Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

AQUACULTURE MODELLING SCREENING & RISK IDENTIFICATION REPORT: Easter Score Holm (ESH1)

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Scope of report

As part of the SEPA Aquaculture Regulatory Framework it is recommended that a proposed application for a marine fin fish aquaculture site should undergo a Screening Modelling and Risk Identification process. SEPA carries out this work and this is described on the SEPA aquaculture website Pre-application section:

(https://www.sepa.org.uk/regulations/water/aquaculture/pre-application/)

This report presents information arising from that process. Screening modelling methods are outlined and maps and tables describing the modelled outputs are shown. Risks arising from consideration of the model output are listed. Conclusions and recommendations are made regarding the proposed site.

Executive summary

SEPA has received a proposal for a marine fin fish aquaculture site called Easter Score Holm (ESH1). This is located within The Deeps at location: 435325, 1143470 (Easting, Northing). The purpose of this application is to allow an increase in biomass at the existing site, from 2499.6t to 3988t. The proposed pens will also be moved onto new seabed.

No screening modelling has been undertaken for this site, however other data has been assessed as part of the risk identification, and we have concluded the following:

- It is likely that discharges from Easter Score Holm (ESH1), as currently proposed, will be able to comply with the relevant aspects of the SEPA Aquaculture Regulatory Framework.
- Features at risk, identified at this stage, are unlikely to influence the feasibility of the proposed site with respect to the regulatory framework. These risks should be examined using a detailed marine model.
- Easter Score Holm (ESH1) is suitable to progress to the next stage of the pre-application process outlined on the SEPA website.

List of abbreviations

SEPA	Scottish Environment Protection Agency
AZE	Allowable Zone of Effects – terminology from previous regulatory framework
ITI	Infaunal Trophic Index

List of chemical abbreviations

AZA	Azamethiphos

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1 Introduction

Screening Modelling and Risk Identification are important steps in the SEPA regulatory framework for marine pen fish farms. They are carried out by SEPA at the pre-application stage, which is described in detail at:

https://www.sepa.org.uk/regulations/water/aquaculture/pre-application/.

This document briefly describes the objectives of screening and risk identification and summarises the methods used. Screening output for the proposed site is then presented with comments. Risks identified from the screening output are detailed. Conclusions and recommendations about the suitability of the proposed site are then made.

1.1 The objectives of screening modelling and risk identification

A summary of the modelling methods employed during screening modelling is outlined in section 1.2. The objectives of screening modelling and risk identification are outlined below.

1.1.1 Screening modelling

Marine Modelling technology can be used to simulate and predict the potential influence of discharges on the marine environment. SEPA will require the majority of proposed farms to conduct **detailed** marine modelling, as outlined in our Aquaculture Modelling guidance [1] and on the SEPA Website.

Marine modelling can also be used at an earlier stage to provide an initial estimate of the influence of material discharged from a proposed site.

SEPA will carry out marine modelling at the screening and risk identification stage. This is a simplified version of the detailed modelling required of the applicant. However, it will be sufficient to perform an initial risk assessment of a proposal. Screening marine modelling will also include discharges from other relevant aquaculture sites and major sources.

The objectives of the simplified screening modelling are to:

- Produce maps of the predicted dispersive and erosive capacity of the sea areas in the vicinity of aquaculture sites
- Produce maps of the predicted spread of sediment discharged from aquaculture sites
- Produce maps of the predicted spread of bath treatment medicines from aquaculture sites
- Present an analysis of the potential influence of sediment and bath treatment discharges from the proposed site alongside existing sites within the surrounding sea area
- Present information on the sensitive features and sites of interest within the surrounding sea area, which must be addressed during pre-application work
- Present a summary of the suitability of the proposal with respect to the dispersal of waste and how this may be modelled.

1.1.2 Risk identification

Maps and analysis of screening output will be compared to information relating to sensitive features and relevant areas of interest. These may include:

- Marine Protected Area (MPA)
- Special Area of Conservation (SAC)
- Priority Marine Feature (PMF)
- Any site identified via consideration of other permitted or regulatory activities.

SEPA Staff will meet to discuss screening model output and the relevant sensitive features information. Following this meeting, a list of identified risks will be added to this report.

1.1.3 Conclusion of screening modelling and risk identification

Following the identification of risks, SEPA will present a summary of the suitability of the proposal with respect to the:

- Dispersal of waste from the proposed site and other sources
- Risks posed to sensitive features
- Likely level of modelling that will be required to address the risks identified.

1.2 Screening modelling methods

Marine models divide the sea up into a "grid" of boxes or triangles (often called cells). Each of these is given a water depth. This grid has been set up within a marine modelling software package called MIKE 21 which is manufactured by the company DHI A/S (https://www.dhigroup.com/).

Marine models carry out calculations across a grid to work out how seawater moves and mixes in response to tidal and weather forces. Marine models can also be used to simulate how seawater moves and mixes due to salinity and temperature differences across an area, particularly in response to inputs of freshwater from rivers. For pollutant influence assessments the mixing (dispersion) of dissolved (bath medicine) and particulate (sediment) pollutants can also be estimated. Calculations within a marine model can be performed in three dimensions (3D), where the grid is split into layers to better represent how properties of the sea change with depth. Two dimensional (2D) models can also be created where processes over the water depth are simplified. The amount of mixing in a marine model can be varied using settings in the software.

Screening modelling is currently carried out with 2D models using average mixing settings in the model software. In many areas, this approach will be sufficient to make an initial estimate of the influence of a proposed site. Our screening assessment will take into account factors which may limit a 2D approach. We will also consider whether a particular location is adequately represented by the available models.

1.2.1 Water movement and mixing modelling

Water movement and mixing modelling (hydrodynamics) has been carried out to generate one month of results. The boundaries (edge(s) of) the model have been driven using the "wider domain" Scottish Shelf Model [2]. Wind forces and freshwater inputs have been applied to the model from the same source. The results generated are an estimate of the average water movement and mixing conditions within the model area.

1.2.2 Sediment waste modelling

Screening modelling provides a precautionary and **indicative** estimate of the size, location and intensity of waste organic material released from aquaculture sites.

The release of sediment from sources within the model area is simulated using one month of hydrodynamic results along with particle tracking modelling technology. Virtual particles are continually introduced to the model grid to represent the potential dispersion of sediment from the sources. Particles in the model are moved and mixed by the hydrodynamics. Additionally, particles are assigned simplified properties, which allow them to settle through the water and be re-suspended (eroded and lifted) from the sea bed.

1.2.3 Bath medicine modelling

Screening modelling provides a precautionary and **indicative** estimate of the size, location and concentration of bath medicine releases.

The release of bath treatment medicine from sources within the model area is simulated using hydrodynamic results along with particle tracking modelling technology. Virtual particles are introduced to the model grid to represent the potential dispersion of bath medicines from the sources. Particles in the model are moved and mixed by the hydrodynamics. Releases of bath medicines are simulated under worst case mixing (dispersion) conditions, which occur under neap tides. The maximum treatment amount likely to be used at each site is released into the model at the same time and plumes are tracked over the following 96 hours (4 days). Treatment amounts used at screening have been derived from an analysis of historical data. Additionally, all bath medicine particles are concentrated within the top 5 m of the sea area. As all bath medicines are likely to disperse in a similar way, only Azamethiphos (AZA) has been modelled at the screening stage.

1.2.4 Nutrient assessment

Whilst nutrients are not directly modelled during screening, the dispersion of bath medicine releases will give an indication of the likely level of nutrient dispersion. This will be considered alongside any pre-existing nutrient assessment information that may be available.

1.2.5 Analysis of modelling output

SEPA processes the screening modelling output and places it into a standard analysis application built in TIBCO Spotfire. The application allows for the production of standard maps and tables, which are presented below.

2 Screening modelling

2.1 Site proposal

A risk assessment has been carried out for a biomass increase at a CAR licenced farm: Easter Score Holm (ESH1). The existing farm at this location has a current biomass of 2499.6t. This application is to increase the biomass at this farm to 3988t. The proposal is to site the farm at location: 435325, 1143470 (Easting, Northing), and the proposed pens will be over some new seabed. For the risk assessment presented here all relevant licenced sites have been considered in conjunction with the proposal for this site.

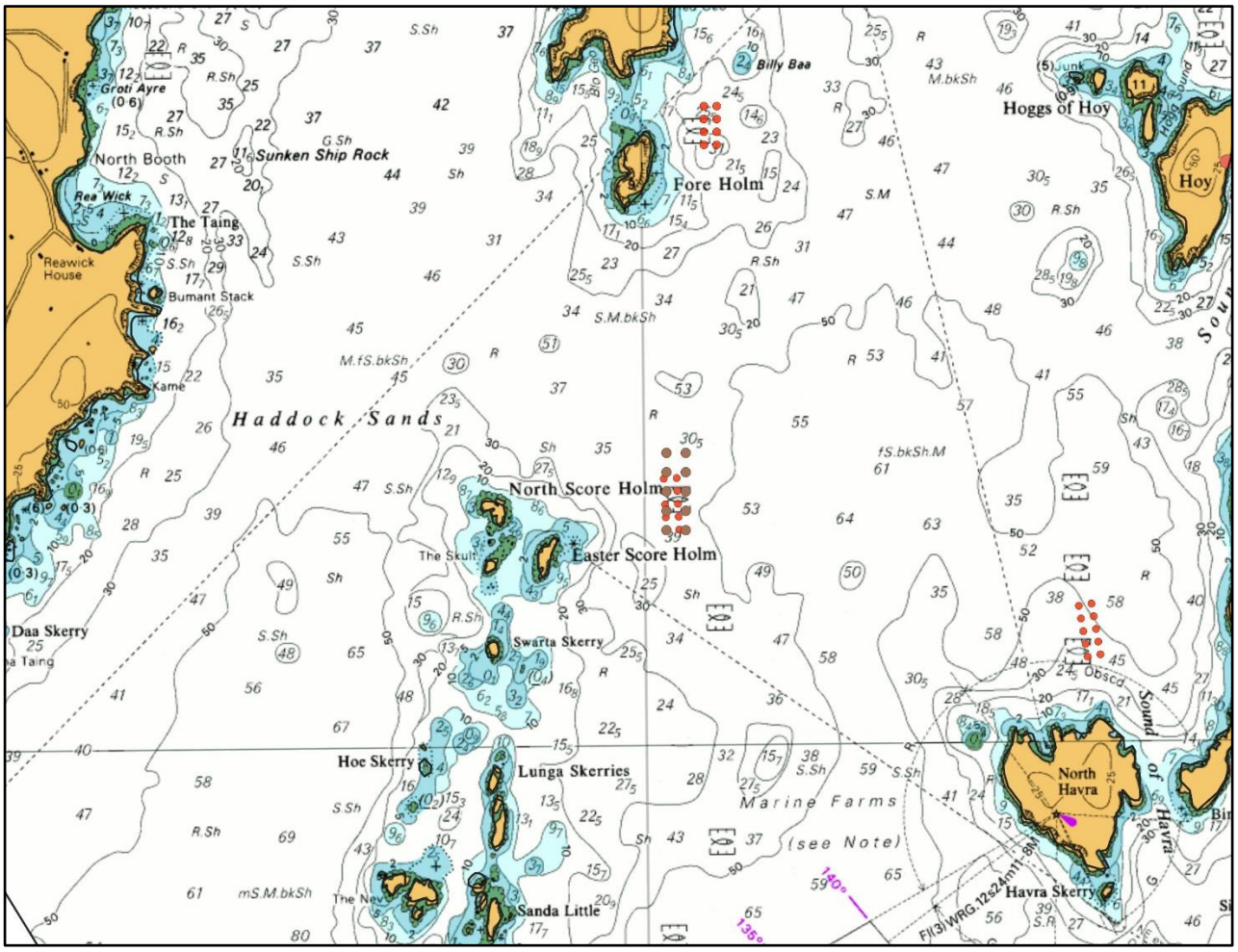

Figure 1. Existing (red) and proposed (brown) pen layouts for Easter Score Holm (ESH1).

2.1.1 Accuracy of model in the area surrounding the proposed site

The Pentland Firth and Orkney Waters model which covers this area, has very low resolution over the entirety of Shetland, making it unusable for the purposes of screening modelling. A

new Shetland model is currently in development. However for this application, screening modelling has not been undertaken, and other evidence has instead been considered.

Marine fin fish aquaculture farms using open-net pens will benefit from operating in locations where there are strong, repeating, water currents to erode and disperse waste.

For the purposes of screening we consider locations which meet the following water flow criteria to be generally suitable for larger farms:

Locations with average water flow speeds of greater than, or equal to, 0.12 metres per second (0.23 knots)
Locations where water flow speeds are often above the threshold of 0.095 meters per second (0.18 knots).

Locations with these properties are likely to disperse discharged material rapidly, and regularly erode sediment discharged to the seabed. In general, we would look for these properties to be maintained over a large area around a proposed site.

The thresholds stated above are indicative.

Based on previously submitted current meter data and knowledge of this area we can make the following observations about the proposed site location:

- It lies in a moderate dispersion area. Dispersion is lower towards the sea lochs, and higher offshore.
- It lies in an area where water flow has a moderate low capacity to erode material on the seabed.

3 Risk identification

Features which require attention are presented with any additional comments. Identified features will need to be considered during the pre-application phase.

These should be addressed in the applicant "Method Statement". Please refer to the Modelling Method Statement section on the SEPA Website.
(https://www.sepa.org.uk/regulations/water/aquaculture/pre-application/)

3.1 Identified features which require attention

3.1.1 Table of identified features

Based on an assessment of the area, the following features of interest have been identified.

Table 1: Table of identified features

No.	Feature Name	Feature Type	Location (Easting, Northing)	Brief Reason For Identification
1	ESH1	Fish Farm	(435325, 1143470) (Fig.2)	Risk from sediment and bath medicine plume interaction.
2	BGEO1	Fish Farm	(435726, 1146673) (Fig.2)	Risk from sediment and bath medicine plume interaction.
3	BGEO2	Fish Farm	(435680, 1147320) (Fig.2)	Risk from sediment and bath medicine plume interaction.
4	BUR1	Fish Farm	(438097, 1140499) (Fig.2)	Risk from sediment and bath medicine plume interaction.
5	CLI4	Fish Farm	(436565, 1138287) (Fig.2)	Risk from sediment and bath medicine plume interaction.
6	EHIL3	Fish Farm	(436517, 1140594) (Fig.2)	Risk from sediment and bath medicine plume interaction.
7	ELAN1	Fish Farm	(437692, 1139455) (Fig.2)	Risk from sediment and bath medicine plume interaction.
8	FOR2	Fish Farm	(435490, 1145040) (Fig.2)	Risk from sediment and bath medicine plume interaction.

9	NHAV1	Fish Farm	(436965, 1143086) (Fig.2)	Risk from sediment and bath medicine plume interaction.
10	PVOE1	Fish Farm	(438900, 1138900) (Fig.2)	Risk from sediment and bath medicine plume interaction.
11	SAND1	Fish Farm	(435200, 1150000) (Fig.2)	Risk from sediment and bath medicine plume interaction.
12	SANDA1	Fish Farm	(435550, 1142030) (Fig.2)	Risk from sediment and bath medicine plume interaction.
13	SBIX1	Fish Farm	(435000, 1148900) (Fig.2)	Risk from sediment and bath medicine plume interaction.
14	SEL3	Fish Farm	(433310, 1146000) (Fig.2)	Risk from sediment and bath medicine plume interaction.
15	SHOY1	Fish Farm	(437700, 1145000) (Fig.2)	Risk from sediment and bath medicine plume interaction.
16	SPO1	Fish Farm	(435334, 1138344) (Fig.2)	Risk from sediment and bath medicine plume interaction.
17	STRO1	Fish Farm	(438200, 1144000) (Fig.2)	Risk from sediment and bath medicine plume interaction.
18	STRO2	Fish Farm	(437649, 1142440) (Fig.2)	Risk from sediment and bath medicine plume interaction.
19	WEI2	Fish Farm	(437500, 1145430) (Fig.2)	Risk from sediment and bath medicine plume interaction.
20	WEI3	Fish Farm	(437090, 1146320) (Fig.2)	Risk from sediment and bath medicine plume interaction.
21	WEIA1	Fish Farm	(438300, 1147700) (Fig.2)	Risk from sediment and bath medicine plume interaction.

22	WEIB1	Fish Farm	(437400, 1147800) (Fig.2)	Risk from sediment and bath medicine plume interaction.
23	WHI2	Fish Farm	(439000, 1142200) (Fig.2)	Risk from sediment and bath medicine plume interaction.
24	Sea Grasses	PMF Habitat	Shapefile 1. (Fig.2)	Risk from sediment influence
25	Maerl Beds	PMF Habitat	Shapefile 2. (Fig.2)	Risk from sediment influence.
26	Blue Mussel Beds	Shellfish Site	Shapefile 3. (Fig.2)	Risk from sediment influence.
27	Horse Mussel Beds	Shellfish Site	Shapefile 4. (Fig.2)	Risk from sediment influence.

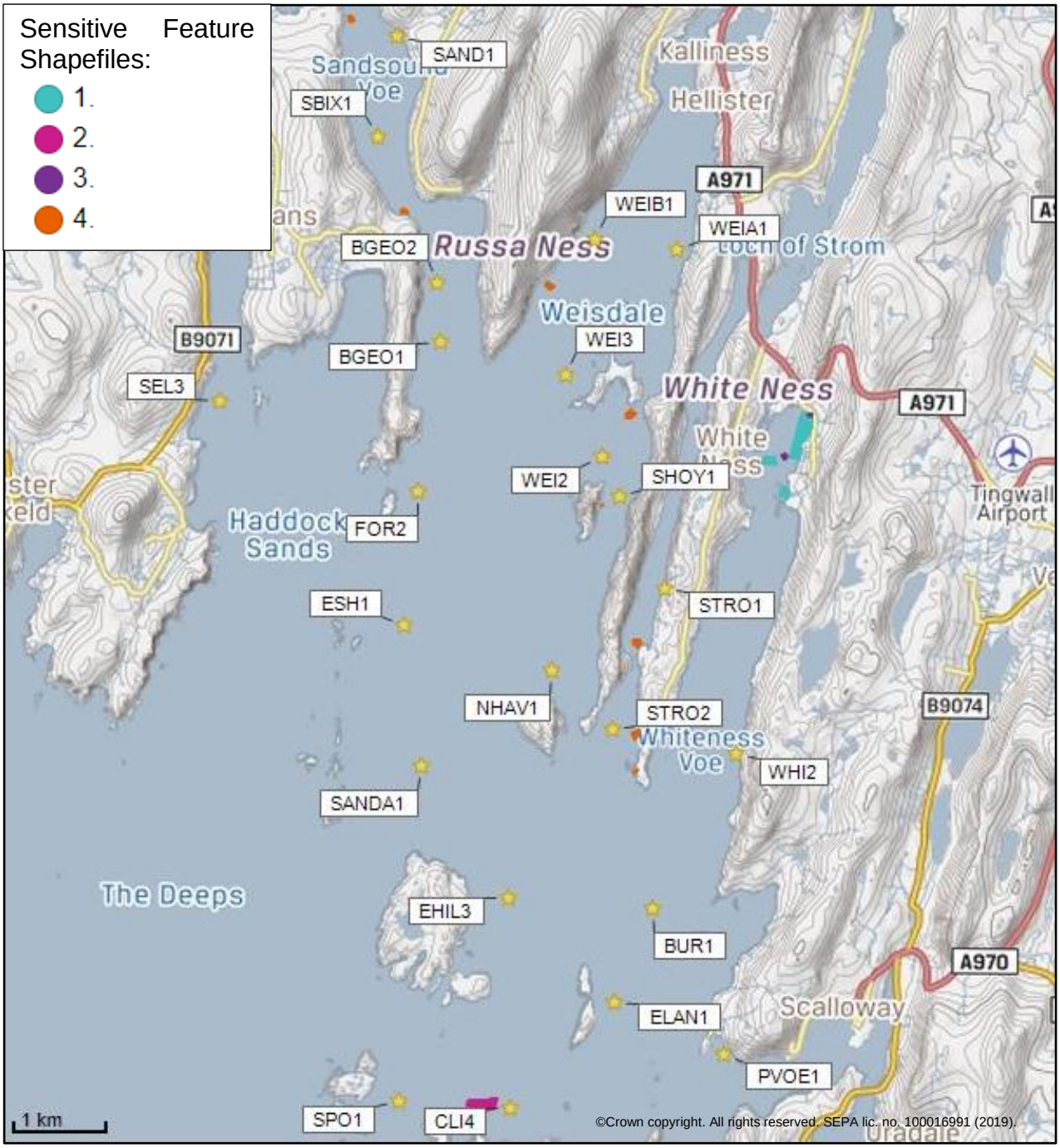

Figure 2. Existing sites in the vicinity of the proposed site (Easter Score Holm (ESH1)).

3.2 Additional comments on identified features

Although screening modelling has not been carried out, the density of existing farms in this area poses a risk of interactions between farms, and cumulative risks, from both sediment and bath medicine plumes. Detailed marine modelling will be required to ensure that the influence and interactions between all sites highlighted in Figure 2 are low.

Maerl Beds (Shapefile 1.), Sea Grasses (Shapefile 2.) and Mussel Beds (Shapefiles 3. and 4.) have also been identified as sensitive Priority Marine Features potentially at risk from

sediment discharges. Marine modelling will need to ensure influence from Easter Score Holm (ESH1), on these sensitive features is low.

3.3 Risks identified from contextual site data

The most recent survey in 2018 at Easter Score Holm (ESH1) was classified as unaccepted, as it was carried out 5 months prior to the site reaching peak biomass. The four previous self-monitoring surveys dating back to the last biomass increase in 2010 have all been satisfactory, with the AZE stations having only a changed or slightly impacted status based on ITI scores.

Should this application proceed, the total licenced biomass in this area would be 29500.4t.

Table 2: Table of licenced biomass from farms identified as likely to add to cumulative risks.

Site ID	Biomass (tonnes)	Last production cycle
ESH1	3988	Proposed
BGEO1	2635	2009
BGEO2	1209	2007
BUR1	1922.6	2020
CLI4	1332	2020
EHIL3	1500	2009
ELAN1	1642.8	2020
FOR2	1650	2017
NHAV1	1496	2017
PVOE1	960	2013
SAND1	100	Active Licence
SANDA1	1500	2007
SBIX1	1000	2002
SEL3	963	2008
SHOY1	1190.5	2009
SPO1	1500	2018
STRO1	150	2001
STRO2	1500	2007
WEI2	1190.5	2009
WEI3	1221	2009

WEIA1	100	Active licence
WEIB1	250	Active Licence
WHI2	500	Site no longer exits

4 Conclusion of screening modelling and risk identification

Following screening modelling and risk identification we make a number of conclusions and recommendations.

4.1 Conclusions

4.1.1 Screening Modelling

- The proposed site (Easter Score Holm (ESH1)) is in an area of moderate dispersion and has a moderate capacity to erode the seabed.
- From assessment of flow in this area, and previous monitoring data:
    - Information presented in section 3 indicates that the relative influence of Easter Score Holm (ESH1) is likely to be moderate compared to other sites for a similar tonnage.
    - The influence on the surrounding sea area from the proposed biomass increase at Easter Score Holm (ESH1) is likely to be relatively low.
    - The areas of influence from Easter Score Holm (ESH1) and other existing sites in this area (highlighted in Figure 2) may interact.
    - It is likely that discharges of bath medicines from Easter Score Holm (ESH1) will be dispersed to moderate levels over a moderate area.
    - Easter Score Holm (ESH1) is likely to result in a relatively low increase in the total influence of all sites modelled. Bath medicine plume interactions are likely to occur between other existing sites in this area (highlighted in Figure 2).
- Due to the dispersive nature of the waters surrounding the site nutrient discharges from Easter Score Holm (ESH1) are unlikely to have a strong influence on the surrounding sea area.

4.1.2 Risk Identification

Although screening modelling was not undertaken, the large tonnage proposed at this site, and large number of sites in the surrounding areas, means the risk to the wider environment from sediment and bath influence needs to be assessed. Several features of interest have also been identified, which may be influenced by the proposed site (Easter Score Holm (ESH1)). These will require further attention during pre-application work, and are outlined in section 3. Further detailed modelling will need to demonstrate that these are at a low risk of impact.

4.2 Recommendations

4.2.1 Site suitability

Consideration of screening modelling and risk identification suggests that it is possible that discharges from the proposed site will be able to comply with the relevant aspects of the SEPA Aquaculture Regulatory Framework. This must be demonstrated with a detailed marine model.

It is also possible that the site will be able to comply with our mixing zone regulatory framework. This will need to be demonstrated using the NewDepomod model. It is strongly recommended that default NewDepomod modelling is undertaken prior to any marine modelling, to ensure the local impacts of the proposed biomass are acceptable.

Features at risk, identified at this stage, do not appear to influence the feasibility of the proposed site, with respect to the regulatory framework. These risks should be examined using a detailed marine model.

Following the engagement meeting(s), this report will be revised and this should allow to the applicant to submit a method statement which address the issues raised in this document.

4.2.2 Further modelling

- Whilst screening modelling has not been carried out, the risks identified in this report, combined with the large tonnage proposed at this site, means detailed marine modelling will be required for both sediment and bath medicines, to ensure there are no additional risks to the environment from this application.
- This marine model should include discharges from Easter Score Holm (ESH1) and all other sites included in this screening risk identification.
- The resolution of the marine model should be relatively fine around the proposed site, and features identified as at risk.
- It is strongly recommended that default NewDepomod modelling is undertaken prior to any marine modelling, to ensure the local impacts of the proposed biomass are acceptable.

5 References

[1] *Regulatory Modelling Guidance For The Aquaculture Sector. Published on SEPA website.*

[2] *http://marine.gov.scot/information/wider-domain-scottish-shelf-model.*