses at an industry level, or they may cause serious harm to the environment.
Moderate	Associated with diseases that have less pronounced biological effects. Such effects may harm economic performance at an enterprise/regional level. These diseases may be amenable to control measures at a significant cost, or their effects may be temporary. They may affect the environment, but such harm would not be irreversible.
Low	Associated with diseases that have mild biological effects and would normally be amenable to control measures. Such diseases would be expected to harm economic performance at an enterprise/regional level. Effects on the environment would be minor or temporary.
Negligible	Associated with diseases that have no significant or only transient biological effects. Such diseases may be readily amenable to control measures. The economic effects would be low at an enterprise level and insignificant at a regional level. Effects on the environment would be insignificant

2.5. Risk estimation (Risk): an estimation of the overall risk posed by a hazard, calculated from the probability of establishment and the consequence assessment through a conversion table (Table 4). If the result is "Yes", the risk is considered acceptable, "No" means the risk is not acceptable **in the absence of risk management measures** and "Yes/No" means the risk is uncertain.
The risk determined is the **unrestricted estimate of risk, i.e. the risk based on the absence of risk management)**. Each hazard is considered separately in the risk evaluation (table 5).

Table 4: *risk estimation table.*

		Significance of Consequences →			
		Negligible (N)	Low (L)	Moderate (M)	High (H)
Probability of Establishment ↑	High (H)	Yes	No	No	No
	Moderate (M)	Yes	No	No	No
	Low (L)	Yes	Yes	No	No
	Very Low (VL)	Yes	Yes	Yes/No	No
↓	Negligible (N)	Yes	Yes	Yes	Yes

Table 5: *risk estimation for the specific hazards. See above for risk quantifying abbreviations.*

Viruses						
Hazard	**R**	**E**	**PE**	**C**	**Risk**	**Notes**
1.1.1. (VHSv)	VL	H	VL	H	Not acceptable	- Detected in wrasse in Scotland, associated with clinical disease. - Very rarely isolated from salmon (susceptibility unclear), can affect rainbow trout (present in rainbow trout in Norway) - Endemic in wild fish populations in Europe (type 3) - Notifiable.
1.1.2. (EHNv)	N	N/A	N/A	N/A	acceptable	- Not present in Ireland. - Can affect redfin perch and rainbow trout (freshwater). - salmon only infected experimentally. - Notifiable
1.1.3. (ISAv – HPR deleted)	N	N/A	N/A	N/A	acceptable	- Not present in Ireland. - Notifiable.
1.1.4. (IHNv)	N	N/A	N/A	N/A	acceptable	- Not present in Ireland. - Notifiable.
1.1.5. (SAV)	VL	H	VL	M	uncertain	- Present in Ireland (salmon and wild fish) - Salmon in affected areas are vaccinated.
1.1.6. (IPNv)	VL	H	VL	M	uncertain	- Present in Ireland. - All salmon stocks are vaccinated.

1.1.7. (PRV)	L	H	L	unknown	uncertain	- Present in Ireland (salmon and possibly wild fish). - Can affect salmon (high prevalence in Ireland, rarely associated with disease)
1.1.8. (PMCv)	VL	H	VL	M	uncertain	- Present in Ireland (salmon and lumpfish *Cyclopterus lumpus*).
1.1.9. (VNNv)	VL	M	VL	L	acceptable	- Present in UK and Norway (Halibut and Cod). - Does not affect salmon
1.1.10. (*Ranavirus*)	unknown	unknown	unknown	unknown	uncertain	- Only detected in lumpfish to date (Ireland, Scotland, Iceland) - Significance unknown
1.1.11. (SGPV)	VL	N	N	M	uncertain	- Associated with disease in Norway and UK. - Occasionally detected in freshwater in Ireland.
1.1.12. (novel viruses)	unknown	unknown	unknown	unknown	Uncertain	- unknown

Bacteria						
Hazard	**R**	**E**	**PE**	**C**	**Risk**	**Notes**
1.2.1. *(R. salmoninarum)*	VL	L	N	H	acceptable	- Present in UK and Norway (salmon and rainbow trout). - Notifiable.
1.2.2. *(A. salmonicida (atypical))*	VL	H	VL	M	uncertain	- Present in Ireland (wrasse, lumpfish and salmon). - Research indicates that salmon are not susceptible to the same subtypes as wrasse and lumpfish. - Not vertically transmitted.
1.2.3. *(A. salmonicida (typical))*	H	H	H	M	Not acceptable	- Present in Ireland (salmon) - Can affect salmon, lumpfish and wrasse - All salmon stocks are vaccinated.
1.2.4. *(V. anguillarum)*	VL	H	VL	M	uncertain	- Present in Ireland (cod). - Can affect salmon, lumpfish and wrasse. - Salmon and lumpfish in susceptible areas are vaccinated.
1.2.5 (*V. splendidus*	H	L	L	L	acceptable	- Ubiquitous in marine environment. - Opportunistic pathogen of salmon.

						- Salmon in susceptible areas are vaccinated.
1.2.6 *(V. tapetis)*	M	L	L	L	acceptable	- Ubiquitous in marine environment. - Not known to infect salmon.
1.2.7 (*V. salmonicida)*	VL	M	VL	M	uncertain	- Present in Ireland (salmon). - Salmon in susceptible areas are vaccinated.
1.2.8 *(M. viscosa)*	VL	M	VL	M	uncertain	- Present in Ireland (salmon). - Salmon in susceptible areas are vaccinated.
1.2.9. (*Pasteurella skyensis*)	L	L	VL	M	Uncertain	- Present in Scotland - High risk of introduction from shared vessels travelling between Scotland & Ireland
1.2.10. (*Piscirickettsia salmonis*)	M	M	M	M	Not acceptable	- Present in Ireland (salmon & lumpfish) - No vaccines currently available in Ireland
1.2.11. (*Francisella* spp.)	VL	VL	N	L	acceptable	- Present in Ireland (cod). - Does not affect salmon.
1.2.12. (*Mycobacterium* spp)	VL	M	VL	L	acceptable	- Present in Ireland (ornamental and wild fish). - Can occasionally affect salmon.
1.2.13. (*Tenacibaculum* spp.)	VL	VL	N	L	acceptable	- Present in Ireland (lumpfish and salmon). - Opportunistic pathogen.
1.2.14. (Novel bacteria)	unknown	unknown	unknown	unknown	uncertain	- Unknown.

Parasites						
Hazard	**R**	**E**	**PE**	**C**	**Risk**	**Notes**
1.3.1. (*G. salaris)*	N	N/A	N/A	N/A	acceptable	- Only in freshwater - no threat to marine species. - Can affect salmon in freshwater. - Notifiable.
1.3.2. (*N. perurans*)	M	H	M	M	not acceptable	- Present in Ireland (salmon, lumpfish and wrasse). - Endemic in Irish salmon farming.
1.3.3. (*Lepeophtheirus salmonis)*	H	H	H	H	Not acceptable	- Present in Ireland (farmed and wild salmonids) - Endemic in Irish salmon farming
1.3.4. (*Caligus elongatus)*	M	H	M	M	Not acceptable	- Present in Ireland (farmed and wild fish, including Atlantic salmon, wrasse and lumpfish)

						- Endemic in the marine environment
1.3.5. *(Novel parasites)*	unknown	unknown	unknown	unknown	uncertain	- Unknown.
Fungi						
Hazard	**R**	**E**	**PE**	**C**	**Risk**	**Notes**
1.5.1. (Novel fungi)	unknown	unknown	unknown	unknown	uncertain	- Unknown

The risks posed by following pathogens is rated "not acceptable" or "uncertain" **in the absence of risk management measures:**
VHSv, SAV, IPNv, PRV, PMCv, SGPV, novel viruses., typical and atypical *Aeromonas salmonicida*, *Vibrio anguillarum*, *Vibrio salmonicida*, *Moritella viscosa*, *Pasteurella skyensis*, *Piscirickettsia salmonis*, novel bacteria, *Neoparamoeba perurans*, *Lepeophtheirus salmonis, Caligus elongatus*, novel parasites and novel fungi.

Some of the pathogens listed above are widespread in the marine environment and in Irish salmon aquaculture (SAV, PRV, *M. viscosa, N. perurans, L. salmonis, C.elongatus*). The risk posed by stocking salmon into sea pens is not always a significant overall increase in risk, depending on disease and vaccination status of salmon, level of prevalence and severity of infections detected.

To account for the varying significance of pathogen introduction, **consequences of non-notifiable pathogen identification should always be subject to a case specific veterinary evaluation.** This should take into account the nature of the pathogen, severity of infection detected and the health status/vaccination status of salmon on site. Risk management measures should be put in place following evaluation of all factors (See 3.7).

3. Risk management:

Implementation of measures to reduce the risks posed by the particular hazards to an acceptable level.

3.1. Surveillance of all salmon stocks:
A yearly disease screening of all populations (freshwater as well as sea sites) should be conducted to test for the presence of pathogens of concern. Fish should be tested as follows:

- Bacteriology: inoculation of kidney material from loop/swab into bacteria culture media: i.e tryptone soya agar (TSA), tryptone soya agar plus salt (TSASA), Columbia blood agar (BCA) and thiosulfate citrate bile salts sucrose agar (TCBS) (individual fish).
- Virology: inoculation of kidney, spleen and heart material into tissue culture cell lines: i.e. BF-2 (bluegill fry) and EPC (epithelial papilloma of carp) (maximum of 5 fish per pool).
- Histology: any fish showing signs of disease and a minimum of 5 fish should be sampled for histology

No fish should be stocked on to salmon farms before results are evaluated.

3.2. Biosecurity and continuous health monitoring of salmon in sea pens:
- Disease outbreaks are often stress associated and the welfare of fish should be maintained at the highest level possible. Care should be taken to minimize impact of stressful events such as transport and movement, grading of salmon, net cleaning, and any process that involves handling fish.
- Mortalities should be monitored continuously, and categorised by clinical signs (runts, lesions, gill disease, predation, other). Infectious agents should be identified as early as possible to maximise chances of successful treatment and recognition of diseases of concern.
- Fish should be screened for *Neoparamoeba perurans* and sea lice regularly.
- If possible, diseases should be treated at an early stage to maximise welfare and survival.
- The health status of salmon stocks on site should be assessed as in 3.1 once a year for every site.
- Veterinary inspections should be carried out on a quarterly basis (routine visits) and when morbidity or mortalities are observed (diagnostic visits).

3.3. Mixing of different generations within a site:
The mixing of generations of salmon within a sea site is not advised.

3.4. Vaccination:
Vaccinating salmon is advised if commercial vaccines are available for diseases that have proven problematic in the area.

3.5. Consequences of hazard detection:
If hazards are detected, the movement of fish is to be suspended pending a case specific veterinary evaluation and risk management proposal.

Risk management measures should be implemented if:

a) movement of fish results in a significant risk increase for salmon, or
b) stress associated with movement and stocking, in combination with pathogen detected, presents a significant disease or welfare concern for the salmon.

Measures can include treatment, postponing movement, advising against movement or culling.

It should be noted that this risk analysis, while qualitative, has been undertaken with reference to the available scientific literature and data from industry partners from Ireland, UK, Norway and Iceland. This risk analysis is based on the current state of my knowledge. As more data regarding the diseases and welfare requirements becomes available, there may be a need to reassess the current knowledge to enable adequate risk management.

The risk assessment framework used here has been adapted from AQUIS (1999) and and based on Annex 3, code of good practice, Scottish fin fish aquaculture (2015).

AQIS (Australian Quarantine and Inspection Service) (1999) Import risk analysis on non-viable salmonids and non-salmonid marine finfish. AusInfo, GPO Box 1920, Canberra ACT 2601.

O.I.E. (Office International des Epizooties) (2015) Section 2. Chapter 2.1. Risk analysis. Aquatic Animal Health Code, World Animal Health Organisation, Paris. http://www.oie.int/en/international-standard-setting/aquatic-code/access-online/

Appendix 2.4

Wastes and Biosecurity

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	08/09/2022 (Joseph Gibbons)	**Last revision date**	27/07/2022
Date changed	27/07/2022 (Michelle Hay)	**Next revision date**	12/11/2023

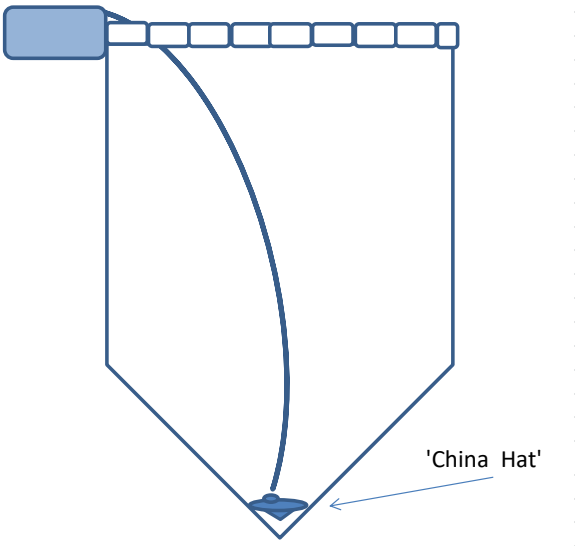
Use of Lift-Up Systems and mort removal

1. Scope:

Lift-Up systems are used to remove dead fish from pens, and are installed in suitable Mowi sites from Donegal to Cork. Divers remove dead fish from pens as required on any site.

2. Installing Lift-Up System:

i. Moor boat up to the selected pen, and assemble lift-up system on deck before deploying. Refer to manufacturers manual.
ii. Attach pipes to the ‘china hat’ and lower into the water with adequate lifting eyes or straps. Various models have different lifting eyes, therefore it is important to ensure correct lifting with appropriate equipment.
iii. Lower slowly until the ‘china hat’ reaches the bottom/cone of the net.
iv. Divers then enter the water and gently position ‘china hat’ in the centre. Secure to bottom of the net.



3. Operation of Lift-Up System:

i. Moor boat to pen alongside the discharge pipe. Attach compressor hose to compressor, and then place the end of the discharge pipe into a dewatering unit or a brailer/net sock.
ii. Start compressor and turn valve halfway until water starts to flow. The compressor delivers air into the pipe coming from the ‘china hat’ to create a vacuum which pulls the dead fish to the surface. Adjust the valve accordingly during flow

4. Divers for manual mort removal:

Divers can remove dead fish from all sites, this can either be with hand nets or nets hauled up by the accompanying work boat. Divers routinely service sites as required and provide the removal along with other services on site. As part of the removal process, divers fill in a mort record of the number of morts removed and cause.

5. Recording of mort numbers:

Where any fish are removed from a pen, the number of fish removed should be counted accurately, or as accurately as possible. Divers and site staff are asked to ensure that this counting process is as accurate as possible to avoid any deviations in the figures due to underestimations or overestimations in the counting processes. This applies to minimal losses as well as larger events. This is required to ensure that we can accurately track the stock in the pens.

6. Records:

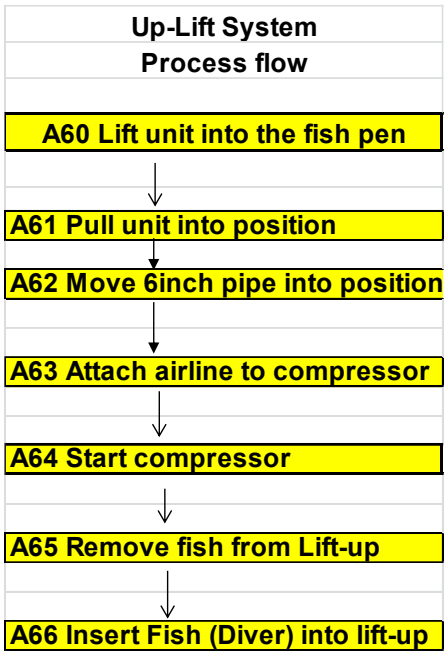
Record all numbers of mortalities and cause of death on the attached ‘Mortality Record’. Submit to relevant marine office.

7. HES:

Ensure appropriate PPE is worn. Observe manual handling procedures.

8. Safety Risk Assessment & Process Flow

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Location and process	Ireland / Marine Production / Housekeeping & Bio Security	**Document category**	Procedures
Last approved date	06/09/2022 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	25/01/2022 (Patrick Shovelin)	**Next revision date**	12/11/2023

Marine Housekeeping and Biosecurity:

1. Scope:

The following SOP details the minimum housekeeping, cleaning and disinfection standards for all marine sites.

2. Records:

Record all details on the Equipment Cleaning & Disinfectant Log (TQM 29487).

3. General Housekeeping:

Canteens, offices, toilets and other staff facilities must be kept clean and tidy at all times. Waste is segregated on site, and removed by an approved contractor. Please refer to waste monitoring & management procedure (TQM 25564).

All equipment must have a designated storage area when not in use. Equipment must first be washed with detergent and then disinfected before transfer to storage or any other site. Please refer to marine cleaning and disinfection procedure (TQM 29486).

Feed should be stored in a clean, dry, ventilated area, free from rubbish or debris. When loaded on barges it must be covered with a dark heavy tarpaulin.

Empty feed bags must be collected on feed barges and floating vessels and secured as soon as possible after use. Use an empty one tonne feed tote bag (secured to the vessel) to collect the bags. All collected bags are then returned to the local Marine Operations yard for bailing and collection by a licensed waste recycling contractor.

Feed silos in boats and barges must be maintained as required.

Algae must be removed from steps, slip ways, floats and pontoons when possible.

Dead fish retrieved by divers must be promptly removed for disposal in a designated mort bin (labeled ‘CAT 2’) to relevant shore base.

Note: Only waste transporters with an ABP Category 2 waste permit may be used to remove fallen stock waste to the approved rendering plant.

All divers gear should be thoroughly disinfected following use.

4. Personnel and Movement of Equipment:

All equipment must be washed and disinfected before transfer to any other site or prior to removal for storage. Please refer to marine cleaning and disinfection procedure. Record all details on Equipment Cleaning & Disinfectant Log.

All site visitors should be provided with assigned visitors PPE where possible. Disinfection baths must be available upon entry to all sites. Visitors to site must sign relevant visitor's logs.

Staff should maintain a good standard of personal hygiene, frequently changing soiled clothes and washing hands.

5. Wellboats:

Each wellboat/live fish carrier is responsible for cleaning and disinfection of their vessels between sites. The responsible site manager should ensure a signed certificate of cleaning and disinfection is obtained prior to commencement of any work operations on site. This certificate must be returned to relevant marine office.

6. Trucks:

During smolt transfer season, marine personnel should liaise with freshwater managers to ensure all tanks transporting fish on trucks have been thoroughly cleaned and disinfected. Evidence should be sought and filed in the event of an audit.

7. HES & Precautions:

Wear appropriate PPE when using cleaning and disinfection products. Refer to SDS sheets.

Location and process	Ireland / Marine Production / Environmental Management	**Document category**	Procedures
Last approved date	01/06/2022 (McManus, Catherine)	**Last revision date**	01/06/2022
Date changed	01/06/2022 (McManus, Catherine)	**Next revision date**	26/09/2023

Chemical Stock Control at Marine Sites

1. Scope

This procedure outlines the requirements for controlling chemicals at all Marine Production Units. For the purpose of this procedure, chemicals are broken down into two groups

1. Detergents and disinfectants.
2. Oils & lubricants

2. Records

- Chemical Store log
- Equipment cleaning and disinfectant log
- Relevant SDS for all products
- Supplier delivery note
- Cleaning & disinfection records
- Foot bath fill records
- Bund checks

3. Responsibility

It is the responsibility of the Site Managers to ensure that this procedure is adhered to.

Only cleaning substances listed on TQM document 29684 are permitted for organic production sites. It is the responsibility of the Marine Regional Manager to consult with the Technical Manager before purchase.

4. Chemical Storage

4.1 All products must be checked against the purchase order on file. A supplier's delivery note must be stored in the Marine Support Office.

4.2 The chemical store log must include chemical/medication name, quantity, date received, batch code, expiry date, quantity and date issued from the store

4.3 All chemicals/compounds must be clearly labelled and sealed.

4.4 If the expiry date on a batch of chemical has been reached, a 'FOR DISPOSAL' label must be applied to the item concerned and the Manager informed immediately. The out of date item must be stored in a quarantine area until removed for disposal. Disposal must be in accordance with Waste monitoring and Management SOP No.25564.

4.5 The first in first out principal applies to all chemical use - oldest product must be used first.

4.6 A physical count of chemicals in storage must be carried at each month end. This should be reconciled with use and delivery. Records are held by the Marine Purchasing Manager and submitted to accounts each month.

5. HES

5.1 Observe all SDS for all chemicals

5.2 Wear appropriate PPE when handling and administering chemicals

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Transfer and Transporting of Fuel with Bowser **Mowi Ireland**

Location and process	Ireland / Marine Production / Operational Procedures	**Document category**	Procedures
Last approved date	17/11/2020 (Joseph Gibbons)	**Last revision date**	12/11/2020
Date changed	12/11/2020 (Michelle Hay)	**Next revision date**	12/11/2023

Transfer and Transporting of Fuel with Bowser:

1. Scope:

It is necessary to move fuel from shore to feed barges at Mowi sites to power automatic feeding systems.

2. Precautions:

Fuel must only be filled into strong good condition bowsers with no leaks. All pipework, steel supporting cradles and valves must be properly fitted and in good condition. Only fill bowser to a safe filling level. DO NOT EXCEED THIS MARK.
Ensure spill kits/absorbent pads are available in the event of a spillage. Observe emergency plan for chemical spills.

3. Procedure:

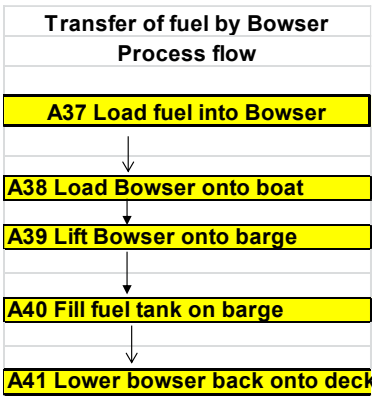
i. With appropriate lifting slings, lift bowser from shore/pier to deck of boat. Secure bowsers to deck of boat to prevent movement during transport.
ii. Upon arrival at barge, again lift bowser with appropriate slings from boat to deck on barge.
iii. When dispensing fuel into barge by gravity feed, ensure the bowser is stable and secured properly to the barge. Remove all tangles or kinks in the outlet hose. Place the outlet hose at a sufficient depth into the receptacle tank before opening valves on bowser. NEVER LEAVE A FILLING HOSE UNATTENDED.
iv. Lift empty bowser from barge back to deck of boat.

4. HES:

Ensure appropriate PPE is worn. Observe manual handling procedures. Ensure spill kits are available. Observe SDS sheets of fuel being transported.

5. Safety Risk Assessment & Process Flow:

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Appendix 3

MOWI Standard Operating Procedures II Fish Heath, Predator Control and Environmental Policy

Appendix 3.1

Fish Health Management

Location and process	Ireland / Quality Management / Operation	**Document category**	Procedures
Last approved date	26/10/2021 (McManus, Catherine)	**Last revision date**	26/10/2021
Date changed	26/10/2021 (McManus, Catherine)	**Next revision date**	30/11/2023

MEDICATION OF FISH

1. PURPOSE

To allow best practice in the choice, handling and use of specific medicines and to ensure that fish harvested following treatment, contain no drug residues, or have residues below the medicine's Maximum Residue Limit (MRL) and that Mowi Ireland follows market and sales restrictions in different markets.

2. DEFINITION OF MEDICINES

Medicines or chemotherapeutants are defined as all substances intended for use in the diagnosis, prevention, mitigation, cure or treatment of a condition or disease, including substances with effect on the central nervous system like sedatives and anaesthetics used on eggs, juveniles or any other stage of fish that are harvested for food production.

Chemotherapeutants used primarily for the treatment of specific disease conditions in fish. The majority of these are prescription-only medicines (POM) which can only be used under the direction of a veterinary surgeon (VS). Medicines may be administered in feed, by direct application (normally bath treatment in water), or by direct inoculation (normally injection). The medicines used are usually preparations licensed for treating fish, although prescription may be made under a special trial licence, where field trial data will be collected. Occasionally, a medicine not licensed for use in fish may be used under specific prescribing legislation.

3. APPROVED MEDICATION LIST:

Only those medicines listed in the Mowi Ireland positive list are permitted for use in farming operations. Refer to the approved medication list in Mercatus Farmer. No medicines can be applied unless they follow this procedure.

The approved midication list must refer to;

- Chemical name
- Chemical type
- Product name
- Supplier
- Indication
- Administration
- Dose(s)
- Withdrawal period
- MRL production
- MRL more strict markets
- MRL most strict markets
- Restrictions ASC
- Export/sales restrictions

If new substances or applications need to be introduced the positive list must be updated and reapproved by the Technical Manager and inform the Mowi ASA Global Tehcnical Manager for Food Safety before being activated by local BU Mercatus farmer support and **before** the substance can be administered. If use of a substance is terminated, deactivate the substance in Mercatus Farmer.

The medicines list is approved whe the medicines are made available in Mercatus Farmer.

The approval of medicines must include an assessment of:

- Legality for use in the appropriate jurisdiction **and** in the jurisdiction/s to which final product is destined
- Maximum Residue Limits (MRLs) achieved by the respective withdrawal periods **and** the MRLs in the jurisdiction/s to which final product is destined.

Only medicines licenced in Ireland (or authorised under a test certificate, emergency drug release, according to the "cascade regulation", exemption prescription or similar) for use on that species can be included in the positive list.

Withdrawal periods to be applied must be indicated on the positive list and should, as a minimum, be according to legislation in that jurisdiction or according to product guidance.

If a substance that is not approved in a certain market is included on the positive list, or the MRL achieved with the respective withdrawal period is above the MRL in certain markets, this must be clearly indicated on the list as "Market restrictions".

Routines need to be in place to ensure that products treated with medicines not approved for certain markets or with other market restrictions (e.g., different withdrawal or MRL requirements) are not shipped to those markets.

4. Requirements for ASC farms (ref. 5.2.2 and 5.2.8 in ASC standard)

- Antibiotics that are not allowed in general in ASC farms are included in the appendix “WHO list of critically important antimicrobials -WHO CIA list 6th edition” (see link below).
- Medicines that are not approved by the primary salmon producing countries or importing countries are thus not approved for use at ASC-certified farms (ref ASC 5.2.2) This needs to be taken into consideration for new medicines. This information needs to be registered in the medicine positive list in Mercatus Farmer.

5. PURCHASE OF MEDICINES:

The Fish Health Manager will arrange purchase of medicines from the approved Vet supplier. Purchase may be for direct use, or to replenish stocks held centrally.

6. STORAGE OF MEDICINES:

Medicines including vaccines, held in stock are kept in locked stores at Rinmore Pharmacy Store, Altan, Pettigo, Clare Island Sea Farms and the Cork sites office.

Keys are held by the Fish Health Manager, relevant site manager and the Rinmore Laboratory Technical staff.

7. Prescriptions and medicine use:

- All prescriptions shall be issued by a licensed Veterinarian.
- Use of medicines must be in accordance with licensed Veterinarian instructions
- Use medicines per legislation and Best Practice
- Ensure medication is administered to fish by trained staff only
- All treatments must be registered in Mercatus Farmer

Any in-feed compounds which are required will be mixed at an authorised feed mill under veterinary prescription and shall be dispensed to the individual sites.

Sites using prescription only medicines must have a copy of the veterinary prescription before use.

All sites will be issued with MSDS sheets for all approved chemotherapeutants likely to be used.

8. MEDICINES STOCK CONTROL

Copies of medicine purchase orders are kept by the Fish Health and Laboratory Managers.

Medicines delivered to production sites are checked and recorded on medicine logs (name, date, quantity, batch number, expiry date and supplier). A record is kept of medicines dispensed, including the destination site.

9. CHOICE OF MEDICINE AND TREATMENT DOSES

Choice will consider any available laboratory information, efficacy data, known potential adverse effects, withdrawal period, environmental concerns, and cost. The decision to treat with a chosen medicine is ultimately the responsibility of the Fish Health Manager. However, this will normally be discussed with the Site Manager and Department Manager before proceeding.

Antibacterial treatments will require isolation of the pathogen and determination of antibiotic sensitivity pattern. Treatment may be started if the Fish Health Manager deems there is a clinical need and escalating losses must be limited. his information is available to try and limit escalating losses. Prophylactic application of antibiotics is forbidden.

10. INSTRUCTIONS FOR IN FEED MEDICATION

For all treated feed, a copy of the dose /mixes required per pen is sent to the site and the Fish Health Manager together with more specific written instructions for feeding to the fish.

Details supplied to the site for treatment purposes are:

- Name of site and site manager
- Name of medicine and feed type

- Medicine dose and inclusion rate in feed
- Total quantity of medicine and medicated feed
- Crop, pens/tanks and biomass to be treated
- Feeding rate, quantity to be fed per tank/pen and duration of treatment
- Withdrawal period before human consumption
- Appropriate health and safety information and any special precautions

The Vet Surgeon (Fish Health Manager) in turn will issue a prescription for each treatment. This is maintained on file in the relevant production office and copies sent to the relevant sites.

Prior to handing medicated feed, staff must wear gloves, boots, overalls, and dust masks.

11. STORAGE OF MEDICATED FEED

Feed prepared and not yet fed must be clearly identified as medicated and protected from wetting, contamination, and spillage.

Post in-feed medication, feed storage silos on boats and barges should be flushed through and then cleaned. Refer to marine cleaning and disinfection procedures.

12. INSTRUCTIONS FOR BATH MEDICATION

Lice treatments are used on a volume per volume or weight per volume basis and standard doses have been compiled for different wellboat or treatment tarpaulin sizes. Alterations to standard protocols must be agreed with the Fish Health Manager beforehand, but no specific instructions are otherwise required.

Personal Protective Equipment requirements outlined in treatment SOP’s must be adhered to.

13. TREATMENT RECORDS:

Details of treatments and dates are recorded on site and transferred to the Mercatus farmer database.

Computerised records are also kept at Head Office, summarising the relevant information.

Copies of veterinary directions are filed on site and held centrally

14. WITHDRAWAL PERIODS

Withdrawal periods applied shall be, as a minimum, as indicated in the Mowi Ireland positive list.

Withdrawal periods run from the end of treatment and are usually measured in degree C days.

Treatment dates and daily temperatures are recorded on site and transferred to the Mercatus farmer database or on a freshwater treatment spread sheet.

The statutory withdrawal period for the medicine is divided by the average daily temperature in centigrade to give the withdrawal period in days and the clear date is calculated accordingly. The withdrawal period must be indicated on Mercatus database. For organic farming this calculated withdrawal is then doubled. For some markets, withdrawal periods more than organic regulations must be applied. Refer to the positive medicine list. If in doubt consult with the Technical Manager.

Licensed medicines used according to their data sheet specifications carry the withdrawal periods in degree C days. Please note the approved medication list for approved treatments.

Any medicine used out-with its data sheet will have a 500-degree C Day withdrawal applied unless otherwise directed by the Fish Health Manager.

15. RESIDUE CONTROL:

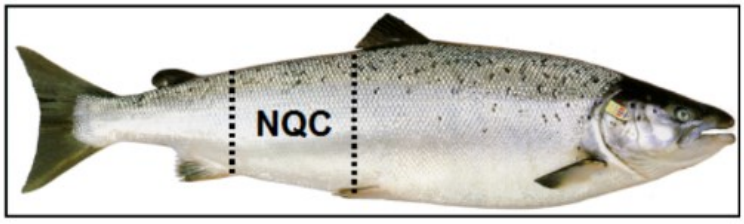
Following application, actual residue levels at the end of withdrawal period shall be verified by testing.

All treatments on fish groups (on a pen basis) should be verified with residue testing. Exemption is given for Anaesthetics and Hydrogen peroxide.

Testing should preferably be conducted at end of withdrawal period. For Organic farming, pre-harvest testing is acceptable.

For antibiotic treatments, all treatments during the sea phase must be followed by a pre-harvest positive release at site- level. (Positive release can be covered by the testing at end of withdrawal period as mentioned above or as a separate testing pre-harvest).

- Residue testing
    - Sampling: Sample 5 individual fish from the treated population.
    - Cut: Salmonids: NQC- the NQC is made by making two cutes perpendicular to the sideline, one behind the dorsal fin and the other at the gut opening.



Other species: Select a representative portion of the edible part of the fish, ca 250g.

1. Sample size preparation, and packing needs: For Eurofins: Debone, grind, and mix and homogenizes the meat from each of the 5 samples, keep skin on. (Or instruct the laboratory to do so).

2. Packing: Wrap sample in aluminium foil and pack in plastic bags. Freeze samples and send frozen by courier to the laboratories.

3. Marking: use pen with permanent ink to mark the Sample id from the Chain of Custody/Order form onto labels attached to the plastic bags- or written directly on the plastic bags. Make sure there is no contact with the fish samples to avoid cross contamination.

4. Chain of Custody/Order sheet: Fill in the ordering sheet and the sheet "Sample-information" (see appendix/Links). The order sheet only is sent together with the samples to the laboratory.

Use laboratories with accredited methods for the relevant residue testing. Method used must have a LOQ maximum at the MRL of the strictest market or ideally 50% of the strictest MRL

- That the product will be sold to. (An overview of analyses, LOQs and price for analyses available through Eurofins is available under "additional information")
- Analysis: the 5 fish samples should be analysed as single fish samples for AB residue testing but can be analysed as a pooled sample for other residue testing.
- Samples should preferably be analysed on a homogenate including skin (muscle and skin in natural proportions) if no legislative requirements or technical reasons (i.e., OTC) to analyse skin off.
- Analysis results: Analysis results and sample information should be registered in LIMS.

16. Reporting and communication of test data

As a rule, all the residue data from the LIMS database is confidential data and must be treated with great care, both related to internal and external communication. In wrong hands the data can be misinterpreted and have a negative effect.

Results from the residue control are reported in Mowi LIMS and are available in the LIMS Info view reports under "Food Safety- drug residues"

General rules for use of results:

- Each BU can use their own data in internal and external communication.
- Each BU can also inform externally about the Mowi residue program, and show/present examples during audits and other visits but SHOULD NOT reports any results other than their own.
- All communication of results externally must be in line with Mowi communication strategy.
- Any reporting of data from different Business Units must be coordinated with the Technical Director of Mowi ASA.

17. CONSUMER SAFETY:

The Marine Operations Manager is responsible for notifying the Fish Health Manager, Harvest Manager, Technical Manager, Sales Director, and the Site Manager of treatments which may be required close to harvest and of informing them of the clear date following the withdrawal period. These managers are responsible for ensuring that fish undergoing a withdrawal period are not harvested until after the clear date.

18. ORGANIC PRODUCTION CONSIDERATIONS:

Permission must be obtained from the various Organic Aquaculture certifying bodies to administer a treatment – either orally or by bath as indicated in the approved medicines list. Requests for permission to treat must be based on clinical need and supported by a veterinary report and vet prescription.

19. HEALTH & SAFETY INFORMATION:

Gloves and protective overalls must be worn by site personnel handling medicated feed.

Personnel with known drug sensitivities must not be involved in handling medicated feed. The Fish Health Manager should be consulted over the nature of the medicine if there are any doubts.

Pregnant women should not be involved in handling or mixing medicated feed.

20. References

- Critically important antimicrobials for human medicine 6th edition 2018
- https://digicomply.sgs.com/app/login?pref=%2Fsearch
- Overview statutory limits for veterinary medicines: https://digicomply.sgs.com/app/login?pref=%2Fsearch

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	09/11/2022 (Joseph Gibbons)	**Last revision date**	09/11/2022
Date changed	09/11/2022 (Patrick Shovelin)	**Next revision date**	03/11/2023

Freshwater Bath Treatment Procedure

1. Scope:

The most effective method for removal of amoeba parasites from salmon gills is by means of a freshwater bath. This procedure outlines the steps required for freshwater baths using a wellboat.

2. Fish Welfare:

Withhold feed from fish to be treated for a minimum of 3 days before the treatment.
Remove any fallen stock in the pen before the bath is due to commence.

3. Procedure:

3.1 Lift or remove net weights and tie up the net with the exception of the area where fish are to be loaded.

3.2 Tie up the Wellboat at the loading area alongside pen.

3.3 Crowd using a float-line (corks) from opposite side to the wellboat.

3.4 Fish are then pumped on board the wellboat via pipes

Precaution: Only use fully tested lifting chains/slings to lift pipes.

3.5 The fish are put through the dewatering unit and into the freshwater in the well of the wellboat.

3.6 The fish remain in the freshwater for a minimum of 3 hours.

3.7 When the bath is completed the fish are pumped off the wellboat via pipes back into the pen.

4. Records & Reporting:

All baths must be recorded in the MHI Wellboat Treatment record sheet. (TQM 26083)

5. Responsibility:

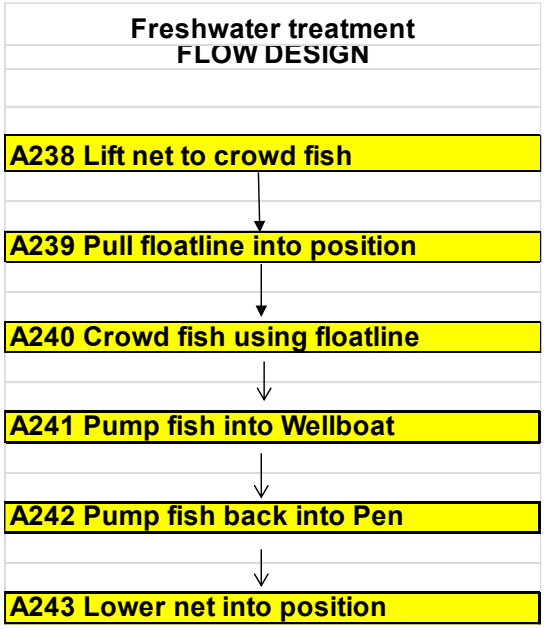
The Site Manager & staff must monitor fish welfare at all times.
Divers must be present on site. Pens are normally dived before and after the bath treatments. The divers will also assist the well boat crew if required.
Wellboat staff will monitor fish welfare in wells and to ensure the fish are loaded correctly

and that fish are not stressed at any time.

6. PPE:

Appropriate PPE to be worn when completing these tasks by all staff involved.

7. HES Risk Assessment:



Mowi Ireland

Veterinary Health Management Plan

2022

Approved by: S. Vesanto Date: 22.6.2022

Sandra Vesanto

Fish Health Manager & Veterinarian
Mowi Ireland

› Mowi Ireland

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INDEX:

1	**Scope**	**3**
2	**Goals**	**4**
3	**Procedures**	**4**
4	**Responsibilities and Qualifications**	**4**
5	**Required Surveillance Level**	**4**
6	**Monitoring of Fish Health**	**5**
7	**Notification of the Marine Institute of Any Disease Outbreaks**	**5**
8	**Monitoring of Stock Performance**	**5**
9	**Stocking, On-Growing and Handling**	**5**
10	**Predator Control**	**6**
11	**Disposal of Mortalities**	**6**
12	**Production Records**	**6**
13	**Vaccination**	**7**
14	**Therapeutic Treatments**	**7**
15	**Sea Lice Control and Fallowing**	**8**
16	**Use of Cleanerfish for Lice Control**	**8**
17	**Plankton and Jellyfish Monitoring and Mitigation**	**9**
18	**Disease Challenges**	**10**
19	**Chemical Stores**	**11**
20	**Visitors Log Book**	**11**
21	**Hygiene and Disinfection Procedures**	**11**
22	**Feed and Feeding Practices**	**12**
23	**Transportation of Fish**	**12**
24	**Harvesting of Fish**	**16**
25	**Contacts**	**17**
26	**Appendices**	**18**

1. SCOPE

The following document outlines the Fish Health Management Plan for all freshwater and marine salmon production facilities owned or operated by Comhlucht Iascaireachta Fanad Teoranta, trading as Mowi Ireland, and any sites leased from other license holders by Mowi Ireland.

Production sites for which this plan is applicable are as follows:

Site	Location	Aquaculture Licence ref.
Ahabeg	Bantry Bay, Co. Cork	T5/444 E
Altan	Procklis, Falcarragh, Co. Donegal	T12/93/3
Clare Island - Inishcannon	Achill, Co. Mayo	T10/54 A, B, C
Clare Island - Inishdoonver	Achill, Co. Mayo	T10/67A
Clare Island - Portlea site	Achill, Co. Mayo	T10/58 B AQ 678
Clare Island - Smolt Site	Achill, Co. Mayo	T10/58 A AQ 678
Cranford A	Mulroy Bay, Co. Donegal	T12/77 (78)
Cranford B	Mulroy Bay, Co. Donegal	T12/77/E
Creevin	Inver Bay, Co. Donegal	T12/63A&B
Deenish	Kenmare Bay, Co. Cork	T6/202; AQ198
Gearhies	Bantry Bay, Co. Cork	AQ321 - T5/122/4
Glinsk	Mulroy Bay, Co. Donegal	AP/17/1 - 2/00;T12/77/7
Inishfarnard	Kenmare Bay, Co. Cork	T5/233; AQ199
Kindrum Breeding Unit	Kindrum, Letterkenny, Co. Donegal	AQ202/78
Kindrum sea site	Mulroy Bay, Co. Donegal	T12/77A
Letterard	Bertraghboy Bay, Carna, Co. Galway	T9/107
Millbrook Hatcheries	Trentagh, Letterkenny, Co. Donegal	T12/091
Millstone	Mulroy Bay, Co. Donegal	T12/77C
Pettigo	Teivetooey, Pettigo, Co. Donegal	T12/116; AQ56
Roancarrig	Bantry Bay, Co. Cork	T5/444 D
Swilly	Lough Swilly, Co. Donegal	T12/85/1; FCL 215
Whilins	Inver Bay, Co. Donegal	T12/96 A&B

This plan will underpin the obligations of Mowi Ireland under the following EU and national legislation:

I. Commission Delegated Regulation (EU) 2020/691 of 30 January 2020 supplementing Regulation (EU) 2016/429 of the European Parliament and of Council as regards rules for aquaculture establishments and transporters of aquatic animals

II. European Communities (Health of Aquaculture Animals and Products) regulations 2008 (S.I. No 261 of 2008), 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).

III. EC Council Directive 2001/82/EC and SI 144 of 2007 (Animal Remedies Regulations).

IV. Commission Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 as amended in Regulation (EU) 2019/1009, 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).

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

2. GOALS

The goals of the Fish Health Management Plan for Mowi Ireland are as follows:

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

3. PROCEDURES

These goals will be instituted and achieved through high standards of animal husbandry, regular veterinary visits, daily record keeping and adherence to the IFA Aquaculture Fish Health Code of Practice for Salmonid Aquaculture in Ireland (2011) as well as *The Farmed Salmonid Health Handbook* developed by the AquaPlan project (2017).

4. RESPONSIBILITIES AND QUALIFICATIONS

The Technical Manager, Catherine McManus, will be responsible for the overall implementation of the health plan. Implementation of related procedures is the responsibility of the Freshwater and Marine Operations Managers. The designated veterinarian responsible for the primary care of the Mowi Ireland fish stocks is Mowi Ireland veterinarian, Sandra Vesanto. The veterinary practice contracted for further diagnostics as well as additional site visits for Mowi Ireland is Pharmaq Analytiq Ireland, Oranmore, Co. Galway. The aforementioned veterinary practitioners have the legal authority to diagnose disease and prescribe medications.

In addition, the Mowi Ireland Fish Health Surveillance Team is responsible for routine surveillance of fish health at sea and freshwater. Where appropriate, this team will interact with Freshwater Operations and Site Managers.

All members of the Mowi Ireland Fish Health Surveillance Team hold scientific qualifications to a minimum The National Framework of Qualifications (NFQ) Level 8 in addition to having considerable experience in the area of fish health surveillance.

5. REQUIRED SURVEILLANCE LEVEL

Under the Annex 1 of the new Fish Health Regime, all sites under the control Mowi Ireland are considered to require **High Surveillance** for the following reasons:

- Broodstock sites provide for Mowi Ireland and other farms.
- All freshwater units produce stock for on-growing elsewhere within the country and abroad.
- All other sites are marine based.

6. MONITORING OF FISH HEALTH

The health of fish will be closely monitored and recorded at four levels:

- Daily observations by the site managers and feeding operatives of fish behaviour during routine operations such as feeding and net changing. Any unusual behaviour will be recorded on the daily feeding sheets and reported immediately to the Operations Manager and the Mowi Ireland Veterinarian.
- Professional divers will examine the behaviour and general health of the fish on a regular basis. Diver observations and a breakdown of mortality numbers by likely cause of death will be recorded on the "Mortality Record" sheets.
- The company Veterinarian will carry out regular clinical examinations of the stock. In conjunction with Pharmaq Analytiq Ireland, the sites will be visited approximately bi-monthly providing at least six visits annually. During visits, fish will be anaesthetised and clinically examined for general behaviour, body condition and external abnormalities. Samples will be screened for skin, gill and internal parasites and recent mortalities also dissected and assessed for any unusual findings. Full laboratory support is provided by the designated veterinary practice (Pharmaq Analytiq Ireland), including bacteriology, histology, serology, virology, mycology and water quality. Written reports and 24 hour support/ consultation will also be provided by Pharmaq Analytiq Ireland.
- The stock performance (e.g. feeding rate, mortality rates) will be assessed at least once a week by the Production Manager for any indication of disease/abnormalities in the stock.

7. NOTIFICATION OF THE MARINE INSTITUTE OF ANY DISEASE OUTBREAKS

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.

8. MONITORING OF STOCK PERFORMANCE

The growth performance on site will be assessed by carrying out sample weights from a representative number of fish on a regular basis. In addition, Feed Conversion (FCR), SGI (Specific Growth Index) and Biological Conversion Ratios (BCR) are continuously monitored and compared to Key Performance Indicators.

9. STOCKING, ON-GROWING AND HANDLING

The company is committed to ensuring that the following principles and procedures are adhered to:

- The welfare of fish shall at all times be of prime importance.
- Prior to handling or examination, fish are anaesthetised with an approved anaesthetic, Tricaine. Withdrawal periods must be observed prior to harvesting handled fish (70°

degree days for conventional aquaculture production, 21 days for organic fish).

- The company will ensure that stocks are sourced from disease free farms with no clinical health problems. These farms must be certified as specific disease-free hatcheries in approved health zones. The Fish Health Unit at the Marine Institute, Rinville, Oranmore, Co. Galway will be notified of all fish movements between farms/sites at least 72 hours before movement occurs (fax to 091 387201 or email to notification@marine.ie). The most recent fish health inspection report will be forwarded to the Fish Health Unit with movement notifications. Records of all stock transfers to and from the farm will be kept for a minimum of five years.
- Salmon will be vaccinated with licensed vaccines. Choice and need for vaccine will be based on site health risk assessment which will be reviewed at least annually by the Managing Director, Technical Manager, Mowi Ireland Veterinarian, Fish Health Consultant (Pharmaq Analytiq Ireland), Marine Operations and Freshwater Operations Managers.
- The Operations Manager shall ensure that fish are stocked at a level that ensures the health and wellbeing of fish and in accordance with industry recommendations.
- Prior to fish transfer, the Operations Manager will arrange that the stock is examined to ensure that fish have no internal or external abnormalities such as skeletal deformities, or clinical symptoms of disease.

10. PREDATOR CONTROL

Predation from birds and seals shall be minimised by deploying top nets and, where necessary, outer predator nets.

11. DISPOSAL OF MORTALITIES

Mortality removal will be carried out regularly, to maintain the health of stocks. The frequency of mortality dives will be determined by the site manager based on time of year and numbers/type of mortalities. Records of mortalities shall be maintained for each pen/tank. These background mortalities will be rendered by either Glenmore Biogas Ltd or College Proteins in accordance with Animal By-Products Regulations. In the unlikely event of large scale mortalities, arrangements shall be made with O'Donohue's Transport and College Proteins to transport fallen stock for high temperature rendering. Emergency procedures for mass mortality are appended to this plan.

12. PRODUCTION RECORDS

The company will maintain records of all relevant production information. The following information will be recorded:

- Site name
- Pen identification
- Stock type
- Number of fish
- Number of cleanerfish
- Biomass (kg)
- Stocking densities (kg/m³)
- Pen dimensions

- Mortality numbers categorised by likely cause of death
- Fish movements and grading
- Harvest details (pen ID, number of fish, biomass and quality grades)
- Daily oxygen and water temperature records
- Sample weights
- Treatment details
- Feed rates and feed type
- Details of net changes

13. VACCINATION

Where appropriate and effective vaccines are available, all sea going stock will be vaccinated. Choice of vaccine for each cohort of fish will be based on a fish health risk assessment. Vaccine efficacy will be considered in all risk assessments.

14. THERAPEUTIC TREATMENTS

The company veterinarian will determine, where necessary, the appropriate medication to control and/or prevent the outbreak of disease. The veterinarian can supply the animal remedy and prescription to the Operations Manager and/or the feed mill, where appropriate. The Operations Manager will ensure that all animal remedies will be administered according to veterinary advice and/or manufacturers' instructions. All animal remedies will be stored and administered in accordance with the relevant legislation (Animal Remedies Regulations 2007).

The Operations Manager will ensure that the following detailed records are maintained in the "Animal Remedies Record File" for five years following treatment:

- Name of the veterinarian prescribing the animal remedy.
- The name, quantity and date of purchase of the animal remedy.
- Prescription number and date of issue of medicine/chemical.
- Identification of the treated fish/pen.
- Administration method, dosage rate, water temperature and signature of the Production Manager overseeing the administration of the medicine.
- Minimum withdrawal period advised by the veterinarian or manufacturers' instructions and the earliest date for harvesting. In the case of organic fish production, the recommended withdrawal period is multiplied by two.
- Where SLICE is administered for the control of sea lice, the Mowi Ireland standard of a minimum of 1,000 degree days withdrawal is required.

All information will be reported in the Animal Remedies Records file concomitant with treatments. The Operations Manager will present the Animal Remedies Records to an authorised officer (such as a Department of Agriculture, Food and the Marine or the Marine Institute official) upon request.

Any mechanical de-lousing treatments (i.e. use of Hydrolicer or Thermolicer) and freshwater baths against Amoebic Gill Disease (AGD) or prolonged freshwater baths for the control of sea lice will also be recorded in the Animal Remedies Record file.

15. SEA LICE CONTROL AND FALLOWING

Weekly examinations of fish in each site will be conducted throughout the year with a minimum of 20 fish per pen in all pens. All lice stages will be counted and recorded per pen. It is the aim of the company to have average adult female lice levels of less than 0.2 per fish and this, coupled with fallowing, use of cleanerfish, lice bioassay monitoring and rotation of medicines, should ensure good lice control. For ASC (Aquaculture Stewardship Council) sites, during the sensitive period, the action limit is set at 0.1 mature female lice per fish. In order to facilitate good lice control, the following tools will be employed:

- Fallowing between stocks. A minimum fallowing period of 6 weeks is recommended.
- Single year class separation. An all-in-all-out policy should be used whenever possible.
- Proper management of fish densities. Densities will not exceed local SOP's or national guidelines/regulations.
- Clean nets for water circulation. Lice counts are lower when nets are clean and cleanerfish are more effective.
- Routine removal of moribund fish. These fish harbour more lice and should be removed daily.
- Routine removal of mortalities. Daily removal is recommended.
- Co-ordinated and synchronised treatments. These are to be performed within appropriate biological areas.
- Stress reduction, as stress significantly increases susceptibility to lice.
- Deployment of cleanerfish in sites with a higher risk of sea lice infestation.

16. USE OF CLEANERFISH FOR LICE CONTROL

Increasingly, cleanerfish (wrasse and lumpfish) are being used by Mowi Ireland for the control of sea lice. This brings with it an onus of responsibility for the health and welfare of the cleanerfish species and the salmon alike. The prevention and control of disease and pathogen spread as well as fish welfare are of paramount importance, regardless of whether the fish are of farmed or wild origin. In order to achieve this, guidelines for the culture, capture and subsequent maintenance of cleanerfish for use in salmon aquaculture have been developed by Mowi Ireland according to industry standards and the Mowi Code of Best Practice. The guidelines are included in the list of key Standard Operating Procedures. A minimum of the following rules shall apply:

- Cleanerfish will not be fished within a 1km radius of a salmon sea farm, unless they will be deployed to that specific farm.
- Cleanerfish will not be sourced from areas where there are outbreaks of clinical disease in salmon or cleanerfish populations.
- Wherever possible, cleanerfish should be sourced from within a bay/ sea loch. By preference and for biosecurity purposes, the capture and deployment of cleanerfish shall be confined within each of the following compartments:
    - North West Donegal
    - South West Donegal
    - West (Clew Bay and Galway Bay)
    - South West (Kenmare and Bantry Bay)
- Only in exceptional circumstances and following the completion of a risk assessment

should fish be moved from other bays.
- Since it is not practical to collect and store cleanerfish prior to stocking on salmon sites, the Fish Health Unit of the Marine Institute will be notified of the proposed cleanerfish stocking plan at least 2 weeks in advance of the cleanerfish collection and deployment season (notification@marine.ie). In the unlikely event of moving cleanerfish between compartments, cleanerfish will be held in holding tanks and assessed by a veterinarian before movement.
- In conjunction with site visits, regular health checks will be carried out on cleanerfish. In case of elevated mortalities, a veterinarian has to be notified immediately and veterinary examination undertaken.
- Copies of the cleanerfish pre-movement health reports will be furnished to the Marine Institute during the deployment season.
- Handling of wrasse and lumpfish will be kept to a minimum.
- Wherever possible, lumpfish will be vaccinated before deployment to sea at the Ocean Matters hatchery in Anglesey, UK or Bantry Marine Research Station, Co. Cork, depending on the origin of the fish. Fish will be dip-vaccinated twice and receive a booster i.p. injection with an autogenous vaccine before deployment. This vaccine has been developed specifically for lumpfish in Ireland and Scotland and contains pathogens from previous disease outbreaks of lumpfish in sea sites.
- Dead cleanerfish will be removed and documented on a regular basis, same as the salmon mortalities. This is important to monitor overall health and keep track of stocking ratios between cleanerfish and salmon.
- Sick or injured fish should be disposed of quickly and humanely with a blow to the head or an overdose of anaesthetic.

Cleanerfish left in pens after harvesting will be killed humanely and usually not be re-deployed for biosecurity reasons. However, in case of a salmon farm being harvested out without displaying any major disease challenges throughout the production cycle, re-capture and overwintering of the remaining cleanerfish stocks can be attempted and re-deployment considered after additional disease screening of a minimum of 60 fish.

For any further information on cleanerfish, please revert to the Cleanerfish Health Management Plan, TQM document 42587.

17. PLANKTON AND JELLYFISH MONITORING AND MITIGATION

Fish gill damage due to harmful algal blooms (HAB's), nuisance zooplankton and jellyfish can be a significant health challenge at certain times of the year. Procedures are established for the monitoring and mitigation of HAB's and nuisance plankton (see separate SOP's). Site staff is trained in basic water quality monitoring skills. Since there is a knowledge gap in the management of gill disorders, MOWI Ireland currently supports a number of international research efforts in this area of fish health.

18. DISEASE CHALLENGES

For any potential pathogens that could affect Atlantic salmon in the Marine environment, please refer to separate TQM document no. 42391 "Risk analysis for the stocking of farmed

Atlantic salmon".

In order to limit the fish stocks exposure to potential pathogens as much as possible, strict biosecurity measures as outlined in Article 5 of Commission Delegated Regulation (EU) 2020/691 must be adhered to. These measures include, but are not limited to the following:

- Disinfection points must be installed at critical locations in the aquaculture establishment;
- Where the following functional units exist within the same aquaculture establishment, they must be separated using appropriate hygiene barriers:
    - hatchery units,
    - fattening units,
    - processing units
    - dispatch centre;
- Work clothing and footwear for personnel must be kept solely for use at the aquaculture establishment and cleaned and disinfected regularly;
- Equipment must not be shared between aquaculture establishments but where this is unavoidable, an appropriate protocol for cleaning and disinfection of the equipment must be followed;
- Visitors to the aquaculture establishment must be controlled in cases where they pose a disease risk; these visitors must either:
    - wear protective clothing and footwear provided at the aquaculture establishment, or
    - clean and disinfect any protective clothing and footwear they bring onto the aquaculture establishment on arrival and in the case of non-disposable clothing and footwear, on departure;
- Dead animals must be removed from all production units at a frequency that ensures infective pressure is kept to a minimum but which is practicable given the production method used, and disposed of in compliance with Article 13 of Regulation (EC) No 1069/2009 of the European Parliament and of the Council (1);
- As far as possible, equipment in the aquaculture establishment must be cleaned and disinfected at the end of each production cycle;
- Where aquaculture establishments receive fertilised eggs from other establishments, and where biologically feasible, these eggs must be disinfected appropriately on arrival and all packaging must be disinfected or disposed of in a bio-secure manner;
- The cleaning and disinfection records of transporters must be verified before aquatic animals are loaded or unloaded at the aquaculture establishment;

Operators shall nominate a named person to be in charge of implementing the biosecurity plan for the aquaculture establishment with other personnel reporting to that individual in relation to biosecurity matters.

For any further details on biosecurity, please refer to the site-specific biosecurity plans.

19. CHEMICAL STORAGE

All animal remedies will be stored in a locked room/container on site or the licensed premises in Rinmore. Access to this store is restricted to authorised personnel only. It is the responsibility

of the Site Managers to ensure the following:

- To maintain in and out records including type of medication, date received, batch code, expiry date and date administered in the "Chemicals Store Log".
- To restrict access to nominated personnel.
- To keep the room/container tidy, secure, in a good state of repair and vermin-proof.
- Ensure all chemicals are properly labelled.
- Medicines shall be used in strict rotation observing expiry dates.
- To ensure the proper disposal of empties.
- All chemicals that are past the expiry date shall be disposed of according to the manufacturer's instructions.
- Product datasheets (MSDS) for all chemicals purchased by the company will be filed in the "MSDS Datasheets File" or attached to the relevant SOP in the TQM Enterprise Database.

20. VISITORS LOG BOOK

Access to the premises of the farm is restricted to authorised personnel only. All authorised visitors will be asked to sign the "Visitors Log Book" that is kept in the site office. This log book contains the following details:

- Instructions to visitors on the company's disinfection procedures.
- Date of visit.
- Visitor's name & signature.
- Company/organisation.
- Details of visits to other fish farms within the previous 72 hours.
- Written verification that disinfection procedures were carried out.

21. HYGIENE AND DISINFECTION PROCEDURES

The company operates a documented hygiene and disinfecting programme for the control of entry and elimination of fish pathogens as follows:

- All visitors and personnel that have been in contact with fish from other fish farms are required to undergo disinfection procedures. This also includes diving equipment, wellboat operations and other equipment that might be shared between sites.
- Any equipment transferred onto a site shall be washed and disinfected.
- Dispensers with hand sanitisers as well as disinfectant baths shall be placed at the entrance to the farm to ensure the regular disinfection of footwear and equipment. These shall be topped up regularly and maintained relatively free of organic matter to provide efficacious levels of disinfectant.

22. FEED AND FEEDING PRACTISES

The following SOP's will be strictly adhered to:

- Feed shall only be purchased from a licensed and reputable feed manufacturer.
- Feed orders shall be managed in storage to ensure they do not pass their expiry dates.
- Feed that has deteriorated in quality or has been kept for longer than the stipulated

expiry date shall not be used.
- Feeding practises shall ensure that feed is delivered in sufficient quantity to minimise fish crowding and damage.
- Regular observation of feeding behaviour shall be undertaken to assist the assessment of the feeding level. Any abnormalities in feeding will be reported to the site manager and recorded on the feeding sheet.
- Accurate records of the quantity of food shall be recorded.
- Feed conversion ratios shall be assessed by the Production Manager on a regular basis.
- Automatic feeders shall be maintained in good working order and cleaned regularly.
- At critical/stressful periods during the production, fish may be fed approved diets containing vitamin supplements and/or immune-stimulants.

23. TRANSPORTATION OF FISH

The recommendations of the RSPCA Welfare Standards for Farmed Atlantic Salmon (2018) shall be adhered to at all times:

All persons involved in transportation of fish must be familiar with, and transport fish in accordance with, all relevant legislation.

There must be good lines of communication between all of those involved in transporting/harvesting/grading fish in order to avoid potential or actual welfare problems occurring with the fish. These communications must include the:
- Number of fish to be transported.
- Size range of the fish.
- Average weight of the fish,
- Current health status of the fish.

Any handling of fish prior to transport must:
- Be kept to a minimum.
- Be conducted in such a way as to prevent any unnecessary distress to the fish.
- Not result in fish being out of water for more than 15 seconds (unless anaesthetised).

Changes in water temperature and pH during transportation which could compromise fish welfare must be avoided.
Excessive changes in water temperature and pH during transportation must be avoided.
Water temperature and pH during transportation must be as close as possible to that from which the fish came.
Water must be free from contaminants which may be detrimental to the welfare of the fish.

Site staff responsible for moving fish

All journeys must have a transport plan, which:
- Is up to date.
- Covers important aspects of the journey, including:
    - journey times
    - water qualities
    - contingency plans
    - identity of those responsible for fish welfare.

Managers must ensure that all staff, including transport staff, are aware of this transport plan.

Any handling of fish must be kept to a minimum & conducted in such a way as to prevent any unnecessary distress to the fish.

Only healthy, undamaged fish must be transported.
Care must be taken to ensure dead fish are not loaded for transport.
Sick or seriously injured fish must not be transported & be humanely destroyed.

There must be a named member of staff responsible for monitoring the welfare of the fish during loading and unloading.

Records of procedures relating to loading and unloading must be maintained and include details of any casualties or compromises to the welfare of the fish.

Pre-transport fasting must never exceed 48 hours, unless specified by a veterinary surgeon/senior production manager.

If fish pumps are to be used, they must be appropriate for the size of the fish being pumped to avoid injury.
There must be no joints, kinks, bends or rough internal edges on, or in the pipes which may cause physical injury to the fish.
There must be a procedure in place to ensure that all fish are removed from any pipes or other equipment used at the end of loading and unloading or where a breakdown occurs.
The drop from the end of any pipe must be such that it avoids injuring the fish & allows fish to disperse without others landing on top of them.

Hand nets must be of a correct size so that they can be easily lifted and the fish at the bottom of the net are not injured, have a suitable mesh size for the size of the fish which prevents fish escaping & not be overfilled.
Fish must not be netted before they are ready to be received at the transport tanks.

Transport staff

All equipment that the fish rely on for life support must be inspected at least every 4.5 hours.
If any faults are found in the equipment, any fish in transit must be inspected & any problems must be corrected immediately.
Supplementary oxygen or aeration must be available during all transportation, which is sufficient to last at least 50% longer than the anticipated journey length.
Oxygen levels must be monitored throughout the journey (including for any internal journeys) & maintained at a minimum of 80% saturation and/or a minimum of 7mg/litre.
Excessive changes in water temperature and pH during transportation must be avoided.

Any fish which die during transportation must be separated from live fish immediately upon arrival. Records must be kept of any deaths or injuries that occur during transportation.
Transport containers must be cleaned and disinfected after each consignment, to prevent the spread of disease.

Fry transport

Calculation of stocking densities of the floor area of tanks must take into account the tendency of fry to crowd together on the bottom of the tank. The oxygen supply to the

bottom of the tank must take into account the nature of fry crowding behaviour.
There must be a procedure in place to ensure that all fish are removed from any pipes or other equipment used at the end of loading or unloading, and also in case of emergency breakdown.
If a hose is used to flush the tank out at the end of a discharge, it must not be aimed at the fish, but at the side of the tank in order to avoid injuring the fish.
Oxygen levels must be continuously monitored & maintained at a minimum of 7mg/litre.
Air sausages must be securely attached to avoid damaging the fish.

Road transport

The driver of the vehicle must:
- Be fully aware of the transport regulations relating to the fish.
- Understand the needs of the fish being transported.
- Drive in a manner which will not compromise the welfare of the fish.

Tank insulation must be such that it allows the water to remain at a constant temperature +/- 1.5°C from the start of the journey.

Before leaving the site, the driver must perform a visual check of the oxygen levels and rates of aeration into the tanks & record the oxygen levels on the record sheet.

All transport tanks and life support systems must be fit for purpose & be without leaks, chips or cracks.

After the required stocking density has been reached, tanks must be filled to the top with good quality water from a known source. The maximum stocking density must be set so that water quality can be maintained for the duration of the journey.

The maximum stocking density will depend on the distance travelled, but as a general guide it should be within 60–100kg/m3.

Diffused oxygen must be spread around the water column by the use of an oil free compressor.
There must be sufficient aeration to avoid dead spots.
All lids, outlets and any other openings must be fully secured before departure.

During the journey, if oxygen levels become unstable, the driver must:
- Be able to visually check the fish for signs of stress.
- Be able to identify the cause of the oxygen instability.
- Take appropriate action to ensure the welfare of the fish.

After arriving on site, discharge must take place without undue delay. The lorry must be sited to ensure that all tanks can be fully emptied, taking into account any cambers which may be apparent in the ground.
Valves must be suitable for more than one fish to pass through at any one time.
All pipes must be securely attached to prevent fish from escaping during the unloading process.
All unloading must be through valves which do not compromise the welfare of the fish, rather than netting fish from the tanks.
Any pipes used for unloading must be able to be adjusted in order to account for any rise and fall in the tide.

Water must always be in the tanks during unloading in order to avoid the last fish becoming dry and without oxygen. There must be a system for flushing the tanks at the end of unloading to ensure that the last fish is removed without compromising their welfare.

Wellboat transport – smolts

The journey must be planned to ensure that arrivals at the loading and unloading sites are such that they avoid delays in moving the fish.
There must be trained and competent staff available at the site that is to receive fish.
Vessel crew members and skippers must have completed or be able to demonstrate that plans are in place to complete a recognised fish welfare course.

Maximum stocking densities must:
- **Be within 40–50kg/m3 (depending on water quality and size of smolts).**
- **Be set so that water quality can be maintained over the length of the journey.**

If fish counting equipment is in place, it must:
- Be over a de-waterer.
- Be fully maintained.
- Be regularly calibrated to maintain accuracy.
- Be of a design not likely to cause damage or injury to the fish.

The number of fish to be loaded must be known in order to be able to verify compliance with the stocking density.
There must be enough light in the well to enable easy inspection of the fish.
Pumps and pipes used for unloading must be positioned to minimise the height and distance that the fish have to be pumped. Pumps and pipes must be free of any rough edges which might damage the fish.
There must be a method in place to ensure that no fish are left in the pipes after pumping, or during a breakdown.
A humane process must be in place to safeguard fish welfare when removing the last fish from the well.

Water flow through the wells at discharge must be sufficient to facilitate movement of the fish & not be so strong as to cause the fish injury.

A system must be in place to ensure that the numbers of fish to be discharged into each receiving enclosure is pre-planned and reported to well boat staff before discharge begins.

Any fish which die during transportation must be separated from live fish as soon as possible after arrival. Records must be kept of any deaths or injuries that occur during transportation.

24. HARVESTING OF FISH

Ref. Humane Slaughter Association: *Humane Harvesting of Salmon & Trout Guidance on the Humane Handling and Killing of Salmon and Trout. In HAS & CJA 2005. ISBN 1 871561 29 9.*

Current European Legislation requires that all farmed animals are spared avoidable suffering and pain. Although there are few countries that specifically mention fish in their welfare at slaughter legislation, the current general animal welfare laws cover all vertebrates including fish. Besides the legal imperative, humanely killed fish may attract a higher premium and

may be of better quality than conventionally killed fish. As the scientific evidence that fish feel stress and pain increases, the ethical consumer will demand fish that are killed in a humane manner.

Withdrawal of food

Food is withdrawn from fish prior to slaughter to enable the gut to empty its contents. This reduces the chances of the fish being contaminated by gut contents during processing, and thus maintains the keeping quality and hygiene of the final product. Current limited research suggests that, depending on water temperature, a minimum of 72 hours is adequate for the complete emptying of the fish gut whilst minimising adverse welfare effects. Research carried out by Marine Harvest ASA and Nofima (*MHN starvation stress project CAC-study: Pre-harvest feed withdrawal and effects on stress; Sven Martin Jørgensen, Rune Waagbø, Gerrit Timmerhaus, Pål A. Olsvik; April 2015*) showed there to be no negative impact of starving fish for a longer duration (up to 14 days), neither with respect to general fish welfare nor their ability to cope with stress. Thus recommended minimum feed withdrawal duration at varying water temperatures is as follows:

≤ 7°C 5 days feed withdrawal
8-12°C 4 days feed withdrawal
≥ 13°C 3 days feed withdrawal

Crowding

Crowding exposes fish to a rapidly increasing stocking density. As a result, oxygen availability and general water quality may also decrease rapidly. The fish are brought closer to the surface thus increasing their exposure to sunlight. There is also an increased risk of damage from abrasion through contact with nets or other fish. The adverse effects of crowding may be reduced by slowly crowding to reasonable densities. Clean nets and additional oxygen reduce the rate at which the water quality deteriorates. The fish must be brought up and crowded slowly. When fish are crowded too densely, they show vigorous burrowing, gasping and splashing. On the other hand, a good crowd is calm with only the occasional fin breaking the surface. Fish should only be crowded for a maximum of 2 hours.

Removal from water

Removing fish from water will involve some amount of stress. This can be minimised if the time the fish are kept out of water is kept to a minimum. As a guide, fish should not be held out of water for longer than 15s as after that they will show aversive behaviour and become progressively difficult to handle. Pumps and other equipment used to move fish should be regularly checked and maintained. Pipes should be kept as short and straight as possible and should be flushed during extended breaks and at the end of each harvest. Brail nets should have a lining that keeps some water in and reduces damage by abrasion. Loaded brail nets should be moved slowly and should only be emptied after making contact with the killing table. Over-filling the nets may result in physical damage and suffocation.

The killing process is potentially very stressful. The Humane Slaughter Association currently recommends percussive stunning.

Percussive stunning

The traditional method of stunning by a concussive blow to the head remains an inexpensive manner to dispatch fish. A strike of sufficient energy to the head of a fish results in an immediate loss of sensibility. The blow should be targeted at a position where the brain is closest to the surface of the head and where the skull is at its thinnest. An effectively stunned fish will immediately stop rhythmic movement of the opercula and the eye roll reflex. If placed into water, it cannot maintain its balance and it may show muscular quivers. Such a fish will not be responsive to handling and will not exhibit escape responses. Percussive stunning may be irrecoverable, but it is advisable to bleed the fish immediately after a stun to prevent recovery and to improve appearance, taste and keeping quality of the product.

Percussive stunning may be achieved using a priest for small numbers of fish, or for emergency or back-up purposes. For routine commercial operations, automated percussive stunners are advised. It is difficult to maintain the required accuracy with priest stunning when large numbers of fish are being processed. A priest should therefore always be available for dispatching of fish that escape the stunning machine and in case of machine failures.

25. CONTACTS

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26. APPENDICES

Key Standard Operating Procedures	TQM Database Ref. No
AMX Bath Treatment (Tarpaulin)	26133
AMX Lice Treatment in Wellboats	29142
Cleanerfish Capture and Management Protocol	39773
Cleanerfish Feed Record	42155
Cleanerfish Feeding	42603
Cleanerfish Health Management Plan	42587
Cleanerfish Hide Cleaning	42606
Cleanerfish Removal	42607
Cleanerfish Transport	35566
Cleanerfish Welfare policy	42692
Disinfection of Ova	28435
Emergency Plan for Fish Escapes	25561
Emergency Plan for Mass Mortalities	25560
Freshwater Bath Treatments	36945
Freshwater Tank, Channel and Equipment Cleaning	28424
Fry/Smolt Loading and Transport	28436
Gill Disease Monitoring including AGD	33878
Hydrogen Peroxide Lice Treatment in Wellboats	23392
Hydrogen Peroxide Treatment in Tarpaulin	30553
Lice Monitoring	25450
Marine Cleaning and Disinfection	29486
Marine Housekeeping and Biosecurity	29488
Medication of Fish	24337
Method for Inhalation Anaesthesia using Tricaine	21239
MHI Positive Medicine List	27783
Net Washing and Disinfection	28648
Plankton and Jellyfish Monitoring and Mitigation	25555
Predator Control	29575
Risk Analysis for Import of Lumpfish Eggs into Ireland from Norway	42462
Risk Analysis for the Import of Captive Reared Lumpfish into Ireland	42463
Risk Analysis for the Movement of Wild-Caught Wrasse in Ireland	42464
Risk Analysis for the Stocking of Farmed Atlantic Salmon	42391
Salinity Challenge Test and Smolt Evaluation	28441

Sea Lice Treatment Efficacy Monitoring	26072
Sea Lice Treatment Rotation	22961
Sea Lice Treatment with Slice	26077
Smolt Transfer to Sea	25478
Sub-optimal Sea Lice Treatment Efficacy Follow-Up	26074
Use of Idema Net Washer	25468
Vaccination	28440
Washing Pen Pontoons at sea	31003
Waste Monitoring and Management	25564

› Mowi Ireland

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Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
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Plankton & Jellyfish Monitoring & Mitigation

1. Scope:

To monitor water quality in the vicinity of all Mowi seawater sites, thereby assisting in the mitigation of potential plankton blooms.

2. Daily Mandatory Site Monitoring:

Oxygen is measured daily using a handheld oxygen meter on each site. If % saturation drops below 60%, feeding is ceased immediately.
Where available, cameras also assist in daily observations of turbidity and fish behaviour.
A Secchi Disk is used daily to measure turbidity on each site. The depth is recorded on daily feed sheets. If water is extremely turbid, feeding will be ceased.
To use a secchi disk, lower the disk beyond a point of disappearance, then raise it until it appears and lower it slightly to set the secchi depth. Ensure the measurement is taken from the shady side of the boat between 9am and 3pm daily.

Observations are recorded on the Daily feed record sheet.

3. Zooplankton:

A zooplankton tow is conducted once or twice daily on each site, and analysed by trained staff on site. If there are no issues on site, the sample will be stored for 2 -3 weeks and disposed of thereafter.

Materials required:

- Zooplankton tow net
- Small weight, such as weight from diving belt to attach to towing net
- Lugol's iodine
- Funnel
- Sample bottle
- Dissection microscope
- Bogorof tray
- Zooplankton identification poster
- Pipette
- Van Dorn sampler (only occasionally)
- Book "Coastal Plankton" by Larink & Westerheide

To conduct a tow, ensure the net has a detachable weight firmly secured to the base. Screw the sampling bottle to the tail of the net and tighten. When in the desired position (usually in the centre of the site, outside a pen), drop the net to approximately 5 meters from the bottom. Do not allow the net to hit the bottom as it will disturb sediment. Gradually haul the net in and onto deck of boat, gently shaking it once the net breaks the surface so that everything trapped on the sides of the net will end up in the sampling bottle. Using fresh seawater, gently rinse the edges of the net into the sampling bottle. Remove bottle by unscrewing from the tow net. If the divers report a layer of something at a certain depth, consider taking a specific sample from this depth with the Van Dorn sampler. Rinse the mesh with fresh water to avoid crystallisation of sea water on the mesh.

Sample analysis with the dissection microscope:

- Add Lugol's iodine to the sample until it has the colour of weak tea – this kills the plankton and improves the contrast and makes it easier to see.
- Stir the water in the sampling containers well to get a good mix.
- Using a plastic pipette, fill the sample into the Bogorof tray until it is filled to at least 2 thirds.
- Have a look at the sample underneath the dissection microscope. If the sample is too dense to count easily, dilute it by a factor of 10 and try again.
- Count the entire tray. Make sure to focus up and down as some species like *Noctiluca scintillans* tend to float on the water surface while most others sink to the bottom of the tray, so it is easy to miss one or the other.
- After counting, measure the volume of water you had in the tray to be able to calculate numbers back to a number per cubic litre. If you had to dilute the sample, don't forget to multiply it by 10 in the end.

4. Phytoplankton:

Water samples are taken once or twice daily at each Mowi site, and some sites take a weekly sample to be analysed by the Marine Institute. A report is issued by the Marine Institute after species have been identified and counted. This is used as a feedback for staff on site to compare their plankton identification and numbers.

Materials required:

- Lund tube or phytoplankton net
- Van Dorn sampler (occasionally)
- Lugol's iodine
- Sampling bottles
- Sedgwick Rafter counting chamber
- Pipette
- Stereo microscope
- Phytoplankton identification poster
- Book "Coastal Phytoplankton" by Kraberg, Baumann & Dürselen

Sampling protocol:

- **Lund tube & plankton tow nets**: take water sample from the *entire* water column, good to get a first overview of what's in the water in general. Lower tube/net into water, bend tube so that no water can escape during uplift and then fill all the water into a container to analyse under the microscope.

- **Van Dorn sampler**: able to take water samples at *specific depths.* Take samples from 5, 10 and 15m depths (5m depth should be enough during winter months). Lower the sampler to each required depth and release the weight to fill the sampling chamber with water from that specific depth, and then fill the water into a container for analysing.

- **Sample analysis with the stereo microscope:**

- Add Lugol's iodine to the sample until it has the colour of weak tea – this improves the contrast of the plankton and makes it easier to see.
- Stir the water in the sampling containers well to get a good mix.
- Take 1ml of the sample with the plastic pipette and fill it into the Sedgewick-Rafter cell.
- Put the cover slip on top of the cell, try to not enclose any air bubbles in it as this makes it more difficult to analyse the sample.
- Look at the water sample underneath the stereo microscope, using the x10 magnification as a first overview. If you can't distinguish certain features of the plankton, go up to a x40 magnification to identify it.
- Scan through the entire cell, counting the contents of each individual square.
- If there is a certain species in abundance, calculate its number in cells per cubic litre.
- Use the book "Coastal Phytoplankton" for identification.

Remember, even if the species you identified is classified as harmless, large numbers of ANY species can cause problems for the fish by oxygen depletion and may require additional aeration of the pens, especially at night-time or when the plankton starts to die off.

For the Marine Institute sample: Use a Lund tube, take a water sample at approximately 10m deep in centre of the site and pour into sampling bottle provided by the Marine Institute. Each sample must be fixed with 1 – 2 drops of Lugol's iodine, until the water sample is straw-like in colour. Fill out labels supplied by the Marine Institute with all relevant details and fix to the outside of the sample bottle. Place the sample in a padded envelope and post to the Phytoplankton Lab, Marine Institute, Rinville, Oranmore, Co. Galway. If a problem is suspected, phone ahead to the Marine Institute and the sample will be prioritised.

5. Mitigation

In the event of a plankton bloom, or if the presence of harmful species is suspected, feeding will be immediately stopped. Fish are thereby maintained at a deeper position in the water column, minimising the impact of the bloom. Depending on oxygen levels and species present during a bloom, additional aeration will have to be turned on either continuously or at night-time.

Net cleaning/washing is carried out every 8 – 10 days per net, preventing fouling and allowing for good water exchange through pens. Please refer to procedure for use of Idema net and RONC net washers.

5. HES

Ensure all appropriate PPE is worn during handling of Lugol's iodine and formalin.

Location and process	Ireland / Marine Production / Housekeeping & Bio Security	**Document category**	Procedures
Last approved date	06/04/2017 (Joseph Gibbons)	**Last revision date**	11/11/2016
Date changed	11/11/2016 (McManus, Catherine)	**Next revision date**	11/05/2023

Marine Cleaning and Disinfection Procedure:

1. Scope:

The following SOP details the minimum cleaning and disinfection requirements for equipment and personnel at all marine sites.

2. Records:

Record all details on the Equipment Cleaning & Disinfectant Log. Disinfectant of nets should be recorded on specific log, see relevant procedure.

3. Equipment:

Equipment must first be washed with detergent and then disinfected before transfer to storage or any other site. This should be recorded on the attached log. The list of equipment (not exhaustive) is:

- Diving Gear/Equipment
- Fish Pumps & other pipework
- Mort bins
- Mort collection nets
- Pens (following use, when on shore for maintenance) and associated equipment/grid
- Nets (no detergent applied, only disinfectant following thorough wash in net washing drum)
- Fish sampling bin, box net and hand net
- Disinfectant footbaths

Data sheets of detergent and disinfectant should be observed for directions on application and dilution rates.

Also feed storage areas should be regularly swept and kept clean at all times.

4. Personnel:

All staff are responsible for cleaning and disinfecting their PPE where appropriate. At a minimum, PPE must be cleaned and disinfected when staff are moving from one site to another. Where possible, staff should use designated, site specific gear rather than moving PPE from one site to another. Staff should observe disinfectant points for boots at all times.

Visitors PPE should be washed, disinfected and dried after each use. This should also be logged on the attached record.

5. HES & Precautions:

Wear appropriate PPE when handling detergent and disinfectant. Observe relevant SDS sheets.

6. Risk Assessment:

Work Operation: **Marine Cleaning & Disinfection**

OPERATING CONDITIONS: Normal

Marine Cleaning and Disinfection

Mowi Ireland

Location and process	Ireland / Marine Production / Housekeeping & Bio Security	**Document category**	Procedures
Last approved date	06/04/2017 (Joseph Gibbons)	**Last revision date**	11/11/2016
Date changed	11/11/2016 (McManus, Catherine)	**Next revision date**	11/05/2023

Risk Key: **1 - 3 = Low Risk**
4 = Medium Risk
6 – 9 = High Risk

Hazard	Adverse Effects	Hazard Score – No Controls	Controls Measures	Hazard Score with Control	Additional Controls Required
Manual Handling of equipment	Back, cuts to limbs	6	Training, Forklift	3	No Controls Required
Disinfectant Splash (Undiluted)	Eye Injury, dermatitus	9	Gloves, boots, oilsking, goggles, face mask, chemical training, SDS	3	No Controls Required
Spray from pressure washer	Dermatitis, eye injury	9	Gloves, goggles, face mask, oilskins, spill kits, SDS, housekeeping	3	No Controls Required
Spillages of disinfectant	Cuts to limbs, slikp/fall	6	Gloves, Housekeeping, boots, spill kits, chemical training, SDS	3	No Controls Required
Wind (Spray from dispensor)	Dermatitus, inhalation, eye injury	9	Work downwind, face mask, PPE	3	No Controls Required
Disinfectant storage	Spill	6	Chemical store, spill kit, training, SDS, Spill tray, cool dark area	3	No Controls Required
Bin for dive disinfection	Fall into bin	6	Lid kept on bin, out of childrens reach.	3	No Controls required

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	13/01/2023 (Michelle Hay)	**Last revision date**	12/01/2023
Date changed	12/01/2023 (Michelle Hay)	**Next revision date**	12/01/2024

Alphamax Bath Treatment:

1. Scope:

The following procedure describes the bathing method for Alphamax lice treatment using tarpaulins.

2. Responsibility:

It is the responsibility of the Seawater Director to ensure that site Managers follow this procedure as described.

3. When to Treat:

3.1 When the numbers of ovigerous female lice reaches an average of 0.2 per fish. The Seawater Director and the Fish Health Manager must be informed of intention and reason for treatment and the Fish Health Manager/ Veterinary surgeon must issue a prescription and a written direction,

3.2 Fish must be starved for at least 24 hours prior to treatment. For well boat treatments, fish must be starved for 3-5 days.

3.3 In organic stocks, permission must be obtained from the organic certifying bodies before treatments may be carried out.

4. Storage and Issue of Therapeutics:

The Fish Health Manager the Marine Purchase Manager is responsible for storage and issue of Alphamax. All transactions relating to the ordering, storage and issue of Alphamax are held by the Marine Purchasing Manager and Fish Health Manager.

5. Pen bath treatment method:

5.1 Record water temperature and dissolved oxygen before commencing treatment on lice treatment sheet.

5.2 Where required, diffusers should be used to administer the treatment.

5.3 Lift net to all but the last 3 loops (2.5 meters depth).

5.4 If required, oxygenate cage to 10 - 15% higher than background levels, in preparation for a sudden demand in oxygen by the fish. (eg. unusually warm weather).

5.5 Introduce the tarpaulin up tide of the pen.

5.6 Using the two ropes, guide the skirt under the pen and make sure all four sides of the tarpaulin are out of the water to avoid any water escaping. Ensure that there is only a minimum number of staff present and work can only continue upwind.

5.1 Put on all necessary protective gear, oilskins, gloves, face-mask and eye shield.

5.2 Using a graduated cylinder, measure out required dose according to table below.

CAGE DIMENSIONS	PEN DEPTH approx.	PEN VOL. approx.	Alphamax Treatment Vol. (10 mg/ml Deltamethrin) Bath application = 0.3 ml/m^3
31.8 m dia. circle	4 m	3,186 m^3	956 ml for 40 mins.
40.2 m dia circle	4 m	5,058 m^3	1,518 ml for 40 mins.
Wellboat	NA	Various	0.3ml/m^3 for 40 min

Administer Alphamax to the pen after diluting in a bucket or watering can, taking care to avoid creating aerosols and unnecessary splashing.

Remove tarpaulin slowly to avoid sudden change in water conditions. Replace net and ropes to original depths.

6. Records and Reporting:

6.1 Record oxygen levels and water temperature during treatment on the treatment record sheet in addition to volumes of treatment compound used per pen and batch numbers. Details of the crowding must also be recorded. These records must be available for inspection by the relevant Government Departments. A copy of the record format is attached to this procedure.

6.2 Copies of all treatments in addition to pre and post treatment lice counts must be forwarded to the Technical Manager for efficacy assessment.

7. HES Risk Assessment

All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.

Process Flow:

A47 Lift net & Crowd fish
A48 Pull float line into Position
A49 Crowd fish using float line
A50 Pump fish to hold of boat
A51 Pre mix Alpha-max
A54 Pump Alpha Max into well
A55 Pump fish back into Pen
A56 Lower pen net into position

Appendix 3.2

Material Safety Data Sheets for Positive List of Medicines

Company: **Mowi Ireland**
Last update: 26/10/2021

Mowi Positive Medicine List

Chemical name	Medicine type	Product name	Supplier	Indication	Administration	Dose	Withdrawal period	MRL production	MRL more strict markets	MRL most strict market	ASC standard restrictions	Export / sales restrictions*
	Vaccine	ALPHA JECT micro® 6	Pharmaq	*A. salmonicida* subsp. *Salmonicida* , *L. anguillarum,* serotype O1 & O2a *V. salmonicida* IPNV Serotype Sp *M. viscosa*	I.P injection	0.05ml	Zero	No relevance			No	No. Permitted for organic fish.
	Vaccine	Aquavac PD7		Salmon pancreas disease virus (SPDV) strain F93-125, Infectious pancreatic necrosis virus (IPNV) serotype Sp, *Aeromonas salmonicida* subsp. *Salmonicida* , *Vibrio salmonicida* , *Vibrio anguillarum* serotype O1 & O2a, *Moritella viscosa*	I.P injection	0.1ml	Zero	No relevance			No	No. Pernitted for organic fish
	Vaccine	CLYNAV	Elanco	PD (SAV)	I.M injection	0.05ml	Zero	No relevance			No	No. Permitted for organic fish
	Vaccine	ALPHA JECT micro 1 PD	Pharmaq	Salmon pancreas disease virus (SPDV) strain AL V405	I.P injection	0.05ml	Zero	No relevance			No	No. Permitted for organic fish.
Emamectin benzoate	Ectoparasitic	SLICE	MSD	Antiparasitic treatment for fontrol of sealice	Oral	50µg/kg	60 days for export to USA	100 ng/g	US	US- 60 days withdrawal	No	**No but documentation 60 days withdrawal period required for US.** Permitted for organic fish
Deltamethrin	Ectoparasitic	AMX	Pharmaq	Antiparasitic treatment for control of sealice	Bath	0.2ml/m^3	10 degree days.	10 ng/g	Norway/EU/US	N/EU- 10 ng/g; US- absence	No	No- **but verification of absence/ no detection required for US**. Permitted for organic fish.
Paramove®	Ectoparasitic	Hydrogen peroxide 49%	Solvay	Antiparasitic treatment for control of sealice	Bath	1,500 mg/l	24 hours for organic fish	Not required			No	No. Permitted for organic fish.
Tricaine methanesulfonate	Anaesthetic	Tricaine	Pharmaq Ltd	Anaesthetize fish for handling	Bath	7 - 30ppm	21 days	Permitted - No MRL	Canada	0,01 mg/kg	No	No - **but verification <10ppb required for Canada**. 21 days withdrawal for US. Permitted for organic fish
Aqui-S vet	Sedation /Anaesthesia	Isoeugenol	Scan Aqua AS	Sedate/Anaesthetize fish for handling	Bath	Sedation 2 - 5mg/l; Anaesthesia 10 - 14mg/l	4 degree days	6 mg/kg	EU/Norway	6mg/kg	No	Not approved for US
Oxytetracycline	Antibacterial	Maracycline	Univet	Antibiotic	Oral	75mg/kg	800 degree days	100 ng/g	EU	100 ng/g	No	No. Permitted for organic fish.
Florocol	Antibacterial	Florfenicol	MSD	Antibiotic	Oral	1.5g/kg	150 degree days (300 dd for organic fish)	1000ug/kg			No	No. Pernmitted for organic fish
Engemycin	Antibacterial	Oxytetracycline (10% DD solution)	Agri Health	Antibiotic	I.P injection	1ml/10kg	150 degree days (300 dd for organic fish)	100ng/g	EU	100ng/g	No	No. Permitted for pet food.
Betamox	Antibacterial	Amoxicillin trihydrate (150mg/ml suspension)	Agri Health	Antibiotic	I.P injection	1ml/10kg	Use in broodstock only	50ug/kg	EU	50ug/kg	No	MRL applies for pet food.
Bronopol	Antifungal	Pyceze	Elanco	Fungicide	Bath	30-80mg/l	Zero	Permitted - No MRL			No	
Chloramine	Antibacterial	Halmid	Pharmaq	Antiseptic bath for FW	Bath	2-20ppm	No relevance				No	

***If "Sales/ market restrictions" is indicated with other than "No", consult the Food Safety or Fish Health Manager to clarify restrictions or measures to be taken pre harvest. Unless otherwise stated, permitted in Organic production.**

Catherine McManus
Food Safety Manager/ Technical Manager

PACKAGE LEAFLET:

ALPHA JECT micro 1 PD emulsion for injection for Atlantic salmon

1. NAME AND ADDRESS OF THE MARKETING AUTHORISATION HOLDER AND OF THE MANUFACTURING AUTHORISATION HOLDER RESPONSIBLE FOR BATCH RELEASE, IF DIFFERENT

Marketing authorisation holder and manufacturer responsible for batch release:
Pharmaq AS
Skogmo Industriområde
Industrivegen 50
7863 Overhalla
Norway

2. NAME OF THE VETERINARY MEDICINAL PRODUCT

ALPHA JECT micro 1 PD emulsion for injection for Atlantic salmon

3. STATEMENT OF THE ACTIVE SUBSTANCES AND OTHER INGREDIENTS

1 dose (0.05 ml) contains:

Active substance:
Formaldehyde inactivated culture of:
Salmon Pancreas Disease Virus (SPDV) strain AL V405 RPS_{end}[a] ≥ 80%

[a] RPS_{end} = Relative percentage survival at end control mortality in a laboratory test in Atlantic salmon

Adjuvant: Paraffin, light liquid (mineral oil): 23 mg
Excipients: Sorbitan oleate, Polysorbate 80

Emulsion for injection. White to cream coloured emulsion.

4. INDICATION

For active immunisation of Atlantic salmon to reduce mortality, lesions in the heart and pancreas and impaired growth caused by Pancreas Disease (PD).

Onset of immunity: 516 degree days.
Duration of immunity: at least 12 months.

5. CONTRAINDICATIONS

None

6. ADVERSE REACTIONS

Melanisation and vaccine residues are very commonly observed in the abdominal cavity after vaccination. Mild visceral adhesions (corresponding to Speilberg scores 1 – 2) are very common, moderate adhesions (corresponding to Speilberg scores 3) are common, while the occurrence of severe adhesions (corresponding to Speilberg score ≥ 4) is very rare.

Spinal deformities of the so-called “cross-stitch vertebrae” type, have been commonly reported after the use of Alpha Ject micro 1 PD, primarily in fish put at sea in the autumn (S0-generation). These deformities are believed to have multifactorial causes and are possibly linked to the vaccine’s PD component. However, a causal relationship has not been proven.

The frequency of adverse reactions is defined using the following convention:
- very common (more than 1 in 10 animals treated displaying adverse reaction(s))
- common (more than 1 but less than 10 animals in 100 animals treated)
- uncommon (more than 1 but less than 10 animals in 1,000 animals treated)
- rare (more than 1 but less than 10 animals in 10,000 animals treated)
- very rare (less than 1 animal in 10,000 animals treated, including isolated reports)

If you notice any side effects, even those not already listed in this package leaflet or you think that the medicine has not worked, please inform your veterinary surgeon.

7. TARGET SPECIES

Atlantic salmon (*Salmo salar* L) with a minimum weight of 28 g.

8. DOSAGE FOR EACH SPECIES, ROUTE AND METHOD OF ADMINISTRATION

Dosage
A single dose of 0.05 ml per fish with a minimum weight of 28 g.

Administration route
The vaccine should be administered by intraperitoneal (i.p) injection into the midline about one fin length anterior to the base of the pelvic fin.

9. ADVICE ON CORRECT ADMINISTRATION

The vaccine should be left to slowly reach 15 – 20 °C by keeping it at room temperature. The vaccine should be well shaken prior to use by squeezing and shaking for approx. 2 minutes. Only administer if the vaccine appears as a homogenous, cream coloured emulsion.

The fish should be anaesthetised prior to injection. It is recommended to starve the fish for a minimum of 48 hours before vaccination.

To reduce the risk of adverse reactions, it is important to deposit the entire dose into the abdominal cavity. The injection needle used should have appropriate length to penetrate the abdominal wall by 1 – 2 mm.

The injection devices used for vaccination, i.e. automatic vaccination machines or manual syringes, must be designed and suitable for administration of the recommended dose volume in the target species. The devices must be operated by trained personnel and should be calibrated according to the manufacturers´ recommendation prior to use. Special care should be taken to ensure air is removed from the injection equipment (chambers and tubes) prior to vaccination. Regular dose controls (number of injections per bag) are recommended.

10. WITHDRAWAL PERIOD

Zero degree days.

11. SPECIAL STORAGE PRECAUTIONS

Keep out of the sight and reach of children.

Store and transport refrigerated (2 °C – 8 °C).
Do not freeze.
Protect from light.

Do not use this veterinary medicinal product after the expiry date which is stated on the label after "EXP".

Shelf life after first opening the container: 10 hours

Do not use if the vaccine shows signs of a brownish water phase in the bottom of the container before shaking. Contact the manufacturer for further advice.

12. SPECIAL WARNINGS

Special precautions for use in animals:
Fish with clinical symptoms of disease should not be vaccinated. Vaccination should preferably be performed at water temperatures of 15°C or lower. Avoid vaccination during smoltification.

Special precautions to be taken by the person administering the veterinary medicinal product to animals:
The use of needle guards is recommended in order to reduce the risk of accidental self-injection.

To the user:
This product contains mineral oil. Accidental injection/self injection may result in severe pain and swelling, particularly if injected into a joint or finger, and in rare cases could result in the loss of the affected finger if prompt medical attention is not given. If you are accidentally injected with this product, seek prompt medical advice even if only a very small amount is injected and take the package leaflet with you. If pain persists for more than 12 hours after medical examination, seek medical advice again.

To the physician:
This product contains mineral oil. Even if small amounts have been injected, accidental injection with this product can cause intense swelling which may, for example, result in ischemic necrosis and even the loss of a digit. Expert, PROMPT, surgical attention is required and may necessitate early incision and irrigation of the injected area, especially where there is involvement of finger pulp or tendon.

Fertility:
Vaccination of broodfish is not recommended and should be subject to a risk benefit evaluation of the prescribing veterinarian/fish health biologist.

Interaction with other medicinal products and other forms of interaction:
Safety and efficacy data are available which demonstrate that this vaccine can be administered with PHARMAQ's oil adjuvanted multivalent vaccines containing the following antigens: *Aeromonas salmonicida*, *Listonella anguillarum* O1 and O2a, *Vibrio salmonicida*, *Moritella viscosa* and Infectious Pancreas Necrosis Virus (IPNV). The vaccines are administered intraperitoneally either simultaneously (one injection) or in immediate succession (two injections) while fish are anaesthetised.

No information is available on the safety and efficacy of this vaccine when used with any other veterinary medicinal product except the products mentioned above. A decision to use this vaccine

before or after any other veterinary medicinal product therefore needs to be made on a case by case basis.

Overdose (symptoms, emergency procedures, antidotes):
Administration of the vaccine in 0.1 ml (double dose) shows no other adverse reactions than those described in the section "Adverse reactions".

Incompatibilities:
Do not mix with any other veterinary medicinal products.

13. SPECIAL PRECAUTIONS FOR THE DISPOSAL OF UNUSED PRODUCT OR WASTE MATERIALS, IF ANY

Ask your veterinarian/fish health biologist how to dispose of medicines no longer required. These measures should help to protect the environment.

14. DATE ON WHICH THE PACKAGE LEAFLET WAS LAST APPROVED

June 2021

15. OTHER INFORMATION

Reduction of mortality during clinical outbreaks of Pancreas Disease has been documented for up to 15 months post vaccination under field conditions.

Injection bags made of a multilayer plastic foil. The giving port is closed with a rubber stopper.
Pack size: 250 ml and 500 ml

Not all pack sizes may be marketed.

To be supplied only on veterinary prescription.
Vm 21714/4005

PACKAGE LEAFLET:

ALPHA JECT micro 6 emulsion for injection for Atlantic salmon

1. NAME AND ADDRESS OF THE MARKETING AUTHORISATION HOLDER AND OF THE MANUFACTURING AUTHORISATION HOLDER RESPONSIBLE FOR BATCH RELEASE, IF DIFFERENT

Marketing authorisation holder and manufacturer responsible for batch release:
Pharmaq AS
7863 Overhalla
Norway

2. NAME OF THE VETERINARY MEDICINAL PRODUCT

ALPHA JECT micro 6 emulsion for injection for Atlantic salmon.

3. STATEMENT OF THE ACTIVE SUBSTANCES AND OTHER INGREDIENTS

1 dose (0.05 ml) contains:

Active substance:
Formaldehyde inactivated cultures of:

Aeromonas salmonicida subsp. *salmonicida*	RPS ≥ 70 %
*Listonella anguillarum** serotype O1	RPS ≥ 75 %
*Listonella anguillarum** serotype O2a	RPS ≥ 75 %
Vibrio salmonicida	RPS ≥ 90 %
Moritella viscosa	RPS ≥ 60 %
Infectious Pancreatic Necrosis Virus serotype Sp	0.12-0.28 AU

RPS: Relative Percentage Survival in challenge studies on Atlantic salmon.
AU: Antigenicity Units (quantity of virus antigen measured in the final product).
* *Listonella anguilllarum* is synonymous with *Vibrio anguillarum.*

Adjuvant:
Paraffin, light liquid (mineral oil): 23 mg.

Emulsion for injection. White to cream coloured.

4. INDICATIONS

For active immunisation of Atlantic salmon to reduce mortality caused by infections with *Aeromonas salmonicida* (furunculosis), *Vibrio salmonicida* (coldwater vibriosis), *Listonella anguillarum* serotype O1 and O2a (vibriosis), *Moritella viscosa* (winter sore) and IPNV (infectious pancreatic necrosis).

Onset of immunity: 520 degree days post vaccination for the bacterial antigens and
600 degree days post vaccination for IPNV.

Duration of immunity: 1 year for the bacterial antigens and 5.5 months for IPNV.

5. CONTRAINDICATIONS

None.

6. ADVERSE REACTIONS

The frequency of adverse reactions observed after vaccination in laboratory studies and field trails:

Very common: Melanisation in the abdominal cavity
Mild visceral adhesions (Speilberg score 1-2)
Common: Moderate visceral adhesions (Speilberg score 3)
Very rare: Serious visceral adhesions (Speilberg score ≥ 4)

The severity of adverse reactions may be influenced by different factors such as sanitation, vaccination technique, fish size at vaccination and water temperature during vaccination and in the first 6-12 weeks after vaccination. As a general precaution it is recommended to perform vaccination at water temperature of 15°C or below.
Small fish and high water temperature may increase the severity of adverse reactions.

The frequency of adverse reactions is defined using the following convention:
- very common (more than 1 in 10 animals treated displaying adverse reaction(s))
- common (more than 1 but less than 10 animals in 100 animals treated)
- uncommon (more than 1 but less than 10 animals in 1,000 animals treated)
- rare (more than 1 but less than 10 animals in 10,000 animals treated)
- very rare (less than 1 animal in 10,000 animals treated, including isolated reports).

If you notice any side effects, even those not already listed in this package leaflet or you think that the medicine has not worked, please inform your veterinary surgeon/fish health biologist.

7. TARGET SPECIES

Atlantic salmon (*Salmo salar*) of a minimum weight of 25 g.

8. DOSAGE FOR EACH SPECIES, ROUTE(S) AND METHOD OF ADMINISTRATION

Dosage
Administer a single dose of 0.05 ml per fish. Fish should not be vaccinated more than once.

Administration route
The vaccine should be administered by intraperitoneal (i.p) injection into the midline about one fin length anterior to the base of the pelvic fin.
It is recommended to starve the fish for a minimum of 48 hours before vaccination.
The fish should be anaesthetised prior to injection.

9. ADVICE ON CORRECT ADMINISTRATION

To reduce the risk of adverse reactions, it is important to deposit the entire dose in the abdominal cavity. The injection needle used should have appropriate length to penetrate the abdominal wall and 1-2 mm into the abdominal cavity.

Let the vaccine slowly reach 15-20°C by keeping it at room temperature.
Ensure a homogenous emulsion prior to use by squeezing and shaking the vaccine bag for approx. 2 minutes. Only administer the vaccine if it appears as a homogenous, white to cream coloured emulsion after shaking. The vaccine should not be used if the vaccine shows signs of a brownish water phase in the bottom of the container. Contact the distributor for further advice.

The injection devices used for vaccination, i.e. automatic vaccination machines or manual syringes, must be designed and suitable for administration of the recommended dose volume in the target species. The devices must be operated by trained personnel and should be calibrated according to the manufacturers' recommendation prior to use. Special care should be taken to ensure air is removed from the injection equipment (chambers and tubes) prior to vaccination. Regular dose controls are recommended.

The vaccination equipment should be thoroughly cleaned / sterilized before use.

10. WITHDRAWAL PERIOD

Zero degree days.

11. SPECIAL STORAGE PRECAUTIONS

Keep out of the sight and reach of children.

Store and transport refrigerated (2°C-8°C).
Do not freeze.
Protect from light.

Do not use this veterinary medicinal product after the expiry date which is stated on the label after EXP.
Shelf life after first opening the container: 10 hours.

12. SPECIAL WARNINGS

Special precautions for use in animals:
Vaccinate healthy fish only.

Vaccination should preferably be performed at water temperatures of 15°C or below.
Do not vaccinate at water temperatures below 3°C or above 18°C.
Avoid vaccination during smoltification.

Special precautions to be taken by the person administering the veterinary medicinal product to animals:
People with known hypersensitivity to fish vaccines should avoid contact with the veterinary medicinal product.
Protective equipment consisting of guarded needles should be used during manual vaccination.
Ensure that the method of fixation and handling of the fish minimises the risk of accidental self-injection. Repeated self-injections may aggravate the adverse effects or increase the risk of anaphylactic shock.

To the user:
This veterinary medicinal product contains mineral oil. Accidental self-injection may result in severe pain and swelling, particularly if injected into a joint or finger, and in rare cases could result in the loss of the affected finger if prompt medical attention is not given. If you are accidentally injected with this veterinary medicinal product, seek prompt medical advice even if only a very small amount is injected and take the package leaflet with you. If pain persists for more than 12 hours after medical examination, seek medical advice again.

To the physician:
This veterinary medicinal product contains mineral oil. Even if small amounts have been injected, accidental injection with this product can cause intense swelling, which may, for example, result in ischaemic necrosis and even the loss of a digit. Expert, PROMPT, surgical attention is required and may necessitate early incision and irrigation of the injected area, especially where there is involvement of finger pulp or tendon.

Fertility:
The potential effect of vaccination on spawning function has not been investigated.
Vaccination of broodfish should only be done according to a benefit-risk assessment by the responsible veterinarian/fish health biologist.

Interaction with other medicinal products and other forms of interaction:
No information is available on the safety and efficacy of this vaccine when used with any other veterinary medicinal product. A decision to use this vaccine before or after any other veterinary medicinal product therefore needs to be made on a case by case basis.

Overdose (symptoms, emergency procedures, antidotes):
Following administration of 0.1 ml of the vaccine (double dose) no other adverse reactions than those described in section "Adverse reactions" were seen.

Incompatibilities:
Do not mix with any other veterinary medicinal product.

13. SPECIAL PRECAUTIONS FOR THE DISPOSAL OF UNUSED PRODUCT OR WASTE MATERIALS, IF ANY

Ask your veterinary surgeon or fish health biologist how to dispose of medicines no longer required. These measures should help to protect the environment.

14. DATE ON WHICH THE PACKAGE LEAFLET WAS LAST APPROVED

March 2019

15. OTHER INFORMATION

250 ml or 500 ml multilayer plastic foil bag. The giving port is closed with a sealed rubber stopper.

Pack sizes:
250 ml and 500 ml
Not all pack sizes may be marketed.

For animal treatment only.
To be supplied only on veterinary prescription.

For any information about this veterinary medicinal product, please contact:
PHARMAQ AS, Postboks 267 Skøyen, 0213 Oslo, Norway

SAFETY DATA SHEET

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name or designation of the mixture	AMX
Registration number	-
Synonyms	AMX® * Alpha Max * ALPHA MAX® * AMX Deltametrina 10mg/ml * AMX® Deltametrina 10 mg/ml
Issue date	16-October-2018
Version number	02
Revision date	06-May-2020
Supersedes date	16-October-2018

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses	Veterinary Medicinal Product.
Uses advised against	Not for human use.

1.3. Details of the supplier of the safety data sheet

Company name:	PHARMAQ AS (part of Zoetis)
Office address:	Industrivegen 50
Postal address:	Skogmo Industriområde NO-7863 Overhalla, Norway
Phone number:	+47 74 28 08 00
Fax number:	+47 74 28 08 01
Email:	customer.service@pharmaq.no
Website:	http://www.pharmaq.no
Emgergency telephone number:	Norway (Giftinformasjonen): +47 22 59 13 00 United Kingdom: 999 or 112 Italy: 112 Spain (Servicio De Información Toxocológica): +34 91 562 04 20
Additional emergency telephone number:	International CHEMTREC (24 hours): +1-703-527-3887

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

The mixture has been assessed and/or tested for its physical, health and environmental hazards and the following classification applies.

Classification according to Regulation (EC) No 1272/2008 as amended

Health hazards		
Skin corrosion/irritation	Category 2	H315 - Causes skin irritation.
Serious eye damage/eye irritation	Category 2	H319 - Causes serious eye irritation.
Reproductive toxicity (the unborn child)	Category 1B	H360D - May damage the unborn child.
Specific target organ toxicity - single exposure	Category 3 respiratory tract irritation	H335 - May cause respiratory irritation.
Environmental hazards		
Hazardous to the aquatic environment, long-term aquatic hazard	Category 1	H410 - Very toxic to aquatic life with long lasting effects.

Hazard summary Causes serious eye irritation. Causes skin irritation. May cause irritation to the respiratory system. May cause reproductive effects. Dangerous for the environment if discharged into watercourses. Occupational exposure to the substance or mixture may cause adverse health effects.

2.2. Label elements

Label according to Regulation (EC) No. 1272/2008 as amended

Contains: 2-Methylpropan-1-ol, Deltamethrin, N-methyl-2-pyrrolidone

Hazard pictograms

Signal word Danger

Hazard statements

H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H360D	May damage the unborn child.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statements

Prevention

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P261	Avoid breathing mist/vapor.
P264	Wash thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/protective clothing/eye protection/face protection.

Response

P308 + P313	IF exposed or concerned: Get medical advice/attention.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337 + P313	If eye irritation persists: Get medical advice/attention.
P302 + P352	IF ON SKIN: Wash with plenty of water.
P332 + P313	If skin irritation occurs: Get medical advice/attention.
P304 + P340	IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P312	Call a POISON CENTRE/doctor if you feel unwell.
P362 + P364	Take off contaminated clothing and wash it before reuse.
P391	Collect spillage.

Storage

P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.

Disposal

P501	Dispose of contents/container in accordance with local/regional/national/international regulations.

Supplemental label information None.

2.3. Other hazards Not a PBT or vPvB substance or mixture.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

General information

Chemical name	%	CAS-No. / EC No.	REACH Registration No.	Index No.	Notes
Deltamethrin	1	52918-63-5 258-256-6	-	607-319-00-X	
Classification:	Acute Tox. 3;H301, Acute Tox. 3;H311, Acute Tox. 3;H331, Aquatic Acute 1;H400(M=1000000), Aquatic Chronic 1;H410(M=1000000)				
2-Methylpropan-1-ol	0,5	78-83-1 201-148-0	-	603-108-00-1	
Classification:	Flam. Liq. 3;H226, Skin Irrit. 2;H315, Eye Dam. 1;H318, STOT SE 3;H335, STOT SE 3;H336				
N-methyl-2-pyrrolidone	≥ 25	872-50-4 212-828-1	-	606-021-00-7	#
Classification:	Skin Irrit. 2;H315, Eye Irrit. 2;H319, STOT SE 3;H335, Repr. 1B;H360D				

List of abbreviations and symbols that may be used above

#: This substance has been assigned Union workplace exposure limit(s).
M: M-factor
PBT: persistent, bioaccumulative and toxic substance.
vPvB: very persistent and very bioaccumulative substance.
All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

Composition comments The full text for all H-statements is displayed in section 16.

SECTION 4: First aid measures

General information IF exposed or concerned: Get medical advice/attention. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. For personal protection, see section 8 of the SDS.

4.1. Description of first aid measures

Inhalation Move to fresh air. Call a physician if symptoms develop or persist. For breathing difficulties, oxygen may be necessary.

Skin contact Remove contaminated clothing. Wash off with soap and water. If skin irritation or rash occurs: Get medical advice/attention. Wash contaminated clothing before reuse.

Eye contact Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation develops and persists.

Ingestion Rinse mouth. Call a physician or poison control centre immediately. Only induce vomiting at the instruction of medical personnel. Never give anything by mouth to an unconsious person.

4.2. Most important symptoms and effects, both acute and delayed Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. May cause respiratory irritation. Skin irritation. May cause redness and pain.

4.3. Indication of any immediate medical attention and special treatment needed Provide general supportive measures and treat symptomatically. Symptoms may be delayed. Monitor respiratory, cardiac and central nervous system.

SECTION 5: Firefighting measures

General fire hazards No unusual fire or explosion hazards noted. Material will burn in a fire.

5.1. Extinguishing media

Suitable extinguishing media Alcohol resistant foam. Powder. Carbon dioxide (CO2).

Unsuitable extinguishing media Do not use water jet as an extinguisher, as this will spread the fire.

5.2. Special hazards arising from the substance or mixture During fire, gases hazardous to health may be formed.

5.3. Advice for firefighters

Special protective equipment for firefighters Self-contained breathing apparatus and full protective clothing must be worn in case of fire.

Special fire fighting procedures Move containers from fire area if you can do so without risk.

Specific methods Use standard firefighting procedures and consider the hazards of other involved materials.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

For non-emergency personnel Keep unnecessary personnel away. Local authorities should be advised if significant spillages cannot be contained.

For emergency responders Keep unnecessary personnel away. Ensure adequate ventilation. Ventilate the contaminated area. Wear appropriate protective equipment and clothing during clean-up. Avoid breathing mist or vapour. Avoid contact with eyes, skin, and clothing. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.

6.2. Environmental precautions Avoid release to the environment. Inform appropriate managerial or supervisory personnel of all environmental releases. Prevent further leakage or spillage if safe to do so. Avoid discharge into drains, water courses or onto the ground.

6.3. Methods and material for containment and cleaning up Remove sources of ignition. Ensure adequate ventilation. Prevent product from entering drains.

Large Spills: Stop the flow of material, if this is without risk. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Clean surface thoroughly to remove residual contamination.

Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.

Never return spills to original containers for re-use.

6.4. Reference to other sections For personal protection, see section 8 of the SDS. For waste disposal, see section 13 of the SDS.

SECTION 7: Handling and storage

7.1. Precautions for safe handling Do not handle until all safety precautions have been read and understood. Do not handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. Use only with adequate ventilation. Wear appropriate personal protective equipment. Avoid breathing mist or vapour. Avoid contact with eyes, skin, and clothing. Avoid prolonged exposure. Observe good industrial hygiene practices. When using, do not eat, drink or smoke. Wash thoroughly after handling. Wash contaminated clothing before reuse. Avoid release to the environment. Use appropriate container to avoid environmental contamination.

7.2. Conditions for safe storage, including any incompatibilities Store locked up. Store in a well-ventilated place. Store at room temperature. Store in original tightly closed container. Keep away from heat, sparks and open flame. Keep away from food, drink and animal feeding stuffs. Keep out of the reach of children. Use appropriate container to avoid environmental contamination. Store away from incompatible materials (see Section 10 of the SDS).

7.3. Specific end use(s) Veterinary antiparasitic.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits

Austria. MAK List, OEL Ordinance (GwV), BGBl. II, no. 184/2001

Components	Type	Value	Form
2-Methylpropan-1-ol (CAS 78-83-1)	MAK	150 mg/m3	
		50 ppm	
	STEL	600 mg/m3	
		200 ppm	
N-methyl-2-pyrrolidone (CAS 872-50-4)	MAK	40 mg/m3	Vapour.
		10 ppm	Vapour.
	STEL	80 mg/m3	Vapour.
		20 ppm	Vapour.

Belgium. Exposure Limit Values.

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	TWA	154 mg/m3
		50 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Bulgaria. OELs. Regulation No 13 on protection of workers against risks of exposure to chemical agents at work

Components	Type	Value
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Croatia. Dangerous Substance Exposure Limit Values in the Workplace (ELVs), Annexes 1 and 2, Narodne Novine, 13/09

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	MAC	154 mg/m3
		50 ppm
	STEL	231 mg/m3
		75 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	MAC	40 mg/m3

Croatia. Dangerous Substance Exposure Limit Values in the Workplace (ELVs), Annexes 1 and 2, Narodne Novine, 13/09

Components	Type	Value
		10 ppm
	STEL	80 mg/m3
		20 ppm

Cyprus. OELs. Control of factory atmosphere and dangerous substances in factories regulation, PI 311/73, as amended.

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	TWA	150 mg/m3
		50 ppm

Czech Republic. OELs. Government Decree 361

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	Ceiling	600 mg/m3
	TWA	300 mg/m3
N-methyl-2-pyrrolidone (CAS 872-50-4)	Ceiling	80 mg/m3
	TWA	40 mg/m3

Denmark. Exposure Limit Values

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	Ceiling	150 mg/m3
		50 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	TLV	20 mg/m3
		5 ppm

Estonia. OELs. Occupational Exposure Limits of Hazardous Substances. (Annex of Regulation No. 293 of 18 September 2001)

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	TWA	150 mg/m3
		50 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Finland. Workplace Exposure Limits

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	STEL	230 mg/m3
		75 ppm
	TWA	150 mg/m3
		50 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

France. Threshold Limit Values (VLEP) for Occupational Exposure to Chemicals in France, INRS ED 984

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	VME	150 mg/m3

Regulatory status: Indicative limit (VL)

France. Threshold Limit Values (VLEP) for Occupational Exposure to Chemicals in France, INRS ED 984

Components	Type	Value
		50 ppm
Regulatory status:	Indicative limit (VL)	
N-methyl-2-pyrrolidone (CAS 872-50-4)	VLE	80 mg/m3
Regulatory status:	Regulatory indicative (VRI)	
		20 ppm
Regulatory status:	Regulatory indicative (VRI)	
	VME	40 mg/m3
Regulatory status:	Regulatory indicative (VRI)	
		10 ppm
Regulatory status:	Regulatory indicative (VRI)	

Germany. DFG MAK List (advisory OELs). Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area (DFG)

Components	Type	Value	Form
2-Methylpropan-1-ol (CAS 78-83-1)	TWA	310 mg/m3	
		100 ppm	
N-methyl-2-pyrrolidone (CAS 872-50-4)	TWA	82 mg/m3	Vapour and aerosol.
		20 ppm	Vapour and aerosol.

Germany. TRGS 900, Limit Values in the Ambient Air at the Workplace

Components	Type	Value	Form
2-Methylpropan-1-ol (CAS 78-83-1)	AGW	310 mg/m3	
		100 ppm	
N-methyl-2-pyrrolidone (CAS 872-50-4)	AGW	82 mg/m3	Vapour.
		20 ppm	Vapour.

Greece. OELs (Decree No. 90/1999, as amended)

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	STEL	300 mg/m3
		100 ppm
	TWA	300 mg/m3
		100 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Hungary. OELs. Joint Decree on Chemical Safety of Workplaces

Components	Type	Value
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
	TWA	40 mg/m3

Iceland. OELs. Regulation 154/1999 on occupational exposure limits

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	STEL	150 mg/m3
		50 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm

Iceland. OELs. Regulation 154/1999 on occupational exposure limits

Components	Type	Value
	TWA	40 mg/m3
		10 ppm

Ireland. Occupational Exposure Limits

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	STEL	225 mg/m3
		75 ppm
	TWA	150 mg/m3
		50 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Italy. Occupational Exposure Limits

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	TWA	50 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Latvia. OELs. Occupational exposure limit values of chemical substances in work environment

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	TWA	10 mg/m3
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Lithuania. OELs. Limit Values for Chemical Substances, General Requirements

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	TWA	10 mg/m3
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Luxembourg. Binding Occupational exposure limit values (Annex I), Memorial A

Components	Type	Value
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Malta. OELs. Occupational Exposure Limit Values (L.N. 227. of Occupational Health and Safety Authority Act (CAP. 424), Schedules I and V)

Components	Type	Value
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3

Malta. OELs. Occupational Exposure Limit Values (L.N. 227. of Occupational Health and Safety Authority Act (CAP. 424), Schedules I and V)

Components	Type	Value
		20 ppm
	TWA	40 mg/m3
		10 ppm

Netherlands. OELs (binding)

Components	Type	Value
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
	TWA	40 mg/m3

Norway. Administrative Norms for Contaminants in the Workplace

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	Ceiling	75 mg/m3
		25 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TLV	20 mg/m3
		5 ppm

Ordinance of the Minister of Labour and Social Policy on 6 June 2014 on the maximum permissible concentrations and intensities of harmful health factors in the work environment, Journal of Laws 2014, item 817

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	STEL	200 mg/m3
	TWA	100 mg/m3
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
	TWA	40 mg/m3

Portugal. OELs. Decree-Law n. 290/2001 (Journal of the Republic - 1 Series A, n.266)

Components	Type	Value
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Portugal. VLEs. Norm on occupational exposure to chemical agents (NP 1796)

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	TWA	50 ppm

Romania. OELs. Protection of workers from exposure to chemical agents at the workplace

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	STEL	200 mg/m3
		66 ppm
	TWA	100 mg/m3
		33 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Slovakia. OELs. Regulation No. 300/2007 concerning protection of health in work with chemical agents

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	TWA	310 mg/m3
		100 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Slovenia. OELs. Regulations concerning protection of workers against risks due to exposure to chemicals while working (Official Gazette of the Republic of Slovenia)

Components	Type	Value	Form
2-Methylpropan-1-ol (CAS 78-83-1)	TWA	310 mg/m3	
		100 ppm	
N-methyl-2-pyrrolidone (CAS 872-50-4)	TWA	40 mg/m3	Vapour.
		10 ppm	Vapour.

Spain. Occupational Exposure Limits

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	TWA	154 mg/m3
		50 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Sweden. OELs. Work Environment Authority (AV), Occupational Exposure Limit Values (AFS 2015:7)

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	STEL	250 mg/m3
		75 ppm
	TWA	150 mg/m3
		50 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	Ceiling	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Switzerland. SUVA Grenzwerte am Arbeitsplatz

Components	Type	Value	Form
2-Methylpropan-1-ol (CAS 78-83-1)	STEL	150 mg/m3	
		50 ppm	
	TWA	150 mg/m3	
		50 ppm	
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	160 mg/m3	Vapour and aerosol.
		40 ppm	Vapour and aerosol.
	TWA	80 mg/m3	Vapour and aerosol.
		20 ppm	Vapour and aerosol.

UK. EH40 Workplace Exposure Limits (WELs)

Components	Type	Value
2-Methylpropan-1-ol (CAS 78-83-1)	STEL	231 mg/m3
		75 ppm
	TWA	154 mg/m3
		50 ppm
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

EU. Indicative Exposure Limit Values in Directives 91/322/EEC, 2000/39/EC, 2006/15/EC, 2009/161/EU

Components	Type	Value
N-methyl-2-pyrrolidone (CAS 872-50-4)	STEL	80 mg/m3
		20 ppm
	TWA	40 mg/m3
		10 ppm

Biological limit values

Croatia. BLV. Dangerous Substance Exposure Limit Values at Workplace, Annexes 4 (as amended)

Components	Value	Determinant	Specimen	Sampling Time
N-methyl-2-pyrrolidone (CAS 872-50-4)	70 mg/g	5-Hydroxy-N-methyl-2-pyrrolidone	Creatinine in urine	*
	20 mg/g	2-Hydroxy-N-methylsuccinimide	Creatinine in urine	*

* - For sampling details, please see the source document.

Germany. TRGS 903, BAT List (Biological Limit Values)

Components	Value	Determinant	Specimen	Sampling Time
N-methyl-2-pyrrolidone (CAS 872-50-4)	150 mg/l	5-Hydroxy-N-methyl-2-pyrrolidon	Urine	*

* - For sampling details, please see the source document.

Spain. Biological Limit Values (VLBs), Occupational Exposure Limits for Chemical Agents, Table 4

Components	Value	Determinant	Specimen	Sampling Time
N-methyl-2-pyrrolidone (CAS 872-50-4)	70 mg/g	5-Hidroxi-N-metil-2-pirrolidona	Creatinine in urine	*
	20 mg/g	2-Hidroxi-N-metilsuccinimida	Creatinine in urine	*

* - For sampling details, please see the source document.

Recommended monitoring procedures Follow standard monitoring procedures.

Derived no effect levels (DNELs) Not available.

Predicted no effect concentrations (PNECs) Not available.

Exposure guidelines NMP (CASRN 872-50-4): DNEL: Derived No Effect Level.
ECHA: European Chemical Agency.
Inhalation. 14,4 mg/m3. Dermal 4,8 mg/kg/day.

EU Exposure Limit Values: Skin designation

N-methyl-2-pyrrolidone (CAS 872-50-4) Can be absorbed through the skin.

Slovenia. OELs. Regulations concerning protection of workers against risks due to exposure to chemicals while working (Official Gazette of the Republic of Slovenia)

N-methyl-2-pyrrolidone (CAS 872-50-4) Can be absorbed through the skin.

Control banding approach Deltamethrin: Zoetis OEB 4 - Sensitizer (control exposure to the range of 1ug/m3 to <10ug/m3, provide additional precautions to protect from skin contact)

8.2. Exposure controls

Appropriate engineering controls

Avoid exposure - obtain special instructions before use. Ensure adequate ventilation, especially in confined areas. Keep air contamination levels below the exposure limits or within the OEB range listed above in this section. Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

General information

Use personal protective equipment as required. Personal protection equipment should be chosen according to the CEN standards and in discussion with the supplier of the personal protective equipment.

Eye/face protection

Wear tight-fitting goggles or face shield. (e.g. EN 166).

Skin protection

- Hand protection

REACH: Risk Management Measures for Workers - Dermal
Wear appropriate chemical resistant gloves. Impervious gloves. Nitrile or neoprene gloves are recommended. (Ref: BS-EN 374, BS-EN 420).

- Other

REACH: Risk Management Measures for Workers - Dermal
Wear appropriate chemical resistant clothing. Impervious protective clothing is recommended if skin contact with drug product is possible and for bulk processing operations.

Respiratory protection

REACH: Risk Management Measures for Workers - Inhalation
Do not breathe dust/fume/gas/mist/vapours/spray. In case of insufficient ventilation, wear suitable respiratory equipment. Whenever air contamination (mist, vapor or odor) is generated, respiratory protection is recommended as a precaution to minimize exposure. If airborne exposures are within or exceed the Occupational Exposure Band (OEB) range, wear an appropriate respirator with a protection factor sufficient to control exposures to the bottom of the OEB range. If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn. (Ref: EN 143).

Thermal hazards

Wear appropriate thermal protective clothing, when necessary.

Hygiene measures

Observe any medical surveillance requirements. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

Environmental exposure controls

Inform appropriate managerial or supervisory personnel of all environmental releases.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance

Physical state	Liquid.
Form	Liquid.
Colour	Light yellow.
Odour	Slight. Amine-like.
Odour threshold	Not available.
pH	Not available.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	100,0 °C (212,0 °F)
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.

Upper/lower flammability or explosive limits

Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Vapour pressure	Not available.
Vapour density	Not available.
Relative density	Not available.

Solubility(ies)

Solubility (water)	Miscible @ 20C/68F
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.
Explosive properties	Not explosive.
Oxidising properties	Not oxidising.

9.2. Other information

Density	1,04 g/cm3 @ 20C/68F

SECTION 10: Stability and reactivity

10.1. Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
10.2. Chemical stability	Material is stable under normal conditions.
10.3. Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
10.4. Conditions to avoid	Contact with incompatible materials. Avoid temperatures exceeding the flash point. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources.
10.5. Incompatible materials	Peroxides. Phenols. Oxidizing agents.
10.6. Hazardous decomposition products	Irritating and/or toxic fumes and gases may be emitted upon the product's decomposition. May include products of carbon, nitrogen.

SECTION 11: Toxicological information

General information Occupational exposure to the substance or mixture may cause adverse effects.

Information on likely routes of exposure

Inhalation May cause irritation to the respiratory system. Prolonged inhalation may be harmful.

Skin contact Causes skin irritation.

Deltamethrin	Species: Rabbit Severity: Non-irritating

Eye contact Causes serious eye irritation.

Deltamethrin	Species: Rabbit Severity: Mild
N-methyl-2-pyrrolidone	Species: Rabbit Severity: Moderate

Ingestion May be harmful if swallowed. However, ingestion is not likely to be a primary route of occupational exposure.

Symptoms Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. May cause respiratory irritation. Skin irritation. May cause redness and pain.

11.1. Information on toxicological effects

Acute toxicity

Product	Species	Test Results
AMX		
Dermal		
ATE		> 10000 mg/kg
Inhalation		
ATE		> 10 mg/l
Oral		
ATE		> 5000 mg/kg

Components	Species	Test Results
2-Methylpropan-1-ol (CAS 78-83-1)		
Acute		
Dermal		
LD50	Rabbit	3392 mg/kg

Components	Species	Test Results
Oral		
LD50	Rat	2,46 g/kg
Deltamethrin (CAS 52918-63-5)		
Acute		
Dermal		
LD50	Rat	> 2000 mg/kg
		700 mg/kg
Inhalation		
LC50	Rat	0,232 mg/l
Oral		
LD50	Rat	87,4 mg/kg
Chronic		
Oral		
NOAEL	Mouse	1 mg/kg/day, 97 weeks Central nervous system; Not carcinogenic
Subacute		
Dermal		
NOAEL	Rat	1000 mg/kg/day, 21 days No effects at maximum dose
Subchronic		
Oral		
NOAEL	Dog	10 mg/kg/day, 13 weeks Central nervous system
	Rat	10 mg/kg/day, 13 weeks Central nervous system
N-methyl-2-pyrrolidone (CAS 872-50-4)		
Acute		
Dermal		
LD50	Rabbit	8000 mg/kg
Oral		
LD50	Mouse	7725 mg/kg
	Rat	3914 mg/kg
Chronic		
Inhalation		
NOEL	Rat	0,4 mg/l, 2 years Not carcinogenic
Subacute		
Oral		
NOAEL	Mouse	2500 ppm, 28 days Kidney
	Rat	6000 ppm, 28 days None identified

Skin corrosion/irritation Causes skin irritation.

Corrosivity

Deltamethrin	Species: Rabbit Severity: Non-irritating

Serious eye damage/eye irritation Causes serious eye irritation.

Eye contact

Deltamethrin	Species: Rabbit Severity: Mild
N-methyl-2-pyrrolidone	Species: Rabbit Severity: Moderate

Respiratory sensitisation Due to partial or complete lack of data the classification is not possible.

Skin sensitisation Due to partial or complete lack of data the classification is not possible. Pyrethroids can cause allergic dermatitis.

Skin sensitisation

Deltamethrin	GPMT Species: Guinea Pig Severity: negative

Germ cell mutagenicity Due to partial or complete lack of data the classification is not possible.

Mutagenicity

Deltamethrin	Bacterial Mutagenicity (Ames) Result: negative Species: Salmonella , E. coli
N-methyl-2-pyrrolidone	Bacterial Mutagenicity (Ames) Result: negative Species: Salmonella
Deltamethrin	In Vivo Cytogenetics Result: negative Species: Mouse Bone Marrow In Vivo Micronucleus Result: negative Species: Mouse Bone Marrow

Carcinogenicity Due to partial or complete lack of data the classification is not possible.

Hungary. 26/2000 EüM Ordinance on protection against and preventing risk relating to exposure to carcinogens at work (as amended)

Not listed.

IARC Monographs. Overall Evaluation of Carcinogenicity

Deltamethrin (CAS 52918-63-5)	3 Not classifiable as to carcinogenicity to humans.

Reproductive toxicity May damage the unborn child.

Developmental effects

N-methyl-2-pyrrolidone	0,36 mg/l Embryo / Fetal Development, Maternal Toxicity Not Teratogenic Result: NOEL Species: Rat Organ: Inhalation
Deltamethrin	10 mg/kg/day Embryo / Fetal Development, Not Teratogenic Result: NOAEL Species: Mouse Organ: Oral 10 mg/kg/day Embryo / Fetal Development, Not Teratogenic Result: NOAEL Species: Rat Organ: Oral 12 mg/kg/day Fertility and Embryonic Development, No effects at maximum dose Result: NOAEL Species: Mouse Organ: Oral
N-methyl-2-pyrrolidone	237 mg/kg Embryo / Fetal Development, Maternal Toxicity Fetotoxicity Not Teratogenic Result: NOAEL Species: Rat Organ: Dermal
Deltamethrin	5 mg/kg/day Fertility and Embryonic Development, No effects at maximum dose Result: NOAEL Species: Rat Organ: Oral

Reproductivity

N-methyl-2-pyrrolidone	237 mg/kg/day Reproductive & Fertility, Maternal toxicity Fetotoxicity Result: NOEL Species: Rat Organ: Dermal

Specific target organ toxicity - single exposure May cause respiratory irritation.

Specific target organ toxicity - repeated exposure Due to partial or complete lack of data the classification is not possible. This product may affect Nervous system. through prolonged or repeated exposure.

Aspiration hazard Due to partial or complete lack of data the classification is not possible.

Mixture versus substance information No information available

Other information Not available.

SECTION 12: Ecological information

12.1. Toxicity Very toxic to aquatic life with long lasting effects. Avoid release to the environment.

Components		Species	Test Results
2-Methylpropan-1-ol (CAS 78-83-1)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia pulex)	950 - 1200 mg/l, 48 hours
Fish	LC50	Bleak (Alburnus alburnus)	1000 - 3000 mg/l, 96 hours
Deltamethrin (CAS 52918-63-5)			
Aquatic			
Crustacea	EC50	Daphnia magna (Water Flea)	0,0001 mg/l, 48 Hours
Fish	LC50	Brachydanio rerio (Zebra fish)	0,002 mg/l, 96 Hours
		Carp (Cyprinus carpio)	0,0019 - 0,0026 mg/l, 96 hours
		Lepomis macrochirus (Bluegill Sunfish)	0,0007 mg/l, 96 Hours
		Oncorhynchus mykiss (rainbow trout)	0,0004 mg/l, 96 Hours

12.2. Persistence and degradability No data is available on the degradability of this product.

12.3. Bioaccumulative potential No data available for this product.

Bioconcentration factor (BCF) Not available.

12.4. Mobility in soil No data available for this product.

12.5. Results of PBT and vPvB assessment Not a PBT or vPvB substance or mixture. Not available.

12.6. Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

12.7. Additional information

Estonia Dangerous substances in groundwater Data

2-Methylpropan-1-ol (CAS 78-83-1)	Pesticides (total) 0,5 ug/l Pesticides (total) 5 ug/l

Estonia Dangerous substances in soil Data

2-Methylpropan-1-ol (CAS 78-83-1)	Synthetic pesticides (total of active substances) 0,5 mg/kg Synthetic pesticides (total of active substances) 20 mg/kg Synthetic pesticides (total of active substances) 5 mg/kg

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Residual waste Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied.

EU waste code The Waste code should be assigned in discussion between the user, the producer and the waste disposal company. EWC: 18 02 05.

Disposal methods/information	Avoid release to the environment. Do not discharge into drains, water courses or onto the ground. Do not allow this material to drain into sewers/water supplies. Considering the relevant known environmental and human health hazards of the material, review and implement appropriate technical and procedural waste water and waste disposal measures to prevent occupational exposure and environmental release. It is recommended that waste minimization be practiced. The best available technology should be utilized to prevent environmental releases. This may include destructive techniques for waste and wastewater. Dispose of contents/container in accordance with local/regional/national/international regulations.
Special precautions	Dispose in accordance with all applicable regulations.

SECTION 14: Transport information

ADR

14.1. UN number	UN3082
14.2. UN proper shipping name	Environmentally hazardous substance, liquid, n.o.s. (Deltamethrin)
14.3. Transport hazard class(es)	
Class	9
Subsidiary risk	-
Label(s)	9
Hazard No. (ADR)	90
Tunnel restriction code	-
14.4. Packing group	III
14.5. Environmental hazards	Yes
14.6. Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

RID

14.1. UN number	UN3082
14.2. UN proper shipping name	Environmentally hazardous substance, liquid, n.o.s. (Deltamethrin)
14.3. Transport hazard class(es)	
Class	9
Subsidiary risk	-
Label(s)	9
14.4. Packing group	III
14.5. Environmental hazards	Yes
14.6. Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

ADN

14.1. UN number	UN3082
14.2. UN proper shipping name	Environmentally hazardous substance, liquid, n.o.s. (Deltamethrin)
14.3. Transport hazard class(es)	
Class	9
Subsidiary risk	-
Label(s)	9
14.4. Packing group	III
14.5. Environmental hazards	Yes
14.6. Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

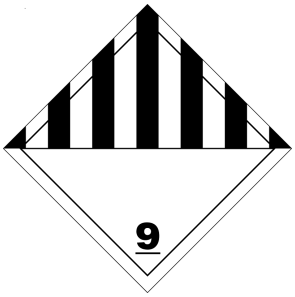
IATA

14.1. UN number	UN3082
14.2. UN proper shipping name	Environmentally hazardous substance, liquid, n.o.s. (Deltamethrin)
14.3. Transport hazard class(es)	
Class	9
Subsidiary risk	-
14.4. Packing group	III
14.5. Environmental hazards	Yes
ERG Code	9L
14.6. Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Other information	
Passenger and cargo aircraft	Allowed with restrictions.
Cargo aircraft only	Allowed with restrictions.

IMDG

14.1. UN number	UN3082
14.2. UN proper shipping name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (Deltamethrin), MARINE POLLUTANT
14.3. Transport hazard class(es)	
Class	9
Subsidiary risk	-
14.4. Packing group	III
14.5. Environmental hazards	
Marine pollutant	Yes
EmS	F-A, S-F
14.6. Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not established.

ADN; ADR; IATA; IMDG; RID



Marine pollutant

General information

IMDG Regulated Marine Pollutant. As of January 1, 2015, materials offered for transport that are classified for transportation only as Marine Pollutants and which are packaged in single or combination packagings containing a net quantity per single or inner packaging of 5 Liters or less for liquids or having a net mass per single or inner packaging of 5 kilograms or less for solids are NOT subject to ICAO/IATA, IMDG, or ADR transport regulations provided the general packaging requirements of those regulations are met. Refer to ICAO/IATA A197, IMDG 2.10.2.7, ADR SP 375. Please refer to the applicable dangerous goods regulations for additional information. Transport according to the requirements of the appropriate regulatory body.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

EU regulations

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex I and II, as amended

Not listed.

Regulation (EC) No. 850/2004 On persistent organic pollutants, Annex I as amended

Not listed.

Regulation (EU) No. 649/2012 concerning the export and import of dangerous chemicals, Annex I, Part 1 as amended

Not listed.

Regulation (EU) No. 649/2012 concerning the export and import of dangerous chemicals, Annex I, Part 2 as amended

Not listed.

Regulation (EU) No. 649/2012 concerning the export and import of dangerous chemicals, Annex I, Part 3 as amended

Not listed.

Regulation (EU) No. 649/2012 concerning the export and import of dangerous chemicals, Annex V as amended

Not listed.

Regulation (EC) No. 166/2006 Annex II Pollutant Release and Transfer Registry, as amended

Not listed.

Regulation (EC) No. 1907/2006, REACH Article 59(10) Candidate List as currently published by ECHA

N-methyl-2-pyrrolidone (CAS 872-50-4)

Authorisations

Regulation (EC) No. 1907/2006, REACH Annex XIV Substances subject to authorization, as amended

Not listed.

Restrictions on use

Regulation (EC) No. 1907/2006, REACH Annex XVII Substances subject to restriction on marketing and use as amended

N-methyl-2-pyrrolidone (CAS 872-50-4)

Directive 2004/37/EC: on the protection of workers from the risks related to exposure to carcinogens and mutagens at work, as amended.

Not listed.

Other EU regulations

Directive 2012/18/EU on major accident hazards involving dangerous substances, as amended

2-Methylpropan-1-ol (CAS 78-83-1)
Deltamethrin (CAS 52918-63-5)

Other regulations	The product is classified and labelled in accordance with Regulation (EC) 1272/2008 (CLP Regulation) as amended. This Safety Data Sheet complies with the requirements of Regulation (EC) No 1907/2006, as amended.
National regulations	Young people under 18 years old are not allowed to work with this product according to EU Directive 94/33/EC on the protection of young people at work, as amended. Follow national regulation on the protection of workers from the risks of exposure to carcinogens and mutagens at work, in accordance with Directive 2004/37/EC.
15.2. Chemical safety assessment	No Chemical Safety Assessment has been carried out.

SECTION 16: Other information

List of abbreviations	ATE: Acute Toxicity Estimate according to REGULATION (EC) No 1272/2008 (CLP).
References	Not available.
Information on evaluation method leading to the classification of mixture	The data contained in this SDS may have been gathered from confidential internal sources, raw material suppliers, or from the published literature. The classification for health and environmental hazards is derived by a combination of calculation methods and test data, if available.
Full text of any H-statements not written out in full under Sections 2 to 15	H226 Flammable liquid and vapour. H301 Toxic if swallowed. H311 Toxic in contact with skin. H315 Causes skin irritation. H318 Causes serious eye damage. H319 Causes serious eye irritation. H331 Toxic if inhaled. H335 May cause respiratory irritation. H336 May cause drowsiness or dizziness. H360D May damage the unborn child. H400 Very toxic to aquatic life. H410 Very toxic to aquatic life with long lasting effects.
Revision information	SECTION 8: Exposure controls/personal protection: Appropriate engineering controls SECTION 8: Exposure controls/personal protection: Exposure guidelines SECTION 8: Exposure controls/personal protection: Eye/face protection SECTION 8: Exposure controls/personal protection: - Hand protection SECTION 8: Exposure controls/personal protection: Respiratory protection SECTION 8: Exposure controls/personal protection: - Other Transport Information: Material Transportation Information
Training information	Follow training instructions when handling this material.
Disclaimer	Zoetis Inc. believes that the information contained in this Safety Data Sheet is accurate, and while it is provided in good faith, it is without warranty of any kind, expressed or implied. If data for a hazard are not included in this document there is no known information at this time. The information in the sheet was written based on the best knowledge and experience currently available.

SUMMARY OF PRODUCT CHARACTERISTICS

1. NAME OF THE VETERINARY MEDICINAL PRODUCT

Aquavac PD7
Emulsion for injection

2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Per dose of 0.1 ml vaccine:
Active substance:
Salmon pancreas disease virus (SPDV) strain F93-125, inactivated, ≥ 75% RPP[1]
Infectious pancreatic necrosis virus (IPNV) serotype Sp, inactivated, ≥ 1.5 ELISA units[2]
Aeromonas salmonicida subsp. salmonicida, inactivated, ≥ 10.7 $\log_2$ ELISA units[3]
Vibrio salmonicida, inactivated, ≥ 90% RPS[4]
Vibrio anguillarum serotype O1, inactivated, ≥ 75% RPS
Vibrio anguillarum serotype O2a, inactivated, ≥ 75% RPS
Moritella viscosa, inactivated, ≥ 5.8 $\log_2$ ELISA units

[1]RPP: relative percentage protection in a laboratory test in Atlantic salmon
[2]Antigenic mass measured in the final product
[3]Serological response in Atlantic salmon
[4]RPS: relative percentage survival in a laboratory test in Atlantic salmon

Adjuvant:
Light liquid paraffin

For a full list of excipients, see section 6.1

3. PHARMACEUTICAL FORM

White to nearly white emulsion for injection.

4. CLINICAL PARTICULARS

4.1 Target species

Atlantic salmon (*Salmo salar* L)

4.2 Indications for use, specifying the target species

For active immunisation of Atlantic salmon to reduce clinical signs, viral shedding and mortality from infection with SPDV (Pancreas disease) and to reduce clinical signs and mortality from infections with IPNV (Infectious pancreatic necrosis), *Aeromonas salmonicida* subsp. *salmonicida* (furunculosis), *Vibrio salmonicida* (cold-water vibriosis), *Vibrio anguillarum* serotype O1 and O2a (vibriosis), and *Moritella viscosa* (wound disease).

Onset of immunity: 500 degree days after vaccination for the bacterial antigens and SPDV and 608 degree days after vaccination for IPNV.
Duration of immunity: at least 18 months for all bacterial antigens. At least 16 months for SPDV.
Duration of immunity for IPNV has not been documented.

4.3 Contraindications

None

4.4 Special warnings

None

4.5 Special precautions for use

Special precautions for use in animals
The vaccine should not be used in diseased or unhealthy fish, fish receiving medical treatment or fish during smoltification.
Do not vaccinate below 2.5 °C or above 17 °C.
Vaccination at high water temperatures (≥ 17 °C) may increase local reactions.
Vaccination of fish below the recommended weight may increase local reactions.
Incorrect vaccination, stress and poor hygiene may lead to increased side effects.

Special precautions to be taken by the person administering the veterinary medicinal product to animals
Personal protective equipment consisting of e.g. needle protector should be used when handling the product.
In case of accidental self-injection, seek medical advice immediately and show the package leaflet or label to the physician.

To the user:
This product contains mineral oil. Accidental injection/self injection may result in severe pain and swelling, particularly if injected into a joint or finger, and can result in the loss of the affected finger if prompt medical attention is not given.
If you are accidentally injected with this product, seek prompt medical advice even if only a very small amount is injected and take the package leaflet with you.
If pain persists for more than 12 hours after medical examination, seek medical advice again.

To the physician:
This product contains mineral oil. Even if small amounts have been injected, accidental injection with this product can cause intense swelling, which may, for example, result in ischaemic necrosis and even the loss of a digit. Expert, PROMPT, surgical attention is required and may necessitate early incision and irrigation of the injected area, especially where there is involvement of finger pulp or tendon.

4.6 Adverse reactions (frequency and seriousness)

Oil adjuvant increases the risk of side effects after vaccination in the form of adhesions and pigmentation in the abdominal cavity. Usually moderate adhesions are seen that can be removed manually and these normally do not involve downgrading at slaughter.

Adhesions typically have an average Speilberg score ≤ 2 with a distribution over fish from 1 to 3.
More extensive changes (Speilberg score 4) may occur, normally in less than 3% of the vaccinated population.
Vaccination may lead to reduction in appetite the first period after vaccination.

4.7 Use during pregnancy, lactation or lay

Do not use in broodstock. The possible effects of vaccination on spawning have not been investigated.

4.8 Interaction with other medicinal products and other forms of interaction

No information is available on the safety and efficacy of this vaccine when used with any other veterinary medicinal product. A decision to use this vaccine before or after any other veterinary medicinal product therefore needs to be made on a case by case basis.

4.9 Amounts to be administered and administration route

Dose: a single dose of 0.1 ml.

Administration: intraperitoneally along the central line, approximately 1 pelvic fin length in front of the pelvic fin base in Atlantic salmon. Shake the bottle well before use.

Vaccination is recommended for fish above 30 grams.

Food should be withheld at least 2 days prior to vaccination. The fish should be anaesthetised before vaccination. The length and the diameter of the applied needle should be adapted to the actual fish size. Ensure that the recommended dose is deposited into the abdominal cavity before the needle is withdrawn.

4.10 Overdose (symptoms, emergency procedures, antidotes), if necessary

Administration of an overdose may result in increased local reactions compared to single dose administration.

4.11 Withdrawal period

Zero degree days.

5. IMMUNOLOGICAL PROPERTIES

Stimulates active immunity against Pancreas disease, Infectious pancreatic necrosis, furunculosis, cold-water vibriosis, vibriosis and wound disease in Atlantic salmon.
ATCvet code: QI10AL

Pharmacotherapeutic group: Inactivated bacterial and viral vaccine.

6. PHARMACEUTICAL PARTICULARS

6.1 List of excipients

Light liquid paraffin
Polysorbate 80
Sorbitan monooleate
Phosphate buffered saline

6.2 Incompatibilities

Do not mix with any other veterinary medicinal product.

6.3 Shelf life

Shelf-life of the veterinary medicinal product as packaged for sale: 9 months.
Shelf-life after first opening the container: use within the same day.

6.4 Special precautions for storage

Store and transport refrigerated (2 – 8 °C). Do not freeze.

6.5 Nature and composition of immediate packaging

Bottles of polyethylene terephthalate (PET) closed with a rubber stopper and aluminium cap.
Package size: 500 ml (5,000 doses).

6.6 Special precautions for the disposal of unused veterinary medicinal products or waste materials derived from use of such products

Any unused veterinary medicinal product or waste materials derived from such veterinary medicinal product should be disposed of in accordance with local requirements.

7. MARKETING AUTHORISATION HOLDER

Intervet International B.V.
Wim de Körverstraat 35
5831 AN Boxmeer
Nederland

8. MARKETING AUTHORISATION NUMBER

13-9717

9. DATE OF FIRST AUTHORISATION / RENEWAL OF THE AUTHORISATION

03.02.2015

10. DATE OF REVISION OF TEXT

15.12.2015

PROHIBITION OF SALE, SUPPLY AND/OR USE

Not applicable.

Oxytetracycline (10%) Formulation

Version	Revision Date:	SDS Number:	Date of last issue: 26.03.2022
1.5	09.04.2022	5499550-00006	Date of first issue: 10.03.2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : Oxytetracycline (10%) Formulation

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Veterinary product

Recommended restrictions on use : Not applicable

1.3 Details of the supplier of the safety data sheet

Company : MSD
Kilsheelan
Clonmel Tipperary, IE

Telephone : 353-51-601000

E-mail address of person responsible for the SDS : EHSDATASTEWARD@msd.com

1.4 Emergency telephone number

1-908-423-6000

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Skin irritation, Category 2	H315: Causes skin irritation.
Eye irritation, Category 2	H319: Causes serious eye irritation.
Skin sensitisation, Category 1	H317: May cause an allergic skin reaction.
Reproductive toxicity, Category 1A	H360D: May damage the unborn child.
Short-term (acute) aquatic hazard, Category 1	H400: Very toxic to aquatic life.
Long-term (chronic) aquatic hazard, Category 1	H410: Very toxic to aquatic life with long lasting effects.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :

Signal word : Danger

Hazard statements : H315 Causes skin irritation.
H317 May cause an allergic skin reaction.
H319 Causes serious eye irritation.
H360D May damage the unborn child.
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statements : **Prevention:**
P201 Obtain special instructions before use.
P264 Wash skin thoroughly after handling.
P273 Avoid release to the environment.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.

Response:
P308 + P313 IF exposed or concerned: Get medical advice/ attention.
P391 Collect spillage.

Hazardous components which must be listed on the label:
oxytetracycline

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

Ecological information: The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

Toxicological information: The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Components

Chemical name	CAS-No. EC-No. Index-No. Registration number	Classification	Concentration (% w/w)
oxytetracycline	79-57-2 201-212-8	Skin Sens. 1A; H317 Repr. 1A; H360D Aquatic Acute 1; H400 Aquatic Chronic 1; H410 M-Factor (Acute aquatic toxicity): 10	>= 10 - < 20

		M-Factor (Chronic aquatic toxicity): 10	
Ethanolamine	141-43-5 205-483-3 603-030-00-8	Acute Tox. 4; H302 Acute Tox. 4; H332 Acute Tox. 4; H312 Skin Corr. 1B; H314 Eye Dam. 1; H318 STOT SE 3; H335 Aquatic Chronic 3; H412 --- specific concentration limit STOT SE 3; H335 >= 5 % --- Acute toxicity estimate Acute oral toxicity: 1,089 mg/kg Acute inhalation toxicity (vapour): 11 mg/l Acute dermal toxicity: 1,018 mg/kg	>= 1 - < 2.5
Sodium hydroxymethanesulphinate	6035-47-8	Muta. 2; H341 Repr. 2; H361d	>= 0.1 - < 1

For explanation of abbreviations see section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice : In the case of accident or if you feel unwell, seek medical advice immediately.
When symptoms persist or in all cases of doubt seek medical advice.

Protection of first-aiders : First Aid responders should pay attention to self-protection, and use the recommended personal protective equipment when the potential for exposure exists (see section 8).

If inhaled : If inhaled, remove to fresh air.
Get medical attention.

In case of skin contact : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.
Get medical attention.
Wash clothing before reuse.

Thoroughly clean shoes before reuse.

In case of eye contact : In case of contact, immediately flush eyes with plenty of water for at least 15 minutes.
If easy to do, remove contact lens, if worn.
Get medical attention.

If swallowed : If swallowed, DO NOT induce vomiting.
Get medical attention.
Rinse mouth thoroughly with water.

4.2 Most important symptoms and effects, both acute and delayed

Risks : Causes skin irritation.
May cause an allergic skin reaction.
Causes serious eye irritation.
May damage the unborn child.

4.3 Indication of any immediate medical attention and special treatment needed

Treatment : Treat symptomatically and supportively.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media : Water spray
Alcohol-resistant foam
Carbon dioxide (CO2)
Dry chemical

Unsuitable extinguishing media : None known.

5.2 Special hazards arising from the substance or mixture

Specific hazards during fire-fighting : Exposure to combustion products may be a hazard to health.

Hazardous combustion products : Carbon oxides
Nitrogen oxides (NOx)

5.3 Advice for firefighters

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.
Use personal protective equipment.

Specific extinguishing methods : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Use water spray to cool unopened containers.
Remove undamaged containers from fire area if it is safe to do so.
Evacuate area.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Follow safe handling advice (see section 7) and personal protective equipment recommendations (see section 8).

6.2 Environmental precautions

Environmental precautions : Avoid release to the environment.
Prevent further leakage or spillage if safe to do so.
Prevent spreading over a wide area (e.g. by containment or oil barriers).
Retain and dispose of contaminated wash water.
Local authorities should be advised if significant spillages cannot be contained.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Soak up with inert absorbent material.
For large spills, provide dyking or other appropriate containment to keep material from spreading. If dyked material can be pumped, store recovered material in appropriate container.
Clean up remaining materials from spill with suitable absorbent.
Local or national regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which regulations are applicable.
Sections 13 and 15 of this SDS provide information regarding certain local or national requirements.

6.4 Reference to other sections

See sections: 7, 8, 11, 12 and 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Technical measures : See Engineering measures under EXPOSURE CONTROLS/PERSONAL PROTECTION section.

Local/Total ventilation : If sufficient ventilation is unavailable, use with local exhaust ventilation.

Advice on safe handling : Do not get on skin or clothing.
Avoid breathing mist or vapours.
Do not swallow.
Do not get in eyes.
Wash skin thoroughly after handling.
Handle in accordance with good industrial hygiene and safety practice, based on the results of the workplace exposure assessment
Keep container tightly closed.
Take care to prevent spills, waste and minimize release to the

environment.

Hygiene measures : If exposure to chemical is likely during typical use, provide eye flushing systems and safety showers close to the working place. When using do not eat, drink or smoke. Contaminated work clothing should not be allowed out of the workplace. Wash contaminated clothing before re-use.
The effective operation of a facility should include review of engineering controls, proper personal protective equipment, appropriate degowning and decontamination procedures, industrial hygiene monitoring, medical surveillance and the use of administrative controls.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep in properly labelled containers. Store locked up. Keep tightly closed. Store in accordance with the particular national regulations.

Advice on common storage : Do not store with the following product types:
Strong oxidizing agents
Self-reactive substances and mixtures
Organic peroxides
Explosives
Gases

7.3 Specific end use(s)

Specific use(s) : No data available

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational Exposure Limits

Components	CAS-No.	Value type (Form of exposure)	Control parameters	Basis
oxytetracycline	79-57-2	TWA	500 µg/m3 (OEB 2)	Internal
	Further information: DSEN			
		Wipe limit	100 µg/100 cm²	Internal
Ethanolamine	141-43-5	TWA	1 ppm 2.5 mg/m3	2006/15/EC
	Further information: Indicative, Identifies the possibility of significant uptake through the skin			
		STEL	3 ppm 7.6 mg/m3	2006/15/EC
	Further information: Indicative, Identifies the possibility of significant uptake through the skin			
		OELV - 8 hrs (TWA)	1 ppm 2.5 mg/m3	IE OEL
	Further information: Substances which have the capacity to penetrate intact skin when they come in contact with it, and be absorbed into the body			
		OELV - 15 min (STEL)	3 ppm 7.6 mg/m3	IE OEL

	Further information: Substances which have the capacity to penetrate intact skin when they come in contact with it, and be absorbed into the body

Derived No Effect Level (DNEL) according to Regulation (EC) No. 1907/2006:

Substance name	End Use	Exposure routes	Potential health effects	Value
Ethanolamine	Workers	Inhalation	Long-term local effects	3.3 mg/m3
	Workers	Skin contact	Long-term systemic effects	1 mg/kg bw/day
	Consumers	Inhalation	Long-term local effects	2 mg/m3
	Consumers	Skin contact	Long-term systemic effects	0.24 mg/kg bw/day
	Consumers	Ingestion	Long-term systemic effects	3.75 mg/kg bw/day

Predicted No Effect Concentration (PNEC) according to Regulation (EC) No. 1907/2006:

Substance name	Environmental Compartment	Value
Ethanolamine	Fresh water	0.085 mg/l
	Freshwater - intermittent	0.028 mg/l
	Marine water	0.0085 mg/l
	Sewage treatment plant	100 mg/l
	Fresh water sediment	0.434 mg/kg dry weight (d.w.)
	Marine sediment	0.0434 mg/kg dry weight (d.w.)
	Soil	0.0367 mg/kg dry weight (d.w.)

8.2 Exposure controls

Engineering measures

Use appropriate engineering controls and manufacturing technologies to control airborne concentrations (e.g., drip-less quick connections).
All engineering controls should be implemented by facility design and operated in accordance with GMP principles to protect products, workers, and the environment.
Laboratory operations do not require special containment.

Personal protective equipment

Eye protection : Wear safety glasses with side shields or goggles.
If the work environment or activity involves dusty conditions, mists or aerosols, wear the appropriate goggles.
Wear a faceshield or other full face protection if there is a potential for direct contact to the face with dusts, mists, or aerosols.

Hand protection
Material : Chemical-resistant gloves

Skin and body protection : Work uniform or laboratory coat.
Respiratory protection : If adequate local exhaust ventilation is not available or exposure assessment demonstrates exposures outside the recommended guidelines, use respiratory protection.

Filter type	:	Equipment should conform to I.S. EN 14387 Combined particulates and organic vapour type (A-P)

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	:	suspension
Colour	:	No data available
Odour	:	No data available
Odour Threshold	:	No data available
Melting point/freezing point	:	No data available
Initial boiling point and boiling range	:	No data available
Flammability (solid, gas)	:	Not applicable
Flammability (liquids)	:	No data available
Upper explosion limit / Upper flammability limit	:	No data available
Lower explosion limit / Lower flammability limit	:	No data available
Flash point	:	No data available
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
pH	:	No data available
Viscosity		
Viscosity, kinematic	:	Not applicable
Solubility(ies)		
Water solubility	:	No data available
Partition coefficient: n-octanol/water	:	Not applicable
Vapour pressure	:	No data available
Relative density	:	No data available
Density	:	No data available
Relative vapour density	:	Not applicable
Particle characteristics		
Particle size	:	Not applicable

9.2 Other information

Explosives	:	Not explosive
Oxidizing properties	:	The substance or mixture is not classified as oxidizing.
Evaporation rate	:	Not applicable
Molecular weight	:	No data available

SECTION 10: Stability and reactivity

10.1 Reactivity
Not classified as a reactivity hazard.

10.2 Chemical stability
Stable under normal conditions.

10.3 Possibility of hazardous reactions
Hazardous reactions : Can react with strong oxidizing agents.

10.4 Conditions to avoid
Conditions to avoid : None known.

10.5 Incompatible materials
Materials to avoid : Oxidizing agents

10.6 Hazardous decomposition products
No hazardous decomposition products are known.

SECTION 11: Toxicological information

11.1 Information on hazard classes as defined in Regulation (EC) No 1272/2008
Information on likely routes of exposure : Inhalation
Skin contact
Ingestion
Eye contact

Acute toxicity

Not classified based on available information.

Product:

Acute oral toxicity	:	Acute toxicity estimate: > 2,000 mg/kg Method: Calculation method
Acute inhalation toxicity	:	Acute toxicity estimate: > 20 mg/l Exposure time: 4 h Test atmosphere: vapour Method: Calculation method
Acute dermal toxicity	:	Acute toxicity estimate: > 2,000 mg/kg Method: Calculation method

Components:

oxytetracycline:

Acute oral toxicity	:	LD50 (Rat): 4,800 mg/kg LD50 (Mouse): 2,240 mg/kg Remarks: Evidence of phototoxicity was observed
Acute inhalation toxicity	:	Remarks: No data available
Acute dermal toxicity	:	Remarks: No data available
Acute toxicity (other routes of administration)	:	LD50 (Rat): 4,840 mg/kg Application Route: Intramuscular LD50 (Mouse): 3,500 mg/kg Application Route: Subcutaneous

Ethanolamine:

Acute oral toxicity	:	LD50 (Rat): 1,089 mg/kg Acute toxicity estimate: 1,089 mg/kg Method: Calculation method
Acute inhalation toxicity	:	Acute toxicity estimate: 11 mg/l Exposure time: 4 h Test atmosphere: vapour Method: Expert judgement Remarks: Based on harmonised classification in EU regulation 1272/2008, Annex VI
Acute dermal toxicity	:	LD50 (Rabbit, female): 1,018 mg/kg Acute toxicity estimate: 1,018 mg/kg Method: Calculation method

Sodium hydroxymethanesulphinate:

Acute oral toxicity	:	LD50 (Rat): > 5,000 mg/kg Method: OECD Test Guideline 423 Remarks: Based on data from similar materials
Acute dermal toxicity	:	LD50 (Rat): > 2,000 mg/kg Method: OECD Test Guideline 402 Remarks: Based on data from similar materials

Skin corrosion/irritation

Causes skin irritation.

Components:

oxytetracycline:

Remarks : No data available

Ethanolamine:

Species : Rabbit
Result : Corrosive after 3 minutes to 1 hour of exposure

Sodium hydroxymethanesulphinate:

Species : Rat
Result : No skin irritation
Remarks : Based on data from similar materials

Serious eye damage/eye irritation

Causes serious eye irritation.

Components:

oxytetracycline:

Remarks : No data available

Ethanolamine:

Species : Rabbit
Result : Irreversible effects on the eye

Sodium hydroxymethanesulphinate:

Species : Rabbit
Method : OECD Test Guideline 405
Result : No eye irritation
Remarks : Based on data from similar materials

Respiratory or skin sensitisation

Skin sensitisation

May cause an allergic skin reaction.

Respiratory sensitisation

Not classified based on available information.

Components:

oxytetracycline:

Test Type : Human repeat insult patch test (HRIPT)
Result : Sensitiser

Ethanolamine:

Test Type : Maximisation Test
Exposure routes : Skin contact
Species : Guinea pig
Result : negative

Sodium hydroxymethanesulphinate:

Test Type	:	Maximisation Test
Exposure routes	:	Skin contact
Species	:	Guinea pig
Method	:	OECD Test Guideline 406
Result	:	negative
Remarks	:	Based on data from similar materials

Germ cell mutagenicity

Not classified based on available information.

Components:

oxytetracycline:

Genotoxicity in vitro	:	Test Type: Microbial mutagenesis assay (Ames test) Result: negative Test Type: Mouse Lymphoma Metabolic activation: Metabolic activation Result: positive Test Type: sister chromatid exchange assay Test system: Chinese hamster ovary cells Result: equivocal Test Type: Chromosomal aberration Result: negative
Genotoxicity in vivo	:	Test Type: Micronucleus test Species: Mouse Cell type: Bone marrow Application Route: Oral Result: equivocal Test Type: in vivo assay Species: Mouse Application Route: Intraperitoneal injection Result: negative
Germ cell mutagenicity- Assessment	:	Weight of evidence does not support classification as a germ cell mutagen.

Ethanolamine:

Genotoxicity in vitro	:	Test Type: Bacterial reverse mutation assay (AMES) Result: negative Test Type: In vitro mammalian cell gene mutation test Method: OECD Test Guideline 476 Result: negative Test Type: Chromosome aberration test in vitro Result: negative

Genotoxicity in vivo	:	Test Type: Mammalian erythrocyte micronucleus test (in vivo cytogenetic assay) Species: Mouse Application Route: Ingestion Method: OECD Test Guideline 474 Result: negative

Sodium hydroxymethanesulphinate:

Genotoxicity in vitro	:	Test Type: Bacterial reverse mutation assay (AMES) Method: OECD Test Guideline 471 Result: negative Remarks: Based on data from similar materials
Genotoxicity in vivo	:	Test Type: Mammalian erythrocyte micronucleus test (in vivo cytogenetic assay) Species: Mouse Application Route: Intraperitoneal injection Method: OECD Test Guideline 474 Result: positive Remarks: Based on data from similar materials
Germ cell mutagenicity- Assessment	:	Positive result(s) from in vivo mammalian somatic cell mutagenicity tests.

Carcinogenicity

Not classified based on available information.

Components:

oxytetracycline:

Species	:	Mouse
Application Route	:	Oral
Exposure time	:	104 weeks
Result	:	negative

Species	:	Rat
Application Route	:	Oral
Exposure time	:	103 weeks
Result	:	equivocal
Target Organs	:	Adrenal gland, Pituitary gland
Remarks	:	The mechanism or mode of action may not be relevant in humans.
Carcinogenicity - Assessment	:	Weight of evidence does not support classification as a carcinogen

Reproductive toxicity

May damage the unborn child.

Components:

oxytetracycline:

Effects on fertility	:	Test Type: Two-generation reproduction toxicity study

Species: Rat
Application Route: Oral
Fertility: NOAEL: 18 mg/kg body weight
Result: No effects on fertility, No effect on reproduction capacity, No significant adverse effects were reported

Effects on foetal development : Test Type: Embryo-foetal development
Species: Rat
Application Route: Oral
Embryo-foetal toxicity: LOAEL: 48 mg/kg body weight
Result: Postimplantation loss., Skeletal malformations

Test Type: Embryo-foetal development
Species: Rat
Application Route: Oral
General Toxicity Maternal: LOAEL: 1,200 mg/kg body weight
Embryo-foetal toxicity: NOAEL: 1,500 mg/kg body weight
Result: No teratogenic effects
Remarks: Maternal toxicity observed.

Test Type: Embryo-foetal development
Species: Mouse
Application Route: Oral
General Toxicity Maternal: LOAEL: 1,325 mg/kg body weight
Embryo-foetal toxicity: NOAEL: 2,100 mg/kg body weight
Result: No teratogenic effects
Remarks: Maternal toxicity observed.

Test Type: Embryo-foetal development
Species: Rabbit
Application Route: Intramuscular
Embryo-foetal toxicity: LOAEL: 41.5 mg/kg body weight
Result: Postimplantation loss., No foetal abnormalities

Test Type: Embryo-foetal development
Species: Dog
Application Route: Intramuscular
Embryo-foetal toxicity: LOAEL: 20.75 mg/kg body weight
Result: Skeletal and visceral variations, Postimplantation loss.

Reproductive toxicity - Assessment : Positive evidence of adverse effects on development from human epidemiological studies.

Ethanolamine:

Effects on fertility : Test Type: Two-generation reproduction toxicity study
Species: Rat
Application Route: Ingestion
Method: OECD Test Guideline 416
Result: negative
Remarks: Based on data from similar materials

Effects on foetal development : Test Type: Embryo-foetal development
Species: Rat

Application Route: Ingestion
Method: OECD Test Guideline 414
Result: negative

Sodium hydroxymethanesulphinate:

Effects on fertility : Test Type: Combined repeated dose toxicity study with the reproduction/developmental toxicity screening test
Species: Rat
Application Route: Ingestion
Method: OECD Test Guideline 422
Result: negative
Remarks: Based on data from similar materials

Effects on foetal development : Test Type: Embryo-foetal development
Species: Rat
Application Route: Ingestion
Method: OECD Test Guideline 414
Result: positive
Remarks: Based on data from similar materials

Reproductive toxicity - Assessment : Some evidence of adverse effects on development, based on animal experiments.

STOT - single exposure

Not classified based on available information.

Components:

Ethanolamine:

Assessment : May cause respiratory irritation.

STOT - repeated exposure

Not classified based on available information.

Components:

Ethanolamine:

Assessment : No significant health effects observed in animals at concentrations of 0.2 mg/l/6h/d or less.

Repeated dose toxicity

Components:

oxytetracycline:

Species : Rat
LOAEL : 198 mg/kg
Application Route : Oral
Exposure time : 13 Weeks
Target Organs : Bone
Remarks : No significant adverse effects were reported

Species	:	Mouse
LOAEL	:	7,990 mg/kg
Application Route	:	Oral
Exposure time	:	13 Weeks
Target Organs	:	Bone
Remarks	:	No significant adverse effects were reported

Species	:	Dog
NOAEL	:	125 mg/kg
LOAEL	:	250 mg/kg
Application Route	:	Oral
Exposure time	:	12 Months
Target Organs	:	Testis
Remarks	:	Significant toxicity observed in testing

Species	:	Rat
NOAEL	:	40 mg/kg
LOAEL	:	100 mg/kg
Application Route	:	Intraperitoneal
Exposure time	:	14 Days
Target Organs	:	Kidney

Ethanolamine:

Species	:	Rat
NOAEL	:	> 120 mg/kg
Application Route	:	Ingestion
Exposure time	:	> 75 Days
Remarks	:	Based on data from similar materials

Species	:	Rat
NOAEL	:	>= 0.15 mg/l
Application Route	:	inhalation (dust/mist/fume)
Exposure time	:	28 Days
Method	:	OECD Test Guideline 412

Sodium hydroxymethanesulphinate:

Species	:	Rat
NOAEL	:	600 mg/kg
Application Route	:	Ingestion
Exposure time	:	90 Days
Method	:	OECD Test Guideline 408
Remarks	:	Based on data from similar materials

Aspiration toxicity

Not classified based on available information.

11.2 Information on other hazards

Endocrine disrupting properties

Product:

Assessment	:	The substance/mixture does not contain components consid-

ered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

Experience with human exposure

Components:

oxytetracycline:

Ingestion : Symptoms: Gastrointestinal disturbance, tooth discoloration
Remarks: May cause birth defects.

SECTION 12: Ecological information

12.1 Toxicity

Components:

oxytetracycline:

Toxicity to fish	:	LC50 (Oryzias latipes (Japanese medaka)): 110 mg/l Exposure time: 96 h Method: OECD Test Guideline 203
Toxicity to daphnia and other aquatic invertebrates	:	EC50 (Daphnia magna (Water flea)): 621 mg/l Exposure time: 48 h Method: OECD Test Guideline 202 EC50 (Daphnia magna (Water flea)): 669 mg/l Exposure time: 48 h Method: OECD Test Guideline 202
Toxicity to algae/aquatic plants	:	EC50 (Anabaena): 0.032 mg/l Exposure time: 72 h NOEC (Anabaena): 0.0031 mg/l Exposure time: 72 h
M-Factor (Acute aquatic toxicity)	:	10
Toxicity to microorganisms	:	EC50 : 17.9 mg/l Exposure time: 3 h Test Type: Respiration inhibition Method: OECD Test Guideline 209 NOEC : 0.2 mg/l Exposure time: 3 h Test Type: Respiration inhibition Method: OECD Test Guideline 209
M-Factor (Chronic aquatic toxicity)	:	10

Ethanolamine:

Toxicity to fish	:	LC50 (Cyprinus carpio (Carp)): 349 mg/l Exposure time: 96 h Method: Directive 67/548/EEC, Annex V, C.1.
Toxicity to daphnia and other aquatic invertebrates	:	EC50 (Daphnia magna (Water flea)): 65 mg/l Exposure time: 48 h Method: Directive 67/548/EEC, Annex V, C.2.
Toxicity to algae/aquatic plants	:	ErC50 (Pseudokirchneriella subcapitata (green algae)): 2.8 mg/l Exposure time: 72 h Method: OECD Test Guideline 201 NOEC (Pseudokirchneriella subcapitata (green algae)): 1 mg/l Exposure time: 72 h Method: OECD Test Guideline 201
Toxicity to microorganisms	:	EC10 (Pseudomonas putida): > 1,000 mg/l Exposure time: 30 min Method: OECD Test Guideline 209
Toxicity to fish (Chronic toxicity)	:	NOEC: 1.24 mg/l Exposure time: 41 d Species: Oryzias latipes (Orange-red killifish) Method: OECD Test Guideline 210
Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity)	:	NOEC: 0.85 mg/l Exposure time: 21 d Species: Daphnia magna (Water flea)

Sodium hydroxymethanesulphinate:

Toxicity to fish	:	LC50 (Leuciscus idus (Golden orfe)): > 10,000 mg/l Exposure time: 96 h Remarks: Based on data from similar materials
Toxicity to daphnia and other aquatic invertebrates	:	EC50 (Daphnia magna (Water flea)): > 100 mg/l Exposure time: 48 h Method: OECD Test Guideline 202 Remarks: Based on data from similar materials
Toxicity to algae/aquatic plants	:	ErC50 (Desmodesmus subspicatus (green algae)): 370 mg/l Exposure time: 72 h Method: OECD Test Guideline 201 Remarks: Based on data from similar materials
Toxicity to microorganisms	:	EC50 : > 1,000 mg/l Exposure time: 4 h Remarks: Based on data from similar materials
Toxicity to fish (Chronic toxicity)	:	NOEC: 13.5 mg/l Exposure time: 35 d Species: Danio rerio (zebra fish)

Method: OECD Test Guideline 210
Remarks: Based on data from similar materials

Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity) : NOEC: 5.6 mg/l
Exposure time: 21 d
Species: Daphnia magna (Water flea)
Method: OECD Test Guideline 211
Remarks: Based on data from similar materials

12.2 Persistence and degradability

Components:

Ethanolamine:

Biodegradability : Result: Readily biodegradable.
Biodegradation: > 90 %
Exposure time: 21 d
Method: OECD Test Guideline 301A

Sodium hydroxymethanesulphinate:

Biodegradability : Result: Readily biodegradable.
Biodegradation: 77 %
Exposure time: 28 d
Method: OECD Test Guideline 301B
Remarks: Based on data from similar materials

12.3 Bioaccumulative potential

Components:

Ethanolamine:

Partition coefficient: n-octanol/water : log Pow: -2.3
Method: OECD Test Guideline 107

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Endocrine disrupting properties

Product:

Assessment : The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at

levels of 0.1% or higher.

12.7 Other adverse effects

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product	:	Dispose of in accordance with local regulations. According to the European Waste Catalogue, Waste Codes are not product specific, but application specific. Waste codes should be assigned by the user, preferably in discussion with the waste disposal authorities.
Contaminated packaging	:	Empty containers should be taken to an approved waste handling site for recycling or disposal. If not otherwise specified: Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number or ID number

ADN	:	UN 3082
ADR	:	UN 3082
RID	:	UN 3082
IMDG	:	UN 3082
IATA	:	UN 3082

14.2 UN proper shipping name

ADN	:	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (oxytetracycline)
ADR	:	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (oxytetracycline)
RID	:	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (oxytetracycline)
IMDG	:	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (oxytetracycline)
IATA	:	Environmentally hazardous substance, liquid, n.o.s. (oxytetracycline)

14.3 Transport hazard class(es)

ADN	:	9
ADR	:	9
RID	:	9

IMDG : 9

IATA : 9

14.4 Packing group

ADN

Packing group	:	III
Classification Code	:	M6
Hazard Identification Number	:	90
Labels	:	9

ADR

Packing group	:	III
Classification Code	:	M6
Hazard Identification Number	:	90
Labels	:	9
Tunnel restriction code	:	(-)

RID

Packing group	:	III
Classification Code	:	M6
Hazard Identification Number	:	90
Labels	:	9

IMDG

Packing group	:	III
Labels	:	9
EmS Code	:	F-A, S-F

IATA (Cargo)

Packing instruction (cargo aircraft)	:	964
Packing instruction (LQ)	:	Y964
Packing group	:	III
Labels	:	Miscellaneous

IATA (Passenger)

Packing instruction (passenger aircraft)	:	964
Packing instruction (LQ)	:	Y964
Packing group	:	III
Labels	:	Miscellaneous

14.5 Environmental hazards

ADN

Environmentally hazardous : yes

ADR

Environmentally hazardous : yes

RID

Environmentally hazardous : yes

IMDG

Marine pollutant : yes

IATA (Passenger)

Environmentally hazardous : yes

IATA (Cargo)
Environmentally hazardous : yes

14.6 Special precautions for user

The transport classification(s) provided herein are for informational purposes only, and solely based upon the properties of the unpackaged material as it is described within this Safety Data Sheet. Transportation classifications may vary by mode of transportation, package sizes, and variations in regional or country regulations.

14.7 Maritime transport in bulk according to IMO instruments

Remarks : Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

REACH - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles (Annex XVII)	:	Conditions of restriction for the following entries should be considered: Number on list 3
REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59).	:	Not applicable
Regulation (EC) No 1005/2009 on substances that deplete the ozone layer	:	Not applicable
Regulation (EU) 2019/1021 on persistent organic pollutants (recast)	:	Not applicable
Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals	:	Not applicable
REACH - List of substances subject to authorisation (Annex XIV)	:	Not applicable

Seveso III: Directive 2012/18/EU of the European Parliament and of the Council on the control of major-accident hazards involving dangerous substances.

		Quantity 1	Quantity 2
E1	ENVIRONMENTAL HAZARDS	100 t	200 t

Other regulations:
Take note of Directive 92/85/EEC regarding maternity protection or stricter national regulations, where applicable.
Take note of Directive 94/33/EC on the protection of young people at work or stricter national regulations, where applicable.

The components of this product are reported in the following inventories:

AICS	:	not determined
DSL	:	not determined
IECSC	:	not determined

15.2 Chemical safety assessment

A Chemical Safety Assessment has not been carried out.

SECTION 16: Other information

Other information	:	Items where changes have been made to the previous version are highlighted in the body of this document by two vertical lines.

Full text of H-Statements

H302	:	Harmful if swallowed.
H312	:	Harmful in contact with skin.
H314	:	Causes severe skin burns and eye damage.
H317	:	May cause an allergic skin reaction.
H318	:	Causes serious eye damage.
H332	:	Harmful if inhaled.
H335	:	May cause respiratory irritation.
H341	:	Suspected of causing genetic defects.
H360D	:	May damage the unborn child.
H361d	:	Suspected of damaging the unborn child.
H400	:	Very toxic to aquatic life.
H410	:	Very toxic to aquatic life with long lasting effects.
H412	:	Harmful to aquatic life with long lasting effects.

Full text of other abbreviations

Acute Tox.	:	Acute toxicity
Aquatic Acute	:	Short-term (acute) aquatic hazard
Aquatic Chronic	:	Long-term (chronic) aquatic hazard
Eye Dam.	:	Serious eye damage
Muta.	:	Germ cell mutagenicity
Repr.	:	Reproductive toxicity
Skin Corr.	:	Skin corrosion
Skin Sens.	:	Skin sensitisation
STOT SE	:	Specific target organ toxicity - single exposure
2006/15/EC	:	Europe. Indicative occupational exposure limit values
IE OEL	:	Ireland. List of Chemical Agents and Occupational Exposure Limit Values - Schedule 1
2006/15/EC / TWA	:	Limit Value - eight hours
2006/15/EC / STEL	:	Short term exposure limit
IE OEL / OELV - 8 hrs (TWA)	:	Occupational exposure limit value (8-hour reference period)
IE OEL / OELV - 15 min (STEL)	:	Occupational exposure limit value (15-minute reference period)

ADN - European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways; ADR - Agreement concerning the International Carriage of Dangerous Goods by Road; AIIC - Australian Inventory of Industrial Chemicals; ASTM - American Society for the Testing of Materials; bw - Body weight; CLP - Classification Labelling Packaging Regulation; Regulation (EC) No 1272/2008; CMR - Carcinogen, Mutagen or Reproductive Toxicant; DIN - Standard of the German Institute for Standardisation; DSL - Domestic Substances List (Canada); ECHA - European Chemicals Agency; EC-Number - European Community number; ECx - Concentration associated with x% response; ELx - Loading rate associated with x% response; EmS - Emergency Schedule; ENCS - Existing and New Chemical Substances (Japan); ErCx - Concentration associated with x% growth rate response; GHS - Globally Harmonized System; GLP - Good Laboratory Practice; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; IBC - International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk; IC50 - Half maximal inhibitory concentration; ICAO - International Civil Aviation Organization; IECSC - Inventory of Existing Chemical Substances in China; IMDG - International Maritime Dangerous Goods; IMO - International Maritime Organization; ISHL

- Industrial Safety and Health Law (Japan); ISO - International Organisation for Standardization; KECI - Korea Existing Chemicals Inventory; LC50 - Lethal Concentration to 50 % of a test population; LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose); MARPOL - International Convention for the Prevention of Pollution from Ships; n.o.s. - Not Otherwise Specified; NO(A)EC - No Observed (Adverse) Effect Concentration; NO(A)EL - No Observed (Adverse) Effect Level; NOELR - No Observable Effect Loading Rate; NZIoC - New Zealand Inventory of Chemicals; OECD - Organization for Economic Co-operation and Development; OPPTS - Office of Chemical Safety and Pollution Prevention; PBT - Persistent, Bioaccumulative and Toxic substance; PICCS - Philippines Inventory of Chemicals and Chemical Substances; (Q)SAR - (Quantitative) Structure Activity Relationship; REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals; RID - Regulations concerning the International Carriage of Dangerous Goods by Rail; SADT - Self-Accelerating Decomposition Temperature; SDS - Safety Data Sheet; SVHC - Substance of Very High Concern; TCSI - Taiwan Chemical Substance Inventory; TECI - Thailand Existing Chemicals Inventory; TRGS - Technical Rule for Hazardous Substances; TSCA - Toxic Substances Control Act (United States); UN - United Nations; vPvB - Very Persistent and Very Bioaccumulative

Further information

Sources of key data used to compile the Safety Data Sheet : Internal technical data, data from raw material SDSs, OECD eChem Portal search results and European Chemicals Agency, http://echa.europa.eu/

Classification of the mixture:		**Classification procedure:**
Skin Irrit. 2	H315	Calculation method
Eye Irrit. 2	H319	Calculation method
Skin Sens. 1	H317	Calculation method
Repr. 1A	H360D	Calculation method
Aquatic Acute 1	H400	Calculation method
Aquatic Chronic 1	H410	Calculation method

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and shall not be considered a warranty or quality specification of any type. The information provided relates only to the specific material identified at the top of this SDS and may not be valid when the SDS material is used in combination with any other materials or in any process, unless specified in the text. Material users should review the information and recommendations in the specific context of their intended manner of handling, use, processing and storage, including an assessment of the appropriateness of the SDS material in the user's end product, if applicable.

IE / EN

PHARMAQ

MATERIAL HEATH & SAFETY DATA SHEET

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY

Product Name: Aquatet (Oxytetracycline Hydrochloride BP)

Name and Address of contact:
PHARMAQ Ltd
Unit 15, Sandleheath Industrial Estate,
Fordingbridge,
Hants. SP6 1PA
Telephone number 01425 656081

2. COMPOSITION/INFORMATION ON INGREDIENTS

Oxytetracycline hydrochloride, CAS No. 2058-46-0
A yellow, hygroscopic, crystalline powder, odourless with a bitter taste.

3. HAZARD IDENTIFICATION

Risks during normal handling are low.

4. FIRST AID MEASURES

Skin Contact	Wash with soap and warm water. Remove contaminated clothing.
Eye Contact	Wash copiously with water for up to 15 minutes. Seek medical advice if symptoms persist.
Ingestion	Wash out mouth with water and seek medical advice. Do not induce vomiting.
Inhalation	Remove to fresh air. If gross levels seek medical advice.

5. FIRE FIGHTING MEASURES

Extinguish with water, foam, powder or CO_2
Thermal decomposition may produce toxic fumes of hydrochloric acid and oxides of nitrogen.

6. ACCIDENTAL RELEASE MEASURES

Spillage - sweep up with care and place in resealable chemical disposal container. Wear mask in dust atmosphere. Avoid contamination of sewers and watercourses.

7. HANDLING AND STORAGE

Specific handling data

Precautions:	Observe good manufacturing practice, keeping dust to a minimum. Avoid inhalation, ingestion and contact with skin and eyes.
Protective clothing:	Wear gloves, industrial overalls, eyeshields and face mask.

Storage
Store in a well closed container below 25°C away from light and moisture.

8. EXPOSURE CONTROL/PERSONAL PROTECTION

O.E.L.	0.5mg/M^3	8 hour TWA
Personal Protection:	See 7 above.	

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Fine, bright yellow powder
Odour:	None
pH:	1% solution 2.3 to 2.9
Boiling point:	N/A
Melting point:	Decomposes
Solubility:	1 in 2 in water

10. STABILITY AND REACTIVITY

Stable in normal conditions. Avoid temperatures in excess of 25°C. Thermal decomposition evolves toxic, corrosive fumes of hydrogen chloride and nitrogen oxides.

11. TOXICOLOGICAL INFORMATION

Moderately toxic by subcutaneous route, toxic by intravenous route. Mildly toxic by ingestion. Experimental tera togenic and reproductive effects. Mutagenic data.

12. ECOLOGICAL INFORMATION

None available

13. DISPOSAL CONSIDERATIONS

Consult Local Authority or a licensed waste disposal contractor for disposal of material, spillage or contaminated waste.

14. TRANSPORT INFORMATION

Not classified or subject to ADR provisions.

15. REGULATORY INFORMATION

EC Classification: Exempt

Users should ensure they comply with relevant local and national legislation. In the UK these products are classified as substances hazardous to health according to the Control of Substances Hazardous to Health Regulations 1994.

16. OTHER INFORMATION

Regulation 5 of the Chemical (Hazard Information and Packaging for Supply) regulations 1994 does not require suppliers of veterinary products to provide safety data sheets. However, as there are health considerations in handling this product, this Product Safety Information Sheet is provided to fulfil suppliers obligations under Section

6 of the Health and Safety at Work etc. Act 1974 and also to help users in risk assessments required by the Control of Substances Hazardous to Health Regulations 1994.

The information presented herein is believed to be true and accurate. No warranty or guarantee, expressed or implied is made regarding the information or the performance of the product, since the conditions of use are beyond our control We assume no liability for incidental, consequential or direct damage of any kind, no matter what the cause.

Merck Animal Health
One Merck Dr.
Whitehouse Station, NJ 08889

MATERIAL SAFETY DATA SHEET

Merck Animal Health urges each user or recipient of this MSDS to read the entire data sheet to become aware of the hazards associated with this material.

SECTION 1. IDENTIFICATION OF SUBSTANCE AND CONTACT INFORMATION

MSDS NAME: **SLICE (Emamectin Benzoate 0.2% Aquaculture Premix)**

SYNONYM(S): SLICE Premix

MSDS NUMBER: SP000125

EMERGENCY NUMBER(S): (908) 423-6000 (24/7/365) English Only

Transportation Emergencies - CHEMTREC:
(800) 424-9300 (Inside Continental USA)
(703) 527-3887 (Outside Continental USA)
Rocky Mountain Poison Center (For Human Exposure):
(303) 595-4869

Animal Health Technical Services:
For Animal Adverse Events: Small Animals and Horses: (800) 224-5318
For Animal Adverse Events: Livestock: (800) 211-3573
For Animal Adverse Events: Poultry: (800) 219-9286

INFORMATION: Animal Health Technical Services:
For Small Animals and Horses: (800) 224-5318
For Livestock: (800) 211-3573
For Poultry: (800) 219-9286

MERCK MSDS HELPLINE: (800) 770-8878 (US and Canada)
(908) 473-3371 (Worldwide)
Monday to Friday, 9am to 5pm (US Eastern Time)

SECTION 2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Powder
White, Gray
Characteristic odor
May be harmful by inhalation, skin absorption or if swallowed.
May be harmful with prolonged or repeated exposure.
May cause effects to:
nervous system
Very toxic to aquatic organisms.
May cause long-term adverse effects in the aquatic environment.

POTENTIAL HEALTH EFFECTS:

Only information about the ingredients that are expected to contribute significantly to the potential health hazard profile of the formulation(s) are presented.

No systemic toxicity, eye irritation, or skin irritation was observed in acute animal studies using the SLICE premix formulation. SLICE premix is not expected to cause dermal sensitization based on available data on the ingredients in the formulation.

Animals experienced nervous system effects (decreased activity, lethargy, tremors) and nerve damage following acute or chronic inhalation, dermal, or oral exposure to pure emamectin benzoate. Chronic effects were observed at low dosages.

Corn starch is a mild skin irritant and may cause dermatitis with chronic skin exposure. Inhalation of corn starch may aggravate pre-existing lung conditions. Corn starch may cause mechanical irritation to the eye and respiratory tract.

LISTED CARCINOGENS

Fields in the above table that do not contain data indicate that the materials have not been classified as human or animal carcinogens.

SECTION 3. COMPOSITION AND INFORMATION ON INGREDIENTS

PRODUCT USE: Aquaculture product

CHEMICAL FORMULA: Mixture.

The formulation for this product is proprietary information. Only hazardous ingredients in concentrations of 1% or greater and/or carcinogenic ingredients in concentrations of 0.1% or greater are listed in the Chemical Composition table. Active ingredients in any concentration are listed. For additional information about carcinogenic ingredients see Section 2.

CHEMICAL COMPOSITION

INGREDIENT	CAS NUMBER	PERCENT
Emamectin Benzoate	137515-74-4	0.2
Starch	9005-25-8	40-50
Propylene Glycol	57-55-6	<10

ADDITIONAL INFORMATION: This MSDS is written to provide health and safety information for individuals who will be handling the final product formulation during research, manufacturing, and distribution. For health and safety information for individual ingredients used during manufacturing, refer to the appropriate MSDS for each ingredient. Refer to the package insert or product label for handling guidance for the consumer.

SECTION 4. FIRST AID MEASURES

INHALATION: Remove to fresh air. If any trouble breathing, get immediate medical attention. Administer artificial respiration if breathing has ceased. If irritation or symptoms occur or persist, consult a physician.

SKIN CONTACT: In case of skin contact, while wearing protective gloves, carefully remove any contaminated clothing, including shoes, and wash skin thoroughly with soap and water. If irritation or symptoms occur or persist, consult a physician.

EYE CONTACT: In case of eye contact, immediately rinse eyes thoroughly with plenty of water. If wearing contact lenses, remove only after initial rinse, and continue rinsing eyes for at least 15 minutes. If irritation occurs or persists, consult a physician.

INGESTION: Rinse mouth and drink a glass of water. Do not induce vomiting unless under the direction of a qualified medical professional or Poison Control Center. If symptoms persist, consult a physician.

SECTION 5. FIRE FIGHTING MEASURES

FLAMMABILITY DATA:

Flash Point: Not determined (liquids) or not applicable (solids).

SECTION 5. FIRE FIGHTING MEASURES

EXPLOSION HAZARDS:
Under normal conditions of use, this material does not present a significant fire or explosion hazard. However, like most organic compounds, this material may present a dust deflagration hazard if sufficient quantities are suspended in air. This hazard may exist where sufficient quantities of finely divided material are (or may become) suspended in air during typical process operations. An assessment of each operation should be conducted and suitable deflagration prevention and protection techniques employed.

The sensitivity of this material to ignition by electrostatic discharges has not been determined. In the absence of testing data, all conductive plant items and operations personnel handling this material should be suitably grounded.

SPECIAL FIRE FIGHTING PROCEDURES:
Wear full protective clothing and self-contained breathing apparatus (SCBA).

SUITABLE EXTINGUISHING MEDIA:
Carbon dioxide (CO2), extinguishing powder or water spray.

See Section 9 for Physical and Chemical Properties.

SECTION 6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:
Avoid generation of dust during clean-up. Wear appropriate personal protective equipment as specified in Section 8. Keep personnel away from the clean-up area.

SPILL RESPONSE / CLEANUP:
All spills should be handled according to site requirements and based on precautions cited in the MSDS. In the case of liquids, use proper absorbent materials. For laboratories and small-scale operations, incidental spills within a hood or enclosure should be cleaned by using a HEPA filtered vacuum or wet cleaning methods as appropriate. For large dry or liquid spills or those spills outside enclosure or hood, appropriate emergency response personnel should be notified. In manufacturing and large-scale operations, HEPA vacuuming prior to wet mopping or cleaning is required.

ENVIRONMENTAL PRECAUTIONS:
This product is very toxic to aquatic organisms. Do not allow product to reach ground water, water course, sewage or drainage systems.

See Sections 9 and 10 for additional physical, chemical, and hazard information.

SECTION 7. HANDLING AND STORAGE

HANDLING:
Keep containers adequately sealed during material transfer, transport, or when not in use. Wash face, hands, and any exposed skin after handling. Do not eat, drink, or smoke when using this substance or mixture.

Appropriate handling of this material is dependent on many factors, including physical form, duration and frequency of process or task, and effectiveness of engineering controls. Site-specific risk assessments should be conducted to determine the feasibility and the appropriateness of all exposure control measures. See Section 8 (Exposure Controls) for additional guidance.

STORAGE:
Store in a cool, dry, well ventilated area.
Store between 2 and 30 deg C.

See Section 8 for exposure controls and additional safe handling information.

SECTION 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

OCCUPATIONAL EXPOSURE BAND (OEB):
OEB 3: >=10<100 mcg/m^3. Materials in an OEB 3 category are considered moderate health hazards. The OEB is a range of airborne concentrations expressed as an 8-hour Time Weighted Average (8-hr. TWA) and is intended to be used with Industrial Hygiene Risk Assessment to assist with industrial hygiene sampling and selection of proper controls for worker protection. Consult your site safety and industrial hygiene staff for guidance on handling and control strategies.

INTERNAL OCCUPATIONAL EXPOSURE LIMIT (8-hr TWA):
15 mcg/m^3

Wipe Limit:
150 mcg/100cm2

EXPOSURE CONTROLS
The health hazard risks of handling this material are dependent on many factors, including physical form, duration and frequency of process or task, and effectiveness of engineering controls. Site-specific risk assessments should be conducted to determine the feasibility and the appropriateness of all exposure control measures. Exposure controls for normal operating or routine procedures follow a tiered strategy. Engineering controls are the preferred means of long-term or permanent exposure control. If engineering controls are not feasible, appropriate use of personal protective equipment (PPE) may be considered as alternative control measures. Exposure controls for non-routine operations must be evaluated and addressed as part of the site-specific risk assessment.

RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT (PPE):

Respiratory Protection:	Respiratory protective equipment (RPE) may be required for certain laboratory and large-scale manufacturing tasks if potential airborne breathing zone concentrations of substances exceed the relevant exposure limit(s). Workplace risk assessment should be completed before specifying and implementing RPE usage. Potential exposure points and pathways, task duration and frequency, potential employee contact with the substance, and the ability of the substance to be rendered airborne during specific tasks should be evaluated. Initial and ongoing strategies of quantitative exposure measurement should be obtained as required by the workplace risk assessment. All RPE must conform to local and regional specifications for efficacy and performance. Consult your site or corporate health and safety professional for additional guidance.
Skin Protection:	Gloves that provide an appropriate barrier to the skin are recommended if there is potential for contact with this material. Consult your site safety staff for guidance.
Eye Protection:	Safety glasses with side shields. Use of goggles or full face protection may be required based on hazard, potential for contact, or level of exposure. Consult your site safety staff for guidance.
Body Protection:	In small-scale or laboratory operations, lab coats or equivalent protection is required. Disposable Tyvek or other dust impermeable suit should be considered based on procedure or level of exposure. Use of additional PPE such as shoe coverings, gauntlets, hood, or head covering may be necessary. Consult your site safety staff for guidance. In large-scale or manufacturing operations, disposable Tyvek or other dust impermeable suit is recommended and based on level of exposure. Use of additional PPE such as shoe coverings, gauntlets, hood, or head covering may be necessary. Consult your site safety staff for guidance.

EXPOSURE LIMIT VALUES

INGREDIENT	CAS NUMBER	ACGIH TLV (TWA)	OSHA PEL (TWA)
Starch	9005-25-8	10 mg/m^3	15 mg/m^3

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

FORM: Powder
COLOR: White, Gray
ODOR: Characteristic odor
SOLUBILITY:
Water: Soluble

See Section 5 for flammability/explosivity information.

SECTION 10. STABILITY AND REACTIVITY

STABILITY/ REACTIVITY:
Stable under normal conditions.

INCOMPATIBLE MATERIALS / CONDITIONS TO AVOID:
Extremes of temperature. Damp conditions. Oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS / REACTIONS:
Carbon oxides (COx).

SECTION 11. TOXICOLOGICAL INFORMATION

The information presented below pertains to the formulated product unless indicated otherwise.

ACUTE TOXICITY DATA

INHALATION:
Emamectin Benzoate: Inhalation LC50 (4hr): 2.1-2.4 mg/L (rat).
Changes in the central nervous system or peripheral nerves were observed following inhalation of >2.4 mg/L emamectin benzoate; however, in another study, exposure to <0.1 mg/L of emamectin benzoate caused no treatment-related effects. The SLICE premix formulation is not expected to cause similar effects to those of emamectin benzoate, due to the low concentration of the active ingredient in the premix formulation.

SKIN:
Not irritating.

Rabbits exhibited tremors, nerve damage, and mydriasis when exposed dermally to emamectin benzoate for 4 or 24 hours (LOEL: 500 mg/kg).

EYE:
Not irritating.

ORAL:
SLICE premix: Oral LD50: >2000 mg/kg (rats)
There were no deaths and no signs of systemic toxicity noted in an acute oral toxicity study in rats.

DERMAL AND RESPIRATORY SENSITIZATION:
Emamectin benzoate was not sensitizing in guinea pig dermal sensitization studies. Therefore, the SLICE premix formulation is not expected to cause dermal sensitization due to the low concentration of active ingredient (emamectin benzoate) in the premix formulation.

REPEAT DOSE TOXICITY DATA

SUBCHRONIC / CHRONIC TOXICITY:
Mice, rats and dogs were administered 0.2 to 12.5 mg/kg/day emamectin (as the benzoate or hydrochloride salt) in the feed or by oral gavage in various sub-chronic and chronic studies ranging from 15 days to 105 weeks. Common effects that were observed during the studies included tremors, significant reductions or increases in body weight and food consumption, decreased activity, and/or lethargy. Additional effects observed in rodents included mortality and adverse effects on posture, gait, rearing, grip strength, and/or righting reflex. At termination, effects were observed on the central or peripheral nervous systems including, but not limited to, neuronal vacuolation or degeneration of the brain, spinal cord, and/or sciatic nerves, axonal degeneration, degenerationn of the retinal ganglionic cells, sciatic and optic nerve lesions. In addition, skeletal muscle atrophy was observed in dogs in a 14-week study, and vacuolation of hepatocytes and chronic proliferative cystitis in the urinary bladder was observed in rats in a 104-week study.

The no observed effect levels (NOEL) for these studies are as follows: NOEL (15-day study): 0.1 mg/kg/day (mice); NOELs (14-week studies): 0.5 to 1 mg/kg/day (rat); NOEL (53-week study): 1.0 mg/kg/day (rat); NOELs (14- and 53-week studies): 0.25 mg/kg/day (dogs); NOEL (79-week study): 2.5 mg/kg/day (mice); NOEL (105-week study): 0.25 mg/kg/day (rat).

REPRODUCTIVE / DEVELOPMENTAL TOXICITY:
Emamectin (as benzoate salt) did not cause teratogenicity in rats or rabbits at oral dosages ranging from 2 to 8 mg/kg/day and 1.5 to 6 mg/kg/day, respectiviely. There was an increase in the number of fetuses with supernumerary ribs and an increase incidence of delayed ossification in fetal rats in the high dosage group (8 mg/kg/day). Maternal toxicity was observed in both rats and rabbits in the high dosage groups.

In a two generation reproductive study, male and female rats were fed emamectin (as benzoate salt) at dosages ranging from 0.1-3.6 mg/kg/day. Reductions in weight gain and food intake were observed in F0 rats in the high dosage group; at necropsy, neuronal degeneration of the brain or spinal cord was also found. In the F1a litters, the percentage of live pups per litter was significantly reduced in the high dosage group. During lactaion, the pups in this group showed signs of tremors and hind limb extension or splay; these effects continued during the post-weaning phase. In the F1b litters, the top dose was reduced to 1.8 mg/kg/day, resulting in a reduction of the severity of the effects observed. There were significant decreases in both the fecundity and fertility indices at the F2 mating at this dose. Signs of toxicity were observed in only one litter from the F2 mating. The no observed effect level (NOEL) was 0.6 mg/kg/day based on reduced body weight, food intake, fecunditiy and fertility rates, and neuronal degeneration. In a separate study, mated female rats were given oral gavage dosages of emamectin (as benzoate salt) at 0.1 to 3.6 mg/kg/day from Day 6 of gestation to Day 20 of lactation. No adverse effects were observed on the dams. Tremors, hindlimb extension, and reduced body weight gain were observed in the pups in the high dosage group. Some effects were still observed during the post-weaning period. NOEL was 0.6 mg/kg/day.

MUTAGENICITY / GENOTOXICITY:
Emamectin was negative in bacterial mutagenicity studies, a gene mutation assay (HPRT locus) in chinese hamster lung cells, a chromosomal abberation assay, and in a metaphase analysis in mice. Positive results were shown in an in vitro test for DNA damage in rat hepatocytes.

CARCINOGENICITY:
Emamectin (as benzoate salt) was not carcinogenic in mice or rats in a 79- or 105-week study, respectively.

SECTION 12. ECOLOGICAL INFORMATION

There are no data for the final product or its formulation(s). The information presented below pertains to the following ingredient(s).

ECOTOXICITY DATA

PRODUCT / CHEMICAL NAME	STUDY TYPE	RESULT	COMMENTS
Emamectin Benzoate	48-hr EC50 (daphnid)	0.001 mg/L	NOEC: 0.0003 mg/L
	96-hr EC50 (mysid shrimp)	0.000043 mg/L	NOEC: 0.000018 mg/L
	96-hr LC50 (rainbow trout)	0.174 mg/L	NOEC: 0.0487 mg/L
	96-hr LC50 (fathead minnow)	0.194 mg/L	NOEC: 0.156 mg/L
	96-hr LC50 (sheepshead minnow)	1.34 mg/L	
	Early Life Stage (fathead minnow)	LOEC: 0.028 mg/L	NOEC: 0.330 mg/L
	21-day Reproduction (daphnid)	LOEC: 0.00016 mg/L	NOEC: 0.000088 mg/L
	Oral LD50 (mallard duck)	76 mg/kg	NOEC: <25 mg/kg

ENVIRONMENTAL DATA

PRODUCT / CHEMICAL NAME: Emamectin benzoate

Water Solubility: 24 mg/L (pH: 7.04)
Partition Coefficient (log Pow) Results: 5.0 (pH 7.0)

ADDITIONAL ECOTOXICITY / ENVIRONMENTAL INFORMATION:
Emamectin Benzoate: Photolytic Half-life (natural water): 6.9 days (fall)
10.9 days (winter)
3.6 days (summer)

SECTION 13. DISPOSAL CONSIDERATIONS

MATERIAL WASTE:
Disposal must be in accordance with applicable federal, state/provincial, and/or local regulations. Incineration is the preferred method of disposal, when appropriate. Operations that involve the crushing or shredding of waste materials or returned goods must be handled to meet the recommended exposure limit(s).

PACKAGING AND CONTAINERS:
Disposal must be in accordance with applicable federal, state/provincial, and/or local regulations.

SPECIAL ENVIRONMENTAL HANDLING PROCEDURES:
This product contains materials that are harmful to the environment. Do not allow product to reach ground water, water courses, sewage or drainage systems.

SECTION 14. TRANSPORT INFORMATION

This material is not subject to the transportation regulations of DOT, IATA, and the IMO.

Non-regulated per 49 CFR 173.150(f) for ground shipments of non-bulk packagings.

ADR CLASSIFICATION:

Proper Shipping Name: Environmentally hazardous substance, solid, n.o.s. (emamectin benzoate)
Hazard Class: 9
UN Number: UN 3077
Packing Group: III
Classification Code: M7

ADDITIONAL INFORMATION:
Although this material is regulated only under the ADR, both the IATA and IMO have special provisions that allow the shipper to transport materials under the shipping name "Environmentally hazardous substance, solid, n.o.s." if the material is being transported under both ADR and either IATA or IMO regulations.

SECTION 15. REGULATORY INFORMATION

TSCA LISTING

INGREDIENT	TSCA
Starch	X
Propylene Glycol	X

U.S. STATE REGULATIONS

INGREDIENT	California Proposition 65	CARTK	NJRTK	CTRTK	MARTK
Starch					X
Propylene Glycol			3595		

INGREDIENT	PARTK	MNRTK	MIRTK	RIRTK
Starch	X	X		X
Propylene Glycol	X	X		X

SECTION 16. OTHER INFORMATION

Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained therein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequence of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).

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Monday to Friday, 9am to 5pm (US Eastern Time)

MSDS CREATION DATE: 30-Mar-2000

SUPERSEDES DATE: 19-Jan-2012

SECTIONS CHANGED (US SUBFORMAT): 7
SIGNIFICANT CHANGES (US SUBFORMAT): OEB, OEL, Wipe Limit

SAFETY DATA SHEET
Tricaine Pharmaq

The safety data sheet is in accordance with Commission Regulation (EU) 2015/830 of 28 May 2015 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

SECTION 1: Identification of the substance/mixture and of the company/undertaking

Date issued	15.09.2016
Revision date	09.11.2016

1.1. Product identifier

Product name	Tricaine Pharmaq
No requirement for SDS	There is no requirement according to the REACH Regulation (EC) No. 1907/2006, Article 31.

1.2. Relevant identified uses of the substance or mixture and uses advised against

Product group	Veterinary medicinal products
Use of the substance/preparation	Powder for solution bath for the treatment of fish. Anesthetic.

1.3. Details of the supplier of the safety data sheet

Distributor

Company name	Pharmaq AS
Office address	Industrivegen 50
Postal address	Skogmo Industriområde
Postcode	7863
City	Overhalla
Country	Norge
Tel	74280800
Fax	74280801
E-mail	customer.service@pharmaq.no
Website	http://www.pharmaq.no

1.4. Emergency telephone number

Emergency telephone	Emergency telephone number (Italy):112 Emergency telephone number Norway (Giftinformasjonen):+47 22 59 13 00 Emergency telephone number (UK):999 or 112

SECTION 2: Hazards identification

2.1. Classification of substance or mixture

CLP Classification, Comments	This is a veterinary medicinal product, and is therefore not a subject to classification and labelling of chemicals.
Substance / mixture hazardous properties	Irritating to the eyes, skin and respiratory system.

2.2. Label elements

Other EU labelling requirements	This is a veterinary medicinal product, and is thus not a subject to classification and labelling of chemicals.

2.3. Other hazards

PBT / vPvB	The chemical contains no PBT or vPvB substances.

SECTION 3: Composition/information on ingredients

3.1. Substances

Substance	Identification	Classification	Contents
3-ethoxycarbonylanilinium methanesulphonate	CAS no.: 886-86-2 EC no.: 212-956-8	Skin Irrit. 2;H315; Eye Irrit. 2;H319; STOT SE3;H335;	100 %

Substance comments	See section 16 for explanation of hazard statements (H) listed above.

SECTION 4: First aid measures

4.1. Description of first aid measures

General	Emergency telephone number: see section 1.4.
Inhalation	Fresh air and rest. Get medical attention if any discomfort continues.
Skin contact	Remove contaminated clothing. Wash the skin immediately with soap and water. Contact physician if irritation continues.
Eye contact	Immediately flush with plenty of water for up to 15 minutes. Remove any contact lenses and open eyes wide apart. Contact physician if irritation persists.
Ingestion	Rinse mouth with water. Drink a few glasses of water or milk. Do not induce vomiting. Get medical attention if any discomfort continues. Do not give victim anything to drink if he is unconscious.

4.2. Most important symptoms and effects, both acute and delayed

Acute symptoms and effects	Eye contact: Irritating to eyes and may cause redness and burning. Inhalation: May cause respiratory irritation. Skin contact: The chemical irritates the skin and can cause itching, burning and redness.

4.3. Indication of any immediate medical attention and special treatment needed

Other Information	Treat symptomatically. No specific information from the manufacturer.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media	Dry-powder, carbon dioxide (CO2), water mist, foam.
Improper extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.

5.2. Special hazards arising from the substance or mixture

Fire and explosion hazards	Not flammable, but combustible.
Hazardous combustion products	May include, but is not limited to: Carbon monoxide (CO). Carbon dioxide (CO2). Sulphurous gases (SOx). Nitrous gases (NOx). Decomposition may produce toxic gases.

5.3. Advice for firefighters

Personal protective equipment	Use compressed air equipment when the chemical is involved in fire. In case of evacuation, an approved protection mask should be used. See also section 8.
Other Information	Containers close to fire should be removed immediately or cooled with water.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures	Provide adequate ventilation.
Personal protection measures	Use protective equipment as referred to in section 8. Avoid inhalation of vapours and contact with skin and eyes.

6.2. Environmental precautions

Environmental precautionary measures	Do not allow to enter into sewer, water system or soil.

6.3. Methods and material for containment and cleaning up

Cleaning method	Sweep up and place into an appropriate container.
Containment	Collect in suitable containers and deliver as hazardous waste according to section 13.

6.4. Reference to other sections

Other instructions	See also sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Handling	Provide adequate ventilation. Avoid inhalation of vapours and contact with skin and eyes. Change contaminated clothing. Use protective equipment as referred to in section 8. People with known hypersensitivity (allergy) to anesthetics like Tricaine Mesilate (Tricaine Methane Sulphonate) should not handle the veterinary medicinal product."

Protective Safety Measures

Advice on general occupational hygiene	Wash hands after contact with the chemical. Change contaminated clothing and take off protective equipment before the meal. Do not smoke, drink or eat in the workplace.

7.2. Conditions for safe storage, including any incompatibilities

Storage	Store in closed original container in a dry place. Store protected against heat and direct sunlight.

7.3. Specific end use(s)

Specific use(s)	See section 1.2.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational Exposure limit values

Substance	Identification	Value	TWA Year
Respirable dust		8-hour TWA: 4 mg/m³	
Total inhalable dust		8-hour TWA: 10 mg/m³	
Total inhalable dust (Norway)		8-hour TWA: 10 mg/m³	
Respirable dust (Norway)		8-hour TWA: 5 mg/m³	

Other Information about threshold limit values	References (laws/regulations): EH40/2005 Workplace exposure limits, with later amendments. Norwegian regulation on exposure limits: "FOR-2011-12-06-1358 Forskrift om tiltaksverdier og grenseverdier for fysiske og kjemiske faktorer i arbeidsmiljøet samt smitterisikogrupper for biologiske faktorer (forskrift om tiltaks- og grenseverdier)". Italian regulation on exposure limits Allegato XXXVIII Valori limite di esposizione professionale (Italy) Contains no substances with occupational exposure limit values.

8.2. Exposure controls

Limitation of exposure on workplace	Provide adequate ventilation, including appropriate local extraction, to ensure that the defined occupational exposure limit is not exceeded. The personal protective equipment must be CE-marked and the latest version of the standards shall be used. The protective equipment and the specified standards recommended below are only suggestions, and should be selected on advice from the supplier of such equipment. A risk assessment of the work place/work activities (the actual risk) may lead to other control measures. The protection equipments suitability and durability will depend on application.

Respiratory protection

Respiratory protection	In case of inadequate ventilation or risk of inhalation of dust, use suitable respiratory equipment with particle filter (type P2).
Reference to relevant standard	EN 143 (Respiratory protective devices. Particle filters. Requirements, testing, marking).

Hand protection

Hand protection	Use chemical resistant gloves. The chemical is solid and cannot penetrate normal glove materials.
Reference to relevant standard	BS-EN 374 (Protective gloves against chemicals and micro-organisms). BS-EN 420 (Protective gloves. General requirements and test methods).
Breakthrough time	No specific information from the manufacturer.
Thickness of glove material	No specific information from the manufacturer.
Additional hand protection measures	Replace gloves if signs of wear and tear.

Eye / face protection

Eye protection	Use tight fitting goggles if dust is generated.
Reference to relevant standard	EN 166 (Personal eye-protection. Specifications).

Skin protection

Skin protection (except hands)	Wear appropriate clothing to prevent reasonably probable skin contact.

Appropriate environmental exposure control

Environmental exposure controls	Do not allow to enter into sewer, water system or soil.

Other Information

Other Information	Emergency shower and eye wash facilities should be available at the workplace.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	Solid. Crystalline powder. (Fine powder.)
Colour	White.
Odour	None.
Comments, Odour limit	Not specified by the manufacturer.
Comments, pH (as supplied)	Not specified by the manufacturer.
Melting point/melting range	**Value:** 147-150 °C
Comments, Boiling point / boiling range	Not specified by the manufacturer.
Comments, Flash point	Not specified by the manufacturer.
Comments, Evaporation rate	Not specified by the manufacturer.
Flammability (solid, gas)	Not specified by the manufacturer.
Comments, Explosion limit	Not specified by the manufacturer.
Comments, Vapour pressure	Not specified by the manufacturer.
Comments, Vapour density	Not specified by the manufacturer.

Comments, Specific gravity	Not specified by the manufacturer.
Solubility in water	Insoluble in cold water.
Comments, Partition coefficient: n-octanol / water	Not relevant for a mixture.
Comments, Spontaneous combustability	Not specified by the manufacturer.
Comments, Decomposition temperature	Not specified by the manufacturer.
Comments, Viscosity	Not relevant.
Explosive properties	Not explosive.
Oxidising properties	Not oxidising.

9.2. Other information

Other physical and chemical properties

Comments	No further information is available.

SECTION 10: Stability and reactivity

10.1. Reactivity

Reactivity	No test data available.

10.2. Chemical stability

Stability	The chemical is stable under normal conditions of storage and use.

10.3. Possibility of hazardous reactions

Possibility of hazardous reactions	Arise in contact with incompatible materials (see section 10.5) and/or under inappropriate conditions (see section 10.4).

10.4. Conditions to avoid

Conditions to avoid	Moisture.

10.5. Incompatible materials

Materials to avoid	Acids, acid chlorides, acid anhydrides, chloroformates and strong oxidizing agents.

10.6. Hazardous decomposition products

Hazardous decomposition products	None under normal conditions. See also section 5.2.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Toxicological Information:

LD50 oral	**Value:** 4000 mg/kg **Animal test species:** rabbit
LD50 oral	**Value:** 2400 mg/kg **Animal test species:** mouse
LD50 oral	**Value:** 5200 mg/kg **Animal test species:** rat
LD50 dermal	**Value:** 170 mg/kg **Animal test species:** mouse **Comments:** (Intravenous)

Acute toxicity, Mixture estimate

Assessment of acute toxicity classification	Based on available data, the classification criteria are not met.

Potential acute effects

Inhalation	Dust may irritate the respiratory system.
Skin contact	Irritates the skin. May cause redness, stinging and itching.
Eye contact	Irritating to eyes and may cause redness, watering and stinging.

Ingestion	May cause discomfort if swallowed.
Assessment corrosion / irritation classification	Irritating to skin.
Aspiration hazard	Based on available data, the classification criteria are not met.
Assessment eye damage or irritation, classification	Causes serious eye irritation.

Delayed effects / repeated exposure

Sensitisation	The chemical contains small amount of allergy-causing material which may give rise to allergy to sensitive persons. Based on available data, the classification criteria are not met.
STOT-single exposure	May cause respiratory irritation.
STOT-repeated exposure	Based on available data the classification criteria are not met.

Carcinogenic, Mutagenic or Reprotoxic

Carcinogenicity	Based on available data, the classification criteria are not met.
Mutagenicity	Based on available data, the classification criteria are not met.
Reproductive toxicity	Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

12.1. Toxicity

Ecotoxicity	The chemical is not classified as harmful to the environment.

12.2. Persistence and degradability

Persistence and degradability	Parts of the chemical are degradable.

12.3. Bioaccumulative potential

Bioaccumulative potential	No data available on bioaccumulation.

12.4. Mobility in soil

Mobility	Insoluble in water. Sinks in water.

12.5. Results of PBT and vPvB assessment

PBT assessment results	The chemical contains no PBT-substances.
vPvB evaluation results	The chemical contains no vPvB substances.

12.6. Other adverse effects

Other adverse effects / Remarks	Do not allow to enter into sewer, water system or soil.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Specify the appropriate methods of disposal	Used solution shall be filtered through a charcoal filter. Clinical waste from veterinary establishments are not allowed to deposit. Carbon filter with medicine must be disposed of in a proper manner. The waste code (EWC-Code) is intended as a guide. The user must select a code if the use differs from the one mentioned below.
EWC waste code	EWC: 18 02 06 chemicals other than those mentioned in 18 02 05
Other Information	Do not empty into drains.

SECTION 14: Transport information

14.1. UN number

Comments	Not considered as dangerous goods under UN, IMO, ADR/RID or IATA/ICAO regulations.

14.2. UN proper shipping name

Comments	Not relevant.

14.3. Transport hazard class(es)

Comments	Not relevant.

14.4. Packing group

Comments	Not relevant.

14.5. Environmental hazards

Comments	Not relevant.

14.6. Special precautions for user

Special safety precautions for user	Not relevant.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Pollution category	Not relevant.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

References (laws/regulations)	Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures (CLP-regulation) with later amendments. Commission Regulation (EU) No 453/2010 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) The List of Wastes (England) (Amendment) Regulations 2005. (SI 2005 No. 895). The List of Wastes Regulations (Northern Ireland) 2005. Dangerous Goods regulations DIRECTIVE 2001/82/EC of the european Parliament and of the council of 6 November 2001 on the Community code relating to veterinary medicinal products FOR-2012-06-16 nr 622 Norwegian regulation on classification, labeling and packaging of substances and mixtures (CLP), with later amendments. FOR-2008-05-30 nr 516 Norwegian regulation on the registration, evaluation, authorization and restriction of chemicals (REACH Regulation), with later amendments. Norwegian regulations on waste, no. 930/2004, from the Ministry of Environment. Dangerous Goods regulations. Norwegian regulation FOR-2007-01-16 nr 50 on the use of veterinary medicines, as amended.

15.2. Chemical safety assessment

Chemical safety assessment performed	No

SECTION 16: Other information

Supplier's notes	The information contained in this SDS must be made available to all those who handle the product.
List of relevant H-phrases (Section 2 and 3).	H315 Causes skin irritation. H335 May cause respiratory irritation. H319 Causes serious eye irritation.
Abbreviations and acronyms used	ADR: The European Agreement concerning the International Carriage of Dangerous Goods by Road RID: The Regulations concerning the International Carriage of Dangerous Goods by Rail IMDG: The International Maritime Dangerous Goods Code ICAO-TI: International Civil Aviation Organization - Technical Instructions for

	the Safe Transport of Dangerous Goods by Air IATA: The International Air Transport Association LD50: Lethal dose, is the amount of a substance given to a group of test animals, which causes the death of 50%. Log Pow: Partition coefficient: n-octanol / water PBT: Persistent, Bioaccumulative and Toxic vPvB: very Persistent and very Bioaccumulative EWC: European Waste Code (a code from the EU's common classification system for waste) Infectious waste: waste from medical or veterinary treatment and/or related to research containing viable microorganisms or their toxins which are known or believed to cause disease in humans or other living organisms.
Important data sources used to construct the safety data sheet	Suppliers Safety data sheet dated: 14.10.2013
Information which has been added, deleted or revised	New Safety Data Sheet.
Checking quality of information	This SDS is quality controlled by Kiwa Teknologisk Institutt in Norway, certified according to the Quality Management System requirements specified in ISO 9001:2008.
Version	1
Responsible for safety data sheet	Pharmaq AS
Prepared by	Kiwa Teknologisk Institutt as, Norway v/ Maria Andersen

Location and process	Ireland / Laboratory / Fish Health	**Document category**	Procedures
Last approved date	06/02/2015 (McManus, Catherine)	**Last revision date**	13/01/2023
Date changed	06/02/2015 (McManus, Catherine)	**Next revision date**	13/01/2024

Method for Inhalation Anaesthesia using Tricaine

1. Scope:

This procedure is to be followed for simple handling of fish where no artificial ventilation is required. For example, in grading, sample weighing, lice assessments and laboratory sampling. The active ingredient in Tricaine is tricaine mesilate (100% Tricaine Methane Sulphonate).

2. Records:

Records of all Tricaine preparation and use must be maintained by Laboratory staff and site managers. This is a legal requirement.

3. Materials:

Tricaine powder
Water

4. Stock Solution prep.

Add 100 g of Tricaine to one litre of water. 1ml of stock solution will contain 100 mg of tricaine mesilate.

5. Method:

Prepare anaesthetic bath to a final concentration of 100 mg/1 by adding 1ml of stock solution for every litre of water used.

NOTE: The Tricaine stock solution has a shelf life of one month only.

Ensure that the anaesthetic bath is placed close to a tank or cage for fish recovery otherwise prepare a recovery vessel with clean, well-oxygenated water.

Ensure that the stock tank / cage, anaesthetic bath and recovery cage/tank/vessel are all at the same temperature. Adjust if necessary.

Always test a small number of fish first to note the effects.

Quickly net out a small batch of fish from stock and transfer immediately to the anaesthetic bath. The number of fish per batch will depend on the time taken to handle each fish. On no account should the fish remain in the anaesthetic bath for extended periods. As a rough guide fish should not remain in the anaesthetic bath for longer than 10 minutes.

Operations should commence as soon as a fish can be picked up without struggling.

After handling, the fish should be placed immediately in the recovery tank/cage/vessel. Substantial recovery will normally occur within 1 minute.

On no account should the recovery tank/cage/vessel be allowed to become overstocked. Mortalities associated with this procedure will most likely originate from either:

(a) Anaesthetic overdose.

(b) Lack of oxygen.
(c) Drop in pH.

5. Therapeutic Withdrawal:

A withdrawal of 70 degree days applies to fish that have been exposed to Tricaine.

6. Records:

The laboratory shall maintain a log of all stock solutions issued to sites with details of preparation date, site issued to and volume dispensed in the following file;

L:\Tricaine Log

7. HES Precautions:

Wear gloves when handling
Work in a well ventilated area.
Return out of date Tricaine to the lab for disposal.

SAFETY DATA SHEET

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name or designation of the mixture	CLYNAV Injection
Registration number	-
Synonyms	None.

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses	Veterinary Vaccine
Uses advised against	None known.

1.3. Details of the supplier of the safety data sheet

National Supplier

Company name	Elanco Europe Ltd.
Address	Lilly House, Priestley Road Basingstoke RG24 9NL United Kingdom
Telephone	+44 1256 353131
e-mail	lilly_msds@lilly.com
Emergency telephone number	CHEMTREC International +1-703-527-3887
1.4. Information on operation hours	24 hours

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008 as amended

This mixture does not meet the criteria for classification according to Regulation (EC) 1272/2008 as amended.

2.2. Label elements

Label according to Regulation (EC) No. 1272/2008 as amended

Hazard pictograms	None.
Signal word	None.
Hazard statements	The mixture does not meet the criteria for classification.

Precautionary statements

Prevention	Not available.
Response	Not available.
Storage	Not available.
Disposal	Not available.

Supplemental label information	None.
2.3. Other hazards	None known.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

The components are not hazardous or are below required disclosure limits.

SECTION 4: First aid measures

General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

4.1. Description of first aid measures

Inhalation	Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Wash off with soap and water. Get medical attention if irritation develops and persists.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. Get medical attention if symptoms occur.

4.2. Most important symptoms and effects, both acute and delayed	None known.
4.3. Indication of any immediate medical attention and special treatment needed	Treat symptomatically.

SECTION 5: Firefighting measures

General fire hazards	This product is an aqueous mixture which will not burn.
5.1. Extinguishing media	
Suitable extinguishing media	Use fire-extinguishing media appropriate for surrounding materials.
Unsuitable extinguishing media	Not available.
5.2. Special hazards arising from the substance or mixture	Not available.
5.3. Advice for firefighters	
Special protective equipment for firefighters	Wear suitable protective equipment.
Special fire fighting procedures	Not available.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	Keep unnecessary personnel away. For personal protection, see section 8.
For emergency responders	Keep unnecessary personnel away. Use personal protection recommended in Section 8 of the SDS.
6.2. Environmental precautions	Avoid discharge into drains, water courses or onto the ground.
6.3. Methods and material for containment and cleaning up	Prevent entry into waterways, sewer, basements or confined areas. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use.
6.4. Reference to other sections	For personal protection, see section 8. For waste disposal, see section 13 of the SDS.

SECTION 7: Handling and storage

7.1. Precautions for safe handling	Observe good industrial hygiene practices.
7.2. Conditions for safe storage, including any incompatibilities	Keep refrigerated. Recommended storage temperature: 2 to 8 C (36 to 46 F)
7.3. Specific end use(s)	Not available.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters	
Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Recommended monitoring procedures	Follow standard monitoring procedures.
Derived no effect levels (DNELs)	Not available.
Predicted no effect concentrations (PNECs)	Not available.
8.2. Exposure controls	
Appropriate engineering controls	General ventilation normally adequate.

Individual protection measures, such as personal protective equipment

General information	Not available.
Eye/face protection	Safety glasses with side-shields conforming to EN 166.
Skin protection	
- Hand protection	Protective gloves complying with EN 374.
- Other	Wear suitable protective clothing.
Respiratory protection	No personal respiratory protective equipment normally required.
Thermal hazards	Not available.
Hygiene measures	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.
Environmental exposure controls	Environmental manager must be informed of all major releases.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance

Physical state	Liquid.
Form	Liquid.
Colour	Not available.
Odour	Not available.
Odour threshold	Not available.
pH	Not applicable.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	Not applicable.
Evaporation rate	Not applicable.
Flammability (solid, gas)	Not applicable.

Upper/lower flammability or explosive limits

Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Vapour pressure	Not applicable.
Vapour density	Not applicable.
Relative density	Not available.
Solubility(ies)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not applicable.
Explosive properties	Not explosive.
Oxidising properties	Not oxidising.
9.2. Other information	No relevant additional information available.

SECTION 10: Stability and reactivity

10.1. Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
10.2. Chemical stability	Material is stable under normal conditions.
10.3. Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
10.4. Conditions to avoid	Contact with incompatible materials.
10.5. Incompatible materials	Strong oxidising agents.
10.6. Hazardous decomposition products	No hazardous decomposition products are known.

SECTION 11: Toxicological information

General information	Not available.

11.1. Information on toxicological effects

Acute toxicity	No data available.
Skin corrosion/irritation	Due to partial or complete lack of data the classification is not possible.
Serious eye damage/eye irritation	Due to partial or complete lack of data the classification is not possible.
Respiratory sensitisation	Due to partial or complete lack of data the classification is not possible.
Skin sensitisation	Due to partial or complete lack of data the classification is not possible.
Germ cell mutagenicity	Due to partial or complete lack of data the classification is not possible.
Carcinogenicity	Due to partial or complete lack of data the classification is not possible.
Reproductive toxicity	Due to partial or complete lack of data the classification is not possible.
Specific target organ toxicity - single exposure	Due to partial or complete lack of data the classification is not possible.
Specific target organ toxicity - repeated exposure	Due to partial or complete lack of data the classification is not possible.
Aspiration hazard	Due to partial or complete lack of data the classification is not possible.
Mixture versus substance information	No information available.
Other information	Not available.

SECTION 12: Ecological information

12.1. Toxicity	No toxicity data noted for the ingredient(s).
12.2. Persistence and degradability	No data is available on the degradability of this product.
12.3. Bioaccumulative potential	Not available.
Partition coefficient n-octanol/water (log Kow)	Not available.
Bioconcentration factor (BCF)	Not available.
12.4. Mobility in soil	No data available.
12.5. Results of PBT and vPvB assessment	No Chemical Safety Assessment has been carried out.
12.6. Other adverse effects	Not available.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Residual waste	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.
EU waste code	The Waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Disposal methods/information	Collect and reclaim or dispose in sealed containers at licensed waste disposal site.
Special precautions	Dispose in accordance with all applicable regulations.

SECTION 14: Transport information

ADR

Not regulated as dangerous goods.

RID

Not regulated as dangerous goods.

ADN

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code Not established.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

EU regulations

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex I and II, as amended

Not listed.

Regulation (EC) No. 850/2004 On persistent organic pollutants, Annex I as amended

Not listed.

Regulation (EU) No. 649/2012 concerning the export and import of dangerous chemicals, Annex I, Part 1 as amended

Not listed.

Regulation (EU) No. 649/2012 concerning the export and import of dangerous chemicals, Annex I, Part 2 as amended

Not listed.

Regulation (EU) No. 649/2012 concerning the export and import of dangerous chemicals, Annex I, Part 3 as amended

Not listed.

Regulation (EU) No. 649/2012 concerning the export and import of dangerous chemicals, Annex V as amended

Not listed.

Regulation (EC) No. 1907/2006, REACH Article 59(10) Candidate List as currently published by ECHA

Not listed.

Authorisations

Regulation (EC) No. 1907/2006, REACH Annex XIV Substances subject to authorization, as amended

Not listed.

Restrictions on use

Regulation (EC) No. 1907/2006, REACH Annex XVII Substances subject to restriction on marketing and use as amended

Not listed.

Other EU regulations

Directive 2012/18/EU on major accident hazards involving dangerous substances

Not listed.

Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work, as amended

Not listed.

Other regulations The product does not need to be labelled in accordance with EC directives or respective national laws.

National regulations Follow national regulation for work with chemical agents.

15.2. Chemical safety assessment No Chemical Safety Assessment has been carried out.

SECTION 16: Other information

List of abbreviations Not available.

References Not available.

Information on evaluation method leading to the classification of mixture The classification for health and environmental hazards is derived by a combination of calculation methods and test data, if available.

Full text of any H-statements not written out in full under Sections 2 to 15 None.

Revision information

SECTION 5: Firefighting measures: Suitable extinguishing media
SECTION 5: Firefighting measures: Special fire fighting procedures
SECTION 5: Firefighting measures: Special protective equipment for firefighters
SECTION 5: Firefighting measures: Unsuitable extinguishing media
SECTION 5: Firefighting measures: 5,2. Special hazards arising from the substance or mixture
SECTION 5: Firefighting measures: Specific methods
SECTION 5: Firefighting measures: General fire hazards

Disclaimer

As of the date of issuance, we are providing available information relevant to the handling of this material in the workplace. All information contained herein is offered with the good faith belief that it is accurate. THIS MATERIAL SAFETY DATA SHEET SHALL NOT BE DEEMED TO CREATE ANY WARRANTY OF ANY KIND (INCLUDING WARRANTY OF MERCHANT ABILITY OR FITNESS FOR A PARTICULAR PURPOSE). In the event of an adverse incident associated with this material, this safety data sheet is not intended to be a substitute for consultation with appropriately trained personnel. Nor is this safety data sheet intended to be a substitute for product literature which may accompany the finished product.

For additional information contact:
Elanco Animal Health
0011+1-877-352-6261
0011+1-800-428-4441

Florfenicol Solid Formulation

Version	Revision Date:	SDS Number:	Date of last issue: 10.10.2020
2.5	09.04.2021	444133-00013	Date of first issue: 07.01.2016

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : Florfenicol Solid Formulation

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Veterinary product

1.3 Details of the supplier of the safety data sheet

Company : MSD
Kilsheelan
Clonmel Tipperary, IE

Telephone : 353-51-601000

E-mail address of person responsible for the SDS : EHSDATASTEWARD@msd.com

1.4 Emergency telephone number

1-908-423-6000

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Reproductive toxicity, Category 2	H361fd: Suspected of damaging fertility. Suspected of damaging the unborn child.
Specific target organ toxicity - repeated exposure, Category 1	H372: Causes damage to organs through prolonged or repeated exposure.
Short-term (acute) aquatic hazard, Category 1	H400: Very toxic to aquatic life.
Long-term (chronic) aquatic hazard, Category 1	H410: Very toxic to aquatic life with long lasting effects.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :

Signal word : Danger

Hazard statements : H361fd Suspected of damaging fertility. Suspected of damaging the unborn child.
H372 Causes damage to organs through prolonged or repeated exposure.

H410 Very toxic to aquatic life with long lasting effects.

Precautionary statements : **Prevention:**

P201 Obtain special instructions before use.
P260 Do not breathe dust.
P273 Avoid release to the environment.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.

Response:

P308 + P313 IF exposed or concerned: Get medical advice/ attention.
P391 Collect spillage.

Hazardous components which must be listed on the label:

Florfenicol

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

Ecological information: The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

Toxicological information: The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

Dust contact with the eyes can lead to mechanical irritation.
Contact with dust can cause mechanical irritation or drying of the skin.
May form explosive dust-air mixture during processing, handling or other means.

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Components

Chemical name	CAS-No. EC-No. Index-No. Registration number	Classification	Concentration (% w/w)
Florfenicol	73231-34-2	Repr. 2; H361fd STOT RE 1; H372 (Liver, Brain, Testis, Spinal cord, Blood, gallbladder) Aquatic Acute 1; H400 Aquatic Chronic 1; H410	>= 50 - < 70

		M-Factor (Acute aquatic toxicity): 10 M-Factor (Chronic aquatic toxicity): 10	

For explanation of abbreviations see section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice : In the case of accident or if you feel unwell, seek medical advice immediately.
When symptoms persist or in all cases of doubt seek medical advice.

Protection of first-aiders : First Aid responders should pay attention to self-protection, and use the recommended personal protective equipment when the potential for exposure exists (see section 8).

If inhaled : If inhaled, remove to fresh air.
Get medical attention.

In case of skin contact : In case of contact, immediately flush skin with soap and plenty of water.
Remove contaminated clothing and shoes.
Get medical attention.
Wash clothing before reuse.
Thoroughly clean shoes before reuse.

In case of eye contact : If in eyes, rinse well with water.
Get medical attention if irritation develops and persists.

If swallowed : If swallowed, DO NOT induce vomiting.
Get medical attention.
Rinse mouth thoroughly with water.

4.2 Most important symptoms and effects, both acute and delayed

Risks : Suspected of damaging fertility. Suspected of damaging the unborn child.
Causes damage to organs through prolonged or repeated exposure.

Contact with dust can cause mechanical irritation or drying of the skin.
Dust contact with the eyes can lead to mechanical irritation.

4.3 Indication of any immediate medical attention and special treatment needed

Treatment : Treat symptomatically and supportively.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media : Water spray
Alcohol-resistant foam
Carbon dioxide (CO2)
Dry chemical

Unsuitable extinguishing media : None known.

5.2 Special hazards arising from the substance or mixture

Specific hazards during fire-fighting : Avoid generating dust; fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.
Exposure to combustion products may be a hazard to health.

Hazardous combustion products : Carbon oxides
Nitrogen oxides (NOx)

5.3 Advice for firefighters

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.
Use personal protective equipment.

Specific extinguishing methods : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Use water spray to cool unopened containers.
Remove undamaged containers from fire area if it is safe to do so.
Evacuate area.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Follow safe handling advice (see section 7) and personal protective equipment recommendations (see section 8).

6.2 Environmental precautions

Environmental precautions : Avoid release to the environment.
Prevent further leakage or spillage if safe to do so.
Retain and dispose of contaminated wash water.
Local authorities should be advised if significant spillages cannot be contained.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Sweep up or vacuum up spillage and collect in suitable container for disposal.
Avoid dispersal of dust in the air (i.e., clearing dust surfaces

with compressed air).
Dust deposits should not be allowed to accumulate on surfaces, as these may form an explosive mixture if they are released into the atmosphere in sufficient concentration.
Local or national regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which regulations are applicable.
Sections 13 and 15 of this SDS provide information regarding certain local or national requirements.

6.4 Reference to other sections

See sections: 7, 8, 11, 12 and 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Technical measures	:	Static electricity may accumulate and ignite suspended dust causing an explosion. Provide adequate precautions, such as electrical grounding and bonding, or inert atmospheres.
Local/Total ventilation	:	Use only with adequate ventilation.
Advice on safe handling	:	Do not breathe dust. Do not swallow. Avoid contact with eyes. Avoid prolonged or repeated contact with skin. Wash skin thoroughly after handling. Handle in accordance with good industrial hygiene and safety practice, based on the results of the workplace exposure assessment Minimize dust generation and accumulation. Keep container closed when not in use. Keep away from heat and sources of ignition. Take precautionary measures against static discharges. Do not eat, drink or smoke when using this product. Take care to prevent spills, waste and minimize release to the environment.
Hygiene measures	:	If exposure to chemical is likely during typical use, provide eye flushing systems and safety showers close to the working place. When using do not eat, drink or smoke. Wash contaminated clothing before re-use. The effective operation of a facility should include review of engineering controls, proper personal protective equipment, appropriate degowning and decontamination procedures, industrial hygiene monitoring, medical surveillance and the use of administrative controls.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers	:	Keep in properly labelled containers. Store locked up. Store in accordance with the particular national regulations.
Advice on common storage	:	Do not store with the following product types: Strong oxidizing agents

Organic peroxides
Explosives
Gases

7.3 Specific end use(s)

Specific use(s) : No data available

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational Exposure Limits

Components	CAS-No.	Value type (Form of exposure)	Control parameters	Basis
Florfenicol	73231-34-2	TWA	100 µg/m3 (OEB 2)	Internal

8.2 Exposure controls

Engineering measures

Use feasible engineering controls to minimize exposure to compound.
All engineering controls should be implemented by facility design and operated in accordance with GMP principles to protect products, workers, and the environment.

Personal protective equipment

Eye protection : Wear safety glasses with side shields or goggles.
If the work environment or activity involves dusty conditions, mists or aerosols, wear the appropriate goggles.
Wear a faceshield or other full face protection if there is a potential for direct contact to the face with dusts, mists, or aerosols.

Hand protection
Material : Chemical-resistant gloves

Skin and body protection : Work uniform or laboratory coat.

Respiratory protection : If adequate local exhaust ventilation is not available or exposure assessment demonstrates exposures outside the recommended guidelines, use respiratory protection.
Equipment should conform to I.S. EN 143

Filter type : Particulates type (P)

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state : powder
Colour : white
Odour : No data available
Odour Threshold : No data available

Melting point/freezing point : No data available

Initial boiling point and boiling : No data available

range

Flammability (solid, gas)	:	May form explosive dust-air mixture during processing, handling or other means.
Flammability (liquids)	:	No data available
Upper explosion limit / Upper flammability limit	:	No data available
Lower explosion limit / Lower flammability limit	:	No data available
Flash point	:	Not applicable
Auto-ignition temperature	:	No data available
Decomposition temperature		
Decomposition temperature	:	No data available
pH	:	No data available
Viscosity		
Viscosity, kinematic	:	Not applicable
Solubility(ies)		
Water solubility	:	No data available
Partition coefficient: n-octanol/water	:	Not applicable
Vapour pressure	:	No data available
Relative density	:	No data available
Density	:	No data available
Relative vapour density	:	Not applicable
Particle characteristics		
Particle size	:	No data available

9.2 Other information

Explosives	:	Not explosive
Oxidizing properties	:	The substance or mixture is not classified as oxidizing.
Evaporation rate	:	Not applicable

SECTION 10: Stability and reactivity

10.1 Reactivity

Not classified as a reactivity hazard.

10.2 Chemical stability

Stable under normal conditions.

10.3 Possibility of hazardous reactions

Hazardous reactions : May form explosive dust-air mixture during processing, handling or other means.
Can react with strong oxidizing agents.

10.4 Conditions to avoid

Conditions to avoid : Heat, flames and sparks.
Avoid dust formation.

10.5 Incompatible materials

Materials to avoid : Oxidizing agents

10.6 Hazardous decomposition products

No hazardous decomposition products are known.

SECTION 11: Toxicological information

11.1 Information on hazard classes as defined in Regulation (EC) No 1272/2008

Information on likely routes of exposure : Inhalation
Skin contact
Ingestion
Eye contact

Acute toxicity

Not classified based on available information.

Components:

Florfenicol:

Acute oral toxicity : LD50 (Rat): > 2,000 mg/kg

LD50 (Mouse): > 2,000 mg/kg

LD50 (Dog): > 1,280 mg/kg

Acute inhalation toxicity : LC50 (Rat): > 0.28 mg/l
Exposure time: 4 h

Acute dermal toxicity : Remarks: No data available

Acute toxicity (other routes of administration) : LD50 (Rat): 1,913 - 2,253 mg/kg
Application Route: Intraperitoneal

LD50 (Mouse): 100 mg/kg
Application Route: Intravenous

Skin corrosion/irritation

Not classified based on available information.

Components:

Florfenicol:

Species	:	Rabbit
Result	:	No skin irritation

Serious eye damage/eye irritation

Not classified based on available information.

Components:

Florfenicol:

Species	:	Rabbit
Result	:	Mild eye irritation

Respiratory or skin sensitisation

Skin sensitisation

Not classified based on available information.

Respiratory sensitisation

Not classified based on available information.

Components:

Florfenicol:

Test Type	:	Maximisation Test
Species	:	Guinea pig
Result	:	negative

Germ cell mutagenicity

Not classified based on available information.

Components:

Florfenicol:

Genotoxicity in vitro	:	Test Type: Bacterial reverse mutation assay (AMES) Result: negative Test Type: DNA damage and repair, unscheduled DNA synthesis in mammalian cells (in vitro) Test system: rat hepatocytes Result: negative Test Type: In vitro mammalian cell gene mutation test Test system: mouse lymphoma cells Result: negative Test Type: Chromosome aberration test in vitro Test system: Chinese hamster ovary cells Result: positive
Genotoxicity in vivo	:	Test Type: Micronucleus test Species: Mouse

Cell type: Bone marrow
Application Route: Oral
Result: negative

Carcinogenicity

Not classified based on available information.

Components:

Florfenicol:

Species	:	Rat
Application Route	:	oral (gavage)
Exposure time	:	2 Years
Result	:	negative
Target Organs	:	Liver, Testes

Species	:	Mouse
Application Route	:	oral (gavage)
Exposure time	:	2 Years
Result	:	negative
Target Organs	:	Testes, Blood

Reproductive toxicity

Suspected of damaging fertility. Suspected of damaging the unborn child.

Components:

Florfenicol:

Effects on fertility	:	Test Type: Two-generation reproduction toxicity study Species: Rat Application Route: Oral Fertility: LOAEL: 12 mg/kg body weight Result: decreased pup survival, reduced lactation
Effects on foetal development	:	Test Type: Embryo-foetal development Species: Rat General Toxicity Maternal: NOAEL: 4 mg/kg body weight Embryo-foetal toxicity: LOAEL: 40 mg/kg body weight Result: No teratogenic effects, Fetotoxicity Remarks: The effects were seen only at maternally toxic doses. Test Type: Embryo-foetal development Species: Mouse Application Route: oral (gavage) General Toxicity Maternal: NOAEL: 120 mg/kg body weight Embryo-foetal toxicity: LOAEL: 40 mg/kg body weight Result: Fetotoxicity
Reproductive toxicity - Assessment	:	Some evidence of adverse effects on sexual function and fertility, based on animal experiments., Some evidence of adverse effects on development, based on animal experiments.

STOT - single exposure

Not classified based on available information.

STOT - repeated exposure

Causes damage to organs through prolonged or repeated exposure.

Components:

Florfenicol:

Target Organs	:	Liver, Brain, Testis, Spinal cord, Blood, gallbladder
Assessment	:	Causes damage to organs through prolonged or repeated exposure.

Repeated dose toxicity

Components:

Florfenicol:

Species	:	Dog
NOAEL	:	3 mg/kg
Exposure time	:	13 Weeks
Target Organs	:	Liver, Testis, Brain, Spinal cord
Species	:	Mouse
NOAEL	:	200 mg/kg
Exposure time	:	13 Weeks
Target Organs	:	Liver, Testis
Species	:	Rat
NOAEL	:	30 mg/kg
Exposure time	:	13 Weeks
Target Organs	:	Liver, Testis
Species	:	Dog
NOAEL	:	3 mg/kg
LOAEL	:	12 mg/kg
Exposure time	:	52 Weeks
Target Organs	:	Liver, gallbladder
Species	:	Rat
NOAEL	:	1 mg/kg
LOAEL	:	3 mg/kg
Exposure time	:	52 Weeks
Target Organs	:	Testis

Aspiration toxicity

Not classified based on available information.

11.2 Information on other hazards

Endocrine disrupting properties

Product:

Assessment	:	The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

SECTION 12: Ecological information

12.1 Toxicity

Components:

Florfenicol:

Toxicity to fish	:	LC50 (Lepomis macrochirus (Bluegill sunfish)): > 830 mg/l Exposure time: 96 h Method: FDA 4.11 LC50 (Oncorhynchus mykiss (rainbow trout)): > 780 mg/l Exposure time: 96 h Method: FDA 4.11
Toxicity to daphnia and other aquatic invertebrates	:	EC50 (Daphnia magna (Water flea)): > 330 mg/l Exposure time: 48 h Method: OECD Test Guideline 202
Toxicity to algae/aquatic plants	:	EC50 (Pseudokirchneriella subcapitata (green algae)): > 2.9 mg/l Exposure time: 14 d Method: FDA 4.01 NOEC (Pseudokirchneriella subcapitata (green algae)): 2.9 mg/l Exposure time: 14 d Method: FDA 4.01 IC50 (Skeletonema costatum (marine diatom)): 0.0336 mg/l Exposure time: 72 h Method: ISO 10253 NOEC (Skeletonema costatum (marine diatom)): 0.00423 mg/l Exposure time: 72 h Method: ISO 10253 EC50 (Lemna gibba (gibbous duckweed)): 0.76 mg/l Exposure time: 7 d Method: OECD Test Guideline 221 NOEC (Lemna gibba (gibbous duckweed)): 0.39 mg/l Exposure time: 7 d Method: OECD Test Guideline 221 EC50 (Navicula pelliculosa (Freshwater diatom)): 61 mg/l Exposure time: 72 h

Method: OECD Test Guideline 201

NOEC (Navicula pelliculosa (Freshwater diatom)): 19 mg/l
Exposure time: 72 h
Method: OECD Test Guideline 201

EC50 (Anabaena flos-aquae): 0.066 mg/l
Exposure time: 72 h
Method: OECD Test Guideline 201

NOEC (Anabaena flos-aquae): 0.051 mg/l
Exposure time: 72 h
Method: OECD Test Guideline 201

M-Factor (Acute aquatic toxicity) : 10

Toxicity to fish (Chronic toxicity) : NOEC: 5.5 mg/l
Exposure time: 32 d
Species: Pimephales promelas (fathead minnow)
Method: OECD Test Guideline 210

Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity) : NOEC: 1.5 mg/l
Exposure time: 21 d
Species: Daphnia magna (Water flea)
Method: OECD Test Guideline 211

M-Factor (Chronic aquatic toxicity) : 10

12.2 Persistence and degradability

No data available

12.3 Bioaccumulative potential

Components:

Florfenicol:

Partition coefficient: n-octanol/water : log Pow: 0.373

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Endocrine disrupting properties

Product:

Assessment : The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

12.7 Other adverse effects

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Dispose of in accordance with local regulations.
According to the European Waste Catalogue, Waste Codes are not product specific, but application specific.
Waste codes should be assigned by the user, preferably in discussion with the waste disposal authorities.

Contaminated packaging : Empty containers should be taken to an approved waste handling site for recycling or disposal.
If not otherwise specified: Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number or ID number

ADN : UN 3077

ADR : UN 3077

RID : UN 3077

IMDG : UN 3077

IATA : UN 3077

14.2 UN proper shipping name

ADN : ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.
(Florfenicol)

ADR : ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.
(Florfenicol)

RID : ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.
(Florfenicol)

IMDG : ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.
(Florfenicol)

IATA : Environmentally hazardous substance, solid, n.o.s.
(Florfenicol)

14.3 Transport hazard class(es)

ADN : 9

ADR : 9

RID : 9

IMDG : 9

IATA : 9

14.4 Packing group

ADN

Packing group	:	III
Classification Code	:	M7
Hazard Identification Number	:	90
Labels	:	9

ADR

Packing group	:	III
Classification Code	:	M7
Hazard Identification Number	:	90
Labels	:	9
Tunnel restriction code	:	(-)

RID

Packing group	:	III
Classification Code	:	M7
Hazard Identification Number	:	90
Labels	:	9

IMDG

Packing group	:	III
Labels	:	9
EmS Code	:	F-A, S-F

IATA (Cargo)

Packing instruction (cargo aircraft)	:	956
Packing instruction (LQ)	:	Y956
Packing group	:	III
Labels	:	Miscellaneous

IATA (Passenger)

Packing instruction (passenger aircraft)	:	956
Packing instruction (LQ)	:	Y956
Packing group	:	III
Labels	:	Miscellaneous

14.5 Environmental hazards

ADN

Environmentally hazardous : yes

ADR

Environmentally hazardous : yes

RID

Environmentally hazardous : yes

IMDG
Marine pollutant : yes

IATA (Passenger)
Environmentally hazardous : yes

IATA (Cargo)
Environmentally hazardous : yes

14.6 Special precautions for user

The transport classification(s) provided herein are for informational purposes only, and solely based upon the properties of the unpackaged material as it is described within this Safety Data Sheet. Transportation classifications may vary by mode of transportation, package sizes, and variations in regional or country regulations.

14.7 Maritime transport in bulk according to IMO instruments

Remarks : Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

REACH - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, preparations and articles (Annex XVII)	:	Not applicable
REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59).	:	Not applicable
REACH - List of substances subject to authorisation (Annex XIV)	:	Not applicable
Regulation (EC) No 1005/2009 on substances that deplete the ozone layer	:	Not applicable
Regulation (EU) 2019/1021 on persistent organic pollutants (recast)	:	Not applicable
Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals	:	Not applicable

Seveso III: Directive 2012/18/EU of the European Parliament and of the Council on the control of major-accident hazards involving dangerous substances.

		Quantity 1	Quantity 2
E1	ENVIRONMENTAL HAZARDS	100 t	200 t

Other regulations:

Take note of Directive 92/85/EEC regarding maternity protection or stricter national regulations, where applicable.
Take note of Directive 94/33/EC on the protection of young people at work or stricter national regulations, where applicable.

The components of this product are reported in the following inventories:

AICS : not determined

DSL : not determined

IECSC : not determined

15.2 Chemical safety assessment

A Chemical Safety Assessment has not been carried out.

SECTION 16: Other information

Other information	:	Items where changes have been made to the previous version are highlighted in the body of this document by two vertical lines.

Full text of H-Statements

H361fd	:	Suspected of damaging fertility. Suspected of damaging the unborn child.
H372	:	Causes damage to organs through prolonged or repeated exposure.
H400	:	Very toxic to aquatic life.
H410	:	Very toxic to aquatic life with long lasting effects.

Full text of other abbreviations

Aquatic Acute	:	Short-term (acute) aquatic hazard
Aquatic Chronic	:	Long-term (chronic) aquatic hazard
Repr.	:	Reproductive toxicity
STOT RE	:	Specific target organ toxicity - repeated exposure

ADN - European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways; ADR - European Agreement concerning the International Carriage of Dangerous Goods by Road; AIIC - Australian Inventory of Industrial Chemicals; ASTM - American Society for the Testing of Materials; bw - Body weight; CLP - Classification Labelling Packaging Regulation; Regulation (EC) No 1272/2008; CMR - Carcinogen, Mutagen or Reproductive Toxicant; DIN - Standard of the German Institute for Standardisation; DSL - Domestic Substances List (Canada); ECHA - European Chemicals Agency; EC-Number - European Community number; ECx - Concentration associated with x% response; ELx - Loading rate associated with x% response; EmS - Emergency Schedule; ENCS - Existing and New Chemical Substances (Japan); ErCx - Concentration associated with x% growth rate response; GHS - Globally Harmonized System; GLP - Good Laboratory Practice; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; IBC - International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk; IC50 - Half maximal inhibitory concentration; ICAO - International Civil Aviation Organization; IECSC - Inventory of Existing Chemical Substances in China; IMDG - International Maritime Dangerous Goods; IMO - International Maritime Organization; ISHL - Industrial Safety and Health Law (Japan); ISO - International Organisation for Standardization; KECI - Korea Existing Chemicals Inventory; LC50 - Lethal Concentration to 50 % of a test population; LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose); MARPOL - International Convention for the Prevention of Pollution from Ships; n.o.s. - Not Otherwise Specified; NO(A)EC - No Observed (Adverse) Effect Concentration; NO(A)EL - No Observed (Adverse) Effect Level; NOELR - No Observable Effect Loading Rate; NZIoC - New Zealand Inventory of Chemicals; OECD - Organization for Economic Co-operation and Development; OPPTS - Office of Chemical Safety and Pollution Prevention; PBT - Persistent, Bioaccumulative and Toxic substance; PICCS - Philippines Inventory of Chemicals and Chemical Substances; (Q)SAR - (Quantitative) Structure Activity Relationship; REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals; RID - Regulations concerning the International Carriage of Dangerous Goods by Rail; SADT - Self-Accelerating Decomposition Temperature; SDS - Safety Data Sheet; SVHC - Substance of Very High Concern; TCSI - Taiwan Chemical Substance Inventory; TRGS -

Technical Rule for Hazardous Substances; TSCA - Toxic Substances Control Act (United States); UN - United Nations; vPvB - Very Persistent and Very Bioaccumulative

Further information

Sources of key data used to compile the Safety Data Sheet	:	Internal technical data, data from raw material SDSs, OECD eChem Portal search results and European Chemicals Agency, http://echa.europa.eu/

Classification of the mixture:		**Classification procedure:**
Repr. 2	H361fd	Calculation method
STOT RE 1	H372	Calculation method
Aquatic Acute 1	H400	Calculation method
Aquatic Chronic 1	H410	Calculation method

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and shall not be considered a warranty or quality specification of any type. The information provided relates only to the specific material identified at the top of this SDS and may not be valid when the SDS material is used in combination with any other materials or in any process, unless specified in the text. Material users should review the information and recommendations in the specific context of their intended manner of handling, use, processing and storage, including an assessment of the appropriateness of the SDS material in the user's end product, if applicable.

IE / EN

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

- Trade name PARAMOVE®

1.2 Relevant identified uses of the substance or mixture and uses advised against

Uses of the Substance/Mixture

- Veterinary hygiene

1.3 Details of the supplier of the safety data sheet

Company

SOLVAY CHEMICALS INTERNATIONAL SA
RUE DE RANSBEEK, 310
1120, BRUXELLES
BELGIUM
Tel: +32-2-2642111
Fax: +32-2-2641802

E-mail address

manager.sds@solvay.com

1.4 Emergency telephone number

+44(0)1235 239 670 [CareChem 24]

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (Regulation (EC) No 1272/2008)

Acute toxicity, Category 4	H302: Harmful if swallowed.
Acute toxicity, Category 4	H332: Harmful if inhaled.
Skin irritation, Category 2	H315: Causes skin irritation.
Serious eye damage, Category 1	H318: Causes serious eye damage.
Specific target organ toxicity - single exposure, Category 3	H335: May cause respiratory irritation. (Respiratory system)

2.2 Label elements

Regulation (EC) No 1272/2008

Hazardous products which must be listed on the label

- Index-No. 008-003-00-9 hydrogen peroxide (49.9 %)

Pictogram

Signal word

- Danger

Hazard statements

- H302 + H332	Harmful if swallowed or if inhaled
- H315	Causes skin irritation.
- H318	Causes serious eye damage.
- H335	May cause respiratory irritation.

Precautionary statements

Prevention

- P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
- P280	Wear protective gloves/ eye protection/ face protection.

Response

- P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
- P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.

Storage

- P403 + P233	Store in a well-ventilated place. Keep container tightly closed.

Disposal

- P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Other hazards which do not result in classification

Results of PBT and vPvB assessment

- This mixture contains no substance considered to be persistent, bioaccumulating and toxic (PBT).
- This mixture contains no substance considered to be very persistent and very bioaccumulating (vPvB).

SECTION 3: Composition/information on ingredients

3.1 Substance

- Not applicable, this product is a mixture.

3.2 Mixture

- Chemical name: Hydrogen peroxide
- Synonyms: Hydroperoxide, Hydrogen dioxide
- Formula: H2O2

Information on Components and Impurities

Chemical name	Identification number	Classification Regulation (EC) No 1272/2008	Concentration [%]
hydrogen peroxide	Index-No. : 008-003-00-9 CAS-No. : 7722-84-1 EINECS-No. : 231-765-0	Oxidizing liquids, Category 1 ; H271 Acute toxicity, Category 4 ; H302 Acute toxicity, Category 4 ; H332 Skin corrosion, Category 1A ; H314 Serious eye damage, Category 1 ; H318 Specific target organ toxicity - single exposure, Category 3 ; H335 (Respiratory system) Chronic aquatic toxicity, Category 3 ; H412 **Specific concentration limit**: C: >= 70 %, Oxidizing liquids, Category 1; H271 C: 50 - < 70 %, Oxidizing liquids, Category 2; H272 C: >= 70 %, Skin corrosion, Category 1A; H314 C: 50 - < 70 %, Skin corrosion, Category 1B; H314 C: 35 - < 50 %, Skin irritation, Category 2; H315 C: 8 - < 50 %, Serious eye damage, Category 1; H318 C: 5 - < 8 %, Eye irritation, Category 2; H319 C: >= 35 %, Specific target organ toxicity - single exposure, Category 3; H335 C: >= 63 %, Chronic aquatic toxicity, Category 3; H412 C: < 63 %, Chronic aquatic toxicity, Category 4; Not classified	49.9
	Registration number: 01-2119485845-22-xxxx		

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice

- Show this safety data sheet to the doctor in attendance.

In case of inhalation

- Move to fresh air.
- Oxygen or artificial respiration if needed.
- Victim to lie down in the recovery position, cover and keep him warm.
- Call a physician immediately.

In case of skin contact

- Remove and wash contaminated clothing before re-use.
- Wash off with soap and water.
- If symptoms persist, call a physician.

In case of eye contact

- Call a physician or poison control centre immediately.
- Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.
- In the case of difficulty of opening the lids, administer an analgesic eye wash (oxybuprocaine).
- Take victim immediately to hospital.

In case of ingestion

- Call a physician or poison control centre immediately.
- Take victim immediately to hospital.
- If swallowed, rinse mouth with water (only if the person is conscious).
- Do NOT induce vomiting.
- Artificial respiration and/or oxygen may be necessary.

- If victim is unconscious:
- Artificial respiration and/or oxygen may be necessary.

- If victim is conscious:
- If swallowed, rinse mouth with water (only if the person is conscious).
- Do NOT induce vomiting.

4.2 Most important symptoms and effects, both acute and delayed

In case of inhalation

Symptoms

- Breathing difficulties
- Cough
- pulmonary oedema
- Nausea
- Vomiting

Effects

- Corrosive to respiratory system.

Repeated or prolonged exposure

- Nose bleeding
- Risk of chronic bronchitis

In case of skin contact

Symptoms

- Redness
- Swelling of tissue

Effects

- Prolonged skin contact may cause skin irritation.

In case of eye contact

Symptoms

- Redness
- Lachrymation
- Swelling of tissue

Effects

- Corrosive
- Causes severe burns.
- Small amounts splashed into eyes can cause irreversible tissue damage and blindness.

In case of ingestion

Symptoms

- Nausea
- Abdominal pain
- Bloody vomiting
- Diarrhoea
- Suffocation
- Cough
- Severe shortness of breath

Effects

- If ingested, severe burns of the mouth and throat, as well as a danger of perforation of the oesophagus and the stomach.
- Risk of respiratory disorder

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician

- Take victim immediately to hospital.
- Immediate medical attention is required.
- Consult with an ophthalmologist immediately in all cases.
- If swallowed
- Avoid gastric lavage (risk of perforation).
- Keep under medical supervision for at least 48 hours.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

- Water
- Water spray

Unsuitable extinguishing media

- None

5.2 Special hazards arising from the substance or mixture

- Decomposition will cause oxygen release which may intensify fire
- Contact with combustible material may cause fire.
- Contact with flammables may cause fire or explosions.
- Risk of explosion if heated under confinement.

5.3 Advice for firefighters

Special protective equipment for firefighters

- In the event of fire, wear self-contained breathing apparatus.
- Use personal protective equipment.
- Wear chemical resistant oversuit

Further information

- Keep product and empty container away from heat and sources of ignition.
- Keep containers and surroundings cool with water spray.
- Approach from upwind.

- Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel

- Evacuate personnel to safe areas.
- Keep people away from and upwind of spill/leak.

Advice for emergency responders

- Use personal protective equipment.
- Drying of this product on clothing or combustible materials may cause fire.
- Keep wetted with water.
- Prevent further leakage or spillage.
- Keep away from incompatible products

6.2 Environmental precautions

- Should not be released into the environment.
- If the product contaminates rivers and lakes or drains inform respective authorities.

6.3 Methods and materials for containment and cleaning up

- Dilute with plenty of water.
- Dam up.
- Do not mix waste streams during collection.
- Soak up with inert absorbent material.
- Keep in properly labelled containers.
- Keep in suitable, closed containers for disposal.
- Never return spills in original containers for re-use.
- Treat recovered material as described in the section "Disposal considerations".

6.4 Reference to other sections

- Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

- Use only in well-ventilated areas.
- Before all operations, passivate the piping circuits and vessels according to the procedure recommended by the producer.
- Use only clean and dry utensils.
- Never return unused material to storage receptacle.
- Keep away from heat.
- Avoid inhalation, ingestion and contact with skin and eyes.
- Keep away from incompatible products

Hygiene measures

- Ensure that eyewash stations and safety showers are close to the workstation location.
- Take off contaminated clothing and shoes immediately.
- Wash contaminated clothing before re-use.
- When using do not eat, drink or smoke.
- Wash hands before breaks and at the end of workday.
- Handle in accordance with good industrial hygiene and safety practice.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures/Storage conditions

- Keep only in the original container.
- Store in a receptacle equipped with a vent.
- Store in a well-ventilated place. Keep cool.
- Keep in properly labelled containers.
- Keep container closed.
- Keep in a bunded area.
- Keep away from heat/sparks/open flames/hot surfaces. No smoking.
- Regularly check the condition and temperature of the containers.

- Keep away from:
- Incompatible products

Packaging material

Suitable material
- aluminium 99,5 %
- stainless steel 304L / 316L
- Approved grades of HDPE.

7.3 Specific end use(s)

- Contact your supplier for additional information

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace occupational exposure limits

Components	Value type	Value	Basis
hydrogen peroxide	TWA	1 ppm 1.4 mg/m3	UK. EH40 WEL - Workplace Exposure Limits
	STEL	2 ppm 2.8 mg/m3	UK. EH40 WEL - Workplace Exposure Limits
hydrogen peroxide	TWA	1 ppm	USA. ACGIH Threshold Limit Values (TLV)

Derived No Effect Level (DNEL) / Derived minimal effect level (DMEL)

Product name	Population	Route of exposure	Potential health effects	Exposure time	Value	Remarks
hydrogen peroxide	Workers	Inhalation	Local effects	Acute	3 mg/m3	
	Workers	Inhalation	Local effects	Long term	1.4 mg/m3	
	General population	Inhalation	Local effects	Acute	1.93 mg/m3	
	General population	Inhalation	Local effects	Long term	0.21 mg/m3	

Predicted No Effect Concentration (PNEC)

Product name	Compartment	Value	Remarks
hydrogen peroxide	Fresh water	0.0126 mg/l	
	Marine water	0.0126 mg/l	
	Intermittent use/release	0.0138 mg/l	
	Fresh water sediment	0.047 mg/kg	
	Marine sediment	0.047 mg/kg	
	Soil	0.0023 mg/kg	
	Sewage treatment plant	4.66 mg/l	

8.2 Exposure controls

Control measures

Engineering measures

- Provide adequate ventilation.
- Apply technical measures to comply with the occupational exposure limits.

Individual protection measures

Respiratory protection

- Use respirator when performing operations involving potential exposure to vapour of the product.
- When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.
- Respirator with a vapour filter (EN 141)
- Recommended Filter type: ABEK-P2
- Self-contained breathing apparatus in case of: 1) large uncontrolled emissions, 2) insufficient oxygen, 3) the mask and cartridge do not give adequate protection.

Hand protection

- Impervious gloves
- Take note of the information given by the producer concerning permeability and break through times, and of special workplace conditions (mechanical strain, duration of contact).

Suitable material

- PVC
- Natural Rubber
- butyl-rubber
- Nitrile rubber

Eye protection

- Chemical resistant goggles must be worn.
- If splashes are likely to occur, wear:
- Tightly fitting safety goggles
- Face-shield

Skin and body protection

- Impervious clothing
- If splashes are likely to occur, wear:
- Chemical resistant apron
- Boots

- Suitable material
- PVC
- Natural Rubber

Hygiene measures

- Ensure that eyewash stations and safety showers are close to the workstation location.
- Take off contaminated clothing and shoes immediately.
- Wash contaminated clothing before re-use.
- When using do not eat, drink or smoke.
- Wash hands before breaks and at the end of workday.
- Handle in accordance with good industrial hygiene and safety practice.

Environmental exposure controls

- Dispose of rinse water in accordance with local and national regulations.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	Physical state: liquid Colour: colourless
Odour	pungent
Odour Threshold	no data available
Molecular weight	34 g/mol
pH	2.0 (21 °C) H2O2 50 % pKa: 11.6 (25 °C)
Melting point/freezing point	Freezing point: -33 °C H2O2 35 %
Initial boiling point and boiling range	Boiling point/boiling range: 108 °C H2O2 35 %
Flash point	does not flash
Evaporation rate (Butylacetate = 1)	no data available
Flammability (liquids)	The product is not flammable.
Flammability/Explosive limit	Explosiveness: Not explosive With certain materials (see section 10).

Auto-ignition temperature	The product is not flammable.
Vapour pressure	1 hPa (30 °C) H2O2 50 %
Vapour density	1 H2O2 50 %
Density	Bulk density: Not applicable
Relative density	1.1 - 1.2
Solubility	Water solubility: completely soluble
Partition coefficient: n-octanol/water	log Pow: -1.57 Method: Calculation method
Decomposition temperature	>= 60 °C Self-Accelerating decomposition temperature (SADT)
Decomposition temperature	< 60 °C Slow decomposition
Viscosity	Viscosity, dynamic : 1.17 mPa.s (20 °C) H2O2 50 %
Explosive properties	no data available
Oxidizing properties	Not considered as oxidizing

9.2 Other information

Henry's Constant	0.00075 Pa.m3/mol (20 °C) not significant, Air, Volatility
Surface tension	75.6 mN/m (20 °C) H2O2 50 %

SECTION 10: Stability and reactivity

10.1 Reactivity

- Contact with other material may cause fire.
- Decomposes on heating with potential large quantities of gas release (oxygen).
- Potential for exothermic hazard

10.2 Chemical stability

- Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

- Contact with combustible material may cause fire.
- Contact with flammables may cause fire or explosions.
- Contact with incompatible material may cause exothermic decomposition with gas release.
- Risk of explosion if heated under confinement.
- Fire or intense heat may cause violent rupture of packages.

10.4 Conditions to avoid

- Contamination
- To avoid thermal decomposition, do not overheat.

10.5 Incompatible materials

- Acids
- Bases
- Metals
- Heavy metal salts
- Powdered metal salts
- Reducing agents
- Organic materials
- Flammable materials

10.6 Hazardous decomposition products

- Oxygen

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Acute oral toxicity	Acute toxicity estimate : 431 mg/kg - Rat , male and female Test substance: Hydrogen peroxide Unpublished reports
Acute inhalation toxicity	LC50 - 4 h (vapour) > 0.17 mg/l - Rat Test substance: Hydrogen peroxide No mortality observed at this concentration. Unpublished reports
Acute dermal toxicity	Acute toxicity estimate 6,440 mg/kg - Rabbit Test substance: Hydrogen peroxide Unpublished reports
Acute toxicity (other routes of administration)	no data available
Skin corrosion/irritation	Causes skin irritation.
Serious eye damage/eye irritation	Causes serious eye damage.

Respiratory or skin sensitisation

hydrogen peroxide	Does not cause skin sensitisation. not sensitising

Mutagenicity

Genotoxicity in vitro

hydrogen peroxide	Ames test with and without metabolic activation positive Published data Chromosome aberration test in vitro with and without metabolic activation positive Unpublished reports

Genotoxicity in vivo

hydrogen peroxide	In vivo micronucleus test - Mouse Oral Method: OECD Test Guideline 474 negative Unpublished reports

Carcinogenicity

hydrogen peroxide	no data available

Toxicity for reproduction and development

Toxicity to reproduction/Fertility

hydrogen peroxide	No toxicity to reproduction

Developmental Toxicity/Teratogenicity

hydrogen peroxide	No toxicity to reproduction

STOT

STOT - single exposure

hydrogen peroxide	Exposure routes: Inhalation Target Organs: Respiratory Tract May cause respiratory irritation.

STOT - repeated exposure

hydrogen peroxide	The substance or mixture is not classified as specific target organ toxicant, repeated exposure according to GHS criteria.
hydrogen peroxide	Inhalation (vapour) 90-day - Rat NOAEC: 7 ppm Target Organs: Respiratory Tract Method: OECD Test Guideline 413 Unpublished reports 90-day - Rat NOAEL: 100 ppm Target Organs: Gastrointestinal tract Method: OECD Test Guideline 408 drinking water Unpublished reports

Aspiration toxicity no data available

Further information no data available

SECTION 12: Ecological information

12.1 Toxicity

Aquatic Compartment

Acute toxicity to fish

hydrogen peroxide	LC50 - 96 h : 16.4 mg/l - Pimephales promelas (fathead minnow) semi-static test Analytical monitoring: yes Unpublished internal reports Harmful to fish.

Acute toxicity to daphnia and other aquatic invertebrates.

hydrogen peroxide	EC50 - 48 h : 2.4 mg/l - Daphnia pulex (Water flea) semi-static test Analytical monitoring: yes Unpublished internal reports Toxic to aquatic invertebrates.

Toxicity to aquatic plants

hydrogen peroxide	ErC50 - 72 h : 2.62 mg/l - Skeletonema costatum (marine diatom) static test Analytical monitoring: yes Unpublished internal reports Toxic to algae.

Toxicity to microorganisms

hydrogen peroxide	EC50 - 0.5 h : 466 mg/l - activated sludge static test Analytical monitoring: yes Method: OECD Test Guideline 209 Unpublished internal reports

Chronic toxicity to fish no data available

Chronic toxicity to daphnia and other aquatic invertebrates.

hydrogen peroxide	NOEC: 0.63 mg/l - 21 Days - Daphnia magna (Water flea) flow-through test Analytical monitoring: yes Published data Harmful to aquatic invertebrates with long lasting effects.

Chronic Toxicity to aquatic plants no data available

12.2 Persistence and degradability

Abiotic degradation — no data available

Physical- and photo-chemical elimination — no data available

Biodegradation

Biodegradability

hydrogen peroxide — Ready biodegradability study:
Method: Degradation in sewage treatment plants
The substance fulfills the criteria for ultimate aerobic biodegradability and ready biodegradability
Inoculum: activated sludge
Unpublished internal reports

Degradability assessment

hydrogen peroxide — The product is considered to be rapidly degradable in the environment

12.3 Bioaccumulative potential

Partition coefficient: n-octanol/water

hydrogen peroxide — Not potentially bioaccumulable

Bioconcentration factor (BCF)

hydrogen peroxide — Not potentially bioaccumulable

12.4 Mobility in soil

Adsorption potential (Koc)

hydrogen peroxide — Adsorption/Soil
Koc: 1.58
Log Koc: 0.2
Method: Structure-activity relationship (SAR)
Unpublished reports

Known distribution to environmental compartments

hydrogen peroxide — Ultimate destination of the product : Water

12.5 Results of PBT and vPvB assessment

This mixture contains no substance considered to be persistent, bioaccumulating and toxic (PBT).

This mixture contains no substance considered to be very persistent and very bioaccumulating (vPvB).

12.6 Other adverse effects

no data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product Disposal

- Limited quantity
- Dilute with plenty of water.
- Flush into sewer with plenty of water.
- Maximum quantity
- Contact manufacturer.
- Contact waste disposal services.
- In accordance with local and national regulations.

Advice on cleaning and disposal of packaging

- Empty containers.
- Clean container with water.
- Dispose of rinse water in accordance with local and national regulations.
- Where possible recycling is preferred to disposal or incineration.
- In accordance with local and national regulations.

SECTION 14: Transport information

ADR

14.1 UN number	UN 2014
14.2 Proper shipping name	HYDROGEN PEROXIDE, AQUEOUS SOLUTION
14.3 Transport hazard class	5.1
Subsidiary hazard class:	8
Label(s):	5.1 (8)
14.4 Packing group	
Packing group	II
Classification Code	OC1
14.5 Environmental hazards	NO
14.6 Special precautions for user	
Hazard Identification Number:	58
Tunnel restriction code	(E)

For personal protection see section 8.

RID

14.1 UN number	UN 2014
14.2 Proper shipping name	HYDROGEN PEROXIDE, AQUEOUS SOLUTION
14.3 Transport hazard class	5.1
Subsidiary hazard class:	8
Label(s):	5.1 (8)
14.4 Packing group	
Packing group	II
Classification Code	OC1
14.5 Environmental hazards	NO
14.6 Special precautions for user	
Hazard Identification Number:	58

For personal protection see section 8.

IMDG

14.1 UN number	UN 2014
14.2 Proper shipping name	HYDROGEN PEROXIDE, AQUEOUS SOLUTION
14.3 Transport hazard class	5.1
Subsidiary hazard class:	8
Label(s):	5.1 (8)
14.4 Packing group	
Packing group	II
14.5 Environmental hazards	NO
Marine pollutant	
14.6 Special precautions for user	
EmS	F-H , S-Q

For personal protection see section 8.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
no data available

IATA

14.1 UN number	UN 2014
14.2 Proper shipping name	Not permitted for transport
14.3 Transport hazard class	Not permitted for transport
14.4 Packing group	
Packing instruction (cargo aircraft)	Not permitted for transport
Packing instruction (passenger aircraft)	Not permitted for transport
14.5 Environmental hazards	NO
14.6 Special precautions for user	

For personal protection see section 8.

ADN

14.1 UN number	UN 2014
14.2 Proper shipping name	HYDROGEN PEROXIDE, AQUEOUS SOLUTION
14.3 Transport hazard class Subsidiary hazard class: Label(s):	5.1 8 5.1 (8)
14.4 Packing group Packing group Classification Code	 II OC1
14.5 Environmental hazards	NO
14.6 Special precautions for user Hazard Identification Number:	 58

For personal protection see section 8.

Other information : IATA: permitted under 40%

Note: The above regulatory prescriptions are those valid on the date of publication of this sheet. Given the possible evolution of transport regulations for hazardous materials, it would be advisable to check their validity with your sales office.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Other regulations

- Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), as amended
- Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, as amended
- Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work,as amended
- COUNCIL DIRECTIVE 96/82/EC on the control of major-accident hazards involving dangerous substances as amended
- Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste

Notification status

Inventory Information	Status
United States TSCA Inventory	- Listed on Inventory
Canadian Domestic Substances List (DSL)	- Listed on Inventory
Australia Inventory of Chemical Substances (AICS)	- Listed on Inventory
Japan. CSCL - Inventory of Existing and New Chemical Substances	- Listed on Inventory
Korea. Korean Existing Chemicals Inventory (KECI)	- Listed on Inventory
China. Inventory of Existing Chemical Substances in China (IECSC)	- Listed on Inventory
Philippines Inventory of Chemicals and Chemical Substances (PICCS)	- Listed on Inventory
Mexico INSQ (INSQ)	- Listed on Inventory
New Zealand. Inventory of Chemical Substances	- Listed on Inventory
EU. European Registration, Evaluation, Authorisation and Restriction of Chemical (REACH)	- If product is purchased from Solvay in Europe it is in compliance with REACH, if not please contact the supplier.

15.2 Chemical safety assessment

- Hydrogen peroxide
- A Chemical Safety Assessment has been carried out for this substance.
- See Exposure scenario

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

- H271	May cause fire or explosion; strong oxidiser.
- H302	Harmful if swallowed.
- H314	Causes severe skin burns and eye damage.
- H315	Causes skin irritation.
- H318	Causes serious eye damage.
- H332	Harmful if inhaled.
- H335	May cause respiratory irritation.
- H412	Harmful to aquatic life with long lasting effects.

Key or legend to abbreviations and acronyms used in the safety data sheet

- STEL	Short-term exposure limit (15-minute reference period)
- TWA	8-hour, time-weighted average

Further information

- This sheet was updated (refer to the date at the top of this page). Subheadings and text which have been modified since the previous version are indicated with two vertical bars.
- Distribute new edition to clients

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. Such information is only given as a guidance to help the user handle, use, process, store, transport, dispose and release the product in satisfactory safety conditions and is not to be considered as a warranty or quality specification. It should be used in conjunction with technical sheets but do not replace them. Thus, the information only relates to the designated specific product and may not be applicable if such product is used in combination with other materials or in any other manufacturing process, unless otherwise specifically indicated. It does not release the user from ensuring he is in conformity with all regulations linked to its activity.

Appendix 3.3

Sea Lice and Sea Lice Treatment

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	26/01/2022 (McManus, Catherine)	**Last revision date**	26/01/2022
Date changed	26/01/2022 (Sandra Vesanto)	**Next revision date**	17/01/2023

Gill Disease Monitoring including AGD

1. Scope

Amoebic Gill Disease (AGD) is caused by a microscopic protozoan parasite (amoeba) named *Neoparamoeba perurans*. The parasite colonises the gills causing severe gill pathology which appears as pale grey/ white swellings and patches on the gills which can develop and spread over the gill surface. As it is vital to bathe fish as early as possible, gills of 20 fish per pen from all pens must be inspected once per week (minimum) on each site. Gill scores must be supported with microscopy from gill scrapes and/or PCR results from gill swabs.

Additionally, it is also important to note other gross gill damage (Proliferative Gill Damage/ PGD), which may be due to other insults such as harmful phytoplankton and stinging jelly fish or zoo plankton.

2. Gross Gill Examination:

Gill examination and scoring should be conducted during weekly lice counts (refer to TQM document 25450).

2.1 A minimum of 20 fish per pen must be inspected.
2.2 To prevent fish escapes ensure a safety net is attached between the fish pen and the boat.
2.3 All fish must be anesthetised with Tricaine prior to examination.
2.4 Note any water discolouration in the anaesthetic bath which may be due to damaged gills. This is usually due to phytoplankton or stinging jellyfish and should be alerted to the site manager immediately. Recent water samples should be checked for the presence of harmful plankton and samples should be sent to the laboratory in Rinmore or the Marine Institute for further analysis if in doubt.
2.5 Visually inspect the gill for white/grey patches or marks, always referring to the new AGD scoring guide (see attached).
2.6 Record score on Weekly Lice/Gill Check sheet, document number 25447.
2.7 Completed records should be logged in the lice counts & treatments file and/or sent to the Marine Technical Support Supervisor.

3. Microscopy

As damage on gills can also be indicative of other gill pathology such as a plankton insult, gill scoring should be supported with microscopy.

3.1 Using the back of a scalpel, take a mucous scrape from a section of white/grey swellings and mount on slide. Examine microscopically for presence of amoeba and/or other parasites. Note if the numbers of amoeba are high or low on the smear.
3.2 A small sample or section of the gill tissue may also be removed and mounted on a slide for examination.
3.3 If necessary, place samples of the gill tissue (<1cm^3) in a pot containing buffered formalin and send to Pharmaq Analytiq Ireland for histopathology processing and examination.

4. Molecular screening for *Neoparamoeba perurans*

Cotton swabs from gills of 5 fish per pen should be taken weekly of fortnightly, stored in lysis buffer and sent to the Marine Institute for analysis, especially at the start of the AGD risk period in spring/early summer.
Experience form previous years has shown that molecular gill swabs show a positive AGD result about a week before the first AGD lesions can be observed macroscopically.

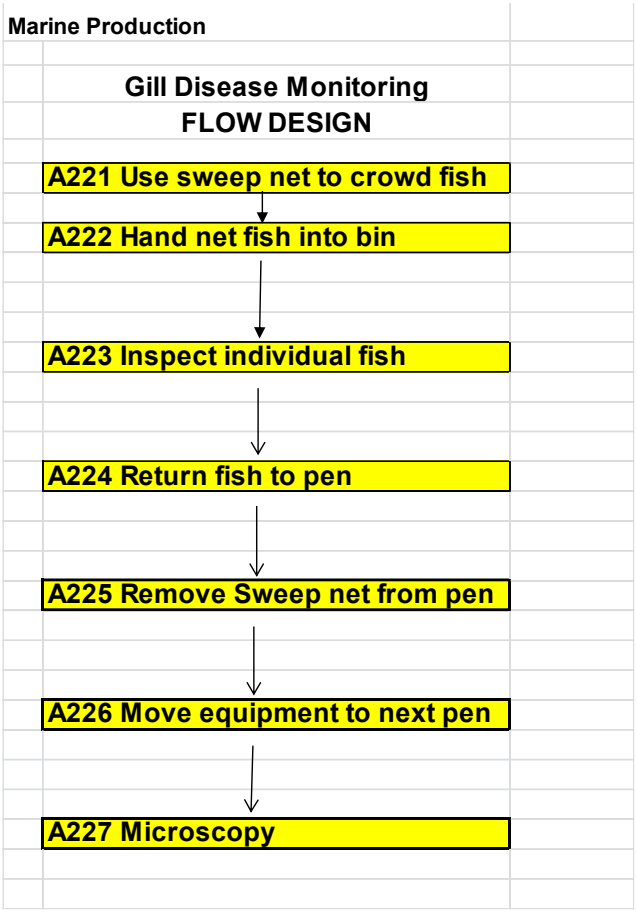
5. Treatment trigger levels

Once AGD scores approach an average of 1, the fish have to be treated as soon as possible. All pens on site need to be treated in as short a period as possible to avoid re-infection of treated pens. The preferred choice of treatment is a 2 – 3-hour long bath with freshwater (either from de-salinated water or a local freshwater stream).
A H2O2 bath treatment can be considered should access to freshwater be limited, but this is usually less efficient than a freshwater bath.
An effort must be made to fish out as many wrasse as possible prior to a freshwater bath to ensure their survival. Wrasse need to be treated separately against AGD using H2O2.

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	26/01/2022 (McManus, Catherine)	**Last revision date**	26/01/2022
Date changed	26/01/2022 (Sandra Vesanto)	**Next revision date**	17/01/2023

6. Process Flow & Risk Assessment

6.1 All marine risk assessments are available on TQM 42229. The numbers listed below in the process flow are related to this procedure.



Cleaner fish Capture and Management Protocol:

The increased use of cleaner fish, namely wrasse and lumpfish, for the control of sea lice, brings with it an onus of responsibility for the health and welfare of the cleaner species and of the salmon alike. Of paramount importance, whether the cleaner fish are wild or cultured in origin is the prevention and control of disease and pathogens and the welfare of the fish.

In order to achieve this in accordance with industry standards and Mowi's code of best practice, the following are guidelines in relation to the culture, capture and subsequent maintenance of cleaner fish for use in salmon aquaculture.

1. Precautions:

1.1 Cleaner fish will not be sourced from areas where there are outbreaks of clinical disease in salmon populations.

1.2 Cleaner fish should be sourced locally from within a bay/sea loch. For biosecurity purposes, the capture and deployment of cleaner fish shall be confined within each of the following compartments;

- North West Donegal
- South West Donegal
- Clew Bay
- Connemara
- South West (Kenmare and Bantry Bays)

1.3 Since it is not practical to collect and store cleaner fish prior to stocking on salmon sites, the fish health section of the Marine Institute will be notified, at least two weeks in advance of the cleaner fish collection and deployment season, of the proposed cleaner fish stocking plan at notification@marine.ie

1.4 In conjunction with site visits, regular health checks on cleaner fish will be carried out. In cases of elevated mortalities, a veterinarian must be notified and a veterinary examination undertaken.

1.5 Handling of wrasse will be kept to a minimum.

1.6 When available, lumpfish will be vaccinated at <5g in the hatchery, before deployment to sea.

1.7 Dead cleaner fish must be removed and documented daily. This is important to monitor overall health, avoid the spread of disease and also to keep track of stocking ratios between cleaner fish and salmon.

1.8 Sick or injured fish should be disposed of quickly and humanely with a blow to the head or over dose of anaesthetic.

2. Wild Wrasse Management

There are five species of wrasse found in Irish waters. These are the ballan wrasse (*Labrus Bergylta),* the goldsinny wrasse *(Ctenolabrus rupestrus)*, the corkwing wrasse, (*Symphodus melops)* and the rock cook wrasse *(Centrolabrus exoletus)*. All five species have been found to be efficient in the removal of sea lice from salmon and can be accepted by fishermen for use in sea pens.

2.1 Fishing

2.1.1 When fishing for wrasse, fishermen should be careful when bringing pots to the surface. This should be done slowly, to avoid the over- expansion of the swim bladder.

2.1.2 Wrasse should be examined for any signs of damage before being placed into holding tanks. Fish showing any signs of injury or infection should be humanely destroyed.

2.1.3 Wrasse should be handled with extreme care, with minimal out of water periods.

2.1.4 There should be good water circulation in the tanks, with pumps with a capacity for a complete water change within 5 minutes being used.

2.1.5 Dissolved oxygen within the tanks should be monitored closely, using dissolved oxygen meters. Oxygen levels should never drop below 80%.

2.1.6 Bycatch such as other fish species and crustaceans should be discarded through pipes beneath the water's surface to avoid predation by seabirds.

2.1.7 Wrasse should not be kept in temporary holding pens for more than a few days.

2.2 Introduction of Wrasse into Sea Pens

2.2.1 Wet landing nets should be used when transferring wrasse from temporary holding pens to holding tanks on supply vessels, for transport to sea pens.

2.2.2 Wrasse should be counted and species identified as they are removed from fishermen's temporary holding pens.

2.2.3 Wrasse should be placed gently into holding pens using a pipe.

2.2.4 The hide should be slowly brought to the side of the sea pen to prevent the disturbance of wrasse already in the pen. The wrasse should be introduced directly into the hide, which should then be slowly moved back to position.

2.2.5 Wrasse should be stocked at a ratio of 5% wrasse to salmon.

2.2.6 Weekly lice counts should be carried out to determine the correct stocking density of cleaner fish in the pens. If lice numbers begin to rise, cleaner fish should be added correspondingly.

2.2.7 Care should be taken in terms of the size of wrasse and the corresponding mesh size of nets in sea pens. This will avoid having escapees and fish becoming gilled in nets. Below is a guide as to the appropriate size of wrasse in relation to mesh size.

2.3 Use of Hides

2.3.1 Artificial kelp hides to be used in all pens containing wrasse.

2.3.2 Each pen has to contain hides.

2.3.3 Hides should be positioned 2- 3 metres below the water surface. This avoids the heaviest growth area and allows for wrasse to choose a depth according to the sea environment.

2.3.4 Hides should not be placed in the middle of the pens within the feeding range of the salmon.

2.3.5 Hides should be set in such a way that the gap in the hides between the two sides of artificial kelp strands is in line with the direction of the current. Salmon generally face in to the direction of the current and in this way they will enter into the hides to be cleaned.

2.4 Cleaning & Biosecurity

It is imperative that hides and nets are kept clean to avoid fouling. A build - up of invertebrates will act as a supplementary food source for the wrasse, that require using less energy to catch and will reduce cleaning activity and efficiency.

2.4.1 In the summer, hides and nets for all pens should be cleaned on a bi weekly basis.

2.4.2 Dead fish should be removed regularly to prevent the spread of disease. They can also potentially act as supplementary food source for the wrasse, reducing cleaning activity.

2.4.3 When using a Lift- Up system, a diver should make sure to clear the opening of the machine before it is switched on, to prevent the uptake of wrasse.

2.5 Removal of Wrasse

2.5.1 Wrasse should be removed from pens prior to harvest or treatments. This should begin at least 2 days before the event.

2.5.2 When removing wrasse from pens, use baited pots. Wrasse can be placed in holding pens temporarily until after the event.

2.5.3 Care should be taken when doing this, that the pots are raised slowly. This will prevent over-inflation of the swim bladder. If over-inflation takes place, wrasse should be returned into the pot and quickly lowered down to five or six metres in order to decompress. Particular care needs to be taken in the winter months, when water temperatures are lower.

2.6 Supplementary feeding

Supplementing the diet of cleanerfish is extremely important. When there is supplementary feed available, cleanerfish are more robust, more likely to remain healthy and have a better chance of surviving temperatures less suitable for them.

- Biomar supply an Organic Lumpfish feed.
-
- Biomar frozen wrasse blocks should be fed to wrasse in feed bag.
- Feeding station for cleaner fish should be placed in the pen, close to the hides of the fish.
- It is important to carry out lice checks on a weekly basis.

2.7 Overwintering of wrasse

In their natural environment, wrasse leave inshore areas in the winter months and seek out deeper waters, with more stable temperatures. In the past, extreme difficulty has been encountered overwintering wrasse in sea pens. They become far less active, virtually dormant, are easily stressed and are vulnerable to disease. It is important to be able to over-winter wrasse in sea pens. Spring is a key time for the recruitment of sea lice, yet it may be difficult to catch wild wrasse to counteract this production at this early stage. A few steps can be taken to maximise survival rates of wrasse over winter.

2.7.1 During the winter months, wrasse become more vulnerable to swim bladder over- inflation. Extreme care must be taken when taking fish to the surface at this time, with a much slower rate of ascent used.

2.7.2 A maintenance diet should be continued over the winter months. Although wrasse become dormant, they continue to feed and an available food source will increase fitness and survivability. Feed rate decreases below between 6- 8 ^{0} C.

2.7.3 It is less important that nets are cleaned in the winter months but fouling should be avoided as wrasse will still graze on sea lice. Sea lice have been found in wrasse stomach's at 4 ^{0} C.

3. Lumpfish Management:

The lumpfish *(Cyclopterus lumpus)* is found naturally around the British Isles. Unlike wrasse, they prefer cooler water temperatures. Difficulties have been encountered in relation to the survival of lumpfish in the summer months. They become vulnerable to infection. Most of what is mentioned about the maintenance of wrasse in sea pens applies directly to lumpfish also. However there are some differences.

Lumpfish do not possess a swim bladder; rather they have modified pelvic fins that they use to attach themselves to surfaces to conserve energy. Although this means there is no worry of damaging the fish due to swim bladder over- expansion, it presents its own set of problems.

Lumpfish will attach to almost all surfaces. This means they can become difficult to handle and transport.

3.1.1 It is recommended that wet landing nets are not used for lumpfish.

3.1.2 When transferring into a sea pen, the lumpfish should be brought to the hides. If they are released at the side of the sea pen, they tend to remain attached here.

3.1.3 Care has to be given when removing hides from the pen for cleaning, as lumpfish can remain attached. Also, care should be given when maintaining lumpfish over the winter as there may still be wrasse overwintering in hides. It may be possible to use structures such as holding pots at the bottom of the pens that the wrasse can use in the winter months.

3.1.4 If netting becomes fouled, it is likely that lumpfish will migrate to the sides of the pens. Here they become vulnerable to being crushed, when nets are being cleaned.

3.1.5 Lumpfish can eat as much as 2% of their body weight per day in supplementary feed.

3.1.6 Biomar's Symbio diet can also be used, although only in pelleted form.

3.1.7 When vaccine becomes available, Lumpfish should be vaccinated greater than 5g in the hatchery, before deployment to sea.

4. Cleaner fish Health Checks

4.1 Regular health checks on cleaner fish should be carried out. In cases of elevated mortalities, a veterinarian must be notified and a veterinary examination undertaken.

4.2 Dead cleaner fish must be removed and documented daily. This is important to monitor overall health, avoid the spread of disease and also to keep track of stocking ratios between cleaner fish and salmon.

4.3 Attention should be paid to fin erosion and damage to the head of cleaner fish. This can be caused by rough handling and can often lead to the onset of secondary infection. Where possible injured or sick fish should be removed and destroyed.

4.4 Sick or injured fish should be disposed of quickly and humanely with a blow to the head.

4.5 Salmon should be monitored for the observation of eye injuries. Wrasse can potentially inflict damage to the eyes of salmon.

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	28/01/2020 (McManus, Catherine)	**Last revision date**	28/01/2020
Date changed	28/01/2020 (McManus, Catherine)	**Next revision date**	01/02/2023

Lice Monitoring

1. Scope:

Sea lice (*Lepoeophtheirus salmonis, Caligus elongatus*) present the most significant health challenge to Atlantic salmon. It is imperative that recruitment of lice onto our stocks is carefully monitored and used to determine the optimum time to take corrective action. This procedure applies to all stocks under the control of Mowi Ireland.

2. Records:

Record results on the Weekly Lice Monitoring & Gill Score sheet (TQM ID 25447). Transfer records onto the Lice Counts and Treatments log on the Marine (V:) Drive.

All counts and in particular, those from the last week of each month for all sites, must be available for review and monthly sustainability reporting by the Technical Support Supervisor.

3. Sampling Frequency:

A minimum of 20 fish per pen of all pens on site must be sampled weekly.

4. Procedure:

Attach a safety net between the fish pen and the boat. Hand-net 3 fish at a time onto the Tricaine anaesthetic bath, sampling a total of 20 fish per pen. After the fish have been anesthetised, carefully lift one out, count the total numbers of Chalimus, pre adults, adult males, adult females and total lice. In addition count total *Caligus* Sealice. The attached identification card may be used.

Return fish directly into its original pen, to allow full recovery. Repeat for all fish sampled.

5. Treatment Trigger:

When average numbers of adult female lice reach **0.2** per fish or total lice numbers exceed 5, a treatment is required. If the site is using cleaner fish, the cleaner fish stocking density needs to be increased in consultation with the Company Veterinarian and the Cleaner Fish coordinator. Should this action prove unsuccessful or insufficient, a therapeutic treatment is required.

For organic production, therapeutic treatments are subject to permission from the organic certifying bodies.
Where possible/relevant, site managers within the same bay must co-ordinate treatments within the same week in order to reduce re-infection pressure on fish.

6. HES Precautions:

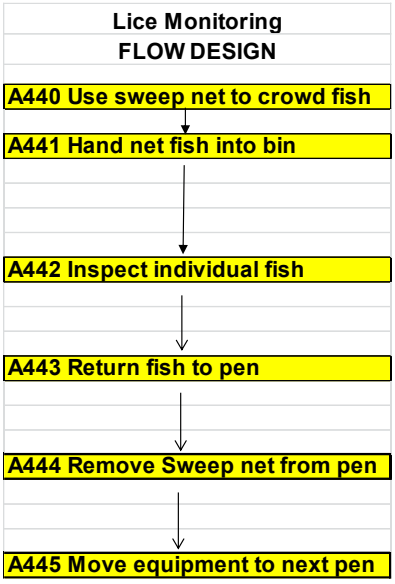
Wear appropriate PPE, including gloves when handling anesthetised fish. Observe manual handling procedures. Observe withdrawal for Tricaine.

7. Safety risk assessment:

Lice Monitoring

Mowi Ireland

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	28/01/2020 (McManus, Catherine)	**Last revision date**	28/01/2020
Date changed	28/01/2020 (McManus, Catherine)	**Next revision date**	01/02/2023



Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	26/07/2021 (McManus, Catherine)	**Last revision date**	26/07/2021
Date changed	26/07/2021 (McManus, Catherine)	**Next revision date**	08/07/2023

Sea lice treatment efficacy- monitoring

1. Purpose:

- To monitor sea lice treatment efficacy and identify potential treatment tolerances.
- To determine any evidence of resistance development at an early stage.
- To build an overview of efficacy patterns and monitor trends.
- To re-enforce accurate pre - and post-treatment lice counts.

2. Responsibility:

It is the responsibility of the Fish Health Manager in conjunction with the Marine Operations Manager.

- To ensure the procedure is implemented
- To ensure the procedure is followed, in accordance with local requirements
- To inform the Mowi ASA VP Fish Health & Welfare of any deviation from the procedure and any changes in legislation that could influence this procedure.

3. Recording treatment efficacy:

Based on pre- and post-treatment lice abundance values, the responsible veterinarian/health manager will monitor treatment efficacy at the cage/unit level for all sea lice treatments as described in this procedure.

If % efficacy is determined to be less than indicated for that product (or in general less than 80%) after the period of time when maximum effect should have been observed then the veterinarian/health manager will refer to the procedure entitled “Sub-optimal treatment effect follow-up” .

The responsible veterinarian/health manager will hold a record of all treatment efficacies for each site.

4. Sampling:

- Follow local monitoring protocols when determining the number of pens and fish to be sampled.

- *Pre-treatment*: sea lice abundance (mean number of lice per fish) is determined at targeted two days (maximum seven days) prior to the start of treatment.

- *Post-treatment:* sea lice abundance is determined in the same pens as for pre-treatment and at (or as close as possible to) the following timepoints (Table 1).

- The lice counts will support the planning of follow-up and alternative treatments while there is still potential benefit to be had from potentiation effects.

Table 1. Timepoints for determining post-treatment sea lice abundance.

Slice treatment	Bath treatment	IGRs (TBZ, DFZ)	Non-medicinal

2 weeks	1 week	1 week	1-2 days
4 weeks	2 weeks	2 weeks	
8 weeks			

5. Definitions and calculation of efficacy

- Efficacy is defined as the therapeutic effect of a sea lice treatment, based on pre- and post-treatment lice abundance, and expressed as a % reduction in lice abundance.
- The efficacy of treatments is normally expected to be >90%.
  Based on current treatment practices and lice counting frequency absolute efficacy is difficult to determine. Additionally, due to the lack of untreated controls the correct formula for efficacy cannot be applied.
- Based on lice abundance (mean number of lice per fish) the following formula will be used for calculating % efficacy;

$$\left(\frac{\textbf{Mean } T_0 \textbf{ abundance} - \textbf{mean } T_x \textbf{ abundance}}{\textbf{Mean } T_0 \textbf{ abundance}} \right) \textbf{ X 100}$$

where; T0 = mean lice abundance pre-treatment
Tx = mean lice abundance (x) week/s post-treatment.

- The Fish Health manager will hold a record of all treatment efficacies for Mowi Ireland.

6. Evaluation of efficacy and follow-up:

The efficacy of treatments is normally expected to be >90%. If % efficacy is determined as less than indicated for the specific product (or in general < 80%) after the time period when maximum effect should have been observed:

- Refer to procedure “Sub-optimal sea lice treatment effect follow-up” TQM ref. 26074.
- The Fish Health Manager will maintain related records.

7. Additional information:

The attached Excel file “Lice Treatment Efficacy Calculator” provides an example model for calculating treatment efficacy.

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	26/01/2022 (McManus, Catherine)	**Last revision date**	26/01/2022
Date changed	26/01/2022 (Sandra Vesanto)	**Next revision date**	16/01/2023

Sea lice treatment with Slice®

1. Pre-treatment planning and preparations:

All treatments against sea lice should be pre-planned as part of the site/area Veterinary Health Plan and in coordination with other sites within the management area/neighbourhood.

If there are indications of increased tolerance to Emamectin benzoate (from previous treatments) or if the last 2 treatments on site were with Slice®, conduct a bioassay to determine sensitivity (TQM 21237). The result of the bioassay should be used by the Veterinary advisor and Technical Manager to guide the decision as to the correct treatment.

2. Quantity of Slice® and medicated feed required;

2.1 Use upper-end estimate of number and upper-end estimate of average live weight to calculate biomass. Depending on the confidence in fish counting and weighing procedures, it may be prudent to add an additional amount e.g. ~10% to this biomass figure. [1]

2.2 To allow for growth, the weight should be projected forward to the last day of the intended treatment period. [2]

2.3 Review current feeding practice and appetite with the site manager on a case-by-case basis, decide on quantity of feed and the feeding strategy to be used. [3]

2.4 Optimal distribution is achieved when Slice® medicated feed constitutes 100% of the daily ration and is fed to daily satiation.

2.5 Consider an Alternate Day Medication feeding strategy if necessary. [4]

2.6 Every effort should be made to provide ca. 10% of the medicated feed by hand around edges of pens for less dominant feeders.

2.7 Calculate the required inclusion rate of Slice® into the feed. [5]

2.8 Avoid major changes in medicated base diet composition from normal feed composition. If necessary, drop a pellet size for treatment of growers and lower pigment level in the medicated base diet. [6]

2.9 Ensure Slice® is top-coated onto medicated base diet.

2.10 Conduct a sea lice count a maximum of 7 days prior to treatment with a target of 2 days prior to treatment.

2.11 Moribund or non-feeding fish should be removed prior to treatment where possible.

2.12 Ensure appetite is not compromised before starting the treatment. In addition, it is recommended to screen for pathogens which may compromise appetite (eg. SAV) during known disease risk periods.

2.13 Withhold feed from the population for 24hr before treatment.

3. Treatment:

3.1 Slice® medicated diet will be administered daily at the prescribed ration for 7 days, targeting a nominal dose of 50µg EmB / kg bwt / day. Alternatively, use Alternate Day Medicating if appropriate (ensuring the same total Slice® dose over 7 days). Any deviation from this should be at the discretion of the prescribing veterinarian and whatever change is made should be recorded.

3.2 Treat all fish on the site simultaneously.

3.3 Slice® medicated feed should be the only feed given during the treatment period i.e. 100% of the daily ration. No un-medicated top-ups should be provided during the treatment.

3.4 Use a feeding regime that maximises feed availability to and within the population. Create a feeding opportunity for as many fish as possible when Slice® medicated feed is being fed – spread in time and space.

3.5 Simultaneously hand feed with ca. 10% of the daily ration for each pen, focusing on delivery around the pen edges. If no fish appear to be taking this feed, incorporate this amount of feed into the daily ration.

3.6 To prevent wastage of medicated feed (do not overfeed), use cameras where available to monitor feed intake.

3.7 Monitor feeding response and behaviour throughout the treatment. Any suspect adverse effects during the treatment should be indicated to the fish health responsible person.

3.8 Take a sample of Slice® medicated feed and archive (ideally frozen) for future analysis to corroborate nominal dose in the diet. [7]

3.9 Prior to handling medicated feed, staff must wear gloves, overalls and dust masks.

4. Post-treatment and follow-up:

4.1 Flesh samples from 5 fish should be taken 24hr post-treatment and frozen for future analysis if required. [8]

4.2 Refer to sea lice counts at 2, 4 and 8 weeks post-treatment to determine treatment efficacy (Ref. procedure "Sea lice treatment efficacy", TQM 26072).

4.3 Analysis of feed and flesh samples will be undertaken if there are indications of reduced efficacy of treatment (Ref. procedure "Sub-optimal treatment effect follow-up", TQM 26074).

4.4 If efficacy is not as desired within 4 weeks, this warrants immediate use of an alternative therapy. By 2 weeks post-treatment, there should be a reduction in numbers and a judgement should be made as to whether a follow up treatment is required at 2-3 weeks post-treatment.

5. Additional information:

References:

(1) In doing so, the veterinarian is neither suggesting nor justifying an excess in biomass over and above reported figures but is simply recognizing the limitations of technology to produce a biomass figure that is 100% accurate all the time.

(2) Fish should grow significantly between the day feed was ordered and the time of administration of the medicated feed. They will continue to grow significantly for the 7 day duration of the course.

(3) Look at the following criteria: Are fish being fed in constant pulses of feed or in discreet meals? If so how many meals are currently being provided. At the end of the day do fish remain hungry or do they seem satiated well before the end of the day. Is there any foreseeable reason why appetite may change before the medicated feed arrives, e.g. lighting regimes, imminent grading, changing temperature?

(4) This strategy may be appropriate if appetite seems moderate to poor or if there is a concern that some fish in the population are disproportionately inappetant and others are feeding normally or well. Alternate Day Medication counteracts disproportionate consumption of medicated feed. (Note: The medicine amount provided over a 7 day period remains the same total dose calculated above and relates only to biomass. This is not an over-dose or under dose). Starve fish on days 0, 2, 4, 6 and provide medicated feed on days 1, 3, 5, 7 of the 7-day course. Through being starved on day 0, all fish should be provided with as much feed as they will take comfortably on day 1, without wastage. This principle follows for days 3, 5 and 7. Fish should feed well and will probably take more than a single day's ration on that day, possibly an extra 20-50%. The judgement of the site manager is crucial to determine the best feeding regime.

(5) Some feed mills only provide a limited number of inclusion rates. However they should - within reason - be able to supply inclusion rates appropriate to the situation, e.g. in 0.5kg/t increments.

(6) Dropping a pellet size increases significantly the surface area of pellets allowing for better mixing of Slice onto the feed. This also increases the number of pellets within a defined volume of feed, thereby improving feed availability and reducing heterogeneity of medicine uptake. Lowering pigment levels for 7 days represents a cost saving and will not measurably affect pigmentation.

(7) It is recommended to take 3 separate samples x 500g.

(8) MSD Animal Health currently pay for the analysis on 5 fish. More than 5 fish would entail additional cost for Mowi Ireland.

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	30/09/2022 (McManus, Catherine)	**Last revision date**	30/09/2022
Date changed	30/09/2022 (Yvonne Booth)	**Next revision date**	15/08/2023

Alphamax Bath Treatment for Wellboats:

1. Scope:

The following procedure describes the bathing method for Alphamax lice treatment using wellboats.

2. Responsibility:

It is the responsibility of the Marine Operations Manager to ensure that site Managers follow this procedure as described.

3. When to Treat:

3.1 When the numbers of ovigerous female lice reaches an average of 0.2 per fish. The Marine Operations Manager and Veterinary Health Manager must be informed of intention and reason for treatment and the Veterinary health manager must issue a written direction.

3.2 Fish must be starved for at least 24 hours prior to treatment.

3.3 In organic stocks, permission must be obtained from the organic certifying bodies before treatments may be carried out.

4. Storage and Issue of Therapeutics:

The Veterinary health manager is responsible for storage and issue of Alphamax.

5. Dosage:

The delousing should be performed in a well-boat to ensure proper control of the treatment volume and the treatment dosage, in addition to reduce the amount of Alpha Max used and the environmental exposure.

Treatment dose: 0.2 ml Alpha Max pr. m^3 (1,000 l) sea water in the treatment unit. This corresponds to 0.002 milligrams deltamethrin/litre sea water.

5.2 Treatment volume for the Grip Transporter Well-boat:

The dosage is calculated according to the actual volume of the treatment unit. The dose rate for the Grip Transporter wellboat is calculated as follows;

Double well capacity = 1,200m^3.
Thus 1,200 x 0.2ml of Alphamax = 240ml Alphamax required. (Active ingredient = 2.4g deltamethrin).
Maximum biomass treated per double well = 100 tons of fish.
Treatment period: 45 minutes

6. Advice on correct Administration:

6.1 Shake the bottle well before use. Calculate the volume of the treatment unit and the Alpha Max dose. Use a suitable container and dilute the calculated quantity of Alpha Max in seawater. Diluting the product in a large volume of seawater will ensure better dispersion and thereby the efficacy of the treatment.

6.2 After a short period of stirring, the diluted solution is spread evenly in the treatment unit. It is recommended to use a pump with low or moderate pressure to further improve an even dispersion.

6.3 Do not disperse under high pressure as this may cause atomising and/or foaming.

6.4 All fish should be oxygenated during treatment. Ensure that the oxygen level is above 7 mg/l before the treatment is initiated and that it is kept above 7 mg/l during the entire duration of the treatment.

6.5 At water temperature below 6°C, the product's safety margin is reduced. Extra precautionary measures should be exercised if treatments are performed at low water temperatures.

6.6 To remove the treatment bath from wells, flush clean seawater through both wells on the Grip Transporter for a period of 15 minutes. Total flushing volume is approximately 1,200m^3. Note: Approximate duration of each bath treatment from loading of fish to flushing of wells is 3.5 hours

7 Records and Reporting:

7.1 Record oxygen levels and water temperature during treatment on the treatment record sheet in addition to volumes of treatment compound used per well boat load and batch numbers. These records must be available for inspection by the relevant Government Departments. A copy of the record format is attached to this procedure.

7.2 Copies of all treatments in addition to pre and post treatment lice counts must be forwarded to the Technical Manager for efficacy assessment.

8 HES Risk Assessment

Work Operation: **Alphamax Bath treatment**

Staff Required for Task: 3 **OPERATING CONDITIONS: Normal**

Risk Key:	**1 - 3**	**=**	**Low Risk**
	4	**=**	**Medium Risk**
	6 – 9	**=**	**High Risk**

Alphamax Bath Treatment for Wellboats

Mowi Ireland

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	30/09/2022 (McManus, Catherine)	**Last revision date**	30/09/2022
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Hazard	Adverse Effects	Hazard Score – No Controls	Control Measures	Hazard Score with Control	Additional Controls Required
Manual Handling while lifting nets	Manual handling injury	8	Manual Handling Training/ Crane	3	No Controls Required
Work over water	drowning	9	PPE/Downing/Sea survival	3	No Controls Required
Addition of treatment material	Splash /inhalation	8	Gloves/ overalls/ boots/ SDS/ training/ respiratory equipment	3	No Controls Required
Weather	Unsteady work surface /spray of treatment material	8	Task not carried out in poor weather conditions	3	No Controls Required
Fumes/ inhalation	Respiratory injuries	8	Gloves/ overalls/ boots/ MSDS/ training/ respiratory equipment	3	No Controls required
Empty containers	Spills/ contamination/ unknown contents	8	Housekeeping/ empty containers returned to chem. Store/SDS	3	No Controls required
Fall Overboard	Drowning	9	Lifejacket/Ring/Sea Survival	3	No Controls Required

Total Assessed Risk = Likelihood x Severity

Likelihood	Severity
1 = Unlikely event: Once every year	1 = Negligible. No Impact or not detectable
2 = Occasional event: Once per month	2 = Significant: impact on critical limits
3 = Frequent event: Once per day	3 = Critical: public health risk, public product recall.

Likelihood	Severity 1	2	3
1	1	2	3
2	2	4	6
3	3	6	9

Low Risk = 1 - 3
Medium Risk = 4
High Risk = 6 - 9

Low Risk - These risks are considered acceptable. No further action is necessary other than to ensure that the controls are maintained.

Medium Risk - Consideration should be as to whether the risks can be lowered, where applicable, to a tolerable level and preferably to an acceptable level, but the costs of additional risk reduction measures should be taken into account. The risk reduction measures should be implemented within a time period.

High Risk - Substantial efforts should be made to reduce the risk. Risk reduction measures should be implemented urgently within a defined time period and it might be necessary to consider suspending or restricting the activity, or to apply interim risk control measures, until this has been completed. Considerable resources might have to be allocated to additional control measures.

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
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Date changed	26/07/2021 (McManus, Catherine)	**Next revision date**	31/07/2023

Sub-optimal sea lice treatment effect follow-up

1. Purpose:

a) To analyse potential factors which may have caused or contributed to sub-optimal sea lice treatment events.

b) To ensure such factors are avoided or minimised in future.

2. Responsibilities:

It is the responsibility of the Fish Health Manager in conjunction with the Marine Operations Manager to ensure this procedure is implemented and followed, in accordance with local requirements. The Mowi Group Manager for Fish Health & Welfare must be informed of any deviation from the procedure and any changes in legislation that could influence this procedure.

3. Definition of a “Sub-optimal treatment effect”:

Based on systematic pre- and post-treatment lice counts, as required through the Sea lice treatment efficacy monitoring procedure and professional judgement, if the efficacy of the product used is less than indicated for that product or in general less than 80% effective in 1 or more pens then the treatment should be considered sub-optimal.

4. Investigating sub-optimal treatment incidents:

The fish health manager should assess the cause of sub- optimal treatment incidents (medicinal or mechanical) by completing the attached “Monitoring file” which can be found as an appendix to this procedure in the TQM document database.

Assessment should be carried out for each pen where a sub-optimal effect is observed using the Monitoring file.

the fish health responsible person

Summary reports generated in this file for sub-optimal events will be archived in a dedicated local folder by the Fish Health Manager.

5. Follow-up:

Data generated will be used by Mowi Ireland for the purposes set out above, to analyse potential factors which contributed to the event and to devise follow-up plans to ensure such factors are avoided or minimised in future.

An updated record of sub-optimal treatments events and respective follow-ups will be maintained by the Fish Health Manager. This will be done in addition to any local legal requirements for investigation/ reporting of such events.

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	08/06/2020 (McManus, Catherine)	**Last revision date**	08/06/2020
Date changed	08/06/2020 (McManus, Catherine)	**Next revision date**	24/06/2023

Sea Lice Treatment Rotation:

1. Purpose:

To reduce the risk of resistance development by sea lice to lice pharmaceuticals.

2. Responsibility:

MOWI Business Unit Veterinarians, Health Managers

- To ensure the procedure is implemented
- To ensure the procedure is followed, in accordance with local requirements

To inform the Mowi VP Fish Health & Welfare of any deviation from the procedure and any changes in legislation, instructions or status of approved medicines that could influence this procedure

3. Procedure:

3.1 Where legislation and product availability permits, sea lice treatments will be rotated to reduce selection pressure and resistance development

3.2 Where there is more than one chemical class available, there will be no more than 2 consecutive treatments with the same chemical class or product on the same site

3.3 Following 2 consecutive treatments with the same chemical class/product then an alternative chemical class/product will be used on the same site, even with a break of several months (due to fallowing and/or a new generation being stocked)

3.4 Treatments with products having shown resistance will not resume until sensitivity is restored

3.5 Resistance bioassays will be conducted;

- If there are indications of reduced sensitivity to a particular product after any single treatment
- If more than 2 consecutive treatments are planned
- If resistance to another product/chemical class exists
- To document restoration of sensitivity

3.6 Product rotation should be applied as a zone management, targeting coordinated rotation also within neighbouring sites in the same area/ zone.

3.7 If product availability is limited and restricts product rotation as defined above, the BU must assure that necessary actions are taken to allow the introduction/ approval of alternative sea lice pharmaceuticals (the actions can

be specific MOWI actions coordinated through Group Technical Department/ VP Fish Health & Welfare or industry initiatives).

4. Additional Information:

Our experience shows that reliance on a single (or few) product (s) or technique will inevitably lead to the development of resistance to that product. The over-reliance on Slice, with its long sub-therapeutic residue profile, has caused particular problems. In addition, it is well known that treatments are never 100% effective and a proportion of tolerant lice exist which act as a reservoir for resistance development. The rotation of products, chemistries and modes of action is a well documented and successful practice in terrestrial pest management for mitigation of resistance development.

Product rotation means switching between products with different modes of action.

Sea Lice Monitoring Overview

A mandatory lice monitoring and control protocol was introduced in Ireland by the then Department of the Marine and Natural Resources (DCMNR) in March 1993. The protocol was strengthened following the Sea Trout Task Force (STTF) Report in 1994 and was last updated by the DCMNR in August 2001[1]. The protocol forms an invaluable tool in the management of sea lice on farmed salmonids.

The Irish salmon farming industry was the first to monitor sea lice levels under statute, involving regular inspections by officers of the Marine Institute, on behalf of the regulator, as required by the protocol. A similar approach has been adopted in Scotland. Elsewhere, as far as is known, similar monitoring procedures to those developed in Ireland have been widely adopted, but they are carried out voluntarily, by the farms themselves. For this reason, lice control is thought to be more rigorous and lice levels on farmed fish generally lower in Ireland than in some other salmon farming nations.

A further protocol of the five issued by the regulator, Monitoring Protocol No.5; fallowing at offshore finfish farms[2] has a number of purposes, including the limitation of the spread of diseases and infestations, between farm sites and generations, by the use of fallowing.

These protocols agree in their main objectives of their Scottish equivalent[3]. This was a forerunner of the establishment of Area Management Agreements (AMA's) in Scotland, as recommended by both the Tripartite Working Group (2000), and the Report of the Joint Government / Industry working Group on Infectious Salmon Anaemia (2000). The counterpart of AMA's in Ireland is the Single Bay Management (SBM) scheme, which is incorporated into Coordinated Local Area Management Schemes (CLAMS), where these have been introduced. In both cases, their objective is to separate salmon farm sites into groups which lie within overlapping tidal excursions from those which lie in separate tidal excursions.

The monitoring methodology set down in Protocol No. 3 comprises the inspection and sampling of fish on every salmonid farm site in each single bay area a minimum of fourteen times per annum. Inspections are to be carried out monthly, with the following exceptions:

- During the "sensitive spring period" for migrating wild salmonid smolt especially sea trout smolt, during March to May, when there are two inspections per month.
- Over the two-month period of December to January, when lice growth is slow and therefore only one inspection is required.

Each inspection comprises the taking of two samples of thirty fish, under standard conditions. The first sample is taken from a standard cage, sampled on every inspection, whilst the second is taken from another cage, selected at random. The primary objectives of the Irish sea lice monitoring protocol are:-

[1] Monitoring Protocol No. 3 for Offshore Finfish Farms; Sea Lice Monitoring and Control, DCMNR

[2] Monitoring Protocol No. 5; Protocol for Fallowing at Offshore Finfish Farms; DCMNR / DAFF, 11th May 2000.

[3] Anon. 1998. A National Treatment Strategy for the Control of Sea Lice on Scottish Salmon farms; a Code of Practice Scottish Salmon Growers Association (now Scottish Quality Salmon).

- To provide an objective measurement of infestation levels on farms, in particular to indicate the settlement of *chalimus*[4] stages of lice to a numerical trigger point at which treatment will be required and to show up the presence of ovigerous female lice, since it is egg hatches from the egg strings carried by ovigerous females that exert infestation pressure in the vicinity of the farm.
- To investigate the nature of sea lice infestations.
- To provide management information to drive the implementation of management and control strategies.
- To facilitate further development and refinement of management and control strategies.

The control strategy set out in the protocol has six main components:-

- Separation of generations.
- A minimum of one month's fallowing of sites between cycles.
- Early harvest of two sea-winter fish[5].
- The use of trigger levels of lice numbers on fish at which point treatment is mandatory. The "year round" trigger level is 2 ovigerous lice[6] per fish, which drops to 0.3 to 0.5 ovigerous lice per fish during the smolt migration months of March to May.
- Targeted treatment regimes.
- Agreed husbandry practices.

The overall objectives of the monitoring and control strategy are:-

- Synchronised production and fallowing in single bay areas to ensure the breaking of disease and parasite life cycles. This requires the use of single year classes in each bay area.
- Zero ovigerous lice objective; salmon farms within single bay areas should have the objective of continuously achieving zero ovigerous salmon lice on stocks. This objective is most critical immediately prior to and during the wild smolt migration periods (February to June inclusive). This is best achieved through:-
    - Strategic timing of fallowing of sites.
    - Rigorous zone control of lice by best currently available treatment methods and synchrony of treatments between farms in the zone.

Two reports issued by the Department of Agriculture Fisheries and Food, now renamed Department of Agriculture, Food and the Marine have advanced the objectives of the original protocols to some degree (DAFF 2008[7], DAFF 2010[8]).

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[4] The first larval stage *of Lepeophtheirus*, following metamorphosis form the infestive copepodid stage, which is free-living, in the plankton, until it finds a salmonid host (generally a salmon or sea trout smolt) to attach to.

[5] This now rarely needs to be applied since harvests of both S1 and S0 origin fish are generally completed before the second sea winter or, at the latest, very soon after it.

[6] Adult female lice bearing eggs.

[7] A strategy for improved pest control on Irish salmon farms. May 2008. Department of Agriculture Fisheries and Food, Dublin. 56pp.

[8] National Implementation Group Report on a strategy for improved pest control on Irish salmon farms. November 2010. Department of Agriculture Fisheries and Food, Dublin. 55pp.

The first of these reports outlined a comprehensive range of measures to provide for enhanced sea lice control and recommended the following:-

1. A joint DAFF / Industry Working Group to be established to identify "break out" site options in areas which have persistent sea lice problems. These options would include the possibility of using redundant sites, to optimise fallowing and separation of generations.
2. Effective and appropriate use of chemical intervention to be reviewed, to take ongoing account of changing environmental conditions, developing farming practices, sensitivity of lice to treatments and fish health issues.
3. The increased availability of well boat capacity coming on stream in the industry to be utilised for controlled bath treatments.
4. The optimisation of product rotation for strategic treatments should be given further consideration as a matter of urgency.
5. BIM and the Marine Institute to engage in intensive consultation with the fish farming industry, both with individual fish farmers and representative organisations, to ensure ongoing optimisation of management practices. To report back to the Minister in four months.
6. BIM and the Marine Institute to establish a working group to report in three months on the potential of alternative treatment approaches and to set out the steps necessary to introduce these approaches.
7. A national implementation group to be established comprising appropriate representation from:-
   - The Coastal Zone Management, Veterinary and Seafood Policy Divisions of the Department of Agriculture, Fisheries and Food.
   - An Bord Iascaigh Mhara..
   - Marine Institute.
   - Industry representatives.

   The group is to provide the Minister, within six months of its establishment, with a full update of the actual situation on the ground, the progress made to reduce sea lice levels and the further steps required, if any, to redress the situation.

8. A New role for SBM (Single Bay Management) as a focus for management cells to manage sea lice control at a local and regional level reporting to the national implementation group.

The second document reports on the implementation of the measures proposed in the first document by the National Implementation Group, established as recommended in Policy 7 above. This document also sets out the National Lice count data, collected between December 2008 and June 2010, by Marine Institute Officers, under the terms of the Monitoring Protocol No3. These data demonstrate that by and large, the implementation of proposed policies brought about a reduction in lice levels over the implementation period.

Appendix 3.4

Predator Control

Predator Control **Mowi Ireland**

Location and process	Ireland / Marine Production / Fish Health	**Document category**	Procedures
Last approved date	14/09/2022 (McManus, Catherine)	**Last revision date**	13/09/2022
Date changed	13/09/2022 (Yvonne Booth)	**Next revision date**	28/09/2025

Predator Control:

1. Scope:

To control potential predators on Marine sites (birds, seals or humans)

2. Birds:

Place top/bird net over the pen with a mesh size that is less than or equal to 6 inch square and smaller where possible.

Use elevation frames to support bird nets in larger pens to ensure the net is a safe distance from the water and any feed rotor: pepper pots, hamster wheels or graphite poles.

Check that top net is not sagging excessively towards the pen centre and adjust when required to keep it taut.

Site staff to check for holes in top nets as part of regular visual checks of site infrastructure.

Daily inspections, when possible, for bird entanglements or entrapments. Site staff should be trained and have the necessary equipment available on site to safely remove any trapped birds. Site staff should be aware of and follow the Mowi Interaction with Wildlife Procedure (TQM 42248) if there is interaction with wildlife, including predators.

Feed on marine sites is to be kept secured in barge silos where available. Barge and workboat decks to be kept clean with feed stored appropriately and any spills cleaned up as soon as possible. Waste appropriately stored and disposed of in accordance with waste legislation requirements to prevent attraction by potential predators.

3. Seals:

Sufficient weight (i.e., weights or sinker tube) should be applied on all nets where possible to make net taut and prevent seal attacks.

Mortalities from pens to be removed daily where possible to mitigate against predators being attracted to the site.

4. Humans:

CCTV systems are in place on a number of sites.

5. Related Documents and Record Sheets

- Interaction with Wildlife Procedure - TQM 42248

Appendix 3.5

Environmental Management Policy

Location and process	Ireland / Policies / Mowi Irl Environmental policy	**Document category**	Policies
Last approved date	06/07/2022 (McManus, Catherine)	**Last revision date**	06/07/2022
Date changed	06/07/2022 (McManus, Catherine)	**Next revision date**	30/09/2024

MOWI IRELAND ENVIRONMENTAL MANAGEMENT POLICY

Mowi Ireland is a fully integrated salmon breeding, farming, processing and sales company. Its business is dependant on the natural environment, requiring the company to apply responsible management practices to control the impacts of its activities on the environment. We consider the aquatic environment to be our most important primary resource and shall be governed by the principles of sustainable and long-term care for the natural environment.

To this end, Mowi Ireland (MI) will be pro-active in the Irish industry in developing environmental strategy for farming and processing operations. The MI environmental management system is based on a systematic approach to environmental management which enables the company to create options for contributing to sustainable aquaculture by:

- protecting the environment by preventing or mitigating adverse environmental impacts;
- mitigating the potential adverse effect of environmental conditions on MI farms and operations;
- assisting MI in the fulfilment of regulatory and corporate compliance obligations;
- enhancing environmental performance;
- controlling or influencing the way MI's products and services are produced and delivered, manufactured, distributed, consumed and disposed by using a life cycle perspective that can prevent environmental impacts from being unintentionally shifted elsewhere within the life cycle;
- achieving financial and operational benefits that can result from implementing environmentally sound alternatives that strengthen MI's market position;
- communicating environmental information to relevant stakeholders.

MI shall at the very least comply with the independent standards of ISO 14001:2015 and the Global Gap Integrated Farm Assurance Standard - Aquaculture Base and will at minimum, comply with all national and corporate environmental legislation and procedures.

Mowi Ireland is committed to the Bord Bia Origin Green sustainability development programme for Irish food, drink and horticulture producer and has been a verified member of this programme since 2013.

In addition, Mowi Ireland is committed to Aquaculture Stewardship Council (ASC) certified programme. The Aquaculture Stewardship Council (ASC) sets standards for sustainable food production which provides guidelines for responsible salmon farming which minimises negative impacts on the environment and enhances local communities.

Mowi Ireland will conduct its operations to ensure the optimal utilisation of all resources. The Company will implement operating practices, processes and procedures which will minimise our impact on the environment and promote fish health and welfare. The company monitors key environmental performance indicators for all operations and will demonstrate continuous improvement on specific areas of importance.

Mowi Ireland will raise environmental awareness of the aspects and impacts of its activities amongst our employees.

Mowi Ireland will work with suppliers and contractors to help minimise environmental impact of products and services. We will strive to develop innovative waste minimisation and management solutions in conjunction with our suppliers.

Mowi Ireland will employ the B.A.T.N.E.E.C. (Best Available Technology Not Entailing Excessive Costs) in equipment and process choice and design. Environmental risk assessments will be carried out on new processes or developments.

EMS policy

Mowi Ireland

Location and process	Ireland / Policies / Mowi Irl Environmental policy	**Document category**	Policies
Last approved date	06/07/2022 (McManus, Catherine)	**Last revision date**	06/07/2022
Date changed	06/07/2022 (McManus, Catherine)	**Next revision date**	30/09/2024

Mowi Ireland will be open with questions about our activities in relation to the natural environment. The Company will work with Single Bay Management and Coordinated Local Aquaculture Management Systems along the coastline (C.L.A.M.S). Interested parties, including the local community, will be consulted by the Company before embarking on major new developments.

Appendix 3.6

Organic Policy

Location and process	Ireland / Policies / Mowi Irl Organic Policy	**Document category**	Policies
Last approved date	06/07/2022 (McManus, Catherine)	**Last revision date**	19/09/2022
Date changed	06/07/2022 (McManus, Catherine)	**Next revision date**	10/09/2024

MOWI IRELAND ORGANIC POLICY

Mowi Ireland is committed to the production of high quality organically certified Atlantic salmon products in harmony with the natural environment. We believe this to be an integral part of responsible, efficient, sustainable aquaculture and profitable business management.

To this end Mowi Ireland is committed to producing salmon in harmony with its natural cycle and with respect for the natural resources on which we depend. Specifically we will produce our salmon and products along the following principals;

- Respect for the needs of our animals and implement high welfare standards which is essential for fish health management
- Conservation of natural resources
- Promotion of renewable resources and minimisation of the use of non-renewable resources in our production and processing systems
- The use of natural processes and substances and mechanical methods in preference to chemically synthetic substances with minimal use of chemically synthesised substances and synthetic processes
- Promote the reduction, reuse and recycling of wastes while avoiding pollution and waste
- No use of Genetically Modified Organisms (GMO's) in our products, feed and processing aids, either directly or indirectly

At the very least, all organically reared and processed salmon produced by Mowi Ireland will comply with the requirements of the following Organic aquaculture production regulations and standards;

- EU Organic regulations 854/2004, 889/2008, 710/2009 and 848/2018
- Irish Certified Quality Salmon – Organic standard,
- Bio-Suisse standard for Organic aquaculture & processing,
- Naturland Standard for Organic Smolt & Salmon Production (Organic farms)

Appendix 3.7

QMS Policy

QMS Policy

Mowi Ireland

Location and process	Ireland / Policies / Mowi Irl Quality Policy	**Document category**	Policies
Last approved date	06/07/2022 (McManus, Catherine)	**Last revision date**	06/07/2022
Date changed	06/07/2022 (McManus, Catherine)	**Next revision date**	30/09/2023

For Mowi Ireland, Quality is a core and strategic value. This is valid for the quality and safety of our salmon products, the health and safety of our stake-holders and the quality of our environmental performance. We believe this to be an integral part of responsible, efficient and profitable business management and sustainable aquaculture.

Mowi Ireland's objective is always to deliver safe and legal salmon products with high technical and nutritional quality to meet our customer requirements and consumer expectations.

Mowi Ireland shall be industry leaders in Quality and Food Safety management throughout our farming, processing and sales operations. Our quality management system shall conform to the requirements listed in the following standards:

- ISO 9001:2015,
- The Irish Certified Quality Aquaculture Organic Salmon Standard with reference to EU Organic regulations 889/2008, 710/2009 and 848/2018 for organic aquaculture production,
- Naturland Standard for Organic Processing,
- Bio-Suisse standard for Organic aquaculture & processing,
- Naturland Standard for Organic Smolt & Salmon Production (Organic farms),
- The British Retail Consortium Global Standard for Food Safety (Rinmore Fish Processing)
- Global Gap Integrated Farm Assurance Standard - Aquaculture base

Mowi Ireland shall work with our customers to ensure delivery of high quality and safe salmon products and services.

Mowi Ireland shall work with our critical suppliers in order to achieve our product and service quality goals.

Mowi Ireland shall maximise individual and team performance through transparent communication, training and development programmes.

Mowi Ireland shall apply the principal of sustainability as a driver towards continuous improvement. Key Performance Indicators shall be established and regularly reviewed in addition to, systems audits, customer feedback and staff contributions and improvement suggestions.

Mowi Ireland benchmarks its quality performance against other producers in the Mowi Group.

Appendix 3.8

Training and Development

Location and process	Ireland / Policies / Training	**Document category**	Policies
Last approved date	20/07/2022 (McManus, Catherine)	**Last revision date**	10/01/2019
Date changed	08/11/2021 (Maurice Kelly)	**Next revision date**	31/12/2022

Mowi Ireland Training Policy

Mowi Ireland is committed to a comprehensive training programme that addresses the training requirements of the company and of individual employees. Annual Training plans are outlined and compiled, and managers and supervisors are expected to regularly participate in training.

Specialist courses are planned where specific training requirements have been identified.

It is the company's policy to provide training and personal development for its entire staff to ensure that all staff may carry out their responsibilities in a manner consistent with the company's ethos. That is to produce salmon (and its intermediate products) of the highest quality in a professional, safe, efficient and environmentally responsible manner. Furthermore, it is to recognise that sound training also facilitates job satisfaction.

Mowi Ireland encourages the execution of training in an active, dynamic manner and designed to ensure maximum participation and transfer of learning. A combination of exercises, activities, questionnaires, video and group discussions are used to ensure full transfer of knowledge. E-learning has also been introduced to aid flexible learning where employees can complete courses at their computer base or in groups with their colleagues. Group training, using key pads to record feedback and results is also used for internal, bespoke training courses. Mowi Academy is the group e-learning system which is also used for e-learning courses.

Employee Involvement

All employees are encouraged to express their training needs for each year through a training needs analysis process which facilitates the compilation of the training plan. In order to promote involvement and expression of viewpoints, employees are encouraged to:

- Consult with their appointed manager/supervisor
- Participate in use of site meetings or department meetings
- Relay viewpoints to staff representatives on social or employee committees
- Use TQM Enterprise database case handling for improvement suggestions.

Location and process	Ireland / Human Resources	/ Training	**Document category**	Procedures
Last approved date	08/11/2021 (Maurice Kelly)		**Last revision date**	30/06/2016
Date changed	08/11/2021 (Maurice Kelly)		**Next revision date**	31/12/2022

Training and Development

1. Scope:

It is the Company's policy to provide training for its staff to ensure that all staff may carry out their responsibilities in a manner consistent with the Company's ethos. That is to produce salmon (and its intermediate products) of the highest quality in a professional, safe, efficient and environmentally responsible manner. Furthermore, it is recognised that sound training also facilitates job satisfaction.

3. Procedures:

3.1 Induction Training:

Upon commencement, an employee in his/her first week (preferably first day) will be taken through an Introduction course which will take the following format:

- Introduction to the Company and its background.
- Company structure.
- Specific aspects of Safety/Maintenance/Manual Handling.
- Items specific to his/her job.
- Hygiene and house keeping training.
- Safety Policy
- Quality Policy
- Environmental Policy
- Contract of employment and appendices.
- Employee orientation checklist.
- Corporate code of conduct.

The employee shall then be advised who his/her Manager/Supervisor is, and it will be the responsibility of that person to oversee their work and on the job training of that employee in addition to providing information to him/her.

During days 2-5 the employee will go through the following:

- Safety statement
- Hygiene / Housekeeping requirements
- Job specific items
- Young person abstract act & poster PRSA – Information & Acknowledgement
- Other - Car Insurance information (+ points/endorsements form).
- code of Conduct.
- Email and internet policies (if applicable).

Each stage of the induction training programme must be signed by both the new employee and his/her manager on completion of form Induction training day1 and day 2-5 Subsequently each employee will receive a copy of the Staff handbook and code of conduct; it must be noted that this handbook covers the conditions of employment, in addition to their contract of employment. Employees must sign the back page of the handbook to show that they have read and understood the conditions of employment. The signed page is returned to the Manager.

The orientation checklist is also used to ensure all information is relayed to the new of transferred employee.

3.2 Development of the Training Plan:

Development of the Training Plan is the responsibility of the Training Coordinator.

Using the Training review and feedback sheet, Departmental Managers discuss training requirements with their staff.
From this record, a site training plan is drawn up by the Training Coordinator and the relevant Manager.
The Training Coordinator arranges for each training plan to be combined in a matrix format. All training plans are summarised in order to compile the overall annual training budget and requirements for the company.

E-Learning courses are also completed on the companies eLearning system NVOLVE. The employee access the courses using their own email address and password.

The Training Plan is then forwarded to the Managing Director to gain their authorisation. Once the plan has been agreed, it is signed by the Managing Director. Exceptional courses arising during the year that are beneficial to staff members but are not included in the training plan, must be individually authorised by the MD/FD.

All funding of courses must be approved by the Managing Director or the Financial Director.

3.3 Implementation of Training:

Training courses are arranged in order of priority by the Training Coordinator.

Each trainer must develop a written training programme for each course to include training objectives which must be compatible with the Business objectives of Mowi Ireland.

Trainees are required to complete course evaluation records which are returned to the Training Coordinator for analysis.

In addition to supporting the cost of the training course, the company will also support text books, study leave, flexible working arrangements to enable the employee to undergo further study. Study leave will be assessed and agreed course by course.

Training records are maintained in trainee files.

Certificates of attendance must be requested for all external course participants and maintained in the training files.
eLearning certificates are held in the systems files, digitally.

3.4 Validation of Training:

Validation of training is completed by means of:

- Training Review and Feedback.
- Staff Appraisals.
- Individual Job performance.
- Site Team performance against established objectives and targets.

3.5 Assessing the Effectiveness of training:

All participants are requested to complete a course evaluation form immediately after the training session.

The effectiveness of all staff training must be reviewed by means of the Training Needs Analysis, appraisals and/or routine audits. Managers must evaluate the competence of his/her staff and retrain where necessary. Task competence is recorded on “InternalTrainrec”. Completed training is also reviewed by Dept. Managers through the Training Needs Analysis process.

3.6 Training Appraisals and Records:

Each new employee must undergo a six month probationary period during which his/her Manager must formally appraise and guide his/her performance.

This appraisal is conducted with the employee using the following record forms:
Form Mowi – Performance Appraisal (Admin – Supervisor level and Upward or Mowi – Operative Grade), whichever is appropriate.

Each form is signed by the employee and the Department Manager on completion. Completed copies must be held in the staff files.

Employees who have been with the Company for 12 months or more must be appraised annually.

It is essential that appraisals are used constructively to identify areas where training is likely to be most beneficial for the Company and the Employee and to identify where re-training is required.

All training records must be treated confidentially and stored in a designated employee file. These are under the control of the Training Coordinator and Dept. Manager. Only Managers and the Training Coordinator may have access to these files.

3.7 Review:

Bi-annually, a training review is carried out by the Training Coordinator and Dept. Manager to assess the effectiveness of training completed for the year to date and to address any outstanding training.

At the end of each calendar year, a comprehensive Training Review is completed to include cost and completion analysis.

Appendix 4

MOWI Standard Operating Procedures III
Emergency Plans

Location and process	Ireland / Emergency plans / HES	**Document category**	
Last approved date	22/02/2022 (Patrick Shovelin)	**Last revision date**	14/01/2022
Date changed	22/02/2022 (Patrick Shovelin)	**Next revision date**	09/02/2023

Fire Evacuation Procedure (General)

1. PROCEDURE:

1.1 When the alarm sounds, go to designated assembly point as quickly as possible.

1.2 Check the location of the fire.

1.3 Confirm the location of the fire with the fire team leader.

1.4 Investigate the presence of a fire in conjunction with the fire team leader. If there is a fire present, ensure that the fire brigade has been called.

1.5 If the alarm is false:

1.6 cancel the fire brigade;

1.7 cancel the evacuation.

1.8 Co-ordinate with the fire brigade chief as to where the fire is, what is burning, how big the fire is and if anyone is missing.

1.9 When the evaluation is complete, mute the fire alarm.

1.10 Once the all-clear has been given, cancel the evaluation, reset the fire alarm and check the status of the system. Temporarily disconnect any detector and/or break glass unit that may still be active.

1.11 When the alarm sounds make safe any equipment that you may be using.

- Proceed to designated assembly point as quickly as possible.
- Confirm with the Site Manager the location of the fire.
- Check status of the fire.

2. Depending on the existence of a fire, its type and size, one of the following actions should be taken.

A. **Small fires:** Tackle fire with available fire fighting equipment.

B. **Large fires:** Attempt to contain it until the fire brigade arrives.

C. **False Alarms:** Cancel the fire-brigade and assist orderly return to work.

In fire conditions, when the local authority fire brigade arrives, the fire chief assumes control of the emergency.

3. Enforce a disciplined evacuation and roll call.

4. Check your allocated office/site/department to ensure that all personnel have left the area.

4.1 In the absence of the Site Manager, the supervisor takes the position of Roll Call Marshall.

4.2 Once all personnel have left your area, proceed to the assembly points and do the roll call.

4.3 Report to the Site Manager either that:

- ✓ all personnel are present and correct, or
- ✓ some people are missing and, if possible, where they were last seen.

Notes: *Roll call marshals must know personally all the employees on their checklist.*

5. When the alarm sounds, make safe any machine or equipment that you are using.

5.2 Proceed:

- ✓ directly ;
- ✓ in an orderly way and ;
- ✓ safely to your nearest exit.

5.3 Do not run. Do not return to the building or attempt to collect personal possessions.

5.4 Proceed to your assembly point by the shortest route.

5.5 Reply "here" when name is called. Do not talk during roll call.

5.6 Provide the fire marshal with any further information you may have about the fire.

5.7 Return directly and in an orderly way to your work station only when you receive authorisation to do so.

6. Fire Drills:

6.1 Mowi Ireland is committed to carrying out fire drills on a regular basis. (6 monthly). The drills are seen as necessary for the safety of all employees. The Site Manager is responsible for carrying out the fire drill. These are to be carried out to meet the defined criteria and to comply with legal requirements.

6.2 Evacuation of the building or site must take no longer than two and a half minutes only.

Notes:

(a) Reports on all fire drills will be placed on the Site Notice Boards;
(b) The criteria of less than two minutes 30 seconds must be met or the drill must be repeated until it is.

7. Management of Runoff liquids:

In the event of a fire, all reasonable steps shall be taken to ensure that liquid runoff is diverted away from waterways, drains and manholes. Where applicable, absorbent mats or bunds shall be used.

8. Records:

Records of fire drills including staff who attends, must be maintained by the Site Manager.

9. RESPONSIBILITY:

Health & Safety Co-ordinator

Location and process	Ireland / Emergency plans / Environment & Sustainability	**Document category**	
Last approved date	13/01/2022 (Patrick Shovelin)	**Last revision date**	13/01/2022
Date changed	13/01/2022 (Patrick Shovelin)	**Next revision date**	09/02/2023

Emergency Plan for Chemical Spills

1. SCOPE:

This procedure outlines steps to be taken in the event of large and small chemical spills at any site under the control of Mowi Ireland. Fuel oils are the principal hazardous chemicals to which this procedure refers.

2. RECORDS

Quantities lost are estimated and recorded by the Site Manager. All spills must be recorded on the incident recording and corrective action form as attached to the appended procedure above. In the case of significant spills, an incident report must be completed and forwarded to MOWI ASA in Oslo with details of the loss, within the first 3 hours of the accident occurring. Refer to the Incident Reporting Procedure in the corporate MQM procedures.

3. METHOD OF OPERATION

3.1 Where holding tanks release fuel oil into bunded areas, immediately contact waste oil disposal Company listed below. The contractor will pump fuel into transport tanks for safe disposal.

3.2 Where fuel oil spills onto surfaces, contain immediately with sand or earth. Cordon off contaminated area to prevent traffic movement etc. Contact the waste oil disposal contractor to remove contaminated sand/earth. Spill kits may also be used for this purpose

3.3 Contact the Waste oil disposal contractor as listed to remove contaminated surface water for safe disposal. (24 hour spillage service available.)

Enva N.I. Ltd.
The Old Mill
Drumaness
Co. Down, BT24 8LS
Telephone; 04897 561574;
Telefax: 04897 561576

Enva Ltd.,
Ballycurreen Industrial Estate
Kinsale Road
Cork
Telephone: 021 4962554
Telefax: 021 4962345

Alpha Environmental Systems Ltd.
32/33 Loughanhill Ind. Estate
Coleraine
N. Ireland
Telephone: 04870 354435
Telefax: 04870 320847

Alpha Environmental Systems Ltd.
Unit 289, Block G,
Blanchardstown Corporate Park 2
Ballycoolin, Dublin, 15.
Telephone: 01 8665972
Telefax: 01 8665979

Alpha Environmental Systems Ltd.

Clyda Business Park,
Mallow,
Cork.
Telephone: 00353 2270253
Telefax: 00353 2250155

3.4 Wear protective clothing and goggles or face shield.

3.5 For small spills, dilute with plenty of water and run to waste. Wash site of spillage thoroughly with detergent and water.

3.6 For large spills, contain liquid with sand / earth or spill kits provided. Transfer contaminated liquid/solid mix to appropriate containers for disposal by designated waste disposal contractor. All residues should be treated as for small spillages.

3.7 Refer to the appended procedure regarding laboratory chemical handling and handling.

3.8 Refer to the SDS sheet for advice on handling & disposal precautions.

3.9 Contain all spills with the spill kit provided.

3.10 With all chemical spills, first aid requirements must be immediately assessed.

3.11 SDS information for all chemicals used must be available on site.

3.12 Where spills occur on skin, immediately remove contaminated clothing and irrigate with copious quantities of water. Obtain medical attention if irritation persists.

3.13 Where eye splashes occur, irrigate with water for at least 15 minutes. Seek medical attention.

3.14 If it is suspected that inhalation of vapours/fumes has occurred, seek medical attention immediately.

3.15 If ingestion occurs, do not induce vomiting. Give copious quantities of water to drink. Seek medical attention.

3. RESPONSIBILITY:

All senior Management are responsible for the implementation of this procedure.

Location and process	Ireland / Emergency plans / HES	**Document category**	
Last approved date	14/01/2022 (Patrick Shovelin)	**Last revision date**	19/12/2022
Date changed	14/01/2022 (Patrick Shovelin)	**Next revision date**	12/12/2024

Emergency Plan for Sinking Boat or Casualty on Board - South West

1. Purpose:

This procedure refers to the emergency actions required in the event of a sea vessel sinking and/or the presence of a badly injured person on board. All boats, barges and harvesting rafts are within the scope of these instructions.

2. Procedure:

2.1 If you are in grave and imminent danger of if there is a life threatening situation the following message should be sent on **Radio Channel 16:**

2.2 Make the distress call **"Mayday, Mayday, Mayday"**.

2.3 State the name of your vessel three times e.g. "**This is Sea Harvester, Sea Harvester, Sea Harvester".**

2.4 Call **"Mayday"** once only.

2.5 Call the name of your vessel once only "**Sea Harvester"**

2.6 Give the position of your vessel e.g. **"In Coulagh Bay, Kenmare River East of Inish Farnard"** or **51^0 42.700' N 010^0 00.600' W**

2.7 Give details of the nature of distress and/or assistance required and number of persons on board.

2.8 Say the word **"Over".**

2.9 Repeat all of above until response is obtained.

2.10 If possible pump out water from vessel.

2.11 Set off a distress flare. Wait a few minutes, then let off a second distress flare.

2.12 Account for all crew members and ensure that they have life jackets on.

2.13 Launch and board life raft (if applicable). Ensure to take on board the handheld VHF and remaining boat flares.

2.14 Cut the life raft tie line (Painter) attached to the sinking vessel.

2.15 Use Drogue on life raft to reduce rate of drift.

2.16 Rig the radar reflectors on the life raft.

GPS readings for sites:

Deenish:	Lat N: 51^0 44.187'	Long W: 010^0 12.429'
Roancarraig:	Lat N: 51^0 39.405'	Long W: 009^0 46.109'
Inishfanard:	Lat N: 51 42.723'	Long W: 010^0 00.604'
Ahabeg:	Lat N: 51° 39.743'	Long W: 009° 45.190'

3. EPIRB (Emergency Position Indicating Radio Beacon)

Some boats are fitted with an EPIRB, depending on DAFM Specification.

An EPIRB is a small battery-powered transmitting device that is carried on board. It is used only in case of emergency. If disaster strikes, some float free and automatically activate, others must be activated manually – staff should familiarise themselves with makes/models on board. All EPIRBs float and will send out a continual signal for 48 hours. Once activated the EPIRB should be left on to make sure the signal is available for detection by satellite and for purposes of homing in on your location.

4. VHF RADIO WITH DSC (Digital Selective Calling)

Most VHF radios are now fitted with DSC. In an emergency this is activated by lifting the safety latch and pressing the red button on the radio, giving off a distress signal indicating vessels details. This information is pre-programmed. Wait about 15 seconds for a DSC acknowledgement from the Coast Guard or a ship station, on Chanel 16. On receipt of a DSC acknowledgement or after about 15 seconds, send a voice distress call on Channel 16.

5. In the event of injury:

3.1 Administer first aid to the injured person.

3.2 If a crew member suffers a serious injury on board which requires medical assistance, the following distress call is made on **Radio Channel 16.**

3.3 Call **“Pan Pan, Pan Pan, Pan, Pan”.**

3.4 Call **“Valencia Radio, Valencia Radio, Valencia Radio”.**

3.5 State the name of the vessel. **“This is Sea Harvester”**

3.6 State location e.g. **“In Coulagh Bay, Kenmare River, East of Irish Farnard”.**

3.7 State nature of distress and request medical assistance and/or evacuation.

3.8 Say **“Over”.**

3.9 Stay with the injured person, keep warm and reassure until help arrives.

Emergency Plan for Mass Mortalities

Mowi Ireland

Location and process	Ireland / Emergency plans / Fish Health	**Document category**	
Last approved date	04/11/2021 (McManus, Catherine)	**Last revision date**	04/11/2021
Date changed	04/11/2021 (McManus, Catherine)	**Next revision date**	17/11/2023

1. DEFINITION OF MASS MORTALITIES

The following criteria define the requirement for handling of mass mortalities:

- The rapid or acute onset of fish mortalities in a pen or tank, which exceeds the site handling capacity
- Where veterinary advice deems the rapid cull of large numbers of fish for health management or fish welfare reasons.
- Where large numbers of fish are too small for sale.
- Where large numbers of fish considered unfit for harvest, are culled.

2. SCOPE & RESPONSIBILITY:

This procedure applies to Freshwater and Marine Operations in all Mowi Ireland regions. Managers in conjunction with Site Managers and the Mowi Ireland (MI) Fish Health Veterinarian are responsible for the operation of this procedure.

3. RECORDS:

- **Marine Mortality Record Sheet**
- **Freshwater Mortality Record Sheet**

4. PROCEDURE:

4.1 Planned Culls:

The decision to cull fish unsuitable for harvest is made by the Processing, Marine Operations Manager and the Managing Director.

The decision to cull freshwater fish too small for sale is made by the Freshwater Manager with reference to the Managing Director.

The necessity to cull fish for fish health or welfare reasons is determined by Veterinary advice with reference to the MI Fish Health Veterinarian, Technical Manager, Marine or Freshwater Operations Managers, Site Manager and the Managing Director.

All culls must be carried out by administration of a lethal dose of anesthesia under the direction of the MI Fish Health Veterinarian.

4.2 Initial Notification of Acute Mortality:

When a site experiences acute, unexpected mortality, the Mowi Ireland Fish Health Veterinarian, Technical Manager, Marine/ Freshwater Operations Manager, Diving Supervisor and Marine Support Manager are informed immediately by radio or telephone.

The Fish Health Veterinarian, and/or Fish Health Technician must visit the site in order to make an initial assessment of the cause of mortality in addition to sampling of fish and water.

Incidents with or impending risk of massive fish mortality exceeding normal operations and where the BU needs to accrue for financial loss according to the accounting principles, an incident report should be completed through the web-based Incident & crisis module.
Link: https://marineharvest1.sharepoint.com/sites/incidents/default.aspx or use the ‘Report new incident’ button found in the Mowi Connect.

4.3 Statutory Notification:

The Production Manager shall notify the Fish Health Unit of the Marine Institute and the Department of Agriculture, Food and Marine within 48 hours of the suspected appearance of any abnormal losses or mortalities and shall carry out instructions issued by the Fish Health Veterinarian including instructions relating to the treatment, disposal and destruction of diseased stocks. Inland Fisheries Ireland must also be notified of such events at fishfarmnotification@fisheriesireland.ie

Where the reason for mortality is not immediately known, additional Veterinary advice will be sought. When established, causes of mortality are furnished to the Marine Institute.

CONTACTS:

Sandra Vesanto,
Fish Health Manager & Veterinarian,
Mowi Ireland,
Kindrum,
Letterkenny,
Co. Donegal,
Ireland
Tel. +353 7491 92189 Mobile +353 87 7957066
Email: sandra.schlittenhardt@mowi.com

Dr Susie Mitchell/ Felix Scholz
Fish Vet Group,
Unit 7B,
Oranmore Business Park
Co. Galway,
Ireland
Telephone 091 792 997
Email : susie.mitchell@fishvetgroup.com
felix.scholz@fishvetgroup.com

Mr Bill Doré
Fish Health Manager
Marine Institute
Renville
Oranmore
Co Galway
Email: bill.dore@marine.ie

Direct: 091 387370
Mobile: 087 9151561

4.4. Disposal of Dead Fish:

All necessary mort bins and boat requirements shall be diverted immediately to the affected Marine site.

All available Company divers shall assist in the removal of dead marine fish. Culled or dying fish must be removed rapidly from site and transported to an approved facility.

In all cases, waste plant operators must be informed immediately of additional waste removal requirements. For freshwater units, transport containers are arranged in conjunction with the approved ABP rendering facility.

Details of approved ABP waste handling facilities are listed on the Approved Waste Contractors List.

4.5 Disinfection:

Personnel involved in the handling of large scale mortalities must not visit any other operation in Mowi Ireland without thorough cleaning and disinfection of clothing and equipment.

All boats, bins, trucks and related equipment must be cleaned and disinfected before use on any other site.

Where disease is suspected, all tanks, nets and related site equipment must be cleaned and disinfected before use.

Refer to disinfection procedures.

6. HES Precautions:

Manual handling procedures must be observed at all times.

Do not overload boats or transport equipment.

Wear appropriate PPE

Location and process	Ireland / Policies / Fish Escape Prevention	**Document category**	Policies
Last approved date	20/05/2022 (McManus, Catherine)	**Last revision date**	20/05/2022
Date changed	20/05/2022 (McManus, Catherine)	**Next revision date**	22/06/2023

Operational Procedure:

Mowi Ireland is a fully integrated salmon farming, processing and sales company, whose business is reliant on the natural environment. Preventing the escape of farmed fish is a priority for Mowi Ireland. Its operations prevent escapes in the following ways:

1. General

- Limit fish movements and handlings to the minimum required (preferably none)
- Adhere to local legislation as a minimum to guarantee the quality of equipment satisfies the requirements to ensure safe containment and zero escapes.
- Read and follow user manuals. Suppliers must be contacted immediately if user instructions are deemed to be inadequate
- Control equipment for damage before and after transport.
- In freshwater units, use minimum 3 barriers (i.e. screens) to prevent escapes through effluent systems draining to sea or rivers. Bottom tank screen counts as one.
- Use barriers/ screen size specified to contain the minimum fish size on site at any time.
- Use barriers to avoid fish escapes during incidental tank flooding.
- Cover outdoor tanks to prevent predation and thus possible escape.
- Take adequate safety measures to prevent escapes during fish handling activities. This may include covering pipes with nets during well boat loading of smolts and/or deployment of catch nets.

2. Equipment and infrastructure:

Mowi Ireland is committed to using equipment that is suitable to the environment in which it operates and will continue to do so as technology evolves. MHI adheres to BAT principals (Best Available Technology) in process choices and design. In April 2016, the Department of Agriculture, Food and the Marine have published a Protocol for the Structural Design of Marine Finfish Farms which must be adhered to for the structural siting and operation of a marine farm.

http://www.agriculture.gov.ie/seafood/aquacultureforeshoremanagement/marinefinfishprotocols/

Critical suppliers of nets, grid frames, anchors and other associated equipment are supplied with stringent specifications to which they must adhere. See tables 1, 2 & 3 below for specifications of floating installations components. Each fish pen is comprised of a net containment system, weighted appropriately depending on site conditions. All pens have bird nets installed to prevent entry of predators. At high risk/energy site, nets are retired after 5 years. In our smolt production units, water intake and outfall screens are in place to prevent wild fish ingress and farmed fish escapes. In addition, all water is discharged through drum filters which also act as a barrier to fish escapes.

3. Maintenance and regular inspections:

Each net and grid on site will be regularly (grid minimum twice a year, nets minimum once per month) inspected by sub aqua divers. Both inspection processes are detailed in individual procedures held in diving section of TQM (Document numbers 28940 and 28941).Maintenance will take place if required by trained personnel under supervision of site manager.

Each pen is fitted with a camera for feeding, which can also detect any potential issues. Site managers and feed operatives are responsible for reporting any problems. In addition to this, on site net washing systems have cameras attached and recording ability.

Mowi Ireland employs a dedicated net repair team to wash, disinfect, inspect and repair all nets that are changed at sea. During maintenance on shore, nets are tested for strength to ensure integrity. Nets are removed from use if the average net break pressure is ≤50% of the original break point on the new net

Please also refer to Floating Fish Farm Installations, TQM Doc No. 28809

4. Preparedness and response:

In the unlikely event of an escape, Mowi Ireland will follow its 'Emergency Plan for Fish Escapes' TQM document number 25561.

5. Awareness/ training:

a) Have in place a site-specific escape risk assessment.
b) Have a joint meeting with all involved should be held to plan major work operations such as net changing, delousing, etc
c) Have available checklists for operational procedures that include escape-related risks. Such checklists should be signed off prior to the execution of operational procedures that involve risk of escapes (e.g. changing nets, cleaning nets, delousing, smolt transfer, harvest, sampling, etc). Checklists should be revised and if needed updated at least once per year.
d) Train all staff in husbandry procedures and made them aware of this procedure and local prevention policies and SOPs. Training must be signed off. Training manuals should be provided on site and regularly updated especially when new equipment is implemented. All staff should also conduct once per year the online training program on Escape Prevention.
e) Undertake, at least once per year an escape preparedness drill that includes contingency response exercises. Drill should include:

    - what to do in the case of a near escape and an escape incident – use different scenarios to discuss the best mitigation action points
    - who does what?
    - discussion on how to improve the contingency plan

f) Have available at every site (electronically & print-out) a flowchart ("Act & Alert") with clear identification of actions & contact details of those who should be notified in the case of a near escape or escape incident. Refer to the regional Fish Escape Action flow charts in the TQM database.

6. Co-operation with Industry:

Mowi Ireland has worked with the Marine Institute (led by SINTEF Norwegian partners) on 'PREVENT ESCAPE' project funded by the EU. In addition, the Mowi Group continually trials new net, pen collar and mooring technology at various global locations.

7. Site Specific Risk Assessments:

HIGH RISK SITES – DEENISH, INISHFARNARD, SWILLY, ALL CLARE ISLAND SITES, BERTRAGHBUI

	Manufacturer, Specification & any other details
Pen	Aqualine/Fusion Marine 126m Pens; 400mm & 450mm pipes, 2 ring or 3 ring
Connection	16-20mm chain, connected by 8.5T shackle
Bridle	2 leg, including 20mm Masterlink, then 19-20mm chain
Cushion Float	CB1100, CB1250, CB2000 Buoys (connected to 20mm interconnecting plate by 16-20mm chain)
Connection	6.5T - 8.5T green pin shackles; 16mm – 20mm galvanised chain
Rope	56mm – 72mm Octoplait rope
Connection	FRAM Masterlinks 17 T 25T & 32T, US Fed Spec Thimbles 52mm & 64mm 8.5T & 12T green pin shackles
Chain	36-42 mm damper chain (stud-link)
Connection	17T green pin shackle, 1 ½ inch & 1 ¾ inch Black ‘D’ shackle
Anchors	750, 1000, 1500, 2000Kgs Steel Anchors
Seabed	Rock, Silt, Sand

MEDIUM RISK SITES – AHABEG, ROANCARRIAG, CREEVIN, WHILINS,

	Manufacturer, Specification & any other details
Pen	Aqualine/Fusion Marine 126m Pens; 400mm & 450mm pipes, 2 ring or 3 ring
Connection	16mm – 20mm chain, connected by minimum 6.5T green pin shackle
Bridle	36mm polysteel, 3+ strand; 13-16mm tested chain
Cushion Float	CB1100, CB1250, CB2000 Buoys (connected to 20mm interconnecting plate by 16-20mm chain)
Connection	6.5T - 8.5T green pin shackles; 19mm – 20mm galvanised chain
Rope	56mm – 64mm 72mm Octoplait specification rope
Connection	28 & 32T Masterlinks, US fed spec thimbles 52mm & 58mm
Chain	36-42 mm damper chain (stud link)
Connection	17T green pin shackle, 1 ½ inch & 1 ¾ inch Black ‘D’ shackle
Anchors	500, 750, 1000, 1500Kgs Steel Anchors
Seabed	Rock, Silt, Sand

LOW RISK SITES – KINDRUM, GLINSK, CRANFORD, MOROSS, MILLSTONE

Fish Escape Prevention Policy

Mowi Ireland

Location and process	Ireland / Policies / Fish Escape Prevention	**Document category**	Policies
Last approved date	20/05/2022 (McManus, Catherine)	**Last revision date**	20/05/2022
Date changed	20/05/2022 (McManus, Catherine)	**Next revision date**	22/06/2023

	Manufacturer, Specification & any other details
Pen	Aqualine/Fusion Marine 80m & 100m Pens including Froya rings 315mm & 400mm pipes, 2 ring or 3 rings
Connection	13-16mm chain, connected by 6.5T green pin shackle
Bridle	36mm polysteel, 3+ strand; 13-16mm tested chain
Cushion Float	CB440, CB650, CB1100, CB1250 Buoys
Connection	8.5T green pin, 6.5T green pin shackles; 19mm galvanised chain
Rope	56mm polysteel, 3+ strand
Connection	8.5T Green pin shackle
Chain	36-42 mm damper chain
Connection	9T Blue ‘D’ shackle
Anchors	500, 750, 1000Kgs Steel Anchors & 2T concrete blocks
Seabed	Rock, Silt, Sand

Location and process	Ireland / Emergency plans / Environment & Sustainability	**Document category**	Procedures
Last approved date	26/09/2022 (McManus, Catherine)	**Last revision date**	26/09/2022
Date changed	23/09/2022 (Yvonne Booth)	**Next revision date**	23/09/2023

Emergency Plan for Fish Escapes

1. SCOPE

This procedure refers to actions required in the event of a significant fish escape from any Freshwater or Marine production site in all Mowi regions in addition to any leased sites operated by Mowi Ireland.

2. RECORDS & RESPONSIBILITY

The Production Operations manager in conjunction with the Site Manager is responsible for the implementation of this procedure.

All escaped fish shall be recorded as such on the appropriate freshwater or marine mortality sheet and in Aquaplanner database system.

3. METHOD OF OPERATION

3.1 Detection of escaped fish:

Fish escapes may be noted by any of the following signs;

- Salmon jumping outside of a marine pen or downstream of a freshwater unit.
- Unexplained and sudden drop in feeding behaviour
- Known net damage due to boat propellers or storms.

3.2 Marine Escapes:

Call the diving team for immediate inspection of the suspected pen. All pens on site are subsequently inspected.

The divers must take cable ties and repair netting and twine for immediate repair of tears or holes in the pen netting.

As soon as the diving inspection is completed, replace the damaged net.
Remove the damaged net to the net repair station where it is thoroughly inspected and photographed. A full report on the net / pen damage and known losses is prepared by the Marine Operations Manager in conjunction with the Site Manager and the Marine Support Manager and forwarded to the Managing Director.

3.3 Freshwater Escapes:

Where freshwater fish escape from a tank or other holding vessel, all site staff must attempt to retrieve these fish from local waterways.
A full report on the reasons for the fish escape must be prepared by the Site Manager and forwarded to the Freshwater Operations Manager and the Managing Director.

3.4 Fishing license:

If appropriate, an application for a temporary fishing license may be sought from the Department of Agriculture, Food and the Marine in order to retrieve escaped fish.

3.5 Statutory Notification:

The Department of Agriculture, Food and the Marine, Aquaculture & Foreshore Management Division in addition to the Marine Institute and Inland Fisheries Ireland must be notified of all fish escapes within 24 hours of first noticing the incident. Where available, details of the reason for the escape must be submitted to these authorities.

3.6 Other relevant documents:

Please also refer to Fish Escape Prevention Policy, TQM document number 36708.

Fish Escape Action Flow Chart South West Marine

Mowi Ireland

Location and process	Ireland / Emergency plans / Environment & Sustainability	**Document category**	Guidelines
Last approved date	19/07/2022 (Michelle Hay)	**Last revision date**	19/07/2022
Date changed	19/07/2022 (Michelle Hay)	**Next revision date**	19/07/2023

ACTIVITIES

Identify pen(s) from which fish have or may have escaped. Phone site Manager and/or assistant site Manager.

Try to close the damaged net by lifting the side ropes.
(Staff member who identifies escape)

↓

Contact the dive Team and request them to arrive on site with net repair kit. Repair kit should also be available on site.
(Staff member who identifies escape)

↓

The Site Manager must contact and inform the Regional Operations Manager and the Stock Husbandry Manager of the escape
(Site Manager)

↓

Dive team enter water and survey all pens on site for damage. Where possible, temporary repairs should be made underwater with repair kits.
(Dive Team members)

↓

Within 3 hours of identifying the escape, report and record preliminary escape details the Mowi web-based "Incident & crisis module".
Inform the Operations Director Farming of the escape.
(Site Manager/Regional Operations Manager/Seawater Director)

↓

Within 24 hours of the escape, Inform the Dept. of Agriculture, Food and Marine - DAFM Section, IFI and the Marine Institute of the escape.
(Seawater Director)

↓

As soon as possible, remove and replace the damaged net/equipment from site for analysis and repair.
(Site Manager/Operations Manager/Seawater Direcor)

CONTACTS

Deenish: [redacted]

Inishfarnard: [redacted]

Roancarrig: [redacted]

Ahabeg: [redacted]

Diving Supervisors
[redacted]

SW Operations Manager: [redacted]
Stock Husbandry Manager: [redacted]
Operations Yard: [redacted]
SW Dive manager [redacted]

https://marineharvest1.sharepoint.com/sites/incidents/default.aspx

Operations Director Farming (Ireland)
[redacted]

Dept. of Agriculture, Food and Marine - AFMD Section.
[redacted]

Marine Institute:
[redacted]

Inland Fisheries Ireland: fishfarmnotification@fisheriesireland.ie

Mowi Ireland Safety Policy

Mowi Ireland

Location and process	Ireland / Policies / Mowi Irl Safety Policy	**Document category**	Policies
Last approved date	06/07/2022 (McManus, Catherine)	**Last revision date**	10/01/2022
Date changed	06/07/2022 (McManus, Catherine)	**Next revision date**	10/01/2023

Mowi Ireland declares its commitment to the following:

In so far as is reasonably practicable, to maintaining the safety, health and welfare of our employees at work and those (contractors/visitors) who may be affected by our activities. This Safety Policy is updated as new legislation/practices come into force and when responsibilities change.

The Mowi Ireland's safety management system shall conform to the guidelines listed in the safety specification ISO 45001:2018.

This Policy shall be made available to staff, contractors, visitors, customers and interested parties.

Specifically we are committed to;

- The design, provision and the maintenance of a place of work, that is as far as is reasonably practicable, safe and without risk to health.
- The design, provision and maintenance of safe means of access to, and egress from a place of work under our control, in so far as are reasonably practicable.
- The design, provision and maintenance of plant and machinery that are in as far as is reasonably practicable, safe and without risk to health.
- The provision of such information, instruction, training and supervision, as is necessary to ensure, so far as is reasonably practicable, the safety and health at work, of our employees.
- The provision and maintenance of suitable protective clothing or equipment that is necessary to ensure the safety and health at work of our employees in circumstances where it is not reasonably practicable for us to control or eliminate hazards in our place of work.
- The preparation and revision as necessary of adequate plans to be followed in emergencies.
- Compliance with all national and corporate occupational health and safety legislation and procedures.
- To ensuring, in so far as are reasonably practicable, safety and the prevention of risk to health at work in connection with the use of any article or substance.
- The provision and maintenance of facilities and arrangements for the welfare of employees.
- Continuous improvement of our safety management system, through systematic audits and reviews.
- Obtaining, where necessary, the services of a competent person (whether under contract of employment or otherwise) for the purpose of ensuring, so far as is reasonably practicable, the safety, health and welfare at work of our employees.

Signed: Catherine McManus.

Catherine McManus

Operations Director (Farming)

Location and process	Ireland / Emergency plans / HES	**Document category**	
Last approved date	14/01/2022 (Patrick Shovelin)	**Last revision date**	14/01/2022
Date changed	14/01/2022 (Patrick Shovelin)	**Next revision date**	16/02/2023

Emergency Plan for Confined Spaces

1. PURPOSE

If no response is received when an 'Entry Controller' attempts to communicate with a worker or workers inside the confined space or if someone inside is seen to collapse or show signs of distress, the following emergency rescue plan should immediately be put into effect:

2. RECORDS

Ref. list of confined spaces in MHI

3. METHOD OF OPERATION

1. The Entry Controller should raise the alarm and summon the rescue team and/or the emergency services, giving the location of the emergency.

2. Under no circumstances should an attempt be made to enter and investigate unless fully trained and has all safety equipment such as breathing apparatus

3. If the casualty is already connected to a winch/fall arrester, the 'Entry Controller' can lift the person out of the confined space, whilst waiting for the rescue team.

4. If the casualty is not connected, only rescue team members should affect a rescue.

5. The permit issuer or the person in charge must know who is authorized for entry; the maximum time allowed inside and should keep a record of who is inside at any one time.

6. The Entry Controller must remain at the entry point whilst a rescue is in progress to give further information if needed.

7. This plan will tested annually.

4. RESPONSIBILITY

Health & Safety Co-ordinator

Location and process	Ireland / Emergency plans / HES	**Document category**	
Last approved date	14/01/2022 (Patrick Shovelin)	**Last revision date**	14/01/2022
Date changed	14/01/2022 (Patrick Shovelin)	**Next revision date**	09/02/2023

Feed Barge Evacuation Procedure

Evacuation of a Feed Barge should be undertaken when there is considered to be a serious threat to the safety of those abroad. Such threats may take the form of fire, smoke, damage or destabilisation.

In the event of evacuation, the following procedures should be followed:

The alarm should be raised verbally and/or by activating the on-board alarm system.

Those below decks should make their way immediately to the surface using the primary escape route or the secondary route if necessary. In the event of electrical failure, emergency lighting will be activated.

Careful consideration should be given before attempting to go below decks to check/assist colleagues, particularly if smoke or fumes are present.

Those already on the upper deck should close off vents and valves and assist in operating escape hatches for those below if necessary. They should ensure that all aboard are accounted for and that buoyancy aids are donned, before closing escape hatches and processing with evacuation.

All on board should make their way down the primary ladder into a waiting boat. A boat or liferaft should always be available for this purpose. If the primary ladder is obstructed, the secondary ladder should be used.

Abandoning the installation by entering the water should only be considered as a last resort.

Crew should make their way to a place of safety i.e. ashore or cage group.

Location and process	Ireland / Emergency plans / HES	**Document category**	
Last approved date	14/01/2022 (Patrick Shovelin)	**Last revision date**	14/01/2022
Date changed	14/01/2022 (Patrick Shovelin)	**Next revision date**	09/02/2023

Emergency Plan for Storm at Sea

Scope:

Due to the nature of the business, a large percentage of the Mowi Ireland workforce are based at sea. Weather conditions at sea can vary, especially in winter where storms at sea result in large sea swells, strong tidal currents and unpredictable wave movement, which combined, can make for trecharous working conditions for staff. Planning is important when these conditions arise.

In the event of unfavourable weather conditions, the Site Manager has full authority to determine when all staff should go ashore. Note young persons (under 18) should not be permitted to work on boats or pens during storms.

Before leaving the Site, the following checks should be carried out:

- Ensure any loose items on deck of the feed barge are secured in place.
- Check the nets on fish pens are hooked in position and water ties are secure.
- Check that all hatches, vents, doors and feed silo lids on the feed barge are closed and secure.
- Ensure the crane on the deck of the feed barge is folded in position.
- Ensure staff have donned appropriate PPE and a hand held VHF is available if using polar boat.
- Make contact with the landbase and let them know your plans so that they will be expecting you at shore.

On vessels, the following applies:

- Turn on your navigation lights.
- Reduce speed to match sea condition.
- Maintain enough power to allow steering.
- Have crew and passengers put on lifejackets. On small boats, seat passengers as low as possible and near the centre line.
- Close and secure all doors, hatches and other openings.
- Ensure that cargo and other objects are secure.
- Ensure that all onboard drains that are designed to be open at sea and freeing ports are open and clear.
- Head for the nearest port of refuge or shore that is safe to approach, if possible.
- Direct the bow into the waves at about a 45-degree angle, if possible.
- Keep bilges free of water.
- Run out a sea anchor on a line from the bow to keep the boat headed into the waves if your engine fails.

- If you have concerns about the safety of your vessel or crew, make early radio contact with the Coast Guard radio station to advise them of your concerns. Do not wait until it is too late.

If you are in grave and imminent danger, or if there is a life threatening situation, the following message should be sent on **Radio Channel 16.**

Follow steps listed below:

- Make the distress call **"Mayday, Mayday, Mayday".**
- State the name of your vessel three times e.g. "**This is Sea Harvester, Sea Harvester, Sea Harvester".**
- Call **"Mayday"** once only.
- Call the name of your vessel once only **"Sea Harvester"**
- Give the position of your vessel.
- Give details of the nature of distress and/or assistance required and the number of persons on board.
- Say the word **"Over".**
- Repeat all of above until response is obtained.
- If possible pump out water from vessel.
- If within sight of land, set off a distress flare.
- Account for all crew members and ensure that they have life jackets on.
- Launch and board life raft (if applicable) and bring handheld VHF, EPIRB, SART or other emergency equipment if available.
- Cut the life raft tie line (Painter) attached to the sinking vessel.
- Use Drogue on life raft to reduce rate of drift.
- Rig the radar reflectors on the life raft.

Appendix 5

MOWI Standard Operating Procedures IV
Single Bay Management Plans

Note: This plan is an example plan and an updated plan will be produced for the proposed sites should the licences be granted.

Integrated Pest Management / Single Bay Management Plan
MOWI IRELAND 2022

Introduction

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 compatible with the arrangements on 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. A major component in this process is the build-up of a communication network between the operators. The non-confrontational environment of SBM 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 SBM 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 license applications
- In response to changing markets
- New husbandry requirements
- Both internal company restructuring and inter-company agreement

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

- separation of generations
- fallowing of sites in between different year classes
- strategic application of chemotherapeutants
- good fish health management
- close co-operation between farms

This management strategy was endorsed by the then Dept. of Marine, the Sea Trout Task Force and the Irish Salmon Growers Association as fundamental to the rational management of the salmon farming industry. This practice has since been re-enforced with the introduction by the Department of Agriculture, Fisheries and Food (DAFF) of "A strategy for improved pest control on Irish salmon farms", published in May 2008, revised 2010. This strategy seeks to establish a new role for SBM (Single Bay Management) as a focus for management cells to manage sea lice control at a local and regional level

This plan outlines how Mowi Ireland (MI) intends to control sea lice infestations at all of its Sea farms in Ireland. This plan is approved by the Mowi Ireland Fish Health Manager.

Sandra Vesanto

Fish Health Manager & Veterinarian

MOWI IRELAND

Monitoring of Sea lice:

The lice monitoring methodology set down in DAFM Protocol No. 3 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 must be 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.

- Over the two-month period of December to January, when lice growth is slow and therefore only one inspection is required.

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.

In addition to the statutory monitoring of Sea lice, Mowi Ireland will examine at least 20 fish from each salmon pen, every week. During the susceptible spring period, if levels of ovigerous female lice numbers reach an average of 0.5 per fish and/or a total of 5 *Lepeophtheirus salmonis* lice 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. If a therapeutic lice treatment is required this is subject to organic regulations concerning allopathic treatments which includes notification to the organic control bodies. For ASC (Aquaculture Stewardship Council) sites, during the sensitive period, the action limit is set at 0.1 mature female lice per fish.

Strategies to combat sea lice infestation in Mowi Ireland Sea farms.

Health status of input stock

All salmon stock introduced into Mowi sea sites will comply with;

I. Commission Delegated Regulation (EU) 2020/691 of 30 January 2020 supplementing Regulation (EU) 2016/429 of the European Parliament and of Council as regards rules for aquaculture establishments and transporters of aquatic animals
II. European Communities (Health of Aquaculture Animals and Products) regulations 2008 (S.I. No 261 of 2008), 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).
III. EC Council Directive 2001/82/EC and SI 144 of 2007 (Animal Remedies Regulations).
IV. Commission Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 as amended in Regulation (EU) 2019/1009, 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).
V. Commission Regulation (EU) No 142/2011 of 25 February 2011 implementing Regulation (EC) No 1069/2009 of the European Parliament and of the Council.

Prior to sea transfer, all salmon smolts will be inspected and certified as disease and parasite free. All such movements into and within salmon production areas shall be notified to the Fish Health section of the Marine Institute.

Management and disposal of biological wastes

Dead fish and runts will be removed regularly, to maintain the health of stocks. The frequency of mortality dives will be determined by the site manager based on time of year and numbers/type of mortalities but at minimum this will be weekly. Records of mortalities shall be maintained for each pen. All dead fish will be sent to an approved Animal By-Product Management Facility.

Where harvesting is carried out at sea, all harvest water including blood will be collected with harvest fish in the wells of the harvest vessel. Thereafter all fish and waste products will be transferred to insulated food tankers and transported by road to the Mowi fish processing plant at Rinmore, Co. Donegal. Blood and waste water are treated in a licenced, on-site effluent treatment facility at the Rinmore plant.

Non-medicinal sea lice management:

Cleaner fish

Mowi Ireland has developed a non-medicinal strategy to control sea lice using cleaner fish. This is the preferred strategy for managing sea lice infestations. Cleaner fish are species which display a natural behaviour of removing parasites and dead skin from other fish species in the wild. The main interest is in wrasse of the genus *Labroides*, of which there are a number of species indigenous to European waters, and the Lumpsucker fish (*Cyclopterus lumpus*) are also used for this purpose.

Mowi Ireland will endeavour to stock all sea sites with cleaner fish. This will involve the stocking of wrasse and Lumpsucker at a minimum stocking rate of 7% of the salmon pen population. Cleaner fish are already deployed in Mowi farms in Ireland with good success. Results to date illustrate that cleaner fish will maintain ovigerous lice levels on salmon in pens at below 0.1 lice per fish. It also has the beneficial effect of radically reducing the use of chemical treatments and, therefore, treatment dispersal. Mowi Ireland's objective is to have a 100% supply of hatchery-reared cleaner fish, available for all its sites, by 2023.

At Mowi sea farms, wrasse cleaner fish will be deployed from the first week in June at a ratio of at least 7 cleaner fish per 100 salmon. Wrasse will only be sourced using locally caught species and using local fishers, or farmed wrasse whenever possible. Since wrasse hibernate during winter months, the site will be stocked with hatchery reared lumpfish sourced from commercial rearing facilities in Ireland and Wales (Mowi owned) between November and May at the same rate. As a precaution, cleaner fish are removed from the pens before size-grading of salmon, freshwater bath treatments and when fasting salmon prior to harvest. All cleaner fish can be re-captured using baited lobster pots or creels.

There are five species of wrasse found in Irish waters. These are the Ballan wrasse (*Labrus bergylta*), the Goldsinny wrasse (*Ctenolabrus rupestrus*), the corkwing wrasse (*Symphodus melops*), the rock cook wrasse (*Centrolabrus exoletus*) and the cuckoo wrasse (*Labrus mixtus*). All five species have been found to be efficient in the removal of sea lice from salmon and can be accepted by fishermen for use in sea pens.

The increased use of cleaner fish, namely wrasse and lumpfish, for the control of sea lice, brings with it an onus of responsibility for the health and welfare of the cleaner fish species and of the salmon alike. Of paramount importance – whether the cleaner fish are wild or cultured in origin – is the prevention and control of disease and pathogens and the welfare of the fish.
In order to achieve this in accordance with industry standards and Mowi's code of best practice, the following are guidelines in relation to the culture, capture and subsequent maintenance of cleaner fish for use in salmon aquaculture:

- Cleaner fish will not be fished within 1km of a sea farm.
- Cleaner fish will not be sourced from areas where there are outbreaks of clinical disease in salmon populations.
- Cleaner fish should be sourced locally from within a bay/sea loch. For biosecurity purposes, the capture and deployment of cleaner fish shall be confined to the local bay area compartments;

Since it is not practical to collect and store cleaner fish prior to stocking on salmon sites, the fish health section of the Marine Institute will be notified, at least two weeks in advance of the cleaner fish collection and deployment season, of the proposed cleaner fish stocking plan at notification@marine.ie.

Mechanical Methods:

Another non-chemical treatment method has been developed by Mowi called HydroLicer®. Salmon are pumped gently into a pipe. They swim against water current and travel down the pipe, tail first. Seawater jets are directed in a special flow pattern into the pipe flow, towards the tails of the salmon, as they pass. The jet is insufficient to stop the salmon from passing through the pipe but is powerful enough to strip sea lice off the salmon. This is achieved because each louse is only attached to the salmon by a suction cup on its thorax. The jets lift the abdomen of each louse, which is not attached and this dislodges the lice from the salmon as they pass. Detached lice are removed and destroyed automatically whilst the deloused salmon are returned to their pen.

The Thermolicer is a non-chemical treatment method used by Mowi Ireland as well. Fish are pumped gently aboard and swim through a section of warmer water (usually between 30 - 33°C). Salmon will stay in this section for a maximum of 30 seconds, which avoids unnecessary stress for the fish. However, exposing the sea lice to this lukewarm water has a stunning effect that makes the lice dislodge from the salmon. Detached lice are removed and destroyed automatically whilst the deloused salmon are returned to their pen.

Both HydroLicer® and Thermolicer offer an effective non-chemical intervention alternative for the treatment of lice infestation. If required, this will be used on site with the intention of achieving zero ovigerous female lice on fish stocks.

Medicinal treatments:

The principal objective in lice treatment is to avoid the development of ovigerous female lice, since it is the Nauplius larvae hatched from egg strings carried by ovigerous female lice, that initiates the spread of infestation. Reduction in ovigerous female lice numbers can be achieved by killing them directly or otherwise by killing any settled lice stage, so that fewer remain viable to develop to maturity. Mowi Ireland focuses its lice treatment regime around the pre-spring treatment.

Mowi will only use treatments that are effective against all lice stages. This can be achieved using the oral treatment Slice®, and the bath treatments Alpha Max® or Paramove®, using either well boat tanks or fully bagged pens. The Mowi Ireland treatment strategy is to rotate treatment products.

Slice® in-feed treatment.

Slice® was developed specifically as an oral treatment against salmonid lice infestation. The recommended dosage is 50µg Emamectin Benzoate per kg fish biomass per day for seven consecutive days. Slice® -medicated feed is supplied by the feed manufacturer, using the appropriate quantity of Slice® pre-mix supplied under veterinary prescription.

If required, Mowi Ireland shall apply one Slice® treatment to stocks in the spring of the first input year. This will at latest be applied in May.

Alpha Max® bath treatment.

Alpha Max® active ingredient is the synthetic pyrethroid, Deltamethrin. Pyrethroids are a group of natural and synthetic chemicals which act on insects and related organisms (such as sea lice) by blocking neural transmission pathways. Deltamethrin does not bio accumulate in fish and, if released into the environment, less than 10% persists (and this part is widely dispersed) after 10 days. Its half- life in sediments under treated fish pens has been found to be 140 days, with 90% biodegraded by 12 months. Mowi Ireland use enclosed well boat tanks for Alpha Max® treatments.

Treatment dosage is 0.2ml Alpha Max®, equivalent to 2µgm of Deltamethrin) per m^3 seawater in the well tank for 40-45 minutes.

Paramove® (H_2O_2) bath treatment.

The active ingredient in Paramove® is Hydrogen peroxide (50%). A treatment is carried out either in well boat tanks or in lifted, fully bagged pens, in rotation with the other available treatments. Hydrogen peroxide is a powerful oxidising agent which kills pre-adult and adult lice by the formation of gas bubbles on and within the organisms. As with other lice medicines, H_2O_2 must be used with care, in rotation with other treatments.

Dosage is 1,500ppm H_2O_2 for 12 to 15 minutes, starting once the full dose has been released into the well. One advantage of H_2O_2 use is that its breakdown products are oxygen and water, which have no environmental impact.

Treatment planning:

Mowi Ireland shall focus its lice treatment regime around the pre-spring treatment. During the months of January to May, numbers of ovigerous female and total *Lepeophtheirus salmonis* will be maintained as close to zero as possible using cleaner fish and appropriate treatments where necessary.

Rotation of Treatment Products:

In order to reduce the risk of resistance development by sea lice to lice pharmaceuticals it is imperative that the limited number of treatment products is rotated in use. Mowi Ireland rotation rules are as follows;

- Where there is more than one chemical class available, there will be no more than 2 consecutive treatments with the same chemical class or product on the same site
- Following 2 consecutive treatments with the same chemical class/product then an alternative chemical class/product will be used on the same site, even with a break of several months (due to fallowing and/or a new generation being stocked)
- Treatments with products having shown resistance will not resume until sensitivity is restored
- Resistance bioassays will be conducted

    - If there are indications of reduced sensitivity to a particular product after any single treatment
    - If more than 2 consecutive treatments are planned
    - If resistance to another product/chemical class exists
    - to document restoration of sensitivity

- Product rotation will be applied as a zone management tool, targeting coordinated rotation also within neighbouring sites in the same area/ zone.

Site Fallowing:

The stocking / fallowing strategy is designed to break sea lice infection and infestation cycles by fallowing for a minimum of one month per cycle.

When appropriate, agreement will be reached with any other fin fish growers in the local embayment through the Single Bay Management system which is chaired by the Marine Institute.

Review of IPM:

The efficacy of Mowi integrated pest management plan shall be reviewed continuously during the operation of sites. Such reviews shall consider advances in knowledge and innovations for sea lice management as well as the sustainable deployment of cleaner fish and other biosecurity aspects.

Appendix 6

Benthic Audit Report

Environmental Survey

Beneath Finfish pens

at Deenish aquaculture site (T6/202),

Kenmare Bay,

Co. Kerry

May 2018

Produced by

AQUAFACT International Services Ltd

On behalf of

Marine Harvest Ireland

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AQUAFACT

Table of Contents

1. Introduction 1

1.1. Site description 1
1.2. Offshore finfish farms – benthic monitoring 3

2. Sampling Procedure & Processing 5

2.1. Dive survey 5
2.2. Sediment Profile Imagery (SPI) 8
2.3. Sampling for organic carbon analysis 10

3. Results 11

3.1. Recent Stocking History 11
3.2. Seabed physical and biological characteristics 11
3.2.1. Photographic record; Transect 1 11
3.2.1.1. Under pen 12
3.2.1.2. Edge of pen 13
3.2.1.3. 10 m from pen 14
3.2.1.4. 20 m from pen 15
3.2.1.5. 50 m from pen 16
3.2.1.6. 100 m from Pen 17
3.2.2. Sediment Profile Imagery – Transect 1 18
3.2.3. Photographic Record; Transect 2 20
3.2.3.1. Under pen 20
3.2.3.2. Edge of pen 21
3.2.3.3. 10 m from pen 22
3.2.3.4. 20 m from pen 23
3.2.3.5. 50 m from pen 24
3.2.3.6. Reference station 25
3.2.4. Sediment Profile Imagery – Transect 2 & Reference 26
3.2.5. Transect Species List 28
3.2.6. Organic Carbon Analysis & ARPD Depths 29

4. Discussion 30

5. Conclusion 31

6. References 31

List of Figures

Figure 1.1: Map showing the location of the Deenish site surveyed in Kenmare Bay 1

Figure 1.2: Map showing the locations of the relevant cSAC and SPA near Kenmare Bay, Co. Kerry 3

Figure 2.1: Transect seafloor station layout, Deenish finfish aquaculture site, Kenmare Bay, 24th May 2018..... 7

Figure 2.2: Diver operated Sediment Profile Imaging camera. The left-hand image gives a view of the camera at the sediment surface. The right-and image shows the SPI camera when inserted into the sediment 8

Figure 2.3: Typical sediment profile images with examples of features relevant to aquaculture operations 9

Figure 3.1: View of pens at Deenish Island site 11

Figure 3.2: T1 – Under pen station, Deenish Island site, 24th May 2018..... 12

Figure 3.3: T1 – Pen edge station, Deenish Island, 24th May 2018 13

Figure 3.4: T1 – 10m, Deenish Island, 24th May 2018..... 14

Figure 3.5: T1 – 20 m station, Deenish Island, 24th May 2018 15

Figure 3.6: T1 – 50 m station, Deenish Island, 24th May 2018 16

Figure 3.7: T1 – 100 m station, Deenish Island, 24th May 2018 17

Figure 3.8: Representative photographs of the seafloor taken along Transect 1 by Sediment Profile Imagery (SPI) apparatus. Marine Harvest finfish aquaculture site, Deenish, Kenmare River, Co. Kerry, 24th May 2018. 19

Figure 3.9: T2 – Under pen station, Deenish Island, 24th May 2018 20

Figure 3.10: T2 – Pen edge station, Deenish Island, 24th May 2018 21

Figure 3.11: T2 – 10 m station, Deenish Island, 24th May 2018 22

Figure 3.12: T2 – 20 m station, Deenish Island, 24th May 2018 23

Figure 3.13: T2 – 50 m station, Deenish Island, 24th May 2018 24

Figure 3.14: Reference station, Deenish Island, 24th May 2018 25

Figure 3.15: Representative photographs of the seafloor taken along Transect 2 by Sediment Profile Imagery (SPI) apparatus. Marine Harvest finfish aquaculture site, Deenish, Kenmare River, Co. Kerry, 24th May 2018. 27

List of Tables

Table 1.1: Matrix of production tonnage versus current speed to determine level of benthic monitoring required 4

Table 3.1: Species noted during dives on the seabed beneath the Deenish pens 28

Table 3.2: Organic carbon results for Deenish (% values, Loss on Ignition at 450°C). 29

Table 3.3: ARPD Depths for Deenish, Kenmare Bay, 24th May 2018 29

1. Introduction

This report documents the environmental conditions of the seabed at a Marine Harvest Ireland finfish (Atlantic salmon *Salmo salar*) aquaculture site (Aquaculture Licence Reference T6/202) in Kenmare Bay, Co. Kerry recorded during surveys undertaken by AQUAFACT on 24th May 2018 (see Figure 1.1). The aquaculture site is situated close to Deenish Island, County Kerry on the northern shore of Kenmare River.

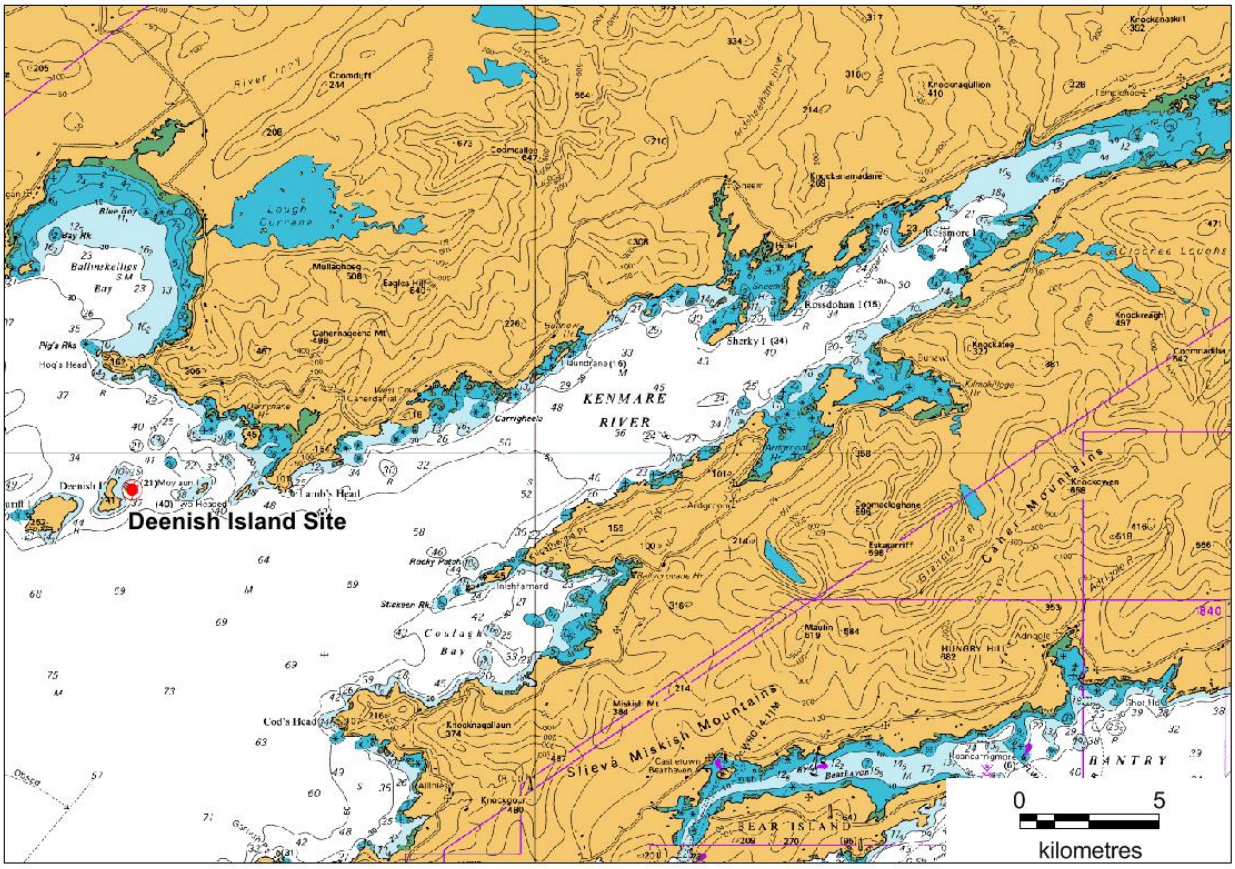

Figure 1.1: Map showing the location of the Deenish site surveyed in Kenmare Bay

1.1. Site description

Kenmare Bay, Co. Kerry, is a long and narrow, south-west facing bay. It is a deep, drowned glacial valley and the bedrock is mainly old red sandstone which forms reefs along the middle of the bay throughout

its length. Exposure to prevailing winds and swells at the mouth diminishes towards the head of the bay while numerous islands and inlets provide further areas of additional shelter.

Deenish Island is part of two Natura 2000 sites (see Figure 1.2), namely the Kenmare River cSAC (Site code: 002158) and the Deenish Island and Scariff Island SPA (Site code: 004175).

The diversity of environmental conditions, from exposed to ultra sheltered, that characterises Kenmare River cSAC results in the presence of a wide range of marine habitats including three listed on Annex I of the EU Habitats Directive, namely reefs, large shallow bay and caves. According to the cSAC site synopsis (available from www.npws.ie) Kenmare Bay is host to a high number of rare and notable marine species present (24) and some uncommon communities. The Kenmare River cSAC is the only known site in Ireland for the northern sea-fan, *Swiftia pallida* and is the only known area where this species and the southern sea-fan *Eunicella verrucosa* co-occur. Midway along the south coast of Kenmare River, a series of sea caves stretch back into the cliff, typically supporting a diversity of epifauna including encrusting sponges, ascidians and bryozoans.

Deenish Island and Scariff Island are small to medium size islands situated between 5 and 7 km west of Lamb's Head off the Co. Kerry coast and thus very exposed to the force of the Atlantic Ocean. The site is a Special Protection Area (SPA) under the E.U. Birds Directive due to its special conservation interest for seabirds including fulmar, Manx shearwater, storm petrel, lesser black-backed gull and Arctic tern. Scariff is the larger of the two islands, with very steep sides rising to a peak of 252 m with the highest cliffs located on the south side. Deenish is less rugged than Scariff, and rises to 144 m in its southern half; the northern half being lower and flatter. The vegetation is mostly grassland, with some heath occurring on the higher ground. Old fields are now overgrown with bracken and bramble. The sea areas within a 500m radius of both islands are included inside the SPA boundary to provide a 'rafting' area for shearwaters.

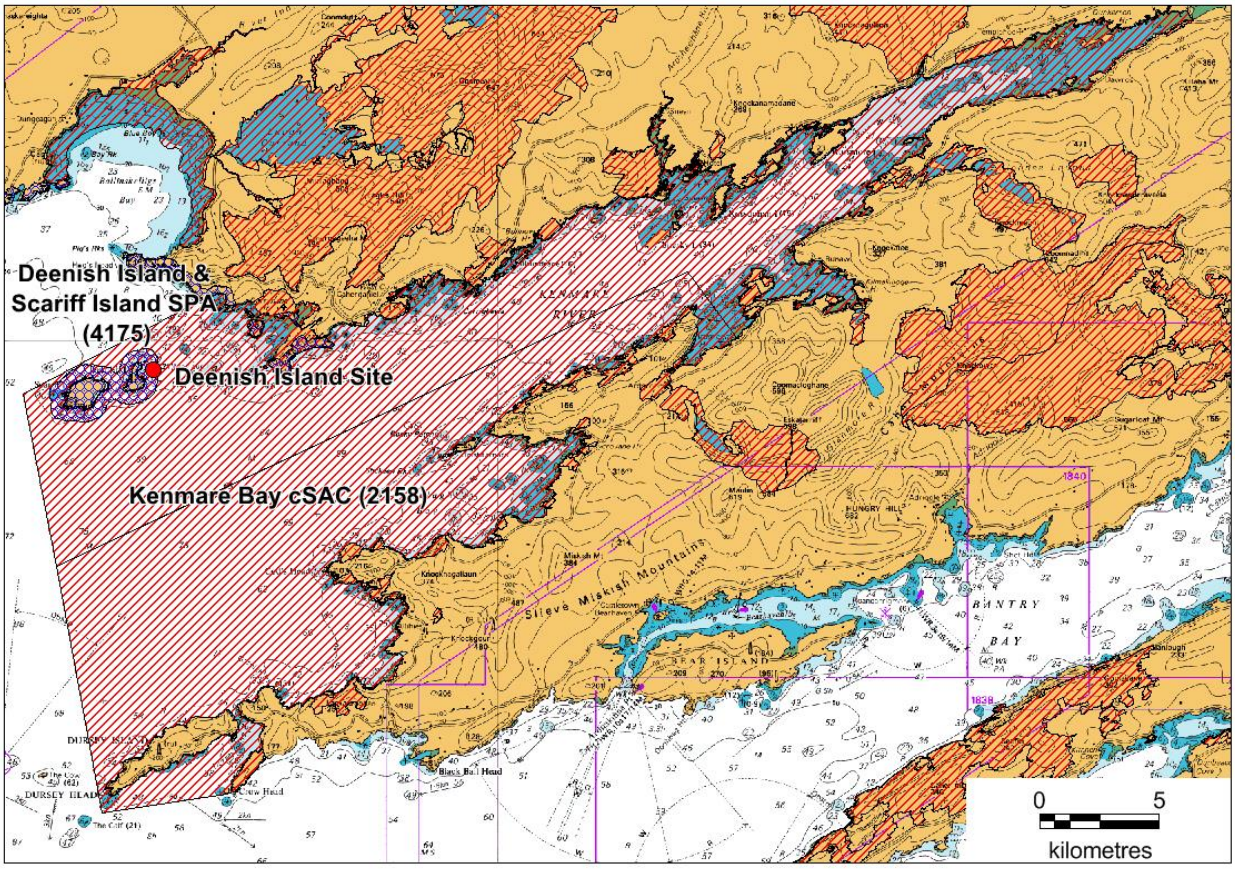

Figure 1.2: Map showing the locations of the relevant cSAC and SPA near Kenmare Bay, Co. Kerry

1.2. Offshore finfish farms – benthic monitoring

The main objective of the survey was to assess the overall state of the environment in relation to the salmon production process. The sites were surveyed according to the revised Benthic Monitoring Guidelines laid down by the Department of Agriculture, Fisheries and Food (December 2008). The benthic monitoring requirements at a fish farm are dependent on the level of biomass held at the site and the local hydrography. Table 1.1 below sets out the level of benthic monitoring required based on tonnage produced and mean current speeds at a fish farm.

Table 1.1: Matrix of production tonnage versus current speed to determine level of benthic monitoring required

	MEAN CURRENT SPEED (CMS^{-1})		
TONNAGE	**<5**	**5-10**	**>10**
0-499	Level I	Level I	Level I
500-999	Level II	Level I	Level I
>1000	Level II	Level II	Level I

The current speed is a mean value calculated from maximum current measurements over spring and neap tidal cycles at the surface and near the bottom. The tonnage refers to the maximum biomass predicted for each site. An annual survey must be carried out at each site (production and smolt) operated by a company. A level I or level II survey may be carried out as follows:

Level I: Video/photographic and visual observations and recordings shall be made at the following stations:

- At a minimum of 2 sites directly beneath the pens
- At the edges of the pens
- Two transects at right angles to each other. Along each transect sampling stations at +/- 10m, +/- 20m, +/- 50m and + 100m from the pens
- At a control site

In addition to the above, the following samples/measurements shall be taken at the same stations as above. These will be used to calculate sediment quality parameters.

- A minimum of one Redox potential reading shall be made at each sampling station.
- A single sediment sample for Organic Carbon measurement.

Level II: In addition to the above, two replicate grab samples shall be captured at each of the sample stations for faunal analysis. The exact locations of sampling points should be agreed in advance with the Department of Agriculture Fisheries and Food (DAFF). The identification and abundance of macro-faunal invertebrates shall be estimated and tabulated. Identification of fauna to the level of species will be

required.

It is important to take note that the exact position of the individual pen structures are not permanently fixed to a single position and there is a relatively large lateral movement due to depth, wind, currents and tides. For this reason, bottom stations particularly those under, at the edge and 10 m away from the pens are taken at the time of sampling but may vary relative to the overlying pen position under various environmental conditions.

2. Sampling Procedure & Processing

All survey work at the Deenish site took place on 24th May 2018. The dives were conducted at a maximum depth of 22.8 m and underwater visibility on the day was good at approximately 5m. The prevailing current direction at the site is north-south and as a result Transect 1 is orientated in this direction. Pen layouts at the time of survey, current direction, dive entry points and benthic transects followed by the divers are shown in Figure 2.1. Mean current speed at the Deenish finfish aquaculture site is 30 cm sec^{-1} (Marine Harvest *pers.comm*.). The fish biomass present in the pens at the time of survey was 1,532.7 tonnes. The survey was carried out at Level 1 as per the guidance matrix displayed in Table 1.1.

Disinfection

Prior to each dive survey for each location all diving equipment, suits and boats are thoroughly disinfected utilising both a dipping and spraying protocol.

2.1. Dive survey

Two dive transects were laid out from the sea surface at each site using a boat equipped with a GPS mapper. Pen locations were noted as DGPS positions. The underwater survey involved direct observation, sampling and recording (through photographs and *in situ* annotations) of benthic conditions by highly experienced, qualified marine biologists and scientific divers. The notes taken *in situ* were transcribed to logs upon surfacing. In addition to standard SCUBA gear the divers were equipped with:

- A high-end dSLR Nikon D200 in a Subal ND20 underwater housing fitted with a 12-24mm lens and two INON strobes. The camera was used to photograph the epibenthos and seafloor features;
- A diver-operated dSPI camera for photographing sediment profiles of the seafloor and calculate redox measurements. This unit uses a Canon EOS 450D camera with Nikkor optics;
- A compass for underwater navigation;
- Pre-labelled bags to store sediment samples for organic carbon analysis;
- Dive slates, torches and waterproof pencils for making observations/notes.

The divers photographed representative areas of the sediment and fauna and recorded observations in situ at the various stations investigated. Notes were completed immediately on surfacing and a map of the dive track was drawn up. Observations recorded during the dive include:

- Presence of bacterial mats and uneaten food;
- Presence of farm-derived litter;
- Presence of gas bubbles or anoxic areas;
- Animals visible or evidence of their presence;
- Macroalgae visible;
- Sediment characteristics, including colour and texture.

The seafloor was photographed at the following stations along two transects at the site (see Figure 2.1):

A. Directly under the pens;
B. Under the edge of the pen;
C. At 10m, 20m, 50m and 100m (on T1) from the pens along the transects.

A reference station was also assessed for each pen block to give a representation of ambient benthic conditions in the area immediately surrounding the pen installations for comparison purposes. The reference station was taken at a distance greater than 150 m from the pen installations to represent the assumed ‘undisturbed’ condition of the seafloor surrounding the sites.

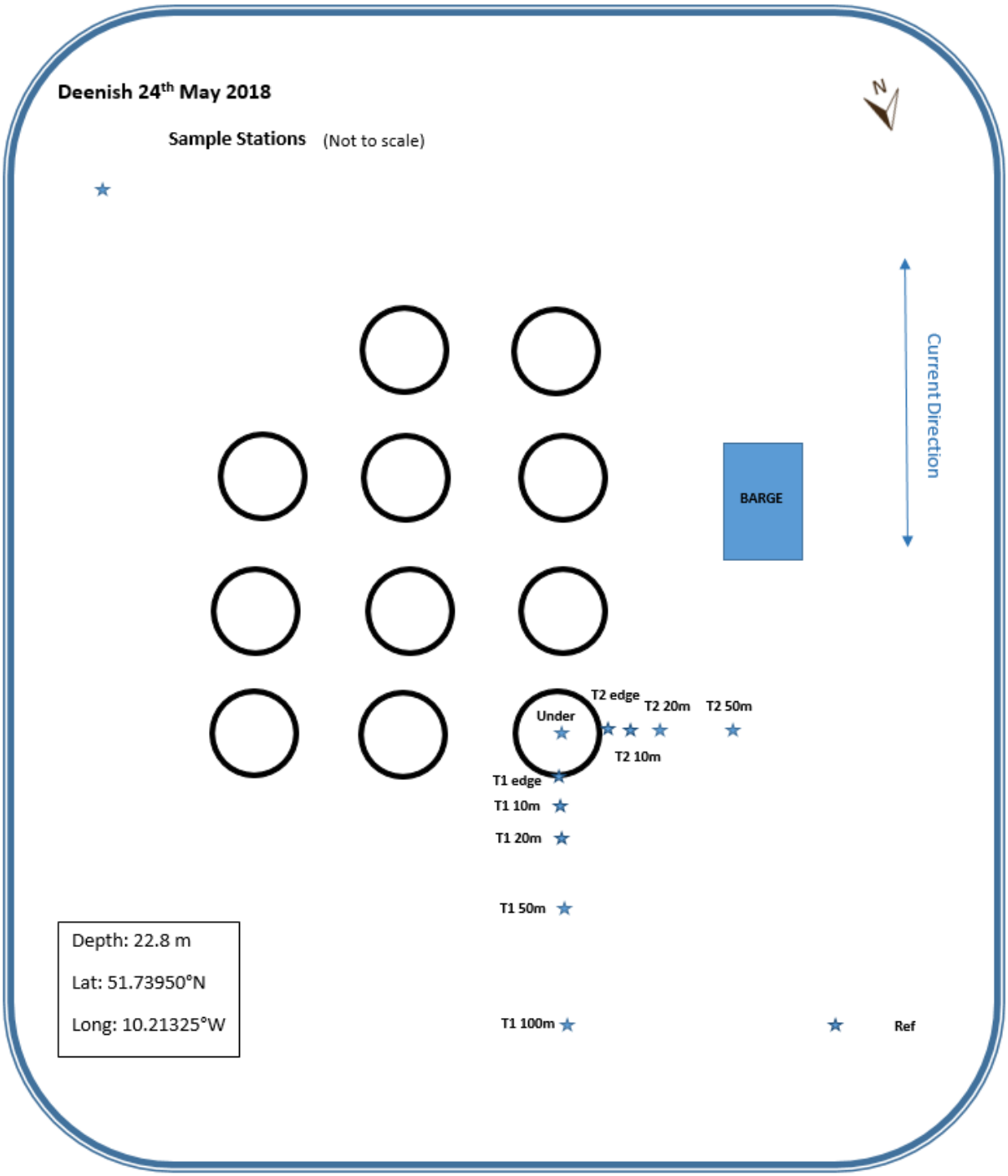

Figure 2.1: Transect seafloor station layout, Deenish finfish aquaculture site, Kenmare Bay, 24th May 2018

2.2. Sediment Profile Imagery (SPI)

Sediment profile images (SPI) obtained for each station along with ARPD depth measurements taken from the images were acquired using a diver-deployed sediment profile imaging camera system. This system is comprised of a digital SLR camera in a water-tight pressure vessel that is mounted above a prism that penetrates the upper 25 cm of sediment (see Figure 2.2). The sediment profile is viewed through a plexiglass window and the image is reflected to the camera lens via a plane mirror. Illumination is provided by an internally-mounted strobe. The prism unit is filled with distilled water – thus ambient water clarity is never a limiting factor in image quality. Upon arrival, the diver depresses the SPI unit into the seafloor and manually triggers the camera. This process is repeated at each station investigated.

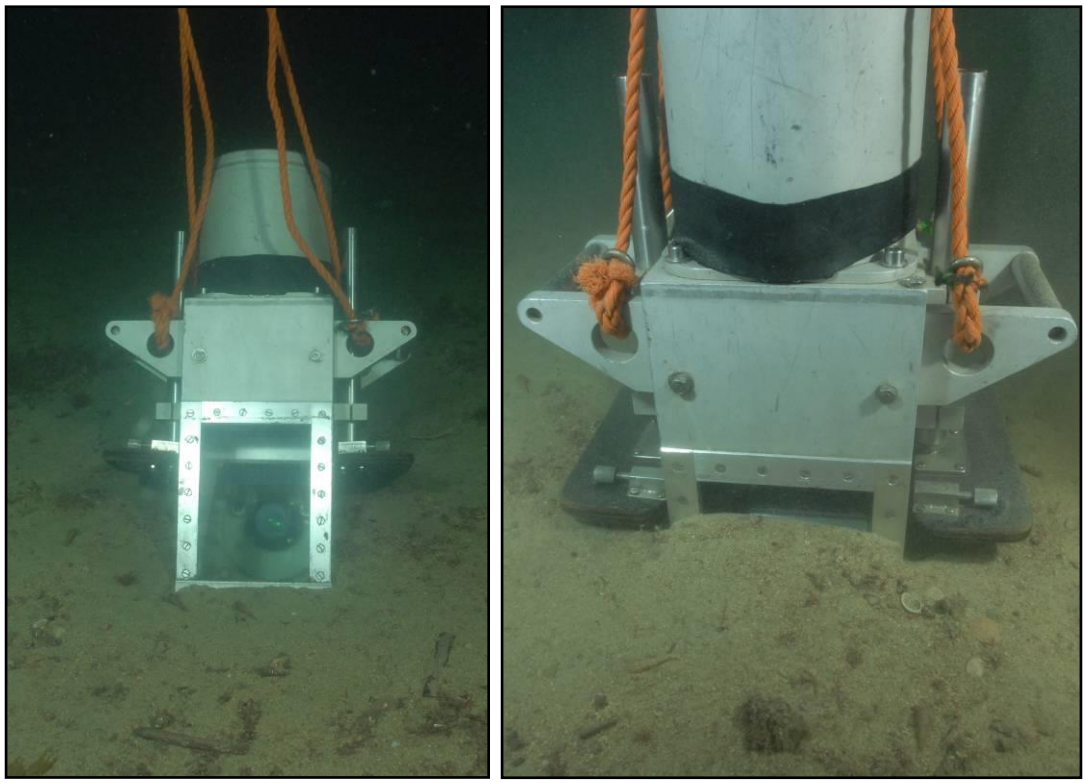

Figure 2.2: Diver operated Sediment Profile Imaging camera. The left-hand image gives a view of the camera at the sediment surface. The right-and image shows the SPI camera when inserted into the sediment

A great deal of information about benthic processes is available from sediment profile images. Measurable parameters, many of which are calculated directly by image analysis, include physical/chemical parameters (i.e. sediment type measured as grain size major mode, prism penetration

depth providing a relative indication of sediment shear strength, sediment surface relief, condition of mud clasts, redox potential discontinuity depth and degree of contrast, sediment gas voids) and biological parameters (i.e. infaunal successional stage of a well documented successional paradigm for soft marine sediments (see Pearson and Rosenberg, 1978), degree of sediment reworking, dominant faunal type, epifauna and infauna, depth of faunal activity, presence of microbial aggregations).

For the purposes of the current survey, the primary feature of interest is the depth of oxygen penetration into the sediments in the vicinity of the finfish pens (this information is required to satisfy the requirements of the Benthic Monitoring Protocol (DAFF, 2008). In this case, the apparent redox potential discontinuity or ARPD depth is measured. Features of particular interest that may be gleaned from SPI images taken in sediments in the vicinity of finfish pens include the presence of:

- uneaten feed pellets (and depth of this material, see Figure 2.3)
- faecal casts
- and depth of shell gravel deposits
- of gas voids in the sediment

Figure 2.3: Typical sediment profile images with examples of features relevant to aquaculture operations

2.3. Sampling for organic carbon analysis

Sediment samples for organic carbon analysis were collected at all stations. Samples were stored in pre-labelled plastic bags, kept in cold freezer boxes onboard the vessel and frozen at -20°C on return to the laboratory. Organic carbon analysis was carried out by ALS laboratories using the Loss on Ignition (LOI) technique. This method involves oven drying the sediment sample in a muffle furnace (450°C for a period of 6 hours) after which time the organic content of the sample is determined by expressing it as a percentage the weight of the sediment after ignition over the initial weight of the sediment.

3. Results

3.1. Recent Stocking History

At the time of the audit, 1,532.7 tonnes of fish were stocked on site having been input to the site (44.6 tonnes) in March 2017 following a 10 week week fallow period. This gave an onsite biomass production of approximately 1,488 tonnes prior to the survey.

Figure 3.1: View of pens at Deenish Island site

3.2. Seabed physical and biological characteristics

The seabed was mainly composed of fine sand under and immediate vicinity of the pen with coarse sand with a shell gravel constituent, the majority of which was composed of the shell of the edible mussel *Mytilus edulis* amongst other species, at the stations further along the transects.

3.2.1. Photographic record; Transect 1

This transect began beneath the northwestern most pen moored on site (see Figure 2.1) and ran for a distance of 100 m north. A total of six stations were investigated.

3.2.1.1. Under pen

The seafloor located directly under the pens was characterised by a medium to fine sand that had a bumpy/dotted appearance due to the presence of a dense polychaete community (*Capitella* spp. complex). Drift brown and red algae were common on the seafloor. The lugworm, *Arenicola marina*, was also present. There were some observations of uneaten feed pellets and waste faecal matter from the above aquaculture pens. No observations of bacterial mats or outgassing were observed.

Figure 3.2: T1 – Under pen station, Deenish Island site, 24th May 2018

3.2.1.2. Edge of pen

The seafloor at the edge station was characterised by soft medium grained sand. As with the under station the surface was dotted with the surface tubes of the opportunistic polychaete infaunal community with a number of *A. marina* casts also present. Drift brown and red algae were scattered over the surface with some uneaten food pellets (see Figure 3.3). No outgassing or bacterial mats were observed at the station.

Figure 3.3: T1 – Pen edge station, Deenish Island, 24th May 2018

3.2.1.3. 10 m from pen

The seafloor conditions observed 10 m along Transect 1 were very similar to those observed at the edge station of the same transect. The sediment was composed of a fine grained sand with a dotted appearance due to the infaunal community. Brown drift algae and phytodetrital debris were also present. In general the benthic environment appeared to be in good condition.

Figure 3.4: T1 – 10m, Deenish Island, 24th May 2018

3.2.1.4. 20 m from pen

The seafloor conditions at the 20 m station along Transect 1 were characterised by fine grained sand. Brown, red and green drift algae were recorded on the seafloor while *A. marina* casts were common. The burrowing anemone *Cerianthus lloydii* was observed with feeding tentacles extended. The presence of the opportunistic *Capitella* sp. complex community indicated the organic input from the aquaculture activity although the seafloor had a healthy oxygenated appearance.

Figure 3.5: T1 – 20 m station, Deenish Island, 24th May 2018

3.2.1.5. 50 m from pen

On moving approximately 50 m away from the pens the seafloor conditions changed considerably, the fine grained sand gave way to coarser more shell dominated sediment. Drift algae and phytodetrital material were present along with the burrowing anemone *C. lloydii*. In general the sediment appeared oxygenated with some darker areas were the ARPD was closer to the surface. There were no obvious signs of impact from the aquaculture activities.

Figure 3.6: T1 – 50 m station, Deenish Island, 24th May 2018

3.2.1.6. 100 m from Pen

The seafloor conditions observed at the 100m station were similar to those observed at the 50m station along Transect 1. There was a high percentage of shell gravel predominately from the mussel *M. edulis*, generally accumulated in troughs with finer medium sand forming peaks. The burrowing anemone *C. lloydii* was common as was the lugworm *A. marina*. In general, the seafloor had an oxygenated appearance and the benthic environment appeared to be in good health (Figure 3.7).

Figure 3.7: T1 – 100 m station, Deenish Island, 24th May 2018

3.2.2. Sediment Profile Imagery – Transect 1

Figure 3.8 presents sediment profile images taken at the six stations visited on Transect 1 of the Deenish site. The substrate of the site was composed of fine and medium grained sand with shell gravel at the under pen station which gradually gave way to a coarser shelly gravelly sand with intact shell at the outer end of the transect. The energy levels experienced by the seafloor in this area is more than likely quite high particularly during winter storms.

The images display a single image and the maximum and minimum apparent redox potential discontinuity (ARPD) depths measured at each station. Each image is 15.5cm × 25cm. ARPD depths ranged from a minimum of 0.1 cm (T1 20m) to a maximum of greater than 13.2 cm (T1 Under). The dense *Capitella* sp. complex community is clearly evident in the under, edge and to a lesser extent 10 m stations. These species increase the ARPD by their bioturbating activity that increases the oxygen content of the sediment.

Due to the relatively coarse nature of the seafloor, the SPI camera achieved relatively low penetrations.

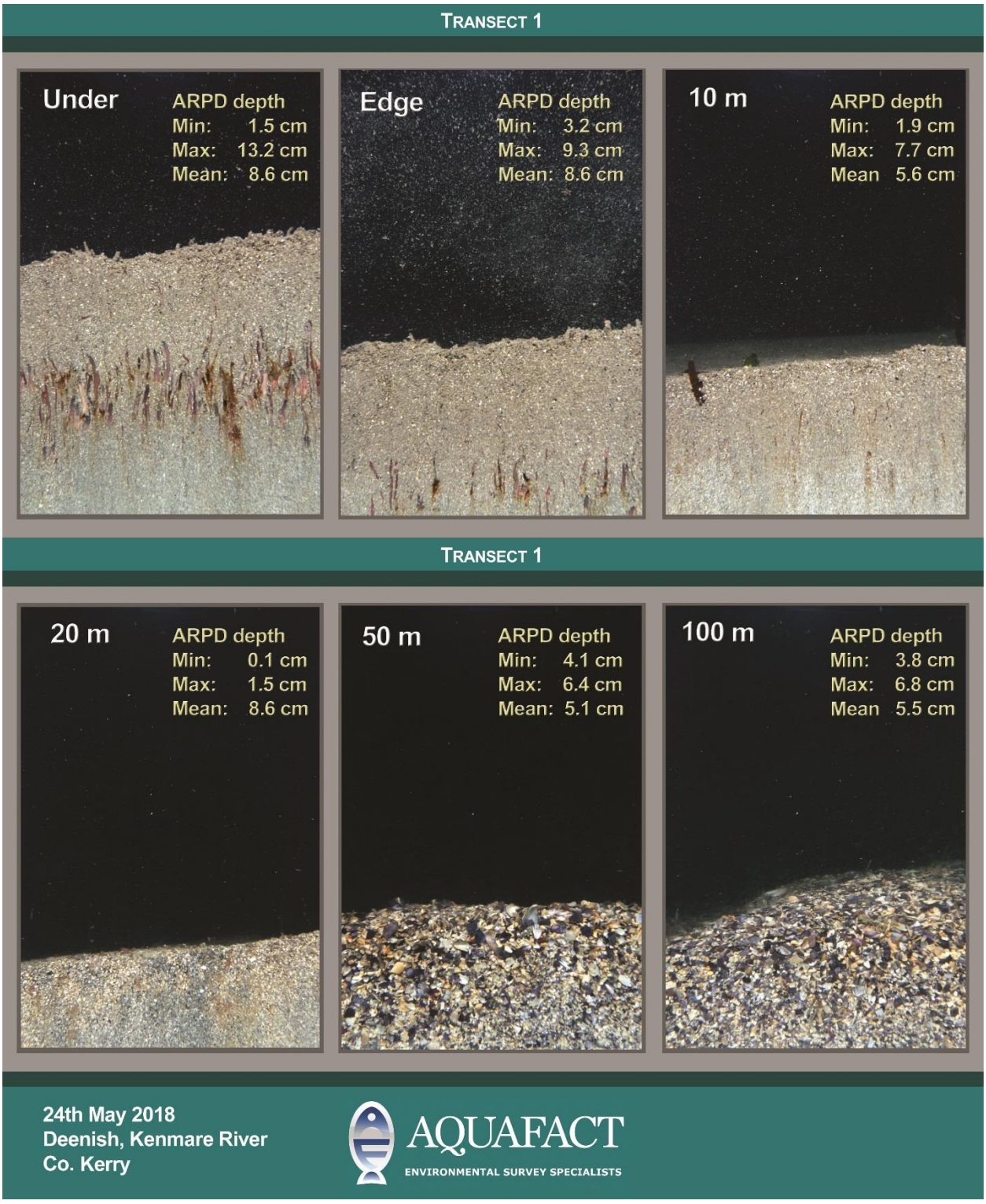

Figure 3.8: Representative photographs of the seafloor taken along Transect 1 by Sediment Profile Imagery (SPI) apparatus. Marine Harvest finfish aquaculture site, Deenish, Kenmare River, Co. Kerry, 24th May 2018.

3.2.3. Photographic Record; Transect 2

This transect began beneath the same pen as Transect 1 and ran for a distance of 50m west. A total of five stations were investigated on Transect 2 with an additional (Reference) station investigated just *c.* 150 m north of the pen edge (See Figure 2.1).

3.2.3.1. Under pen

The seafloor directly beneath the salmon pens on Transect 2 was very similar to the Under pen conditions observed on Transect 1. The sediment was made up of fine grained sand that had a dotted appearance due to the small tubes of the infaunal polychaetes protruding from the sediment surface. The red tentacles of these worms can be seen protruding from the tubes in places. *A. marina* casts were also observed on the sediment surface.

Figure 3.9: T2 – Under pen station, Deenish Island, 24th May 2018

3.2.3.2. Edge of pen

The Edge of pen station along Transect 2 was characterised by a fine grained sand. Drift algae and phytodetrital material were common along with *A. marina* casts resulting from the bioturbating activity in the sediment. Apart from some uneaten feed pellets scattered on the sea bed there were no obvious signs of impact from the overhead pens, and the benthic environment was in relatively good condition.

Figure 3.10: T2 – Pen edge station, Deenish Island, 24th May 2018

3.2.3.3. 10 m from pen

The seafloor conditions at the 10m station on Transect 2 were characterised by fine grained sand with a small amount of shell gravel mainly originating from the blue mussel *M. edulis*. Patches of darker sediment were observed where the deeper less oxygenated sediment had been bioturbated and brought to the surface by the worm *A. marina*. There were no observations of waste material from the adjacent aquaculture site visible on the seabed. In general, the benthic environment of the area seemed to be in good condition.

Figure 3.11: T2 – 10 m station, Deenish Island, 24th May 2018

3.2.3.4. 20 m from pen

Seafloor conditions at the 20m station on Transect 2 were characterised by fine grained sand with a light oxygenated appearance. However, there were some darker patches where the bioturbating activity of *A. marina* had brought less oxygenated sediment to the surface. The anemone *C. lloydii* was common buried in the sand. There were no obvious signs of impact from the above salmon farm activity, with no signs of waste faecal matter or uneaten feed pellets. In general the benthic environment appeared to be in good condition.

Figure 3.12: T2 – 20 m station, Deenish Island, 24th May 2018

3.2.3.5. 50 m from pen

The seafloor at the 50m station on Transect 2 was characterised by fine grained sand with a light oxygenated appearance. The arms of *Amphiura* sp. were observed suspended above the sediment surface feeding. The benthic environment appeared to be in good health.

Figure 3.13: T2 – 50 m station, Deenish Island, 24th May 2018

3.2.3.6. Reference station

A reference station was chosen to provide an example of the natural conditions that occur in the area with the absence of the aquaculture site. The sediment at this station was courser than at previous station, a considerable percentage of shell fraction was observed predominantly composed of *M. edulis*. Drift algae was scattered across the seafloor with the anemone *C. lloydii* and lugworm A. marina buried in the sediment.

Figure 3.14: Reference station, Deenish Island, 24th May 2018

3.2.4. Sediment Profile Imagery – Transect 2 & Reference

Figure 3.15 presents sediment profile images taken at the five stations visited on Transect 2 of the Deenish site and the reference station on 24th May 2018. The figure displays a single image and the maximum and minimum apparent redox potential discontinuity (ARPD) depths measured at each station. Each image is 15.5 cm × 25 cm.

Sediment type varied from medium sands under and close to the pen compared with higher proportions of gravel and shell with increasing distance from the pen. It was difficult to estimate ARPD depths from the station due to the nature of the substrate which didn't allow sufficient prism penetration of the SPI. Despite this, penetration was achieved on all stations and the oxidised sediment layer at the site was considered to be relatively deep, estimated to range from a minimum of 0.5 cm (T2 20m) to a maximum of 11.8 cm (T2 Under). ARPD depths at the Reference station ranged from 5.5 cm to 8.9 cm and a mean ARPD of 6.8 cm. The Capitella sp. complex community is evident at the under, edge and 10m stations while the arms of *Amphiura* sp. are noted protruding into the water column at both the 20m and 50m stations.

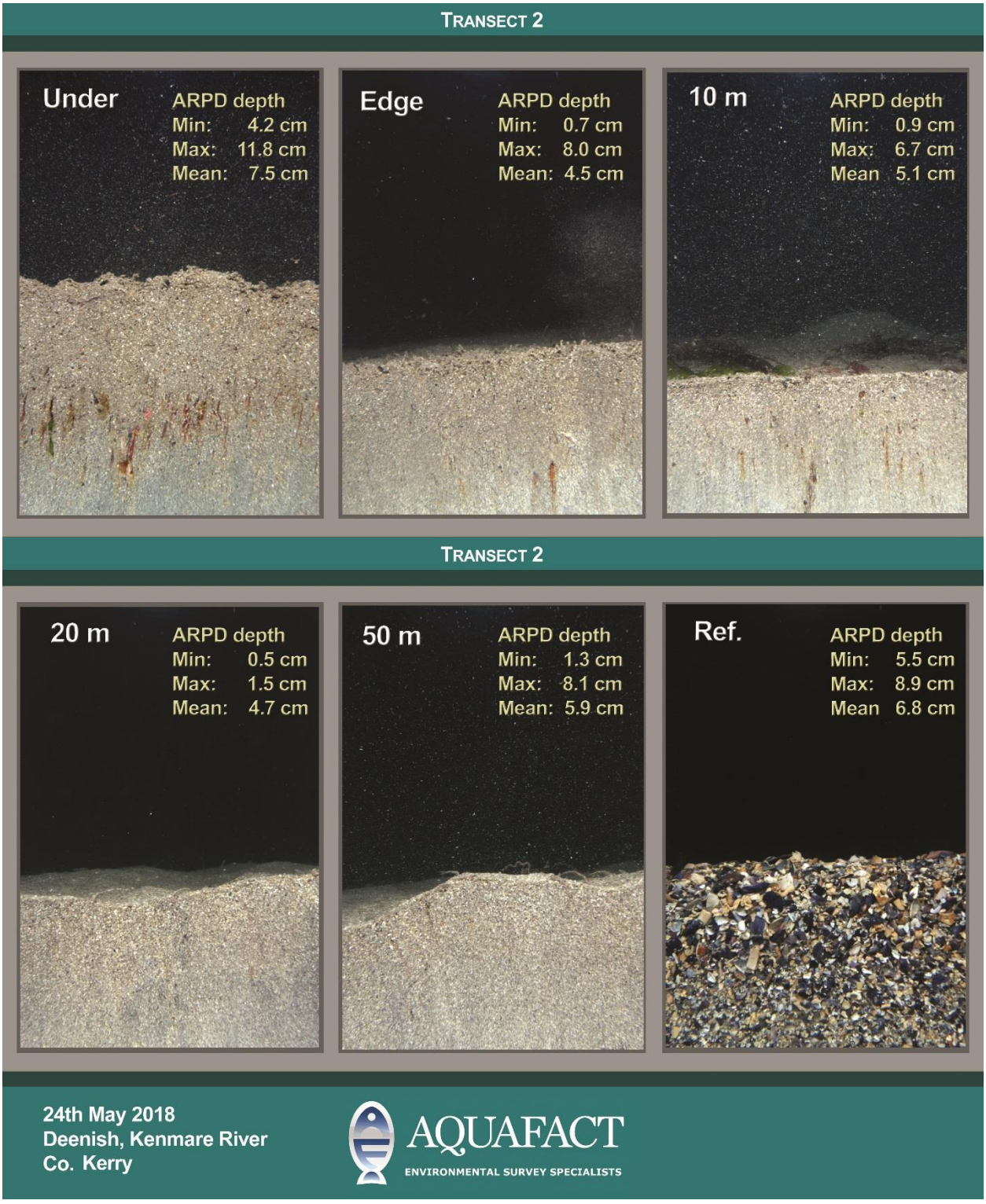

Figure 3.15: Representative photographs of the seafloor taken along Transect 2 by Sediment Profile Imagery (SPI) apparatus. Marine Harvest finfish aquaculture site, Deenish, Kenmare River, Co. Kerry, 24th May 2018.

3.2.5. Transect Species List

Table 3.1 shows a list of species observed during the dives at the Deenish fish farm site on this and previous occasions.

Table 3.1: Species noted during dives on the seabed beneath the Deenish pens

Group	Species	Common Name
(Cnidaria) Hexacorallia	*Cerianthus lloydii*	Tube anemone
(Annelida) Polychaeta	*Spirobranchus* sp. *Lanice conchilega* *Chaetopterus variopedatus* *Arenicola marina*	Tube worm The sand mason Parchment tube worm Lugworm
(Mollusca) Bivalvia	*Pecten maximus* Faceliniidae Aeolidiida Nudibranch	King scallop Sea slugs Sea slugs Sea slugs
(Arthropoda) Decapoda	Paguridae	Hermit crab
Echinodermata	*Luidia ciliaris* *Asterias rubens* *Marthasterias sp* *Ophiura* sp. Amphiuridae sp.	Seven armed starfish Common starfish Starfish Brittlestar Brittlestar
(Chordata) Osteiichthyes	*Pomatoschistus* sp. *Trisopterus minutus* *Labrus bergylta*	Gobies Poor Cod Ballan Wrasse
Rhodophyta	*Delesseria sanguinea* *Phycodrys rubens* *Cryptopleura ramose* *Calliblepharis ciliata* *Lythophyllum* sp.	Sea beech Sea oak
Ochrophyta	*Alaria esculenta*	Edible kelp

3.2.6. Organic Carbon Analysis & ARPD Depths

Table 3.2 shows the organic carbon results from the Deenish stations. Organic carbon levels ranged from 2.2% (T2 20m) to 5.91% (T1 Edge). Levels were higher beneath the cages when compared with the reference site (2.92%) and became lower the greater the distance from the aquaculture site.

Table 3.2: Organic carbon results for Deenish (% values, Loss on Ignition at 450°C).

T1	Under	Edge	10m	20m	50m	100m
LOI %	5.06	5.91	4.9	3.31	3.13	3.2
T2	**Under**	**Edge**	**10m**	**20m**	**50m**	**REF**
LOI %	-	4.42	3.18	2.2	2.3	2.92

Table 3.3 shows in tabular form the ARPD depths from the SPI images from Deenish (see Sections 3.2.2 and 3.2.4).

Table 3.3: ARPD Depths for Deenish, Kenmare Bay, 24th May 2018

Station		Transect 1	Transect 2
Under	Range (cm)	1.5-13.2	4.2-11.8
	Mean (cm)	8.6	7.5
Edge	Range (cm)	3.2-9.3	0.7-8.0
	Mean (cm)	8.6	4.5
10m	Range (cm)	1.9-7.7	0.9-6.7
	Mean (cm)	5.6	5.1
20m	Range (cm)	0.1-1.5	0.5-1.5
	Mean (cm)	8.6	4.7
50m	Range (cm)	4.1-6.4	1.3-8.1
	Mean (cm)	5.1	5.9
100m	Range (cm)	3.8-6.8	-
	Mean (cm)	5.5	-
Reference	Range (cm)	-	5.5-8.9
	Mean (cm)	-	6.8

4. Discussion

The extent to which an overlying fish farm impacts the seafloor is largely dependent on:

- the feeding regime at that farm, i.e. the amount of food that eventually ends up on the seafloor;
- the degree of current movement at the site in question; and
- the depth of water at that site.

These factors combine to form either erosional or depositional locations where organic material is either dispersed or it accumulates, and subsequently affects the receiving environment (*i.e.* the seafloor). The type of biotic community living at a particular site will also play a role in determining bottom conditions there. The influence of feeding activities of populations of starfish, polychaete worms, anemones, crabs and finfish at the Deenish site largely determine the level of impact of overlying farm operations on the benthos there.

Faunal feeding activity can remove large amounts of waste organic material from the seabed beneath a farm facility – with groups of mobile fauna capable of consuming large quantities of material. The fallowing schedule at a site also has a large bearing on benthic impact – most notably the length of time pens have been on site since the last fallow period. The presence of opportunistic deposit feeders such as *Capitella* sp., most notably at the under pen and pen edge stations will tend to help keep the benthic organics in a state of equilibrium at the fish farm sites. Sedimentary organic carbon levels in general are relatively higher at the under and edge of pen conditions at the Deenish site.

Mobile epibenthic scavengers such as starfish, fish and crabs also help in reducing the amount of waste material on the seafloor. This potential speed of the removal of waste was demonstrated in a previous study where photographic evidence was collected showing that epibenthic macrofauna were capable of removing, in less than 7 days, fish feed pellets spread at a density of 3.4 kg dry weight per m^2 on the sediment under a marine fish farm (Smith *et al.*, 1997).

In light of the observations obtained during the current survey, it appears that very little if any habitat

degradation has occurred at the Deenish Island site. Results obtained from both previous studies in 2016 and 2017 yielded similar results and it is proposed that the influence of salmon aquaculture has had a minimal effect on the surrounding benthic environment.

5. Conclusion

On the 24th of May 2018, a benthic audit survey was carried out on the Deenish fish farm site operated by Marine Harvest Ireland. The Deenish survey followed the DCMNR Level I monitoring protocols. The results from the current survey conclude that the overlying aquaculture had little or no effect on the seabed. Stations examined along each of the transects had ARPD depths that were very similar to those recorded at the reference and the site can be considered of good environmental status.

6. References

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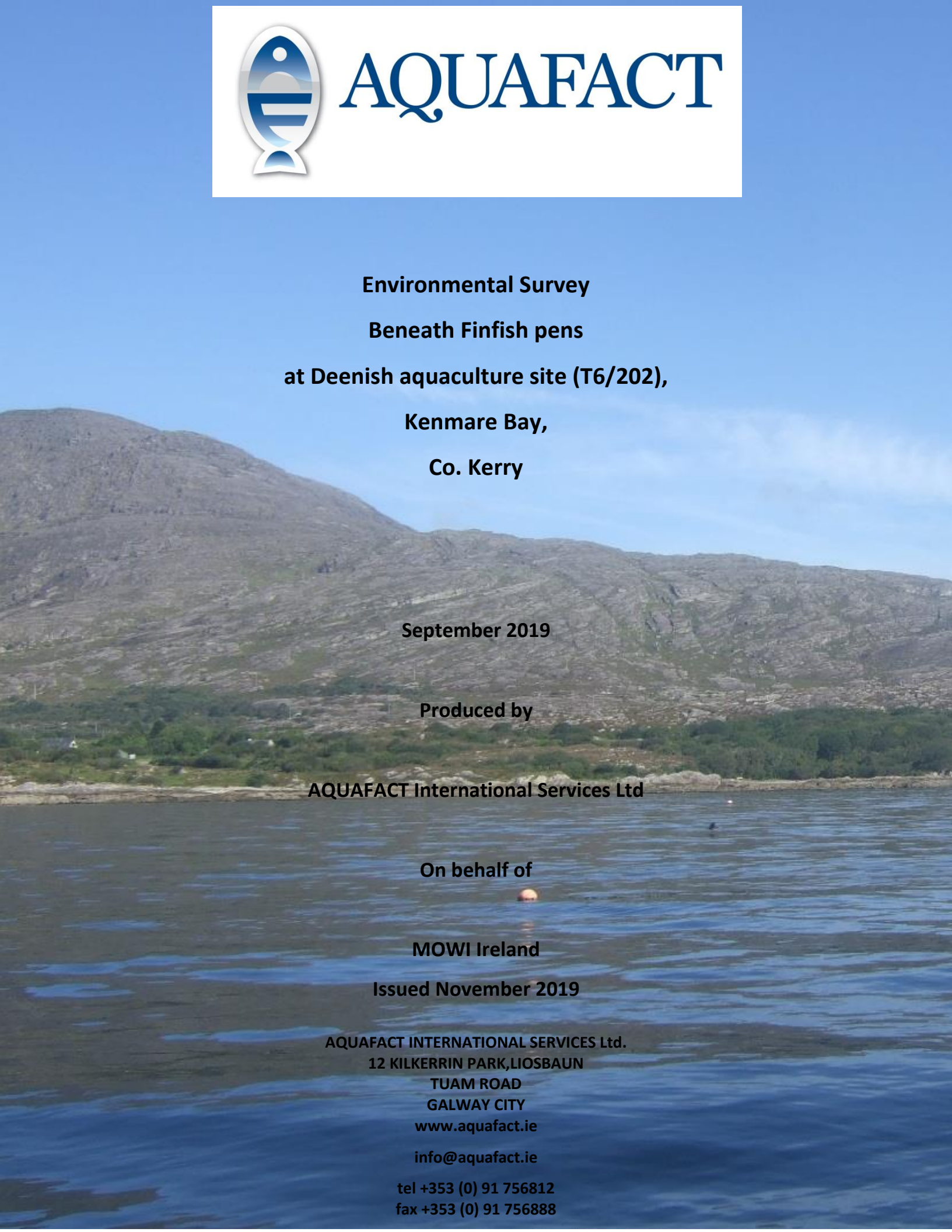
Smith, P., G. Edwards, B. O'Connor, M. Costelloe and J. Costelloe. 1997. Photographic Evidence of the importance of Macrofauna in the Removal of Feed Pellets from the Sediment under Marine Salmon Farms. Bull. Eur. Ass. Fish Pathol. Vol. 17, Issue 1, pages 23-26.



Environmental Survey

Beneath Finfish pens

at Deenish aquaculture site (T6/202),

Kenmare Bay,

Co. Kerry

September 2019

Produced by

AQUAFACT International Services Ltd

On behalf of

MOWI Ireland

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Report Approval Sheet

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AQUAFACT

Table of Contents

1. Introduction 1

1.1. Site description 2
1.2. Offshore finfish farms – benthic monitoring 3

2. Sampling Procedure & Processing 5

2.1. Dive survey 5
2.2. Sediment Profile Imagery (SPI) 8
2.3. Sampling for organic carbon analysis 10

3. Results 11

3.1. Recent Stocking History 11
3.2. Seabed physical and biological characteristics 11
3.2.1. Photographic record; Transect 1 11
3.2.1.1. Under pen 12
3.2.1.2. Edge of pen 13
3.2.1.3. 10 m from pen 14
3.2.1.4. 20 m from pen 15
3.2.1.5. 50 m from pen 16
3.2.1.6. 100 m from Pen 17
3.2.2. Sediment Profile Imagery – Transect 1 18
3.2.3. Photographic Record; Transect 2 20
3.2.3.1. Under pen 20
3.2.3.2. Edge of pen 21
3.2.3.3. 10 m from pen 22
3.2.3.4. 20 m from pen 23
3.2.3.5. 50 m from pen 24
3.2.3.6. Reference station 25
3.2.4. Sediment Profile Imagery – Transect 2 & Reference 26
3.2.5. Transect Species List 28
3.2.6. Organic Carbon Analysis & ARPD Depths 29

4. Discussion 30

5. Conclusion 31

6. References 31

List of Figures

Figure 1.1: Map showing the location of the Deenish site surveyed in Kenmare Bay 1
Figure 1.2: Map showing the locations of the relevant cSAC and SPA near Kenmare Bay, Co. Kerry 3
Figure 2.1: Transect seafloor station layout, Deenish finfish aquaculture site, Kenmare Bay, 13th September 2019 7
Figure 2.2: Diver operated Sediment Profile Imaging camera. The left-hand image gives a view of the camera at the sediment surface. The right-and image shows the SPI camera when inserted into the sediment 8
Figure 2.3: Typical sediment profile images with examples of features relevant to aquaculture operations 9
Figure 3.1: View of pens at Deenish Island site 11
Figure 3.2: T1 – Under pen station, Deenish Island site, 13th September 2019 12
Figure 3.3: T1 – Pen edge station, Deenish Island, 13th September 2019 13
Figure 3.4: T1 – 10m, Deenish Island, 13th September 2019 14
Figure 3.5: T1 – 20 m station, Deenish Island, 13th September 2019 15
Figure 3.6: T1 – 50 m station, Deenish Island, 13th September 2019 16
Figure 3.7: T1 – 100 m station, Deenish Island, 13th September 2019 17
Figure 3.8: Representative photographs of the seafloor taken along Transect 1 by Sediment Profile Imagery (SPI) apparatus. MOWI finfish aquaculture site, Deenish, Kenmare River, Co. Kerry, 13th September 2019. 19
Figure 3.9: T2 – Under pen station, Deenish Island, 13th September 2019 20
Figure 3.10: T2 – Pen edge station, Deenish Island, 13th September 2019 21
Figure 3.11: T2 – 10 m station, Deenish Island, 13th September 2019 22
Figure 3.12: T2 – 20 m station, Deenish Island, 13th September 2019 23
Figure 3.13: T2 – 50 m station, Deenish Island, 13th September 2019 24
Figure 3.14: Reference station, Deenish Island, 13th September 2019 25
Figure 3.15: Representative photographs of the seafloor taken along Transect 2 by Sediment Profile Imagery (SPI) apparatus. MOWI finfish aquaculture site, Deenish, Kenmare River, Co. Kerry, 13th September 2019. 27

List of Tables

Table 1.1: Matrix of production tonnage versus current speed to determine level of benthic monitoring required 4
Table 3.1: Species noted during dives on the seabed beneath the Deenish pens 28

Table 3.2: Organic carbon results for Deenish (% values, Loss on Ignition at 450°C). 29

Table 3.3: ARPD Depths for Deenish, Kenmare Bay, 13th September 2019 29

1. Introduction

This report documents the environmental conditions of the seabed at a MOWI Ireland finfish (Atlantic salmon *Salmo salar*) aquaculture site (Aquaculture Licence Reference T6/202) in Kenmare Bay, Co. Kerry recorded during surveys undertaken by AQUAFACT on 13th September 2019 (see Figure 1.1). The aquaculture site is situated close to Deenish Island, County Kerry on the northern shore of Kenmare River.

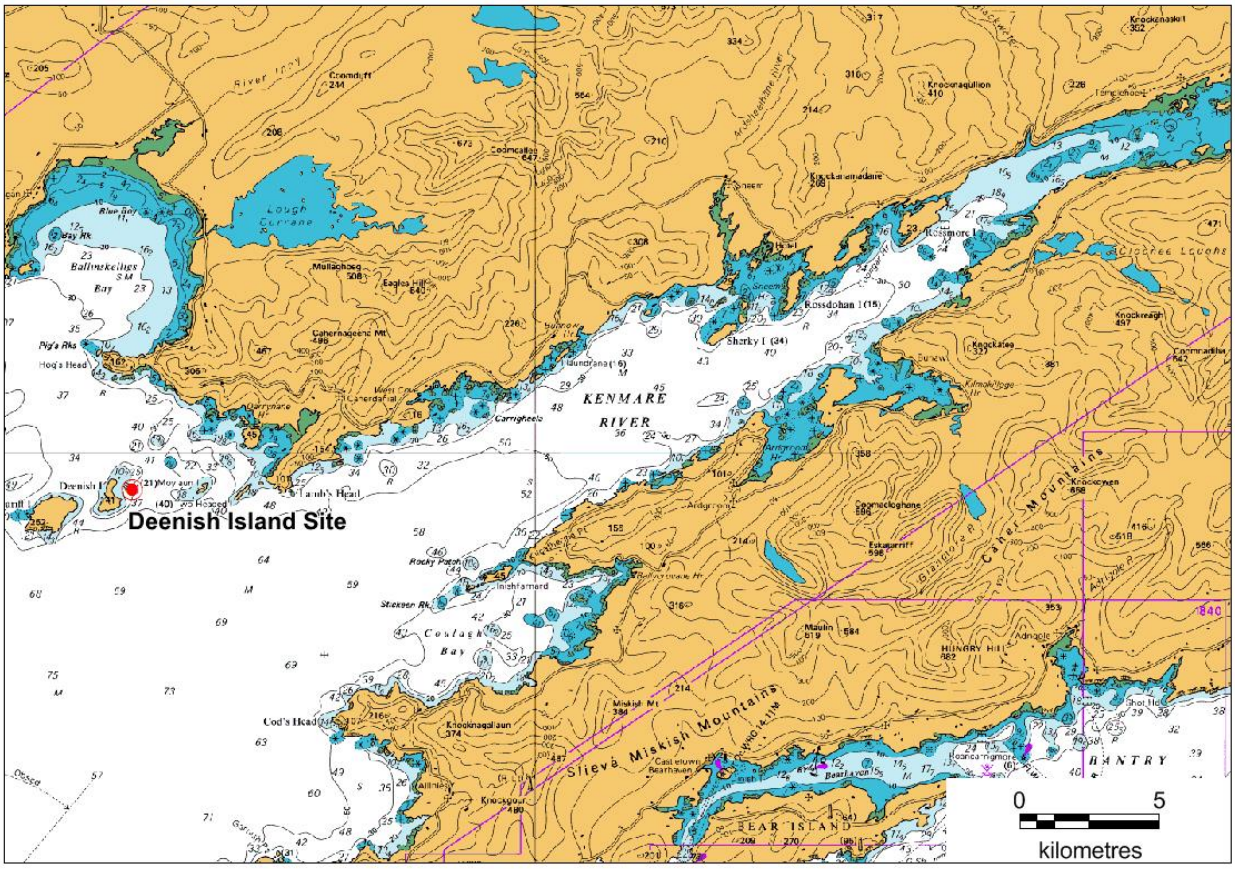

Figure 1.1: Map showing the location of the Deenish site surveyed in Kenmare Bay

1.1. Site description

Kenmare Bay, Co. Kerry, is a long and narrow, south-west facing bay. It is a deep, drowned glacial valley and the bedrock is mainly old red sandstone which forms reefs along the middle of the bay throughout its length. Exposure to prevailing winds and swells at the mouth diminishes towards the head of the bay while numerous islands and inlets provide further areas of additional shelter.

Deenish Island is part of two Natura 2000 sites (see Figure 1.2), namely the Kenmare River cSAC (Site code: 002158) and the Deenish Island and Scariff Island SPA (Site code: 004175).

The diversity of environmental conditions, from exposed to ultra sheltered, that characterises Kenmare River cSAC results in the presence of a wide range of marine habitats including three listed on Annex I of the EU Habitats Directive, namely reefs, large shallow bay and caves. According to the cSAC site synopsis (available from www.npws.ie) Kenmare Bay is host to a high number of rare and notable marine species present (24) and some uncommon communities. The Kenmare River cSAC is the only known site in Ireland for the northern sea-fan, *Swiftia pallida* and is the only known area where this species and the southern sea-fan *Eunicella verrucosa* co-occur. Midway along the south coast of Kenmare River, a series of sea caves stretch back into the cliff, typically supporting a diversity of epifauna including encrusting sponges, ascidians and bryozoans.

Deenish Island and Scariff Island are small to medium size islands situated between 5 and 7 km west of Lamb's Head off the Co. Kerry coast and thus very exposed to the force of the Atlantic Ocean. The site is a Special Protection Area (SPA) under the E.U. Birds Directive due to its special conservation interest for seabirds including fulmar, Manx shearwater, storm petrel, lesser black-backed gull and Arctic tern. Scariff is the larger of the two islands, with very steep sides rising to a peak of 252 m with the highest cliffs located on the south side. Deenish is less rugged than Scariff, and rises to 144 m in its southern half; the northern half being lower and flatter. The vegetation is mostly grassland, with some heath occurring on the higher ground. Old fields are now overgrown with bracken and bramble. The sea areas within a 500m radius of both islands are included inside the SPA boundary to provide a 'rafting' area for shearwaters.

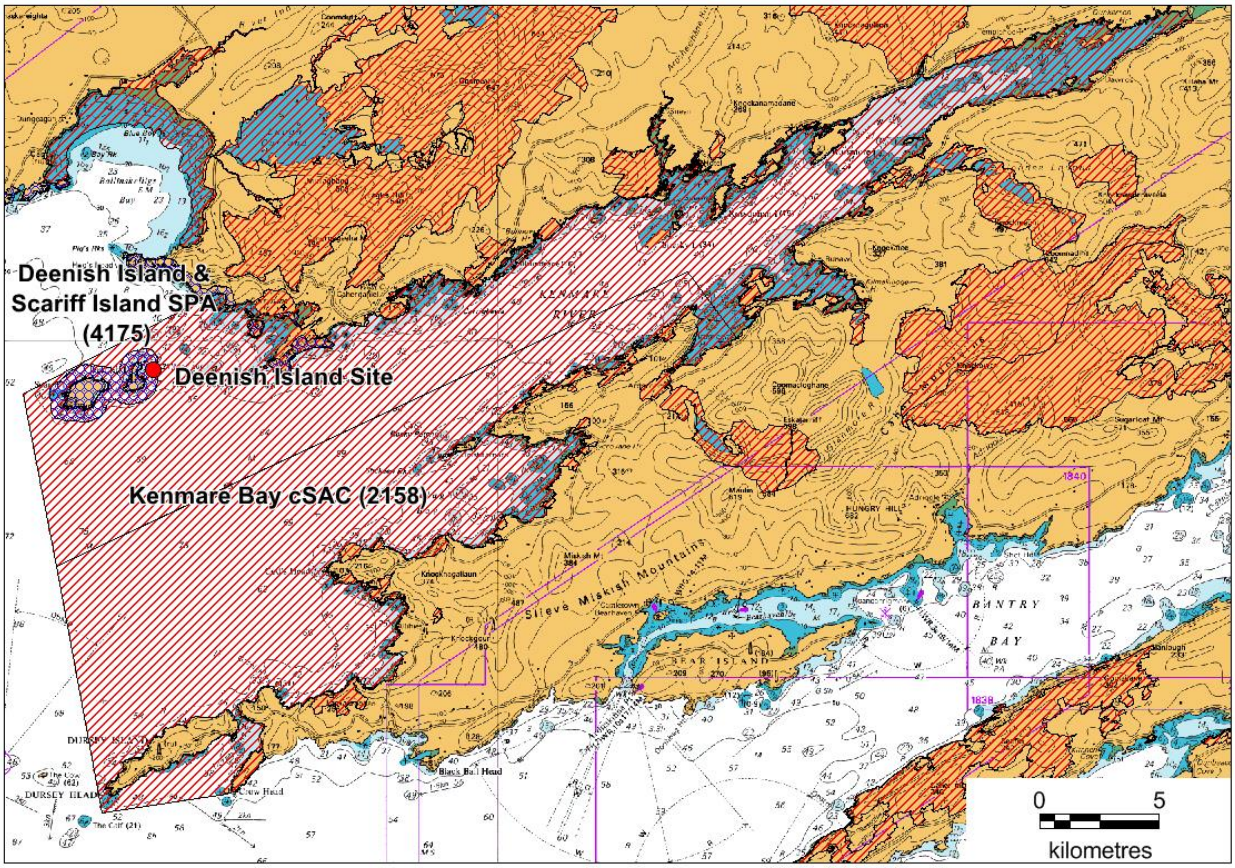

Figure 1.2: Map showing the locations of the relevant cSAC and SPA near Kenmare Bay, Co. Kerry

1.2. Offshore finfish farms – benthic monitoring

The main objective of the survey was to assess the overall state of the environment in relation to the salmon production process. The sites were surveyed according to the revised Benthic Monitoring Guidelines laid down by the Department of Agriculture, Fisheries and Food (December 2008). The benthic monitoring requirements at a fish farm are dependent on the level of biomass held at the site and the local hydrography. Table 1.1 below sets out the level of benthic monitoring required based on tonnage produced and mean current speeds at a fish farm.

Table 1.1: Matrix of production tonnage versus current speed to determine level of benthic monitoring required

	MEAN CURRENT SPEED (CMS^{-1})		
TONNAGE	**<5**	**5-10**	**>10**
0-499	Level I	Level I	Level I
500-999	Level II	Level I	Level I
>1000	Level II	Level II	Level I

The current speed is a mean value calculated from maximum current measurements over spring and neap tidal cycles at the surface and near the bottom. The tonnage refers to the maximum biomass predicted for each site. An annual survey must be carried out at each site (production and smolt) operated by a company. A level I or level II survey may be carried out as follows:

Level I: Video/photographic and visual observations and recordings shall be made at the following stations:

- At a minimum of 2 sites directly beneath the pens
- At the edges of the pens
- Two transects at right angles to each other. Along each transect sampling stations at +/- 10m, +/- 20m, +/- 50m and + 100m from the pens
- At a control site

In addition to the above, the following samples/measurements shall be taken at the same stations as above. These will be used to calculate sediment quality parameters.

- A minimum of one Redox potential reading shall be made at each sampling station.
- A single sediment sample for Organic Carbon measurement.

Level II: In addition to the above, two replicate grab samples shall be captured at each of the sample stations for faunal analysis. The exact locations of sampling points should be agreed in advance with the Department of Agriculture Fisheries and Food (DAFF). The identification and abundance of macro-faunal invertebrates shall be estimated and tabulated. Identification of fauna to the level of species will be

required.

It is important to take note that the exact position of the individual pen structures are not permanently fixed to a single position and there is a relatively large lateral movement due to depth, wind, currents and tides. For this reason, bottom stations particularly those under, at the edge and 10 m away from the pens are taken at the time of sampling but may vary relative to the overlying pen position under various environmental conditions.

2. Sampling Procedure & Processing

All survey work at the Deenish site took place on 13th September 2019. The dives were conducted at a maximum depth of 23.0 m and underwater visibility on the day was very good at approximately 6m. The prevailing current direction at the site is north-south and as a result Transect 1 is orientated in this direction. Pen layouts at the time of survey, current direction, dive entry points and benthic transects followed by the divers are shown in Figure 2.1. Mean current speed at the Deenish finfish aquaculture site is 30 cm sec^{-1} (MOWI *pers.comm*.). The fish biomass present in the pens at the time of survey was 387.2 tonnes. The survey was carried out at Level 1 as per the guidance matrix displayed in Table 1.1.

Disinfection

Prior to each dive survey for each location all diving equipment, suits and boats are thoroughly disinfected utilising both a dipping and spraying protocol.

2.1. Dive survey

Two dive transects were laid out from the sea surface at each site using a boat equipped with a GPS mapper. Pen locations were noted as DGPS positions. The underwater survey involved direct observation, sampling and recording (through photographs and *in situ* annotations) of benthic conditions by highly experienced, qualified marine biologists and scientific divers. The notes taken *in situ* were transcribed to logs upon surfacing. In addition to standard SCUBA gear the divers were equipped with:

- A high-end dSLR Nikon D200 in a Subal ND20 underwater housing fitted with a 12-24mm

lens and two INON strobes. The camera was used to photograph the epibenthos and seafloor features;

- A diver-operated dSPI camera for photographing sediment profiles of the seafloor and calculate redox measurements. This unit uses a Canon EOS 450D camera with Nikkor optics;
- A compass for underwater navigation;
- Pre-labelled bags to store sediment samples for organic carbon analysis;
- Dive slates, torches and waterproof pencils for making observations/notes.

The divers photographed representative areas of the sediment and fauna and recorded observations in situ at the various stations investigated. Notes were completed immediately on surfacing and a map of the dive track was drawn up. Observations recorded during the dive include:

- Presence of bacterial mats and uneaten food;
- Presence of farm-derived litter;
- Presence of gas bubbles or anoxic areas;
- Animals visible or evidence of their presence;
- Macroalgae visible;
- Sediment characteristics, including colour and texture.

The seafloor was photographed at the following stations along two transects at the site (see Figure 2.1):

A. Directly under the pens;
B. Under the edge of the pen;
C. At 10m, 20m, 50m and 100m (on T1) from the pens along the transects.

A reference station was also assessed for each pen block to give a representation of ambient benthic conditions in the area immediately surrounding the pen installations for comparison purposes. The reference station was taken at a distance greater than 150 m from the pen installations to represent the assumed 'undisturbed' condition of the seafloor surrounding the sites.

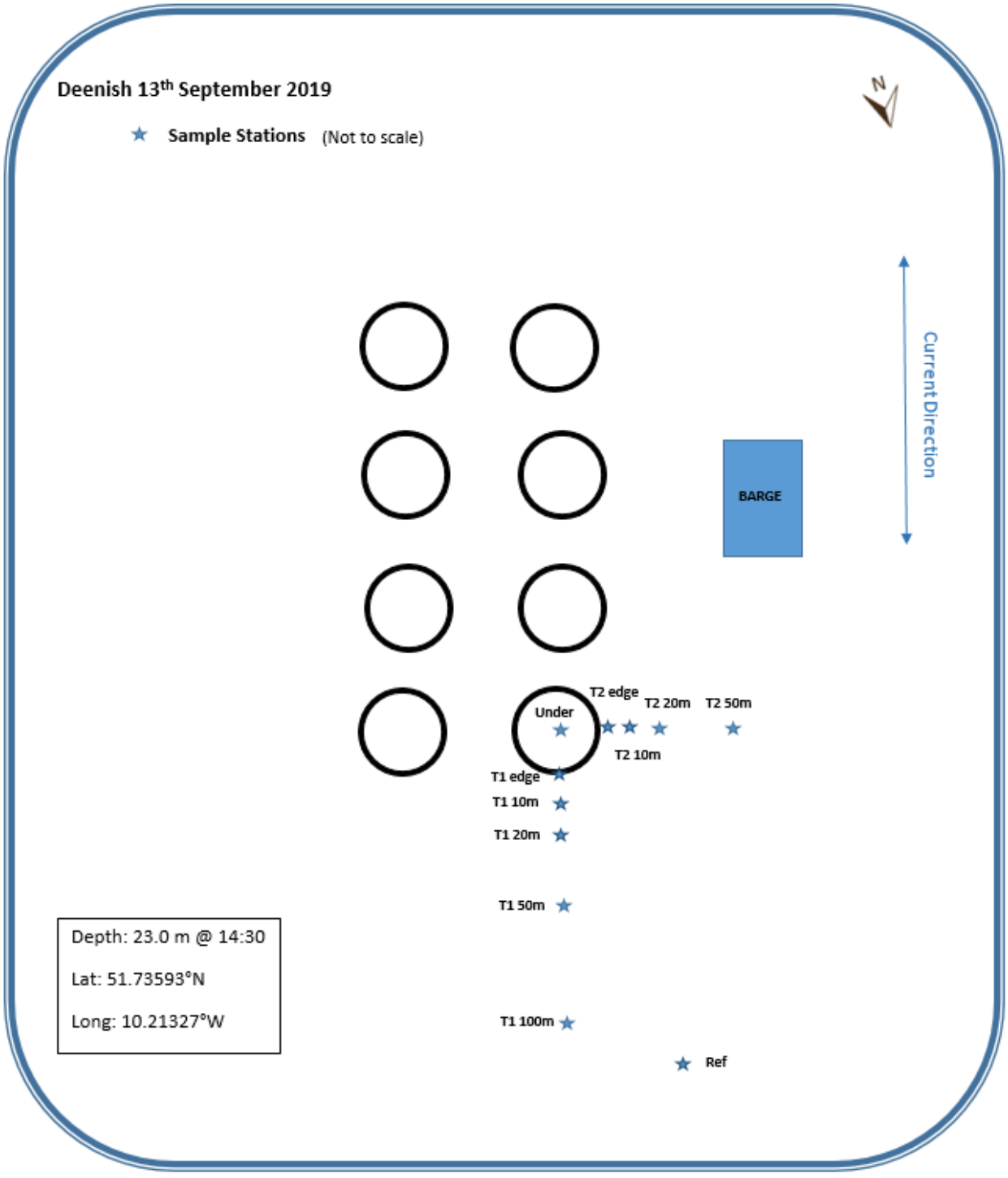

Figure 2.1: Transect seafloor station layout, Deenish finfish aquaculture site, Kenmare Bay, 13th September 2019

2.2. Sediment Profile Imagery (SPI)

Sediment profile images (SPI) obtained for each station along with ARPD depth measurements taken from the images were acquired using a diver-deployed sediment profile imaging camera system. This system is comprised of a digital SLR camera in a water-tight pressure vessel that is mounted above a prism that penetrates the upper 25 cm of sediment (see Figure 2.2). The sediment profile is viewed through a plexiglass window and the image is reflected to the camera lens via a plane mirror. Illumination is provided by an internally-mounted strobe. The prism unit is filled with distilled water – thus ambient water clarity is never a limiting factor in image quality. Upon arrival, the diver depresses the SPI unit into the seafloor and manually triggers the camera. This process is repeated at each station investigated.

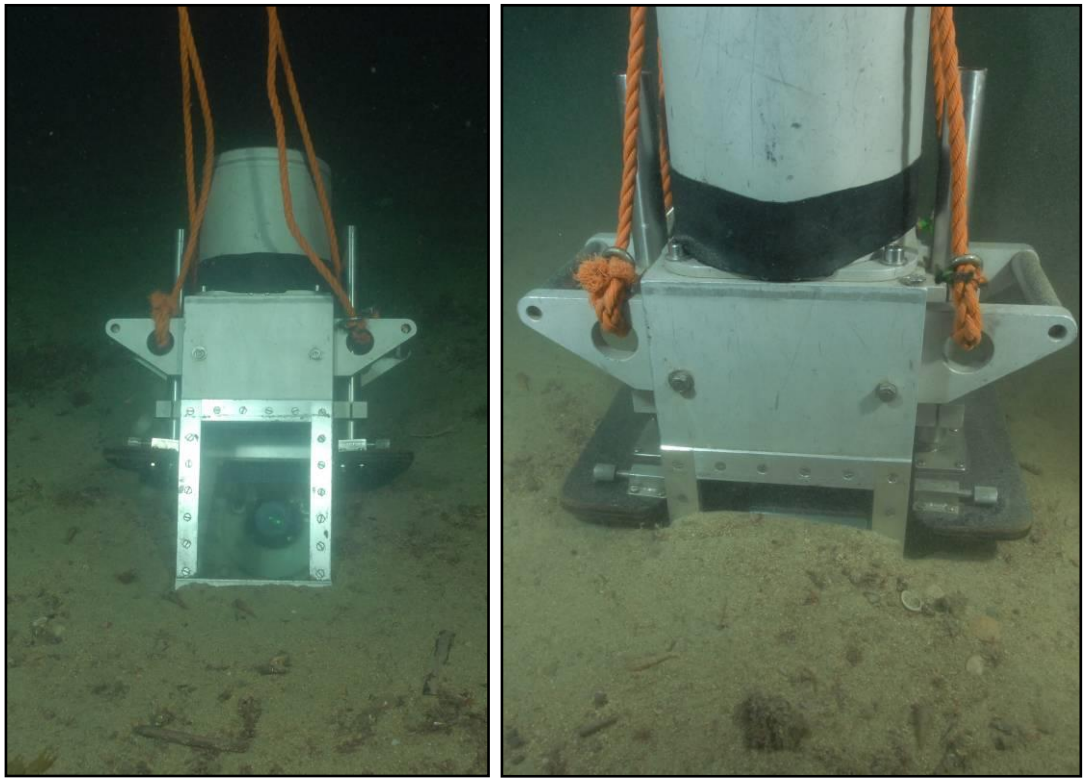

Figure 2.2: Diver operated Sediment Profile Imaging camera. The left-hand image gives a view of the camera at the sediment surface. The right-and image shows the SPI camera when inserted into the sediment

A great deal of information about benthic processes is available from sediment profile images. Measurable parameters, many of which are calculated directly by image analysis, include physical/chemical parameters (i.e. sediment type measured as grain size major mode, prism penetration

depth providing a relative indication of sediment shear strength, sediment surface relief, condition of mud clasts, redox potential discontinuity depth and degree of contrast, sediment gas voids) and biological parameters (i.e. infaunal successional stage of a well documented successional paradigm for soft marine sediments (see Pearson and Rosenberg, 1978), degree of sediment reworking, dominant faunal type, epifauna and infauna, depth of faunal activity, presence of microbial aggregations).

For the purposes of the current survey, the primary feature of interest is the depth of oxygen penetration into the sediments in the vicinity of the finfish pens (this information is required to satisfy the requirements of the Benthic Monitoring Protocol (DAFF, 2008). In this case, the apparent redox potential discontinuity or ARPD depth is measured. Features of particular interest that may be gleaned from SPI images taken in sediments in the vicinity of finfish pens include the presence of:

- uneaten feed pellets (and depth of this material, see Figure 2.3)
- faecal casts
- and depth of shell gravel deposits
- of gas voids in the sediment

Figure 2.3: Typical sediment profile images with examples of features relevant to aquaculture operations

2.3. Sampling for organic carbon analysis

Sediment samples for organic carbon analysis were collected at all stations. Samples were stored in pre-labelled plastic bags, kept in cold freezer boxes onboard the vessel and frozen at -20°C on return to the laboratory. Organic carbon analysis was carried out by ALS laboratories using the Loss on Ignition (LOI) technique. This method involves oven drying the sediment sample in a muffle furnace (450°C for a period of 6 hours) after which time the organic content of the sample is determined by expressing it as a percentage the weight of the sediment after ignition over the initial weight of the sediment.

3. Results

3.1. Recent Stocking History

407,568 fish, with a total biomass of 42.4 tonnes were put to sea in February 2019 following an eight week fallow period. At the time of the audit, 342,362 fish with a total biomass of 387.2 tonnes remained on site giving an onsite biomass production of 344.8 tonnes prior to the survey .

Figure 3.1: View of pens at Deenish Island site

3.2. Seabed physical and biological characteristics

The seabed located immediately beneath the pens at the Deenish site was characterised by fine oxygenated sand that became courser moving towards the outer stations along both transects particularly T1 where large boulders were noted at the extremity.

3.2.1. Photographic record; Transect 1

This transect began beneath the northwestern most pen moored on site (see Figure 2.1) and ran for a distance of 100 m north. A total of six stations were investigated.

3.2.1.1. Under pen

The seafloor beneath the pens was characterised by fine grained sand sediment with an oxygenated appearance. Waste feed material from the above pens was observed on the seabed where several large common starfish *Asterias rubens* were noted scavenging. There were no signs of outgassing or bacterial mats at the station.

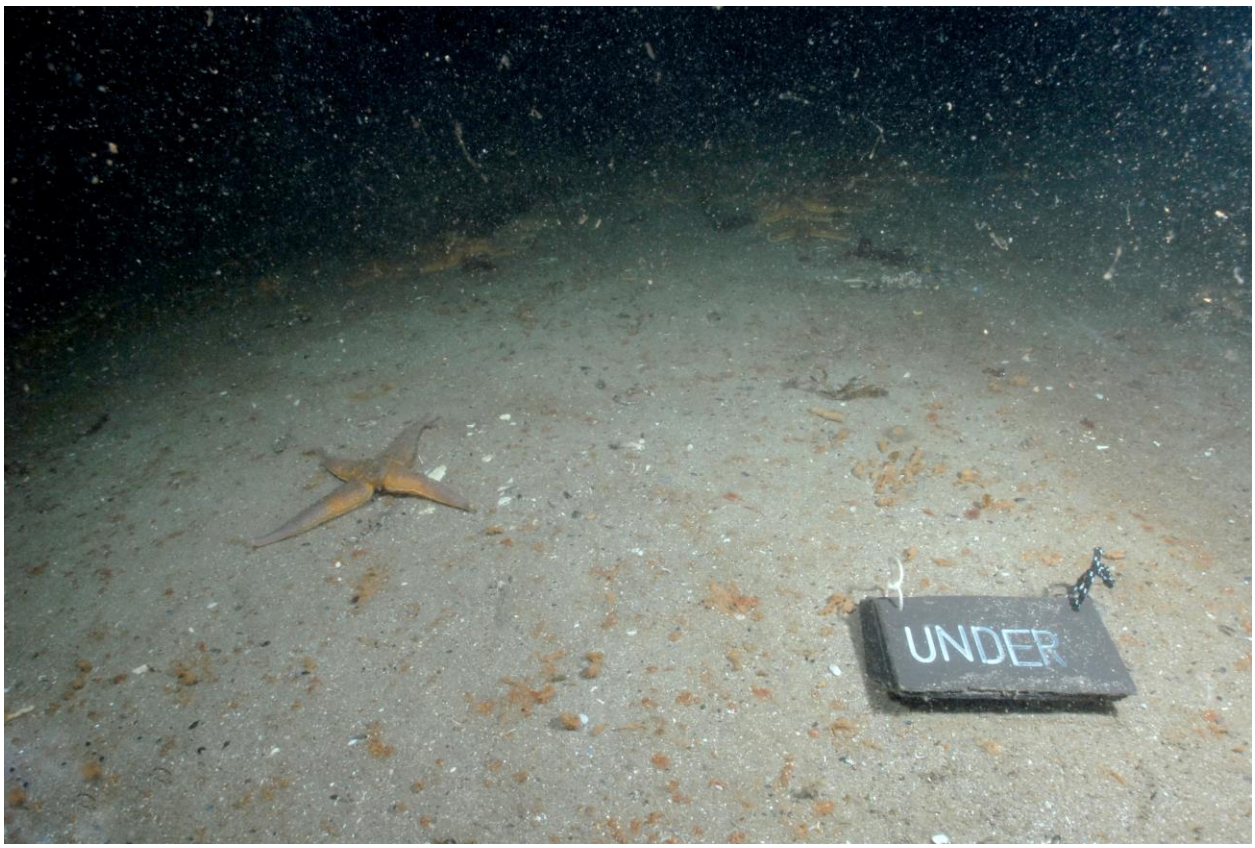

Figure 3.2: T1 – Under pen station, Deenish Island site, 13th September 2019

3.2.1.2. Edge of pen

The seafloor located towards the edge of the pen at the Deenish site was characterised by fine grained sand with mussel shell, waste feed pellets and faecal casts from adjacent pens scattered over the surface. The casts of the lugworm *Arenicola marina* were noted on the seafloor along with several starfish (*A. rubens*) scavenging on the waste organic material. There were no signs of outgassing or bacterial mats.

Figure 3.3: T1 – Pen edge station, Deenish Island, 13th September 2019

3.2.1.3. 10 m from pen

Moving 10m along Transect 1 the fine sand of previous stations (Under and Edge) gave way to courser sand with a higher percentage of shell fragment. Large clumps of shell from the mussel *Mytilus edulis* were observed on the seabed where numerous starfish *A. rubens* were scavenging. The anemone *Sagartia elegans* was noted with its feeding tentacles extended. Some drift algae of various species were also noted (Figure 3.4). There were no signs of outgassing or bacterial mats.

Figure 3.4: T1 – 10m, Deenish Island, 13th September 2019

3.2.1.4. 20 m from pen

Conditions at the 20m station remained similar to that recorded at the 10m station on Transect 1 with a coarse sand/gravel sediment with a high percentage of shell fragments throughout. Large fronds of brown algae were noted on the seafloor where there were few if any macrofauna feeding. No signs of outgassing or bacterial mats were recorded at the 50m station.

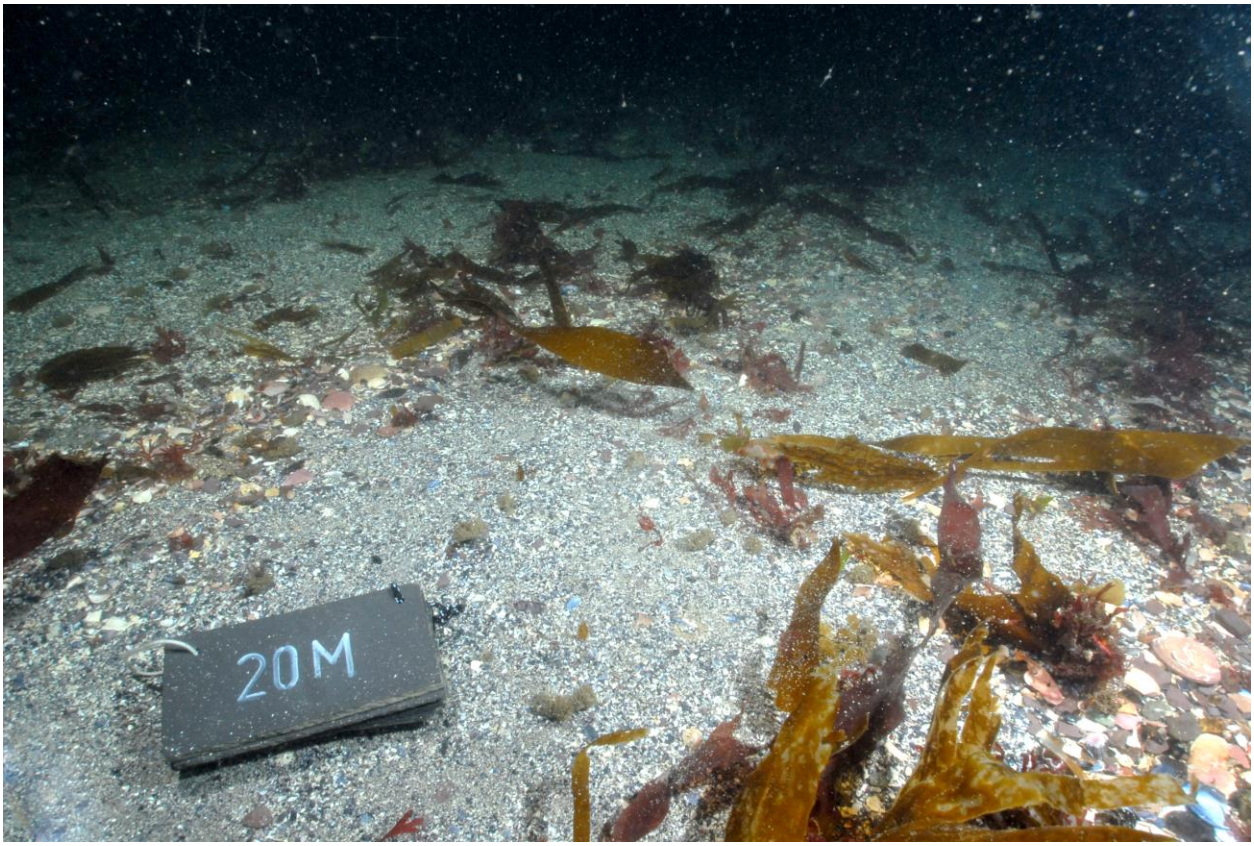

Figure 3.5: T1 – 20 m station, Deenish Island, 13th September 2019

3.2.1.5. 50 m from pen

Seafloor conditions at the 50m station were characterised by a coarse sand/gravel that appeared to be better mixed than previous stations. Large fronds of brown algae still attached were noted along with drift red algae (Figure 3.6). There was no macrofauna observed within the immediate vicinity of the station. No signs of outgassing or bacterial mats were observed at the 50m station.

Figure 3.6: T1 – 50 m station, Deenish Island, 13th September 2019

3.2.1.6. 100 m from Pen

The seafloor at the 100m station was characterised by coarse sand with an oxygenated appearance and a high percentage of shell fragments mixed throughout. The fronds of brown algae were visible along with some drift red algae (Figure 3.7). There were no signs of outgassing or bacterial mats observed at the 100m station with the benthic conditions appearing healthy.

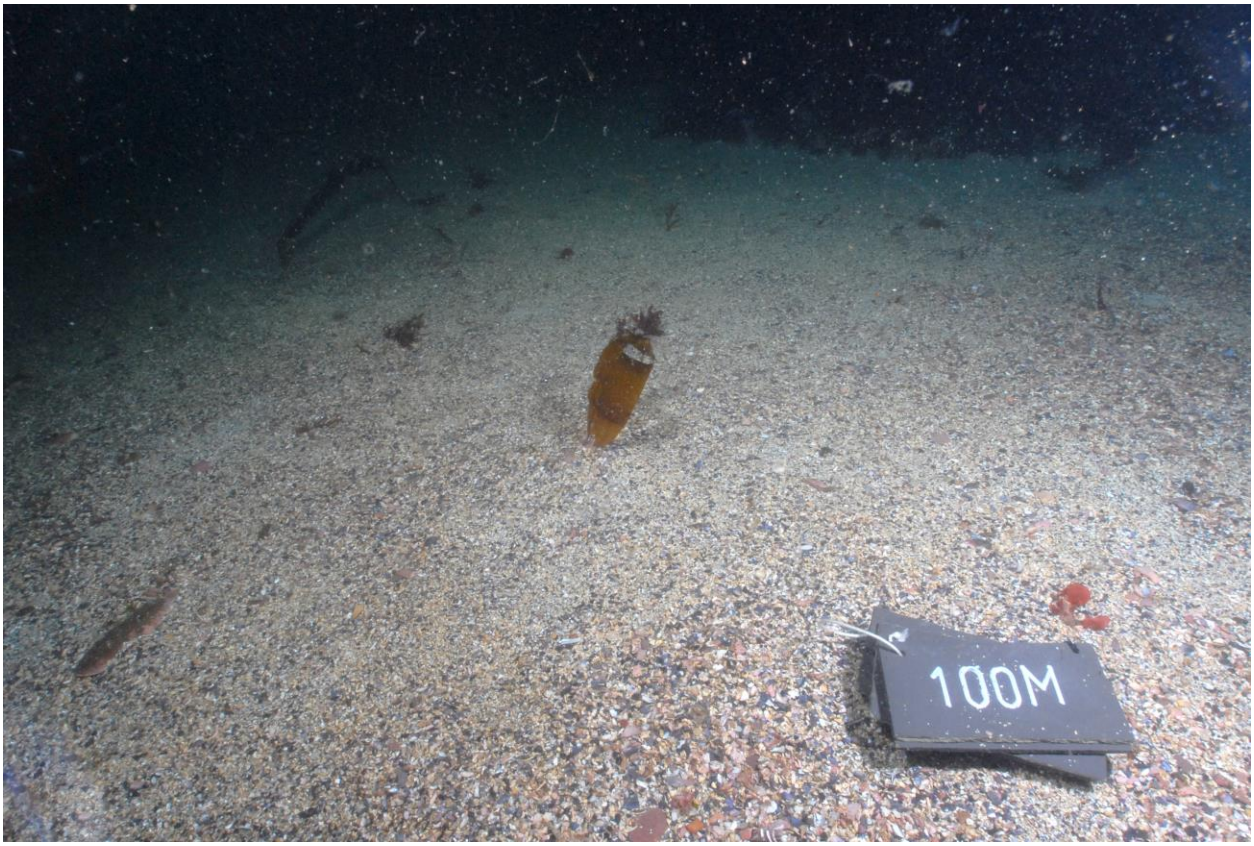

Figure 3.7: T1 – 100 m station, Deenish Island, 13th September 2019

3.2.2. Sediment Profile Imagery – Transect 1

Figure 3.8 presents sediment profile images taken at the six stations visited on Transect 1 of the Deenish site. The substrate of the site was composed of fine and medium-grained sand with shell gravel at the under pen station which gradually gave way to a coarser shelly gravelly sand with intact shell at the outer end of the transect. The energy levels experienced by the seafloor in this area is more than likely quite high particularly during winter storms.

The images display a single image and the maximum and minimum apparent redox potential discontinuity (ARPD) depths measured at each station. Each image is 15.5cm × 25cm. ARPD depths ranged from a minimum of 0.5 cm (T1 10m) to a maximum of greater than 7.1 cm (T1 Edge). Due to the relatively coarse nature of the seafloor, the SPI camera achieved relatively low penetrations.

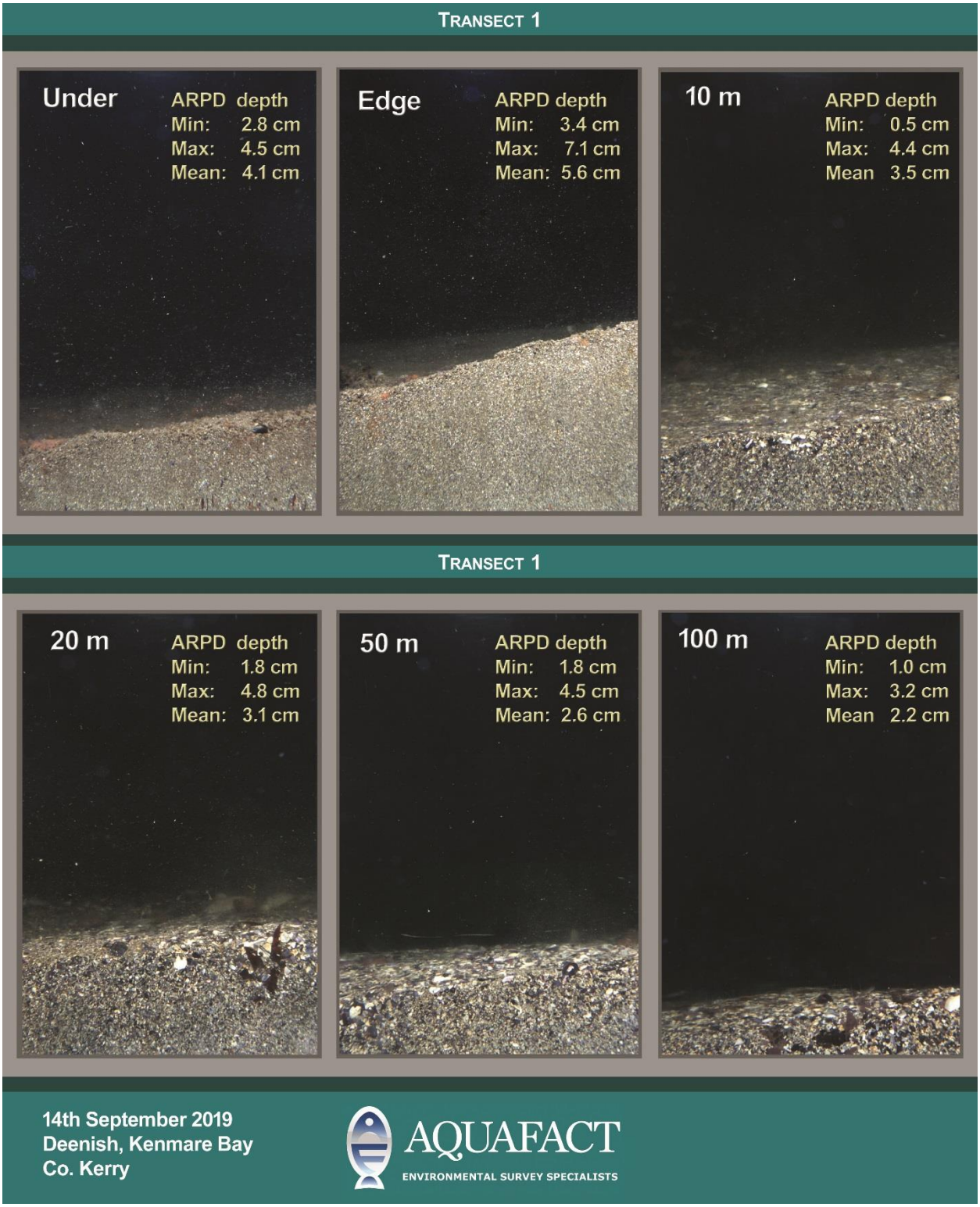

Figure 3.8: Representative photographs of the seafloor taken along Transect 1 by Sediment Profile Imagery (SPI) apparatus. MOWI finfish aquaculture site, Deenish, Kenmare River, Co. Kerry, 13th September 2019.

3.2.3. Photographic Record; Transect 2

This transect began beneath the same pen as Transect 1 and ran for a distance of 50m west. A total of five stations were investigated on Transect 2 with an additional (Reference) station investigated just *c.* 150 m north of the pen edge (See Figure 2.1).

3.2.3.1. Under pen

The seafloor beneath the salmon pens on Transect 2 consisted of sediment that was made up of fine grained sand that had an oxygenated appearance. The remnants of waste feed material were common on the seafloor originating from the above pens. There were no signs of outgassing or bacterial mats at the T2 Under station.

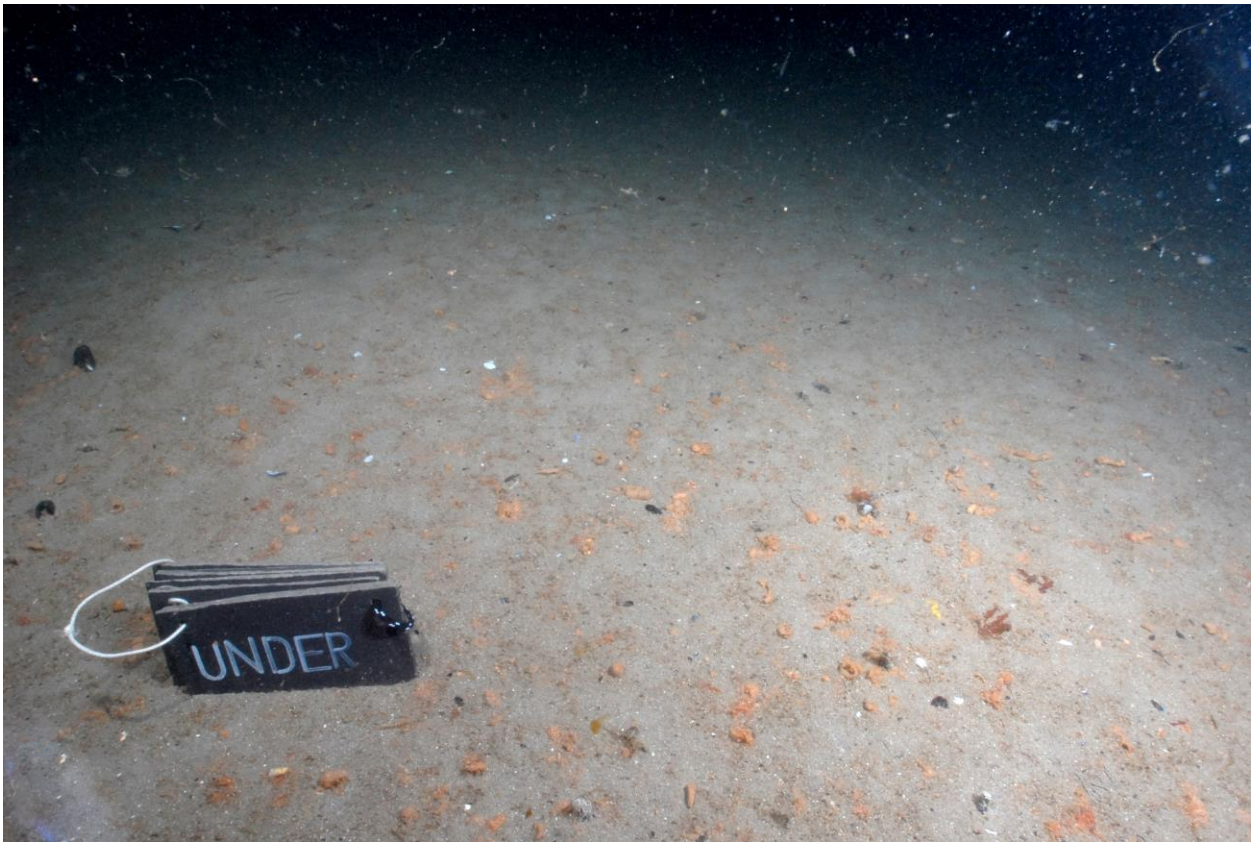

Figure 3.9: T2 – Under pen station, Deenish Island, 13th September 2019

3.2.3.2. Edge of pen

The seafloor located beneath the edge of the pens was characterised by a medium/ fine grained sand with a percentage of shell material throughout. Some whole/ fragments of shell were scattered across the sediment surface the majority originating from the blue mussel *M. edulis* (Figure 3.10). The amount of waste feed observed on the sediment surface had decreased considerably moving away from the Under station. There were no signs of outgassing or bacterial mats observed at the Edge station of Transect 2.

Figure 3.10: T2 – Pen edge station, Deenish Island, 13th September 2019

3.2.3.3. 10 m from pen

The seafloor 10m along Transect 2 consisted of fine sand formed into small ripples due to the prevailing tidal current. Small amounts of waste feed material was observed and brown drift algae were present across the seabed. There were no signs of bacterial mats or outgassing at the T2 10m station.

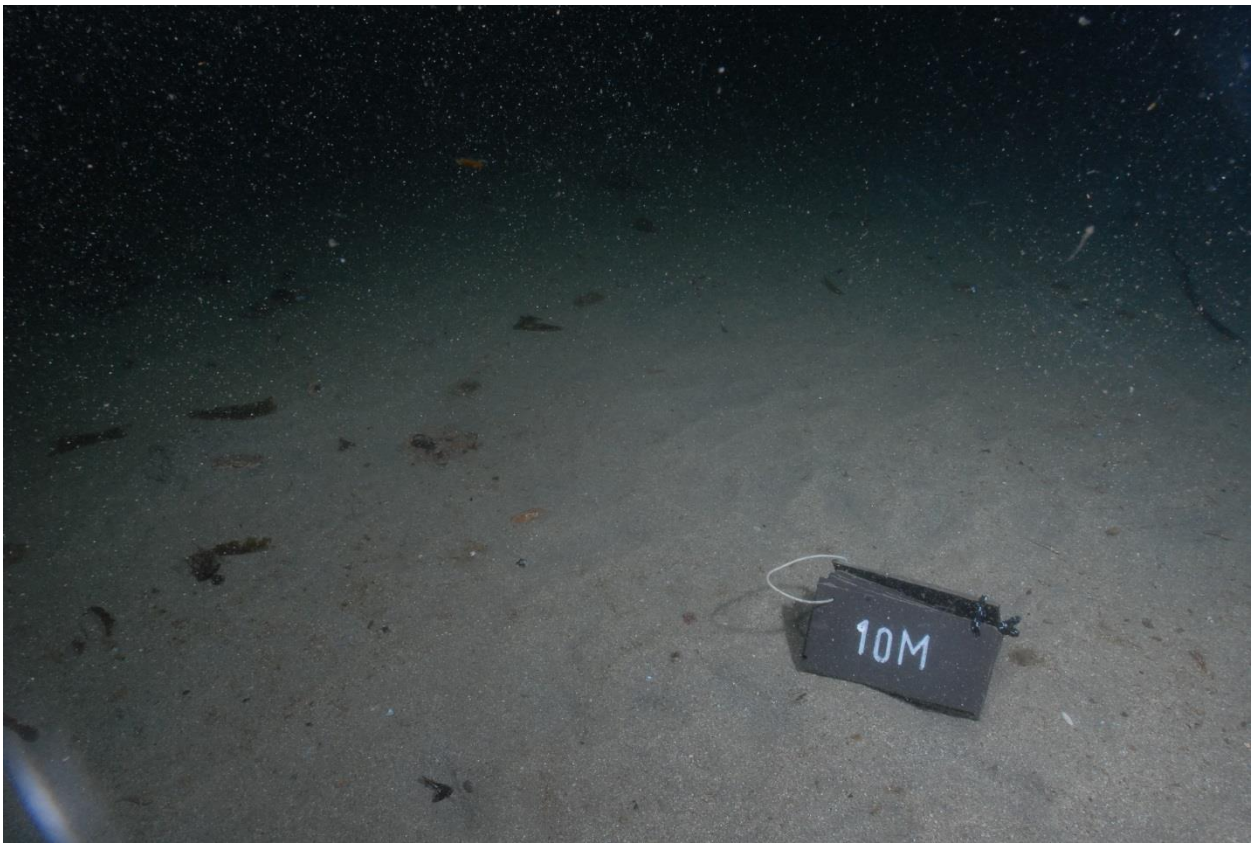

Figure 3.11: T2 – 10 m station, Deenish Island, 13th September 2019

3.2.3.4. 20 m from pen

Seafloor conditions at the 20m station on Transect 2 were characterised by fine grained sand with a light oxygenated appearance. The sand had been manipulated into ripple patterns by the prevailing tidal current (Figure 3.12). Brown drift algae were present across the seabed and there were no signs of macrofauna feeding in the immediate vicinity of the station. No observations of bacterial mats or outgassing were made at this station.

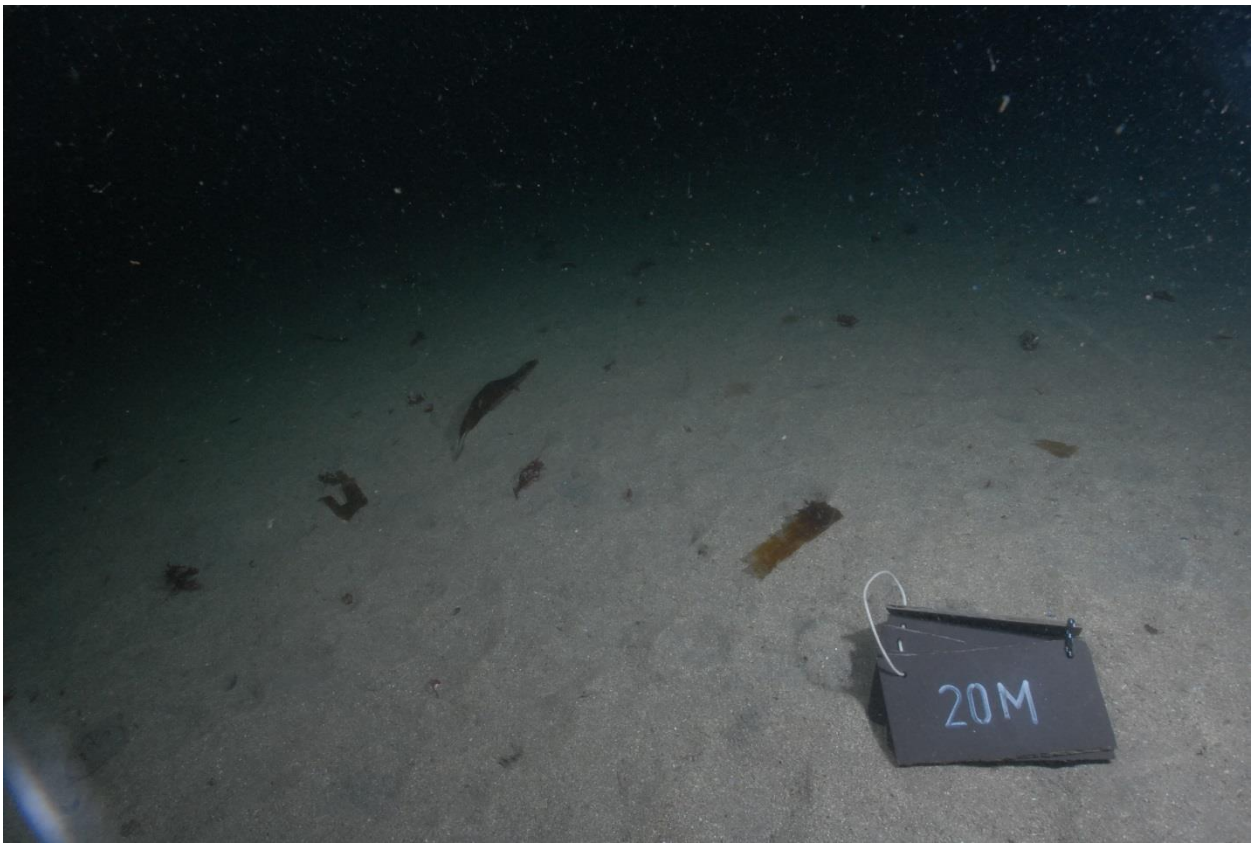

Figure 3.12: T2 – 20 m station, Deenish Island, 13th September 2019

3.2.3.5. 50 m from pen

Seafloor conditions at the 50m station on Transect 2 were characterised by fine grained sand with a light oxygenated appearance. The sand had been manipulated into ripple patterns by the prevailing tidal current (Figure 3.12). Brown drift algae were observed across the seabed and several hermit crabs *Pagurus bernhardus* were observed foraging across the seabed (Figure 3.13). There were no signs of bacterial mats or outgassing made at this station and in general the appearance of the seafloor was healthy.

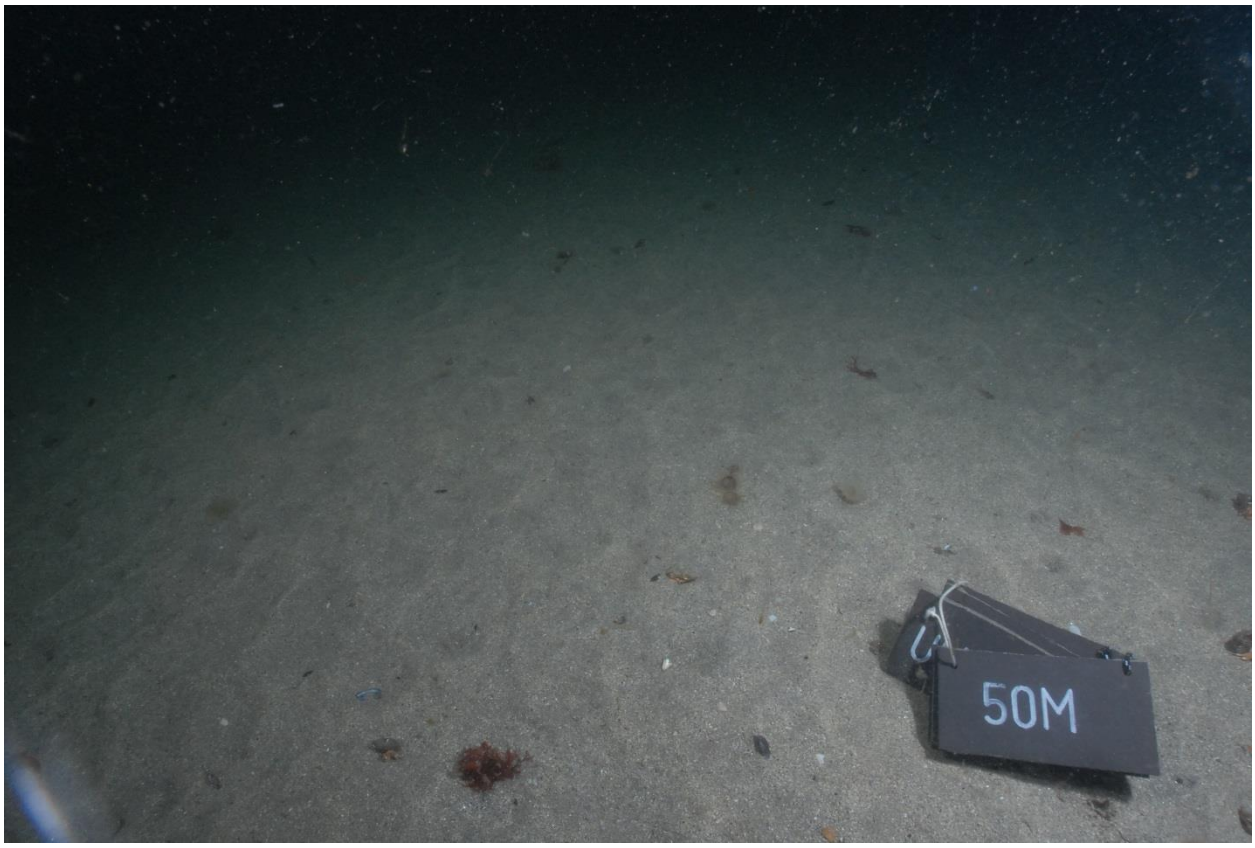

Figure 3.13: T2 – 50 m station, Deenish Island, 13th September 2019

3.2.3.6. Reference station

A reference station was conducted at approximately 150m distance from the pens and was chosen as an example of ambient conditions for the Deenish site. The reference station allows for comparison against stations located along both Transect 1 and 2 in order to quantify the effect of the aquaculture activities on the surrounding environment. The reference station was characterised by coarse sand/ gravel with a high percentage of fragmented shell material. A large frond of brown algae was noted towards the centre of the image (Figure 3.14).

Figure 3.14: Reference station, Deenish Island, 13th September 2019

3.2.4. Sediment Profile Imagery – Transect 2 & Reference

Figure 3.15 presents sediment profile images taken at the five stations visited on Transect 2 of the Deenish site and the reference station on 13th September 2019. The figure displays a single image and the maximum and minimum apparent redox potential discontinuity (ARPD) depths measured at each station. Each image is 15.5 cm × 25 cm.

Sediment type varied from medium sands under and close to the pen compared with higher proportions of shell material with increasing distance from the pen. It was difficult to estimate ARPD depths from the station due to the nature of the substrate which didn't allow sufficient prism penetration of the SPI. Despite this ARPD depths for the stations were relatively deep estimated to range from a minimum of 0.1 cm (T2 20m) to a maximum of 6.6 cm (T2 Edge). ARPD depths at the Reference station ranged from 2.3 cm to 3.7 cm and a mean ARPD of 3.0 cm.

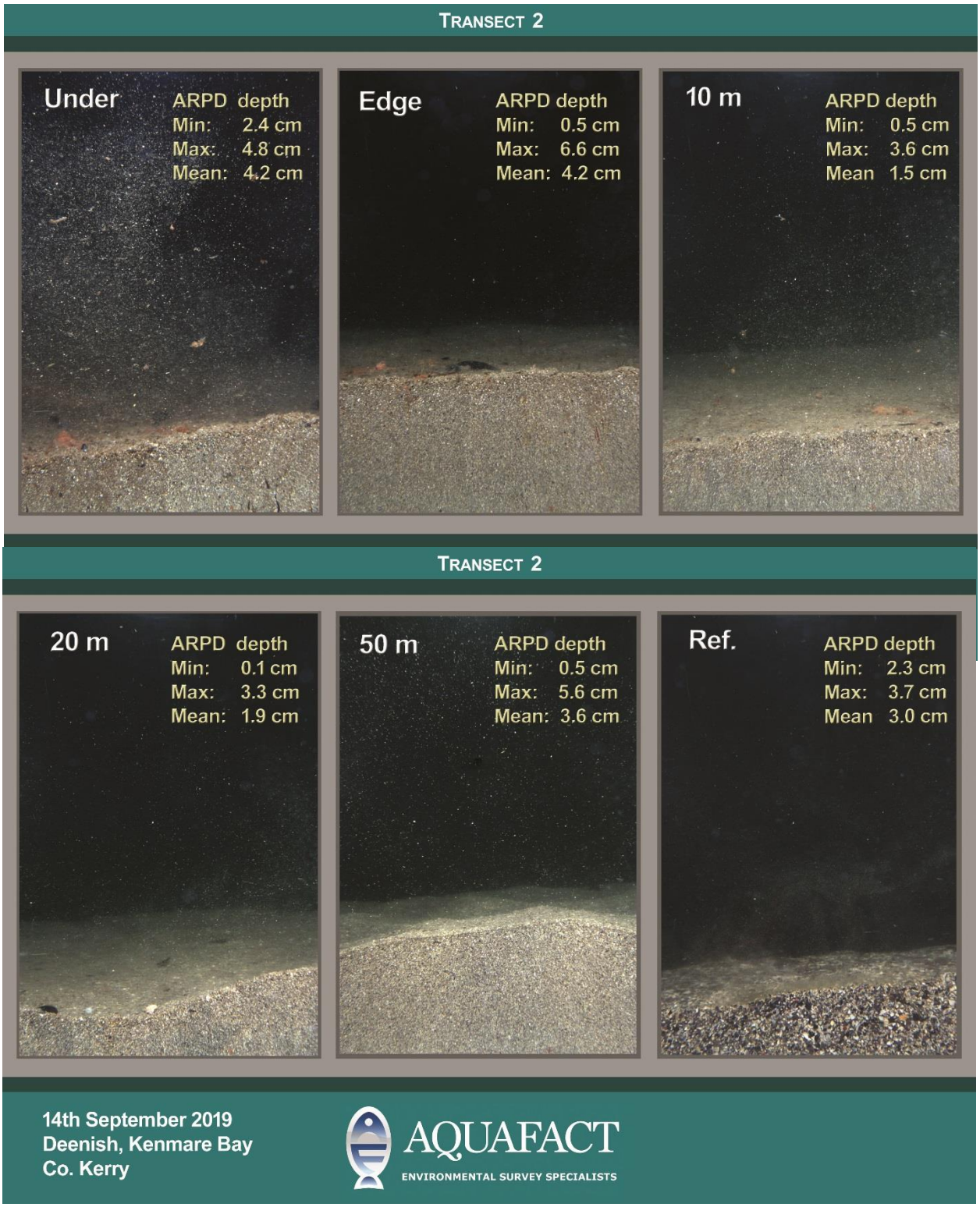

Figure 3.15: Representative photographs of the seafloor taken along Transect 2 by Sediment Profile Imagery (SPI) apparatus. MOWI finfish aquaculture site, Deenish, Kenmare River, Co. Kerry, 13th September 2019.

3.2.5. Transect Species List

Table 3.1 shows a list of species observed during the dives at the Deenish fish farm site on this and previous occasions.

Table 3.1: Species noted during dives on the seabed beneath the Deenish pens

Group	Species	Common Name
(Cnidaria) Hexacorallia	*Cerianthus lloydii* *Sagartia elegans*	Tube anemone Sea anemone
(Annelida) Polychaeta	*Spirobranchus* sp. *Lanice conchilega* *Chaetopterus variopedatus* *Arenicola marina*	Tube worm The sand mason Parchment tube worm Lugworm
(Mollusca) Bivalvia	*Pecten maximus* Faceliniidae Aeolidiida Nudibranch	King scallop Sea slugs Sea slugs Sea slugs
(Arthropoda) Decapoda	Paguridae	Hermit crab
Echinodermata	*Luidia ciliaris* *Asterias rubens* *Marthasterias sp* *Ophiura* sp. Amphiuridae sp.	Seven armed starfish Common starfish Starfish Brittlestar Brittlestar
(Chordata) Osteiichthyes	*Pomatoschistus* sp. *Trisopterus minutus* *Labrus bergylta*	Gobies Poor Cod Ballan Wrasse
Rhodophyta	*Delesseria sanguinea* *Phycodrys rubens* *Cryptopleura ramose* *Calliblepharis ciliata* *Lythophyllum* sp.	Sea beech Sea oak
Ochrophyta	*Alaria esculenta*	Edible kelp

3.2.6. Organic Carbon Analysis & ARPD Depths

Table 3.2 shows the organic carbon results from the Deenish stations. Organic carbon levels ranged from 1.79% (T2 20m) to 3.56% (T1 10m). Levels at all stations were generally higher closer to the pens. Levels were relatively similar to the reference station (2.69%) at all stations.

Table 3.2: Organic carbon results for Deenish (% values, Loss on Ignition at 450°C).

T1	Under	Edge	10m	20m	50m	100m
LOI %	3.16	3	2.52	2.61	2.87	2.31
T2	Under	Edge	10m	20m	50m	REF
LOI %	-	3.41	3.56	1.79	2.06	2.69

Table 3.3 shows in tabular form the ARPD depths from the SPI images from Deenish (see Sections 3.2.2 and 3.2.4). Values are similar to the Reference Station at all Stations.

Table 3.3: ARPD Depths for Deenish, Kenmare Bay, 13th September 2019

Station		Transect 1	Transect 2
Under	Range (cm)	2.8-4.5	2.4-4.8
	Mean (cm)	4.1	4.2
Edge	Range (cm)	3.4-7.1	0.5-6.6
	Mean (cm)	5.6	4.2
10m	Range (cm)	0.5-4.4	0.5-3.6
	Mean (cm)	3.5	1.5
20m	Range (cm)	1.8-4.8	0.1-3.3
	Mean (cm)	3.1	1.9
50m	Range (cm)	1.8-4.5	0.5-5.6
	Mean (cm)	2.6	3.6
100m	Range (cm)	1.0-3.2	-
	Mean (cm)	2.2	-
Reference	Range (cm)	-	2.3-3.7
	Mean (cm)	-	3.0

4. Discussion

The extent to which an overlying fish farm impacts the seafloor is largely dependent on:

- the feeding regime at that farm, i.e. the amount of food that eventually ends up on the seafloor;
- the degree of current movement at the site in question; and
- the depth of water at that site.

These factors combine to form either erosional or depositional locations where organic material is either dispersed or it accumulates, and subsequently affects the receiving environment (*i.e.* the seafloor). The type of biotic community living at a particular site will also play a role in determining bottom conditions there. The influence of feeding activities of populations of starfish, polychaete worms, anemones, crabs and finfish at the Deenish site largely determine the level of impact of overlying farm operations on the benthos there.

Faunal feeding activity can remove large amounts of waste organic material from the seabed beneath a farm facility – with groups of mobile fauna capable of consuming large quantities of material. The fallowing schedule at a site also has a large bearing on benthic impact – most notably the length of time pens have been on site since the last fallow period. The presence of opportunistic deposit feeders such as *Capitella* sp., most notably at the under pen and pen edge stations will tend to help keep the benthic organics in a state of equilibrium at the fish farm sites. Sedimentary organic carbon levels were slightly elevated at the Under and Edge stations however relatively similar to levels observed at the reference station.

Mobile epibenthic scavengers such as starfish, fish and crabs also help in reducing the amount of waste material on the seafloor. This potential speed of the removal of waste was demonstrated in a previous study where photographic evidence was collected showing that epibenthic macrofauna were capable of removing, in less than 7 days, fish feed pellets spread at a density of 3.4 kg dry weight per m^2 on the sediment under a marine fish farm (Smith *et al.*, 1997).

In consideration of the observations obtained during the survey at the Deenish site, it would seem that very little if any habitat degradation has taken place. Impacts are limited to the immediate footprint of the cage and can be summarized as a small amount of waste organic material and slightly elevated OC levels. Results obtained from reports conducted in 2016, 2017 and 2018 revealed similar results to the present survey and it is proposed that the salmon aquaculture site has had little influence on the surrounding benthic environment.

5. Conclusion

On the 14th of September 2019, a benthic audit survey was carried out on the Deenish fish farm site operated by MOWI Ireland. The Deenish survey followed the DCMNR Level I monitoring protocols. The results obtained during the survey suggest that the salmon aquaculture operations in the area are having little to no effect on the surrounding benthic ecology outside the immediate footprint of the pens. Recorded OC levels and ARPD depths were similar to those recorded at the Reference station and can therefore be considered of good environmental status.

6. References

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Appendix 7

Hydrodynamic Modelling

Dispersion Modelling of

Salmon Farm Site at Deenish Island, Kenmare Bay

Produced by

AQUAFACT International Services Ltd

On behalf of

MOWI Ireland

August 2019

Contents

MOWI Ireland **1**

1 Introduction **1**

1.1 Introduction 1

2 Model Development **3**

2.1 Kenmare Bay and approaches Hydrodynamic Model 3

2.2 Boundary Conditions 6

3 Hydrodynamics of Kenmare Bay **8**

3.1 Description 8

3.2 Tidal Velocities and Circulation 8

3.3 Wave Climate 14

3.3.1 Introduction 14

3.3.2 Wave Model Description 14

3.3.3 Development of Model 15

3.3.4 Extreme Wind Data 16

3.3.5 Extreme Wave Data 18

3.3.6 Wave Climate Modelling Results 19

4 Water Quality Dispersion Modelling **27**

4.1 General 27

4.2 Nitrogen Simulation Results 29

4.3 Phosphorous Simulation Results 32

4.4 BOD Simulation Results 35

4.5 Settleable Solids Deposition 38

4.6 Sea Lice Larvae Dispersion 41

5 Conclusions **44**

5.1 General 44

5.2 Nitrogen 44

5.3 Phosphorous 45

5.4 BOD 45

5.5 Settleable Solids 46
5.6 Sea Lice Larvae 46
5.7 Combined Impacts with the Inisfarnard Licensed Farm Site 46

1 Introduction

1.1 Introduction

This hydrodynamic study has been prepared in respect of the proposed renewal of the fish farm licence (Ref: AQ199) off Deenish Island, Kenmare/Ballinskelligs Bay, Co. Kerry (site T6/202), which is ASC Salmon Standard certified. Salmon production has been in operation at the T6/202 Deenish site since 1995 which was previously ran by Silver King Seafoods Ltd., Murpet Fish Ltd. and Gaelic Seafoods Ltd. respectively. The site is now operated by Comhlucht Iascaireachta Fanad Teoranta (trading as MOWI Ireland) since 2004.

The T6/202 site is located on the eastern side of Deenish Island in Kenmare/Ballinskelligs Bay, approximately 5km off Lambs Head Co. Kerry. The proximity of the aquaculture site to Deenish Island on its eastern side provides shelter from westerly and southerly swells. This location has been selected as it is an existing site where salmon production has been carried out successfully for over 20 years.

The location of the proposed Site T6/202 at Deenish Is presented in Figure 1.

This study investigates the water quality impact of the Proposed MOWI Ireland Fish Farming Activities at the proposed licensed Site through the use of three dimensional hydrodynamic and transport dispersion modelling, using the TELEMAC Hydrodynamic Software package. As part of this study the potential sediment deposition rate of settleable solids and sea lice larvae dispersion from the farm sites is also examined. The water quality parameters examined were nitrogen, phosphorous and BOD. The study also investigated the ambient hydrodynamics and wave climate conditions at the proposed aquaculture site.

Figure 1: Location of Production at Deenish Island at the mouth of Kenmare Bay.

2 Model Development

2.1 Kenmare Bay and approaches Hydrodynamic Model

The **TELEMAC** system, and specifically **Telemac-3D** hydrodynamic and water quality module, was used for modelling the hydrodynamics of Kenmare Bay and the relatively slack Coulagh Bay and Ballinskelligs Bay and Inny Strand. **TELEMAC** is a software designed to study environmental processes in free surface transient flows. Therefore, it is applicable to seas and coastal domains, estuaries, rivers and lakes, the main fields of application being hydrodynamics, water quality, sedimentology and waves.

The **TELEMAC** system is a powerful integrated modelling tool for use in the field of free-surface flows. Having been extensively used worldwide (several thousand to date), TELEMAC has become one of the major standards in its field. The various TELEMAC simulation modules use high-capacity algorithms based on the finite-element method. Space is discretised in the form of an unstructured grid of triangular elements which can be refined particularly in areas of special interest. This approach avoids the need for systematic use of embedded models, as is the case with the finite-difference method. **TELEMAC-3D** is a layered three-dimensional computational code describing the horizontal and vertical velocities, water depth and free surface over space and time. In addition, the code solves the transport of several tracers which can be grouped into active and passive tracers, with salinity and temperature being the active tracers which alter density and thus the hydrodynamics and suspended sediment as a passive tracer.

The horizontal coordinates in the model were set as Cartesian coordinates (UTM29N grid) and the bathymetry is specified at every finite element node to Malin Head Datum, which is mean sea level at Malin.

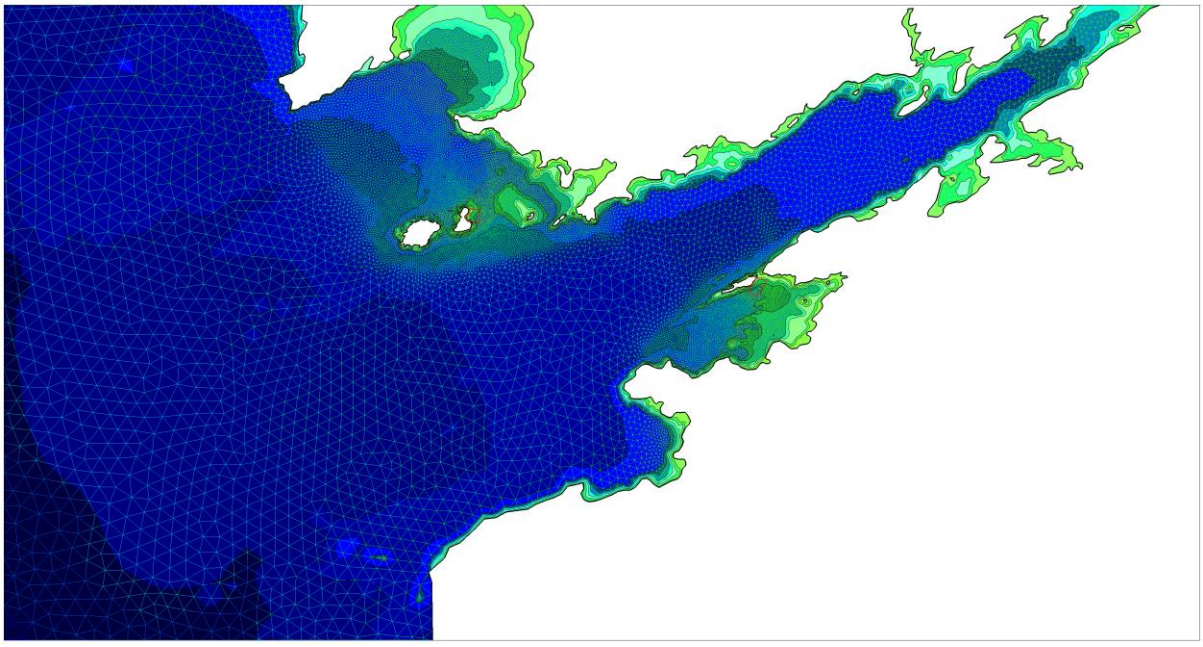

Figure 2: Variable density unstructured triangular finite element mesh used to model Kenmare Bay and approaches

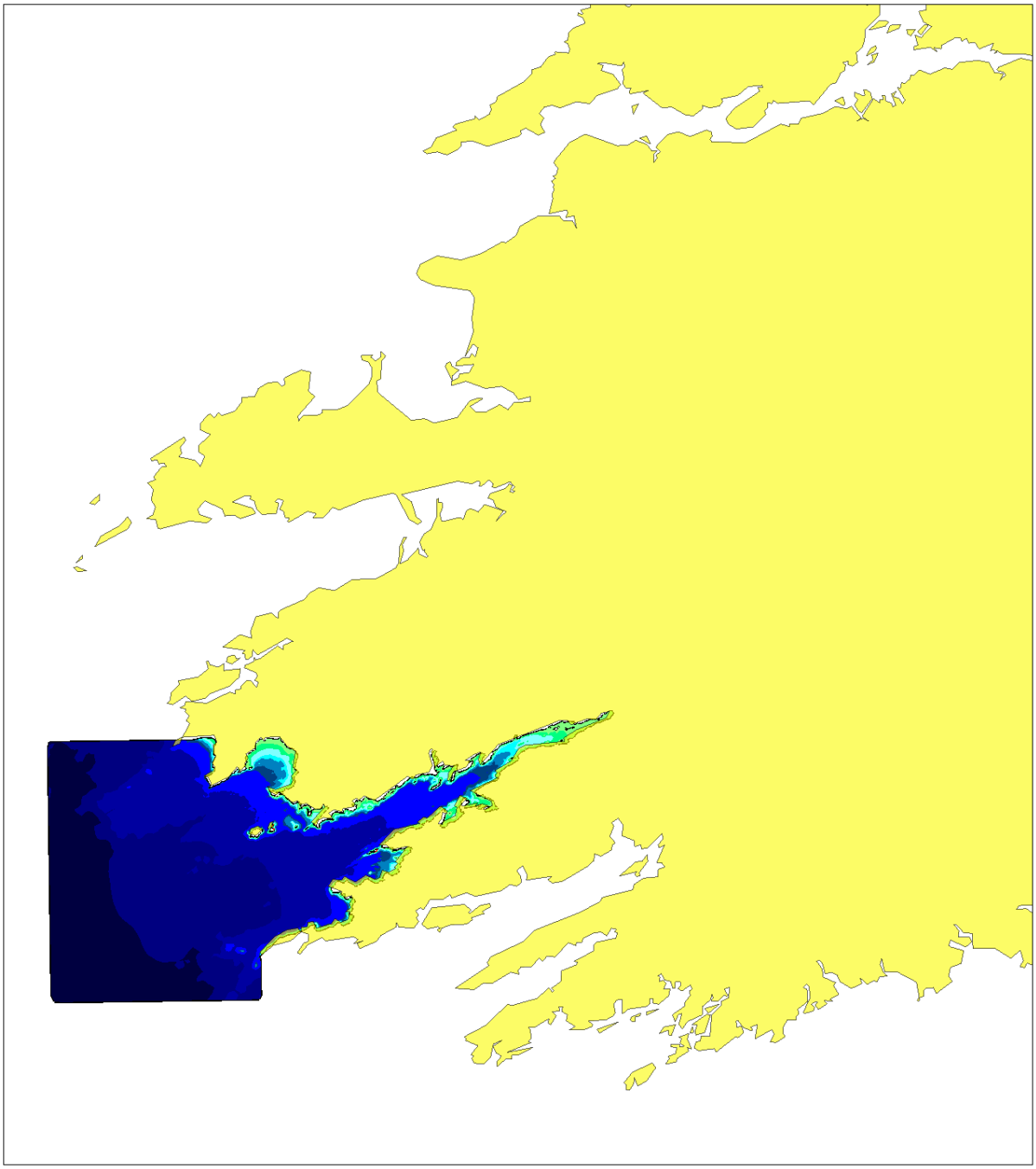

Figure 3: Kenmare Bay and approaches hydrodynamic model extent.

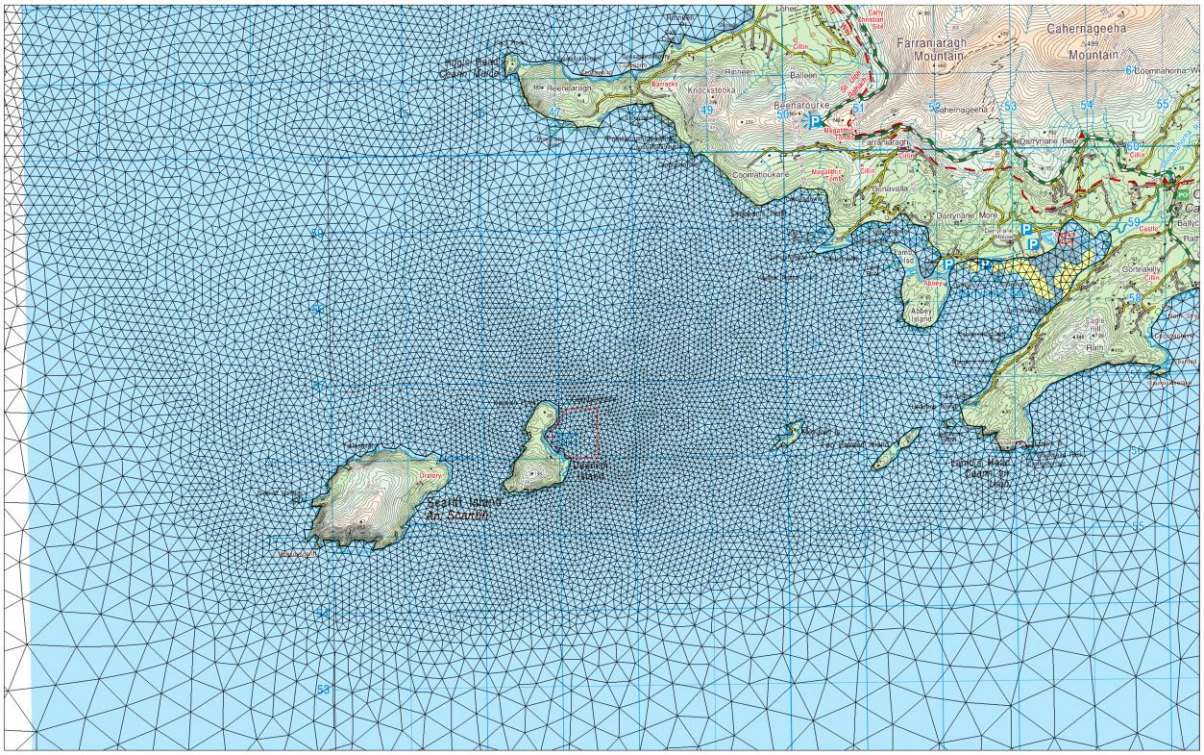

Figure 4: Model Mesh refinement in the vicinity of fish farm site at Deenish Island .

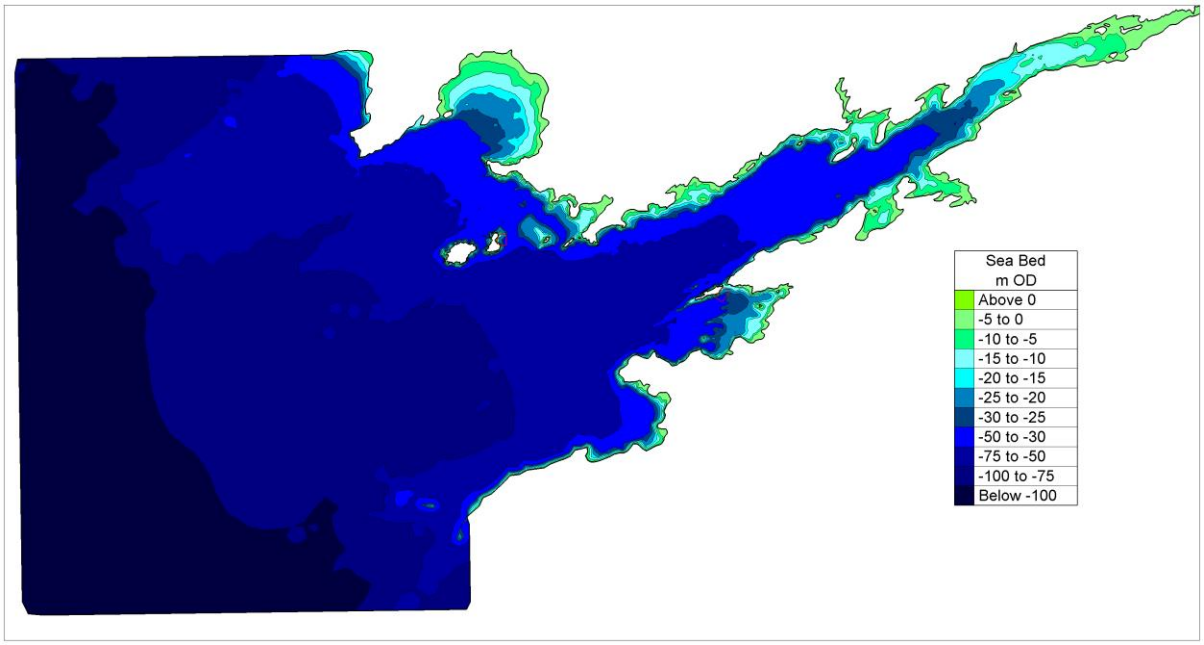

Figure 5: Contour map of bed elevation specified in the hydrodynamic model (data sources: infomar Lidar and sea bed surveys, Admiralty chart, AQUAFACT surveys and BODC 30sec bathymetry data set).

The finite element model domain modelled is shown in Figure 3 and covers an area of 1,381 km^2 from open Atlantic Sea, west of the Dursey Head north to Bray Head at Valencia Island and inshore northeastward to Kenmare Town and the Roughty River. The model had an unstructured finite element mesh of variable density depending on the geometry requirements, total number of 2D computational nodes is 25,133 and the total number of 2D triangular finite elements was 48,029. Seven vertical Layers are included in the model giving a total number of 3D nodes of 175931 and 3D elements of 864,522. The horizontal nodal spacing varies from 30m to 1000m in the open water. (See Figs. 2 and 4).

The hydrodynamics from TELEMAC were determined for full spring-neap lunar cycles (29day lunar period plus 6-day warm up period) and inputted to a the water quality dispersion module and the sediment transport module in **TELEMAC-3D** to determine the spread and fate of soluble and particulate waste from the proposed licensed fish farm site on the eastern side of Deenish Island .

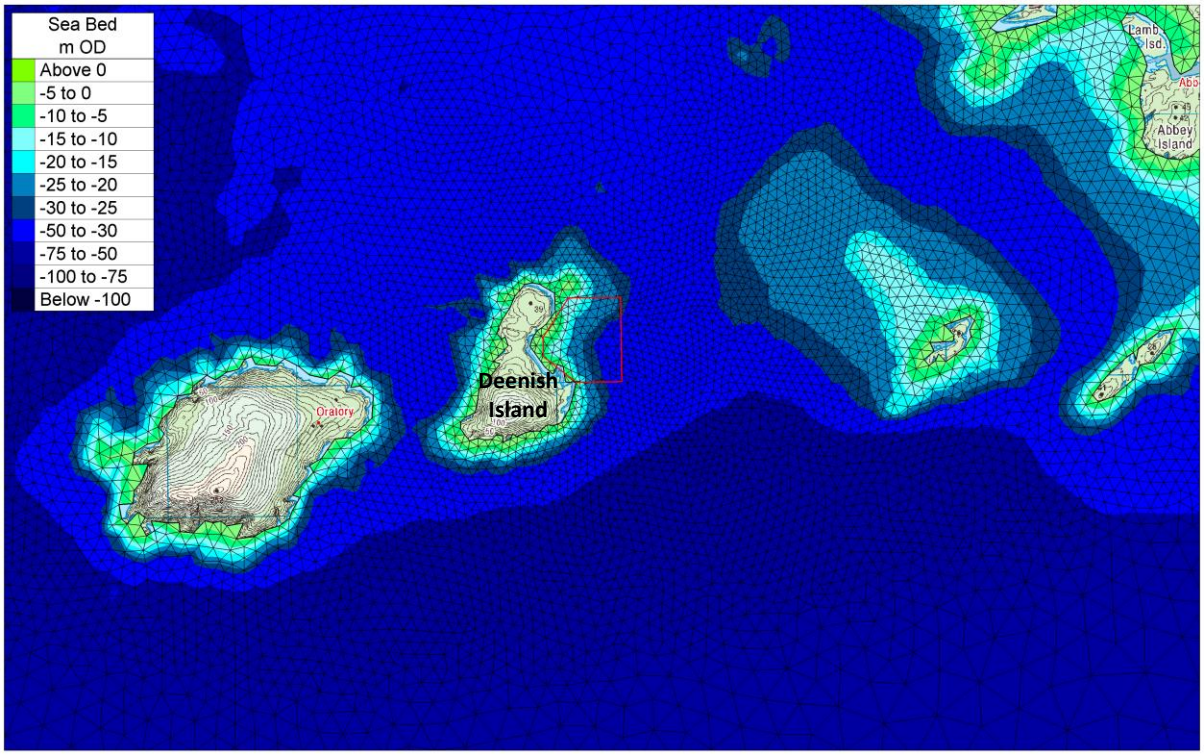

Figure 6: Contour map of bed elevation as represented in the Hydrodynamic Model for licensed Approaches (note farm site boundaries included.

2.2 Boundary Conditions

Boundary conditions for the open sea along the southern, western and northern opensea boundary were generated from regional/local tidal solutions by OSU (Oregon State University). The regional solution was derived from the European Shelf structured grid barotrophic tidal model that covers the North-East Atlantic Ocean with 11 harmonic constituents (M2, S2, N2, K2, K1, O1, P1, Q1, M4, MS4 and MN4), (refer to Fig. 7 for extent of the European Shelf Model (ESM) coverage). The solution gives amplitudes and phases for tidal elevation and transport from which two horizontal components of the current can be

deduced (by dividing transport by water depth). The resolution of the local European Shelf solution is 1/30 degree and is referenced to mean sea level. The harmonic constants from the ESM were interpolated on to the relevant open sea boundary nodes of the local model. Both tidal elevation and tidal velocities were computed from the harmonic constants and specified along the western and northern open sea boundaries every time step. These harmonic constants were also used to reconstruct the initial conditions within the domain at simulation commencement and to define the time varying boundary conditions at each boundary node and at each time step for a specified date and time.

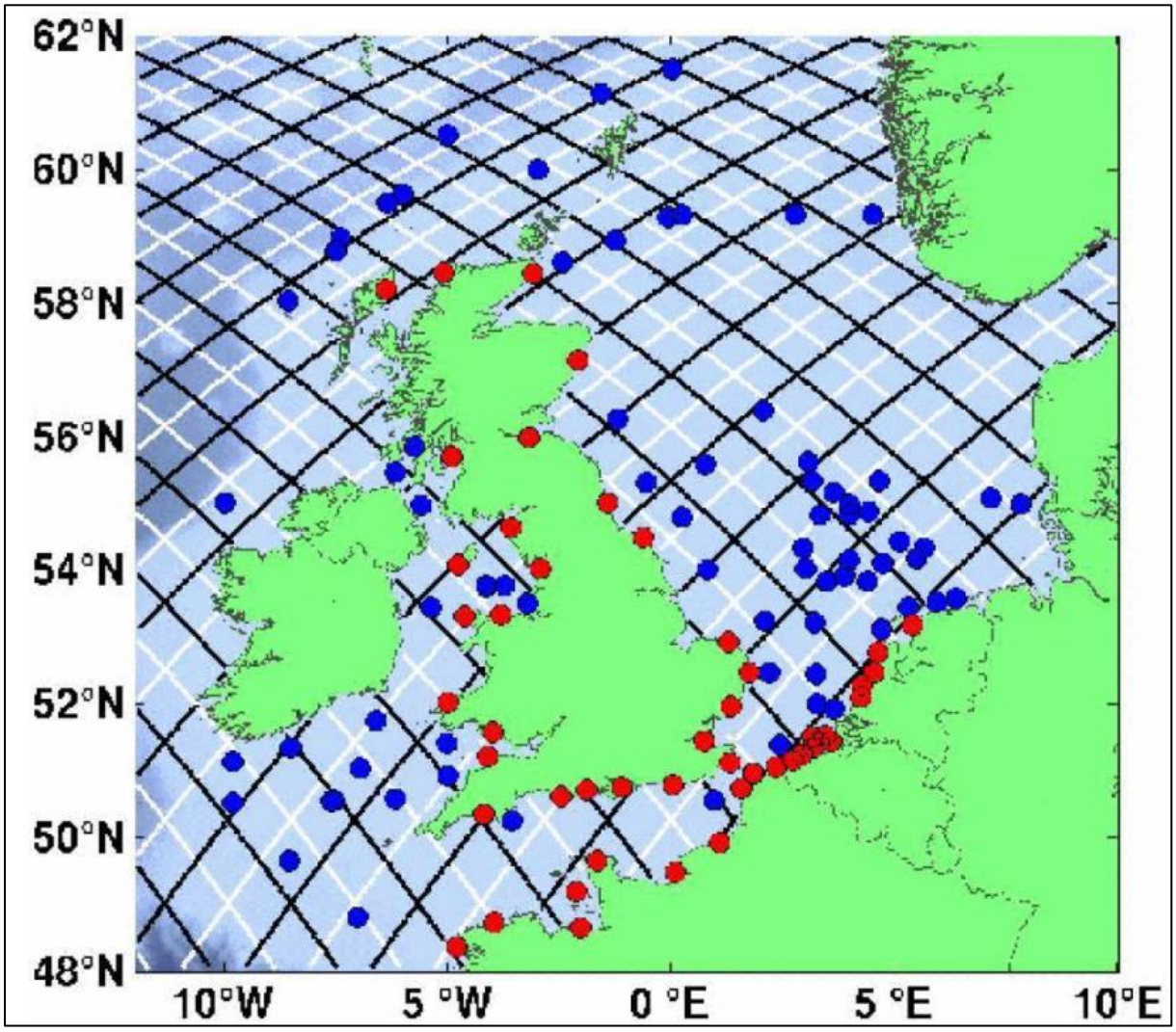

Figure 7: NOOA European Shelf Model extent (blue and red nodes tidal calibration points).

3 Hydrodynamics of Kenmare Bay

3.1 Description

Kenmare Bay is a long, narrow, south-westerly facing bay approximately 12km wide at its mouth and 55km long. At the head of the Bay the Roughty River (202km^2 in catchment area) joins it. Kenmare Town is located on the north side towards the head of the Bay. All along the bays north and south shorelines numerous mountain streams and rivers discharge to the Bay. To the north of Deenish Island and the mouth of Kenmare Bay. Ballinskelligs Bay is located where the River Inny Joins it at Inny Strand to the northwest of Waterville. The bedrock of this area is predominantly old red sandstones. Coulagh Bay is located on the south side near the mouth of Kenmare Bay.

Kenmare Bay is a European site, Kenmare River SAC (Site code 2158) the SAC designation extends from the head of the Bay out to its mouth and includes on the north side, Scarriff and Deenish Islands and on the south side Dursey Island. This SAC is designated for a range of coastal habitats including vegetated shingle, saltmarsh, sand dunes and sea cliffs The adjoining Ballinskelligs Bay also contains an SAC designation, Balinskelligs and Inny Estuary SAC (site code 000335).

The spring tidal range is typically 3.5m and the neap is approximately 50% of this at 1.6 to 1.8m. The flooding tide off the Kenmare Bay Headland runs north northwest and the ebbing tide runs south. Tidal flows in Kenmare bay and the adjoining Coulagh and Ballinskelligs Bays are slack particularly on neap tides influenced by the bay's orientation and relatively deep waters particularly at the mouth to Kenmare Bay. The outer Kenmare Bay area is exposed to Atlantic swells from the southwest and west sectors. The Deenish site is afforded some shelter from Deenish Island in the shallower waters closer to the island. Further offshore of the Island the Atlantic swell waves diffract around the island. The Inisfarnard Site is exposed to westerly waves with some protection provided from Inisfarnard Headland and Dursey Headland to the southwest.

The seabed is quite deep in the main outer channel at 60 to 75m towards the mouth. The enclosed bays of Ballinskelligs and Coulagh are variable with depths generally less than 30m. The Bathymetry at the Deenish Island farm site deepen eastward away from the island and typically depths on the eastern edge of the proposed Licensed area are 33m, 21m on the northern edge, 29m on the southern edge and 6m on it western edge close to the Island.

3.2 Tidal Velocities and Circulation

A hydrographic survey of the tidal currents in outer Kenmare Bay carried out by Irish Hydrodata (Aug 1990) indicated weak tidal stream velocities throughout the outer bay area

with still weather astronomical currents of 0.06 to 0.10m/s in the main channel. Slacker tidal currents were recorded in Coulagh Bay area of the order of 0.02 to 0.04m/s. It was found that the tidal flow direction was almost equally distributed around the compass.

Specific to the Aquaculture sites neap and spring tide drogue surveys of the tidal stream flows at both Deenish Island and Inisfarnard sites was conducted in 1997. These surveys found for the Inisfarnard site that minimum current magnitudes occurred around the turn of the tide in the range of 0.02 to 0.07m/s and maximum current speed was found around the mid-flood period in the range of 0.05 to 0.26m/s. The drogues followed a circulatory, anti-clockwise path from release.

At Deenish Island the currents were generally northwards with higher dispersal than the Inisfarnard site. The drogue releases were strongly influenced by strong wind conditions that prevailed during the tests. The drogues on both neap and spring tides had a tendency of sticking at the site in the shallows. The current direction was found to be generally northwards and averaging over 0.1m/s in all cases.

Overall survey results for Deenish Island indicate that currents run north on the ebb tide, turning through east at low water, to run south to south east on the flood. Flood currents are stronger than ebb currents. Current speed increases slightly with depth. The results suggest dominant currents to the north and south-east in the site area, in particular in spring tides. Longer duration of northern flow, to ebb mid-tide during neaps, results in a net northerly flow. Mean ebb and flood currents of 0.1m/sec, whilst periods of peak currents of 0.25 – 0.35m/sec during the tidal cycle on both Springs and Neaps indicates potential for rapid dispersal and dilution away from the site, even during still weather conditions.

Under the slack tidal streams that characterise the outer Kenmare Bay area the dominant influence on hydrodynamics will be meteorological conditions in respect to variable wind conditions. The mean wind condition is a 5.5m/s wind speed from the southwest.

The computed hydrodynamics from the Telemac model agree reasonably well with the findings from the Irish Hydrodata 1990 survey and the 1997 drogue survey, refer to Figures 8 to 15. At the Deenish Island proposed aquaculture licensed site the tidal stream flows increase eastward away from the Island. The strongest tidal streams occur further east and northeast and southeast of the site with neap tide maximum velocities of 0.1 to 0.15m/s and spring tide maximum velocities of 0.25 to 0.35m/s. Under certain conditions a local anticlockwise gyre occurs in the vicinity of the Farm site influenced by the stronger flows in the narrows between the islands and by the shape of the eastern shoreline of Deenish Island.

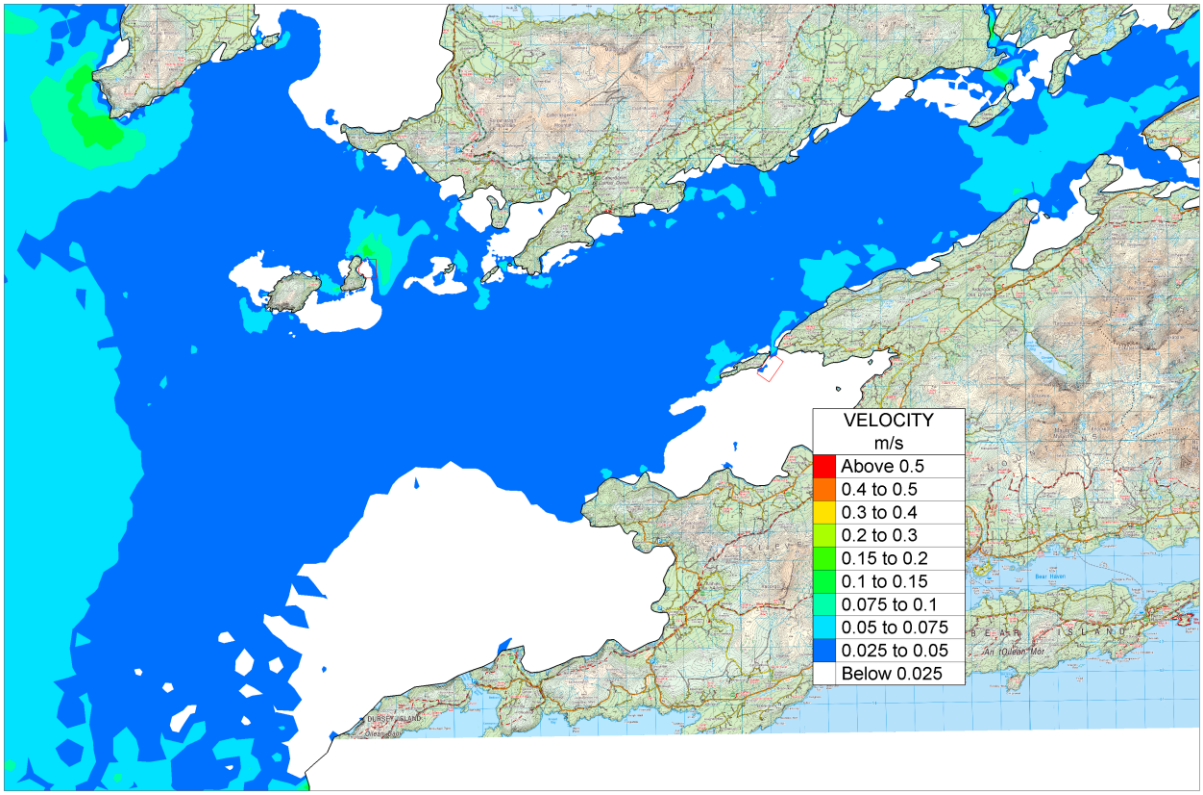

Figure 8: Computed mid-depth tidal velocity magnitudes for ebbing flow on a neap tide

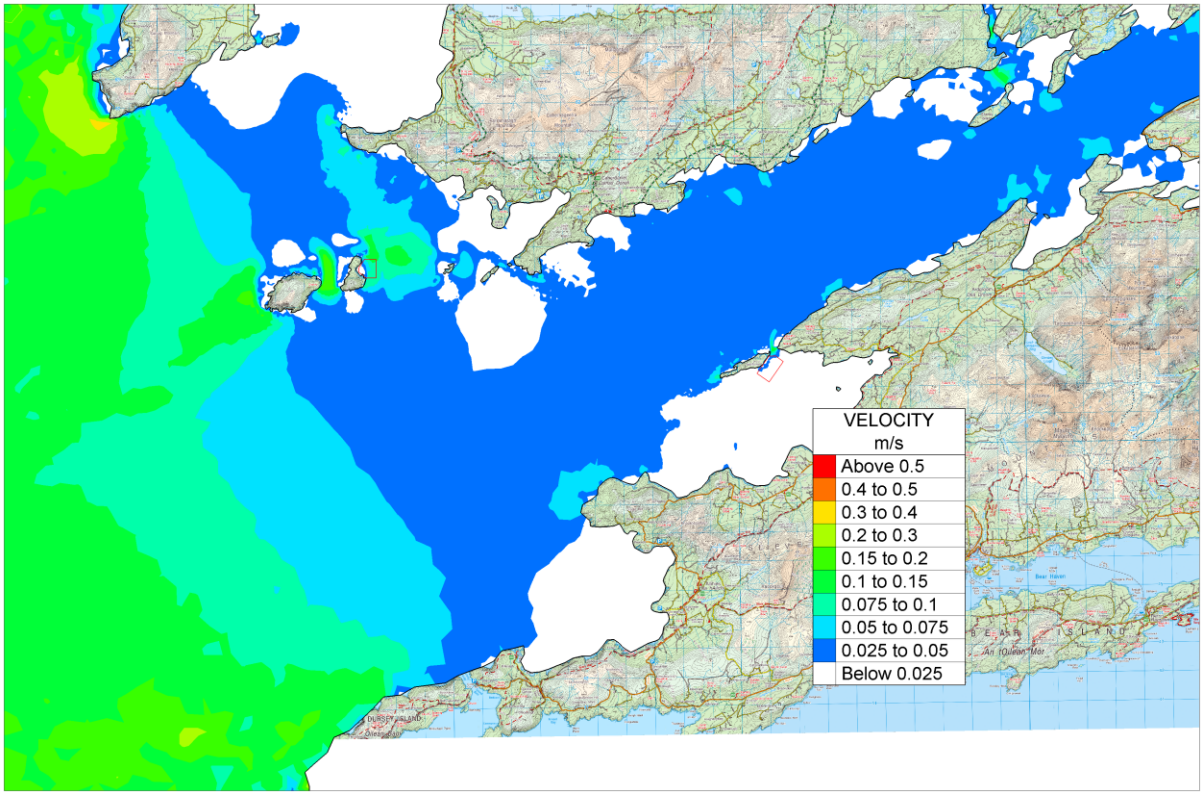

Figure 9: Computed mid-depth tidal velocity magnitudes for flooding flow on a neap tide

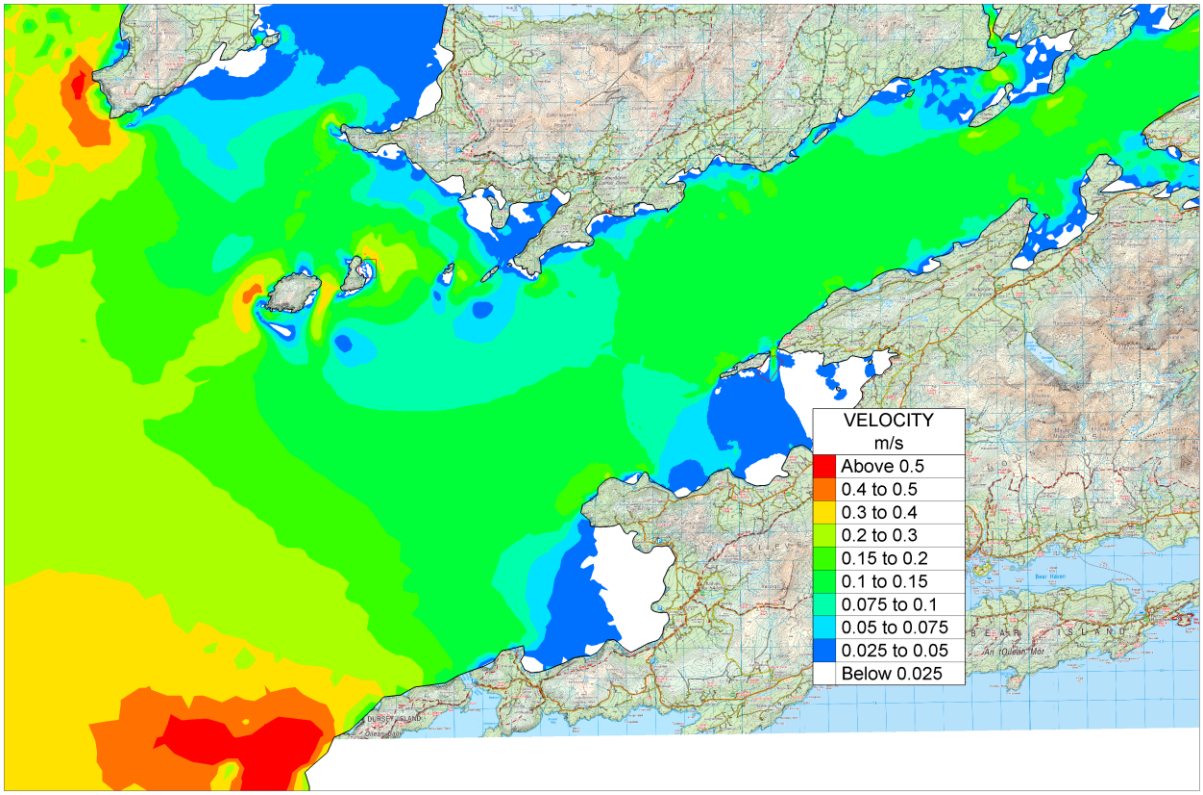

Figure 10: Computed mid-depth tidal velocity magnitudes for ebbing flow on a neap tide

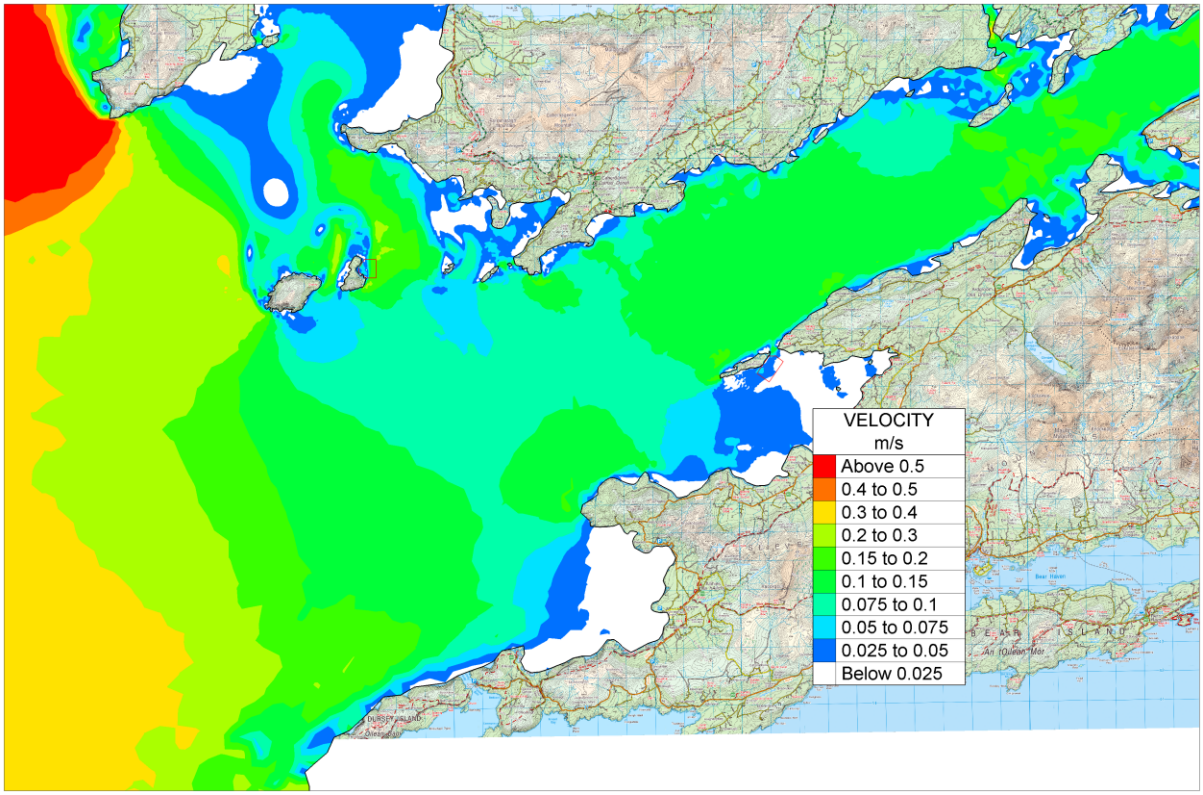

Figure 11: Computed mid-depth tidal velocity magnitudes for ebbing flow on a neap tide

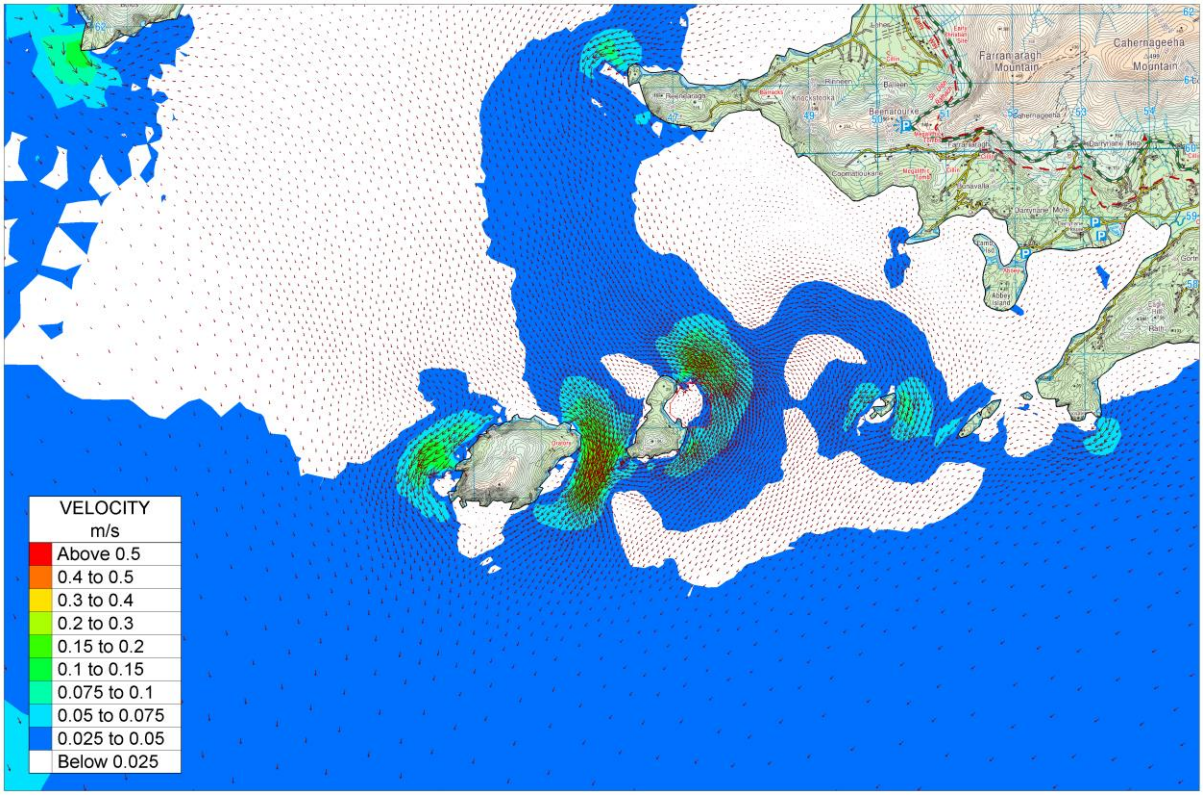

Figure 12: Computed mid-depth tidal velocities in the vicinity of Deenish and Scarriff Islands on ebbing neap tide

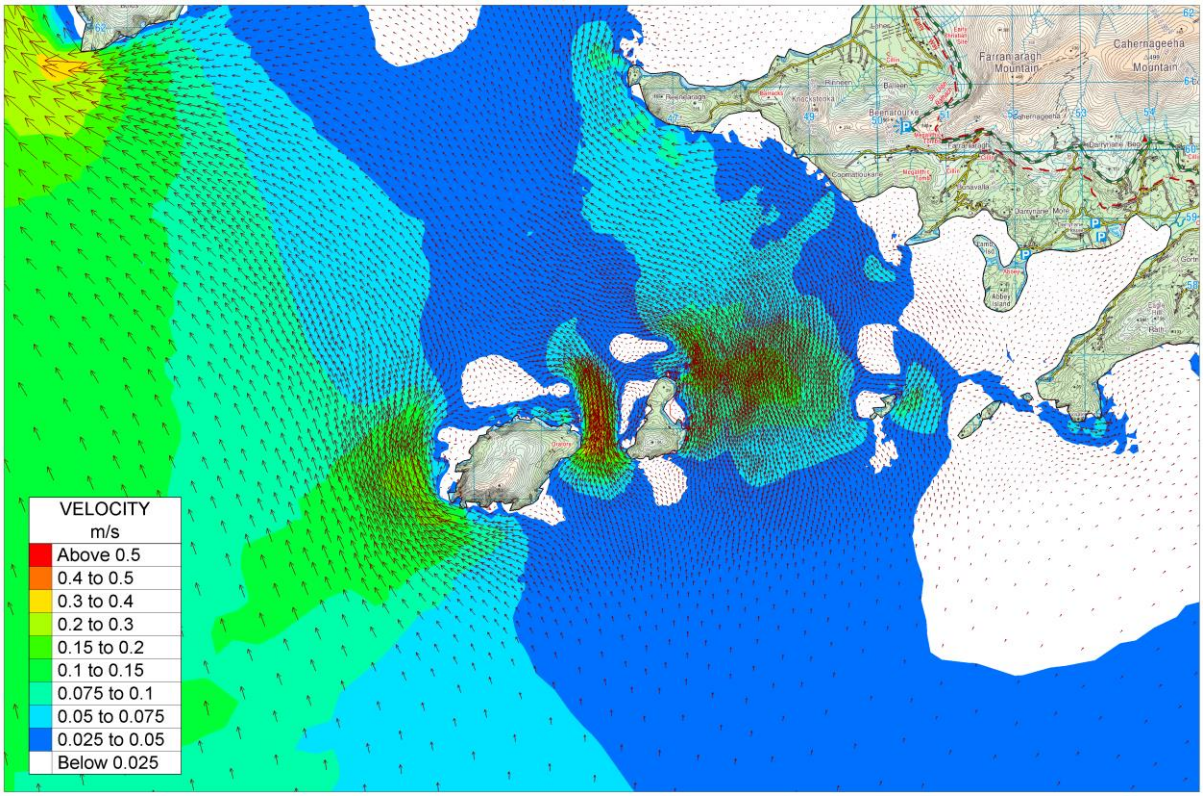

Figure 13: Computed mid-depth tidal velocities in the vicinity of Deenish and Scarriff Islands on flooding neap tide

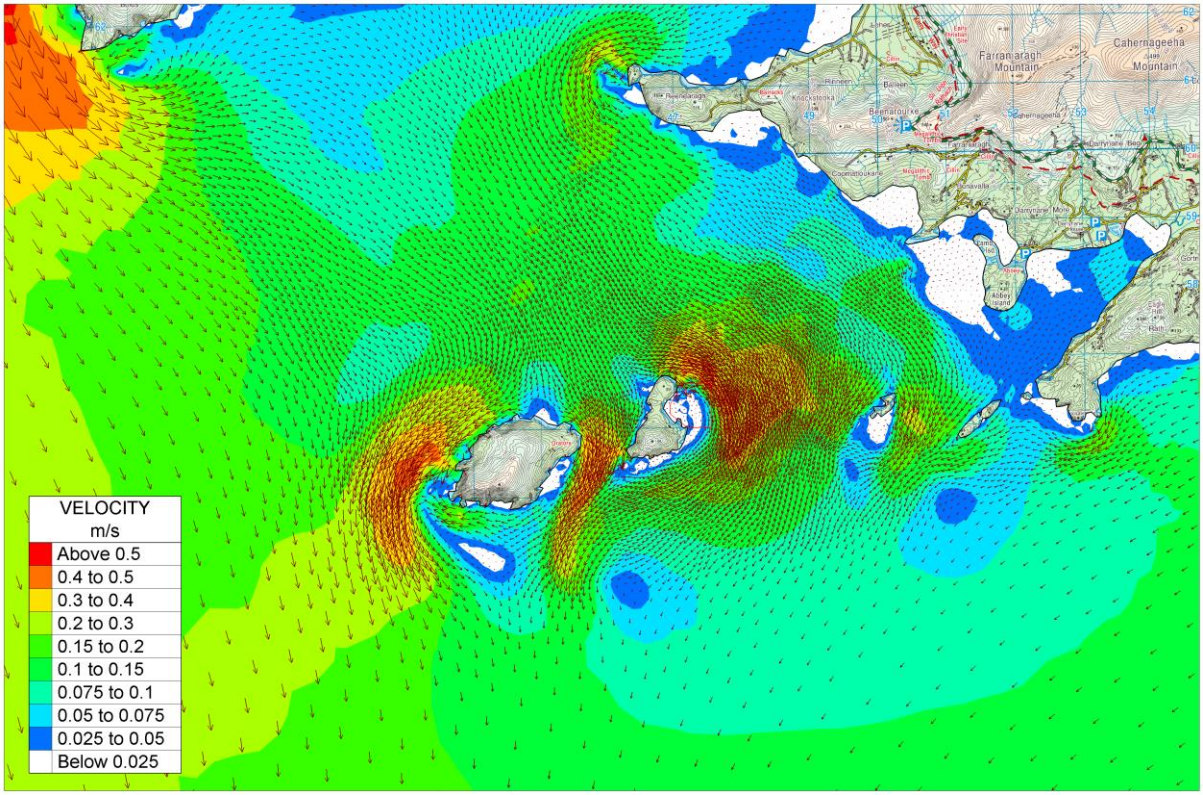

Figure 14: Computed mid-depth tidal velocities in the vicinity of Deenish and Scarriff Islands on an ebbing Spring tide

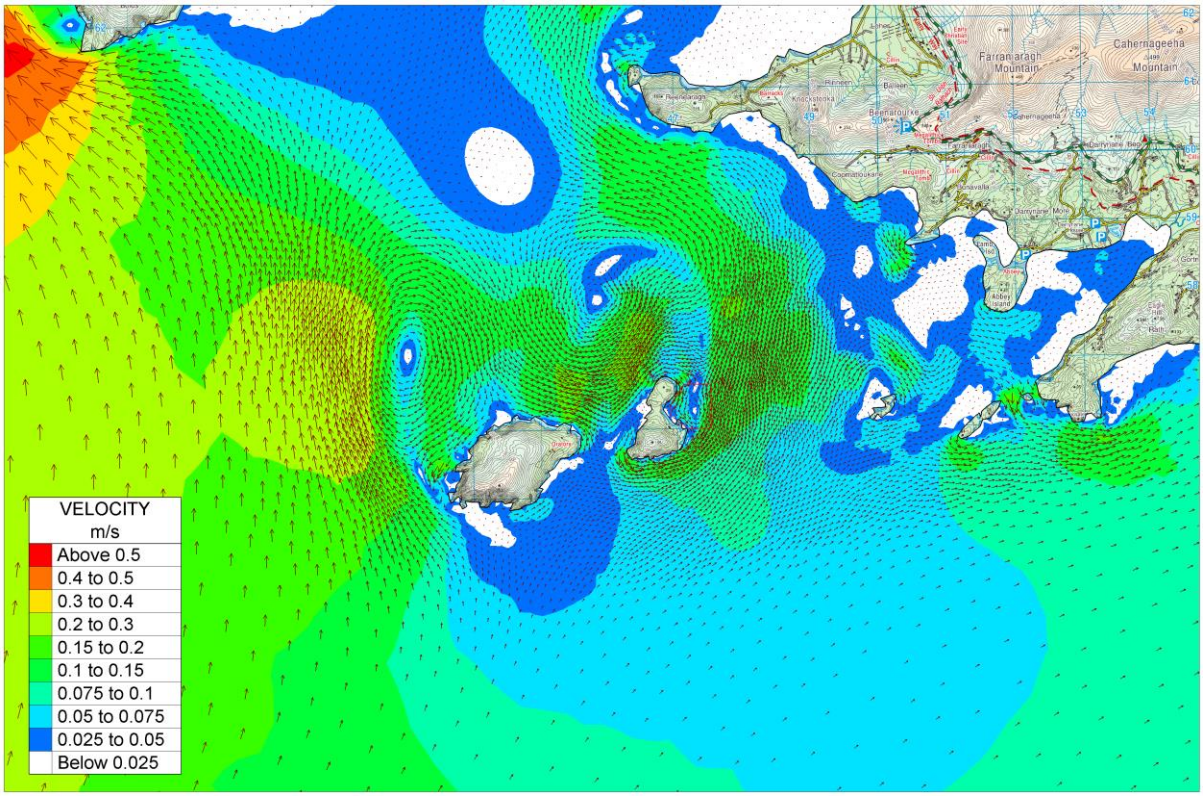

Figure 15: Computed mid-depth tidal velocities in the vicinity of Deenish and Scarriff Islands on a flooding Spring tide

3.3 Wave Climate

3.3.1 Introduction

The section describes the development and application of a finite element Wave Climate model for translating wind and swell waves in Kenmare Bay with particular focus on Deenish Island at the mouth to the Bay. The primary objective is to determine the significant wave heights Hm0, wave periods and critical storm wave directions at the proposed Fish Farm site under swell and local storm wind conditions.

The wave modelling software used is the TOMAWAC Spectral Wave Module of the TELEMAC Hydrodynamic Software System which is recognised Internationally as the industry standard hydrodynamic software modelling package.

3.3.2 Wave Model Description

TOMAWAC is a third generation spectral wave model representing the generation of waves due to winds and offshore climates and propagation of these waves into shallow waters. The following energy dissipation, transfer and propagation processes are modeled by TOMAWAC using an unstructured finite element mesh.

Dissipation processes

- whitecapping dissipation or wave breaking, due to an excessive wave steepness during wave generation and propagation;
- bottom friction-induced dissipation, mainly occurring in shallow water (bottom grain size distribution, ripples, percolation);
- dissipation through bathymetric breaking. As the waves come near the coast, they swell due to shoaling until they break when they become too steep; and
- dissipation through wave blocking due to strong opposing currents.

Energy transfer processes:

- non-linear resonant quadruplet interactions, which is the exchange process prevailing at great depths; and
- non-linear triad interactions, which become the prevailing process at small depths.

Wave propagation-related processes:

- wave propagation due to the wave group velocity and, in this case, to the velocity of the medium in which it propagates (sea currents);
- depth-induced refraction which, at small depths, modifies the directions of the wave-ray and then implies an energy transfer over the propagation directions;

- shoaling: wave height variation process as the water depth decreases, due to the reduced wavelength and variation of energy propagation velocity;
- current-induced refraction which also causes a deviation of the wave-ray and an energy transfer over the propagation directions; and
- interactions with unsteady currents, inducing frequency transfers (e.g. as regards tidal seas).
- Diffraction process is capable of capturing the diffusion of the wave height behind diffracting structures such as headlands but does not represent in detail the diffracted wave field.

Model limitations

Due to model solution structure the following important physical processes are not addressed by the TOMAWAC wave Spectral model:

- diffraction by a coastal structure that includes breakwater, wall or pier / quay , etc.) or a shoal, resulting in an energy transfer towards the shadow areas beyond the obstacles blocking the wave propagation; (for problems in which diffraction must be defined precisely (harbour agitation) the use of a phase resolving model is recommended.
- reflection (partial or total) from a structure or a pronounced depth irregularity; and
- Unable to include drying/mudflat areas

3.3.3 Development of Model

The same finite element, variable density, triangular mesh structure used in the hydrodynamic and transport dispersion modelling of the fish farm pollutant inputs described elsewhere in this report was included in the TOMAWAC model.

The western and southern boundary of the model represents the open sea prescribed incident wave boundary where the propagating Atlantic swell wave is specified using a Jonswap spectrum. Other inputs such as initial conditions that include initial wave conditions and tidal water level (using mean tide) are specified in the model. For the design conditions wind data is specified as a stationary steady state wind of x and y speed components and a drag coefficient. For the local wind-wave simulations a wave growth model is used to develop and propagate the wave field over time within the domain. The model steps in time until steady state wave conditions are attained.

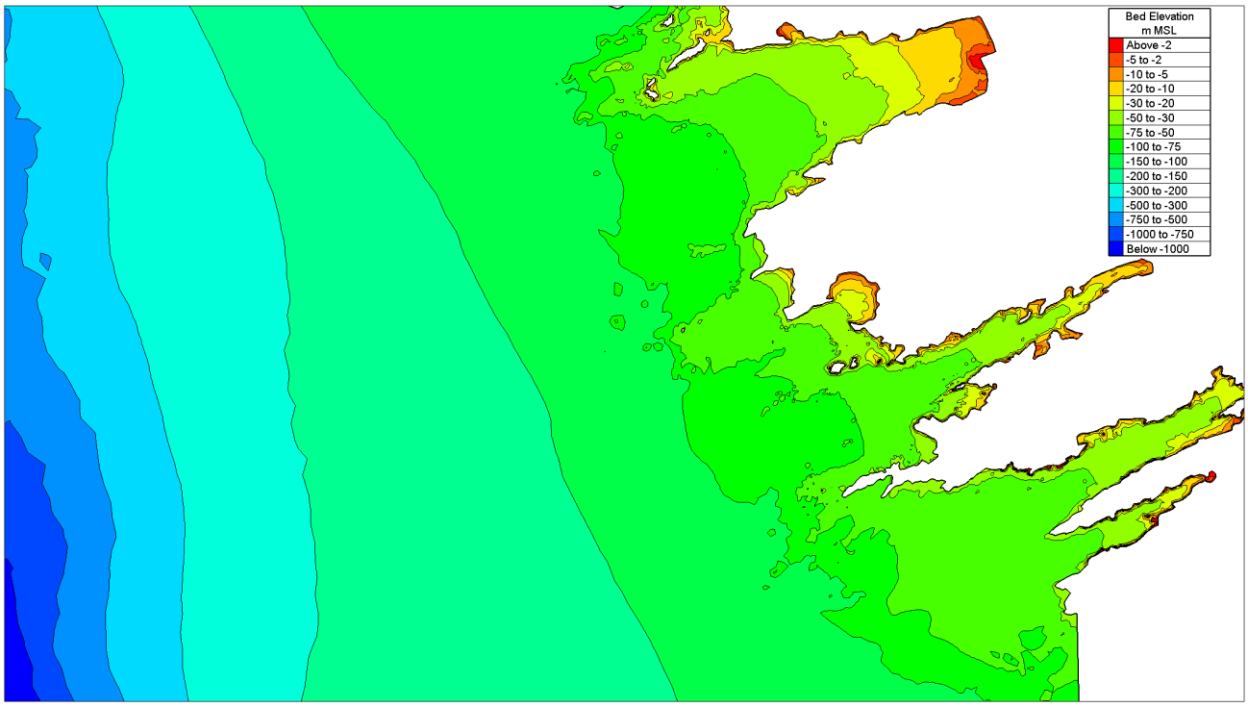

Figure 16: Wave Climate model domain for Kenmare Bay

3.3.4 Extreme Wind Data

There is no absolute maximum wind speed at a given location, as it is always possible that a stronger wind may occur in the future. The most commonly used wind for wave climate studies is a 50-year return period wind. This represents the steady wind speed that is likely to be exceeded once in 50 years. In the case of this study predictions for 100year return periods winds based on hourly observed wind data at Valentia Observatory are used.

Wind data were obtained from the Meteorological Office from the Valentia Meteorological station in Co. Kerry. The data consist of a continuous series of maximum hourly wind speeds and directions recorded over a 30 year period (1989 to 2018). The wind data for each year were segregated into 45-degree sectors and a different return period (50, 100 and 200year) wind speeds was calculated for each direction sector using the well-documented Gumbel (EV1) Distribution Method. Table 1 below presents the 50, 100 and 200year wind speeds calculated for each direction category. The maximum recorded hourly mean wind speed of 29.3m/s over the 30year record was recorded on the 24th December 1998 from a west direction (260degrees).

Wind Direction	Category	50-year Wind Speed [m/s]	100-year Wind Speed [m/s]	200-year Wind Speed [m/s]
337.5 – 22.5	North	18.2	19.3	20.4
22.5 – 67.5	Northeast	17.7	19.1	20.4
67.5 – 112.5	East	19.3	20.5	21.6
112.5– 157.5	Southeast	18.7	19.7	20.7
157.5– 202.5	South	23.1	24.5	25.9
202.5 – 247.5	Southwest	24.1	25.4	26.7
247.5 – 292.5	West	27.0	28.6	30.3
292.5 – 337.5	Northwest	21.4	22.8	24.3
0 – 360	**All directions**	27.8	29.4	31.0

Table 1 Computed Return Period Wind Speeds at Valencia Meteorological Station based on hourly wind speed from 1989 to 2018

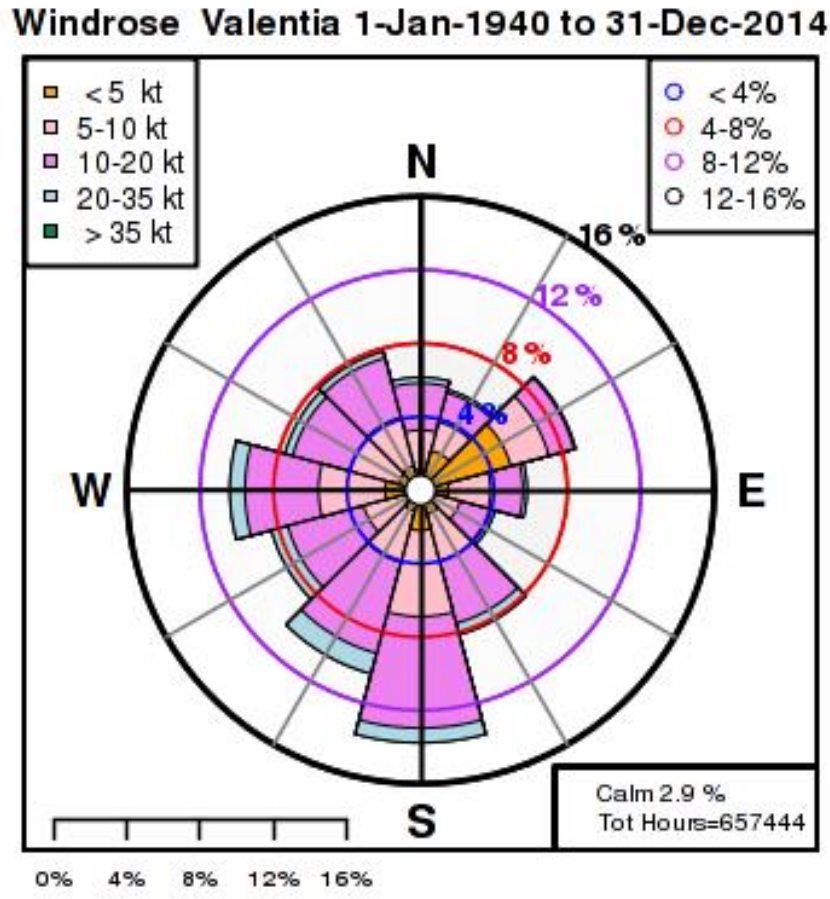

Figure 17: Long-term Wind Rose for Valentia (1940 to 20104), sourced from Met Eireann.

3.3.5 Extreme Wave Data

Wave data for the M3 Buoy (Lat 51.22^{o} and Long -10.55^{o}) off the southwest coast of Ireland is available since September 2002. (There are a number of gaps in the record including missing storm Darwin on the 12 February 2014). The M3 Buoy is located 60km SSW of Deenish Island and only 13 km south of the southern boundary of the wave climate model domain.

Over the available record period the maximum recorded Significant Wave Height was 13.8m with a period of 14 seconds and occurred on the 9th December 2007. Over a record period of 17 years 22 storm events exceeded 10m Significant Wave height and 7 events exceeded the 12m significant wave height. During Storm Ophelia on the 16th October 2017 a significant wave height of 9.8m and a wave period of 10.55seconds was recorded from the southerly sector at M3.

3.3.6 Wave Climate Modelling Results

The wind data statistics in combination the Shore Protection Manual (SPM) (1984) method were used to define the deepwater non-fetch limited wave characteristics for extreme 100year storm events.

The following wave climate simulations were performed so as to determine the most adverse wave climate at the Deenish Island Site at the mouth to Kenmare Bay:

1. Extreme Atlantic Storm Swell event from the South sector of 12.5m Significant Wave height and 13.5sec period
2. Extreme Atlantic Storm Swell event from the Southwest sector of 13.5m Significant wave height and 15 second period
3. Extreme Atlantic Storm Swell event from the West sector of 18m Significant Wave height and 17second period
4. Local wind-waves produced by a 100year return period (24.5m/s) Southerly Wind
5. Local wind-waves produced by a 100year return period (25.4m/s) South-Westerly Wind
6. Local wind-waves produced by a 100year return period (28.6m/s) Westerly Wind

The TOMAWAC simulations were performed which included all of the generating and dissipating source terms and included the diffraction process using the Revised Mild Slope Equation approach by Porter(2003).

The computed significant wave height colour contour plots for the above simulations are presented in Figures 18 to 23. A summary of the computed design wave characteristics at each of the farm cage sites are presented below in Table 2.

Simulations 1 to 3 Extreme 100year Atlantic storm Swell

Site	Significant Wave Height HMO (m)	Mean Wave Period TMOY (sec)	Wave direction (degrees)
South	6.080	11.97	346.5
Southwest	7.923	12.34	352.0
West	7.032	13.87	357.8

Simulations 4 to 6 Local generated Wind Waves within model domain

Site	Significant Wave Height HMO (m)	Mean Wave Period TMOY (sec)	Wave direction (degrees)
South	0.953	5.094	357.0
Southwest	1.305	6.904	5.756
West	1.472	8.685	111.1

Table 2 Summary of Computed Design Wave Conditions at the centre point of the Deenish licenced Site (51.7387° -10.2119°)

The Deenish Island site is shown to be a very exposed site, due to the deep waters on approaches and relatively deep waters at the site itself. Large Atlantic swell waves of long period can significantly impact the licenced site from the south to the west sectors producing 100year storm waves of 6 to 8m. The most critical direction producing the largest wave heights is the Southwest, followed closely by the westerly storm waves. Shelter from Deenish Island is only provided close in towards the shoreline at the proposed licensed site.

The local-wind wave simulation produces maximum significant wave heights of 1.0 to1.5m and for south, southwest and westerly storm winds. As is the case with local wind waves the wave period is shorter than the Atlantic swell conditions computed at 5.1 to 8.7 seconds. Denish Island provides some degree of protection against wind waves which are less capable of diffracting and refracting around the island than the longer period Atlantic swell waves.

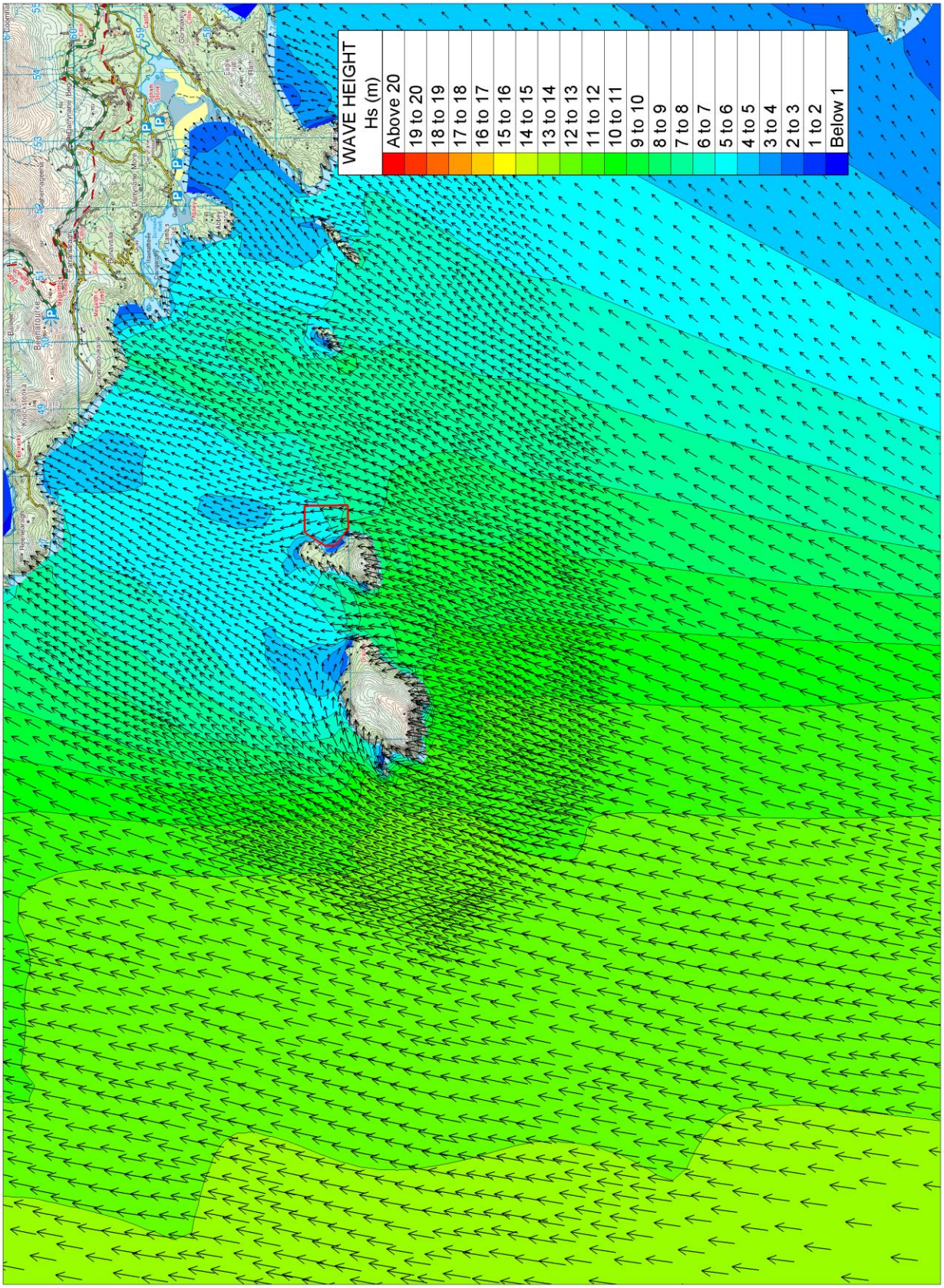

Figure 18: Extreme Athlantic Swell Event – Southerly

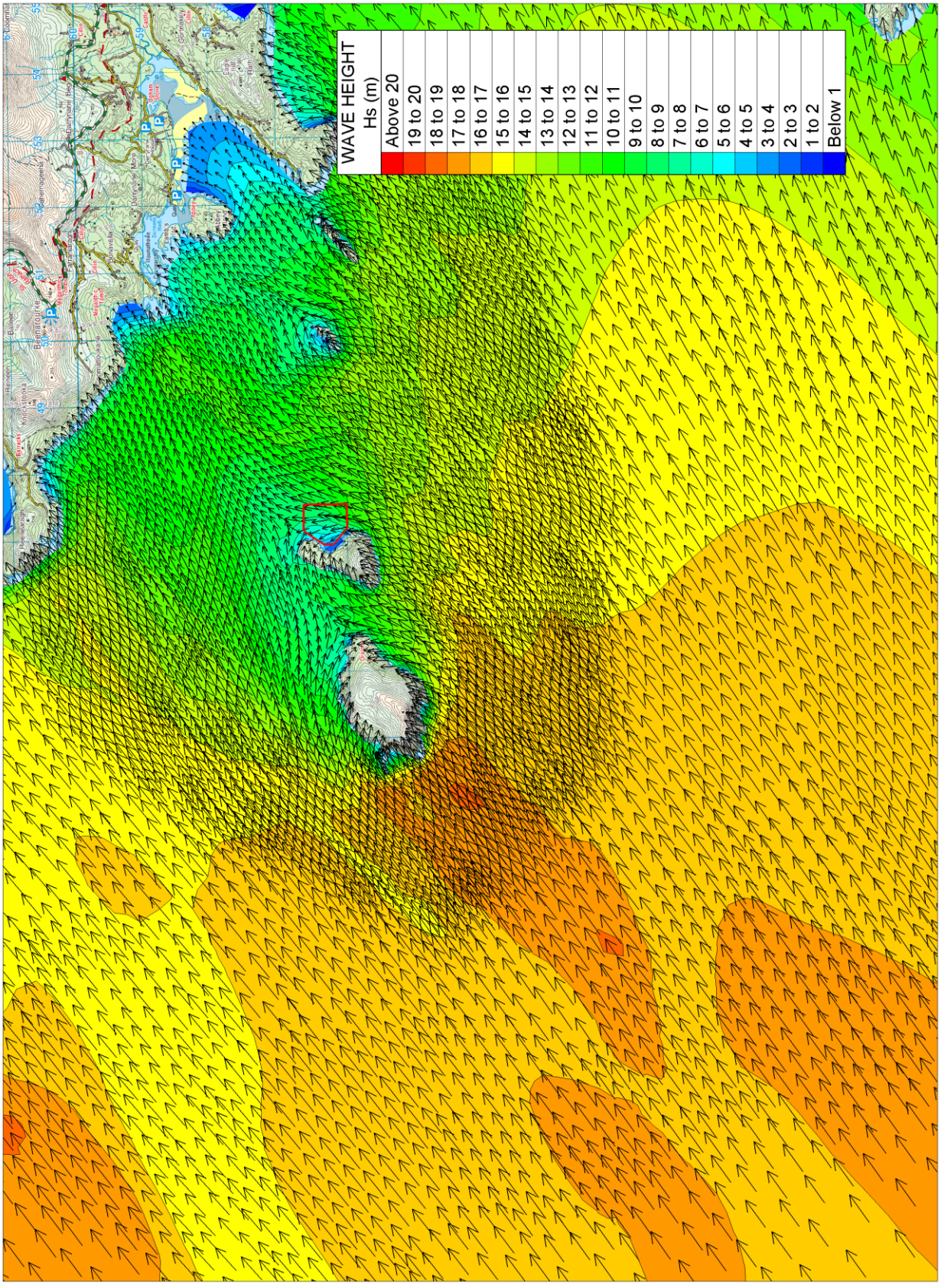

Figure 19: Extreme Athlantic Swell Event – South-westerly

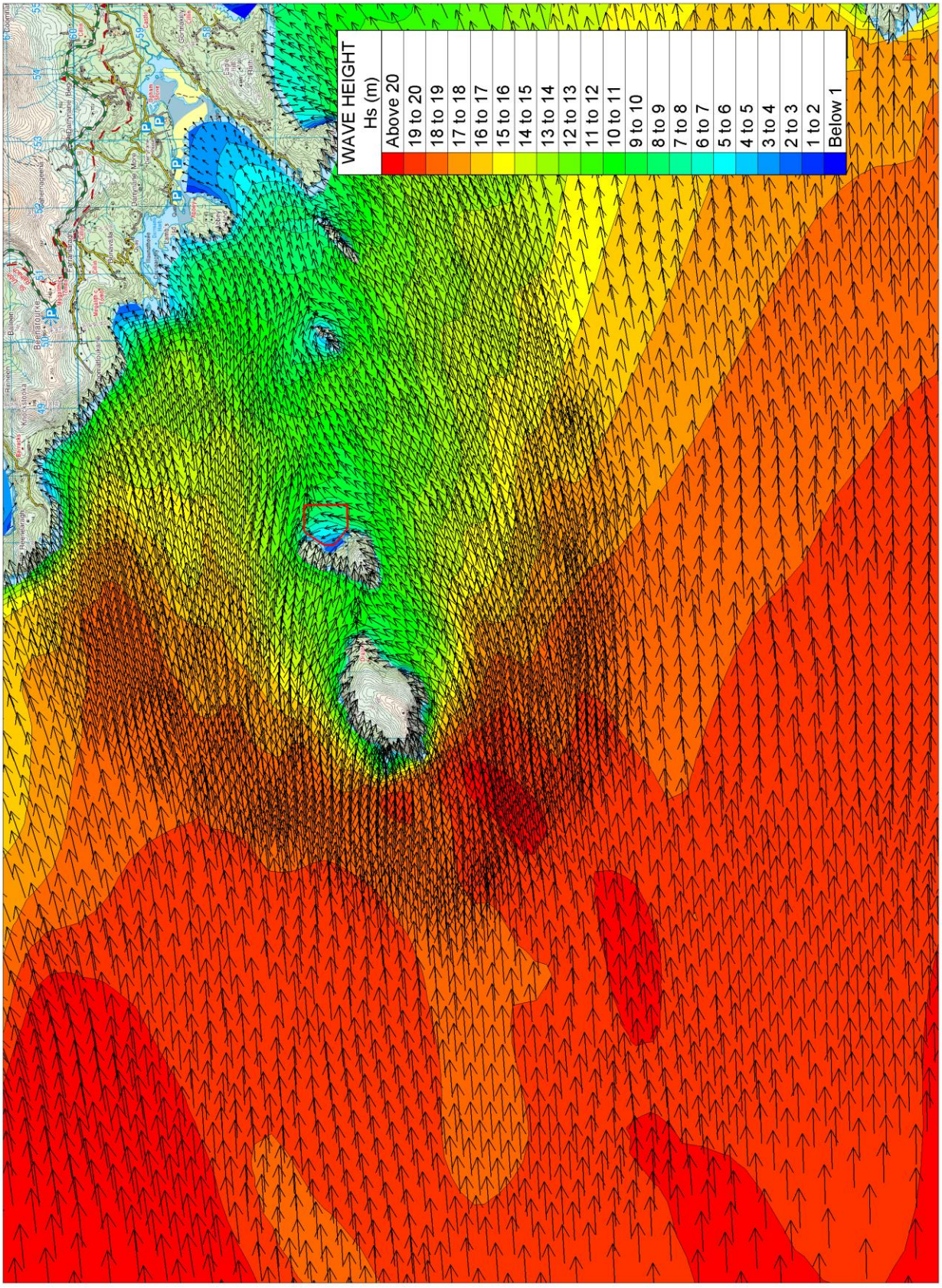

Figure 20: Extreme Athlantic Swell Event – Westerly

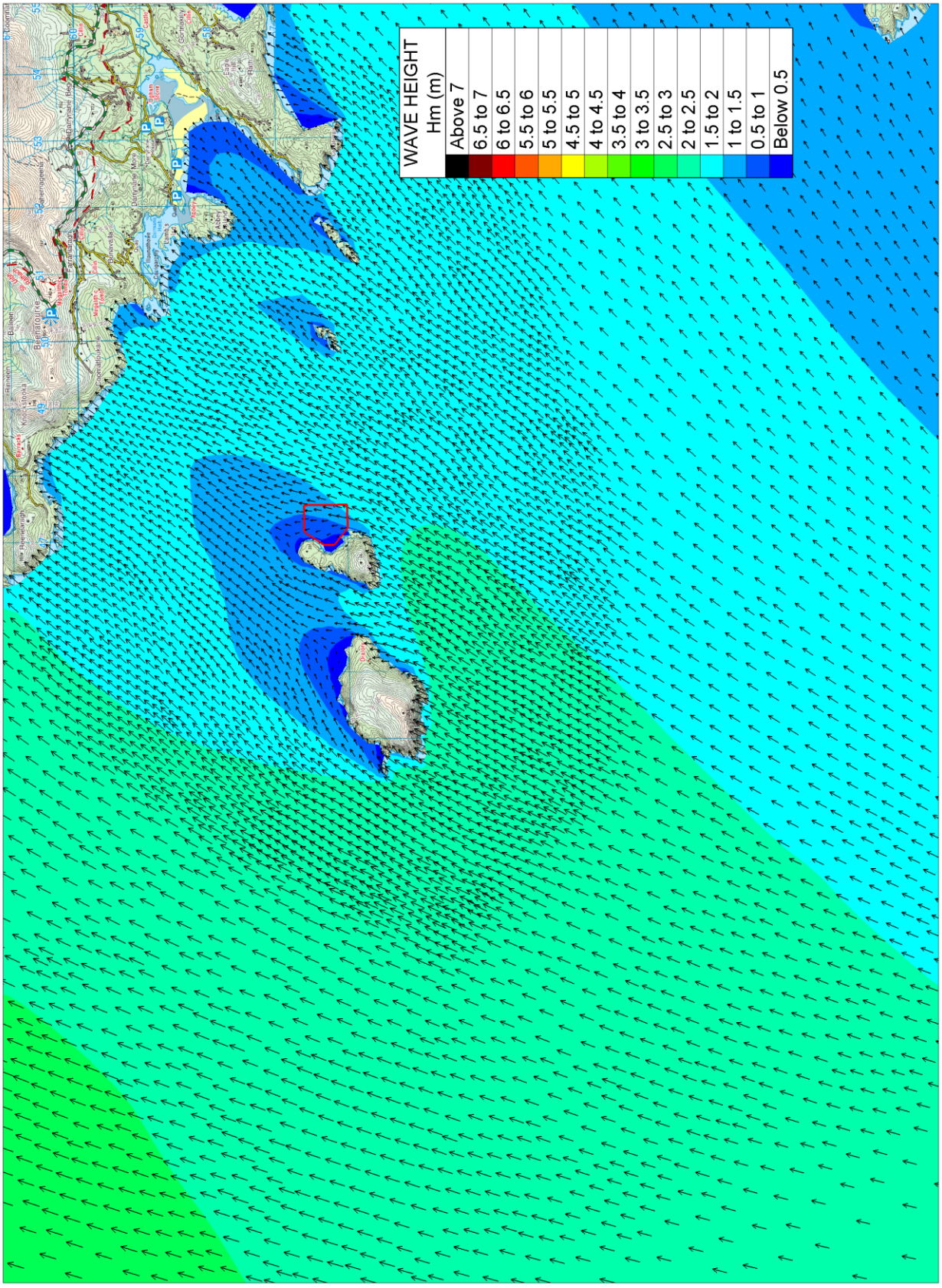

Figure 21: Local Fetch 100year southerly Wind-Waves -

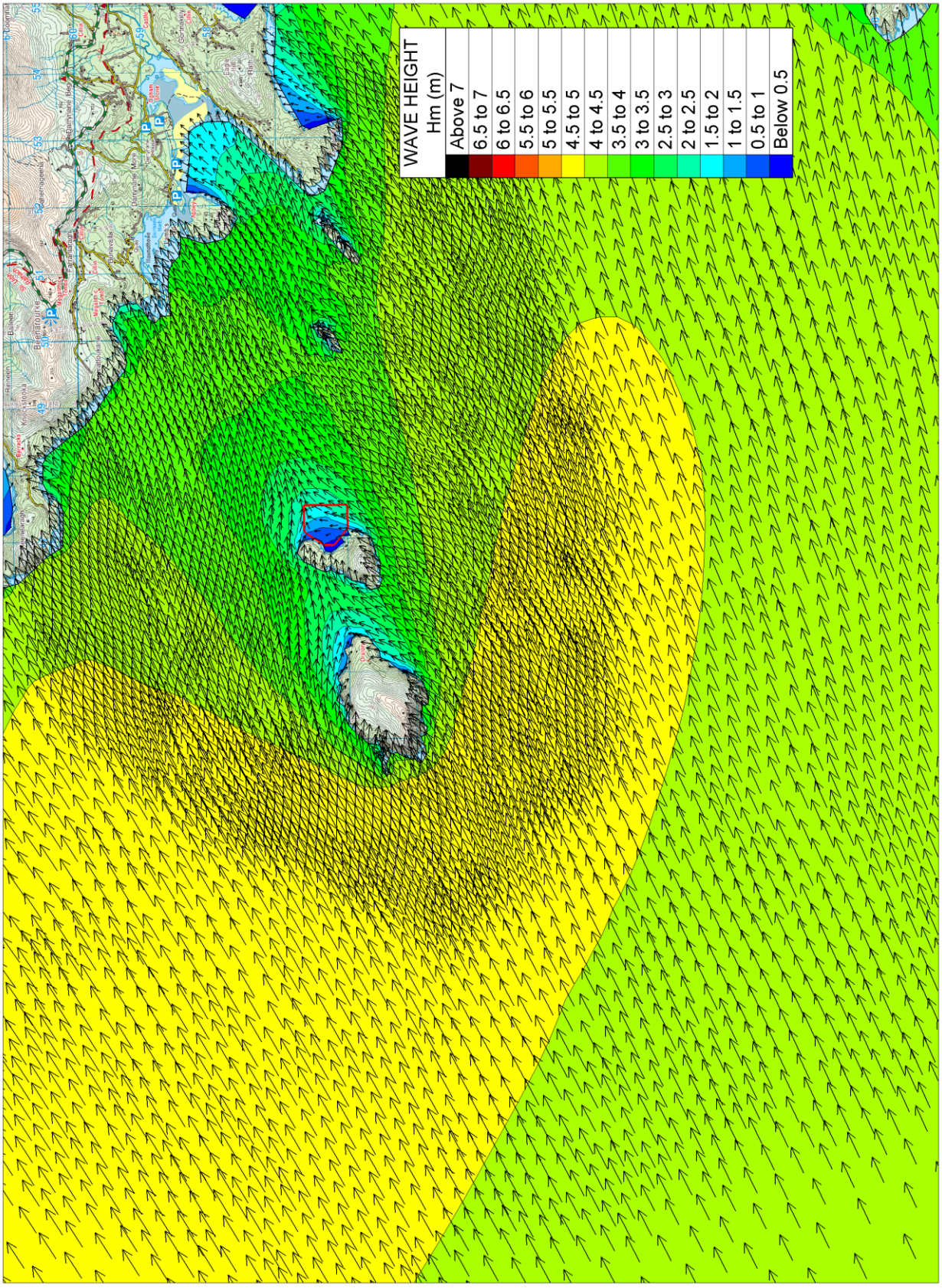

Figure 22: Local Fetch 100year south-westerly Wind-Waves -

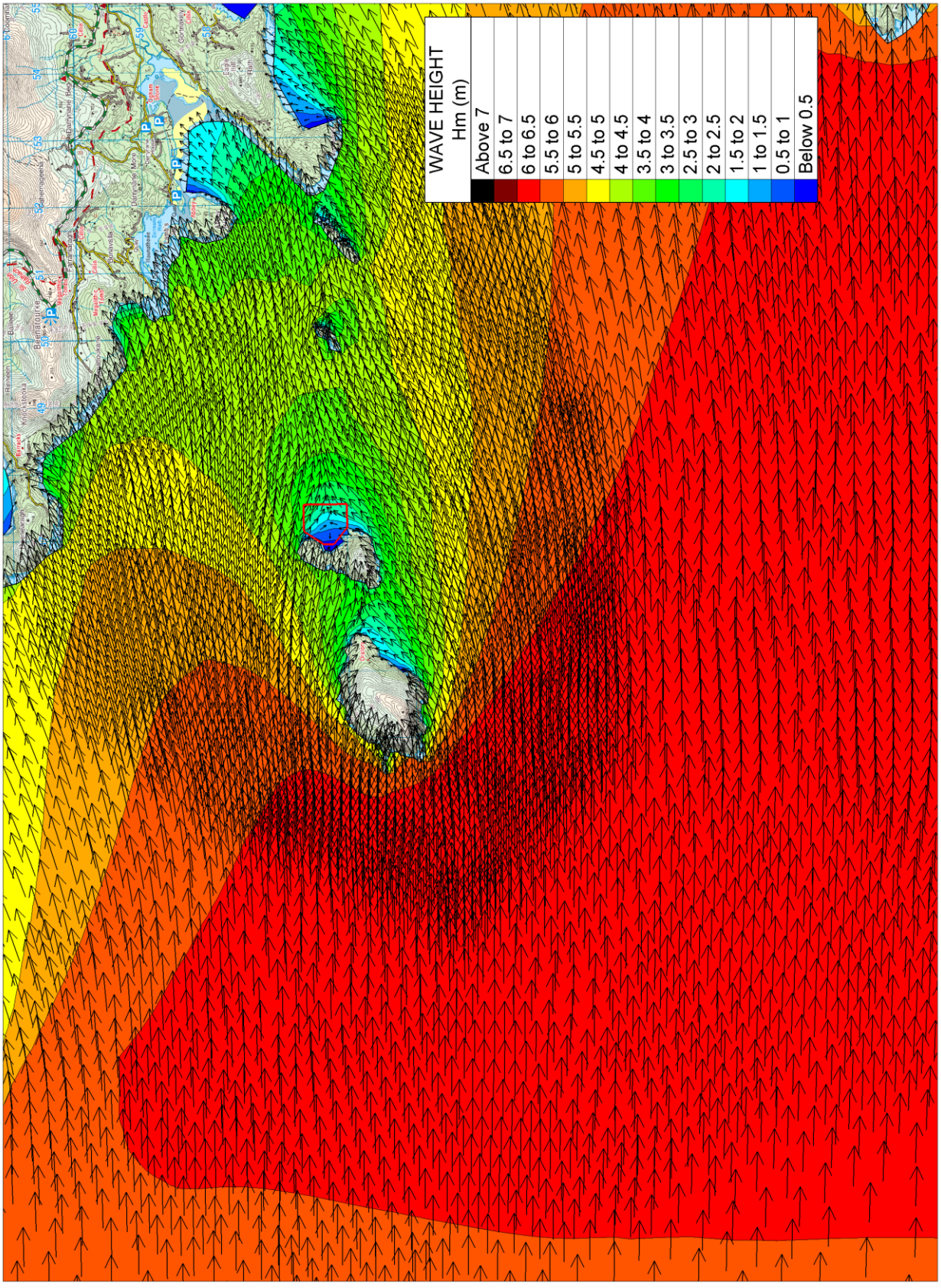

Figure 23: Local Fetch 100year westerly Wind-Waves -

4 Water Quality Dispersion Modelling

4.1 General

The 3-Dimensional Hydrodynamic model described in Section 2 and 3 was run for a 29day lunar cycle simulation period for the sample period 14 April 2019 to 19 May 2019 (typical tidal sample period). The astronomical tide conditions at the open sea boundary were derived from the European Shelf Model. The dispersion model similar to the hydrodynamic uses the full k – epsilon turbulence model to simulate the turbulent mixing within the water column. The water quality model was run with seven vertical layers and the pollutant inputs were introduced at mid-cage depth (c. -4m below water surface).

Soluble pollutant simulations were performed over a 6day warm up period followed by a 29day lunar period using a time step of 15seconds and outputting predicted plume results at 15minute intervals over that period at all computational nodes. The hydrodynamics simulated were representative of a complete spring-neap-spring lunar astronomical cycle The soluble water quality dispersion simulations were performed for nitrogen, phosphorous and BOD modelling a continuous input from fish faeces and feed waste over the 35day simulation period.

The simulation output is presented both as the computed maximum plume concentration envelope and also the average plume concentration envelope. 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 occurrence is relatively low. The average plume concentration 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 28day simulation period.

At 10 selected reference sites selected within the plume extent, locations shown in Figure 24, the statistical quantiles for the median, average, 95-percentile, 99-percentile and maximum concentrations are computed for more detail.

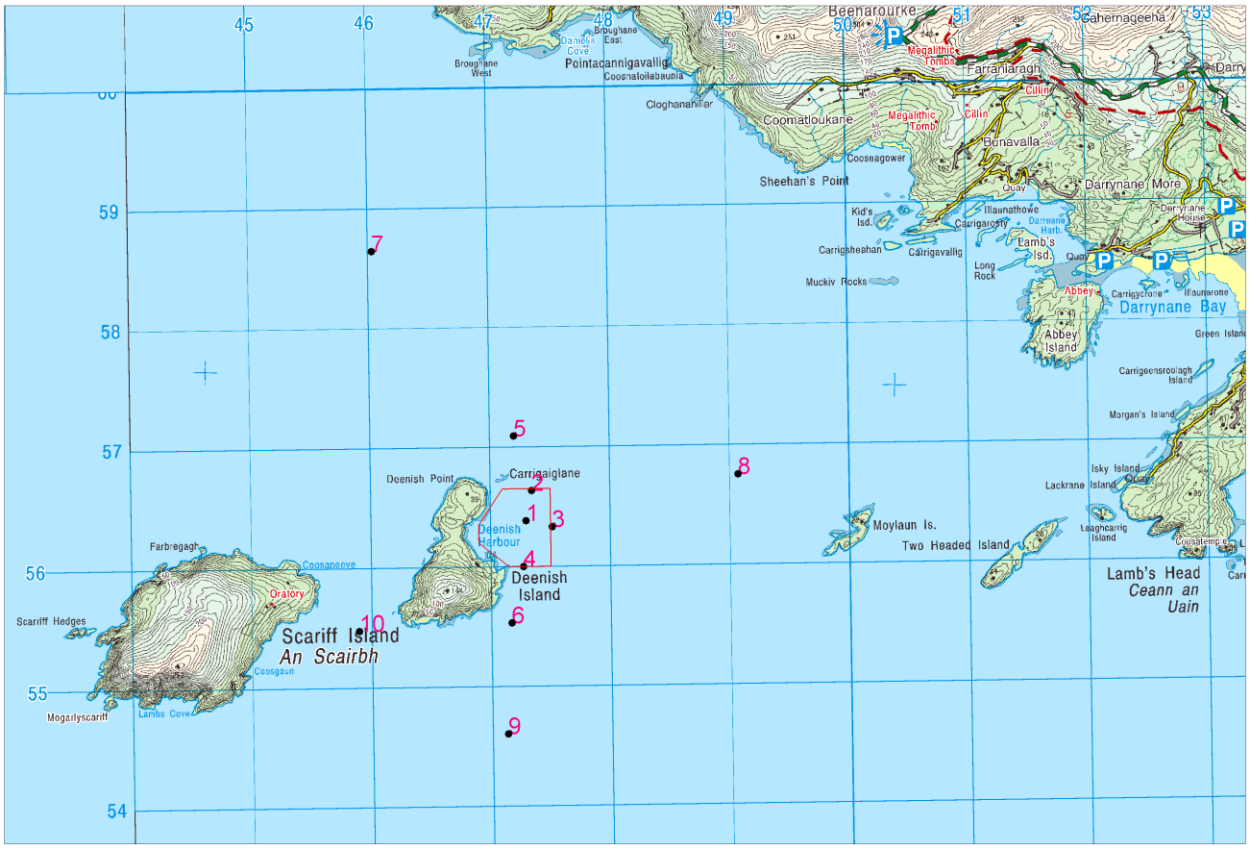

Figure 24: Reference Sites for Water Quality Model statistics

4.2 Nitrogen Simulation Results

Three-dimensional hydrodynamic simulations of the transport and dispersion of total nitrogen loading from the proposed fish farm production at the Deenish Island Site was performed using seven vertical layer model in sigma coordinates and a variable horizontal mesh as described earlier. The solute loading was released as a continuous discharge into the water column at mid-height within fish cage depth (i.e. 4m below surface) and its fate, dispersion and transport modelled.

The production and feeding model of the proposed fish farm operations provides monthly biomass and feeding figures at the production site. This production and feeding model was interrogated and found that the peak output load occurs in the month of May Year 2 of the production cycle having a solids discharge of 60.81 tons with a total nitrogen load of 11.87 tons over the month. The total nitrogen was modelled as a constant discharge of 383kg per day which includes both fish feed wastage and fish faeces.

A conservative worst-case approach was taken by modelling total nitrogen as a conservative solute with no decay rate. In reality soluble nitrogen is readily taken-up and assimilated in the water column through natural primary production by plants and organisms present. The simulation output is presented both as the computed maximum plume concentration envelope and also the tidal average plume concentration envelope, refer to Figures 25 and 26.

At the ten selected reference sites within the area of influence as per Figure 24 the statistical quantiles for the median, average, 95-percentile, 99-percentile and maximum nitrogen concentrations are presented in Tables 3.

The water quality objectives (WQO's) based on the Surface Water Regulations 1989 require for total oxidised Nitrogen/Dissolved Inorganic Nitrogen (DIN) a winter median limit in Coastal Waters (Salinity > 34.5 psu) of 0.17mg/l for high status coastal waters and 0.25mg/l for good status coastal waters. For transitional waters (salinity 0 – 35 psu) the recommended winter median limit varies from 2.6mg/l to 0.25mg/l (for salinities varying from 0 to 35psu).

The proposed farm site is located in coastal waters, whereas the transitional / estuarine zone are only confined to the inner head of the bay where the Kenmare Rivers enters it near Kenmare Town. No perceptible impact is predicted within the transitional waters and only low concentrations are predicted within the coastal waters both at the fish farm and in the medium and far fields.

The maximum predicted concentration occurs within the fish cages at Deenish Island Site and is predicted to be 0.535mg/l, the average concentration is 0.111mg/l N and the median concentration is 0.082 mg/l N. The predicted median (for which the standard applies) concentration at the farm cages and the resultant concentrations throughout the receiving waters meet the EQS DIN limit of 0.17mg/l N. The instantaneous maximum concentration of 0.535mg/l N at the cage site occurs only for a short period and only at a specific location

within the water column (c. 4m below the water surface). The median concentration outside of the proposed licensed area easily meets this EQS DIN standard of 0.17mg/l N being generally below 0.02 mg/l N at the site boundary and within a relatively short distance beyond this < 0.005mg/l.

Table 3 Predicted Total Nitrogen Concentration (mg/l) at Reference Sites for Maximum Production at Deenish Island

Solute Concentration statistics	Reference Sites				
	1	**2**	**3**	**4**	**5**
Average	0.111	0.022	0.008	0.020	0.010
Median	0.082	0.011	0.005	0.010	0.005
95-percentile	0.307	0.079	0.030	0.063	0.035
99-percentile	0.463	0.125	0.050	0.087	0.064
Maximum	0.535	0.199	0.126	0.141	0.107
	6	**7**	**8**	**9**	**10**
Average	0.008	0.002	0.002	0.003	0.004
Median	0.006	0.001	0.001	0.003	0.003
95-percentile	0.021	0.005	0.005	0.006	0.009
99-percentile	0.031	0.009	0.008	0.007	0.013
Maximum	0.052	0.012	0.011	0.011	0.017

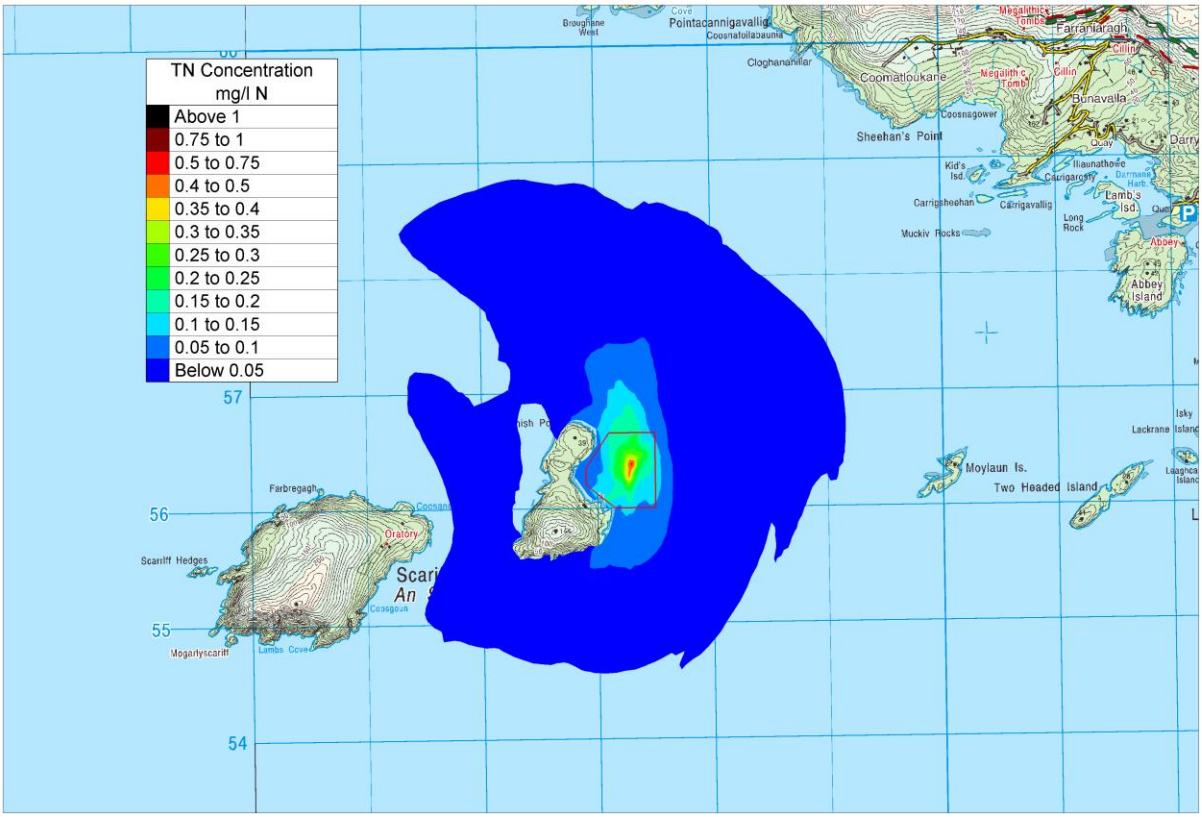

Figure 25: Predicted Maximum Total Nitrogen Concentration Envelope (mg/l N) for Deenish Island Farm Production Site.

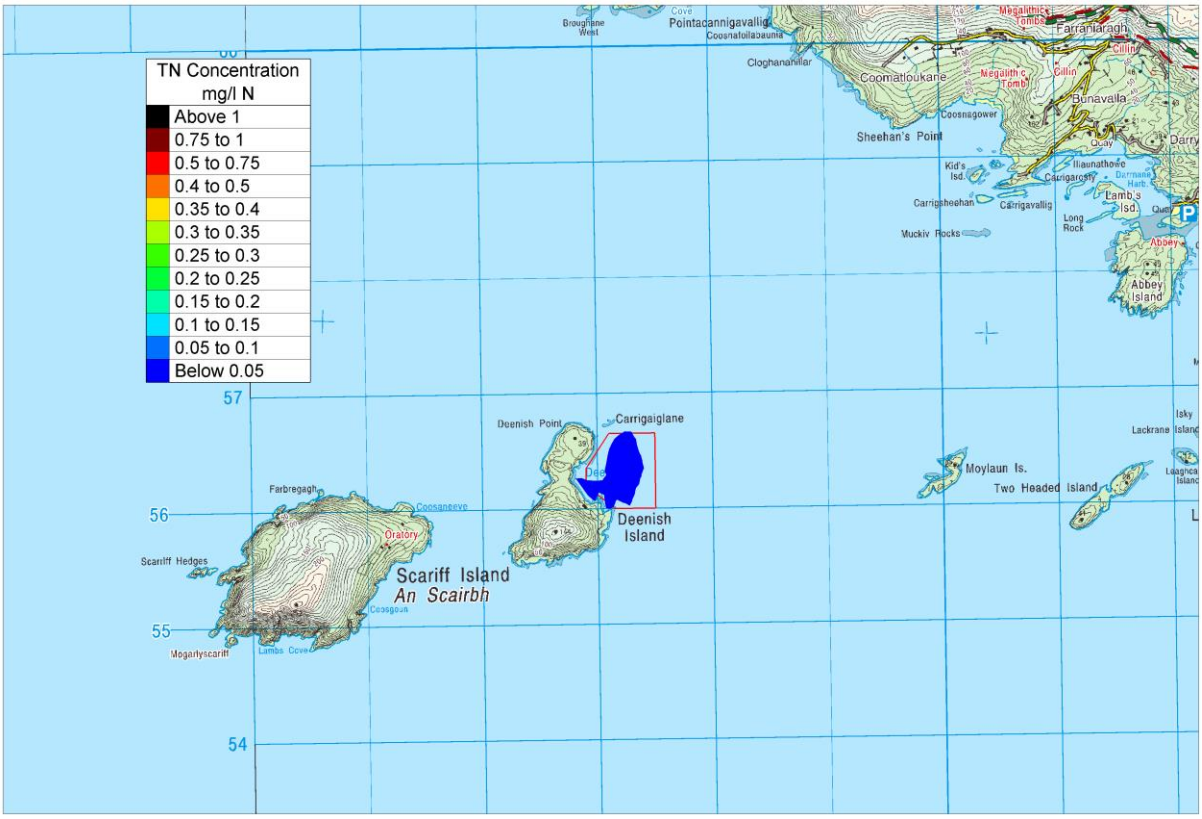

Figure 26: Predicted lunar mean Total Nitrogen Concentration Envelope (mg/l N) for Deenish Island Farm Production Site.

4.3 Phosphorous Simulation Results

Three-dimensional hydrodynamic simulations of the transport and dispersion of total phosphorous loading from the proposed fish farm production at Deenish Island in outer Kenmare Bay was performed using seven vertical layers in sigma coordinates and a variable horizontal mesh as described earlier. The solute loading was released as a continuous discharge into the water column at mid-height within fish cage depth (i.e. 4m below surface) and its fate, dispersion and transport modelled.

The production and feeding model of the proposed fish farm operations provides monthly biomass and feeding figures at both production and harvest sites. This production and feeding model was interrogated and found that the peak output load occurs in the month of May Year 2 of the production cycle having a solids discharge of 60.81 tons with a total phosphorous load of 1.77 tons over the month which was modelled as a constant discharge of (57.1kg per day).

A conservative worst-case approach was taken by modelling total phosphorous as a conservative solute with no decay rate. In reality soluble phosphorous is taken-up and assimilated through natural primary production by plants and organisms present in the water column. Phosphorous unlike nitrogen does not represent the limiting nutrient in coastal waters and therefore no Water Quality Standards apply in respect to phosphorous concentrations.

Soluble Phosphorous simulations were performed over a full 35day simulation period using a time step of 15seconds and outputting predicted plume results at 15minute interval over that period.

The simulation output is presented as the computed maximum plume concentration envelope and the tidal average plume concentration envelope, refer to Figures 27 and 28. The maximum plume concentration envelope plot represents the instantaneous maximum concentration both in the water column and over the horizontal mesh. It should be noted that such maximum concentrations at various computational nodes do not occur simultaneously in time and that the frequency and duration of occurrence is relatively low. The average plume concentration envelope represents the average concentration plume in the water column and over time and is reasonably similar in magnitude to the median concentration particularly over a 29day period.

At the ten selected reference sites within potential area of influence as per Figure 24 the statistical quantiles for the median, average, 95-percentile, 99-percentile and maximum Phosphorous concentrations are presented in Table 4.

The water quality objectives (WQO's) set out in the Surface Water Regulations 1989 give for Molybdate Reactive Phosphorous (MRP) give for transitional waters a winter median limit of 0.06mg P/l for transitional waters with salinity of 0 to 17psu and a winter median limit of 0.04mg P/l for salinity of 35psu. The transitional waters are well inland at the head of the estuary and not impacted by the proposed fish farm discharge plume.

Interrogation of the simulation results show that the predicted phosphorous concentrations are relatively low at a median value of 0.0123mg/l and fall well within the EQS median allowable limit of 0.04mg P/l set for transitional waters. In reality the fish farm site is located in coastal waters at the mouth to the bay which do not have any EQS limit for phosphorous.

Table 4 Predicted Total Phosphorous Concentration (mg/l) at Reference Sites for Maximum Production at Deenish Island

Solute Concentration statistics	Reference Sites				
	1	**2**	**3**	**4**	**5**
Average	0.0165	0.0033	0.0013	0.0029	0.0014
Median	0.0123	0.0016	0.0007	0.0015	0.0007
95-percentile	0.0458	0.0118	0.0045	0.0095	0.0052
99-percentile	0.0691	0.0187	0.0075	0.0130	0.0096
Maximum	0.0797	0.0297	0.0187	0.0210	0.0159
	6	**7**	**8**	**9**	**10**
Average	0.0012	0.0002	0.0003	0.0004	0.0006
Median	0.0009	0.0002	0.0002	0.0004	0.0004
95-percentile	0.0032	0.0007	0.0008	0.0009	0.0013
99-percentile	0.0046	0.0013	0.0012	0.0011	0.0019
Maximum	0.0078	0.0018	0.0016	0.0017	0.0026

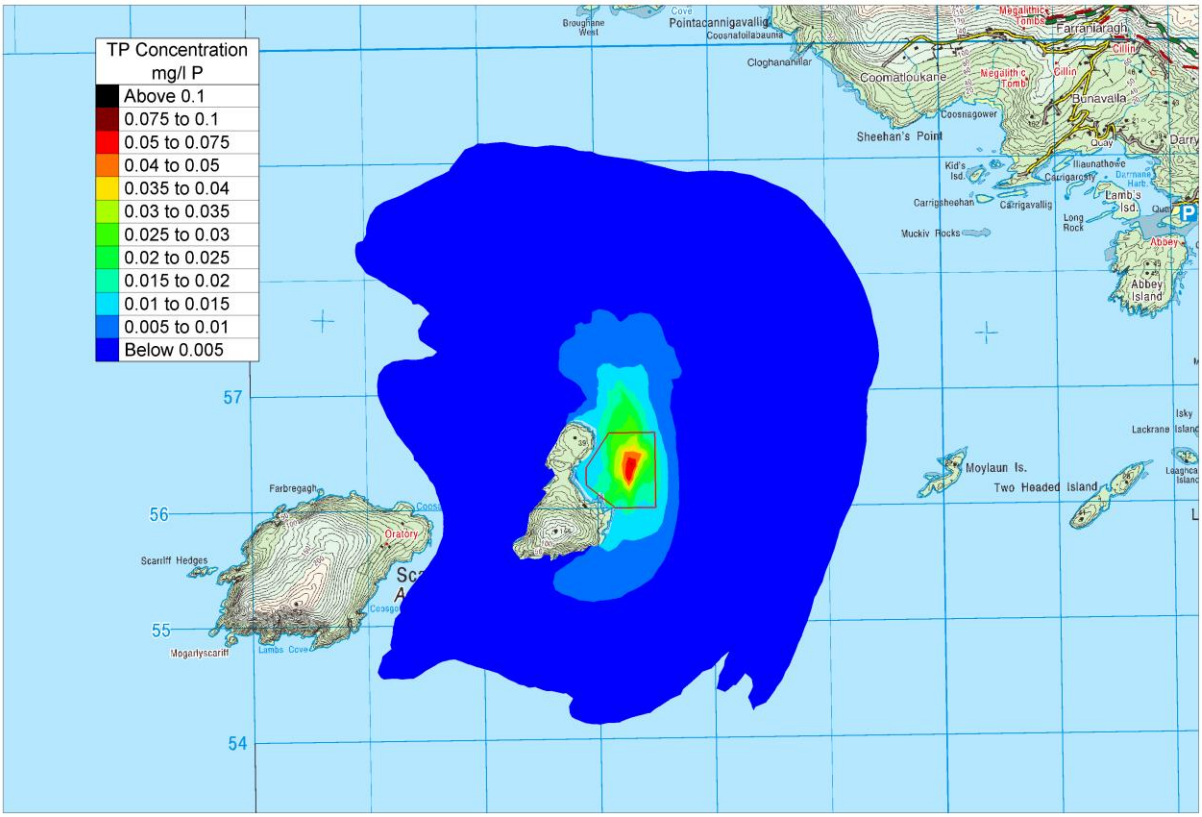

Figure 27: Predicted Maximum Total Phosphorous Concentration Envelope (mg/l P) for Deenish Island Farm Production Site.

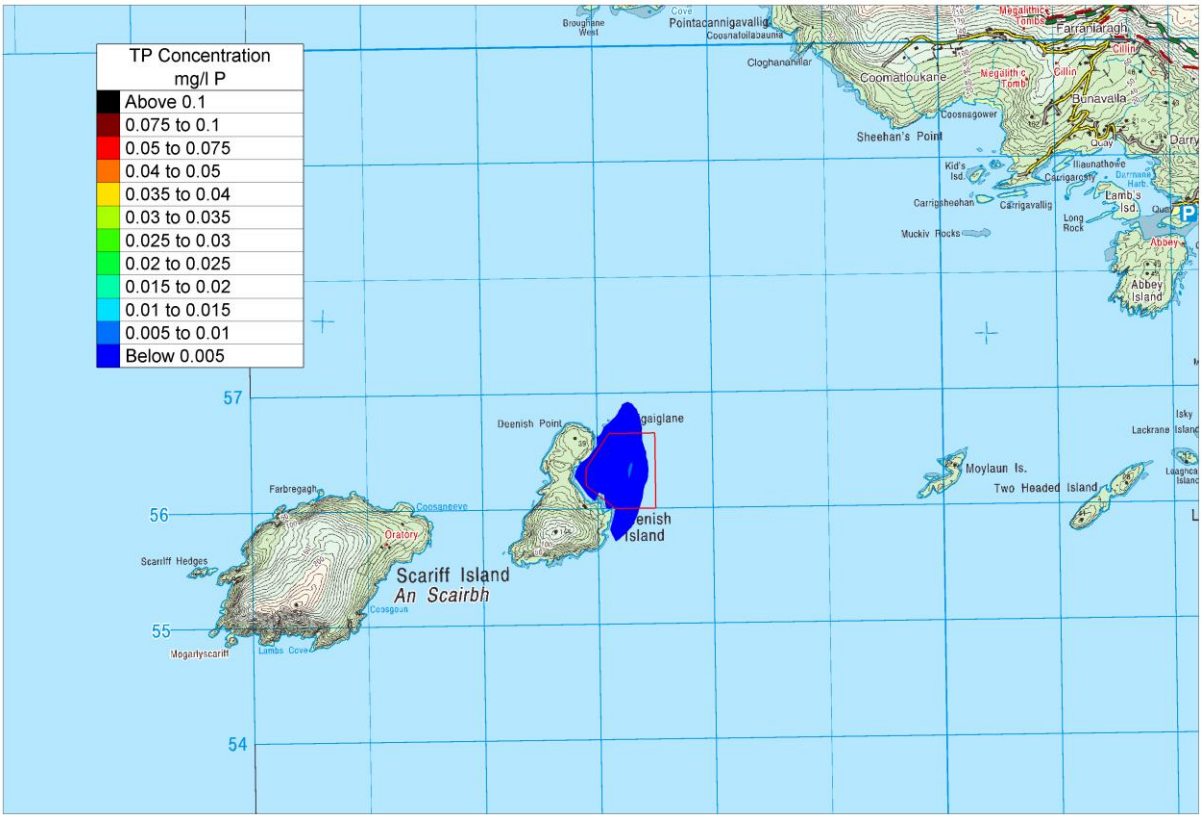

Figure 28: Predicted lunar mean Total Phosphorous Concentration Envelope (mg/l P) for Deenish Island Farm Production Site.

4.4 BOD Simulation Results

Three-dimensional hydrodynamic simulations of the transport and dispersion of total BOD load from the proposed salmon farm production at the Deenish Island Site in Kenmare Bay was performed using a seven vertical layer model, in sigma coordinates and a variable horizontal mesh as described earlier. The solute 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 production and feeding model of the proposed fish farm operations provides monthly biomass and feeding figures at the production site. This production and feeding model was interrogated and found that the peak output load occurs in the month of May Year 2 of the production cycle having a solids discharge of 60.81 tons with a total BOD load of 354.48 tons over the month which was modelled as a constant discharge of (11,434.8kg per day).

BOD simulations were performed over a full 35day lunar period using a time step of 15seconds and outputting predicted plume results at 15minute interval over that period. The hydrodynamics simulated were representative of a complete astronomical spring-neap-spring lunar cycle.

A BOD decay rate of 0.02 day^{-1} (typical decay rate at 10^{o} C in a temperate climate) was input to allow for a limited assimilation of BOD in the water column.

The simulation output is presented both as the computed maximum plume concentration envelope and also the average plume concentration envelope, refer to Figures 29 and 30. 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 occurrence is relatively low.

The average plume concentration envelope represents the average concentration plume in the water column and over time and is reasonably similar in magnitude (generally slightly higher) to the statistical median (50-percentile) concentration, particularly over a 28day lunar simulation period. At the ten selected reference sites within the potential plume extent as per Figure 24 the statistical quantiles for the median, average, 95-percentile, 99-percentile and maximum BOD concentrations are presented in Table 5 to provide more detail.

The water quality objectives (WQO's) based on the Surface Water Regulations 1989 for Biochemical Oxygen Demand (BOD) for Freshwater are maximum value of < 5mg/l and a recommended trigger action value (TAV) for an annual median < 2mg/l. There are no coastal standards for BOD set out but for transitional waters a 95-percentile concentration of < 4mg/l and a 98-percentile of less than 5mg/l.

The fish farm sites are located in coastal waters at the mouth of the bay and the transitional / estuarine zone is confined to the inner head of the bay which is not affected by the fish farm

discharge. The Inny Estuary transitional waters a number of km northeast of the Fish farm site is also not affected by the Fish Farm plume.

Interrogation of the simulation results show that the maximum BOD concentrations at the farm site cages is15.96mg/l O2 which exceeds the EQS limits of 4mg/l O_2. The tidal average concentration at the farm site cages is 3.1mg/l O_2. Immediately outside of the licenced area the predicted tidal average BOD concentrations vary between 0.2 to 0.7mg/l O_2 and the maximum BOD concentrations between 3 and 6mg/l O_2. The adjacent coastal waters surrounding the Denish Island area have predicted tidal average concentrations of 0.05 to 0.1mg/l and maximum concentrations of 0.3 to 0.5mg/l O_2.

The predicted BOD 95-percentile concentration at the boundary of the proposed Licensed site varies from 1mg/l to 2.4mg/l which are within the 4mg/l limits set for transitional waters.

Table 5 Predicted BOD Concentration (mg/l O_2) at Reference Sites for Proposed Maximum loading at Deenish Island

Solute Concentration statistics	Reference Sites				
	1	**2**	**3**	**4**	**5**
Average	3.313	0.671	0.252	0.584	0.286
Median	2.458	0.320	0.140	0.309	0.135
95-percentile	9.170	2.363	0.908	1.894	1.045
99-percentile	13.832	3.742	1.507	2.603	1.918
Maximum	15.963	5.953	3.752	4.197	3.193
	6	**7**	**8**	**9**	**10**
Average	0.233	0.049	0.057	0.086	0.111
Median	0.176	0.036	0.039	0.080	0.082
95-percentile	0.639	0.146	0.151	0.177	0.261
99-percentile	0.912	0.254	0.244	0.212	0.387
Maximum	1.552	0.357	0.320	0.336	0.517

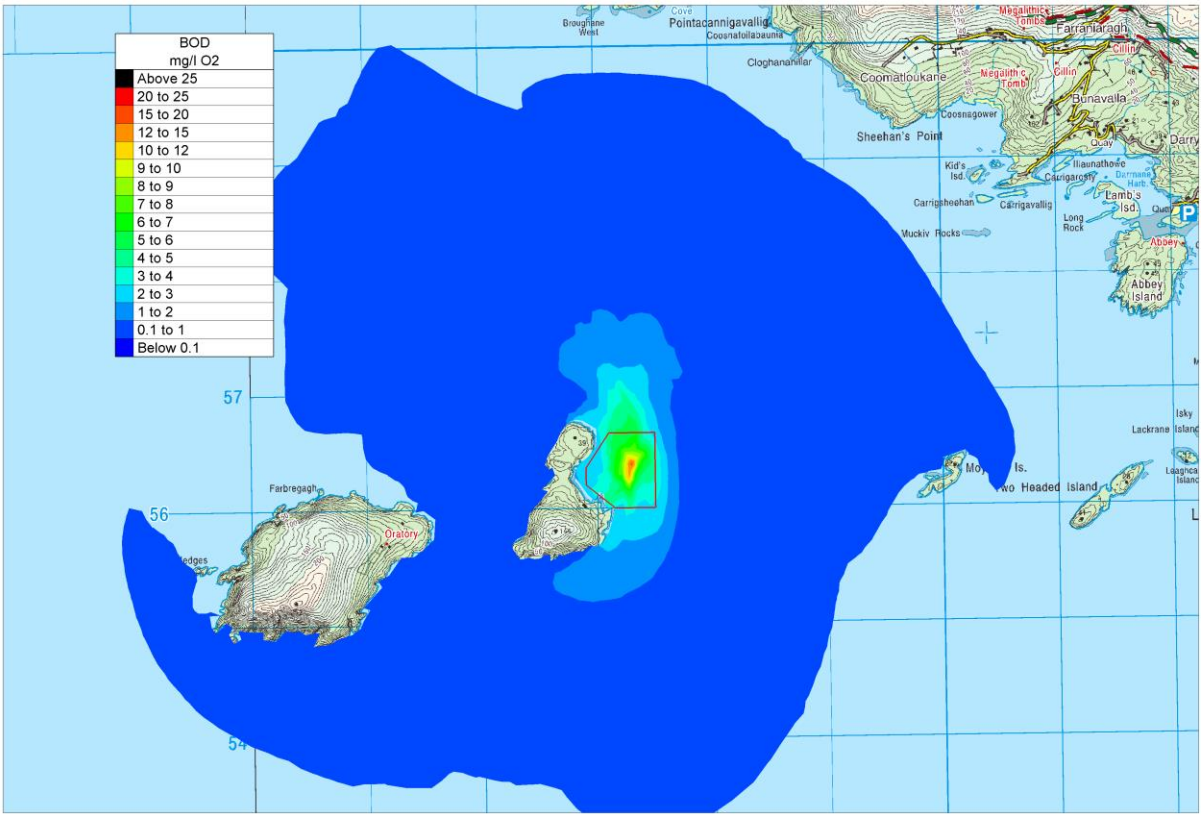

Figure 29: Predicted Maximum BOD Concentration Envelope (x1000 mg/l O2) for Deenish Island Farm Production Site.

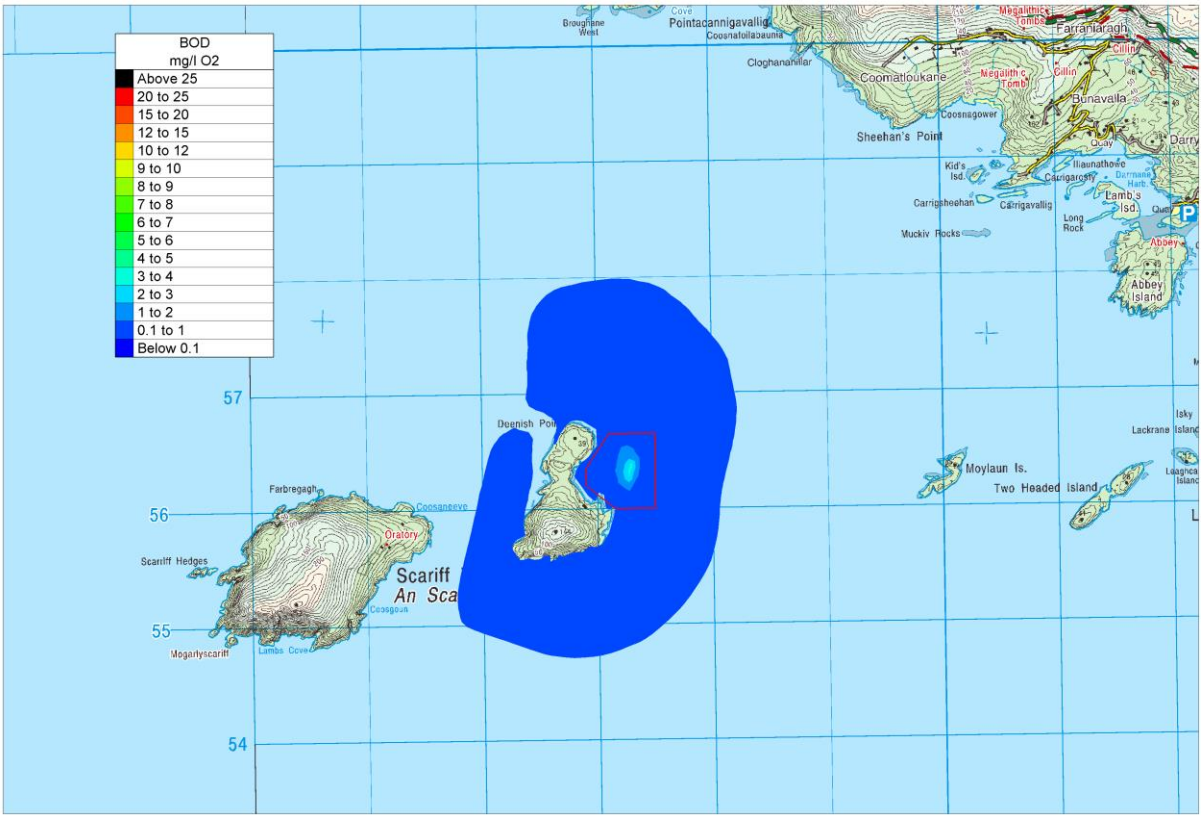

Figure 30: Predicted lunar mean BOD Concentration Envelope (x 1000 mg/l O2) for Deenish Island Farm Production Site.

4.5 Settleable Solids Deposition

Deposition of settleable solids was modelled using the 3-Dimensional Hydrodynamic model for the Production site at Deenish Island. The settleable solids were input as a continuous discharge into the water column at mid-cage depth and its subsequent advection and dispersion modelled both horizontally and vertically.

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 greatest settleable solids load occurs towards the end of the production cycle in the second year associated with the largest biomass. At this stage of production the larger 12mm feed pellets are used which have a rapid settling velocity of 15.5cm per second and therefore any pellets not consumed by the fish (3%) settle out almost instantaneously beneath the fish cages. The faecal waste represents the majority of the settled solids at 84% of the total settleable solids has a typical settling velocity of 3.2cm per second (settling rate recommended by SEPA for Salmon Farms).

The total settleable particulate load from the proposed production site is 64.0T/M (2064.5kg per day) which is 10.3T/M feed and 53.7T/M faecal waste and represents the largest monthly load associated with projected fishing stocks from the grow out model.

The simulations show localised deposition immediately beneath the farm cages and within the Licensed Site area. The predicted deposition rate at the Cages is 1.4mm per month which 1.68kg per m^2 of organic material per month or 54g per m^2 per day. Very Slight migration of settleable solids outside of the licenced production area to the north and south is predicted but the deposition rate is very low at 0.1 and 0.2mm per month immediately to the south and north of the licensed boundary respectively, refer to Figure 31.

The predicted Suspended solids concentration from the proposed farming activity are low with a maximum concentration at the cage sites of 0.38mg/l and a tidal average concentration of 0.19mg/l, refer to Figures 32 and 33.

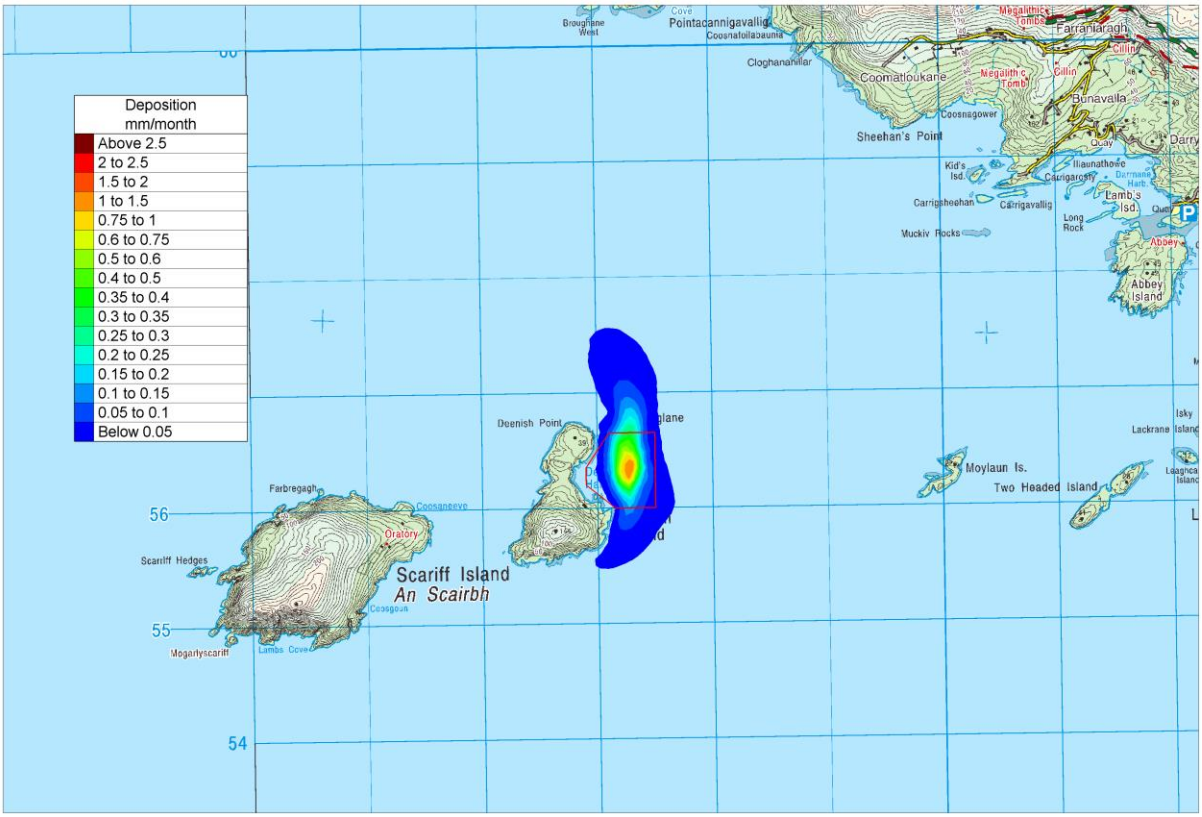

Figure 31: Predicted maximum monthly settleable solids sedimentation rates at Deenish Farm Production Site.

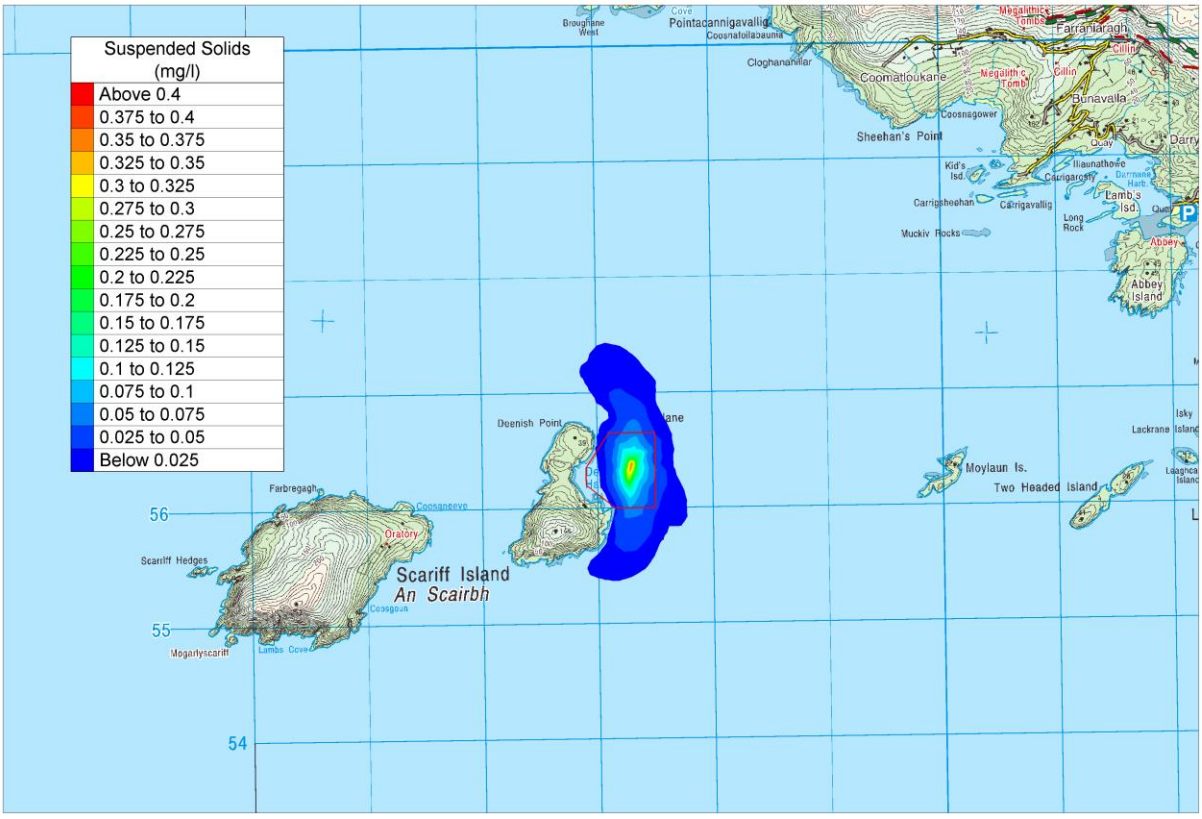

Figure 32: Suspended Solids concentrations – Maximum concentration envelope

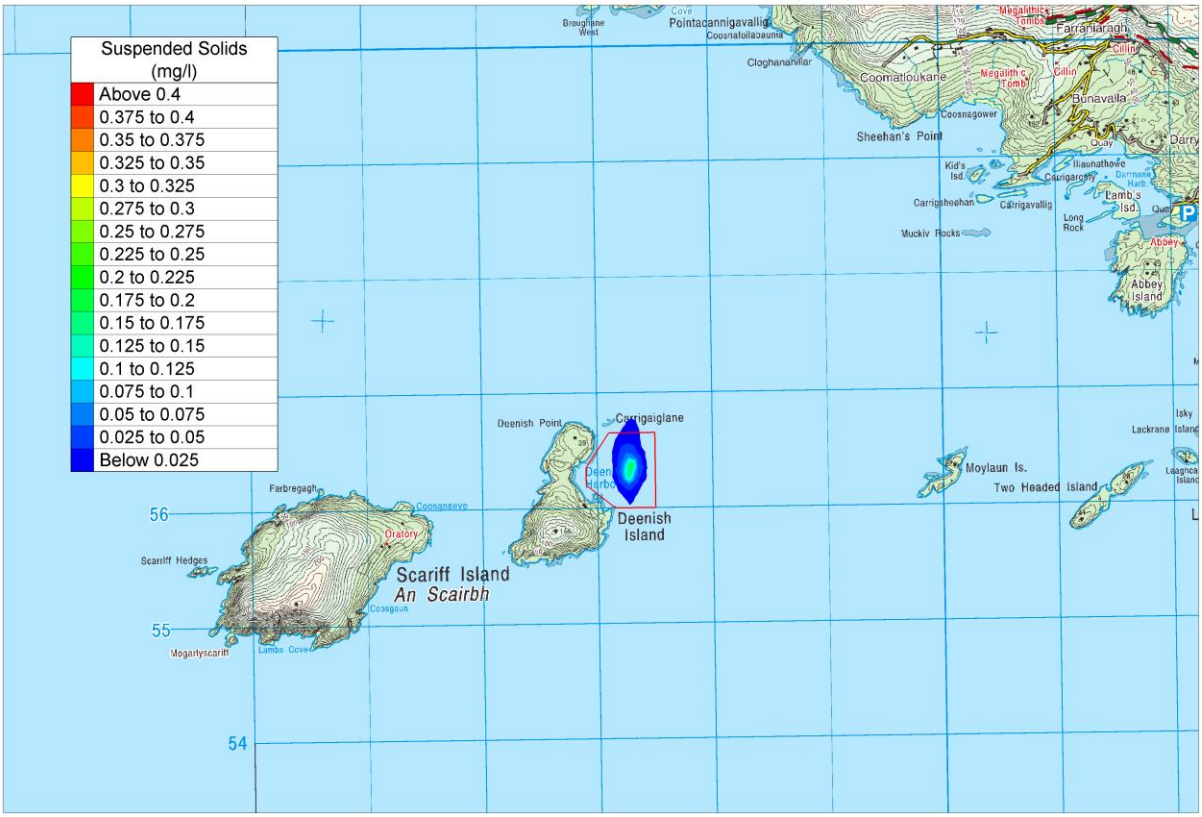

Figure 33: Suspended Solids concentrations – tidal average concentration envelope

4.6 Sea Lice Larvae Dispersion

Three-dimensional hydrodynamic simulations of the transport and dispersion of Sea Lice (Lepeophtheirus salmonis) Larvae from the proposed salmon farm production at Deenish Island in Kenmare Bay was performed using a seven 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.

For the purposes of modelling larval lice dispersal from the salmon farm sites in the bay it was assumed that the average number of adult female Lice per fish is 1 and that each adult female louse releases on average 250 viable Nauplius I Larvae into the water column per hatch. The Nauplius I will metamorphose into Nauplius II larvae which then metamorphoses into the infestive Copepodid larvae stage. These three larval stages are free living in the water column and can be treated as passive particles being advected and dispersed by the ambient currents. The infestive Copepodid larvae stage occurs within approximately 4 days post hatch and generally has a maximum longevity of approximately 10days at typical spring time temperatures. Water temperature affects the die-off rates of the Copepodid larvae. The ability of the Copepodids to latch onto a host is thought to diminish with age. An Exponential decay is used to model the longevity of the larvae with a decay coefficient of 0.241 day-1 (Amundrud and Murray 2009). Other sea lice larvae dispersion modelling studies (Cawley, 1998) used a higher decay rate of 0.364 day-1 based on Johnson & Altibright's (1991) laboratory research into survival rates for temperatures of 12degrees and salinity of 30 to 35 psu.

The department set trigger level for lice treatment during the susceptible spring period (when wild salmon migrate) is 0.5 ovigerous female lice per fish (at bi-weekly monitoring). Therefore, the assumption of 1 ovigerous female lice per fish for baseline simulations of the dispersal of larvae from the Salmon Farm within Kenmare Bay and the potential to infect wild salmon is considered to be reasonably conservative.

The March Year 2 production and harvesting Fish numbers were used has a maximum total of adult fish numbers of 561,041 at the Deenish Island Site. The modelling used 1 louse per Adult Fish producing 250 eggs per louse gives the following average input rate of 52.4 larvae released per second.

The sea lice larvae simulations were performed over a 35day period which included a 6day warm period followed by a 29day lunar cycle lunar period using a time step of 15seconds and outputting predicted plume results at 15minute interval over that period. The hydrodynamics simulated were representative of a complete spring-neap-spring lunar cycle.

The simulation output is presented both as the computed maximum plume concentration envelope and also the average plume concentration envelope, refer to Figures 34 and 35. 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 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 29day simulation period. At the ten selected reference sites as per Figure 24 the statistical quantiles for the median, average, 95-percentile, 99-percentile and maximum concentrations are presented in Tables 6.

The simulations clearly show that lice larval numbers reduce dramatically in concentration away from the farm sites with tidal average concentrations less than 0.1 larvae per m^3 and generally not discernible from background concentrations remote from the licensed farm sites. The instantaneous maximum concentrations just outside of the licensed Farm site is typically at 1 to 2 No /m^3 and rapidly reduces to trace numbers. The predicted maximum larvae concentrations at Production Site is 6.2 No. /m^3.

Table 6 Predicted Nauplius I Concentration (µg/l) at Reference Sites for Maximum Production at Deenish Island

Solute Concentration statistics	Reference Sites				
	1	**2**	**3**	**4**	**5**
Average	1.458	0.228	0.095	0.208	0.086
Median	1.112	0.105	0.041	0.084	0.030
95-percentile	3.771	0.793	0.384	0.749	0.371
99-percentile	5.001	1.452	0.601	1.140	0.604
Maximum	6.175	1.940	0.800	1.547	1.032
	6	**7**	**8**	**9**	**10**
Average	0.067	0.009	0.014	0.019	0.025
Median	0.041	0.003	0.007	0.017	0.017
95-percentile	0.226	0.045	0.048	0.043	0.069
99-percentile	0.319	0.097	0.071	0.065	0.095
Maximum	0.443	0.121	0.092	0.099	0.114

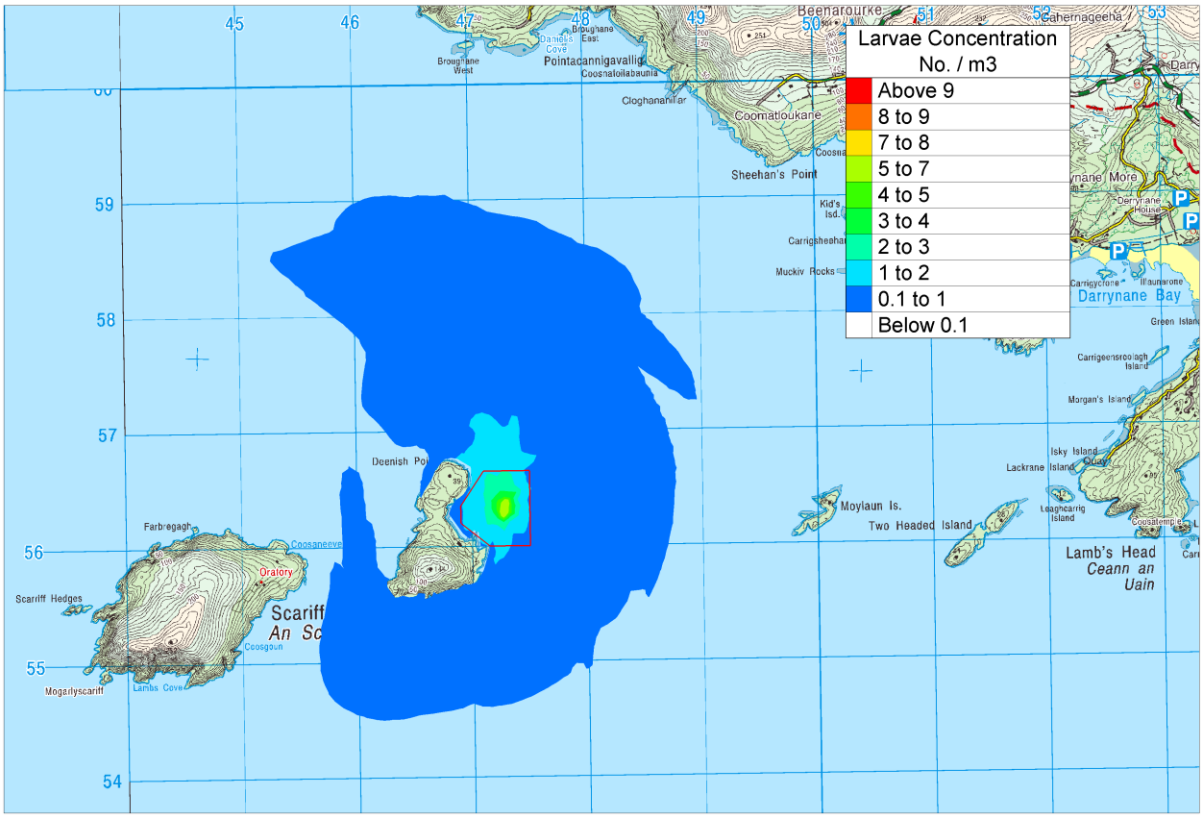

Figure 34: Predicted tidal maximum Nauplius I larvae numbers (No./m3) from the Deenish Island Farm Production Site.

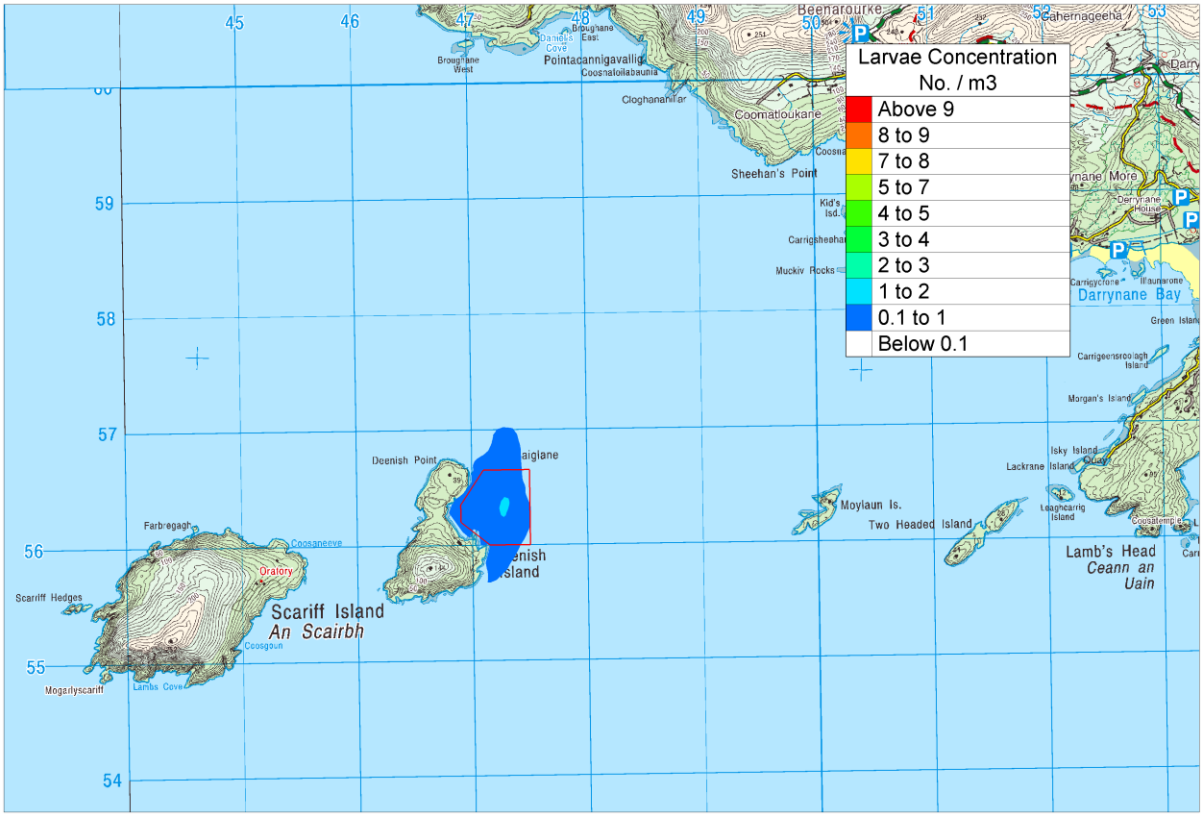

Figure 35: Predicted tidal mean Nauplius I larvae numbers (No./m3) from the Deenish Island Farm Production Site.

5 Conclusions

5.1 General

A robust 3-dimensional hydrodynamic and transport dispersion model of Kenmare Bay and approaches was developed so as to simulate the likely transport patterns and the potential pollutant concentrations within the Bay from proposed farmed fish production at Deenish Island. The predicted hydrodynamics are considered to reasonably reproduce the mixing characteristics of the Bay and the generally reflect the moderately slack flow conditions at the mouth of Kenmare Bay.

Solute dispersion of Nitrogen, Phosphorous and BOD were carried out modelling for a complete 29day lunar cycle. Settleable solids deposition modelling and sea lice larvae dispersion analyses were also performed.

5.2 Nitrogen

The water quality objectives (WQO's) based on the Surface Water Regulations 1989 require for total oxidised Nitrogen/Dissolved Inorganic Nitrogen a winter median limit in Coastal Waters (Salinity > 34.5 psu) of 0.17mg/l for high status coastal waters and 0.25mg/l for good status coastal waters. For transitional waters (salinity 0 – 35 psu) the recommended winter median limit varies from 2.6mg/l to 0.25mg/l. The Deenish Island fish farm site is located in the outer coastal waters area of the bay and sufficiently remote from the inner transitional / estuarine waters of Kenmare Bay and also the Inny Estuary.

Interrogation of the simulation results show that the predicted median / average nitrogen concentrations both nearfield and far field are small and fall well within the Environmental Quality Standard (EQS) of 0.17mg/l for high status coastal waters. Even at the instantaneous maximum concentration envelope within the bay, both single and combined with Inishfarnard Sites, are well less than the EQS limit of 0.17mg/l DIN concentration. The maximum predicted concentration which occurs within the fish cages at Deenish Island Site is predicted to be 0.535mg/l which is above the EQS limit of 0.17mg/l DIN. The instantaneous maximum occurs only for a short period and only at a specific location within the water column (4m below the water surface). The tidal average is 0.111mg/l N for which the standard relates to meets this EQS standard within the Farm site and is well below this limit outside of the farm site at predicted tidal average concentrations of less than 0.05mg/l.

The maximum predicted concentration occurs within the fish cages at Deenish Island Site and is predicted to be 0.535mg/l, the average concentration is 0.111mg/l N and the median concentration is 0.082 mg/l N. The predicted median (for which the standard applies) concentration at the farm cages and the resultant concentrations throughout the receiving waters meet the EQS DIN limit of 0.17mg/l N. The instantaneous maximum concentration of 0.535mg/l N at the cage site occurs only for a short period and only at a specific location within the water column (c. 4m below the water surface). The median concentration outside of the proposed licensed area easily meets this EQS DIN standard of 0.17mg/l N being

generally below 0.02 mg/l N at the site boundary and within a relatively short distance beyond this < 0.005mg/l.

5.3 Phosphorous

The phosphorous dispersion simulation results show that the predicted total phosphorous concentrations both nearfield and farfield are very small and fall well within the EQS median limit of 0.04mg P/l set for transitional waters. In reality the fish farm site is located in coastal waters which does not have any EQS limit for phosphorous (not a limiting nutrient).

The water quality objectives (WQO's) set out in the Surface Water Regulations 1989 give for Molybdate Reactive Phosphorous (MRP) give for transitional waters a winter median limit of 0.06mg P/l for transitional waters with salinity of 0 to 17psu and a winter median limit of 0.04mg P/l for salinity of 35psu.

Interrogation of the simulation results show that the predicted phosphorous concentrations are relatively low at a median value of 0.0123mg/l and fall well within the EQS median allowable limit of 0.04mg P/l set for transitional waters. In reality the fish farm site is located in coastal waters at the mouth to the bay which do not have any EQS limit for phosphorous. Outside of the licensed area the predicted Phosphorous concentrations are low and well within P limits set for freshwater and transitional waters.

5.4 BOD

The BOD dispersion simulation results show that the predicted average BOD concentration is locally high in the vicinity of the proposed Licenced area but remotely reduces to to low levels due to good dispersion within the deep coastal waters.

Interrogation of the simulation results show that the maximum BOD concentrations at the farm site cages is15.96mg/l O2 which exceeds the EQS limits of 4mg/l O_2. The tidal average concentration at the farm site cages is 3.1mg/l O_2. Immediately outside of the licenced area the predicted tidal average BOD concentrations vary between 0.2 to 0.7mg/l O_2 and the maximum BOD concentrations between 3 and 6mg/l O_2. The adjacent coastal waters surrounding the Deenish Island area have predicted tidal average concentrations of 0.05 to 0.1mg/l and maximum concentrations of 0.3 to 0.5mg/l O_2.

The water quality objectives (WQO's) based on the Surface Water Regulations 1989 for Biochemical Oxygen Demand (BOD) for Freshwater are maximum value of < 5mg/l and a recommended trigger action value (TAV) for an annual median < 2mg/l. There are no coastal standards for BOD set out but for transitional waters a 95-percentile concentration of < 4mg/l and a 98-percentile of less than 5mg/l. The fish farm sites is located in the outer bay coastal waters section with the transitional / estuarine zone is only confined to the inner head of the bay and consequently no BOD EQS applies to the site. The predicted BOD 95-

percentile concentration at the boundary of the proposed Licensed site varies from 1mg/l to 2.4mg/l which are within the 4mg/l limits set for transitional waters.

5.5 Settleable Solids

The greatest settleable solids load occurs towards the end of the production cycle in the second year associated with the largest biomass. The total settleable particulate load from the proposed production site is modelled at 64.0 tonnes per month (2064.5kg per day) which is 10.3 tonnes per month feed waste and 53.7 tonnes per month faecal waste and represents the largest monthly load associated with projected fishing stocks from the grow out model.

The simulations show localised deposition immediately beneath the farm cages and within the Licensed site area. The predicted maximum deposition rate at the Cages is 1.4mm per month of organic material which represent 1.68kg per m^2 of organic material per month or 54g per m^2 per day. Very slight migration of settleable solids outside of the licenced production area to the north and south is predicted but the deposition rate is very low at 0.1 and 0.2mm per month immediately to the south and north of the licensed boundary respectively.

The predicted suspended solids concentration from the proposed farming activity are low with a maximum concentration at the cage sites of 0.38mg/l and a tidal average concentration of 0.19mg/l.

5.6 Sea Lice Larvae

The simulations clearly show that lice larval numbers reduce dramatically in concentration away from the farm sites with tidal average concentrations less than 0.1 larvae per m^3 and generally not discernible from background concentrations remote from the licensed farm sites. The instantaneous maximum concentrations just outside of the licensed Farm site is typically at 1 to 2 No /m^3 and rapidly reduces to trace numbers. The predicted maximum larvae concentrations at Production Site is 6.2 No. /m^3.

5.7 Combined Impacts with the Inisfarnard Licensed Farm Site

The simulations shows no potential combined impacts on DIN, MRP, BOD, and sea lice larvae concentrations from combined fish farm activities at both the Deenish Island and Inishfarnard Sites as the respective plumes do not combine being separated by the deep Kenmare Bay channel.

Appendix 8

AA Conclusion Statement by Licensing Authority for Kenmare River Special Area of Conservation

Appropriate Assessment Conclusion Statement by Licensing Authority for aquaculture activities in Kenmare River Special Area of Conservation (SAC) (site code 2158)

This Conclusion Statement outlines how it is proposed to licence and manage aquaculture activities in the above Natura site in compliance with the EU Habitats Directive. Aquaculture in this Natura Site will be licensed in accordance with the standard terms and conditions as set out in the aquaculture licence templates. These are available for inspection on the Department's website at: https://www.agriculture.gov.ie/seafood/aquacultureforeshoremanagement/aquaculturelicensing/aquacultureandforeshorelicencetemplates/
The licences will also incorporate specific conditions so as to accommodate Natura requirements, as appropriate, in accordance with the principles set out in this document.

An Appropriate Assessment report of aquaculture in Kenmare River Special Area of Conservation (SAC) (Site Code: 02158) has been prepared by the Marine Institute on behalf of the Department of Agriculture, Food and the Marine. This report assessed the potential ecological interactions of aquaculture and fisheries activities on the Conservation Objectives of the site. From an aquaculture perspective the information upon which the Appropriate Assessment is based is the definitive list of applications and extant licences for aquaculture available at the time of assessment.

Description of the aquaculture projects

The projects involve the renewal of existing aquaculture activity and the licensing of new aquaculture activity within the SAC. Aquaculture is practiced in a number of locations within the SAC with a focus on shellfish species (mussels, oysters, scallops and clams) and finfish (salmon). Mussels are the predominant shellfish species cultured within the SAC, for example, Killmakilloge and Ardgroom Harbours produce significant amounts of mussel utilising suspended long-lines. There are also a number of sites dedicated to the culture of Atlantic Salmon.

Conservation Features for Kenmare River SAC

Kenmare River is designated as a SAC under the Habitats Directive. This SAC is designated for the habitats Large Shallow Inlet and Bay (1160), Reefs (1170) and Submerged Caves (8330). A number of coastal community types can also be found in the SAC, including those that are sensitive to pressures, which might arise from aquaculture, such as Maerl, seagrass and kelp reefs. The SAC is also

considered an important site for two mammal species, Harbour Seal and the Otter.

Appropriate Assessment

The function of the Appropriate Assessment is to determine if the ongoing and proposed aquaculture activities are consistent with the Conservation Objectives for the site. The National Parks and Wildlife Service (NPWS) provide guidance on interpretation of the Conservation Objectives which are, in effect, management targets for habitats and species in 'Natura' sites. The assessment of activities was informed by this guidance, which is scaled relative to the anticipated sensitivity of the habitats and species to disturbance by the proposed activities. Some activities are deemed to be wholly inconsistent with the long-term maintenance of certain sensitive habitats while other habitats can tolerate a range of activities. For the practical purpose of management of sedimentary habitats a 15% threshold of overlap between a disturbing activity and a habitat is given in the NPWS guidance. Below this threshold disturbance is deemed to be non-significant. Disturbance is defined as that which leads to a change in the characterizing species of the habitat (which may also indicate change in structure and function). Such disturbance may be temporary or persistent in the sense that change in characterizing species may recover to pre-disturbed state or may persist and accumulate over time.

Findings and Recommendations of the Article 6(3) Appropriate Assessment

Aquaculture and Habitats:

The appropriate assessment finds that the majority of activities, at the current and proposed or likely future scale and frequency of activity are consistent with the Conservation Objectives for the Annex 1 Habitats, with the following exceptions:

1. Within the Kenmare River SAC there is an expired licence (no renewal received) for the culture of Scallops on the seabed. This overlapped three keystone communities, '*Zostera* dominated community', '*Maerl* dominated community' and '*Pachycerianthus multiplicatus* community'. Culture of Scallop on the seabed is deemed disturbing to such community types. As key contributors to biodiversity and being sensitive to disturbance these community types must be afforded a high degree of protection and no overlap with a disturbing activity can be tolerated.

2. 'Maerl dominated community' occurs in certain areas (Ardgroom and Killmakilloge Harbours) which are outside of the Qualifying Interests for which the Kenmare River SAC was designated but are still within the SAC

boundary. Maerl, the characterising species of this community, is listed as an Annex V species and as it is within the SAC boundary it must be afforded protection. Suspended mussel culture in Ardgroom Harbour spatially overlaps (1.84%) this community type and is considered disturbing. As a key contributor to biodiversity and being sensitive to disturbance this community type is afforded a high degree of protection and no overlap with a disturbing activity can be tolerated.

3. *'Zostera*-dominated community', as a key contributor to biodiversity and which is sensitive to disturbance should be afforded a high degree of protection i.e. thresholds for impact on these habitats is low and any significant anthropogenic disturbance should be avoided.

Aquaculture and Species:

The appropriate assessment acknowledges that the favourable conservation status of the Harbour Seal has been achieved given the current levels of aquaculture production within the SAC. On this basis the current levels of licensed aquaculture are considered non-disturbing to harbour seal conservation features. The following are the exceptions:

- In Coongar Harbour an oyster farm (licensed) and an application site for mussel culture is in very close proximity to a seal moulting site. The seal site in question has multiple recordings of seals and, therefore, would be considered an important location. The aquaculture site in question has structures confined to the northern portion of the site and cannot expand beyond this immediate area based on the topography of the site. This ensures that the activity will not occur in close proximity to the seal haul-out location. An expansion of intertidal aquaculture activity to areas in the immediate vicinity of the haul out locations would likely increase the risk of disturbance of the seals during the moulting period. The mussel culture site application is an expansion of existing operations and it is likely that seals will be habituated or tolerant of disturbance from this activity;

- In Ardgroom Harbour a mussel farm overlaps a seal site (breeding). A single sighting was recorded at the mussel culture site during 2000 and 2001 – it is assumed, given the lack of natural structures at the site in question, that the seal was hauled out on mussel rafts. The site in question has been licensed (and active) since 1992.

The appropriate assessment found that the aquaculture activities proposed do not pose a threat to the Otter or migrating salmon in the Kenmare River SAC.

Mitigation

Taking account of the recommendations of the Appropriate Assessment, as well as additional technical/scientific observations, the following measures are being taken in relation to licensing in this SAC.

- The overlap of 'scallop culture' with sensitive communities identified in the assessment report is noted. While the scallop culture had been licensed, the licence has expired and no renewal application has been received. The principles that will apply to any further applications for aquaculture in this area are as follows:
  i. No overlap with sensitive habitats will be permitted
  ii. There will be an additional requirement for a sufficient buffer zone to allow for mapping resolution and/or visual enforcement of exclusion

- With one exception, the AA found that the current levels of licensed shellfish and finfish culture and proposed applications are considered non-disturbing to harbour seal conservation features. The exception is the intertidal oyster culture site in Coongar Harbour. If licensing is to be considered for this site, it will be necessary to redraw the site boundaries to exclude the area overlapping the seal haul-out locations to mitigate any disturbance risk to seals.

- A finfish culture site within Kilmakilloge Harbour is in close proximity to designated seal sites. Seal interactions with marine finfish cages have been identified. The risk to seals (as predators) result from their interaction with netting if incorrectly configured. In terms of mitigation and in order to minimise the risk the operator will be instructed to employ a range of management actions including stock management (density control, regular removal of mortalities from cages), use of seal blinds and appropriate net tensioning.

- Aquaculture activity (suspended mussel culture) within Ardgroom Harbour spatially overlaps (1.84%) with the Maerl dominated community and may have negative effects on the distribution and quality of this community type. If licensing is to be considered for this site, it will be

necessary to redraw the site boundaries to exclude the area overlapping the Maerl dominated community, allowing for a suitable buffer zone.

- The location of an intertidal oyster cultivation operation over a *Zostera* bed is considered disturbing. This activity overlaps 18.05% of this community type within the SAC. Given the highly sensitive nature of this community type any activity is likely to have impact either by shading by trestles on seagrass or compaction by transport routes to/through the trestles and increased organic enrichment. It is not proposed to licence this site.

- A licence condition requiring strict adherence to the identified access routes over intertidal habitat in order to minimise species/ habitat disturbance will be required for all relevant sites.

- A licence condition requiring that the licensed and adjoining areas shall be kept clear of all redundant structures (including apparatus, equipment and/or uncontained stock), waste products and operational litter or debris, with provisions for the prompt removal and proper disposal of such material will be required for all relevant sites.

- A licence condition requiring full implementation of the measures set out in the draft Marine Aquaculture Code of Practice prepared by Invasive Species Ireland (e.g. http://invasivespeciesireland.com/cops/aquaculture) will be required for all relevant sites .

- The movement of stock in and out of the Kenmare River SAC should adhere to relevant fish health legislation will be required for all relevant sites.

- The use of updated and enhanced Aquaculture and Foreshore Licences containing terms and conditions which reflect the environmental protection required under EU and National law will be required for all relevant sites;

Conclusion

The Licensing Authority is satisfied that, given the conclusions and recommendations of the Appropriate Assessment process, a decision can be taken in favour of licensing existing and proposed aquaculture operations in Kenmare River SAC, subject to the implementation of the mitigation measures outlined above and other licensing related considerations.

Accordingly, the Licensing Authority is satisfied that by not licensing overlaps with *Zostera* and *Maerl* and other sensitive communities the proposed licensing is not likely to have a significant effect on the integrity of Kenmare River SAC.

September 2019

Appendix 9

Special Areas of Conservation and Special Protection Areas

Special Areas of Conservation

G**lengarriff Harbour and Woodland SAC (000090) -** Located to the south and north-west of Glengarriff Village in west Cork, this site consists of a glacial valley opening out into a sheltered bay with rocky islets. The valley contains old oak woodland and alluvial forest. The underlying rock of the area is Old Red Sandstone, with the soil varying from acid brown earths to alluvial brown earths and peat. The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes): [91A0] Old Oak Woodlands [91E0] Alluvial Forests*. [1024] Kerry Slug (*Geomalacus maculosus*), [1303] Lesser Horseshoe Bat (*Rhinolophus hipposideros*), [1355] Otter (*Lutra lutra*) and [1365], Common (Harbour) Seal (*Phoca vitulina*). Significant effects to Common (Harbour) Seal could not be screened out. Conservation Objectives and conservation attributes and targets set for the species are included below:

Conservation Objective : To maintain the favourable conservation condition of Harbour Seal in the SAC, which is defined by the following list of attributes and targets		
Attribute	**Measure**	**Target**
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.
Moulting behaviour	Moult haul-out sites	Conserve the moult haulout sites in a natural condition.
Resting behaviour	Resting haul-out sites	Maintain the resting haulout sites in a natural condition.
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the sit
Conservation Objective : To maintain the favourable conservation condition of Otter in the SAC, which is defined by the following list of attributes and targets		
Attribute	**Measure**	**Target**
Distribution	Percentage of positive survey sites	No significant decline
Extent of terrestrial habitat	Hectares	No significant decline
Extent of marine habitat	Hectares	No significant decline
Extent of freshwater (river) habitat	Kilometers	No significant decline

Extent of freshwater (lake/lagoon) habitat	Hectares	No significant decline
Couching sites and holts	Number	No significant decline
Fish biomass available	Kilograms	No significant decline

Kenmare River SAC (002158) is designated for the Annex II marine mammal species Common (Harbour) Seal. Common seal has been found to frequent rocky islets near Sneem, Templenoe and Castle Cove, as well as Brennel Island, Illaunsillagh, Kilmackilloge Harbour and Ballycrovane. Potential significant effects to Harbour Common seal could not be screened out. Conservation Objectives and conservation attributes and targets for the species are included below.

Kenmare River SAC [002158] (NPWS, 2013)		
Conservation Objective : To maintain the favourable conservation condition of Harbour Seal in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.
Moulting behaviour	Moult haul-out sites	Conserve the moult haulout sites in a natural condition.
Resting behaviour	Resting haul-out sites	Maintain the resting haulout sites in a natural condition.
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the sit

Roaringwater Bay and Island SAC (000101) is a wide, shallow bay located on the south-west coast of Ireland. The SAC includes the immediate coastline on the mainland from Long Island to Baltimore, together with the whole bay and most of the islands (NPWS 2014). Some of the larger islands included are Sherkin Island, Cape Clear Island, Heir Island, Horse Island, Castle Island and Long Island. Grey Seal is present at the site throughout the year during all aspects of its annual life cycle which includes breeding, moulting, non-breeding, foraging and resting phases. A minimum population for all ages was estimated at 116-149 in 2005. Roaringwater Bay and Islands SAC (000101) may be one of the most important sites in Ireland for Harbour Porpoise (NPWS 2014). Harbour Porpoise in Irish waters are largely resident and observations have shown that they are regular in the waters of Roaringwater Bay. Most observations are in the autumn,

when more than 100 individuals have been recorded in a day. The population has been estimated (in 2008) to be 117-201 individuals. Potential significant effects to the following Annex II species could not be screened out; grey seal and harbour porpoise. Conservation Objectives and conservation attributes and targets for the grey seal and harbour porpoise are included below.

Roaringwater Bay and Islands SAC [000101] (NPWS, 2011)		
Conservation Objective : To maintain the favourable conservation condition of Grey Seal in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.
Moulting behaviour	Moult haul-out sites	Conserve the moult haulout sites in a natural condition.
Resting behaviour	Resting haul-out sites	Maintain the resting haulout sites in a natural condition.
Population composition	Number of cohorts	The grey seal population occurring within this site should contain adult, juvenile and pup cohorts annually
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the sit
Conservation Objective : To maintain the favourable conservation condition of Harbour Porpoise in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the sit

Blasket Islands SAC (00172) is situated at the end of the Dingle peninsula in Co. Kerry (NPWS 2013). The site includes all of the islands in the group as well as a substantial area of the surrounding seas. The site has a large grey seal population (648-833 breeding in 2005; one-off moult count of 989 seals in 2007). This is one of the largest populations in the country and represents about one-third of the Irish population. The seals breed on boulder beaches and caves on several of the islands. The site is of importance for Harbour Porpoise, a species which has a regular presence in Blasket Sound (NPWS 2013). A population estimate in 2008 gave a figure of 267-477 individuals. Potential significant effects to the Harbour Porpoise and Grey Seal could not be screened out; Conservation Objectives and conservation attributes and targets for the grey seal and harbour porpoise are included below.

Blasket Islands SAC [002172] (NPWS, 2014)		
Conservation Objective : To maintain the favourable conservation condition of Grey Seal in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.
Moulting behaviour	Moult haul-out sites	Conserve the moult haulout sites in a natural condition.
Resting behaviour	Resting haul-out sites	Maintain the resting haulout sites in a natural condition.
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the sit
Conservation Objective : To maintain the favourable conservation condition of Harbour Porpoise in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the sit

Lower River Shannon SAC (002165) is very large site stretches along the Shannon valley from Killaloe in Co. Clare to Loop Head/ Kerry Head, a distance of some 120 km (NPWS 2013). The site thus encompasses the Shannon, Feale, Mulkear and Fergus estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head. There is a resident population of Bottle-nosed Dolphin in the Shannon Estuary which is the only known resident population of the species in Ireland. The population is estimated (in 2006) to be 140 ± 12 individuals. Potential significant effects to Bottle-nosed Dolphin could not be screened out: Conservation Objectives and conservation attributes and targets for the species are included below.

Lower River Shannon SAC [002165] (NPWS, 2012)		
Conservation Objective : To maintain the favourable conservation condition of Bottle-nosed Dolphin in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use

Habitat Use: Critical area	Location and Ha	Critical areas, representing habitat used preferentially by bottlenose dolphin, should be maintained in a natural condition
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the site

Slyne Head Islands SAC comprises a long archipelago of islands, islets, rocks and reefs located off the western shores and south-western tip of the Slyne Head Peninsula in Co. Galway (NPWS 2014). The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes): [1170] Reefs [1349] Bottle-nosed Dolphin (*Tursiops truncatus*) [1364] Grey Seal (*Halichoerus grypus*). Potential significant effects to Grey Seal and Bottle-nosed Dolphin could not be screened out. Conservation Objectives and conservation attributes and targets for the Grey seal are included below. Conservation Objectives have not been set for the Bottle-nosed Dolphin

Slyne Head Islands SAC [000328] (NPWS, 2014)		
Conservation Objective : To maintain the favourable conservation condition of Grey Seal in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.
Moulting behaviour	Moult haul-out sites	Conserve the moult haulout sites in a natural condition.
Resting behaviour	Resting haul-out sites	Maintain the resting haulout sites in a natural condition.
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the sit

Slyne Head Peninsula SAC (002074) comprises the peninsula west of Ballyconneely, Co. Galway. It extends northwards to Errislannan Point to include the shallow waters of Mannin Bay. The peninsula is low-lying and undulating, reaching a maximum height of only 64 m (Doon Hill). Mannin Bay is an excellent example of a large shallow bay, with a wide range of sediment types. The islets and rocks at the mouth of the bay give some shelter from Atlantic swells. Conditions become more sheltered towards the head of the bay and are extremely sheltered in Mannin Creek. Potential significant effects to the following Annex II species *Tursiops truncatus* (Bottlenose Dolphin) could not be screened out. Conservation Objectives have not been set for the species

West Connacht Coast SAC (002998) consists of a substantial area of marine waters lying off the coasts of Counties Mayo and Galway in the west of Ireland (NPWS 2014). Comprising two parts, in its northern component the site extends from the coastal waters off Erris Head westwards beyond Eagle Island and the Mullet Peninsula in Co. Mayo. Bottle-nosed Dolphin occurs within the site in all seasons and the area comprises a key habitat for the species both regionally and within Irish waters. Local population estimates off south-west Co. Mayo and Connemara, Co. Galway describe a minimum of 123 dolphins, with possibly up to 150-200 individuals or more, occurring within the site as a whole. Potential significant effects to the bottle-nosed dolphin could not be screened out; Conservation Objectives and conservation attributes and targets for the species are included below.

West Connacht Coast SAC [002998] (NPWS, 2015)		
Conservation Objective : To maintain the favourable conservation condition of Harbour Porpoise in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the site

Saltee Island SAC (000707) comprises the Saltees Islands and a large area of the surrounding seas. There are two islands, Great Saltee and Little Saltee, and a constellation of islets and rocks. The islands are situated between 4 and 5 km off the south Wexford coast. Great Saltee has a breeding population of Grey Seal, one of the very few in eastern Ireland. The breeding population was estimated at 571-744 individuals in 2005. A one-off moult count in 2007 gave a figure of 246 individuals. Potential significant effects to the Grey Seal could not be screened out; Conservation Objectives and conservation attributes and targets for the species are included below.

Saltee Islands SAC [000707] (NPWS, 2011)		
Conservation Objective : To maintain the favourable conservation condition of Grey Seal in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.
Moulting behaviour	Moult haul-out sites	Conserve the moult haulout sites in a natural condition.
Resting behaviour	Resting haul-out sites	Maintain the resting haulout sites in a natural condition.

Population composition	Number of cohorts	The grey seal population occurring within this site should contain adult, juvenile and pup cohorts annually
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the site

Inishbofin and Inishshark SAC (000278) is situated off the Co. Galway coast, about 5.5 km from the mainland. It comprises two main islands, Inishbofin and Inishshark, with several islets and stacks (NPWS 2013). Part of the surrounding marine waters are also included. The site supports a breeding colony of Grey Sea. The breeding population is estimated at 749-963 individuals (in 2005). A one-off moult count in 2007 gave a figure of 270 seals. Potential significant effects to the Grey Seals could not be screened out; Conservation Objectives and conservation attributes and targets for the species are included below.

Inishbofin and Inishshark SAC [000278] (NPWS, 2015)		
Conservation Objective : To maintain the favourable conservation condition of Grey Seal in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.
Moulting behaviour	Moult haul-out sites	Conserve the moult haulout sites in a natural condition.
Resting behaviour	Resting haul-out sites	Maintain the resting haulout sites in a natural condition.
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the sit

Duvillaun Islands SAC (000495) comprises a group of marine islands, rocks and reefs 3 km off the southern tip of the Mullet Peninsula, Co. Mayo. The main islands included are Duvillaun More, Duvillaun Beg, Turduvillaun, Gaghta Island, Keely Island and Leamareha Island (NPWS 2014). The Duvillaun Islands form part of a larger group of islands, together with the Inishkeas, Inishkeeragh and Inishglora. The sites is designated for Grey Seal and Bottlenose Dolphin. The breeding population Grey Seal is estimated at 648-833 individuals (in 2005). Potential significant effects to the Grey Seal and Bottlenose Dolphin could not be screened out; Conservation Objectives and conservation attributes and targets for the Grey Seal are included below. Conservation Objectives have not been set for Bottlenose Dolphin

Duvillaun Islands SAC [000495] (NPWS, 2013)

Conservation Objective : To maintain the favourable conservation condition of Grey Seal in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.
Moulting behaviour	Moult haul-out sites	Conserve the moult haulout sites in a natural condition.
Resting behaviour	Resting haul-out sites	Maintain the resting haulout sites in a natural condition.
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the sit

Inishkea Islands SAC (000507) comprises a series of islands, rock and reef off the west coast of the Mullet Peninsula in north-west Co. Mayo. The Inishkea Islands are the two largest islands. The Inishkeas, together with a group of neighbouring islands, including Inishglora, Inishkeeragh and the Duvillauns, are an important breeding site for Grey Seal. The breeding population is estimated at 665-855 individuals (in 2005). A one-off moult count in 2007 gave a figure of 1,742 seals Potential significant effects to the Grey Seal could not be screened out; Conservation Objectives and conservation attributes and targets for the species are included below.

Inishkea Islands SAC [000507] (NPWS, 2015)		
Conservation Objective : To maintain the favourable conservation condition of Grey Seal in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.
Moulting behaviour	Moult haul-out sites	Conserve the moult haulout sites in a natural condition.
Resting behaviour	Resting haul-out sites	Maintain the resting haulout sites in a natural condition.
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the sit

Rockabilll to Dalkey Island SAC (Site code:003000) includes a range of dynamic inshore and coastal waters in the western Irish Sea. These include sandy and muddy seabed, reefs, sandbanks and islands. This site extends southwards, in a strip approximately 7 km wide and 40 km in length, from Rockabill, running adjacent to Howth Head, and crosses Dublin Bay to Frazer Bank in south Co. Dublin. The site encompasses Dalkey, Muglins and Rockabill islands. The area selected for designation represents a key habitat for the Annex II species Harbour Porpoise within the Irish Sea. Potential significant effects to the Harbour Porpoise could not be screened out; Conservation Objectives and conservation attributes and targets for the species are included below.

Rockabill to Dalkey Island SAC [003000] (NPWS, 2013)		
Conservation Objective : To maintain the favourable conservation condition of Harbour Porpoise in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use

Lambay Island SAC (000204) is a large (250 ha) inhabited island lying 4 km off Portrane on the north Co. Dublin coast (NPWS 2014). It is privately owned and is accessible by boat from Rogerstown Quay. The island rises to 127 m and is surrounded by steep cliffs on the north, east and south slopes Lambay supports the principal breeding colony of Grey Seal on the east coast of Ireland, numbering 196-252 seals, across all ages. Potential significant effects to Grey Seal could not be screened out; Conservation Objectives and conservation attributes and targets for the species are included below.

Lambay Island SAC [000204] (NPWS, 2013)		
Conservation Objective : To maintain the favourable conservation condition of Grey Seal in the SAC, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition.
Moulting behaviour	Moult haul-out sites	Conserve the moult haulout sites in a natural condition.
Resting behaviour	Resting haul-out sites	Maintain the resting haulout sites in a natural condition.
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the sit

Special Protection Sites

Beara Peninsula SPA (004155) consists of high coast and sea cliff sections which supports heath and coastal grassland, as well as sites further inland (NPWS 2015). The SPA is designated for Fulmar and Chough. The Chough species are primarily found along the coast from Bear Island to Reenmore Point, including Dursey Island with the characterised marginal agricultural land with semi-natural vegetation in proximity to the cliffs making this a favourable location for the species. Other species within the SPA include Shag (*Phalacrocorax aristotelis*), Herring Gull (*Larus argentatus*), Lesser Black-backed Gull (*Larus fuscus),* Razorbill (*Alca torda*) and Black Guillemot (*Cepphus grylle*) as well as Peregrine (*Falco peregrinus*). The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018). The site also holds a nationally important population of Fulmar (575 pairs), and populations of other breeding seabirds including: Shag (12 pairs), Herring Gull (20 pairs), Lesser Black-backed Gull (4 pairs), Razorbill (5 pairs) and Black Guillemot (87 individuals in 1999) – all seabird data from 2000. The site is also used by Peregrine (4 pairs in 2002). The Beara Peninsula SPA is one of the most important sites in the country for Chough, with a breeding population of international importance occurring. It also supports a nationally important population of Fulmar. The presence of Chough and Peregrine, both species that are listed on Annex I of the E.U. Birds Directive, is of particular significance. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Sheep's Head to Toe Head SPA (004156) is large site situated on the south-west coast of Co. Cork. It encompasses the high coast and sea cliffs from Sheep's Head to Mizen Head, Brow Head and Crookhaven in the west and from Baltimore to Tragumna Bay, Gokane Point and the Toe Head peninsula in the east. The site includes the sea cliffs, the land adjacent to the cliff edge, an area further inland to the east of Dunlough Bay, and also areas of sand dunes at Barley Cove and Crookhaven. The high water mark forms the seaward boundary. Most of the site is underlain by Devonian sandstones and mudstones, though Carboniferous rocks are also found on the Sheep's Head and Toe Head peninsulas. The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Chough and Peregrine.

Aughris Head SPA (004133) Aughris Head is a rocky headland on the north-facing Co. Sligo coastline, located some 20 km west of Sligo Town (NPWS 2015). Its near-vertical cliffs reach a maximum height of 30 m above sea level (NPWS 2012). The marine area to a distance of 500 m from the base of the cliffs is included in the site. The site was designated for Kittiwake (742 breeding pairs). A survey in 1997 recorded a nationally important population of breeding Kittiwake (742 pairs) and other breeding seabirds including Guillemot (811 pairs), Razorbill (58 pairs) and Fulmar (94 pairs). Other breeding seabirds including Guillemot (811 pairs), Razorbill (58 pairs) and Fulmar (94 pairs). The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Ballycotton Bay SPA (004022) is situated on the south coast of Co. Cork, Ballycotton Bay is an east-facing coastal complex, which stretches northwards from Ballycotton to Ballynamona, a distance of c. 2 km. The site comprises two sheltered inlets which receive the flows of several small rivers. The southern inlet had formerly been lagoonal (Ballycotton Lake) but breaching of the shingle barrier in recent times has resulted in the area reverting to an estuarine system. The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Teal, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Turnstone, Common Gull and Lesser Black-backed Gull. The E.U. Birds Directive pays particular attention to wetlands, and as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds

Ballymacoda Bay SPA (004023) This coastal site stretches north-east from Ballymacoda to within several kilometres of Youghal, Co. Cork. It comprises the estuary of the Womanagh River, a substantial river which drains a large agricultural catchment. Part of the tidal section of the river is included in the site and on the seaward side the boundary extends to, and includes, Bog Rock, Barrel Rocks and Black Rock. The inner part of the estuary is well sheltered by the Ring peninsula, a stabilised sand spit with sand dunes at its northern end and salt marshes on the landward side. The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Wigeon, Teal, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Turnstone, Black-headed Gull, Common Gull and Lesser Black-backed Gull. The site is also of special conservation interest for holding an assemblage of over 20,000 wintering waterbirds. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds

Blasket Islands SPA (004008) The Blasket Islands are situated at the end of the Dingle peninsula in Co. Kerry (NPWS 2015). The site comprises all of the main islands in the group, as well as the various islets and rocks, and also the seas which surround the islands to a distance of 500 m. There are six main islands, plus some smaller islands, islets and sea stacks. The largest island, Great Blasket, is separated from the mainland by the Blasket Sound, a distance of some 2 km. The smallest island, Beginish, lies close to Great Blasket, while the other islands (Inishtooskert, Inishnabro, Inishvickillane, Tearaght Island) are between about 7 km and 12 km from the mainland. The Blasket Islands SPA is one of the most important seabird colonies and is designated for breeding population of Storm Petrel and Manx Shearwater (c. 52,141 and 19,534 pairs respectively; 2000/2001 survey). The site is also designated for nationally important populations: Fulmar (2,179 pairs), Lesser Black-backed Gull (at least 333 pairs), Herring Gull (131 pairs), Kittiwake (773 pairs) and Puffin (4,924 pairs) (1988 survey). An incomplete survey in 1999/2000 recorded a nationally important population of Shag (60 pairs). The site is also designated for Arctic Tern (at least 200 pairs in 1988 and 102 pairs in 2001). Other notable species include Guillemot, Oystercatcher, Peregrine, Raven, Rock Dove, Twite and Wheatear. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Clare Island SPA (004136) Clare Island lies at the entrance to Clew Bay, in Co. Mayo, and some 5 km from the mainland (NPWS 2014). The site comprises all of the cliffs on the island, a length of approximately 10 km, as well as the land adjacent to the cliff edge (inland for 300 m) and the adjacent marine waters (to distances of 200 m or 500 m, depending on auk distribution).The site is designated for important populations of waterbirds including the largest population

in the country of Fulmar (4,029 pairs), and nationally important populations of Shag (89 pairs), Common Gull (39 pairs), Kittiwake (1,785 pairs), Guillemot (1,528 pairs), Razorbill (354 pairs) and Black Guillemot (62 individuals). The site is also designated for Chough (16 pairs) Other notable species at the site include Cormorant, Gannet, Great Black-backed Gull, Herring Gull, Lesser Black-backed Gull, Peregrine and Puffin. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Cliffs of Moher SPA (004005) extends a distance of some 9.5 km along the north Clare coast from Faunmore in the north to just south of Cancregga Point in the south (NPWS 2015). The cliffs, which rise to 203 m in height. The site includes the cliffs, the land adjacent to the cliff edge (inland for 300 m) as well as the adjacent sea area to a distance of up to 500 m from the cliff base. The site is designated for important populations of including Chough (12 pairs 2002/ 2003), Fulmar (3,566 pairs), Kittiwake (7,698 pairs), Guillemot (13,375 pairs) and Puffin (1,365 pairs) and Razorbill (Alca torda) (5,159) (1998/1999 survey). Other notable species at the site include Black Guillemot, Great Black-backed Gull, Herring Gull, and Shag. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Cruagh Island SPA (004170) Cruagh Island is located approximately 2 km west of Omey Island, off the Connemara coast in Co. Galway (NPWs 2010). It is a small- to medium sized, low-lying island (maximum height 62 m) and is uninhabited. The island is dominated by a maritime grassy sward with some exposed rock. The sea area to a distance of 500 m is included in the site to accommodate 'rafting' shearwaters. The site is designated for important populations of Manx Shearwater (3,286 pairs and Barnacle Goose which is a regular visitor to the sites during the winter. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Deenish Island and Scariff Island SPA (004175) Deenish Island and Scariff Island are small- to medium-sized islands situated between 5 and 7 km west of Lamb's Head off the Co. Kerry coast; they are thus very exposed to the force of the Atlantic Ocean. Scariff is the larger of the two (NPWS 2014). It is steep-sided all the way around and rises to a peak of 252 m. The highest cliffs are on the south side. The island vegetation is a mix of maritime grassland, areas dominated by Bracken (*Pteridium aquilinum*) and heathy areas with Ling Heather (*Calluna vulgar*is). The site is designated for important populations of waterbirds including Arctic Tern (54 pairs in 1995) Fulmar (385 pairs in 2000), Lesser Black-backed Gull (97 pairs in 2000), Manx Shearwater (2,311 pairs) and Storm Petrel (estimated 6,200 pairs). Other notable species at the site include Black Guillemot, Great Black-backed Gull, Herring Gull and Shag. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Dingle Peninsula SPA (004153) The Dingle Peninsula SPA is a large site situated on the west coast of Co. Kerry (NPWS 2014). It encompasses the high coast and sea cliff sections of the peninsula from just south of Brandon Point in the north, around to the end of the peninsula at Slea Head, and as far east as Inch

in the south. The site includes the sea cliffs, the land adjacent to the cliff edge, areas of sand dune on the Magharees Peninsula and near Murreagh, and also several upland areas further inland of the coast about Ballybrack, Lough Doon, Anscaul Lough, Arraglen and Ballynane. The site is designated for Chough, Peregrine and Fulmar. The site also supports nationally important populations of Peregrine (5 pairs in 2002) and Fulmar (1,016 pairs), as well as smaller populations of other breeding seabirds: Razorbill (3 pairs), Herring Gull (33 pairs), Lesser Black-backed Gull (2 pairs), Shag (23 pairs) and Great Black-backed Gull (1 pair). The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Duvillaun Islands SPA (004111) comprises a group of marine islands, rocks and reefs, located between 1 and 5 km off the southern tip of the Mullet Peninsula in Co. Mayo (NPWS 2014). The surrounding seas to a distance of 200 m and the area of water between the islands are included in the site. The site is designated for Fulmar, Storm Petrel and Barnacle Goose. The Duvillaun Islands are also of ornithological importance for their colonies of breeding seabirds. The Seabird 2000 survey recorded Fulmar (638 pairs in 2000), Cormorant (20 pairs in 2000) and Black Guillemot (25 pairs in 2000) on Duvillaun More. The populations of Fulmar and Storm Petrel are of national importance. Other breeding seabirds recorded in 2000 include Shag (5 pairs), Herring Gull (5 pairs), Great Black-backed Gull (144 pairs) and Common Gull (25 pairs). The breeding population of Great Black-backed Gull, a resident species, is also of national importance. Peregrine (1 pair) and Chough (1-2 pairs) breed - both are listed on Annex I of the E.U. Birds Directive. Other species which have been recorded breeding on Duvillaun More include Ringed Plover, Oystercatcher, Rock Pipit, Skylark, Wheatear, Raven and Manx Shearwater. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Helvick Head to Ballyquin SPA (004192) is a linear site situated on the south-west coast of Co. Waterford (NPWS 2015). It includes the sea cliffs and land adjacent to the cliff edge between Helvick Head in the east and Ballyquin townland in the south-west. The high water mark forms the seaward boundary, except around Helvick Head where the adjacent sea area to a distance of 500 m from the cliff base is included. The site is designated for Chough, Peregrine, Cormorant, Herring Gull and Kittiwake. The site supports a nationally important population of breeding Chough, a Red Data Book species that is listed on Annex I of the E.U. Birds Directive; 11 breeding pairs were recorded from the site in the 1992 survey and 11 pairs in the 2002/03 survey. The low heath and agricultural farmland on the cliff tops provides good foraging habitat for this species. The site is also of importance for its Peregrine population (5 pairs in 2002). The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

High Island, Inishshark and Davillaun SPA (004144) High Island, Inishshark and Davillaun are small, uninhabited islands lying some 3-5 km north and west of Aughrus Point on the Co. Galway coast (NPWS 2010). Grassland is the main vegetation type found, with vegetated sea cliffs, dry heath, exposed rock and some freshwater marsh also present. The site is designated for Fulmar, Barnacle Goose and Arctic Tern. High Island, Inishshark and Davillaun also hold important breeding seabird sites. The Seabird 2000 survey recorded nationally important numbers of Fulmar (830 pairs) and smaller numbers of other breeding birds including Kittiwake (230 pairs), Manx Shearwater (73 pairs), Shag (30 pairs), Herring Gull (18 pairs) and Common Gull (13 pairs). Storm Petrel breeds on High

Island (estimate of 60 pairs in 2001). In 1995 a survey recorded nationally important numbers of Arctic Tern (64 pairs). The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Horn Head to Fanad Head SPA (004194) comprises a number of separate sections of the north Co. Donegal coastline stretching some 70 km eastwards from Dooros Point, south-west of Horn Head to just south of Saldanha Head, south of Fanad Head (NPWS 2014). The site includes the high coast areas and sea cliffs, land adjacent to the cliff edge and the sand dunes and lake at Dunfanaghy/Rinclevan. The site is designated for Chough, Peregrine, Fulmar, Cormorant, Shag, Kittiwake, Guillemot, Razorbill, Greenland White-fronted Goose and Barnacle Goose. The site is also of special conservation interest for holding an assemblage of over 20,000 breeding seabirds. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Inishmore SPA (004152) Situated approximately 8 km off the south coast of County Galway, Inishmore (Árainn) is the largest of the three Aran Islands (NPWS, 2014). The site comprises all of the cliffs and rocky shore along the entire southern side of the island, part of the low cliffs/rocky shore at the west end, and the low cliffs/rocky shore at the east end - a distance of over 17 km of coastline. Also included are the two islands west of Inishmore (Brannock Island and Rock Island), Straw Island at the east end of Inishmore, the dune system at Barr na Coise, and the adjacent seas out to 500 m from the shoreline. The cliffs vary in height, being often less than 20 m but rising to over 80 m near Dún Aonghasa where they are notably sheer. The site is designated for important populations of birds including Arctic Tern (338 in 1995), Guillemot (2,312 pairs in 1999), Kittiwake (587 pairs in 1999), Little Tern (3 pairs in 1995, 13 pairs in 1999). Other notable species at the site include Black Guillemot, Chough, Fulmar, Great Black-backed Gull, Herring Gull, Peregrine, Razorbill and Shag. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018). The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Ireland's Eye SPA (004117) Ireland's Eye is an uninhabited island located about 1.5 km north of Howth in Co. Dublin (NPWS 2011). The site encompasses Ireland's Eye, Rowan Rocks, Thulla, Thulla Rocks, Carrageen Bay and a seaward extension of 200m in the west and 500m to the north and east. The island has an area of c. 24 ha above the high tide mark. The site is designated for important populations of waterbirds including Cormorant (306 pairs in 1999), Guillemot (1,468 pairs in 1999), Herring Gull (246 pairs in 1999), Kittiwake (941 pairs in 1999), Razorbill (460 pairs in 1999). Other notable species at the site include Fulmar, Gannet, Great black-backed Gull, Greylag Goose, Lesser Black-backed Gull, Light-bellied Brent Goose, Oystercatcher, Peregrine, Puffin, Ringed Plover, Shag and Shelduck. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Iveragh Peninsula SPA (004154) is a large site situated on the west coast of Co. Kerry (NPWS 2015). The site encompasses the high coast and sea cliff sections of the peninsula from just west of Rossbehy in the north, around to the end of the peninsula at Valencia Island and Bolus Head, and as far east as Lamb's Head

in the south. The site includes the sea cliffs, the land adjacent to the cliff edge and also areas of sand dunes at Derrynane and Beginish. The site is designated for an important breeding population of Chough (106 breeding pairs in 1992, 88 in 2002/2003). The site is also designated for Fulmar (766 pairs in 1999-2000), Guillemot (2,860 pairs in 1999-2000), Kittiwake (1,150 pairs in 2000), Peregrine (5 pairs in 1999-2002). The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Kerry Head SPA (004189) is situated on the south side of the mouth of the River Shannon in north Co. Kerry (NPWS 2015). It encompasses the sea cliffs from just west of Ballyheigue, around the end of Kerry Head to the west and north-eastwards as far as Kilmore. The site includes the sea cliffs and land adjacent to the cliff edge. The site is designated for an internationally important population of breeding Chough (32 breeding pairs in the 1992, 30 in the 2002/03 survey). The site is also designated for a nationally important population of Fulmar (421 pairs). Other notable species include Shag (8 pairs in 2000) and Peregrine (2 pairs in 2002). The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Lambay Island SPA (004069) Lambay Island lies approximately 4 km off the north Co. Dublin coastline and is separated from it by a channel of 10-13 m in depth (NPWS 2011). East of Lambay Island the water deepens rapidly into the Irish Sea basin. The island, which rises to 127 m, has an area of 250 ha above high tide mark. The site is designated for important breeding populations of Fulmar (585 pairs in 1999), Lesser Black-backed Gull (309 pairs in 1999), Kittiwake (4,091 pairs in 1999), Herring Gull (1,806 pairs in 1999), Puffin (265 pairs in 1999) and Razorbill (2,906 pairs in 1999). The site is also designated for internationally important populations of Cormorant (675 pairs), Shag (1,122 pairs) and Guillemot (40,705 pairs). Other designated species include Barnacle Goose, Black Guillemot, Common Gull, Curlew, Gannet, Great Black-backed Gull. Notable species at the site include Light-bellied Brent Goose, Manx Shearwater, Oystercatcher, Purple Sandpiper and Turnstone. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Loop Head SPA (004119) Loop Head is situated at the most westerly point in Co. Clare, approximately 20 km south-west of Kilkee (NPWS 2009). The site includes the cliffs, shoreline and the adjacent marine area to a distance of 500 m from the shore. The vertical cliffs are impressive, rising to 60 m and extending for 5 km along the coast. The site is designated for breeding important populations Guillemot (2,687 pairs in 1987) and Kittiwake (690 pairs in 1987). Notable species at the site include; Chough, Fulmar, Peregrine and Razorbill. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Mid-Waterford Coast SPA (004193) encompasses the areas of high coast and sea cliffs in Co. Waterford between Newtown Cove to the east and Ballyvoyle to the west (NPWS 2015). The site includes the sea cliffs and the land adjacent to the cliff edge. Sea cliffs are the predominant habitat of the site; these occur along its length and are generally well-vegetated by a suite of typical sea cliff species. Above the cliffs areas of heath, improved grassland, unimproved wet and dry grassland, and woodland occur. The site is designated for an internationally important population of breeding Chough (24 breeding pairs in the 1992,

20 pairs in the 2002/03). The site is also designated for a nationally important population of Peregrine (10 pairs in 2002), Cormorant (79 pairs in 1999-2000) and Herring Gull (147 pairs in 1999-2000). Other notable species at the site include Black Guillemot, Fulmar, Razorbill and Shag. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Old Head of Kinsale (004021) The Old Head lies approximately 10 km south of the town of Kinsale in Co. Cork, and is a 5 km long headland formed of steeply inclined beds of rock (NPWS 2014). The site comprises a section of the cliffs on the western side of the narrow isthmus leading to the Head and a 500 m seaward extension. These are vertical rock cliffs providing optimum habitat for ledge nesting seabirds. The site is designated for important populations of Guillemot (2,303 pairs in 2000) and Kittiwake (951 pairs in 2001). Other notable species at the site include Chough, Fulmar, Herring Gull, Peregrine, Razorbill and Shag. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Puffin Island SPA (004003) Puffin Island lies approximately 0.5 km off the northern side of St Finan's bay in south-west Co. Kerry (NPWS 2015). It is a long, narrow island of Old Red Sandstone. The island is almost divided into two halves – the southern half is a long narrow, rocky ridge, rising to 130 m, while the northern half broadens into a grassy plateau though has a high point of 159 m. The island is surrounded by mostly steep cliffs and slopes. It is designated for internationally important populations of Storm Petrel (5,177 pairs in 2000) and Manx Shearwater (6,329 pairs in 2000) and nationally important populations of breeding Puffin (5,125 pairs in 2000), Fulmar (447 pairs in 2000), Razorbill (402 pairs in 1985 - incomplete survey in 2000) and Lesser Black-backed Gull (139 pairs in 2000) and Kittiwake (25 pairs in 2000). Other notable species at the site include Great Black-backed Gull, Guillemot and Shag. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Saltee Islands SPA (004002) The Saltee Islands SPA is situated some 4-5 km off the coast of south Co. Wexford and comprises the two islands, Great Saltee and Little Saltee, and the surrounding seas both between them and to a distance of 500 m from them (NPWS 2012). The bedrock of the islands is of Precambrian gneiss and granite. Both islands have exposed rocky cliffs on their south and east – those on Great Saltee being mostly c. 30 m high, those on Little Saltee about half this height. The northern and western sides of both islands are fringed with shingle and boulder shores, backed by boulder clay cliffs, as well as small areas of intertidal sandflats. Sea caves occur at the base of the cliffs on Great Saltee. The Saltee Islands sites is designated for nationally important Gannet colony (2,446 pairs in 2004), Fulmar (520 pairs in 1998-2000), Cormorant (273 pairs in 1998-2000), Shag (268 pairs in 1998-2000), Lesser Black-backed Gull (164 pairs) in 1998-2000, Herring Gull (73 pairs in 1998-2000), Kittiwake (2,125 pairs in 1998-2000), Guillemot (14,362 pairs in 1998-2000), Razorbill (2,505 pairs in 1998-2000) and Puffin (1,822 pairs in 1998-2000). Other notable species recorded at the site include Chough, Hen Harrier and Peregrine..

Saltee Islands SPA [004002] (NPWS, 2011)

Conservation Objective : To maintain the favourable conservation condition of Gannet and Fulmar in the SPA, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline
Productivity rate	Mean number	No significant decline
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline
Prey biomass available	Kilograms	No significant decline
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase
Disturbance at breeding site	Level of impact	No significant increase
Disturbance at marine areas immediately adjacent to the colony	Level of impact	No significant increase
Conservation Objective : To maintain the favourable conservation condition of Guillemot and Razorbill in the SPA, which is defined by the following list of attributes and targets		
Attribute	Attribute	Attribute
Breeding population abundance: individual adult	Breeding population abundance: apparently occupied nests (AONs)	Breeding population abundance: apparently occupied nests (AONs)
Productivity rate	Productivity rate	Productivity rate
Distribution: breeding colonies	Distribution: breeding colonies	Distribution: breeding colonies

Prey biomass available	Prey biomass available	Prey biomass available
Barriers to connectivity	Barriers to connectivity	Barriers to connectivity
Disturbance at breeding site	Level of impact	No significant increase
Disturbance at marine areas immediately adjacent to the colony	Level of impact	No significant increase
Conservation Objective : To maintain the favourable conservation condition of Puffin in the SPA, which is defined by the following list of attributes and targets		
Attribute	Attribute	Attribute
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline
Productivity rate	Mean number	No significant decline
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline
Prey biomass available	Kilograms	No significant decline
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase
Disturbance at breeding site	Level of impact	No significant increase
Disturbance at marine areas immediately adjacent to the colony	Level of impact	No significant increase
Occurrence of mammalian predators	Level of impact	Absent or under control

Conservation Objective : To maintain the favourable conservation condition of Cormorant, Shag, Lesser Black-backed Gull, Herring Gull and Kittiwake in the SPA, which is defined by the following list of attributes and targets		
Attribute	Measure	Target
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline
Productivity rate	Mean number	No significant decline
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline
Prey biomass available	Kilograms	No significant decline
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase
Disturbance at breeding site	Level of impact	No significant increase

Skelligs SPA (004007) comprises Great Skellig and Little Skellig islands (NPWS 2015). These highly exposed and isolated islands, which are separated by a distance of 3 km, are located in the Atlantic some 14 km and 11 km (respectively) off the County Kerry mainland. Both islands are precipitous rocky sea stacks, Great Skellig rising to 218 m and Little Skellig to 134 m. The Skelligs comprise one of the most important seabird colonies in the country for populations and species diversity. The sites is designated for Fulmar (830 pairs in 2002), Gannet (29,683 pairs in 2004), Guillemot (1,652 pairs in 2002), Kittiwake (1,035 in 2002), Puffin (6,000 pairs estimated in 2002), Storm Petrel (9,994 pairs in 2002). Other notable species at the site include Razorbill and Chough. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2013).

The Bull and the Cow Rocks SPA (004066) consists of two very small rock islands, the Cow and the Bull. The site is designated for Storm Petrel, Gannet and Puffin (NPWS 2014). The site hosts one of the most important Storm Petrel colonies in Ireland (3,500 pairs in 2000), as well as the nationally important gannet species possessing its second largest colony in Ireland on Bull Island (3,694 in 2004). Additional bird species include, Great Black-backed Gull, Cormorant,

Kittiwake, Guillemot, Fulmar, Herring Gull and Razorbill. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2013).

Tory Island SPA (004073) Tory Island is a remote, rocky island lying some 11 km to the north of Bloody Foreland in County Donegal (NPWS 2015). The island is around 4 km long by 1 km wide. The eastern section comprises high (up to 83 m), dramatic coastal cliffs which continue along much of the north coastline. The southern shoreline is low-lying, consisting of bedrock shore and boulder beach. A marine area, extending 500 m from the base of the cliffs along the eastern and north-east side of the island, is included within the site. The site is designated for: Fulmar, Corncrake, Razorbill and Puffin. Tory Island SPA supports a breeding population of Corncrake (25 pairs - five year mean between 2003 and 2007, based on records of calling males). Tory Island SPA also supports nationally important breeding populations of Fulmar (641 pairs), Razorbill (671 pairs) and Puffin (1,402 pairs) - all figures from 1999. Other species that occur include Black Guillemot, Black-headed Gull, Chough, Great Black-backed Gull, Guillemot, Herring Gull, Kittiwake, Lapwing, Oystercatcher, Peregrine, Redshank, Ringed Plover, Shag, Snipe, Tree Sparrow, Little Tern and Storm Petrel. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

West Donegal Coast SPA (004150) comprises separate sections of the Co. Donegal coastline and extends from Muckros Head in the south, northwards to Slieve League, Malin Beg, Rocky Point, Glen Head, Slieve Tooey, Maghera, Loughros Point, Dunmore Head, Aran Island, Magheradrumman, Carrickfin, Carnboy, Bunbeg, Magheragallan, Lunniagh, as far as Carrick, to the south of Bloody Foreland (NPWS 2015). The site includes the high coast areas and sea cliffs of the mainland and Aran Island, the land adjacent to the cliff, areas of sand dunes/machair at Maghera, Mullaghderg, Braade/Carrickfin/Carnboy, Magheragallan and Lunniagh/Carrick, and also several areas further inland of the coast at Croaghmuckros and Slieve League, north of Glencolumbkille and south of Dunmore Head. A low-lying area of land on the coast at Bunbeg used by roosting Chough is also included. The site is designated for Chough, Peregrine, Fulmar, Cormorant, Shag, Herring Gull, Kittiwake and Razorbill. Other species noted at the sites include Barnacle Goose, Black Guillemot, Great Black-backed Gull, Lesser Black-backed Gull, Ring Ouzel, Twite and Puffin. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Wicklow Head SPA (004127) Wicklow Head is a rocky headland site situated approximately 3 kilometres south of Wicklow town (NPWS 2012). The cliffs at the sites rise to about 60 m and it is here that most of the seabirds breed. The site comprises the cliffs and cliff-top vegetation, as well as some heath vegetation. The marine area to a distance of 500 m from the base of the cliffs is included in the site. The site was designated for a nationally important population of Kittiwake (956 pairs in 2002). Oher notable species at the site includes Fulmar, Shag, Herring Gull, Guillemot and Razorbill, Black Guillemot, Peregrine, Ravens, Stonechat, Whitethroat and Linnet. The Conservation Objective for the Special Conservation Interests of the site is: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2018).

Appendix 10

Archaeological Assessment

Marine Geo-archaeological Assessment

Proposed Fish-farm Site

Deenish Island

Kenmare Bay, Co. Kerry

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Client:	Marine Harvest Ireland Ltd.
Date:	October 2015
Licence No:	15R0129
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Contents

	Section	Page
1	**Executive Summary**	4
2	**Introduction**	6
	2.1 The Site and the Proposed Development	6
	2.2 The Scope of this Report	9
	2.3 Data Acquisition Method	10
	2.4 Data Processing and Interpretation	15
3	**Results of Survey**	17
	3.1 Desktop Survey	17
	3.1.1 Historical and Archaeological Background	17
	3.1.2 Sites and Monuments Record	22
	3.1.3 Topographical records of The National Museum of Ireland	26
	3.1.4 Record of archaeological excavations	26
	3.1.5 The Shipwreck Inventory	27
	3.1.6 Lewis Topographical Directory	29
	3.1.7 Ports and Harbours Archive	31
	3.1.8 Marine Environment	32
	3.2 Site Survey	34
	3.2.1 Shoreline	34
	3.2.2 Seabed Sediments	37
	3.2.3 Bathymetric Data	40
	3.2.4 Magnetometer Data	42
	3.2.5 Side scan Sonar Data	43
	3.2.6 Results of Survey	45
4	**Conclusions**	47
5	**Recommendations**	48
6	**Bibliography**	49

1 EXECUTIVE SUMMARY

This report details and interprets desktop, shoreline and marine geophysical survey data recorded at the site of and adjacent to the proposed fish-farm development at Deenish Island Kenmare River, Co. Kerry.

The pre-development geophysical surveys were conducted under guidelines and acquisition parameters as recommended by the Underwater Unit of The Department of Arts, Heritage and the Gaeltacht. Geophysical surveys, including bathymetric and side-scan sonar surveys, were conducted from the clients survey vessel at an average lane spacing of 100m.

Kenmare River is located within a rich archaeological landscape; which has been settled from the Mesolithic to the present.

The shoreline inspection revealed that the intertidal zone adjacent to the site of the proposed development is comprised of low near vertical to vertical rock cliffs,

The site surveys provided no features or readings which revealed or indicated the presence of archaeological material. There remains the possibility of archaeological material lying within the finer substrate which comprises the smaller area of the proposed development site at Deenish Island.

It is concluded that:

The archaeological sites listed for the island and townlands adjacent to the proposed development will not be impacted by the development

The seabed at the location of the proposed development will be impacted by the laying and bedding of twenty six substantial anchors.

The visual and photographic inspection of the shoreline adjacent to the seabed survey site revealed no features that could be described as archaeological

The substrate material as visualised by the 500kHz side-scan sonar survey would indicate that the seabed at the site of the proposed development is impacted by hydraulic forces generated by storm forces.

The rock substrate is interpreted as having a low potential for the retention of archaeological material. The coarse substrate is interpreted as having a low to medium potential for the retention of archaeological material. The finer substrate, which comprises the smaller aria

of the site is interpreted as having a high potential for the retention of archaeological material.

No anomalies, which could be interpreted as archaeological were identified from the 500kHz side-scan sonar survey conducted over the proposed development site.

It is recommended that:

1. The proposed fish farm development at Deenish Island site should proceed.

2. A further sidescan survey should be conducted over the Deenish Island site following the installation of the anchors to determine if their installation has revealed the existence of submerged archaeological material.

2 INTRODUCTION

2.1.1 The Site.

The site of the proposed development is located in deep water over a sloping seabed on the northern shore of Kenmare Bay immediately to the east of Deenish Island.

Permission is being sought for to upgrade an existing fish-farm development at the site, which will provide local employment and help sustain the local community. Positional details and the location of the development are provided in Table 1 and Fig's 1- 2

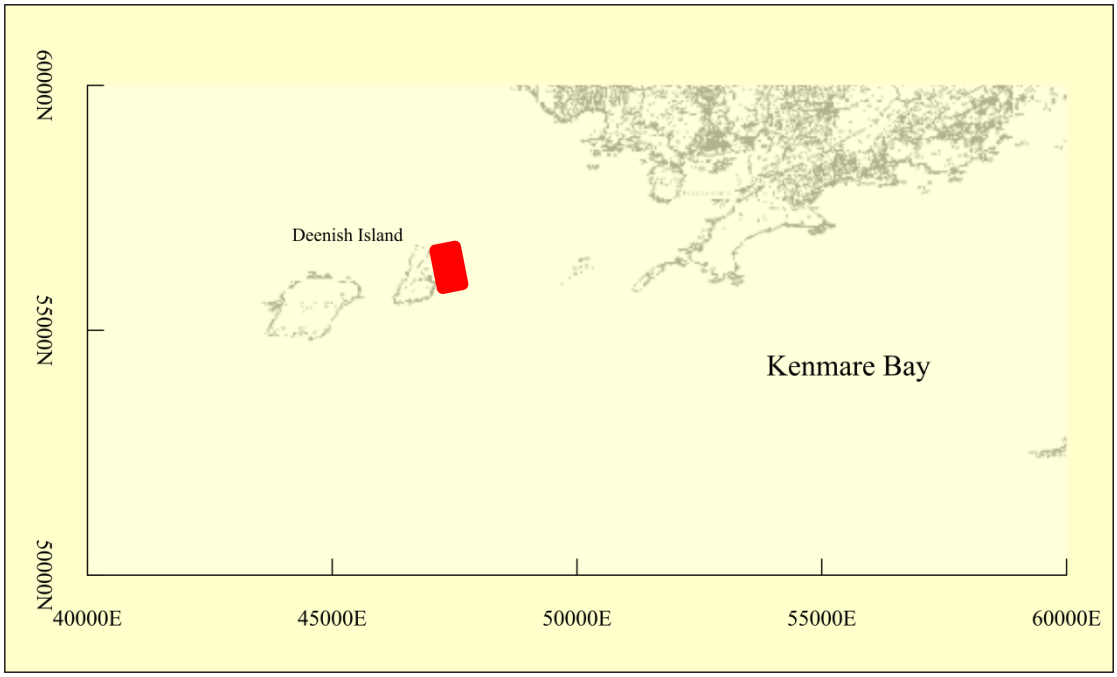

Figure 1: Location chart displaying the proposed Deenish Island development site within its regional context. (The proposed site is displayed as a red rectangle)

Location	Easting	Northing
Northwest Corner	46900	56800
Northeast Corner	47700	56800
Southwest Corner	46900	55600
Southeast Corner	47700	55600

Table 1: The extremity positions of the proposed Deenish Island fish-farm site.
(Positions provided in Eastings & Northings, Irish National Grid)

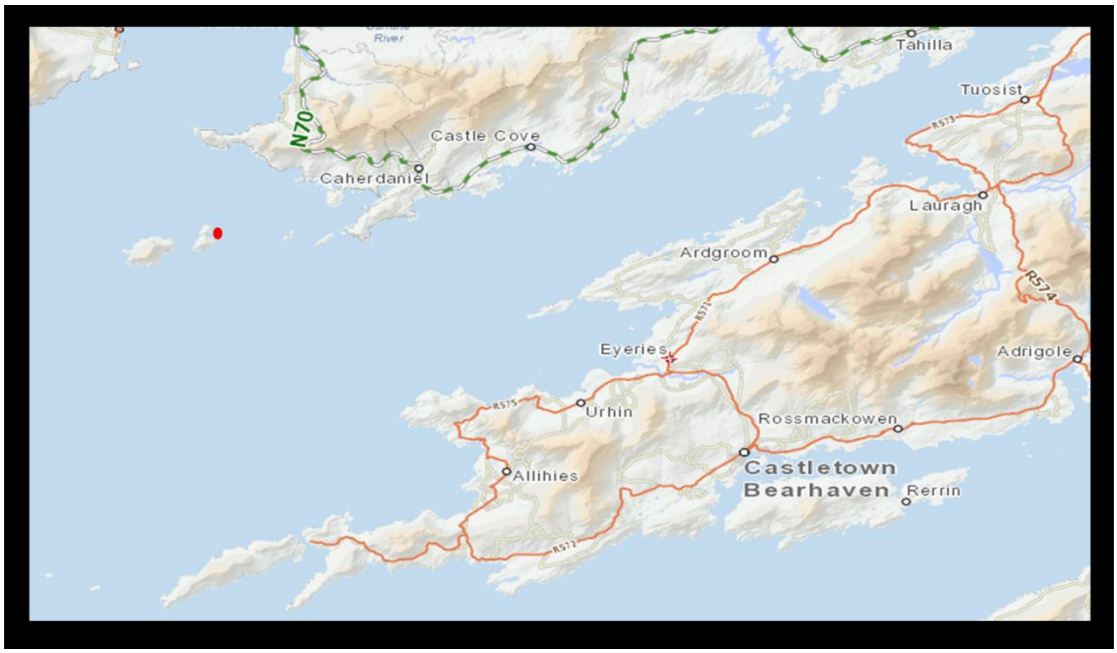

Figure 2: The location of the proposed Deenish Island fish-farm site overlaid on OS Map (The location of the site is represented by a red dot)

2.1.2 The Proposed Development

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The site at Deenish Island has been used for the grow out of farmed salmon since about 1985. The proposed upgraded Deenish Island site will comprise a total seabed area of some 43Ha, to the immediate east of Deenish Island. This general site area was first licensed as a marine salmon grow out site in the mid-eighties, Aquaculture Licence number T06/202. It is emphasised that a salmon farm has been deployed at Deenish Island for about 30 years. No archaeological survey was completed as part of the original application. The upgraded works at the site will comprise the deployment a 15 pens circular sea pens. These will be set within an anchored, submerged grid frame, in a 4 pens by 3 pens arrangement. Each pen will be secured by bridal chains within a grid square. The grid frame will be anchored to the sea bed via mooring ropes, chain and anchors. A feed barge will also be deployed. The amount of contact with the sea bed will be minimal in that the anchors and mooring blocks will impact on a sea bed area of no more than 2m2 each. No other lasting or significant disturbance of the sea bed area is anticipated. The nature of the structures on the site will be temporary and fully moveable. The site will be cleared of equipment if and when it falls out of use.

2.2 The Scope of this Report

This report details and interprets desktop, shoreline and geophysical survey data recorded at the site of a proposed fish-farm development at Deenish Island, Kenmare River, Co.Kerry

The sub-tidal geophysical surveys were conducted under guidelines and acquisition parameters as recommended by the Underwater Unit of The Department of Arts, Heritage and the Gaeltacht.

Licence Number: 15R0129

2.3. Data Acquisition Method

2.3.1. Data Acquisition

Geophysical surveys were conducted from the client's multicat vessel, *Orchid* (Fig.3), at an average lane spacing of 100m. Details of the survey suite and operational parameters are provided in sections 2.3.2-2.3.5 with the details of data processing and analysis provided in sections 2.4.2-2.4.4.

Figure 3: The multicat vessel *Orchid*, from which geophysical surveys at the Deenish Island site were conducted

2.3.2. Global Positioning System

Positional data with a quoted accuracy of 1-3m were provided by a *CSI Wireless DGPS MAX* series differential global positioning system (Fig. 4) with differential corrections supplied by the General Lighthouse Authority (GLA) reference station at Portlinus.

During survey the dGPS antenna was placed at a height over 2m above deck level to maximise its exposure to available satellites. Acquired data are representative of the position of the antenna, therefore the layback (the distance between the antenna and deployed instrument) was recorded. Positional data were downloaded at a rate of 10 readings sec^{-1} via a standard

RS-232 serial port interface into *Coastal Oceanographics Hypack Max* Version 4.3a Gold software on a laptop platform. The NMEA (National Marine Electronics Association) data strings GPGGA (Global Positioning System Fixed Data) and GPVTG (course over ground and ground speed) were recorded in real time as data files, while simultaneously being integrated into the marine geophysical record. Positional data were recorded in degrees and decimal-minutes using the WGS-84 ellipsoid. Parameters utilised for conversion of WGS84 data to Irish Grid are detailed in Table 2.

Figure 4: CSI Wireless DGPS MAX and CDA-2 MAX antenna.

Parameter	Conversion factor
Semi-major Axis	6377340.189
1 / Flattening	299.324964
Latitude of Origin in Degrees	53.500000
Longitude of Origin in Degrees	-8.000000
False Easting	200000.000
False Northing	250000.000
Scale Factor	1.000035
Datum Shift DX	-482.530
Datum Shift DY	130.596
Datum Shift DZ	-564.557
Datum Shift RX	-1.042000
Datum Shift RY	-0.214000
Datum Shift RZ	-0.631000
Datum Shift Scale	8.150000

Table 2: Parameters utilised for conversion of WGS84 data to Irish Grid.

2.3.3. Bathymetric Survey

The bathymetric survey was conducted using a dual single-beam pole-mounted echo-sounder operating at 33 & 200 kHz. This active sonar instrument consists of four basic components: a control-display system, transmitter, transducer, and receiver. When directed by the control and display component, the transmitter produced an oscillating electric signal with unique frequency characteristics (*SeaBeam,* 2000), typically within the 100-300 kHz range (Quinn, 2000). The transducer (a ceramic piezo-electric plate) converted the electrical energy into mechanical vibrations that were transmitted into the water column as an oscillating pressure (sound) wave. This acoustic pulse had a cone angle of 1-40^{o}, orientated vertically downwards so concentrating the energy of the transmitted pulse in a circular area on the sub-stratum (Fresnel Zone). Water depth determines the radius of this circular area (i.e. the deeper the water, the larger the radius of the circular area) insonified by the echo-sounder (Quinn, 2000).

The returning echo from the seabed was received and converted back into an electrical signal by the transducer, which acts as a hydrophone. This signal was transferred to the echo-sounder's receiver system, amplified and passed through a detection scheme, which determines the echo's time of arrival. The receiver component computed the time between transmission and reception of the acoustic pulse (two-way-time (twt)) and determined water depth (d) from half the product of two-way-time (t) and the mean sounding velocity (V_p):

$$d = t\, V_p / 2$$

Depth was automatically logged by the control and display system, which then triggered the next sound pulse.

During survey, positional and bathymetric data were downloaded at a rate of 6 soundings sec^{-1} via an RS-232 serial port interface to a laptop. Layback corrections were not required as the DGPS antenna was mounted directly above the bathymetric transducer at opposite ends of a rigid brace.

2.3.4. Side-Scan Sonar Survey

Side-scan sonar is an active acoustic technique, which uses the backscattering effect of narrow beams of high-frequency sound to produce a map of the acoustic properties of the sea-floor (Fleming, 1976). The system is composed of a towfish, cable for data transmission and topside electronics (processor, display unit and recorder). The beams are transmitted from multiple interconnected transceivers on either side of the towfish and across the seafloor below. The transceiver arrays are arranged linearly to produce narrow horizontal beam angles (typically 1-2°) and wide vertical beam angles (typically 40-50°). The narrow horizontal beamwidth concentrates the energy in a swath perpendicular to the axis of travel (*EdgeTech,* 1994). The towfish generates one pulse of energy at a time (typical duration of <1ms^{-1}) and waits for the sound to be reflected back and received by linear array (twt). As the towfish moves forward, successive sonic transmissions generate parallel data lines on the digital display unit (laptop), which build up to form the acoustic image of the seafloor (sonagraph) (*EdgeTech,* 1994).

The side-scan sonar survey at the Deenish Island site was conducted using a dual-frequency *GeoAcoustics* Model 159A side-scan sonar towfish, 50m kevlar tow-cable and Model SS941 (Fig. 5) transceiver system at an operational frequency of 500kHz. Data were acquired without slant-range correction, with swath width set at 156m (78m range per channel). Trackline spacing was fixed at 100m ensuring that in excess of 150% riverbed coverage was achieved throughout the survey. Sonar data was acquired in SEG-Y format, collected and processed in a *GeoAcoustics GeoPro LC* on an Apple Macintosh laptop platform and logged to disk.

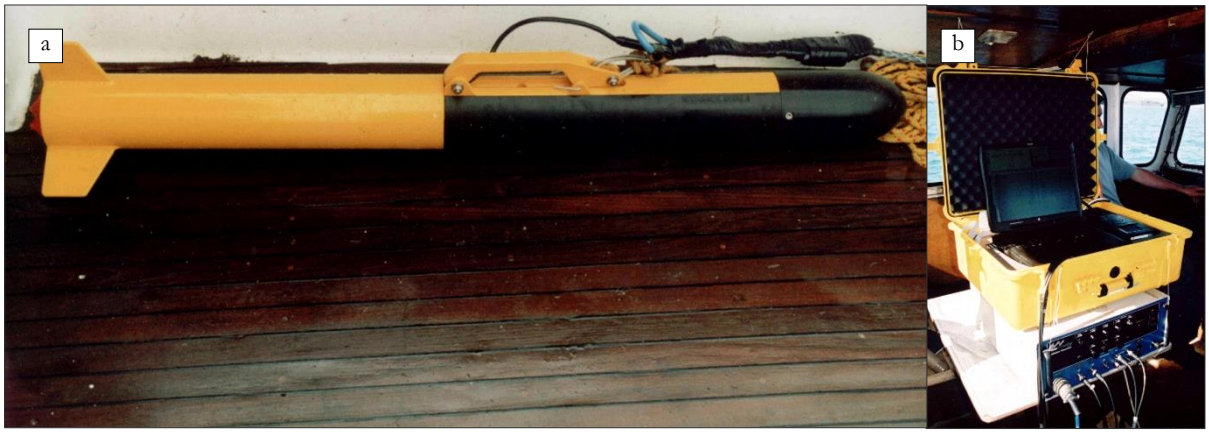


Figure 5: a) Dual-frequency *GeoAcoustics* Model 159A side-scan sonar towfish joined to kevlar towcable. The tow-cable is connected to b) *GeoAcoustics GeoPro LC* processor and digitally interfaced with *Coastal Oceanographics Hypack Max* software.

2.3.5. Magnetometer Survey

The magnetometer survey was not conducted using an *Aquascan AX2000* proton magnetometer linked to a *CSI Wireless DGPS MAX*.

Prior to data acquisition, the magnetometer is fine-tuned to the field-strength in the general area of operation. This enables maximum strength of reception to be received and also acts as a test for a low signal or high noise conditions. The latter is particularly relevant in developed inshore areas where non-archaeological magnetic anomalies, including anchors, chains, overhead and submerged cables, and other vessels, are abundant. These will often have large magnetic signatures, which mask archaeological anomalies. Comparison of magnetic data with side-scan sonar data supports interpretation in this case. As the signal generated by precession is small, the magnetometer cannot be used effectively near AC power sources, nor is the instrument effective in areas of igneous geology, where the base-line field-strength is too high for magnetic anomalies to be identified from the record.

During survey the magnetometer probe was towed behind the survey vessel at a distance of 3-4 times the length of the vessel to avoid detection of its field-distribution pattern. The layback between the dGPS antenna and the magnetometer probe was recorded.

Data were acquired in XYZ Raw ascii files a 2-second sampling interval and displayed in real-time on an interfaced laptop platform. Trackline spacing followed the same 100m pattern as the side-scan sonar survey, thus ensuring adequate coverage for archaeological survey as recommended by the Maritime Unit, The Department of the Environment, Heritage and Local Government.

2.4 Data Processing and Interpretation

2.4.1 GPS

The track line resulting from the bathymetric and side-scan sonar surveys at the proposed Deenish Island development site is displayed in Fig. 6. It is comprised of fourteen survey lines in an approximate north south direction over the proposed development site.

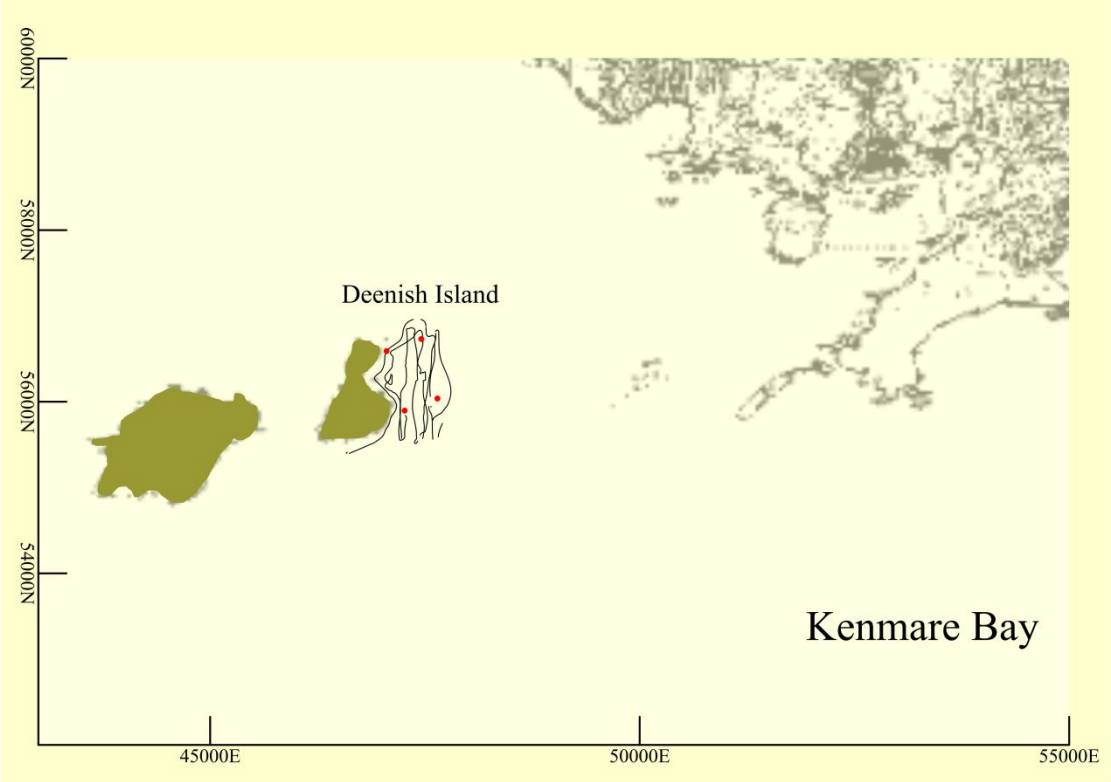


Figure 6: The track lines resulting from the site survey and an outline of the survey site overlaid on OS 6" Map. The extremities of the site are indicated by the red dots.

2.4.2. Bathymetric Survey

Bathymetric XYZ files were processed using *Surfer 8*. Raw ascii files were gridded in 2m bins using the Nearest Neighbour interpolation method. Two- and three-dimensional contour plots were produced for interpretation and data integration.

2.4.3. Side-Scan Sonar Survey

500kHz data in SEG-Y format were examined for each survey line. Sonar data were processed in *GeoPro LC* on an Apple Macintosh platform. Images were extracted as GeoTIFF files for inclusion in this report.

2.4.4. Magnetometer Survey

Magnetometer data were not processed using *Surfer 8*, gridded in 10m bins using the Nearest Neighbour interpolation method. Two- and three-dimensional contour plots were filtered and examined for anomalies.

3 RESULTS OF SURVEY

3.1 Desktop Survey

3.1.1 Historical and Archaeological Background (local historian John Fitzgerald)

Kenmare Bay

Kenmare bay stretches 49km from the Town of Kenmare to the open Atlantic and is 19km wide at its mouth. It narrows gradually as it separates Corks' Beara and Kerrys' Iveragh peninsula. The name Kenmare comes from the Irish "Ceann Mhara " meaning The Head of the Sea. The traditional name of the bay was Inbhear Sceine from the Celtic Inbhear, the arrival point of the mythological Irish ancestor Partholón. The area is rich in archaeological treasures dating back as far as Neolithic times with the Sheen Valley, bordering Kenmare Town hosting sites proving a community existed in the area some 5,000 years ago. Kenmare bay consists of old red sandstone dating back from the Devonian Era going back over 370 million years and was formed from desert sands when Ireland lay 20 degrees south of the equator. The Tectonic plate movement and resultant mountain building, ice sheet coverage and erosion all helped to shape the area we enjoy & know today.

The severe storms of 2014 have unearthed many shell middens like those exposed at Derrynanes' Abbey Island; these may suggest a Mesolithic presence of Sandhill peoples had settled in the dunes. The Kenmare Stone Circle dates back to the Bronze Age and is an impressive Boulder –Dolmen with a giant capstone measuring 2m x 1.8m. Other impressive stone circles can be found at Ardgroom, Cashelkeelty and Uragh on the Beara peninsula. On the Iveragh side the Standing Stone row at Garrough is believed to be a marker guiding Bronze age traders from Derrynane harbour to the Copper mines at Coad.

The South West of Ireland holds one of the richest sources of Copper in Western Europe and sometime before 2,000 BC the Beaker Folk, experts in mining and metalworking came to Ireland from North Africa through Iberia and Britain. These were expert miners of Copper and gold and extraordinarily pervasive traders. The copper mines on both sides of the bay were worked and by 2,000 BC the area became very prosperous, trading copper, bronze and gold to both Northern and Southern Europe. This growth in wealth also led to a growth in civilization. The late Stone Age saw the building of many stone forts with the remains of two at Caherdaniel, "Caher " being the Irish for stone fort. One of the finest examples in the country is the nearby Staigue Fort at Castlecove. Cahergarriff across the bay also has remains of a stone fort. The increased fortification/security in the area, is believed to have been driven by the rising prosperity.

The Celts came to Ireland from Alpine Central Europe around 500BC. They had discovered iron, which was a stronger and more durable metal than bronze. Their knowledge of this superior metal was the advantage that helped them spread and within a few hundred years they were to dominate all Ireland. The Celts had an oral tradition and kept no written records. Carthaginian, Greek and Roman scholars chronicled Celtic Ireland, probably getting their information from the many sailors and traders that visited the country. The Romans had come to conquer nearby Britain but had not continued to Ireland. They brought introduced chariots, built roads and Hilltop/Promontory Forts. It was a country with hundreds of little Kingdoms with Brehon Law being practiced and Blacksmiths, Druids and Poets held in the highest regard.

The first written Irish appeared in the 5th Century around the time Christianity reached the country, a series of lines and grooves carved on stone, known as Ogham Script. We can still find examples of it throughout the country on standing stones. The highest concentration of these stones is in the South of Ireland, with the oldest recorded at Lauragh and the tallest one nearby in Ardgroom.

Throughout these times the sea united rather than divided the peoples of the Whole Atlantic seaboard with fishing fleets, traders and raiders, emigrants, migrants and slaves influencing our evolution. Kenmare bay, with its rich fishing grounds, safe harbours and thriving mines was a vibrant European hub.

Christianity moved into Ireland in the 5th Century and has been a dominant force since. Records show a “Kieran of Saigir”, a pre Patrician Saint was active in Ireland as early as 357AD. According to the Annals of Inisfallen he spent time as a hermit near Caherdaniel in the Copper mine caves at Coad. St Patrick traveled the country with missionary zeal converting the pagan Irish from 461AD to 492AD and was to become the Primate of all Ireland. The 6th Century saw St. Fionan found the monastic settlement on Skellig Michael, now a World Heritage site. This magnificent Island, at the edge of then known world was home to the monks until the late 12th Century. Irish monks became teachers, inventors, great builders and craftsmen and were the scribes that kept vital historical records whilst Western Europe was in turmoil. Irish missionaries traveled abroad to Scotland, Britain and mainland Europe. St Killian who built a church in Lauragh was a missionary in Germany when he was martyred in the early 7th Century as the pagan Angles and Saxons overran Western Europe.

In 1193 the Anglo-Norman Invaders forced the powerful O Sullivan clan from their principle seat at Knockgraffan co Tipperary and pushed them far south to the ocean. At Kenmare they divided into two great branches; the O Sullivan Beare’s who took control of all lands South of Kenmare, (Beara Peninsula), and the O Sullivan Mórs who conquered Iveragh. These O Sullivans were to remain powerful until the English conquest of Ireland in 1602. Most of the area was granted to the Elizabethan “adventurer” Sir Walter Raleigh, who had his main base in Youghal.

Following the Cromwellian campaign 1649-1660 the population was decimated, by war, outbreaks of bubonic plague, forced deportations and enslavement to feed the colonies. 6,000 boys and girls as distinct from young adults were shipped from the region through Bristol to the slave plantations in the West Indies.

Sir William Petty came to Ireland as an army physician and went on to carry out the great land survey that followed the conquest. As payment for his works he was given 270,000 acres in Kerry, he also owned the lands on Beara, essentially gaining possession of all the O'Sullivan Beares and the O Sullivan Mórs' lands. This mountainy land was valued as unsuitable for agriculture and so was cheaper than the lands to the north. So Petty essentially had acquired the lands on both sides of the bay. He saw the huge potential in the safe harbours, the forests, the iron and copper deposits and the world-class fisheries. Petty opened and reopened the iron and copper mines, bringing miners in from Cornwall to work them. He introduced the Seine net fishing boats to the region and established successful salmon, herring, pilchard and mackerel fisheries at Kenmare, Killmackilloge and Dursey. These fish were salt cured in buildings called Fish Palaces and then exported far and wide. The remains of a fish Palace, albeit converted into a dwelling, can be found at Bunaw. Petty also had the bay designated The Kenmare River, so he could have ownership of the lucrative salmon rights for the entire bay. The 18th Century saw the draconian Penal Laws against the conquered Catholics; they could not buy land, could not leave land to a single heir and could not inherit land from a protestant…by 1778 only 5% of the land was owned by Catholics.] They were barred from attending Irelands only university, Trinity College, and forbidden from educating their children on the Continent, a rule they managed to bend. An overdependence on the potato and a blight led to a huge famine in 1741 Which left hundreds of thousands dead.

A healthy smuggling trade between Kenmare bay and France and Spain persisted bypassing the colonial tariffs with brandies, wines tobacco, silks, tea and salt imported, while salted hides, wool, butter and most importantly people. Young men and women were sent to the continent for education, many entered religious service and returned; lots of the men joined the French, Austrian and Spanish armies. In 1787 there were 10 smuggling ships working from Kenmare Bay. The O'Connell's of Derrynane would have controlled most of the trade with cooperation from the O'Sullivan Clan on Beara; Morty Óg O'Sullivan had an eight –gun brigantine sailing up and down the bay…no customs boat could catch or challenge it. Towards the end of the Century the death penalty was introduced firstly for corrupt customs men and later for smugglers who resisted arrest. Catholics were given access to education and later began entering the professions. Smuggling of spirits was to continue for some time but the boom years of smuggling were over.

The 19th Century saw rent increases, greedy landlords agents and poverty and hardship for the vast majority of the Irish.

Scariff and Deenish Islands

Located between 3Km and 5Km from the mainland in Derrynane Bay on the South West edge of the Kenmare Rive the islands form a designated Special Protection Area, as they are important habitats/breeding sites for Fulmar, Manx Shearwater, Storm Petrel, Lesser Black-backed Gull, Artic Tern and Chough.

Deenish Island

Deenish from Dubh Inis or Dark Island comprises 122 acres of mostly Grassland with some Heath on higher ground. It is less rugged than its near neighbour Scariff. It rises to 144m on its Southern side with old fields systems overgrown with Brambles and Bracken.

The 1851 census shows 3 houses with a population of 21, Currans being the tenants of Butlers of Waterville. A dairy herd was milked to produce butter for export and between fishing and farming the family was able to survive. It is said the potato blight of the 1840's didn't reach the Islands. In 1861 one house was occupied and the population had dropped to 6. A move to the mainland and to the new world offered better opportunities for the Islanders with many settling in New York area. In the 1911 census the population is again 6 with the head of the house Patrick Curran recorded as the Landlord.

The Currans were visited by British Forces during the War of Independence, the soldiers became frustrated they could not find any money…The Islanders cash saved from their fishing efforts was hidden in a false bottomed drawer. In1925 the family left the Island but returned each summer for many years to fish the surrounding waters.

Scariff Island

Scariff from An Scairbh meaning narrow ford or landing place is an Island of 366 acres lying about 4 Km from the mainland, less than a km southwest of Deenish Islanf. Grassland, Heath and Bracken make up the vegetation and the Island is home to some interesting Archeological sites. There are the remains of an Hermitage on route to the 252m summit, Pagan remains nearby and a Christian site with the ruins of an Oratory on the NE side of the Island.

On the 23rd of June 1653 Fr Francis O'Sullivan, the Head of the Franciscan Order in Ireland was murdered here by Cromwellian bounty hunters. He had traveled to the court of King Phillip 4th of Spain and organized for Arms and Monies to be sent to the Gaelic Chieftains to fight of the Cromwellian invasion. His skull is in the Franciscan Friary in Killarney while his body is buried on Scariff. A member of the O'Sullivan Mór clan, he was known as "The Red Monk Of Scariff" He is commemorated each June in Derrynane. The landing on the Northern side of the island has steps carved into the stone similar to Skellig Michael and it is believed it may have been home to a small Christian settlement around the same time they settled on the Skelligs.

The 1841 census shows 3 houses with 19 inhabitants, 1851 shows us one house with 13 inhabitants, 1861 gives one house and 10 souls and the 1871 census gives us one house with 4 males and 3 females dwelling there. The O'Sheas who occupied this house show up again in the 1911 census as a family of seven, father, mother, a daughter and four sons. They were to vacate the Island between 1933 and 1935, returning in the summers to fish the surrounding waters.

3.1.2. Sites and Monuments Record

The Record of Monuments & Places (RMP) is a list of archaeological sites known to the National Monuments Service with accompanying RMP Maps, based on OS 6" Sheets, which indicate the location of each recorded site. The RMP list is based on The Sites and Monuments Record files housed in the National Monuments Services offices. The Sites and Monuments Records (SMR) are lists with accompanying maps and files of all certain or possible archaeological sites and monuments mainly dating to before 1700AD for all counties. These lists were in many cases based initially on cartographic, documentary and aerial photographic sources. The SMR (as revised in the light of available fieldwork) form the basis of the statutory RMP. The record is updated on a constant basis and focuses on monuments that predate 1700AD. Buildings belonging to the seventeenth century and later are not well represented in their archive, although they are considered as archaeological sites today. As a result field inspection often reveals additional sites from this recent past.

The Sites and Monuments Record lists nine sites in the Townlands adjacent to the proposed development. The sites are displayed in Figure 7 and listed in Table 3. Details of the sites are provided below

SMR No	Class	Townland	ITM
KE105A001002-	Ecclesiastical enclosure	Scarrif Island	445208, 555677
KE105A001004-	Souterrain	Scarrif Island	445126, 555740
KE105A001005-	Hermitage	Scarrif Island	444366, 555277
KE105A001----	Redundant record	Scarrif Island	0, 0
KE105A002----	Megalithic structure	Scarrif Island	445204, 555756
KE105A003----	Field system	Scarrif Island	0, 0
KE105A003001-	Hut site	Scarrif Island	0, 0
KE105A001001-	Church	Scarrif Island	445142, 555772
KE105A001003-	Children's burial ground	Scarrif Island	445203, 555835

Table 3: The sites recorded in the Sites and Monuments Record for the Townlands (Scarrif Island) adjacent to the proposed development

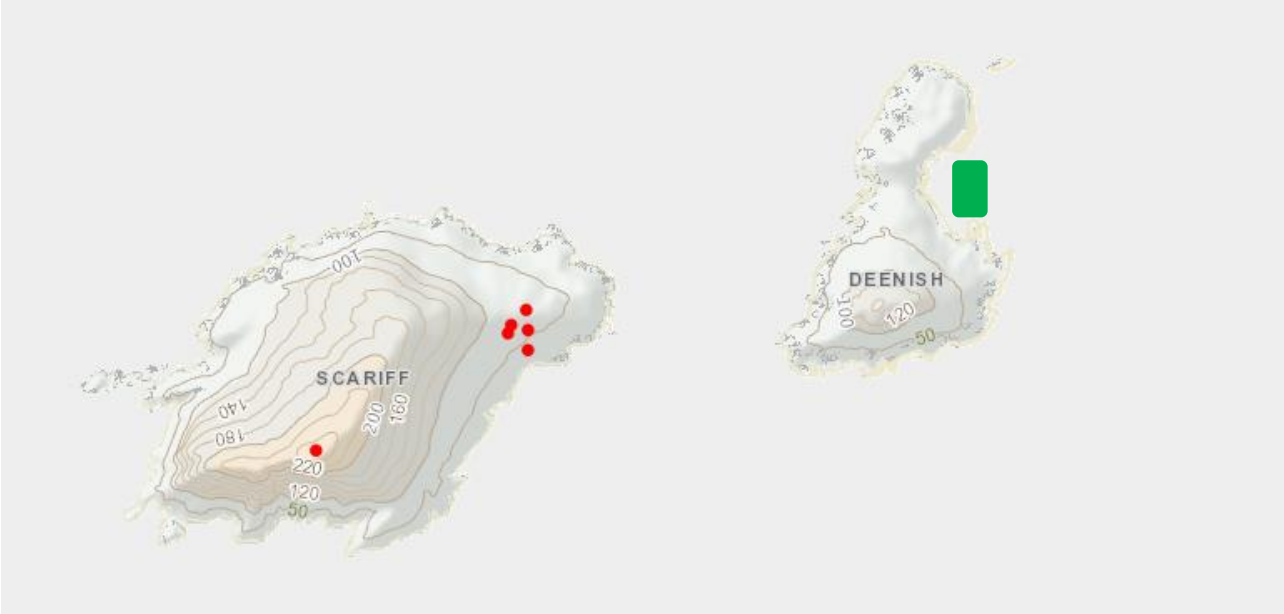


Figure 7: The location of sites recorded in the Sites and Monuments, record for the Townlands adjacent to the proposed development site. The location of the proposed development site is marked by the green rectangle.

KE105A001005-

Class: Hermitage

Townland: SCARIFF

Description: Scariff Island is located 5 km SW of Hog's Head, on the N side of the mouth of Kenmare Bay. The ecclesiastical site KE105A001001- on it is reached by a path that leads uphill from the landing place at Coosaneeve/Cuas na Naomh, on the island's NE shore. It consists of the remains of a terraced oval enclosure, within which is the site of an oratory and a burial ground, as well as a nineteenth century house. Outside the enclosure at SW is a souterrain. Lewis noted 'the vestiges of an ancient hermitage (KE105A-001005-) or cell . . . covered by a mound of earth and stones raised by the Trigonometrical Surveyors of Ireland' on the summit of Scariff Island (1837, 546). There is no apparent trace of this potential site.

KE105A001002-

Class: Ecclesiastical enclosure

Townland: SCARIFF

Description: Scariff Island is located 5 km SW of Hog's Head, on the N side of the mouth of Kenmare Bay. The ecclesiastical site on it is reached by a path that leads uphill from the landing place at Coosaneeve/Cuas na Naomh, on the island's NE shore. It consists of the remains of a terraced oval enclosure, within which is the site of an oratory and a burial ground, as well as a nineteenth century house. Outside the enclosure at SW is a souterrain. The outline of the oval enclosure (KE105A-001002-) is preserved only at S, where it is traversed by a NE-SW field wall, but a number of curving stretches of field boundaries at N may reflect its limits here. The

enclosure measures c. 80m NW SE x c. 55m NE-SW. Its interior slopes steepy downwards to SE, and features two level terraces. The modern house stands on the lower terrace, which measures 13m wide and is delineated at SE by the traversing field wall. The 1.8m high face of the upper terrace features intermittent stretches of a curving drystone revetment. The structure marked 'Oratory' (KE105A-001001-) on the OS maps is located on this terrace, and is preserved as the low sod-covered foundations of a rectangular building which measures c. 7.5m NE-SW x 5.5m NW-SE externally.

KE105A002----

Class: Megalithic structure

Townland: SCARIFF

Description: This site, described in the OSNB (Kilcrohane, 192) as a 24 foot (7.3m) long grave, was located on the NE side of Scariff Island, a short distance S of an ecclesiastical site (KE105A-001----). Henry described the site as 'two erect slabs standing about 20 feet [6.09m] apart', and recorded that local digging at the site revealed no finds (1957, 146). No trace of this site, which was locally known as the 'Giant's Grave', is now apparent.

KE105A001004-

Class: Souterrain

Townland: SCARIFF

Description: Scariff Island is located 5 km SW of Hog's Head, on the N side of the mouth of Kenmare Bay. The ecclesiastical site on it is reached by a path that leads uphill from the landing place at Coosaneeve/Cuas na Naomh, on the island's NE shore. It consists of the remains of a terraced oval enclosure, within which is the site of an oratory and a burial ground, as well as a nineteenth century house. Outside the enclosure at SW is a souterrain. The entrance to a souterrain (KE105A-001004-) is located just outside the enclosure (KE105A-001002-) at SW. Built into a steep slope, it measures .4m high x 1.1m wide and gives access to a passage which extends 2.8m WNW before turning to WSW for a further 4.1m, where it is blocked with collapse. The passage is up to .9m high and averages .9m wide. It is roofed with lintels, and its well-built drystone walls corbel inwards as they rise.

KE105A002----

Class: Megalithic structure

Townland: SCARIFF

Description: This site, described in the OSNB (Kilcrohane, 192) as a 24 foot (7.3m) long grave, was located on the NE side of Scariff Island, a short distance S of an ecclesiastical site (KE105A-001----). Henry described the site as 'two erect slabs standing about 20 feet [6.09m] apart', and recorded that local digging at the site revealed no finds (1957, 146). No trace of this site, which was locally known as the 'Giant's Grave', is now apparent.

KE105A001003-

Class: Children's burial ground

Townland: SCARIFF

Description: Scariff Island is located 5 km SW of Hog's Head, on the N side of the mouth of Kenmare Bay. The ecclesiastical site (KE105A001001-) on it is reached by a path that leads uphill from the landing place at Coosaneeve/Cuas na Naomh, on the island's NE shore. It consists of the remains of a terraced oval enclosure, within which is the site of an oratory and a burial ground, as well as a nineteenth century house. Outside the enclosure at SW is a souterrain. Henry noted a ceallúnach (KE105A-001003-) 'without any feature of interest' c. 90m NE of the oratory (1957, 146). No surface trace of this is now apparent. It may be the disused burial place, noted in the OSNB (Kilcrohane, 29), where Francis O'Sullivan, Provincial of the Irish Franciscan Order, was buried following his execution on Scariff Island in 1653 (Browne 1898, 321).

KE105A001001-

Class: Church

Townland: SCARIFF

Description: Oratory: Scariff Island is located 5 km SW of Hog's Head, on the N side of the mouth of Kenmare Bay. The ecclesiastical site on it is reached by a path that leads uphill from the landing place at Coosaneeve/Cuas na Naomh, on the island's NE shore. It consists of the remains of a terraced oval enclosure, within which is the site of an oratory and a burial ground, as well as a nineteenth century house. Outside the enclosure at SW is a souterrain. The outline of the oval enclosure (KE105A-001002-) is preserved only at S, where it is traversed by a NE-SW field wall, but a number of curving stretches of field boundaries at N may reflect its limits here. The enclosure measures c. 80m NW SE x c. 55m NE-SW. Its interior slopes steepy downwards to SE, and features two level terraces. The modern house stands on the lower terrace, which measures 13m wide and is delineated at SE by the traversing field wall. The 1.8m high face of the upper terrace features intermittent stretches of a curving drystone revetment. The structure marked 'Oratory' (KE105A-001001-) on the OS maps is located on this terrace, and is preserved as the low sod-covered foundations of a rectangular building which measures c. 7.5m NE-SW x 5.5m NW-SE externally. Henry noted a ceallúnach (KE105A-001003-) 'without any feature of interest' c. 90m NE of the oratory (1957, 146). No surface trace of this is now apparent. It may be the disused burial place, noted in the OSNB (Kilcrohane, 29), where Francis O'Sullivan, Provincial of the Irish Franciscan Order, was buried following his execution on Scariff Island in 1653 (Browne 1898, 321). The entrance to a souterrain (KE105A-001004-) is located just outside the enclosure at SW. Built into a steep slope, it measures .4m high x 1.1m wide and gives access to a passage which extends 2.8m WNW before turning to WSW for a further 4.1m, where it is blocked with collapse. The passage is up to .9m high and

averages .9m wide. It is roofed with lintels, and its well-built drystone walls corbel inwards as they rise. Lewis noted 'the vestiges of an ancient hermitage (KE105A-001005-) or cell . . . covered by a mound of earth and stones raised by the Trigonometrical Surveyors of Ireland' on the summit of Scariff Island (1837, 546). There is no apparent trace of this potential site.

3.1.3. Topographical records of The National Museum of Ireland

The National Museum of Ireland Topographical Files is the national archive of all known antiquities recorded by the National Museum. These files relate primarily to artefacts but also include references to monuments and also contain a unique archive of records of previous archaeological excavations. The Museum's files present an accurate catalogue of objects reported to that institution from 1928. There is a computerised database of finds from the 1980's onwards. The find-spots of artefacts can also be an important indication of the archaeological potential of the related or surrounding area.

Inspection of the relevant National Museum of Ireland files for Deenish Island revealed that a stone ring is recorded as having been found on the island 1942. Find number 1942-1749

3.1.4 Record of archaeological excavations

The excavations database contains summary accounts of all the excavations carried out in Ireland – North and South – from 1970 to 2007. It has been compiled from the published Excavations Bulletins from those years, with a similar format. The Excavations Bulletin was started by Tom Delaney in the early 1970s and was revived by Claire Cotter in 1985. Since 1986 it has been compiled by Isabel Bennett and published by Wordwell, with support from the Office of Public Works, the Department of the Environment, Heritage and Local Government.
Analysis of the excavations database revealed no results for an archaeological excavation at or near the location of the proposed fish farm development site at Deenish Island.

3.1.5 The Shipwreck Inventory

The shipwreck inventory is based on a desktop survey with information gathered from a broad range of cartographic, archaeological and historical sources, both documentary and pictorial. The inventory records all known wrecks for the years up to and including 1945 and to date approximately 12,000 records have been compiled and integrated into a database.

Inspection of the inventory of wrecks revealed a listing of seven vessels which were lost in the seas around Deenish Island. The wrecks recoded for the area are detailed below and listed in table four.

A further twenty six vessels are recorded as having been lost within or adjacent to the Kenmare River. The wrecks recorded for the area of the Kenmare River are detailed in Appendix 1.

Number	Name	Date	Location
W06024		12/08/1781	Scariff Island
W06034		15/12/1379	Scariff Island
W05661	*St. Michael*	12/02/1874	Hogs Head
W06022	Cannon		Derrynane Harbour
W06028	Boat		Derrynane Harbour
W06040			Abbey Island
W11615	Cannon		Lamb Island

Table 4: The shipwreck inventory listing of vessels lost in the seas around Deenish Island.

W06024, 12/08/1781, Coumatloukane

Inside Scariff Is., c.2 miles NW Derrynane Harbour

Ship wrecked. Captain David Murray allowed Maurice O'Connell to salvage the cargo, in particular two barrels of indigo.

W06034, 15/12/1379, Scariff Island, Co Kerry

A Cornish expedition in the reign of Richard II had gathered reinforcements at Southampton to be taken to Brittany. The force had seized nuns from a convent where some of the troops had been camped. The commanders were Sir John Arundel, Calvery, Percy, Sir Thos Banastre and other knights. The ships were carried off the Irish coast by gales and 60 nuns were cast overboard to lighten the ship. Sir Johnm Arundel's ship, under master Robert Rust, struck rocks between the island and mainland. 25 other ships, following their leader, were also lost. English contemporary accounts mention Sherkin or Cape Clear as the location of the island where the wrecks occurred, but Irish sources mention Scariff.

W05661, *Ethel B. Jacobs*, 25/10/1899

Abbey Island, Co Kerry, Derrynane Rock near,
125-/148-ton 8-year old wooden schooner, crew of 16. Owner was S. Jacobs of Glouchester and the master was W. Cluett. En route from Castletown Berehaven or from America to Castletownbere for fish when lost.

W05915, *St. Michael*, 12/02/1874
Bray Head, Co Wicklow or Hogs Head, Derrynane
Portuguese ship en route from Liverpool to Rio de Janeiro, lost during a storm. Three of the 28 aboard were lost. 'Stranded and lost in the SE gale, described as the great storm of 12.02, and the reason for such a large crew was that the ST MICHAEL had come across the Austrian barque VITEZ, Galway to Cardiff, when she was west of the Sceligs, and had taken off all her crew.'

W06022 Derrynane Harbour
Six cannon and two anchors are present at this site, which was surveyed by IUART in May 1996

W06028, Derrynane Harbour
Boat was carrying a local poet, Tomás Rua ÓSúilleabháin, and a teacher to Portmagee, sank after striking Carraig Eibhlín Ní Rathaille. A poem laments the loss of the poet's library of manuscripts and books.

W06040, Abbey Island, Co Kerry, Derrynane
Ship wrecked carrying Iron ore.

W11615, *Derrynane Harbour, Cannon Site*
Derrynane Harbour, NW Lamb Island
Anchor and cannon
51 45 38.849N, 10 09 12.821W.

W16750, *San Miguel*, 16/02/1874(r), Derrynane
Barque SAN MIGUEL, en route from Liverpool to Rio Janeiro, with coal, has been wrecked near Derrynane , she had on board the crew of the VITEZ, which had been abandoned , three men drowned, 25 saved

3.1.6 Lewis Topographical Directory

Lewis Topographical Dictionary gives a unique insight into early nineteenth century life within Irish counties and towns. Samuel Lewis first published his two volumes of The Topographical Dictionary of Ireland in 1837. His main aim, along with his previous topographical dictionaries and maps of the United Kingdom, was to give in 'a condensed form', a reliable and unbiased description of each place. The dictionary provides a comprehensive description of all Irish localities as they existed at the time of publication. Every parish, town and village in Ireland, including numbers of inhabitants, the economy, history, topography, religion and parish structures, administration and courts, schools are described. Lewis gives the names of the principal inhabitants (generally landlords, merchants and professionals). The dictionary is the first detailed study of its kind for Ireland, and since it was published just prior to the Irish Potato Famine (1845-49) it is a valuable resource used widely by historians and genealogists alike.

KILCROHANE, a parish, in the barony of DUNKERRON, county of KERRY, and province of MUNSTER, 14 miles (S. W.) from Kenmare; containing 9468 inhabitants. This parish is situated on the northern shore of the great river or bay of Kenmare, along which it extends nearly 14 miles. It is bounded on the east by the river Blackwater, on the west by the bay of Ballinaskelligs, and on the north by a range of lofty mountains which separates it from the barony of Iveragh; and is computed to contain nearly 90,000 statute acres, the greater part of which consists of rocky mountain pasture, waste, and bog, there being but a very small portion in tillage, and that chiefly for potatoes, for which sea manure is used. The land is usually computed by gneeves, of which the parish contains 768, estimated at the annual value of £6720. Nearly in the centre of the parish an inlet of the bay of Kenmare receives the river Sneem, and forms the harbour of that name, where vessels of considerable size may lie securely when not exposed to the south-western gales. The western extremity of the parish terminates in the peninsula called Hog Head, which forms the southern side of the bay of Ballinaskelligs. Along the shore in Kenmare bay are several islands, the principal of which is Rossmore; and about a league off the western shore are those of Scariff and Dinish, called the Hog Islands. There is at present but one main line of road through the parish; but a new line is about to be constructed from Sneem to the pass of Cameduff, where it will meet the new road between Killarney and Kenmare about midway. Several of the inhabitants, including some of the small farmers, are occasionally employed in the fishery of the bay, on which they partly depend for their support; but it is expected that the new road from Sneem will tend materially to develop the agricultural resources of this wild and mountainous district. The bogs, which are deep and extensive, were surveyed about 30 years since, by the late Mr. Nimmo, who reported to the Government that the greater part of them were capable of being drained and brought into cultivation at a moderate expense. On the summit of the mountain called Finabagough, 1200 feet above the level of the sea, is an extensive tract of common, where cattle are grazed during the summer months. The seats are Derrynane, the residence of Daniel O'Cormell, Esq., M.P.; Derriquin, of F. C. Bland, Esq.; Hollywood, of—Hyde, Esq.; Aska, of Dr. Browne; Castle Cove, of Mr.

O'Sullivan; and the glebe-house, of the Rev. S. Mathews. Berrynane, sometimes called Derrynane or Darrynane Abbey, from its proximity to the ruins of the ancient monastery of that name, is situated near the shore of the Atlantic, at the western extremity of the parish: it is an extensive but irregular pile of building, partly in the castellated style, and has been much enlarged by the proprietor, who has also greatly improved the approaches, and extended the shrubberies and plantations as far as the situation, so much exposed to the western gales, will allow. The surrounding scenery, which is of the most wild and romantic description, is terminated on the north by a range of rugged and lofty mountains, from the summit of which an extensive view of the western coast is obtained, embracing the entrances to the bays of Bantry and Kenmare, the bay of Ballinaskelligs, Dursey Island, and the Skellig Isles. Derriquin, also partly castellated, is situated in a finely wooded demesne on the bay of Kenmare, which is here studded with several small islands. The prostrate juniper is found on the shore at this place. A penny post to Cahirciveen has been lately established at Ballybrack. The living is a rectory and vicarage, in the diocese of Ardfert and Aghadoe, united prior to any existing record to the rectory and vicarage of Templenoe, and in the patronage of the Crown: the tithes amount to £258. 9. 2¾., and those of the union to £380. 15.4½|. The church at Sneem is a plain structure, erected about 1790, for which purpose £390 was granted by the late Board of First Fruits, and £100 was granted at the same period towards the erection of the glebe-house. The glebe comprises 23 acres, subject to a rent of £30. In the R. C. divisions this parish forms two separate districts; the eastern, called Ballybog, contains the chapels of Sneem and Thahilla; and the western, called Derrynane, those of Derrynane and Lohurt. The chapel at Sneem is a large plain building, and that at Derrynane is a neat modern edifice, erected at the joint expense of the late General Daniel Count O'Connell, Mr. O'Connell, and Mr. Hartop. The parochial school at Sneem is supported by Mr. Bland, of Derriquin, and the incumbent; a school held in Sneem chapel is chiefly supported by the priest, and a free school at Derrynane by a bequest of £10 per annum from the late General Daniel Count O'Connell (at whose expense the school-house, a neat building, was erected) and by annual donations from Mr. O'Connell and Mr. Hartop: about 250 children are educated in these schools. The ruins of Aghamore or Derrynane Abbey, founded in the seventh century by the monks of St. Finbarr, at Cork, for canons regular of the order of St. Augustine, stand on a peninsula which becomes insulated at spring tides, and has therefore acquired the name of "Abbey Island." A portion of the walls has been washed away by the violence of the waves, but the remains are still considerable, and the eastern window nearly entire. Here is the family vault of the O'Connells. At Coode are the ruins of the old church, and on a hill about a mile from it is a curious hermitage, hewn out of the solid rock, said to have belonged to St. Crohane, the patron saint of the parish. At Cahirdaniel are the remains of a large fortification, consisting of a rampart seven feet high, constructed of large stones, and attributed to the Danes; and at Money Fluch are those of a similar one. But one of the most remarkable ancient structures in Ireland is Staigue Fort, which is generally considered to be unique. It stands on a low hill nearly in the centre of an amphitheatre of barren mountains, open from the south to the bay of Kenmare, from which it is about a mile and a half distant. The

building, which is nearly of a circular form, is constructed of the ordinary stone of the country, but bears no mark whatever of a tool, having been evidently erected before masonry became a regular art. The only entrance is by a doorway barely five feet high, through a wall upwards of 13 feet thick, which opens into an area of about 90 feet in diameter. The circumference is divided into a series of compartments of steps, or seats, ascending to the top of the surrounding wall, in the form of the letter X, and in two of these compartments are entrances to cells constructed in the centre of the wall. The average height of the wall on the outside is 18 feet, battering as it rises by a curve, which produces a very singular effect: the wall also batters on the inside, so as to be reduced from about 13 feet at the bottom to 7 at the top. On the outside the stones are small, and the joints are so filled with splinters of stone as not to be removed without violence. The fort is surrounded by a broad fosse. Various conjectures have been formed as to its origin and use, the most probable of which appears to be that it was erected as a place of refuge for the inhabitants and their cattle from the sudden inroads of the pirates of former time

3.1.7 Ports and Harbours Archive

The Ports and Harbours Archive contains information from State files relating to coastal Irish ports, harbours and landing stages. The archive, not yet completed, is held by the Underwater Archaeology Unit in the Department of Environment, Heritage and Local Government.

Inspection of The Ports and Harbours Archive revealed no information on the construction, use or development of Caherdaniel Harbour.

3.1.8 Marine Environment

The SW coast of Ireland between Mizen Head and Loop Head, 92 miles N, is characterized by bold mountainous peninsulas and deeply indented bays. Most of the coast is bordered by a predominantly rocky and cliffy shore, however, a few stretches of sandy beach fringe the heads of some bays and
coves, and tidal flats are common. Most of the indentations are subject to heavy seas and swell from the North Atlantic, but several good partly protected anchorages are available in some of the bays as well as to leeward of the large islands.

The Kenmare River (51°45'N., 10°00'W.), a narrow, deep inlet extending about 22 miles ENE, is entered between Cod's Head and Lamb's Head about 4.5 miles NNW. The bold, high land on both sides of the entrance rises to elevations in excess of 305m. The rocky and indented shores are mostly foul and must be approached with caution. Small vessels can find shelter in the bays on either shore. Large vessels anchor near the head of the inlet.

Scariff Island (51°44'N., 10°15'W.), 252m high and precipitous, is the outer of a group of islands extending 4.5 miles W from Lamb's Head. Narrow deepwater channels lie between
the islands and afford access to the river entrance for small vessels. The flood and the ebb follow the direction of the shore within the Kenmare River. The flood begins about 5 hours 20 minutes after HW at Galway and the ebb begins about 1 hour before HW at Galway. The spring velocity in the outer part is about 0.5 to 0.8 knot, increasing to a maximum of 1.5 knots farther in. With W gales, there may be a turbulence off Deenish Island (51°44'N., 10°13'W.) and the Dunkerron Islands (51°52'N., 9°38'W.). Between Scariff Island (51°44'N., 10°15'W.) and Lamb's Head (51°44'N., 10°08'W.), the currents set N when the flood sets into the Kenmare River and S with the ebb. Slack water lasts for about 15 minutes between each change.

Ballycrovane Harbor (51°43'N., 9°57'W.), in the NE part of Coulagh Bay about 6 miles ENE of Cod's Head, is entered between Ainrush Islet and the mainland N. The channel at the head of the harbor is narrowed to a width of 0.1 mile by the shoals on either side. Anchorage can be taken, in 7.3 to 9.lm, in the middle of the harbour.

Darrynane is a picturesque land locked natural harbour located to the northwest of Abbey Island close north of Lamb's Head and Derrynane Bay, in Co. Kerry. The small harbour has a narrow entrance between rocks that leads into an excellent anchorage with secure moorings. The harbour provides complete protection in a scenic location free from swell in all conditions. Although protected from the sea the area is somewhat exposed to wind, particularly so to northerly squalls, so that a vessel sheltering from heavy weather can expect some rig noise. The harbour's southwest entrance is extremely narrow requiring careful navigation. Beacons, transits and leading lights are provided but it is best avoided at night. In any rough conditions,

especially from the southwest, the sea will break on the narrow entrance between the rocks making it dangerous if not impassable. Please note the anchorage has becomes popular with water skiers during high summer making for an uncomfortable wash and noise at times. Darrynane Harbour should only be accessed by a vessel that can call on auxiliary power, and not at night unless supported by highly experienced local knowledge. Darrynane (Doire Fhíonáin) 'Fíonán's oak wood', that is now more popularly spelled Derrynane, lies amidst some of the most spectacular scenery in Ireland. It is a popular water leisure location for sailing, water skiers or for families to enjoy a lovely fine sandy beach that shelves gently into crystal clear water. The harbour makes for a great anchorage that is relatively easy to enter, where you can sit out a gale in flat water. There is a pub that serves food during the summer months a couple of hundred yards from the old pier and beach. There is another pub a good hours walk inland that also serves excellent food, but ask for directions if you intend to spend time there. Historically Darrynane is perhaps most famous for being the ancestral home of Daniel O'Connell who resided in Darrynane house about a 600 metre walk beyond the quay. Daniel O'Connell (6 August 1775 – 15 May 1847), known as 'The Liberator', or 'The Emancipator', was an Irish political leader in the first half of the nineteenth century. He campaigned for Catholic Emancipation - the right for Catholics to sit in the Westminster Parliament, denied for over 100 years - and for the Repeal of the Union between Ireland and Great Britain. Daniel O'Connell's house is now open to the public. Situated on 120 hectares of scenic parklands, the House displays many relics of O'Connell's life and career and is well worth a visit. Although Daniel O'Connell was buried in Dublin his family burial plot is on Abbey Island. A plaque with some information can be found surrounding the family grave. More recently Damian Foxhaul of round the world fame came from here where he started his sailing. He was the first Irishman to win a round the world yacht race.

3.2. Site Survey

3.2.1. Shoreline Inspection

The proposed fish farm development site is located off the eastern shore of Deenish island and west of Caherdaniel Harbour in Kenmare Bay, County Kerry (fig. 8a).

The Shoreline adjacent to the location of the proposed development, which did not clear at low water was assessed by way of a boat based visual inspection, supported by photography.
The inspection revealed a shoreline comprised of low vertical or near vertical stone cliffs extending from the grass line to the low waterline. The inspection revealed no features that could be described as archaeological.

c b

d

Figure 8:

(a) View of the proposed development site on the eastern side of Deenish Island (viewed from the east)

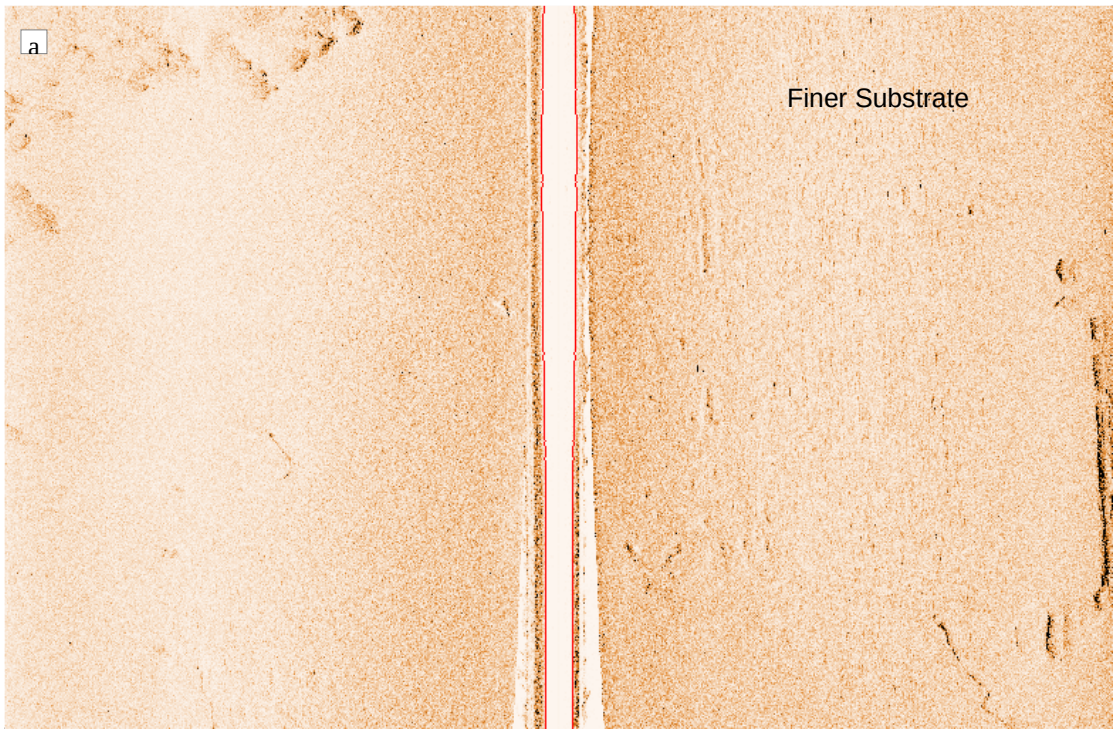
(b) View of the proposed development site on the eastern side of Deenish Island (viewed from the south)

(c) Low cliff face at Deenish Island to the west of the proposed development site (viewed from the south)

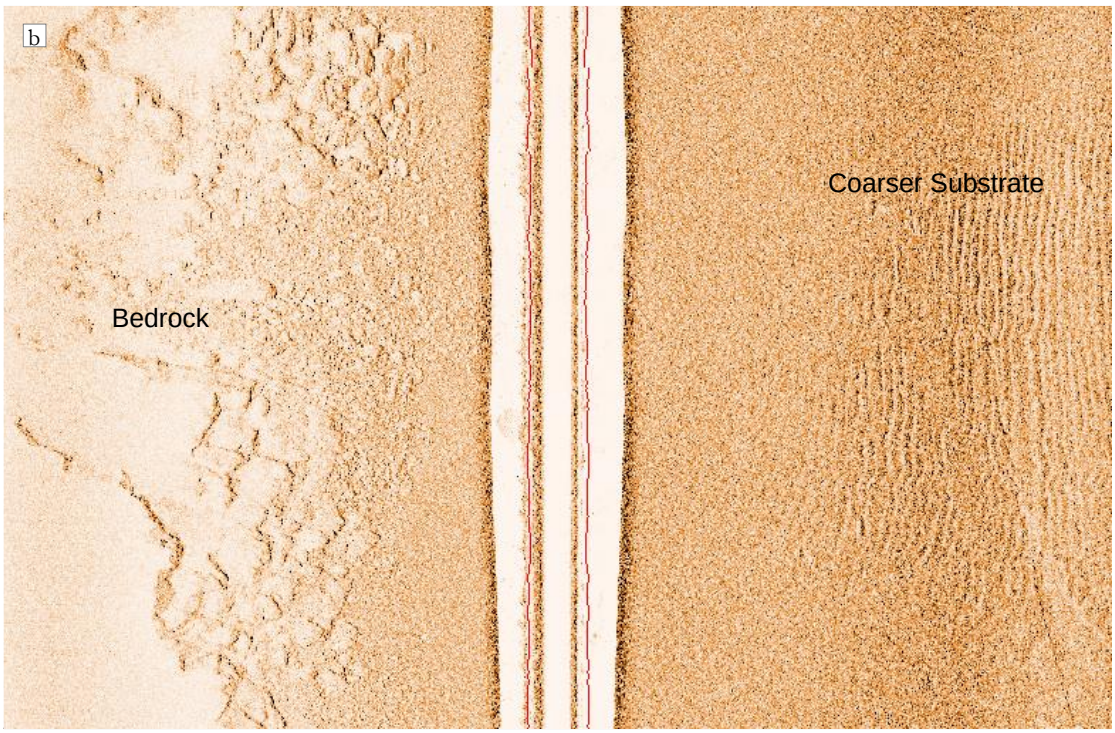
(d) Low cliff face at Deenish Island to the west of the proposed development site (viewed from the south)

3.2.2. Seabed sediments

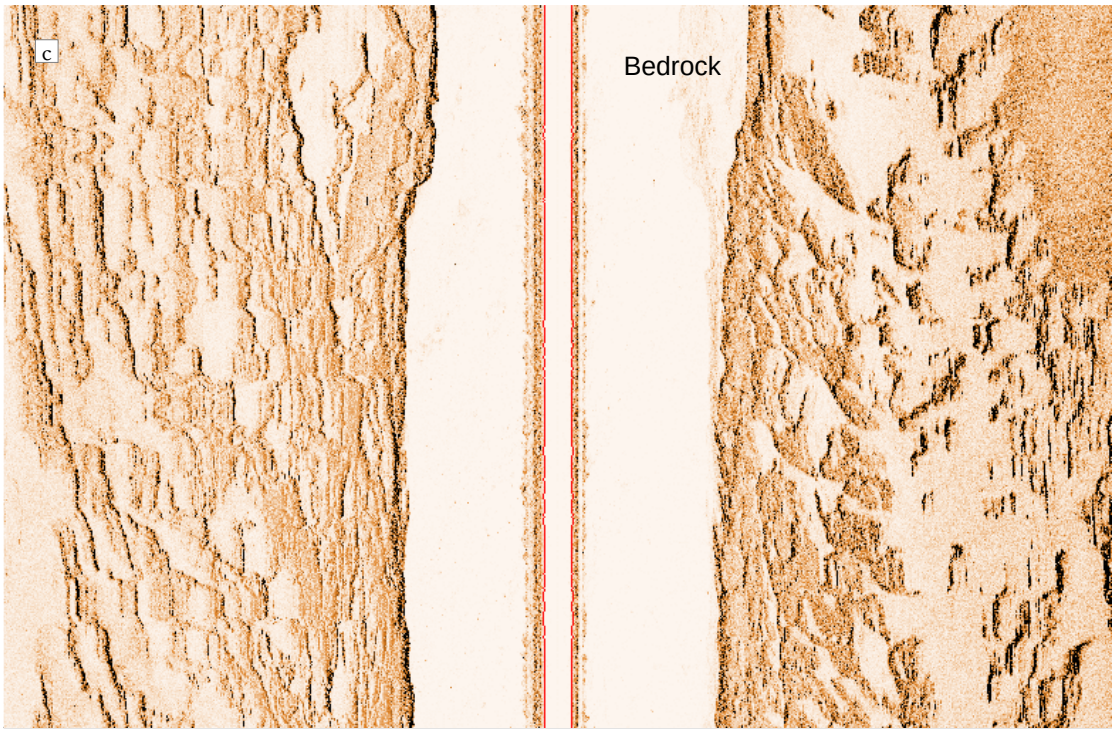
A type image of the seabed substrate at the proposed Deenish Island development site is displayed in figure 9. The substrate is comprised of bedrock, coarse material and a finer material. The coarse material is interpreted as gravels and the finer material interpreted as a sand or fine gravel. A substrate distribution map derived from the sidescan survey data is depicted in figure 10.



(a) Image of a finer substrate



(b) Image of bedrock and a coarser substrate



(c) Image of Bedrock

Figure 9: Sonagraph image from the Deenish Island survey area indicating the backscatter Substrate returns

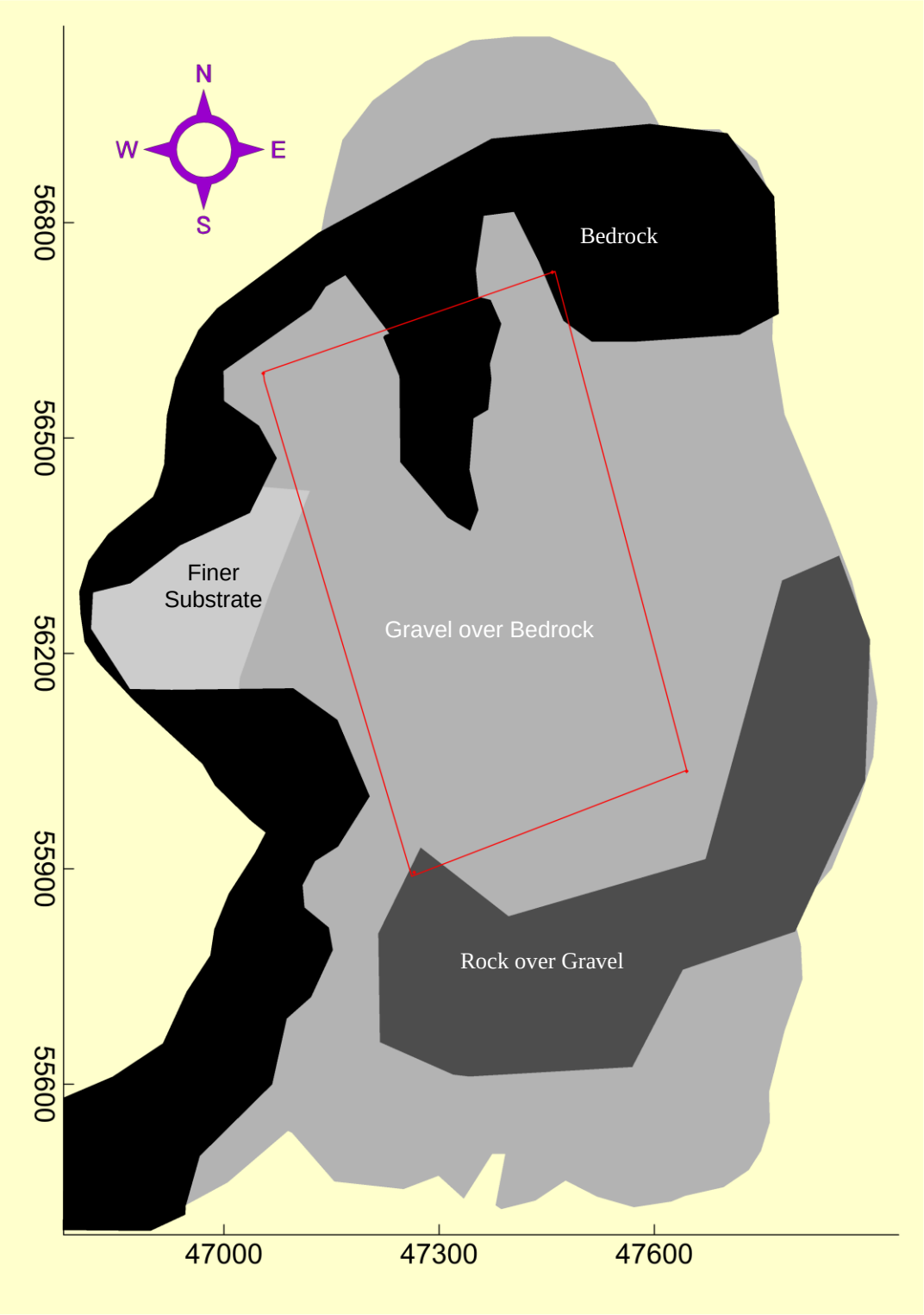


Figure 10: Substrate distribution map derived from the Sidescan data recorded over the proposed development site at Deenish Island. The extent of the proposed development is indicated by the red rectangle. Co-ordinates are in Irish National Grid.

3.2.3 Bathymetric Data

The contoured, digitised bathymetric data for the Deenish Island site are displayed as a 2D plot in figure 11 and as a 3D terrain model in figure 12.

Bathymetry ranges from 2m on the northwest margins of the survey site to depths of up to 50m to the east of the site. The range within the proposed development area extends from 15m to a deep of 50m

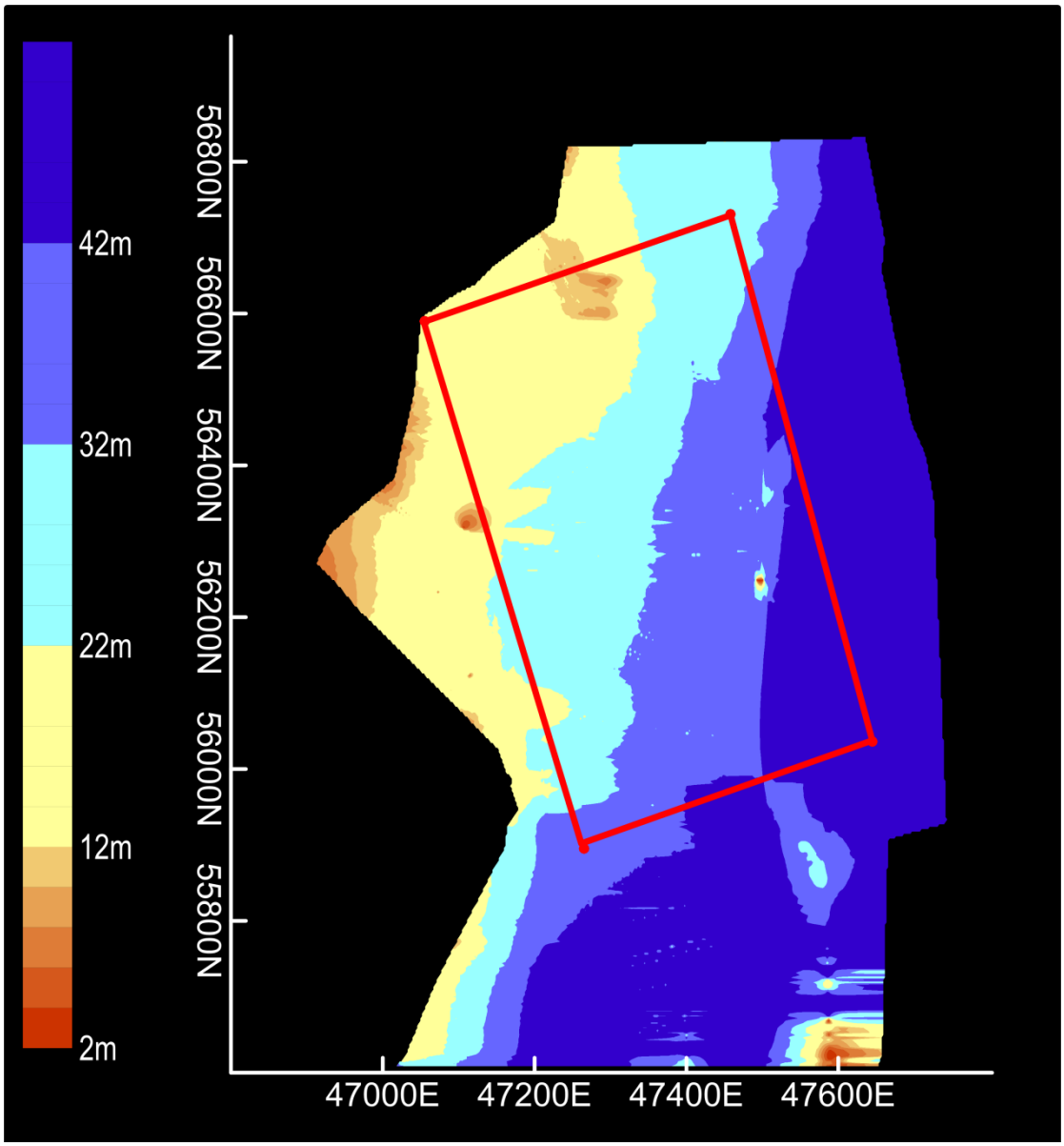


Figure 11: 2D Bathymetric contours of the Deenish Island survey area displaying the extent of the proposed development as an overlay. Co-ordinates are in Irish National Grid.

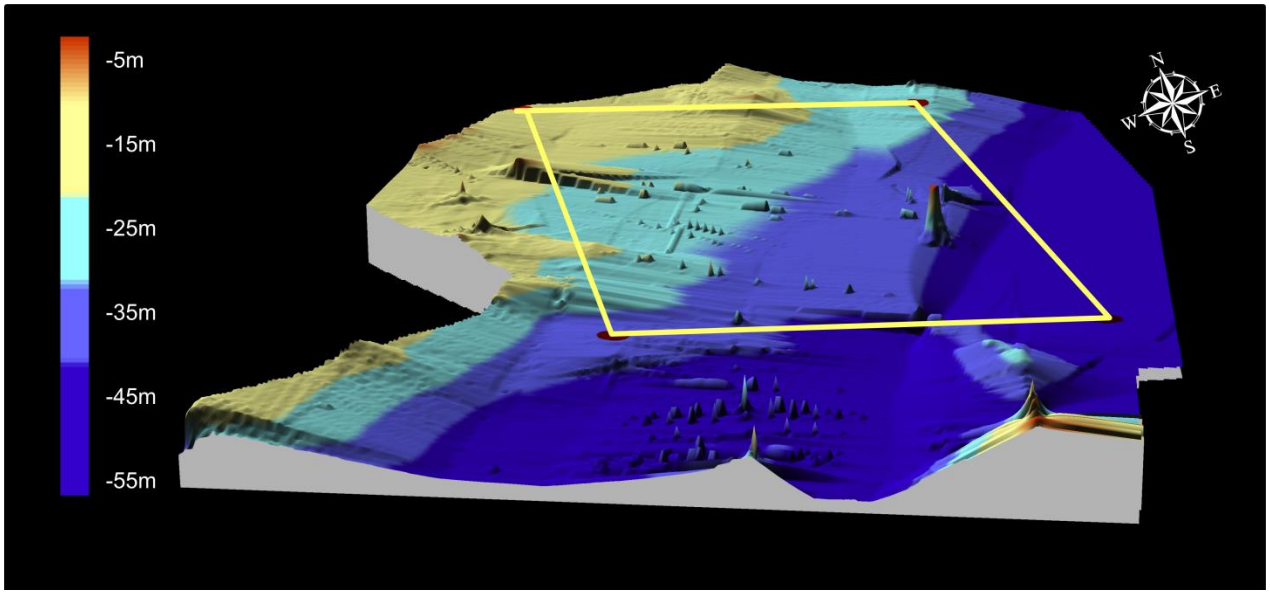


Figure 12: 3D digital terrain model developed from bathymetric data acquired over the site of the proposed development at Deenish Island displaying the extent of the proposed development as an overlay. Co-ordinates are in Irish National Grid.

3.2.4 Magnetometer Data

The mass and extent of metal material existing on and adjacent to the proposed development site at Deenish Island prohibited the use of magnetometery as an investigative e tool.

3.2.5 Side scan Sonar Data

The results obtained from the sidescan survey at the proposed Deenish Island development site are displayed overlaid on an outline of the survey area, relative to the shoreline in figure 13 and as a mosaic of sidescan data in figure 14

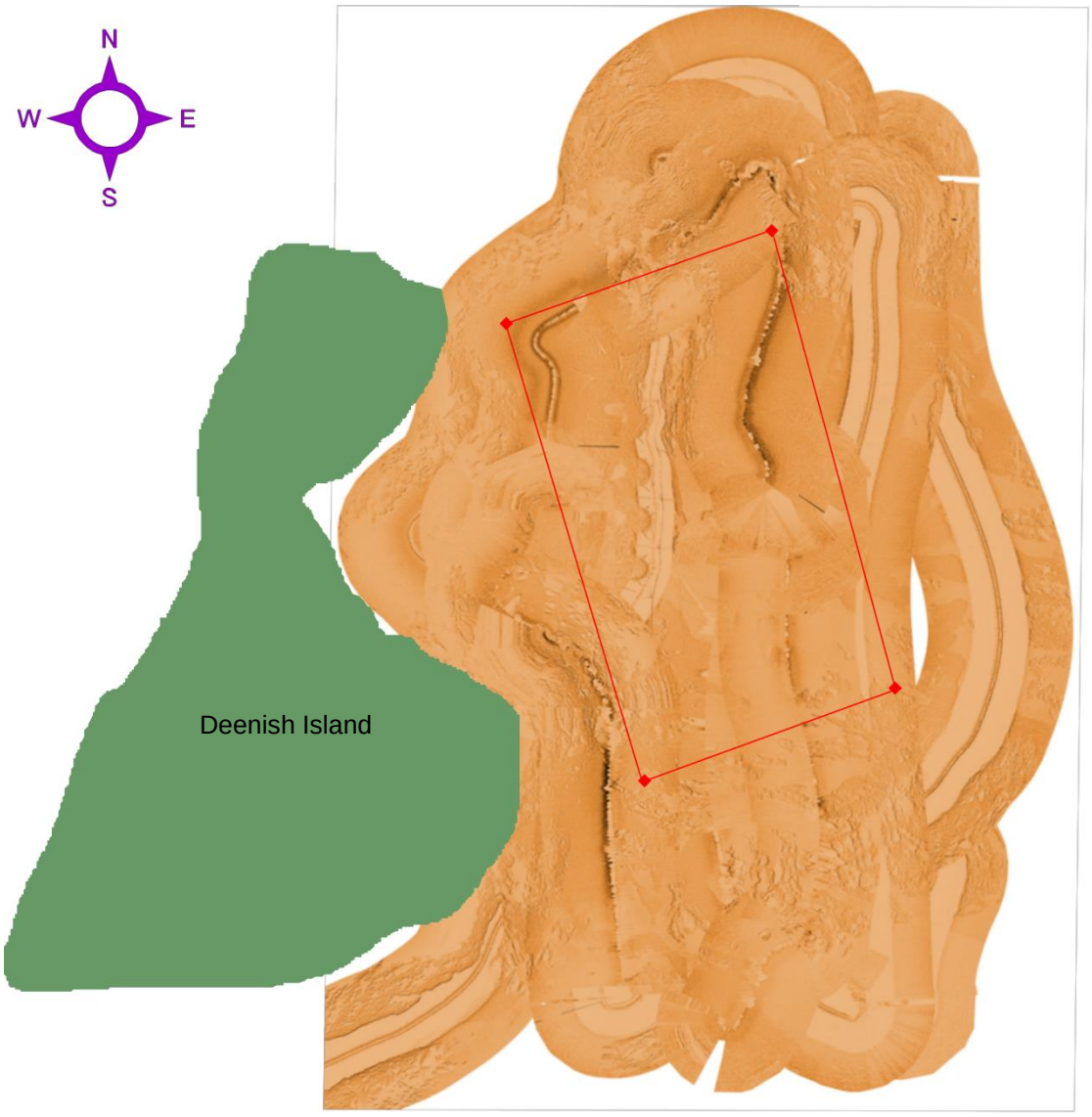


Figure 13: Sidescan Sonar mosaic derived from data acquired over the Deenish Island survey area displayed relative to the shoreline. The extent of the proposed development site is indicated by the red rectangle.

Line by line of analysis of the sidescan data recorded at the proposed Deenish Island development site revealed no features which would indicate the presence of upstanding or submerged archaeological remains.

Figure 14: Sidescan Sonar mosaic derived from data acquired over the Deenish Island survey area.

3.2.6 Results of Survey

The desktop survey revealed that:

- The Kenmare River is located within a rich archaeological landscape, that has been settled from Mesolithic to the present.
- The Sites and Monuments Record lists no site as having been discovered on Deenish Island, it does list three sites for the adjacent Scariff Island and in the Townlands landward and immediately northeast of the proposed development.
- One archaeological finds is recorded for Deenish Island, a stone ring. Find number 1942-1749.
- The inventory of wrecks revealed a listing of seven vessels which were lost within the seas surrounding the islands of Scariff and Deenish. No wrecks are recorded within or immediately adjacent to the proposed development site.
- There is no recording of an archaeological excavation having taken place in the townslands adjacent to the proposed development site.

The site survey's revealed:

- The Shoreline inspection revealed that the shoreline at the location of the proposed development is comprised of a low rock vertical cliff face, which extends from the grass line to the low water line.
- Bathymetry ranges from 2m on the northwest margins of the survey site to depths of up to 50m to the east of the site. The range within the proposed development area extends from 15m to a deep of 50m.
- The distribution of the coarse and finer substrate within the site may indicate that the seabed at this location is subject to hydraulic forces created by storm forces, the impact of which would decrease greatly the survivability of archaeological material within the site.

- Analysis of the sidescan survey data revealed no features which would indicate the presence of archaeological remains.

- The mass and extent of metal material existing on and adjacent to the proposed development site at Deenish Island prohibited the use of magnetometery as an investigative e tool.

The site surveys provided no features or readings which revealed or indicated the presence of archaeological material. There remains the possibility of archaeological material lying within the finer substrate which comprises the smaller area of the proposed development site at Deenish Island.

4 CONCLUSIONS

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- The archaeological sites listed for the island and townlands adjacent to the proposed development will not be impacted by the development

- The seabed at the location of the proposed development will be impacted by the laying and bedding of twenty six substantial anchors.

- The visual and photographic inspection of the shoreline adjacent to the seabed survey site revealed no features that could be described as archaeological

- The substrate material as visualised by the 500kHz side-scan sonar survey would indicate that the seabed at the site of the proposed development is impacted by hydraulic forces generated by storm forces.

- The rock substrate is interpreted as having a low potential for the retention of archaeological material. The coarse substrate is interpreted as having a low to medium potential for the retention of archaeological material. The finer substrate, which comprises a very small aria of the site is interpreted as having a high potential for the retention of archaeological material.

- No anomalies, which could be interpreted as archaeological were identified from the 500kHz side-scan sonar survey conducted over the proposed development site.

5 RECOMMENDATIONS

1. The proposed fish farm development at the Deenish Island site should proceed.

2. A further sidescan survey should be conducted over the Deenish Island site following the installation of the anchors to determine if their installation has revealed the existence of submerged archaeological material.

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Appendix 1

Ship Wrecks of the Kenmare River

W05543, *Agate (SS)*, 18/02/1911, Carrig na Roan Beag, Kenmare

67-/204-ton iron steamship of Glasgow owned by Robertson, W., W. Nile St, Glasgow. Built in 1878 by Seath, T. B. & Co, Glasgow. Measured 36.72 x 6.12 x 2.89 (1 x deck; 3 x bh; q.deck 39ft; f.castle 20ft) and powered by 2-cylinder compression 35 Hp single boiler screw engine, machinery by W. King & Co, Glasgow. Classed 100 A1 (exp) by Lloyd's. En route from Cork to Kenmare with general cargo, crew of 8 under captain D McGlip. Wrecked but all on board were saved.

W05566, *Bayonness / Bayouse*, 25/10/1690, Kenmare River (near Dursey?),mouth of

French frigate lost with cargo in a storm. Of the crew, the captain, lieutenant, pilot and 21 others were lost and 7 survived. 4 of the 31 passengers were saved and landed on the Beara Peninsula.

W05600, *Conceicao da Crux*, 15/03/1831, Kenmare river

Struck rocks in the Kenmare River and went to pieces, en route to Lisbon from Cork.

W05628, *Drake II*, 03/07/1917, Garinish Is., Kenmare River

207-ton 17-year-old steel fishing trawler of Grimsby, sank while on hire to the Admiralty, captain was H. Hutton. Built in 1900 by Earle's Co Ltd, Hull, measured L.34.21 x B.6.55 x D.3.50 (1 x deck; 3 x bh; q.deck 56ft; f.castle 18ft). Powered by 3-cylinder triple expansion 52 Hp single boiler screw engine. Launched in May 1900 as the Drake, given the registered fishing number GY1163, until requisitioned by the Royal Navy in April 1915 when she was renamed DRAKE II and converted to an armed patrol minesweeper, No 817. Lost when wrecked in Kenmare River. Formerly known as DRAKE

W05649, *Elizabeth Anne*, 27/02/1903, Parknasilla Hotel, Kenmare River

This Glasgow schooner was en route from Kenmare to Carnavon in ballast. She had shipped coal to Kenmare and had anchored in the bay due to a storm. The anchors dragged and she was wrecked.

W05670, *Fidelite*, 25/01/1883, Sneem, Kenmare Bay

256-ton 13-year old wooden barque of France, owned by J. Gantel of Marseilles and the master was P.J.Paul. Classed by the Bureau Veritas as '3/3, L.1.1.' for 3 years from September 1881 and had last been surveyed in December 1882. En route from Liverpool to Sierra Leone with 10 crew and a cargo of salt etc. Encountered severe weather and had to take shelter because of leaks. The cargo fouled the bilge pumps, she broke from her anchorage at Tossdohan near

Sneem, went ashore in a WNW force 10 gale on 26 January 1883 and was totally wrecked. There was no loss of life.

W05693, *Godfrey*,07/04/1789, Kenmare River

70-ton Sloop owned by Russell & Co., built in Dungarvan and classed A1 by Lloyd's. En route from Bristol to Tralee, under captain Hickson, wrecked.

W05719, *Hollands Melvaart*, 12/08/1781, Kenmare River, entrance to

Dutch sailing vessel, captain was Melvaart. Ran ashore while being pursued by two Boston vessels, the Cicero, armed with 22 nine-pounders, and a brig. The privateers boarded the wreck and burnt it. 'being prevented from plundering the cargo by a party from the Shore.'

W05735, *Ithuriel*, 07/10/1889, Rossmore Island, Kenmare River, off

319-ton 18-year old wooden barque of Swansea. Built in 1871 by Knight, Prince Edward Island. Measured L.36.93 x B.8.05 x D.4.49 The master and owner was Edward Kearon of Arklow. En route from Newcastle-on-Tyne to Galway with a cargo of 502 tons of coal and a crew of 8 she lost her sails during heavy winds and ran for Kenmare River, struck on a sunken rock in Sneem Harbour, and sank off Rossmore Island in 12 fathoms on 7 October 1889. Crew landed safely.

W05749, *Jolly Cooper*, 15/12/1790, Kenmare River

Vessel lost en route from Milford to Limerick, with groceries and other goods, wrecked off the mouth of the Kenmare River. All hands lost.

W05758, *La Bayonesse*, 25/10/1690, Kenmare River, entrance to

French corvette bound for France with dispatches for King James I. Not listed in French naval records so she was probably a privateer or merchantman. Col. Wilson, the King's messenger, and 11 of 24 crew and passengers survived. A French merchantman, returning to France with dispatches for King James I,which were entrusted to Colonel Wilson, the King's messenger. She carried passengers of whom 31 survived, along with 11 of the crew, who landed on the Beara Peninsula.

W05768, *Laurell*, 28/01/1693, Cappanacush, upper end Kenmare River

150-ton, 10-gun ship under the command of captain Christopher Lyall. En route from Jamaica to London with a cargo of indigo, ginger, cotton, logwood, Roman vitriol, sugar, fustick, pieces of eight and £2,500 worth of gold wedges. Anchored at Rossmore but was driven ashore by the wind. The crew abandoned the wreck and divided the gold among themselves. It was suggested that because of a dispute over the removal of the ship's guns to form a shore battery, the captain ran the ship onto rocks and sent his carpenter to bore holes in the bottom. The cargo was salvaged and placed in a house, which that night was burnt by thieves. '…Salvage of the cargo

was arranged by the local Customs official and a Mr Crump, a king's officer, storing it in the house of a Mr Palmer…'

W05919, *St. Patrick*, 31/12/1876, Kenmare River, Co Kerry, Rossdohan, off

3-ton 1-year old yawl of Tralee. The owner and master was P. McGillicuddy of Tralee. Fishing, in ballast, from Bracchams near Sneem, capsized. Two of the twelve crew were lost.

W05945, *Thistle*,10/12/1786, Kenmare, not known (river)

En route from Cork to Malaga, captain was English. ' –master English, from Cork to Malaga, was wrecked the 10th instant in the River Kenmare; Part of the Cargo was saved.'

W05979, Perch at Templenoo, near Kenmare

The remains of a steel hull, reputed to be a flour boat, lay in this area.

W05997, 09/11/1887, Kenmare, Sneem, near

1000-ton three masted barque en route from Swansea to Galway with a cargo of coal. Drove ashore during a gale after dragging her anchors and striking rocks near Rosdohan Island. Said to have gone ashore, then refloated herself and was two or three miles off before foundering, leaving her masts showing above the surface. The local press reported that her crew were saved, but that statement begs the question why was the vessel not named?

W06052, Carraig na Loinge off Parknasilla, Kenmare River

British ship, possibly a privateer, caught in a gale and wrecked. Some of the crew had come ashore to recruit sailors and survived.

W06075, *Wild Goose*, 25/11/1751. Kenmare

Sloop Wild Goose seized by the excisemen and sunk at Kenmare. The local MP Daniel O'Connell petitioned that she be raised as she was an obstruction to navigation and herring fishing. The Commissioners of Customs and Excise agreed to allow him to have her raised if one third of the value was paid to the seizing officer.

W06181, *Fly*, 24/10/1894,Kenmare River, Ardea Castle, 1M W

2-ton 7-year-old fishing boat owned by J. Connor, Rossmore Island, Co Kerry. En route from Rossmore to Fishing Grounds, in Ballast with a crew of 4 under captain J Coonor. Foundered and lost in Kenmare River, between Maiden Rock and Church Rocks in wind conditions NW force 7. Three lives lost.

W13112, *Holland's Melvaart,* 12/08/1781, Kenmare River, entrance of

The Holland's Melvaart, being chased by the Cicero under Captain Hill with 22 nine-pounders, and a brig privateer, both of Boston, was run on shore the 12th August. at the Entrance of the River Kenmare,where she was boarded, and burnt by the Privateer's crew

W13858, *Conceicao*, 15/03/1831, Kenmare Harbour, rocks off

The Conceicao, Master da Crux, en route from Cork to Lisbon, drifted on the rocks in Kenmare Harbor and went to pieces. Crew saved.

W15142, 24/10/1894, Kenmare

A fishing boat, from Rossmore (Kenmare River), foundered while hauling nets. Three of crew drowned, one saved.

W15608, *Jane*, 20/09/1856, Kenmare, Skillane Ledge

Brigantine Jane, Master Lineham, from Newport with coals, got ashore on the Skillane Ledge, North side of the river.

W16060, 10/10/1857, Kenmare River

A four-oared life-boat, 20 feet long, 6 feet 8 inches wide, painted light grained oak outside, and marked on the starboard quarter Liverpool ; marked inside, on same quarter, The New Steam-tug Company Limited, has been picked up in Kenmare River.

W16560, *Henrietta*, 12/05/1870, Kenmare River

The Henerietta, belonging to the Berehaven Mining Company, went ashore in Kenmare river

Appendix 11

Water Quality Monitoring
Deenish 2010 - 2018

Water Quality from T6/202 Monitoring 2010-2018

Date	Depth	NO_2 µg/l	NO_3 µg/l	NH_4 µg/L	DIN mg/l	Phosphorus µg/L	Chlorophyll µg/L
	1m	3.4	79.78	8.2		43.11	0.72
	Mid	2.53	26.33	7.06		22.45	1.73
28/01/2010	Bottom -1	3.69	88	7.06		33.72	2.14
	1m	2.7	24.4	6.27		51.93	0.5
	Mid	3.26	61.2	4.97		59.69	0.27
26/02/2010	Bottom -1	2.7	63.29	7.56		94.61	0.2
	1m	2.98	79.1	8.85		36.41	0.05
	Mid	2.14	48.79	3.68		24.77	0.96
24/03/2010	Bottom -1	2.98	96.73	4.97		53.87	1.03
	1m	4.16	119.46	28.33		28.74	0.2
	Mid	2.25	114.81	33.21		6.32	0
18/12/2010	Bottom -1	1.98	106.85	22.47		33.91	0
	1m	6.89	122.15	16.6		18.39	0.44
	Mid	3.89	112.67	13.67		66.67	0.14
17/01/2011	Bottom -1	1.98	110.96	15.63		37.36	0
	1m	2.25	50.79	23.44		64.94	0.68
	Mid	1.98	59.86	20.51		21.84	0.79
07/02/2011	Bottom -1	2.52	52.88	34.19		25.29	0.59
	1m	2.8	25.61	9.77		20.11	0.1
	Mid	4.71	30.25	4.88		4.6	0.05
21/03/2011	Bottom -1	1.7	20.18	16.6		0	0.08
	1m	3.73	39.45	16.44		19.05	0
	Mid	4.85	36.93	13.33		33.38	0
17/12/2011	Bottom -1	6.52	55.87	11.25		26.21	0
21/01/2012	1m	2.89	88.66	14.37		26.21	0

	Mid	4.57	65.8	14.37		26.21	0
	Bottom -1	4.01	86.13	14.37		31.59	0
	1m	3.73	87.13	5.03		24.42	0
	Mid	2.89	57.12	2.95		22.63	0
24/02/2012	Bottom -1	3.73	87.13	3.99		28.01	0
	1m	3.73	38.72	6.06		35.17	0.29
	Mid	4.29	30.12	8.14		26.21	0.02
28/03/2012	Bottom -1	4.57	26.92	11.25		26.21	0
	1m	4.08	86.31	23.03		23.7	0.4
	Mid	3.79	82.46	16.47		20.01	0.67
18/12/2012	Bottom -1	4.36	109.4	14.59		29.23	0.07
	1m	3.36	58.18	8.99		31.34	0.19
	Mid	4.21	79.16	6.95		31.34	0.02
25/01/2013	Bottom -1	4.21	94.25	7.97		22.11	
	1m	2.03	235.72	21.89		41.26	0
	Mid	1.32	125.79	25.98		25.17	0
15/02/2013	Bottom -1	0.97	77.3	23.26		21.6	0.06
	1m	3.79	82.46	16.47		20.01	0.67
	Mid	4.11	12.47	18.11		18.67	0.06
14/03/2013	Bottom -1	5.61	22.68	12.79		24.66	0.13
	1m	0.89	66.51	0.45		24.62	0
	Mid	1.74	73.03	0		24.62	0
17/12/2013	Bottom -1	1.45	66.38	0.45		29.95	0
	1m	1.17	85.52	3.58		18.33	0
	Mid	1.17	62.91	2.58		12.66	0
	Bottom -1	0.91	67.45	1.59		14.55	0
10/01/2014	Control	2.52	95.33	12.53		18.33	0
17/02/2014	1m	0.98	28.63	17.22		20.35	0

	Mid	1.27	34.63	5.71		20.35	0
	Bottom -1	0.98	35.47	8.84		18.18	0
	Control	1.06	74.64	5.82		12.42	0
	1m	1.56	19.53	5.71		20.35	0.17
	Mid	1.86	55.73	6.75		29.03	0
	Bottom -1	1.86	63.14	9.89		39.88	0
06/03/2014	Control	0.5	29.45	3.56		16.45	0
	1m	2	44.44	2.07		8.62	
	Mid	3.11	45.3	0.13		12.23	
	Bottom -1	2.55	54.48	9.78		5.01	
05/12/2014	Control	3.01	38.66	4.7		11.59	0
	1m	5.02	47.3	2.63		18.52	
	Mid	4.35	41.24	10.81		23.35	
16/01/2015	Bottom -1	3.68	34.76	6.26		21.74	
	1m	3.01	37.97	8.85		11.59	0
	Mid	3.01	37.97	3.31		11.59	0.22
	Bottom -1	3.29	40.46	3.31		9.68	0
25/02/2015	Control	3.01	38.66	4.7		11.59	0
	1m	2.2	21.5	7.47		0.13	0
	Mid	2.47	26.82	13		9.68	0
	Bottom -1	3.56	35.4	7.47		19.23	0
13/03/2015	Control	4.1	29.39	11.62		11.59	0.15
	1m	2.1	147.73	13.8		64.83	0
	Mid	0.98	87.09	7.08		29.57	0
	Bottom -1	2.1	154.43	33.95		22.52	0
22/12/2015	Control	0.98	80.38	7.08		62.48	0
	1m	1.98	72.9	5.91		43.38	0
11/01/2016	Mid	2.53	81.59	7.9		56.54	0

	Bottom -1	1.7	78.7	5.91		54.5	0
	Control	1.7	80.54	3.92		70.82	0
	1m	2.1	154.43	33.95		22.52	0
	Mid	1.07	6.78	0.72		17.45	0
	Bottom -1	2.49	5.84	0.72		17.45	0.22
29/02/2016	Control	2.77	22.98	3.88		21.4	0.08
	1m	0.98	80.38	7.08		62.48	0
	Mid	7.03	83.84	17.47		34.1	0
	Bottom -1	8.16	98.59	17.47		76.56	0.11
24/03/2016	Control	7.59	87.7	11.54		55.33	0
	1m	2.08	31.52	7.05		33.19	0.85
	Mid	2.92	43.71	9.17		47.15	0.77
09/12/2016	Bottom -1	3.19	48.52	13.41		39.17	0.34
	1m	2.18	131.16	19.38		1.31	3.41
	Mid	1.62	161.38	11.83		2.97	1.02
	Bottom -1	1.05	149.69	6.79		2.35	3.2
06/01/2017	Control	3.58	119.35	7.63		3.79	0.71
	1m	2.44	53.93	14.88		29.33	0
	Mid	2.71	65.1	7.08		27.34	0.18
	Bottom -1	2.44	73.27	7.08		35.3	0.13
17/02/2017	Control	2.29	29.5	18.6		19.69	0.41
	1m	2.02	28.82	5.32		19.69	0.72
	Mid	2.02	31.94	5.32		12.96	0
31/03/2017	Bottom -1	3.11	36.22	81.44		15.2	0.41
	1m	1.66	61.84	1.34	64.84	27	0.66
	Mid	1.38	76.47	1.34	79.19	23.2	0.28
	Bottom -1	1.66	88.64	2.39	92.69	27	0.19
15/12/2017	Control	1.38	109.02	3.43	113.83	23.2	0.58

	1m	2.26	124.37	5.53	132.16	31.51	1.11
	Mid	1.98	116.25	5.53	123.76	29.61	0.59
	Bottom -1	2.26	122.51	3.21	127.98	23.92	0.94
30/01/2018	Control	2.84	42.24	15.57	60.65	30.13	0
	1m	2.57	37.45	7.91	47.93	30.13	0
	Mid	2.29	42.04	9	53.33	28.18	0
	Bottom -1	2.29	43.77	9	55.06	28.18	0
28/02/2018	Control	3.08	132.89	6.69	142.66	27.72	1.14
	1m	2.07	58.69	12.54	73.3	17.66	0.11
	Mid	2.07	58.69	9.38	70.14	19.74	0
	Bottom -1	2.07	62.63	13.59	78.29	17.66	0
31/03/2018	Control	2.36	80.71	11.48	94.55	25.99	0
	1m	3.17	141.06	5.96	150.19	31	
	Mid	3.17	138.49	9.01	150.67	31	
	Bottom -1	3.17	141.06	4.95	149.18	33.07	
12/12/2018	Control	4.33	136.53	4.95	145.81	31	

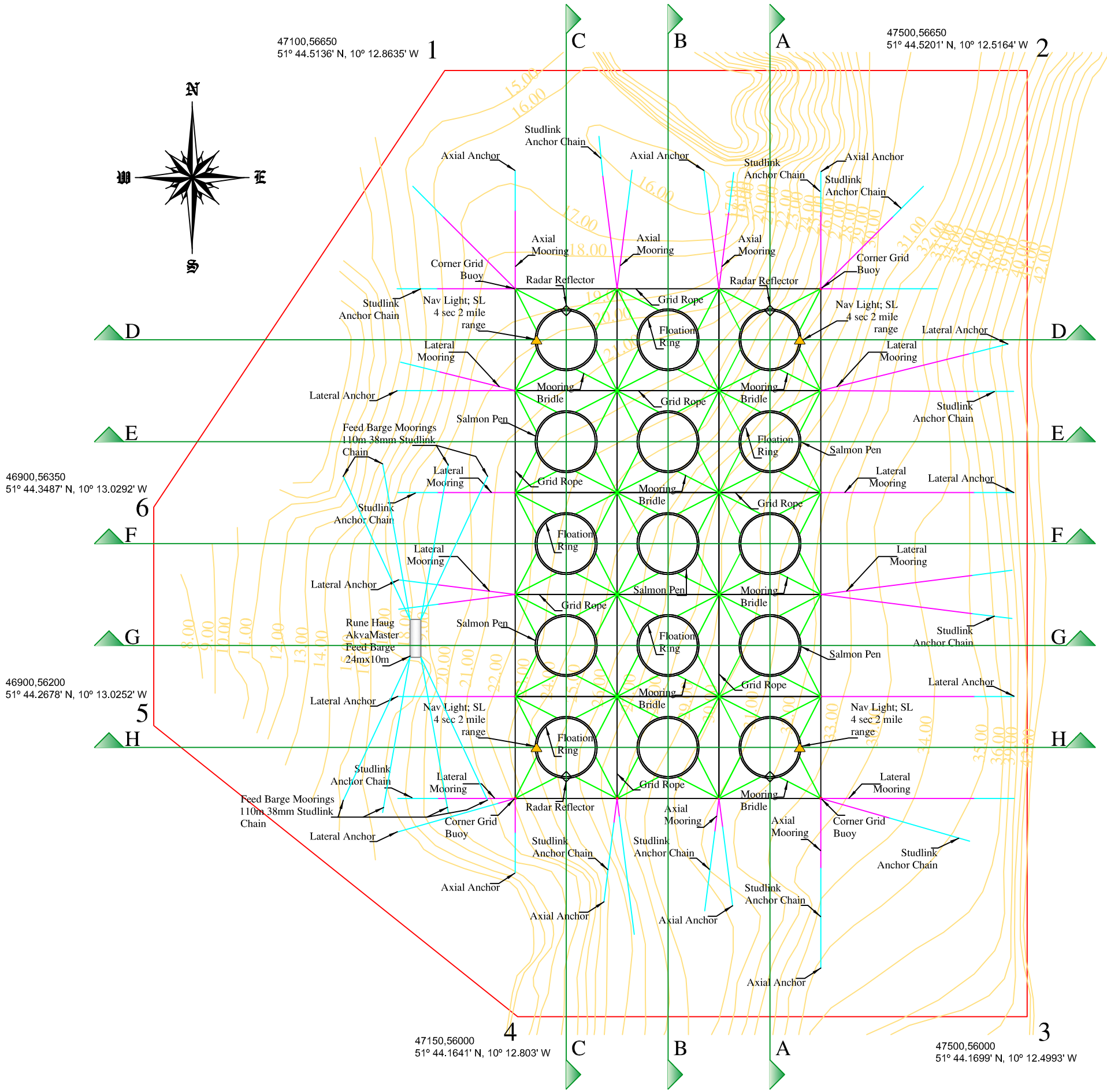
Appendix 12

Schematics

NOTES -

Site Co-Ordinates (ING) :	Eastings	Northings
1.	47100	56650
2.	47500	56650
3.	47500	56000
4.	47150	56000
5.	46900	56200
6.	46900	56350

Grid Co-Ordinates (ING) :	Eastings	Northings
NW.	47148	56500
NE.	47358	56500
SE.	47358	56150
SW.	47148	56150



REVISION A – DAFM COMMENTS

NOTE-
LEVELS RELATE TO BELOW LAT

LOCATION
DEENISH, BALLINSKELLIGS BAY, CO. KERRY.

TITLE
OVERALL SITE LAYOUT

CLIENT
MOWI IRELAND

DRAWING No.	DRAWN BY	SCALE	DATE
H1902–10A	William Gallagher	1:3000@A3	NOVEMBER 2022

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NOTES -

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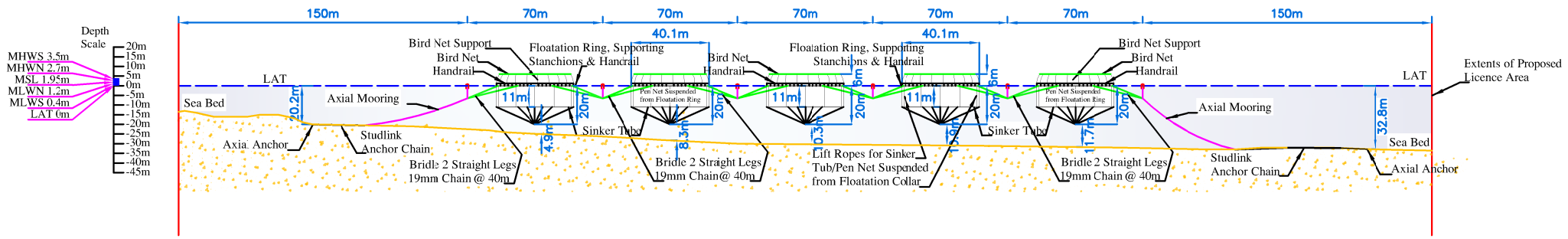

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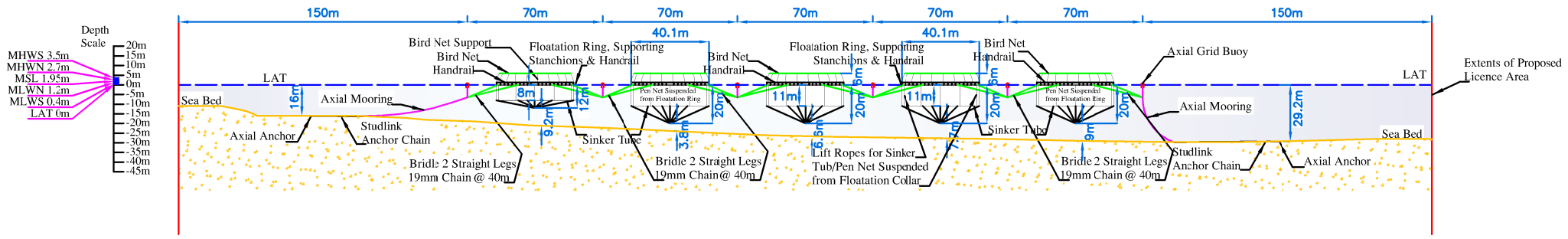

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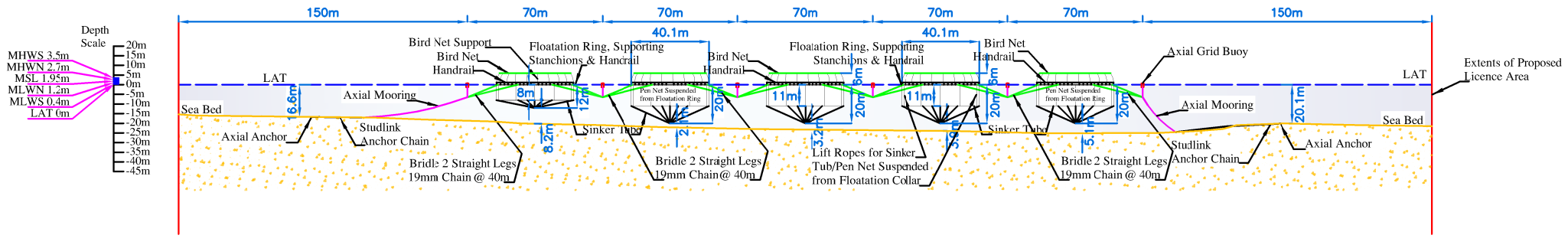

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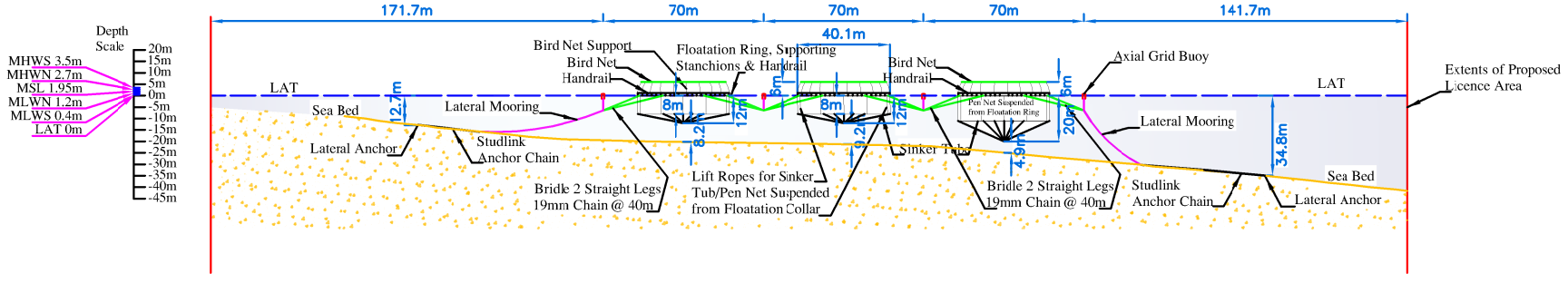

SECTION D-D

REVISION A – DAFM COMMENTS

NOTE-

LEVELS RELATE TO BELOW LAT

LOCATION
DEENISH, BALLINSKELLIGS BAY, CO. KERRY.

TITLE
SITE SECTIONS

CLIENT
MOWI IRELAND

DRAWING No.	DRAWN BY	SCALE	DATE
H1902–11A	William Gallagher	1:3000@A3	NOVEMBER 2022

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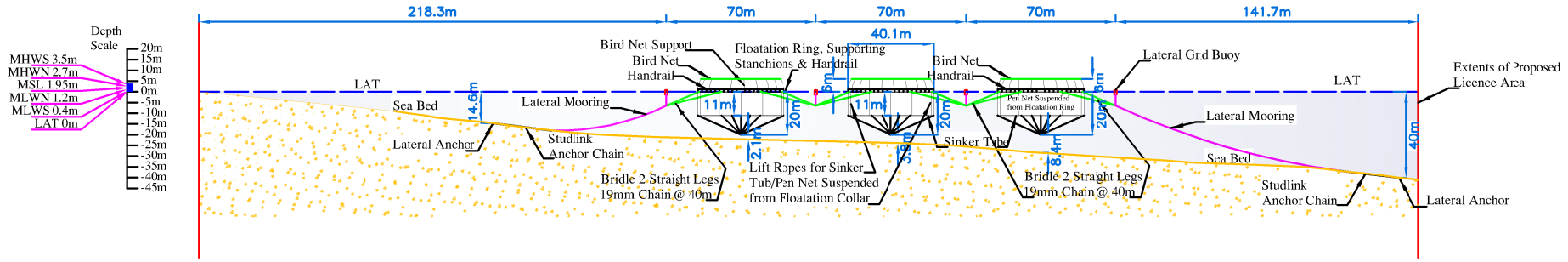
e-mail: info@landsurveyors.ie web: www.landsurveyors.ie
PROFESSIONAL MEMBERS OF THE IRISH INSTITUTION OF SURVEYORS

NOTES -

Site Co-Ordinates (ING) :	Eastings	Northings
1.	47100	56650
2.	47500	56650
3.	47500	56000
4.	47150	56000
5.	46900	56200
6.	46900	56350

Grid Co-Ordinates (ING) :	Eastings	Northings
NW.	47148	56500
NE.	47358	56500
SE.	47358	56150
SW.	47148	56150



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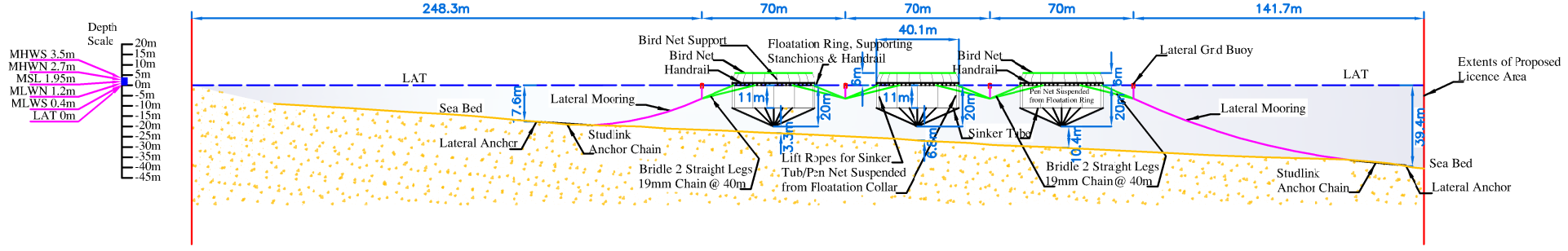

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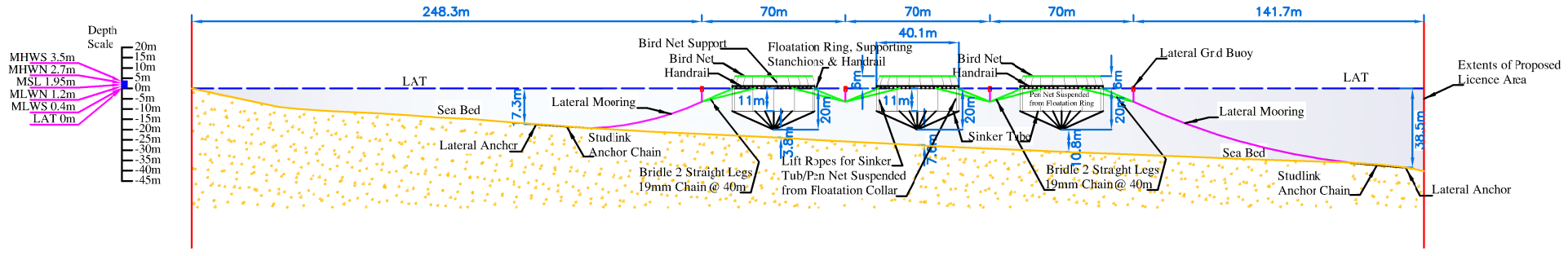

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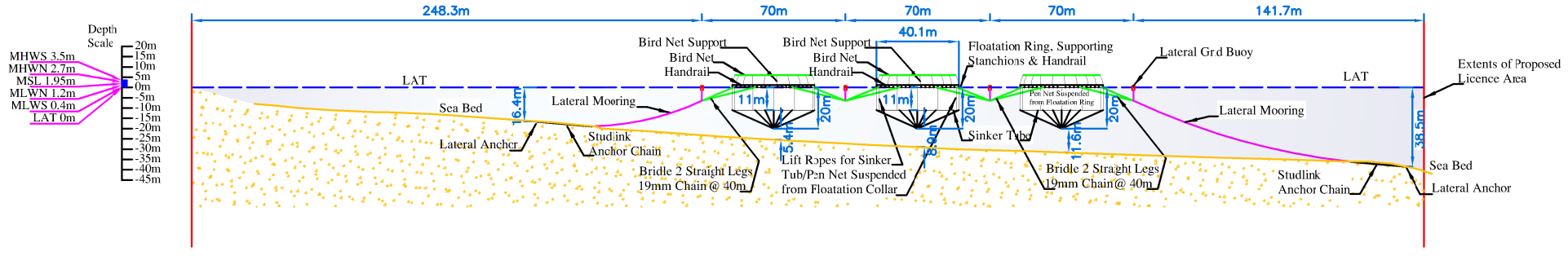

SECTION H-H

REVISION A – DAFM COMMENTS

NOTE-

LEVELS RELATE TO BELOW LAT

LOCATION
DEENISH, BALLINSKELLIGS BAY, CO. KERRY.

TITLE
SITE SECTIONS

CLIENT
MOWI IRELAND

DRAWING No.	DRAWN BY	SCALE	DATE
H1902–12A	William Gallagher	1:3000@A3	NOVEMBER 2022

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6.	46900	56350

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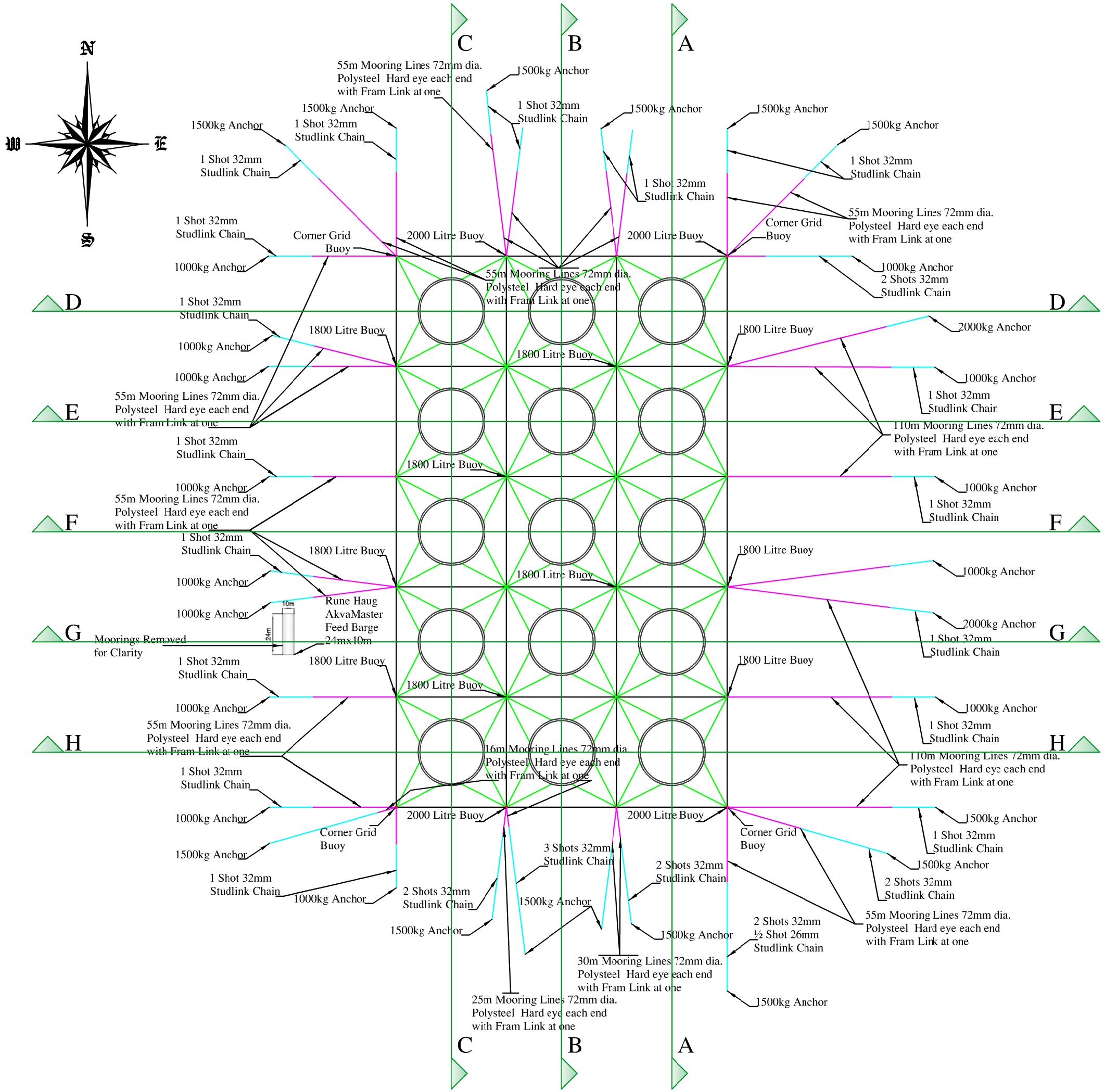

REVISION A – DAFM COMMENTS

NOTE-
LEVELS RELATE TO BELOW LAT

LOCATION
DEENISH, BALLINSKELLIGS BAY, CO. KERRY.

TITLE
PLAN LAYOUT

CLIENT
MOWI IRELAND

DRAWING No.	DRAWN BY	SCALE	DATE
H1902–13A	William Gallagher	1:2500@A3	NOVEMBER 2022

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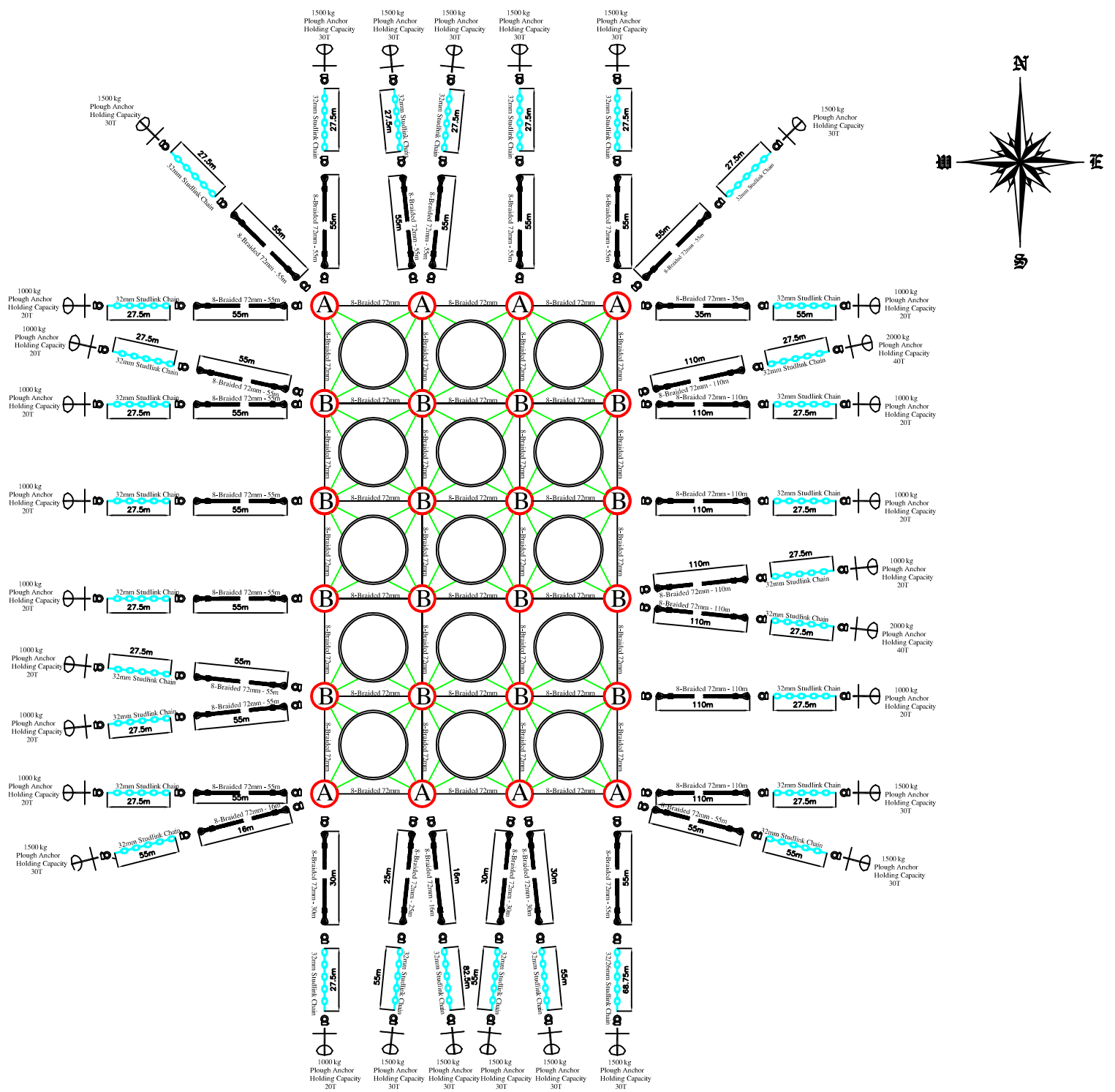
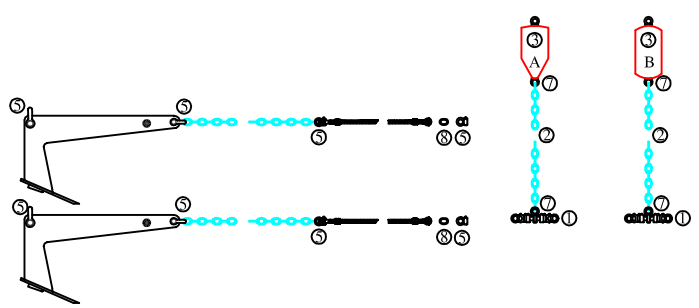
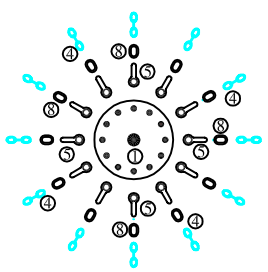


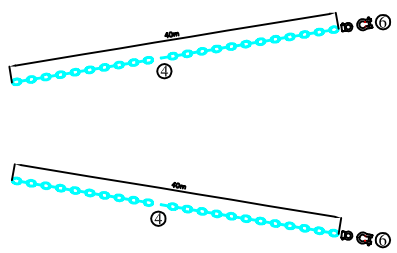
Mooring Line Layout



Details of Grid and Mooring Lines



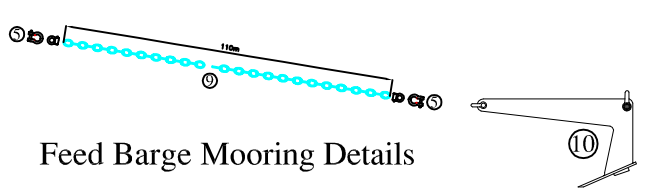
Mooring Plate



Bridle Details

SPECIFICATION REQUIREMENTS

1: Mooring Plate MK 70T
2: Chain for Buoys 22mm 5 metres
3: Buoys
A - 2000 Litre Provinor Aqua 2000 Yellow or similiar
B - 1800 Litre Cipax Cylindrical Buoy CB 1800 Grey or similiar
4: Bridles 19mm Longlinked Galvanised 40 metres
5: Mooring Shackle MBL 60 T
6: Mooring Shackle MBL 40 T
7: Mooring Shackle MBL 28 T
8: Fram Link Blue Line Masterlinks Yellow or similiar
9. 32mm Studlink Chain
10. 1500kg Plough Anchor



Feed Barge Mooring Details

LOCATION
DEENISH, BALLINSKELLIGS BAY, CO. KERRY.

TITLE
COMPONENT DETAILS

CLIENT
MOWI IRELAND

DRAWING No.	DRAWN BY	SCALE	DATE
H1902-14A	William Gallagher	NO SCALE@A3	NOVEMBER 2022

Digital Land Surveyors Ltd
LAND SURVEYS ◆ MAPPING◆ LEGAL LAND MAPS
NO.3 CARNAMUGGAGH UPPER, KILMACRENNAN RD., LETTERKENNY, CO. DONEGAL.
Tel:074 9127720 Mobile: 087 8323916 Fax:074 9128396
e-mail: info@landsurveyors.ie web: www.landsurveyors.ie
PROFESSIONAL MEMBERS OF THE IRISH INSTITUTION OF SURVEYORS

NOTE-
LEVELS RELATE TO BELOW LAT
REVISION A – DAFM COMMENTS

EXTRACT FROM KENMARE RIVER ADMIRALTY CHART NUMBER 2495

DEENISH ISLAND SITE

INISHFARNARD SITE

LOCATION	KENMARE BAY, CO. CORK.
TITLE	ADMIRALTY CHART
CLIENT	MOWI IRELAND

DRAWING No.	SURVEYED BY	SCALE	DATE
H1903–29	William Gallagher	1:50000@A3	SEPTEMBER 2021

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UNIT 4, FIRST FLOOR, GLEN VIEW BUSINESS PARK, CARNAMUGGAGH UPPER KILMACRENNAN ROAD, LETTERKENNY, CO. DONEGAL. F92 V9KE
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e-mail: info@landsurveyors.ie
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46298
57495

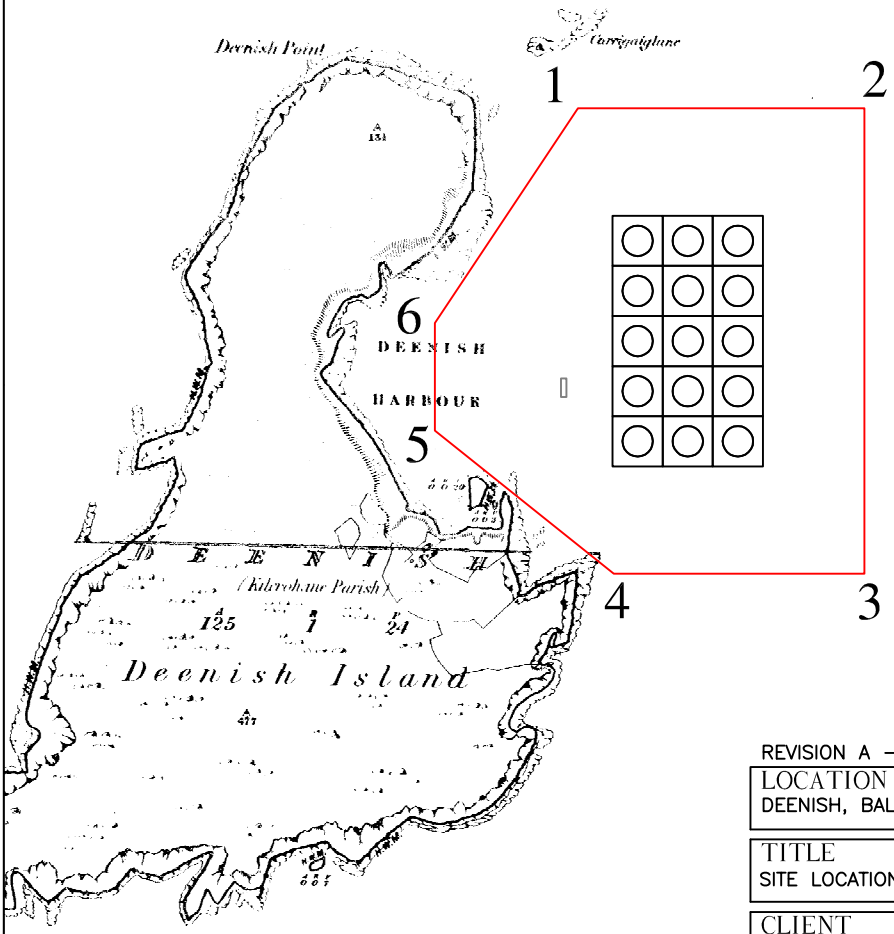
Site Location Map

48115
57595

Salmon Farm Site at Deenish,
Ballinskelligs Bay, Co. Kerry.
Site Location

Site Co-Ordinates (ING) :	Eastings	Northings
1.	47100	56650
2.	47500	56650
3.	47500	56000
4.	47150	56000
5.	46900	56200
6.	46900	56350

Grid Co-Ordinates (ING) :	Eastings	Northings
NW.	47148	56500
NE.	47358	56500
SE.	47358	56150
SW.	47148	56150



REVISION A – DAFM COMMENTS

LOCATION
DEENISH, BALLINSKELLIGS BAY, CO. KERRY.

TITLE
SITE LOCATION MAP

CLIENT
MOWI IRELAND

DRAWING No.	DRAWN BY	SCALE	DATE
H1902-15A	William Gallagher	1:10560@A4	NOVEMBER 2022

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NO.3 CARNAMUGGAGH UPPER, KILMACRENNAN RD.,
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Ordnance Survey Ireland

46298
55033

0 100 200 300 400 Metres
0 150 300 450 600 750 Feet

OUTPUT SCALE: 1:10,560

N

ING CENTRE POINT COORDINATES
47206,56264

PUBLISHED: 14/08/2019
ORDER NO.: 50078896_1
MAP SERIES: 6 Inch Raster, 6 Inch Raster
MAP SHEETS: $1_KY105+105A, KY105+105A

48115
55033

CAPTURE RESOLUTION:
The map objects are only accurate to the resolution at which they were captured.
Output scale is not indicative of data capture scale.
Further information is available at:
http://www.osi.ie; search 'Capture Resolution'
LEGEND:
http://www.osi.ie; search 'Large Scale Legend'

Ordnance Survey Ireland
Suirbhéireacht Ordanáis Éireann.
www.osi.ie.

46298
57495

Site Location Map

48115
57595

Salmon Farm Site at Deenish,
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Site Location

Site Co-Ordinates (ING) :	Eastings	Northings
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3.	47500	56000
4.	47150	56000
5.	46900	56200
6.	46900	56350

Grid Co-Ordinates (ING) :	Eastings	Northings
NW.	47148	56500
NE.	47358	56500
SE.	47358	56150
SW.	47148	56150

NAV LIGHT 4 SEC 2 MILE

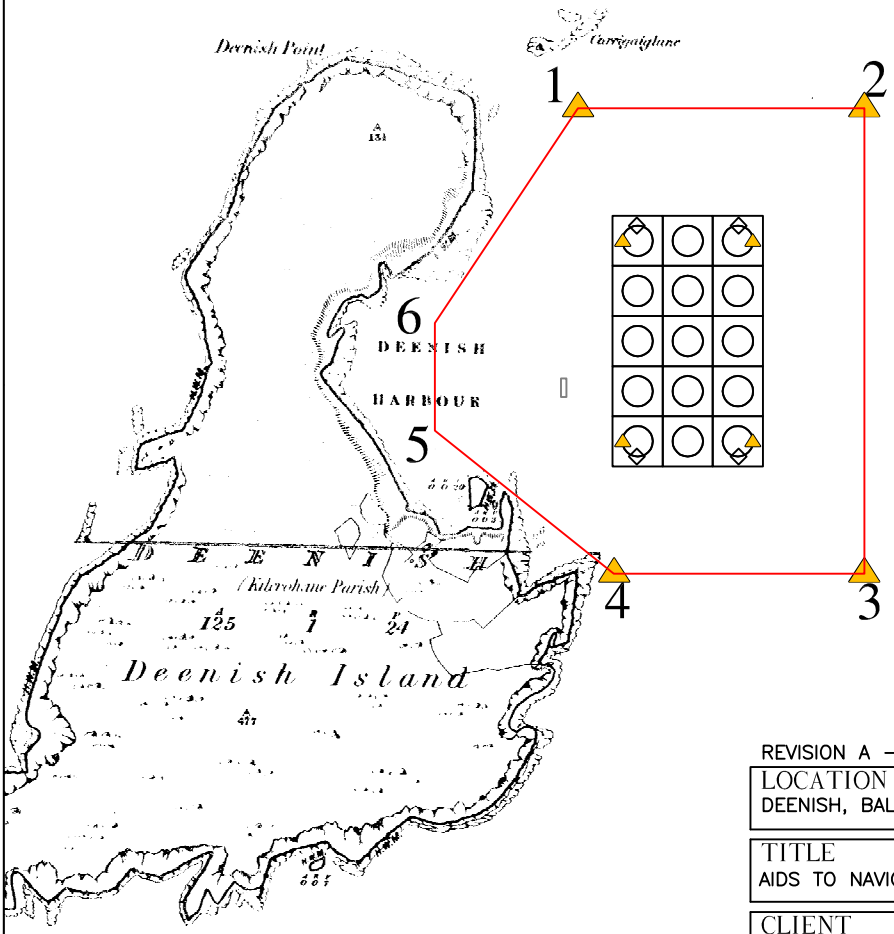
RADAR REFLECTOR

1 Corner Site Buoy with Nav Light 4 Sec 2 Mile

2 Corner Site Buoy with Nav Light 4 Sec 2 Mile

3 Corner Site Buoy with Nav Light 4 Sec 2 Mile

4 Corner Site Buoy with Nav Light 4 Sec 2 Mile



REVISION A – DAFM COMMENTS

LOCATION
DEENISH, BALLINSKELLIGS BAY, CO. KERRY.

TITLE
AIDS TO NAVIGATION

CLIENT
MOWI IRELAND

DRAWING No.	DRAWN BY	SCALE	DATE
H1902-16A	William Gallagher	1:10560@A4	NOVEMBER 2022

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Ordnance Survey Ireland

46298
55033

48115
55033

0 100 200 300 400 Metres
0 150 300 450 600 750 Feet

OUTPUT SCALE: 1:10,560

N

ING CENTRE POINT COORDINATES
47206,56264

PUBLISHED: 14/08/2019
ORDER NO.: 50078896_1
MAP SERIES: 6 Inch Raster, 6 Inch Raster
MAP SHEETS: $1_KY105+105A, KY105+105A

CAPTURE RESOLUTION:
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LEGEND:
http://www.osi.ie; search 'Large Scale Legend'

Ordnance Survey Ireland
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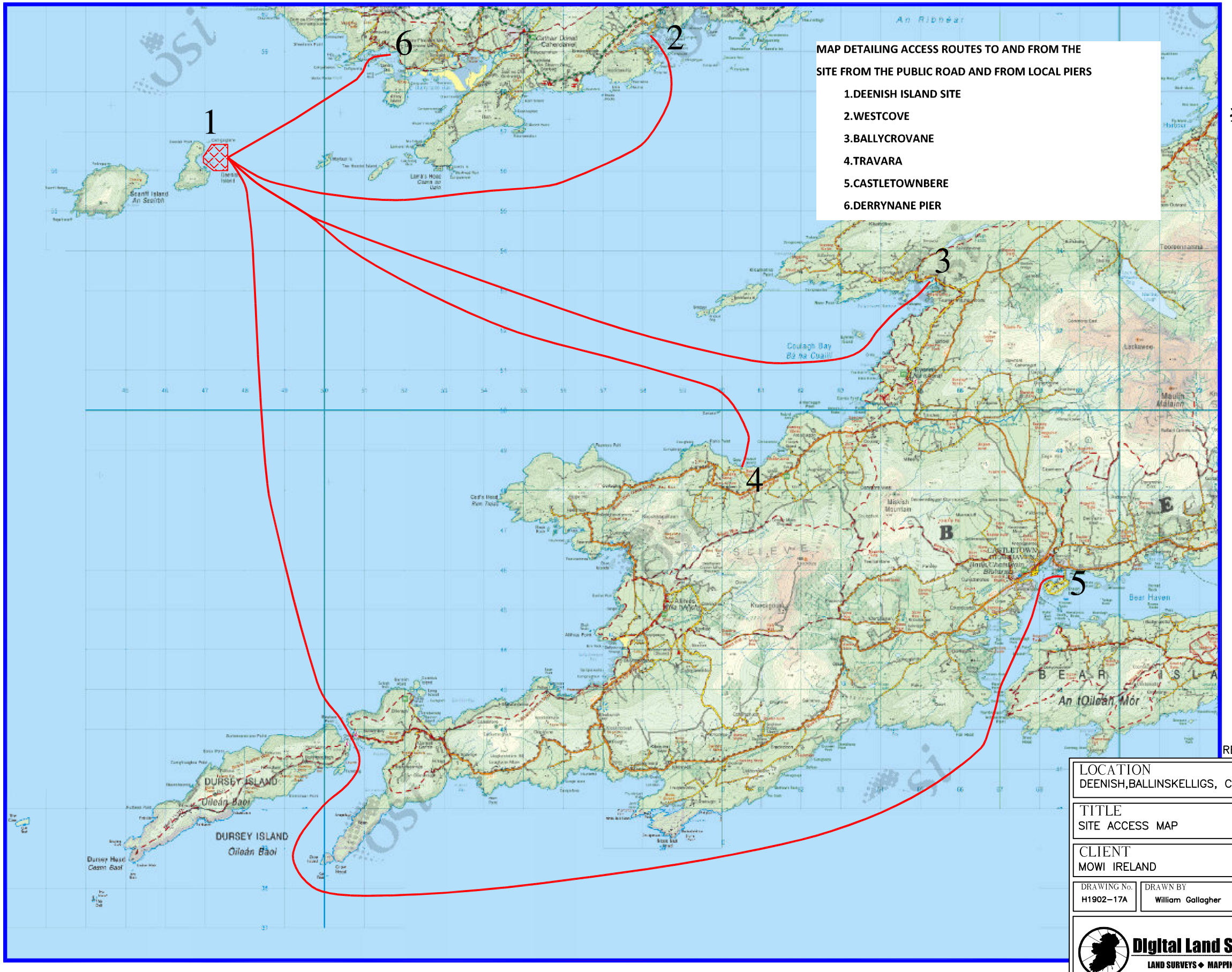
www.osi.ie.



REVISION A – DAFM COMMENTS

LOCATION	DEENISH,BALLINSKELLIGS, CO. KERRY.
TITLE	SITE ACCESS MAP
CLIENT	MOWI IRELAND

DRAWING No.	DRAWN BY	SCALE	DATE
H1902–17A	William Gallagher	1:100000@A3	NOVEMBER 2022

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