AutoDEPOMOD course presentation and notes

DEPOMOD – science and validation

Management scenarios

AutoDEPOMOD and EIA

Annex H – all these terms – where they are buried in this document – page numbers in Annex H are shown in red

Regulatory background

Terminology

Example site set up

Sea lice consents

SEPA documents – where are these on web?

Regulatory objectives

General objective

To develop a capability to model sites individually

- To provide an alternative to the current 25m rectangular AZE
- So that an AZE can be determined according to the site–specific dispersive qualities
- To provide a more objective method to set max. biomass limits based on near-field benthic impact using the capabilities of AutoDEPOMOD
- To determine the distance of appropriate sampling stations from the cage group so that the AZE boundary can be sampled and monitoring can be better targetted

SEPA's objective is to minimise accumulation of organic matter on the seabed which would otherwise cause sediments to become anoxic and sulphidic or impact the invertebrate fauna adversely and so prevent the necessary aeration and reworking of sediment.

Some deposition in the **allowable zone of effects (AZE)** is acceptable as long as sediment reworking animals remain in sufficient diversity and density to maintain a turn over of carbon in the system.

Gross effects such as accumulations of food pellets and bacterial mats are not acceptable outwith the allowable zone of effects, and should be minimised even below the cages.

Page 10

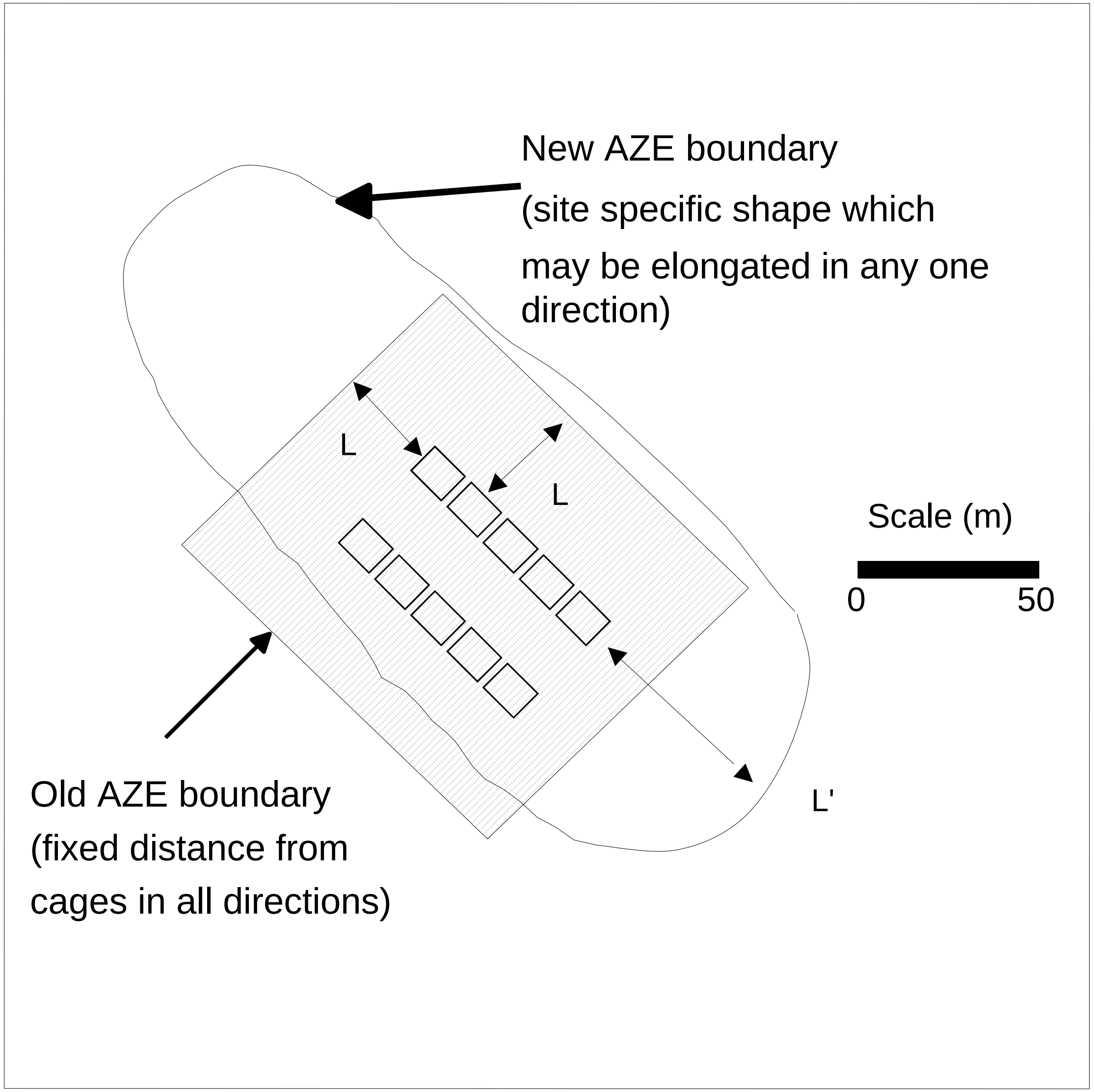
AZE and modelling - The rate at which solids deposition occurs at the seabed (flux – g solids m^{-2} yr^{-1}) and the subsequent availability of this material to the benthic community is linked in the DEPOMOD benthic response model

Solids flux decreases at increasing distance from the farm as finer particles taking longer to settle are dispersed more widely. It is the outer boundary of the deposition footprint (the AZE boundary) which is of primary interest from a modelling viewpoint as site-specific information can be used in a model to determine the shape and extent of the footprint.

This has the effect of allowing farms experiencing ambient currents of highly predictable direction to utilise the AZE area more effectively and inserts the site specific logic into AZE setting (e.g. site specific AZE replaces 25 m fixed AZE)

p 11

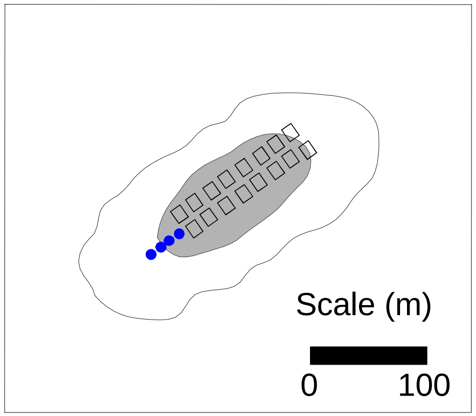
New methodology – site specific AZE – p 16



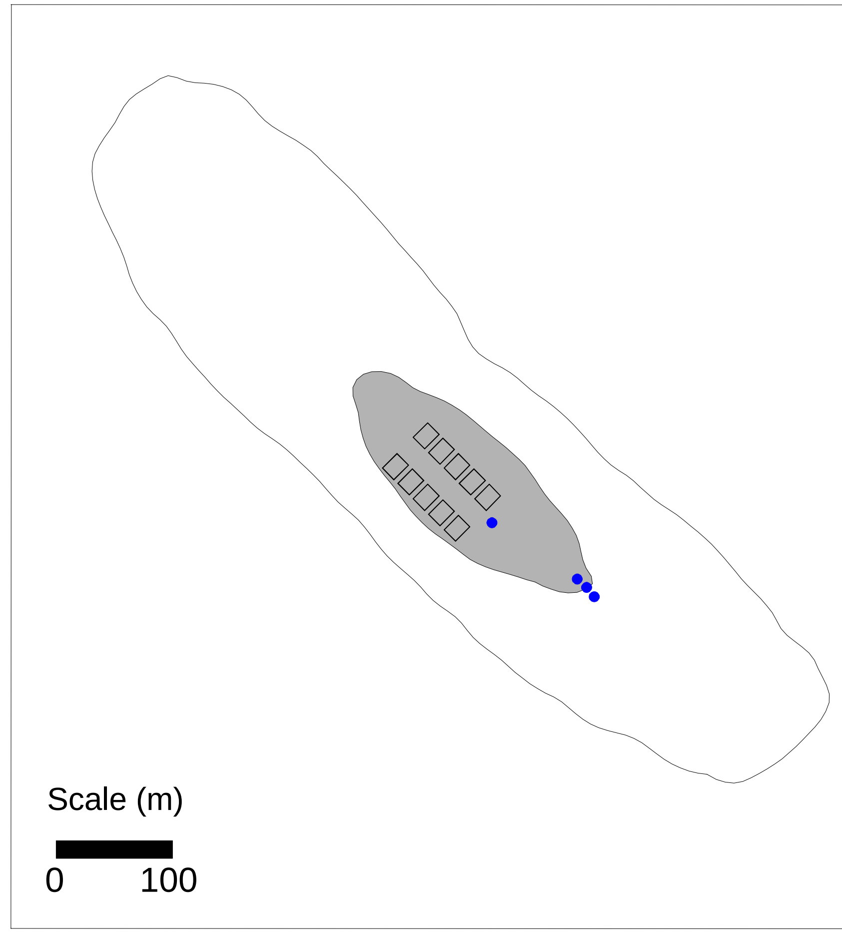
- The old AZE boundary was 25 m in all directions from, the cage
- New AZE is site-specific, and therefore has a characteristic shape and size

Site specific AZE - taking account of current and depth - p 18

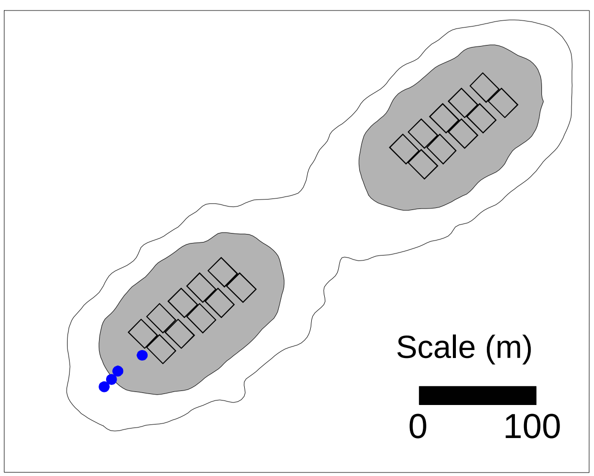
a) dispersive site – high resuspension, small AZE



b) intermediate site – deep, but with low near-bed current – large AZE



c) depositional site – small AZE but high impact



As a result, different sites have different size AZE as in Figure 2.2. At the dispersive site

(a), **high near–bed current** results in resuspension of deposited solids and a small AZE of overall low impact can be expected.

The intermediate site shows the situation that can occur at a **deep site** (b), where surface current results in high dispersion in the water column, but the low near–bed current results in little or no resuspension. As a result, the AZE covers a wide area and is low in overall impact.

The depositional site (c) **has a small AZE** but deposition within this zone can be **expected to be heavy** with a consequent increased risk to the viability of sediment re-worker species.

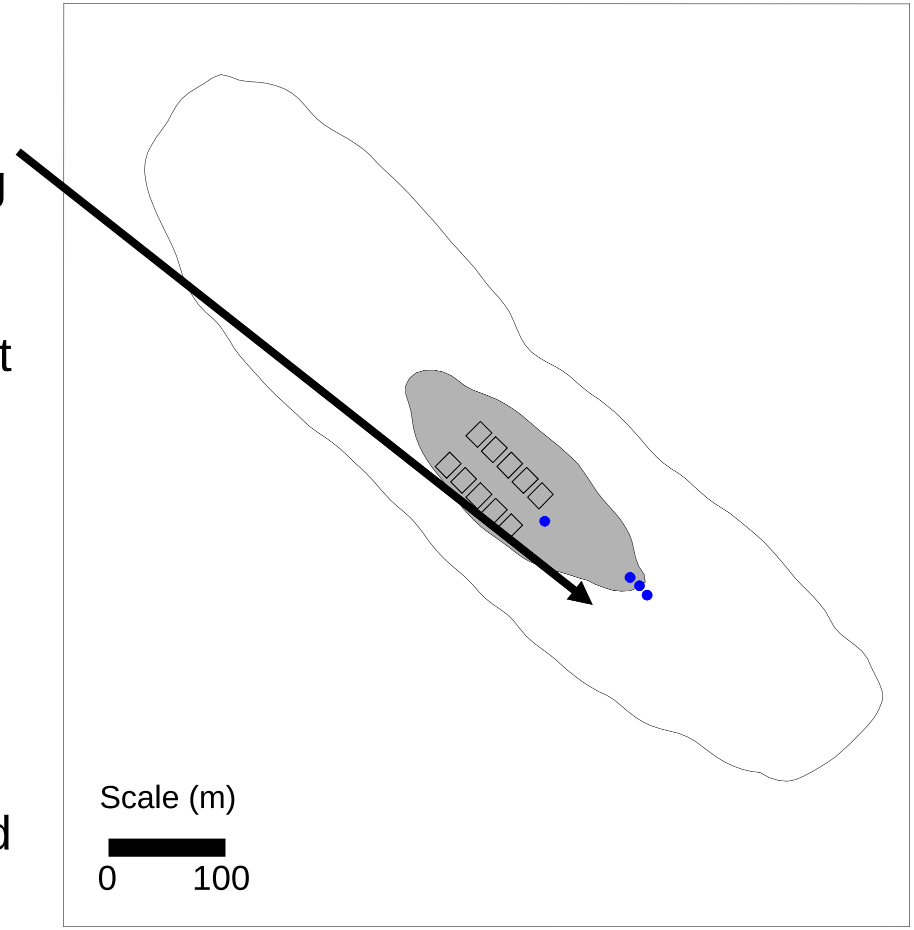
The distance to the AZE boundaries for the examples shown are 25 m, 120 m and 52 m.

p 17

Sampling stations - In Figure 2.2 it is important to note the approximate layout of the proposed sampling stations at these hypothetical sites. These are placed near the cage, one on the AZE boundary and one either side of the boundary. Such a sampling station arrangement maximises the chance of sampling the less impacted end of the organic enrichment gradient at the outer limits of the boundary.

It is also important to note, that no sampling stations perpendicular to the main axis of current are proposed as the greatest distance of the AZE boundary from the cage group is of main interest. Sampling locations will therefore be site-specific and identified in self-monitoring protocols – p 17

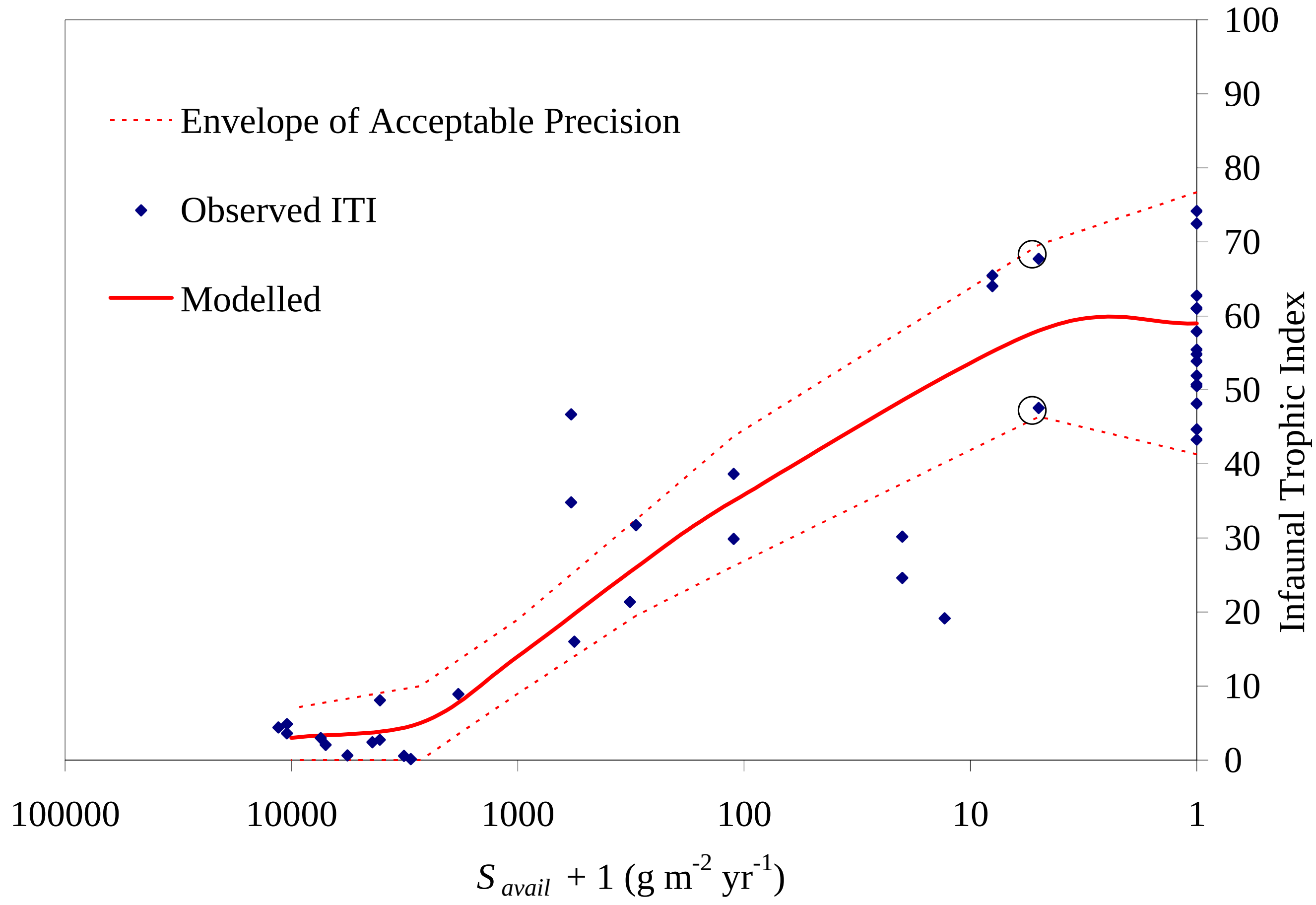
b) intermediate site – deep, but with low near-bed current – large AZE



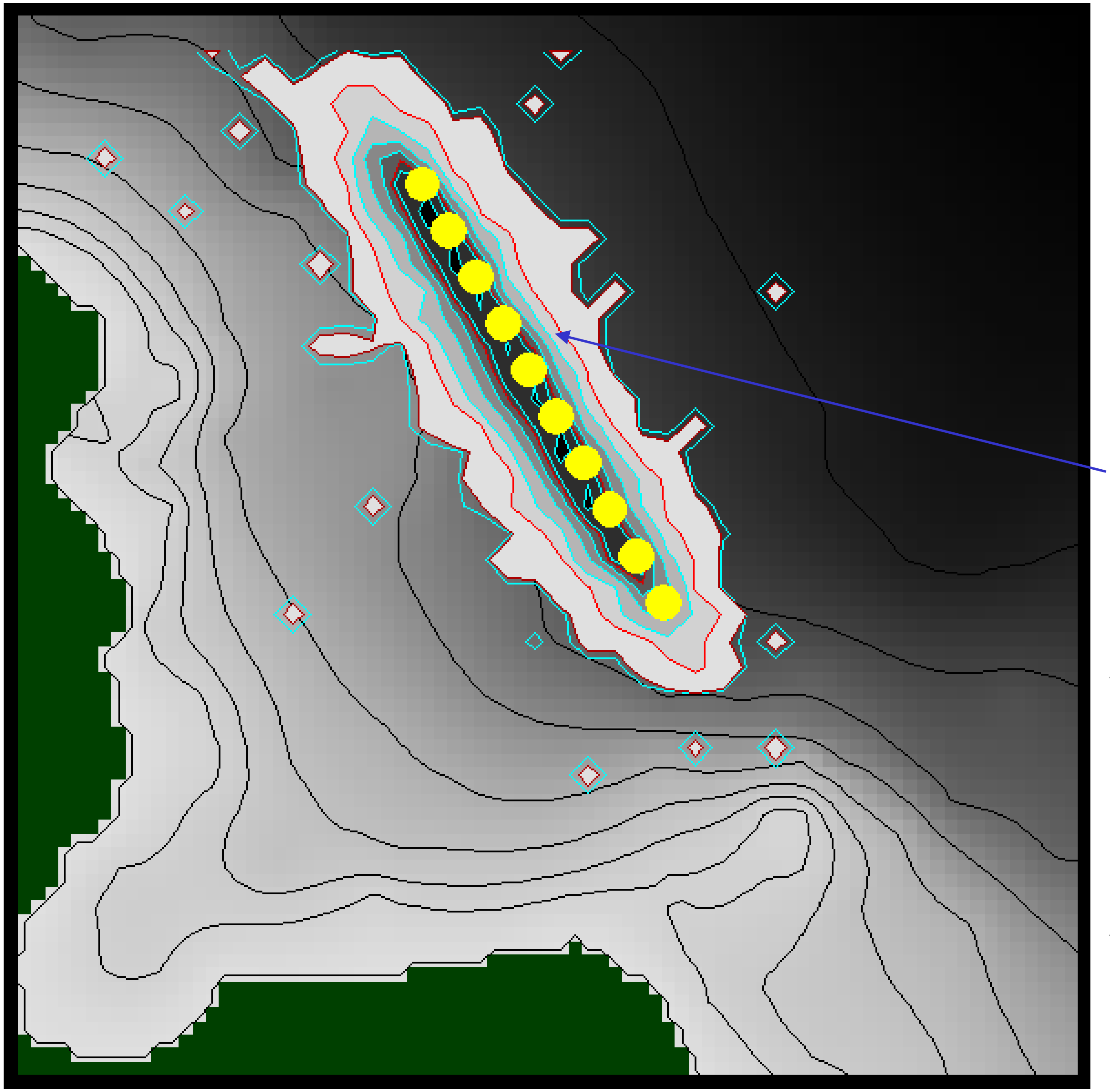
Choice of ITI EQS criteria

80 % of mass contained in 10 ITI

30 ITI defines AZE – page 102



AZE



ITIEQS = 10 ITI

MEQS = 80% solids p 100

Biomass = 2188 t

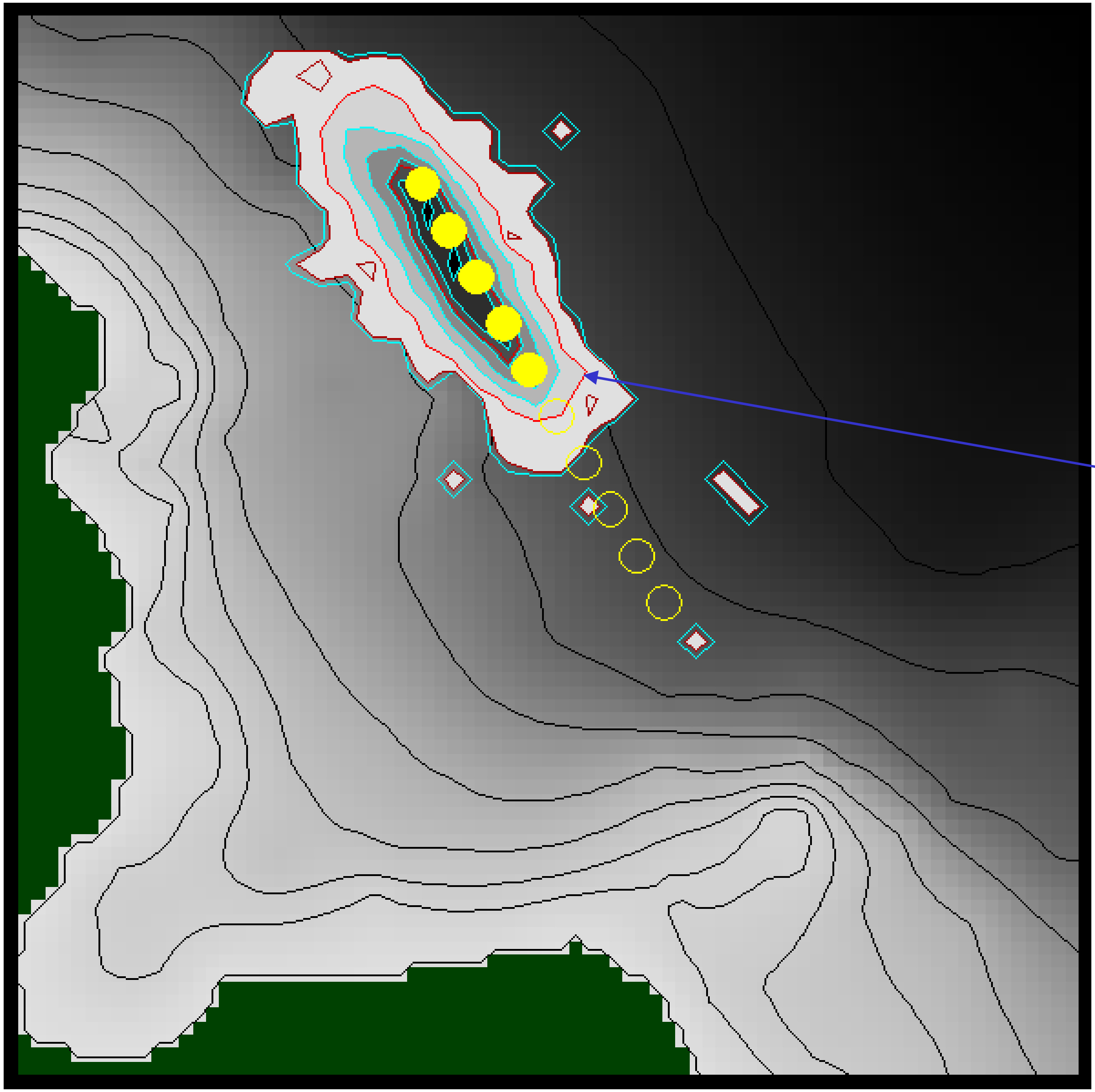
Cages = 10

For 80% of solids, ITI=8.8

As ITI < ITI EQS of 10 then HIGH

(Fail)

Action reduce number of cages and rerun



ITIEQS = 10 ITI

MEQS = 80%
solids p 100

Biomass = 1094 t

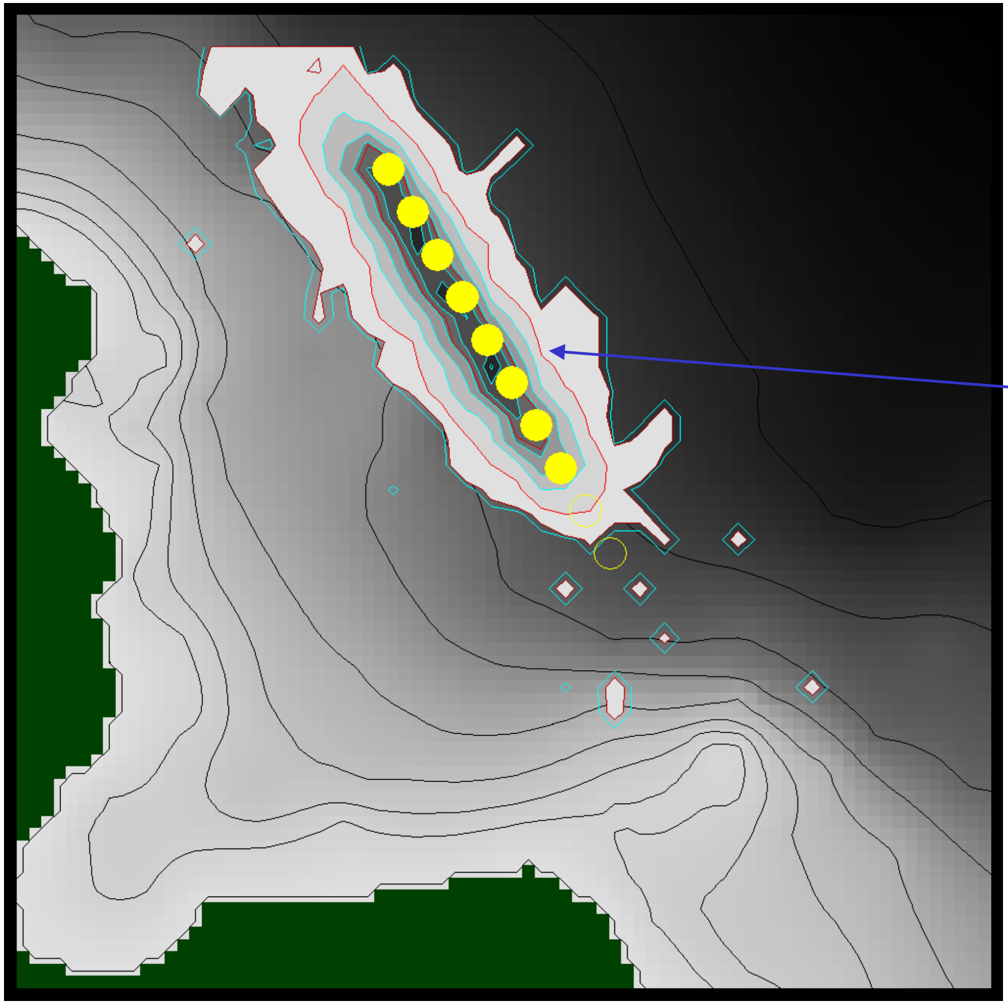
Cages = 5

For 80% of solids, ITI=10.2

As ITI > ITI EQS of 10 then LOW

(Pass, but impact less than allowed, so can optimise site further)

Action increase number of cages and rerun



ITIEQS = 10 ITI

MEQS = 80% solids p 100

Biomass = 1641 t

Cages = 8

For 80% of solids, ITI=10

As ITI = ITI EQS of 10 PASS

Terms from the method that might be found in biomass modelling reports

Site-specific AZE, sampling station transect – as described

Peak biomass – this is modelled rather than whole growing cycle – p 86

The model will iterate through several runs until a PASS occurs (p 85)

Stocking density – 17 kg m^{-3} – from consultation with industry – p 86

Specific Feeding Rate (SFR) - 0.7% biomass day^{-1} – SEPA examined feed returns and 0.7 representative of feed rate at peak biomass – p 86

AutoDISTRIBUTE = On – means that cages are filled to maximum stocking density sequentially – p 87 (must check SD<=17 kg m^{-3})

EQS and compliance testing – 10 ITI and 80% particles contained in footprint (p 103)

Sampling ITI – the footprint area enclosed by the ITI is the AZE - p 104)

Mapping module – used to display the footprint and draw sampling station transects – module output will be seen in reports p 110-115

Quality control checks when looking at reports

- Compare footprint (maximum flux areas) to hydrographic data e.g. shape of footprint with direction (scatter plots)
- Compare with summary stats
- Lay of the land
- Time series plots from hydrographic data sheets

- Pre-application consultation – see document

- Check SD<=17 kg/m^3, Biomass<=2500 t
- ITI >=10 at near field (80% solids)
- Refine run at 10 particles
- Use lowest biomass for Spring and neap
- Use smallest AZE if spring and neap are the same

(last two apply precautionary principle – p 7)

Reporting of Consent Limit Assessment Results – Consent Biomass
p 115

H:7.4 Reporting of Consent Limit Assessment Results – Consent Biomass Details of the site specific modelling process in support of a biomass application should be documented in a report. The marine_sum_v1.xls should also be completed for the site.

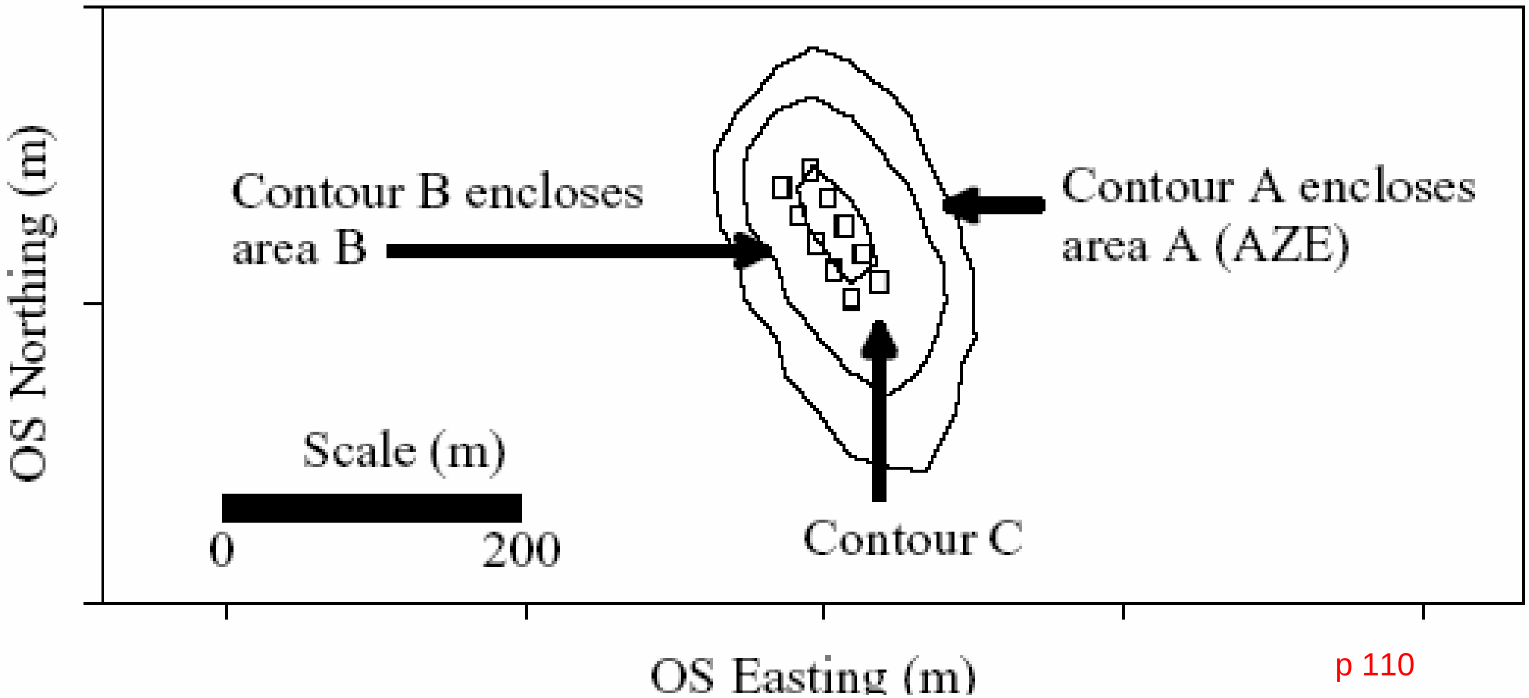
H:7.4.1 Reported model output Upon completion of benthic modelling, SEPA requires that the following parameters be reported:

The peak biomass in tonnes.

The stocking density and the cage depth.

The flux, ITI and area of the 3 contours shown in Figure 7.3. The percentage of solids lost from the model grid, and the total amount of solids release per year at peak biomass. These parameters should be entered into the marine_sum_v1.xls, and referred to in the report where appropriate.

Figure 7.3 Contour map of deposition footprint of 'sitename' (run 15) showing three important contours, A, B and C. Cage centres are shown as squares and the 5 cages in the NE line are used in the simulation p 109



p 110

Contour A – This is the AZE. Contour A is 30 ITI (and 191.8 g m^{-2} yr^{-1}). Area A is 33742 m^2. See 0.

Contour B – This is the contour used for testing against EQS criteria. Contour B is 10 ITI EQS (10.1 ITI within tolerance and 1545 g m^{-2} yr^{-1}). Area B is 17391 m^2. See 0 and Table 7.1.

Contour C – This is the under cage group area used for calculating mean and maximum flux. Contour C is 23290 g m^{-2} yr^{-1} and area C is 2311 m^2. See P23-A.

H:7.4.2 Sampling stations – p 116

The locations of the sampling stations are site specific as shown in Figure 2.2. Thus the NGRs of the 3 sampling stations on the transect, should be reported, together with their depth, distance from cages and the predicted ITI.

In addition details of the 3 sampling stations on a ‘spare transect’ are required. The ‘spare transect’ can be used in the field in the event of a physical inability to sample at the original locations due for example to the absence of soft sediments or the presence of reefs.

H:7.4.3 Contour plots A plot of the solids deposition should be included in the report, showing the location of both the sampling transect and the spare transect. The cross-section through both transects should also be included.

marine_sum.xls

How does Surfer calculate the area of a contour for the sampling area of 30 ITI?

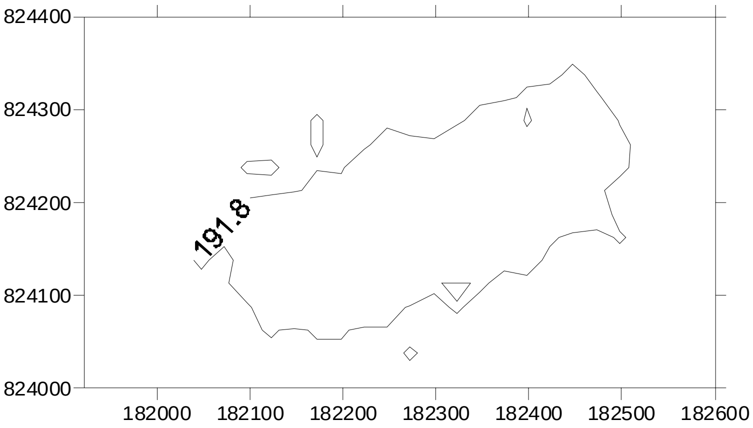
From the Benthic Response curve, 191.8 g/m2/yr results in a 30 ITI **(page 102)**

Open Surfer and using Map > Contour map > New Contour map, load up the .grd file for the run of interest.

Double click on the map and delete all levels,

except for one level and make it 191.8 g/m^2/yr.

This shows the area occupied by this contour.



Now use the Grid volume function with a

value of Z of 191.8 g/m^2/yr

Now examine Positive Planar Area and this will give the area enclosed by the 191.8 g/m^2/yr contour. This will match Sampling Area in Log file

This can also be repeated for any contour level, including the 0.763 ug/kg far field EQS in a Slice run.

Anti-parasitic chemicals – p 15

SEPA's approach to consenting the use of these in-feed therapeutants is based on limiting the maximum concentration of chemical within the surficial layer of the seabed. ..... SEPA has set an "upper limit" on the quantity of chemical that may be applied to a site in a growth cycle. These are 1 times peak biomass for TFBZ and 5 times peak biomass for EmBZ.

Retreatments - For both EmBZ and TFBZ the timing and allowable quantity chemical of retreatments is controlled by calculations of the quantity of chemical still remaining on the seabed. Details of how to make these calculations are issued with discharge consents.

EQS criteria – SEPA's approach to setting chemo-therapeutant consent limits, is based on the comparison of Environmental Quality Standards (EQSs) with predictions of sediment concentrations of active ingredients by AutoDEPOMOD – p 19

Environmental Quality Standards for in-feed chemicals may be applied in two main ways:

- a consent-limiting concentration of chemical permitted within the seabed sediment – "limit"

or

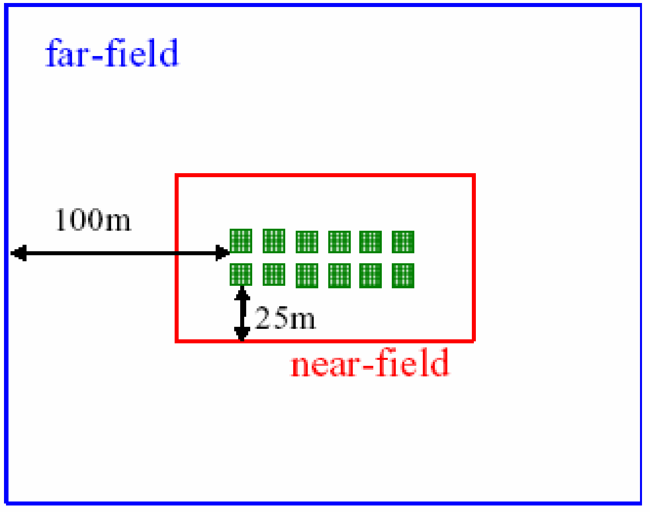
- a non consent-limiting concentration of chemical permitted within the seabed sediment which, if exceeded, will trigger a requirement for enhanced monitoring. - "trigger"

Calc for converting to sediment concentration

see flipboard

Table 2.1 In-feed chemical sediment EQSs				
	Near Field	Type	Far Field	Type
TFBZ	10 mg kg^{-1} dry wt sediment	Trigger	2.0 µg kg^{-1} dry wt sediment	Limit
EmBZ	7.63 µg kg^{-1} wet wt sediment	Trigger	0.763 µg kg^{-1} wet wt sediment	Limit

Figure 2.3 Relation of near and far-field AZE to cage area for anti-parasitic chemical modelling. Note, fixed areas are used in this method as near-field and far-field EQS chemical criteria relate to these areas



p 20, 21 – Emphasize – AZE's are fixed size for Calicide/Slice assessment

Release characteristics

Calicide – 90% over 7 days – p26

SLICE – longer released period – 99% of body load over 223 days – p 29

H:3.6.2 SLICE

The feed load for EmBZ is presented in a time series due to the length of the excretion period – the same kinetics apply as in section H:3.6.1, however the discharge is time varying.

To summarise the discharge characteristics:

1. a quantity of medicated feed (F_a) is fed to the fish over seven days, carrying an associated applied chemical load (M_a);
2. 97% of the medicated feed is consumed (F_c); the remainder (3%) is wasted (F_w) and carries an associated chemical load (M_w);
3. of the consumed medicated feed (F_c), 10% of the active ingredient load is excreted immediately (M_t);
4. the remaining 90% (M_0) of the active ingredient load, the body load, on the consumed medicated feed (F_c) is excreted at an exponential rate, 50% of any initial body load being excreted over 36 days.

Release of EmBz in model – page 29

Table 3.1 shows the proportion of an initial body load discharged over time, and illustrates that nearly 99% of the body load of chemical has been excreted from the fish after a period of 223 days:

Table 3.1 EmBZ excretion profile				
Period	Number of days (post treatment)	Proportion of remaining chemical released (%)	Quantity of original chemical released (%)	Cumulative quantity of chemical released (%)
1	36 (43)	50	50	50
2	72 (79)	50	25	75
3	108 (115)	50	12.5	87.5
4	144 (151)	50	6.25	93.75
5	180 (187)	50	3.125	96.875
6	216 (223)	50	1.5625	98.4375

If footprints from adjacent cage groups overlap, then no account is taken of this in EQS assessments. AZE for the whole site is the sum of the AZE for both cage groups – **NB4 – p24 and P5N p 48**

Log file – see page 66 for SLICE

Documents on SEPA Aquaculture web site

Fish farm modelling update

Marine_sum.xls

Preapplication consultation

Hydrographic data

In-feed consent limits at dispersive sites