

**Kenepuru and Central Sounds Residents Association Inc
Clova Bay Residents Association Inc
Guardians of the Sounds Inc
(Associations)**

**Marlborough Environment Plan Hearing
Variation 1
15 November 2021**

Illustrations - Beatrix Complex AMAs

AMA Illustrations – Beatrix Complex

The following slides illustrate proposed arrays of AMAs for the Beatrix Complex. These illustrations are based on the submissions made by the Associations and indicate some of the key principles applied when determining appropriate AMAs. These include:

1. AMA's should be consistently sited no closer than 100m from mean low tide.
2. Ring-fencing aquaculture development has a significant adverse cumulative effect on natural landscape and natural character values. Accordingly, AMAs in intensively farmed areas such as Clova Bay, Crail Bay, Kauauroa Bay and Beatrix Bay should be contained to *no more* than the generally appropriate 100-300 band unless there is a compelling environmentally focused reason to the contrary.
3. Activity should generally be avoided adjacent to outstanding natural landscapes or features. At the least, this means that AMA's adjacent to these areas should be limited to the *lesser of* a 100-300m ribbon or the amount of surface area currently consented (but located within a 100-300 ribbon).
4. Point to Pont navigation lines should be avoided and navigation channels should not be restricted.
5. Site specific factors, such as the removal of double parked farms and inappropriate AMAs such as AMA 1 in Clova Bay
6. After the above, AMAs should be refined to ensure that activity is contained within the limits prescribed by the Aquaculture Stewardship Council (ASC) Bivalve Standard - Pelagic Effects.

The following slides adopt the following process. Firstly, they show the AMAs as proposed by Variation 1 for an area, then the ASC model heat map for the AMAs proposed by V1 for that area, then the alternative and proposed AMAs by the Associations for that area, and then finally the ASC model heat map for those alternative and proposed AMAs for that area. We have repeated this for four areas, each in turn. They are Clova Bay, Beatrix Bay, Kauauroa Bay and Crail Bay. We have also included a slide illustrating the application of principles 3 and 4 above to Te Puraka Point (Clova Bay AMA 4).

The ASC model slides show the percentage of activity relative to the maximum permitted by the ASC standard. For example, red indicates activity that is at 300% (3 times) the level of activity permitted under the ASC standard.

At the end we have included a slide describing the ASC Model and a slide illustrating the corroborative results of the ASC Model and the NIWA Biophysical Model.

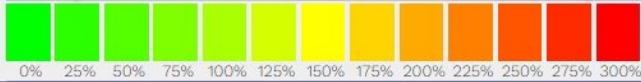
Clova Bay AMAs - As Proposed Under V1



Aquaculture Stewardship Council Bivalve Pelagic Standard With Clova Bay AMAs as Proposed Under V1

ASC Standard - Pelagic Effects

Legend



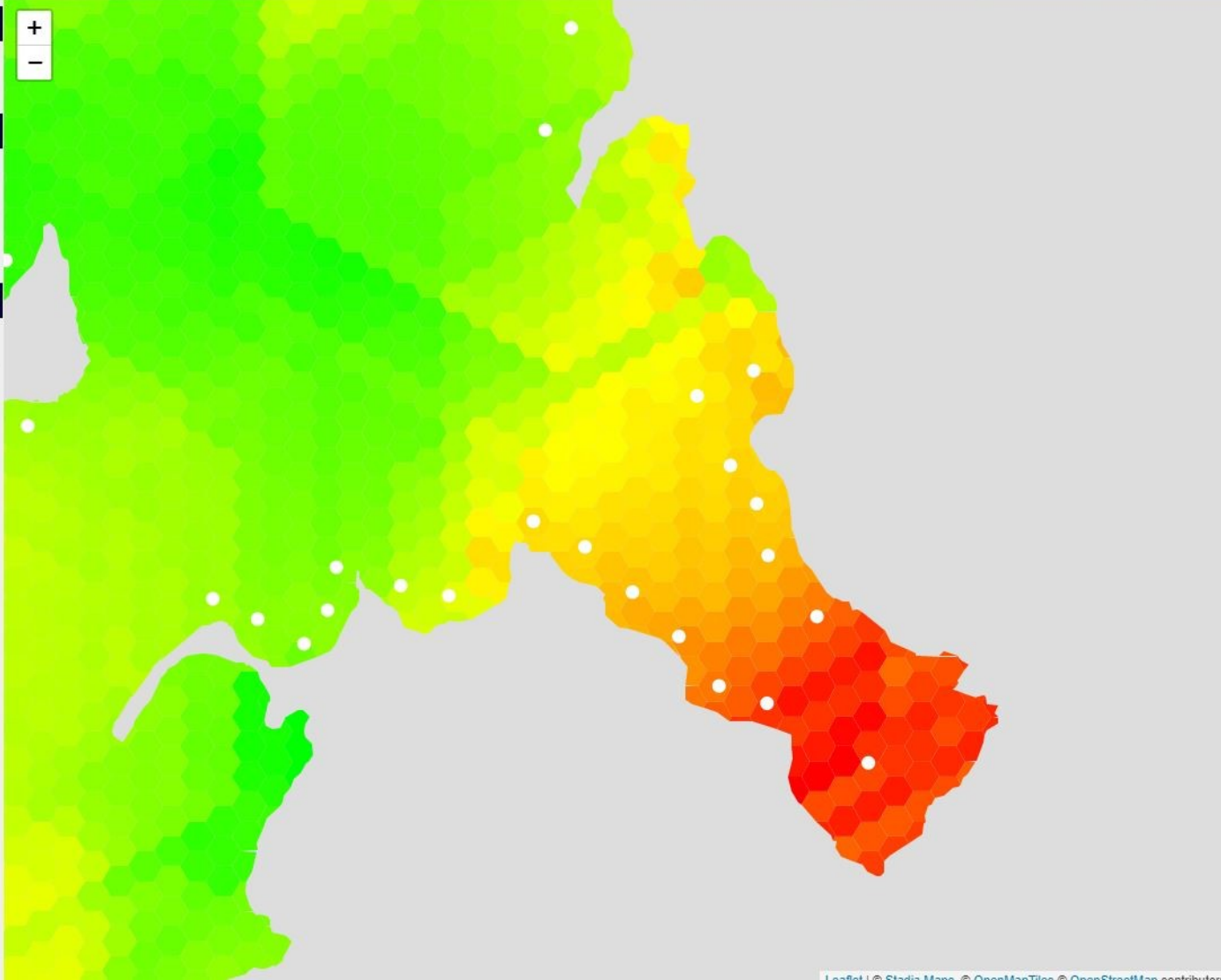
Cell Inspector

Cell Area: 31,494 m²
 AOI Area: 3,165,592 m²
 AOI Volume: 47,483,873 m³
 Influencing Farm Hectares: 66 Ha
 Primary Production Time: 2 days
 Retention Time: 5.88 days
 Clearance Time: 1.95 days

308%
CRITICAL

Marine Farms

Save Farm Data	Load Farm Data		Ha
	Choose File	No file chosen	
#8547:	1.53	1.53	Ha
#8548: Sanford	6.96	10.24	Ha
#8549: Clearwater	4	4	Ha
#8550: Sanford	7.86	10.86	Ha
#8551: Two M F	4.56	4.56	Ha
#8552: Talley's	6.03	6.03	Ha
#8553: MFA (spat)	0	0	Ha
#8555: Sanford	16.78	10.5	Ha
#8556: Wakatu	8.354	8.354	Ha
#8557: Talley's	6.43	6.43	Ha
#8558: Sanford	5	5	Ha
#8559: MFA (spat)	0	0	Ha
#8560: Sea Health Foods	9.2	9.2	Ha
#8265: Ngai Tahu Seafood Resources Limited	8.254	8.254	Ha
#8264: MFA	31.966	31.966	Ha
#8263: Treble Tree	2.74	2.74	Ha
#8511: Sanford Limited	5.23	5.23	Ha
#8512: Sanford Limited	4.84	4.84	Ha
#8513: NZKS	5.59	5.59	Ha
#8514: Wakatu Resources Limited	4	4	Ha
#8515: Crail Bay Trust (farm 1)	13.199	13.199	Ha
#8516: Talley's Group Limited (MOT)	5.82	5.82	Ha
#8517: Sanford Limited	2.5	2.5	Ha



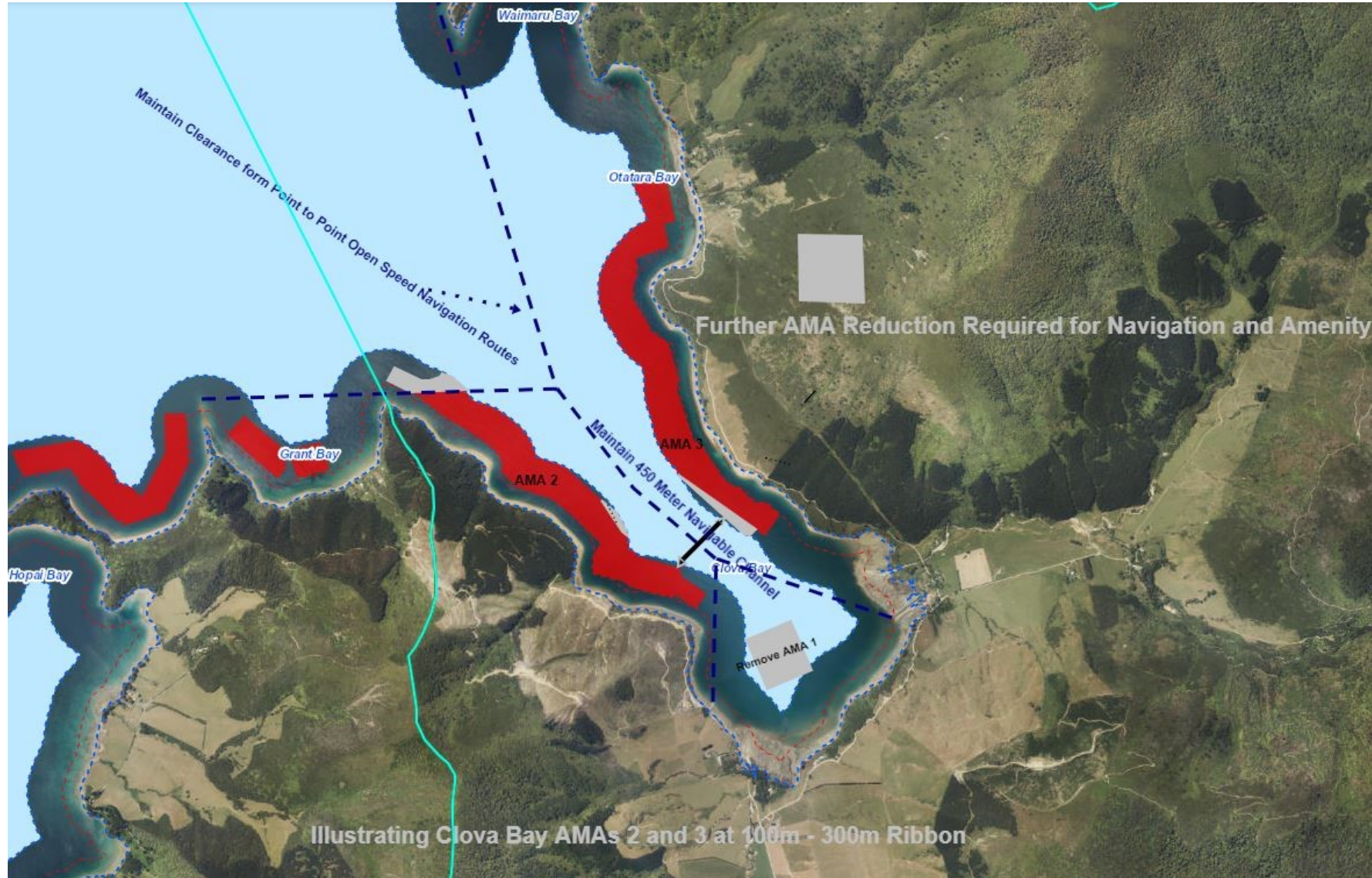
Controls

- Average Water Depth (m):
- Average Tidal Movement (m):
- Average Dropper Line Length (m):
- Mussels per Hectare of Consented Space (millions):
- Adult mussel filtration rate (litres per day):
- Primary Production Time (days):
- Area of Influence (km):
- Diminishig Distance

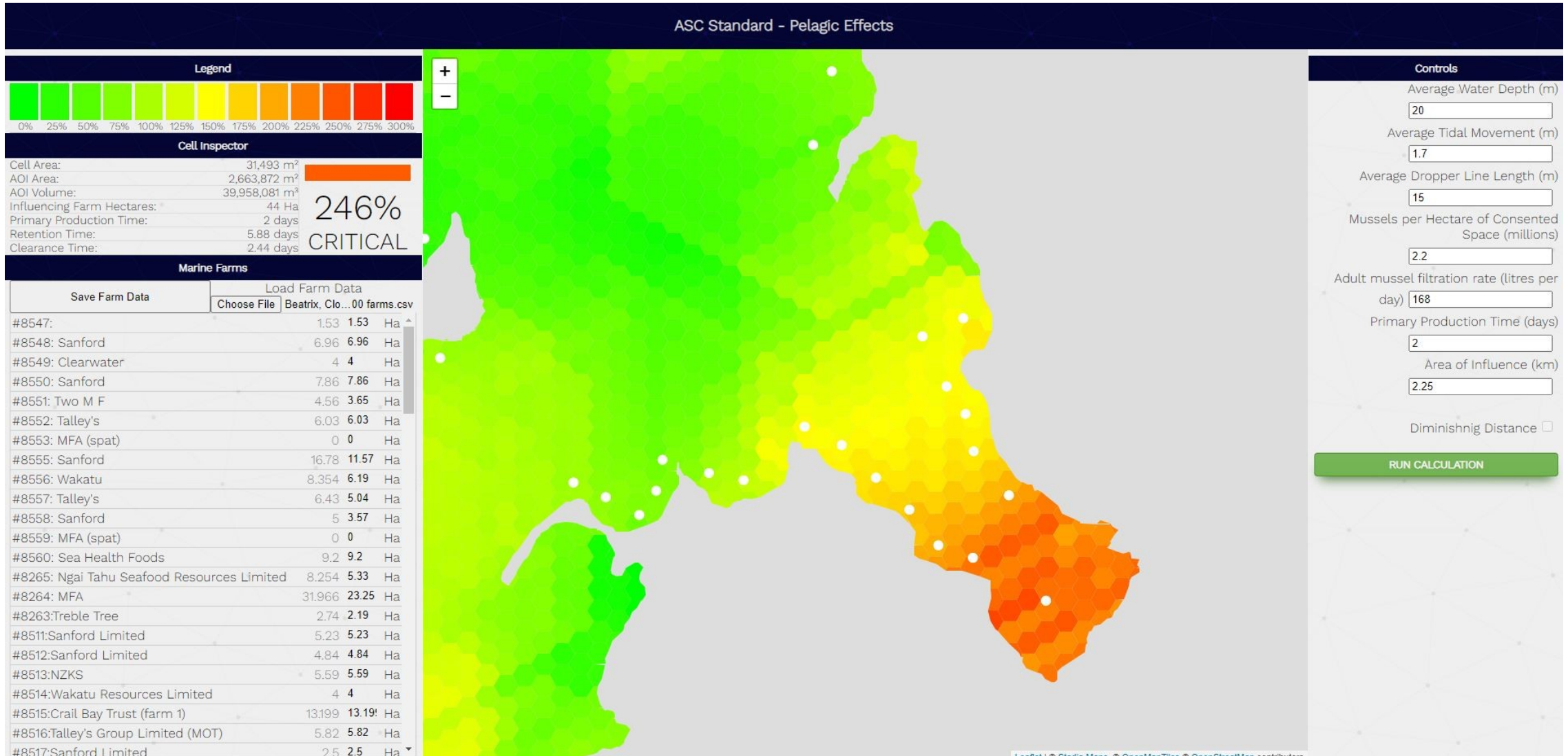
RUN CALCULATION

Clova Bay AMAs

With Ribbon Contained to 100m - 300m

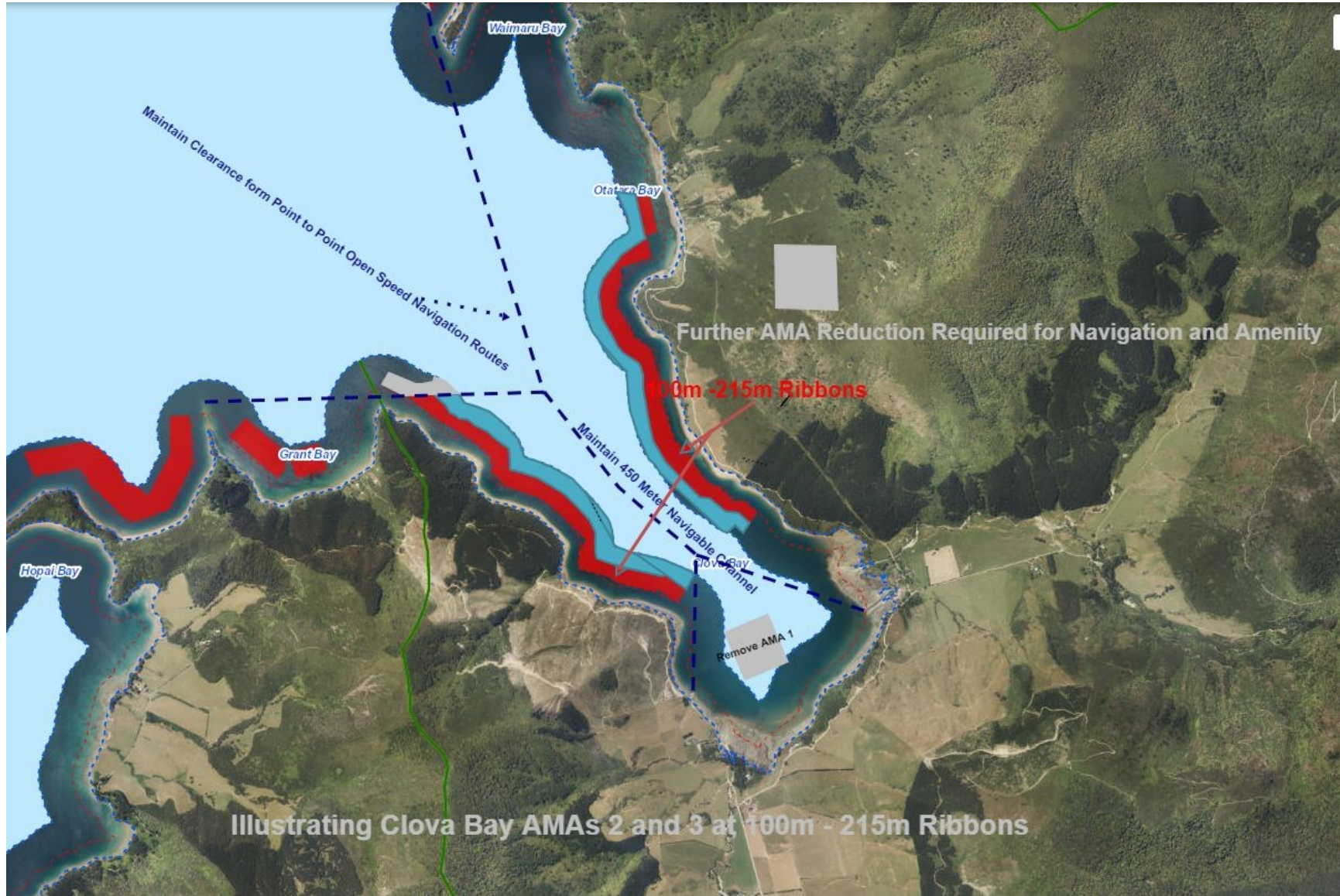


Aquaculture Stewardship Council Bivalve Pelagic Standard Clova Bay AMAs With Ribbon Contained to 100m - 300m



Clova Bay

With AMAs 2 and 3 Contained to a 100m - 215m Ribbon as Proposed by Associations



Aquaculture Stewardship Council Bivalve Pelagic Standard

Clova Bay AMAs 2 and 3 contained to a 100m - 215m Ribbon as Proposed by Associations

ASC Standard - Pelagic Effects

Legend

0% 25% 50% 75% 100% 125% 150% 175% 200% 225% 250% 275% 300%

Cell Inspector

Cell Area:	31,496 m ²
AOI Area:	3,957,663 m ²
AOI Volume:	59,364,938 m ³
Influencing Farm Hectares:	53 Ha
Primary Production Time:	2 days
Retention Time:	5.88 days
Clearance Time:	4.2 days

143%
CRITICAL

Marine Farms

Save Farm Data
Load Farm Data
Choose File Beatrix, Kau...lova 250.csv

#8547:	1.53	1.53	Ha
#8548: Sanford	6.96	5.8	Ha
#8549: Clearwater	4	3	Ha
#8550: Sanford	7.86	7.86	Ha
#8551: Two M F	4.56	2.74	Ha
#8552: Talley's	6.03	5.32	Ha
#8553: MFA (spat)	0	0	Ha
#8555: Sanford	16.78	8.68	Ha
#8556: Wakatu	8.354	3.56	Ha
#8557: Talley's	6.43	2.9	Ha
#8558: Sanford	5	2.05	Ha
#8559: MFA (spat)	0	0	Ha
#8560: Sea Health Foods	9.2	9.2	Ha
#8265: Ngai Tahu Seafood Resources Limited	8.254	5.33	Ha
#8264: MFA	31.966	23.25	Ha
#8263: Treble Tree	2.74	2.19	Ha
#8511: Sanford Limited	5.23	5.23	Ha
#8512: Sanford Limited	4.84	4.84	Ha
#8513: NZKS	5.59	5.59	Ha
#8514: Wakatu Resources Limited	4	4	Ha
#8515: Crail Bay Trust (farm 1)	13.199	13.19	Ha
#8516: Talley's Group Limited (MOT)	5.82	5.82	Ha
#8517: Sanford Limited	2.5	2.5	Ha

Controls

Average Water Depth (m)

Average Tidal Movement (m)

Average Dropper Line Length (m)

Mussels per Hectare of Consented Space (millions)

Adult mussel filtration rate (litres per day)

Primary Production Time (days)

Area of Influence (km)

Diminishig Distance

RUN CALCULATION

Leaflet | © Stadia Maps, © OpenMapTiles © OpenStreetMap contributors

Clova Bay AMA 4 – Te Puraka Point

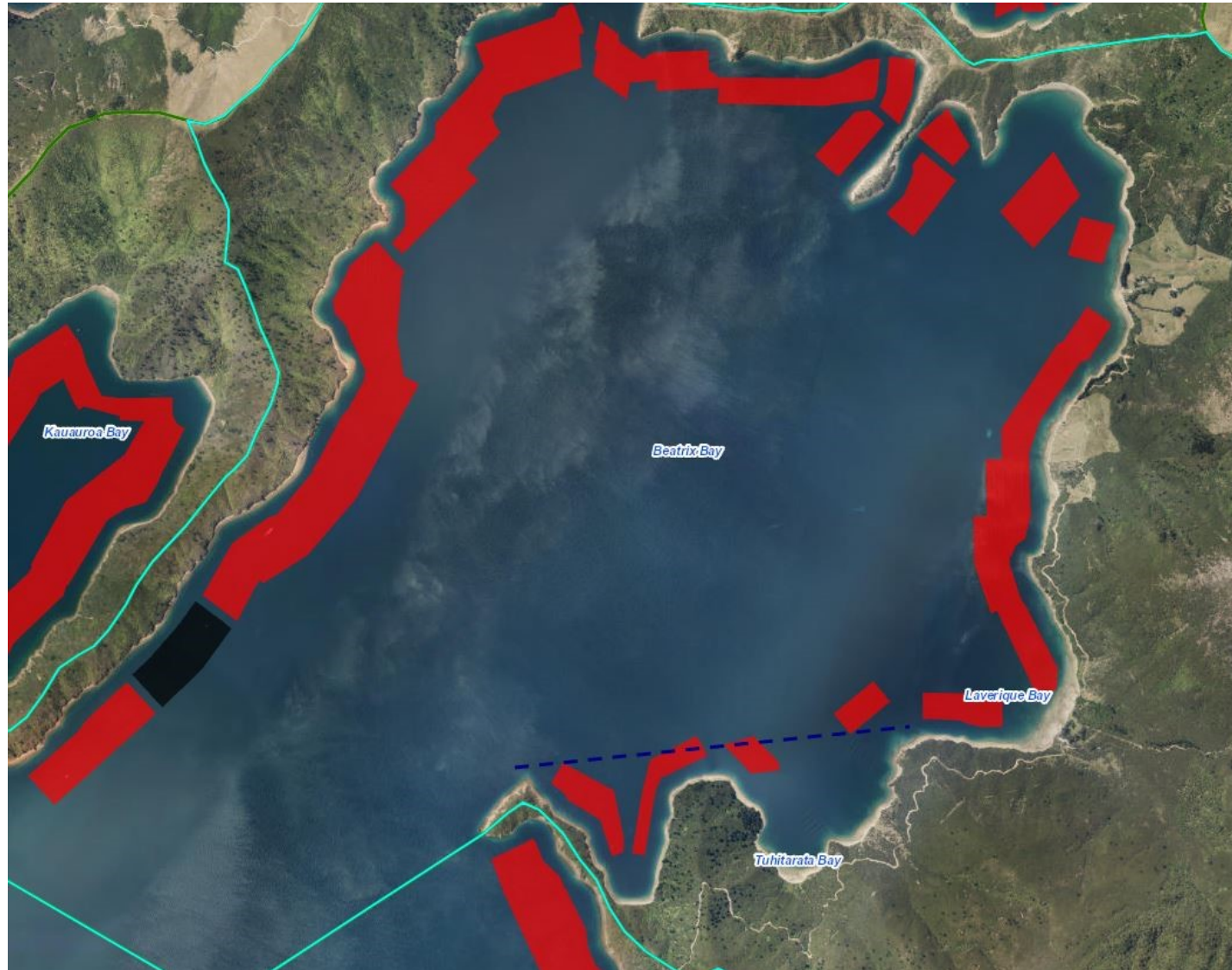


As Proposed by Variation 1

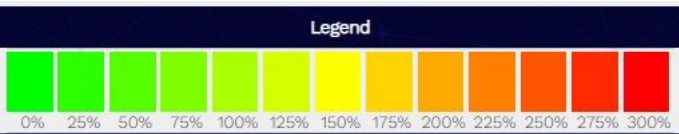


Within minor adjustment for navigation and containment within 100-300m Ribbon

Beatrix Bay AMAs - As Proposed Under V1



Aquaculture Stewardship Council Bivalve Pelagic Standard With Beatrix Bay AMAs as Proposed Under V1



Cell Inspector

Cell Area: 31,537 m²

AOI Area: 5,296,015 m²

AOI Volume: 105,920,299 m³

Influencing Farm Hectares: 112 Ha

Primary Production Time: 2 days

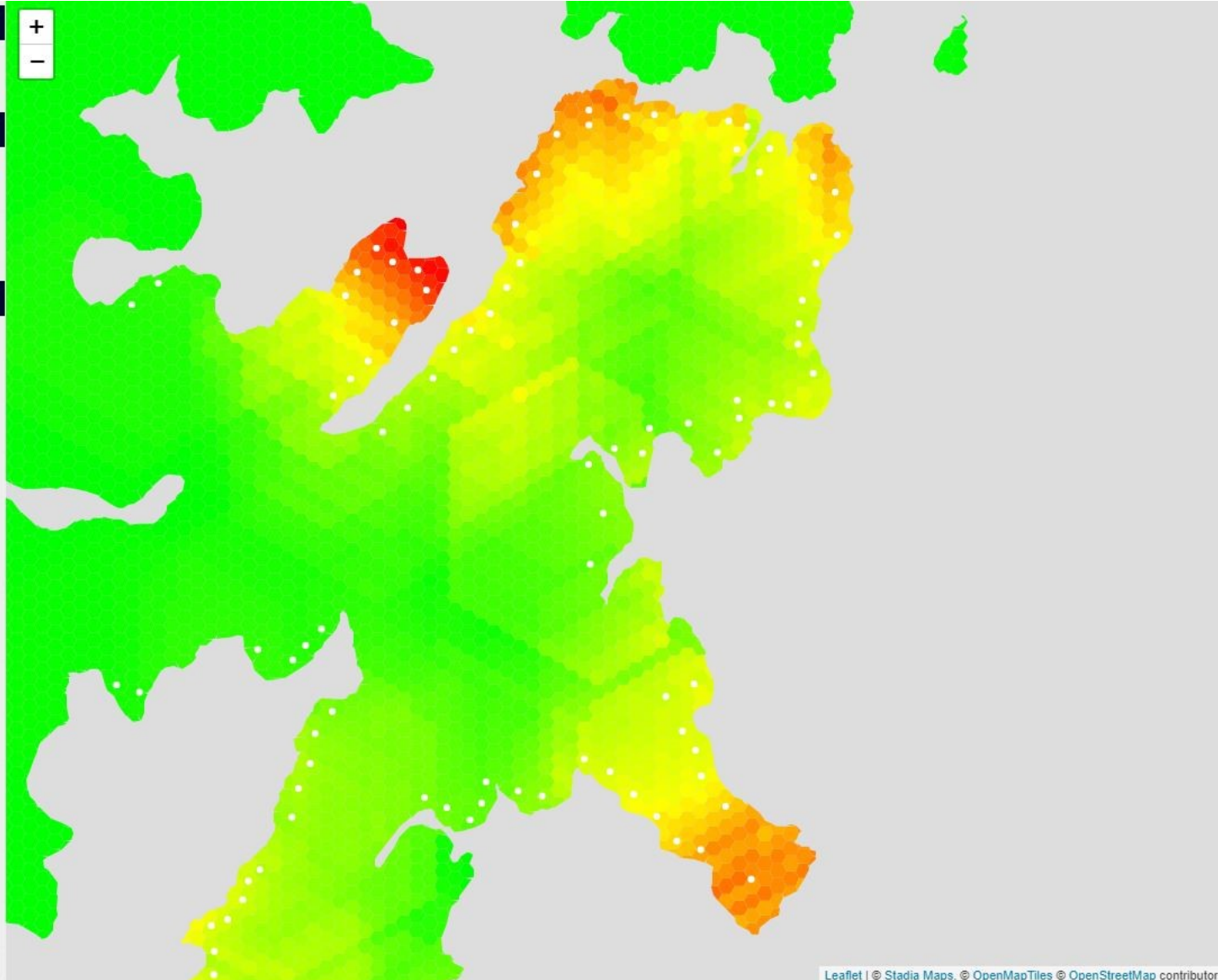
Retention Time: 7.35 days

Clearance Time: 2.55 days

**235%
CRITICAL**

Marine Farms

Save Farm Data	Load Farm Data		
	Choose File	No file chosen	
#8546:Talley's Group Limited	3	3	Ha
#8228: Talley's	10.62	10.62	Ha
#8229: Clearwater	9.67	9.67	Ha
#8230: Ngai Tahu	14.157	14.15	Ha
#8231: Sanford Limited	6.64	6.64	Ha
#8232: Sanford Limited	6.88	6.88	Ha
#8233: Sanford Limited	8.93	8.93	Ha
#8234: Sanford Limited	8.1	8.1	Ha
#8235:Parkhurst Enterprises General Partner Limited	7	7	Ha
#8236: Sanford Limited	19.07	19.07	Ha
#8237: Sanford Limited	15.477	15.47	Ha
#8238: Sanford Limited	8.479	8.479	Ha
#8239: KPF Investments Limited	19.62	19.62	Ha
#8240: J & A Seggie Family Trust	7.3	7.3	Ha
#8241: Sanford Limited	6	6	Ha
#8242: Darryl Gordon Slade	7.942	7.942	Ha
#8243: Sanford Limited	6.57	6.57	Ha
#8244: Sanford Limited	5	5	Ha
#8245: Sanford Limited	7	7	Ha
#8246: Clearwater	10	10	Ha
#8247: Sanford Limited	4.75	4.75	Ha
#8248: MFA (spat)	12	12	Ha



Controls

Average Water Depth (m):

Average Tidal Movement (m):

Average Dropper Line Length (m):

Mussels per Hectare of Consented Space (millions):

Adult mussel filtration rate (litres per day):

Primary Production Time (days):

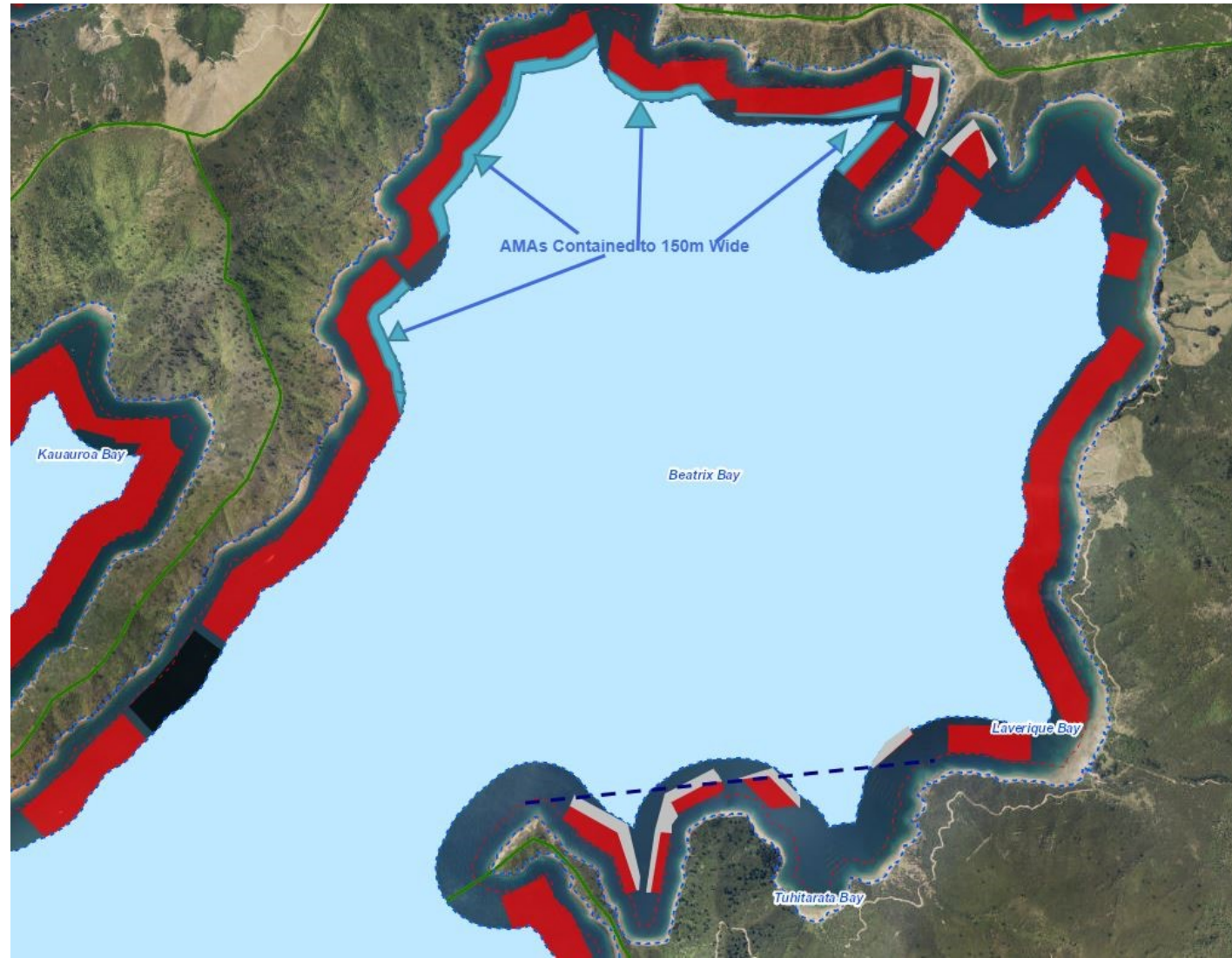
Area of Influence (km):

Diminishig Distance

RUN CALCULATION

Beatrix Bay AMAs as Proposed by Associations

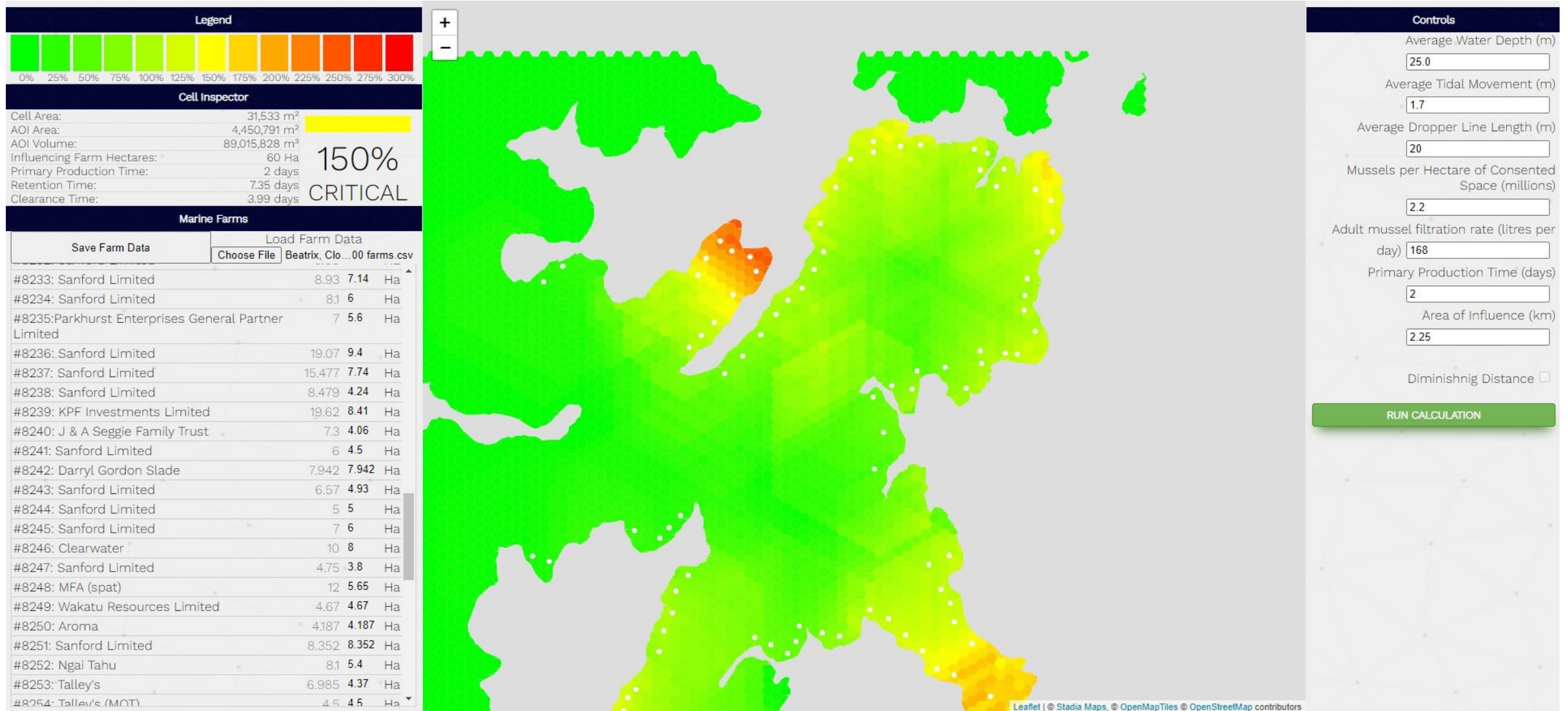
- AMAs 1-5 – As Proposed by V1
- AMAs 6 -10 100-300m Ribbon
- Site 8236 plus AMAs 7 -11 100-250 Ribbon
- AMAs 15 -16 (Excluding Site 8236) 100-300 Ribbon



Aquaculture Stewardship Council Bivalve Pelagic Standard

Beatrix Bay – AMAs As Proposed by Associations

- AMAs 1-5 – As Proposed by V1
- AMAs 6 -10 100-300m Ribbon
- Site 8236 plus AMAs 7 -11 Contained to 100-250 Ribbon
- AMAs 15 -16 (Excluding Site 8236) 100-300 Ribbon



**Kauauroa Bay – Maud Island AMA 13
AMAs As Proposed under V1**



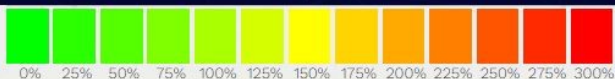
Aquaculture Stewardship Council Bivalve Pelagic Standard

Kauauroa Bay – Maud Island AMA 13

AMAs As Proposed by V1

ASC Standard - Pelagic Effects

Legend



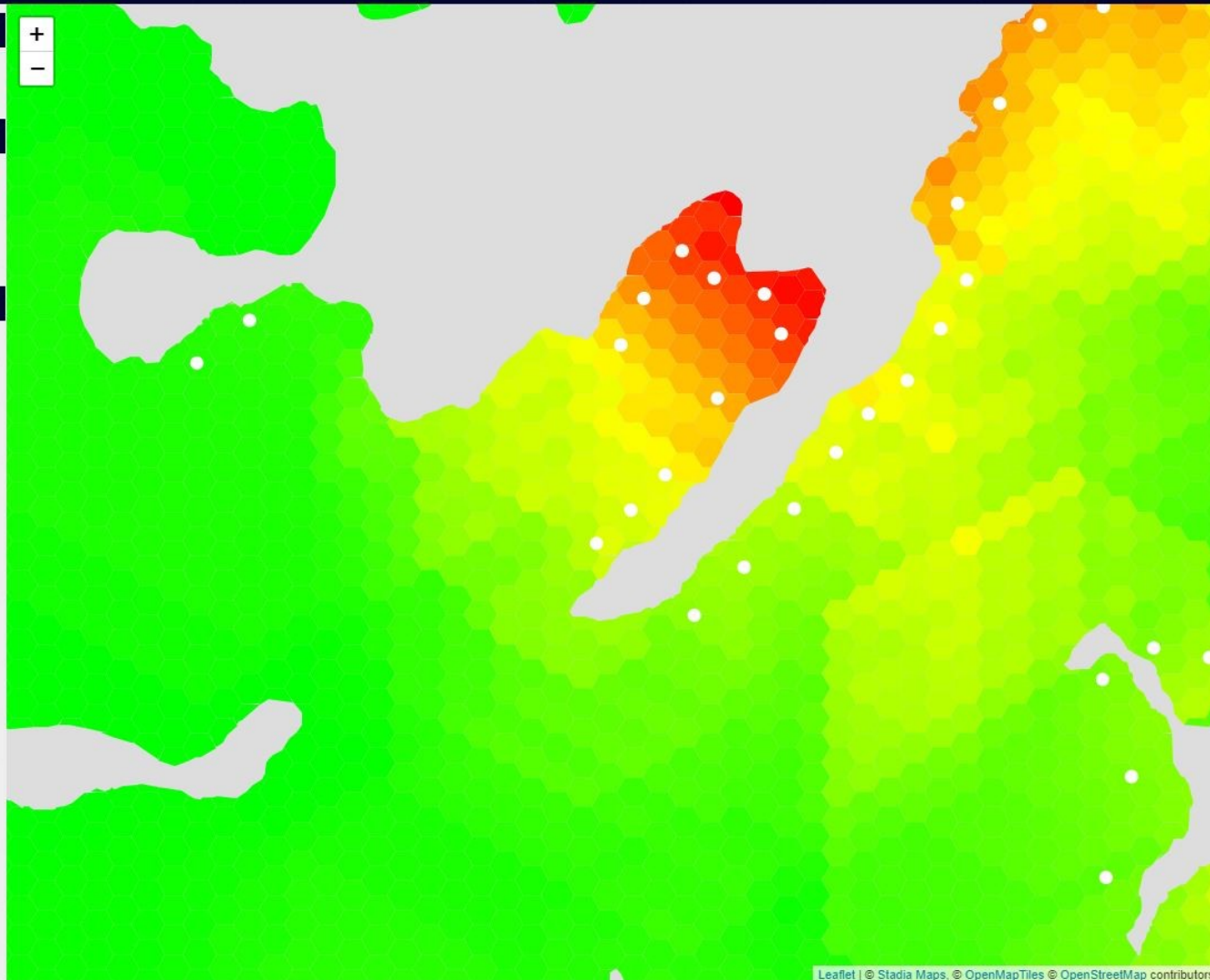
Cell Inspector

Cell Area: 16,840 m²
 AOI Area: 2,440,825 m²
 AOI Volume: 48,816,497 m³
 Influencing Farm Hectares: 66 Ha
 Primary Production Time: 2 days
 Retention Time: 7.35 days
 Clearance Time: 2 days

300%
CRITICAL

Marine Farms

Save Farm Data	Load Farm Data	
	Choose File	No file chosen
#8261: Sanford Limited	2.38	2.38 Ha
#8262: Te Atiawa O Te Waka-A-Maui Limited	7.01	7.01 Ha
#8623: R J Davidson Family Trust & Beleve Limited	2.45	2.45 Ha
#8624: Knight-Somerville Partnership	4.356	4.356 Ha
#8227: Sanford	4.88	4.88 Ha
#8226: Wakatu Resources	5.24	5.24 Ha
#8225: KPF Investments	9.186	9.186 Ha
#8224: Talley's Group	20.68	20.68 Ha
#8223: J & A Seggie	6.097	6.097 Ha
#8222: Sanford	3.6	3.6 Ha
#8221: Sanford	2.3	2.3 Ha
#8220: Sanford	8.98	8.98 Ha
#8219: Sanford	5.28	5.28 Ha
#8218: Sanford	4.76	4.76 Ha
#8353: Sanford	4.705	4.705 Ha
#8352: Sanford	3.145	3.145 Ha
#8351: KPF Investments	3.145	3.145 Ha
#8350: Walker Family	3	3 Ha
#8328: Apex Marine Farm	2.15	2.15 Ha
#8329: Clearwater Mussels	1.8	1.8 Ha
#8217: Kuku Holdings	6.75	6.75 Ha
#8216: Tawhitinui Greenshell	7.6765	7.6765 Ha



Controls

Average Water Depth (m)

25.0

Average Tidal Movement (m)

1.7

Average Dropper Line Length (m)

20

Mussels per Hectare of Consented Space (millions)

2.2

Adult mussel filtration rate (litres per day)

168

Primary Production Time (days)

2

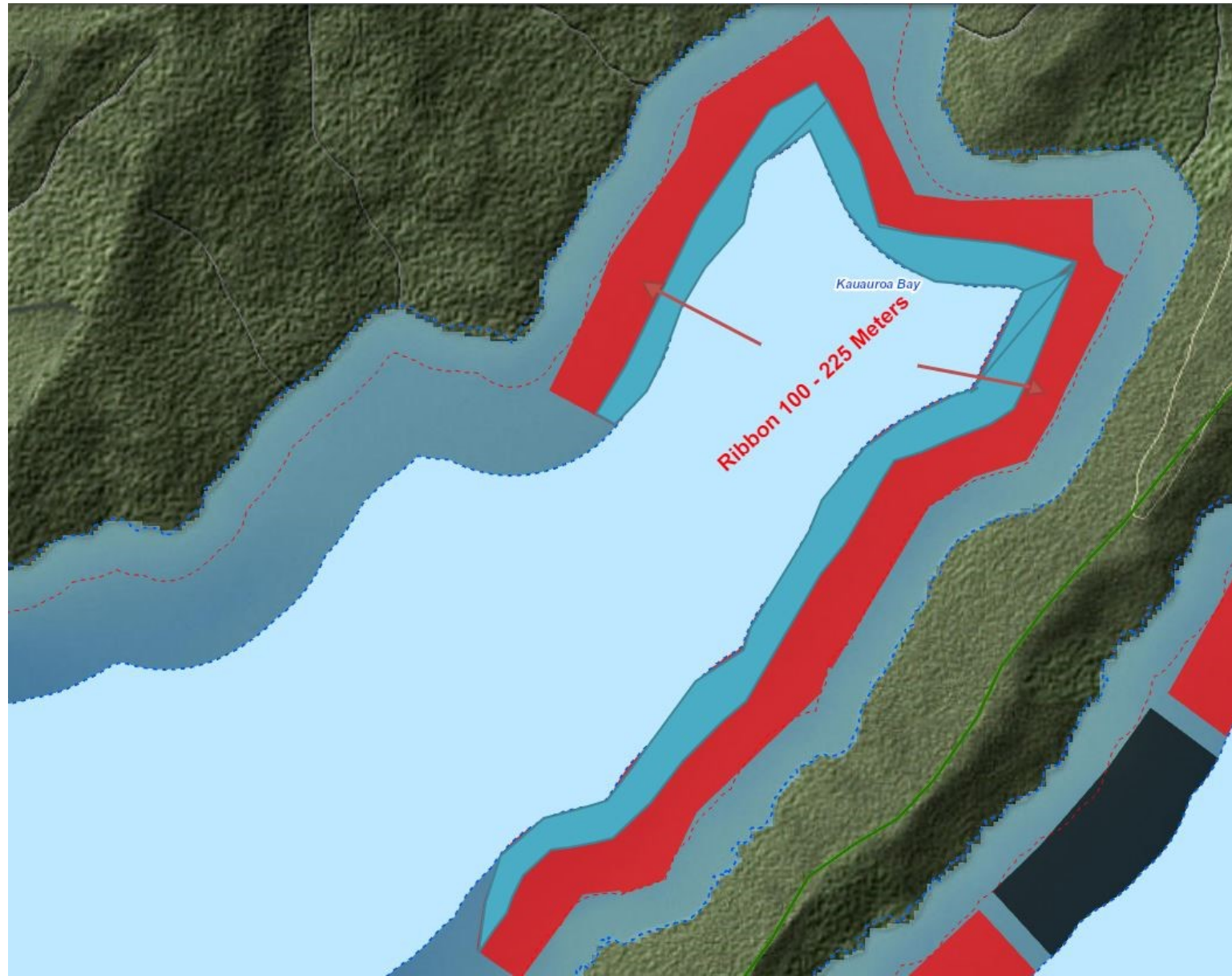
Area of Influence (km)

2.25

Diminishnig Distance

RUN CALCULATION

Kauauroa Bay – Maud Island AMA 13
AMA Ribbon Contained to 100m – 225m as Proposed by Associations



Aquaculture Stewardship Council Bivalve Pelagic Standard

Kauauroa Bay – Maud Island AMA 13

AMA Ribbon Contained to 100m – 225m as Proposed By Associations

Legend

0% 25% 50% 75% 100% 125% 150% 175% 200% 225% 250% 275% 300%

Cell Inspector

Cell Area:	31,536 m ²	<div style="width: 100%; height: 10px; background-color: #00ff00;"></div>
AOI Area:	11,181,172 m ²	
AOI Volume:	223,623,436 m ³	
Influencing Farm Hectares:	0 Ha	
Primary Production Time:	2 days	
Retention Time:	7.35 days	
Clearance Time:	∞ days	

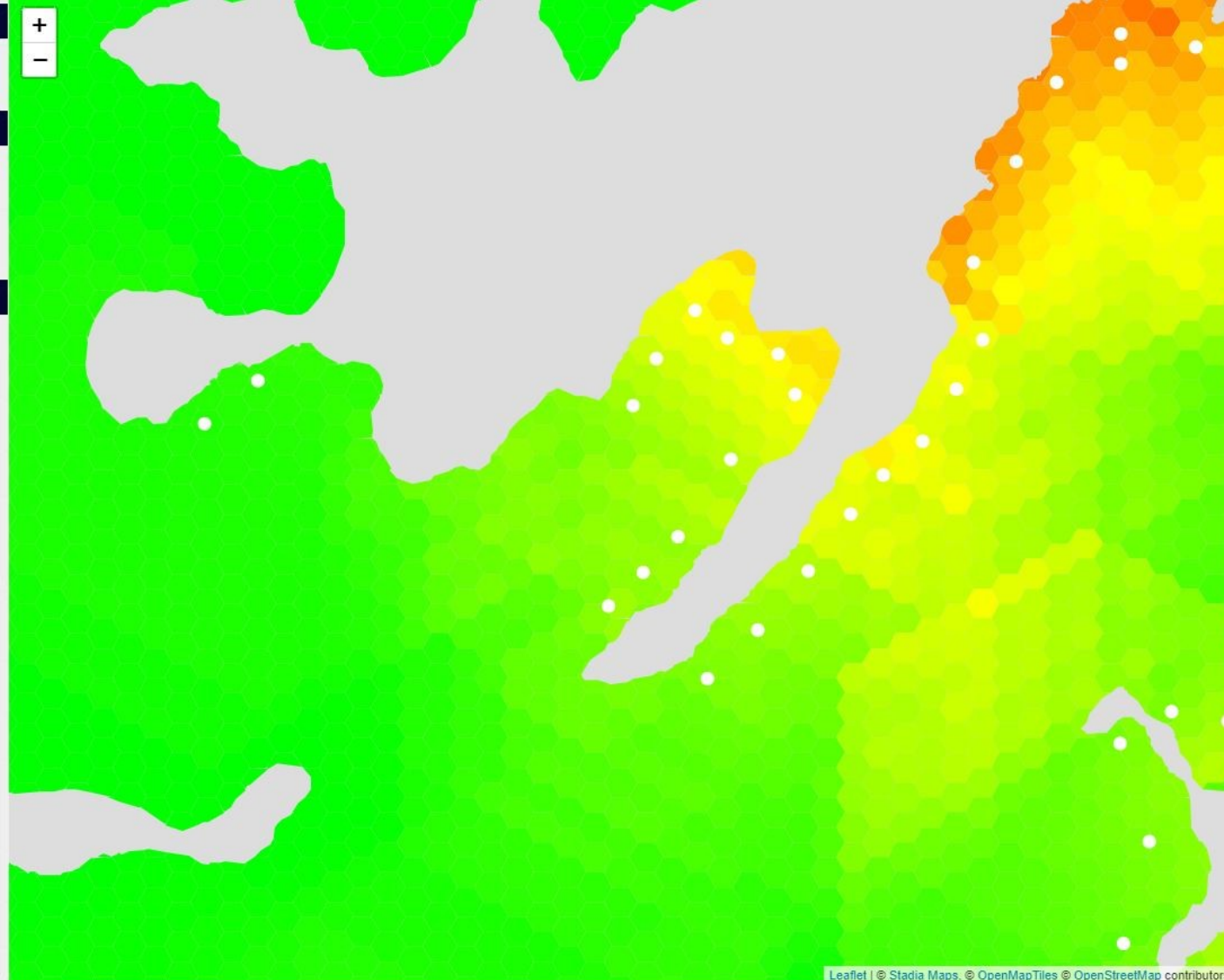
0%

CRITICAL

Marine Farms

Save Farm Data	Load Farm Data	
	Choose File	No file chosen

#8261: Sanford Limited	2.38	2.38	Ha
#8262: Te Atiawa O Te Waka-A-Maui Limited	7.01	7.01	Ha
#8623: R J Davidson Family Trust & Beleve Limited	2.45	2.45	Ha
#8624: Knight-Somerville Partnership	4.356	4.356	Ha
#8227: Sanford	4.88	3.05	Ha
#8226: Wakatu Resources	5.24	2.38	Ha
#8225: KPF Investments	9.186	4.59	Ha
#8224: Talleys Group	20.68	9.57	Ha
#8223: J & A Seggie	6.097	3.31	Ha
#8222: Sanford	3.6	3.6	Ha
#8221: Sanford	2.3	2.3	Ha
#8220: Sanford	8.98	4.49	Ha
#8219: Sanford	5.28	3.67	Ha
#8218: Sanford	4.76	3.31	Ha
#8353: Sanford	4.705	4.705	Ha
#8352: Sanford	3.145	3.145	Ha
#8351: KPF Investments	3.145	3.145	Ha
#8350: Walker Family	3	3	Ha
#8328: Apex Marine Farm	2.15	2.15	Ha
#8329: Clearwater Mussels	1.8	1.8	Ha
#8217: Kuku Holdings	6.75	6.75	Ha
#8216: Tawhitinui Greenshell	7.6765	7.676	Ha



Controls

Average Water Depth (m)

Average Tidal Movement (m)

Average Dropper Line Length (m)

Mussels per Hectare of Consented Space (millions)

Adult mussel filtration rate (litres per day)

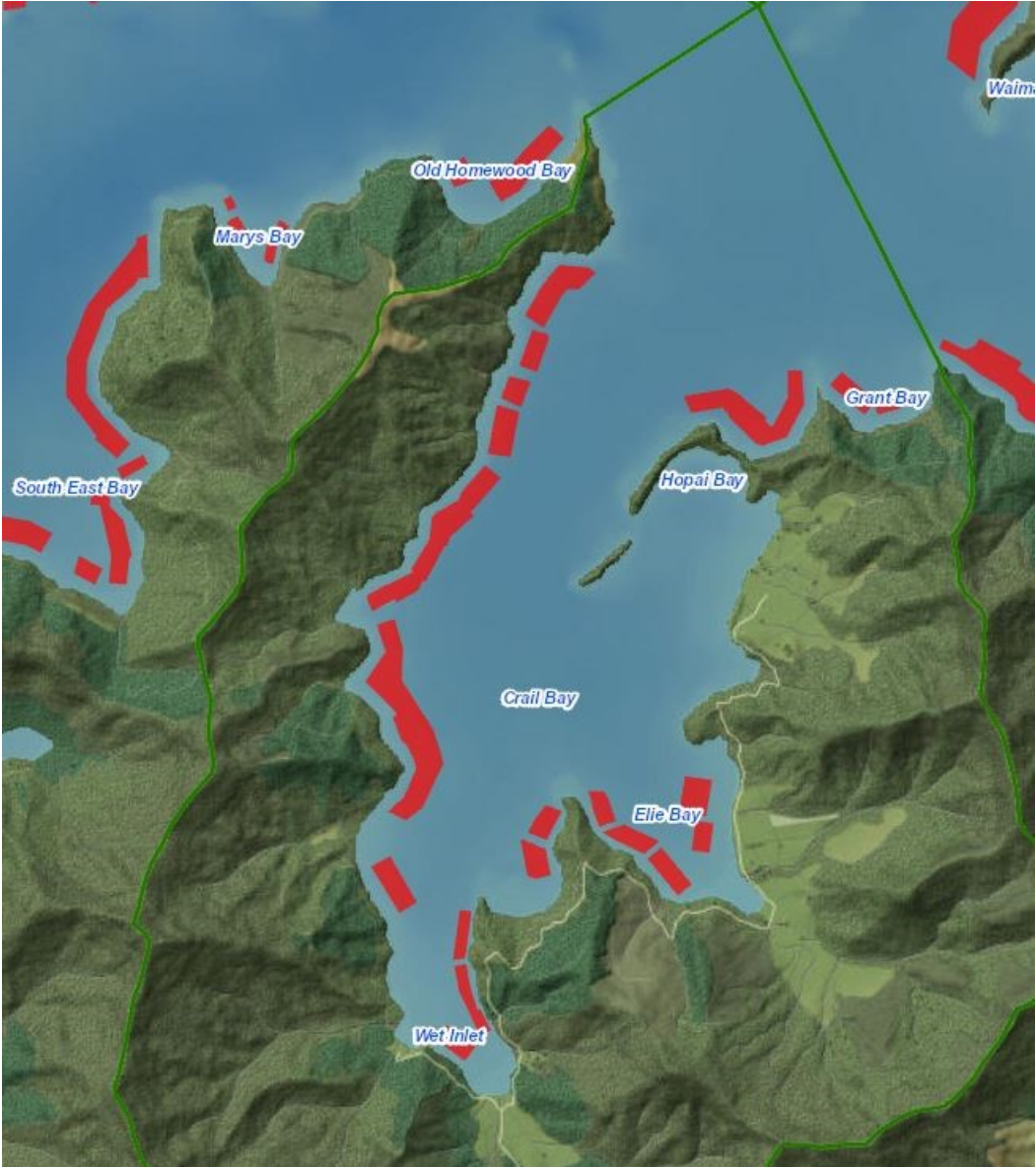
Primary Production Time (days)

Area of Influence (km)

Diminishig Distance

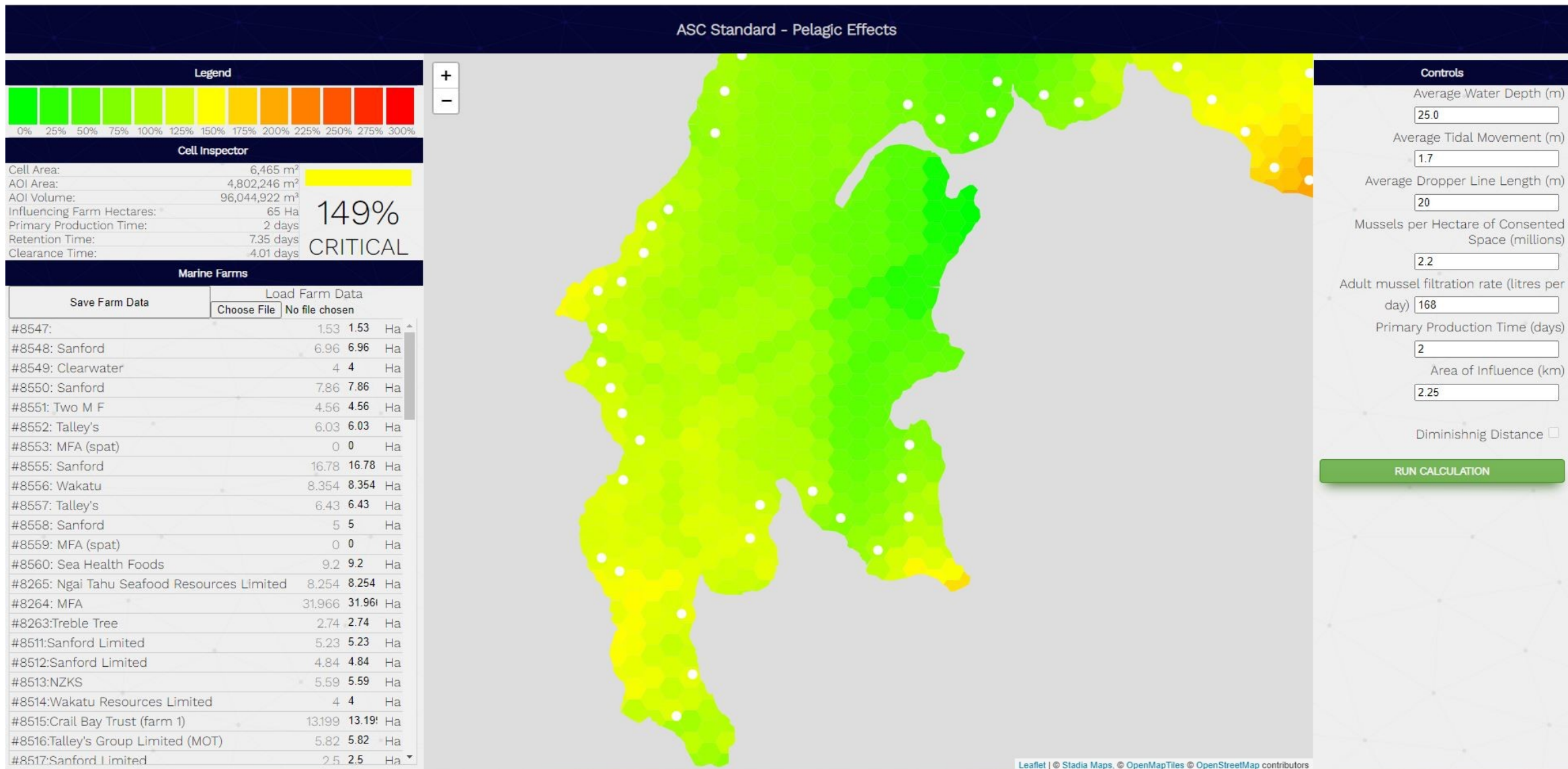
RUN CALCULATION

Crail Bay AMAs Proposed Under V1



Aquaculture Stewardship Council Bivalve Pelagic Standard

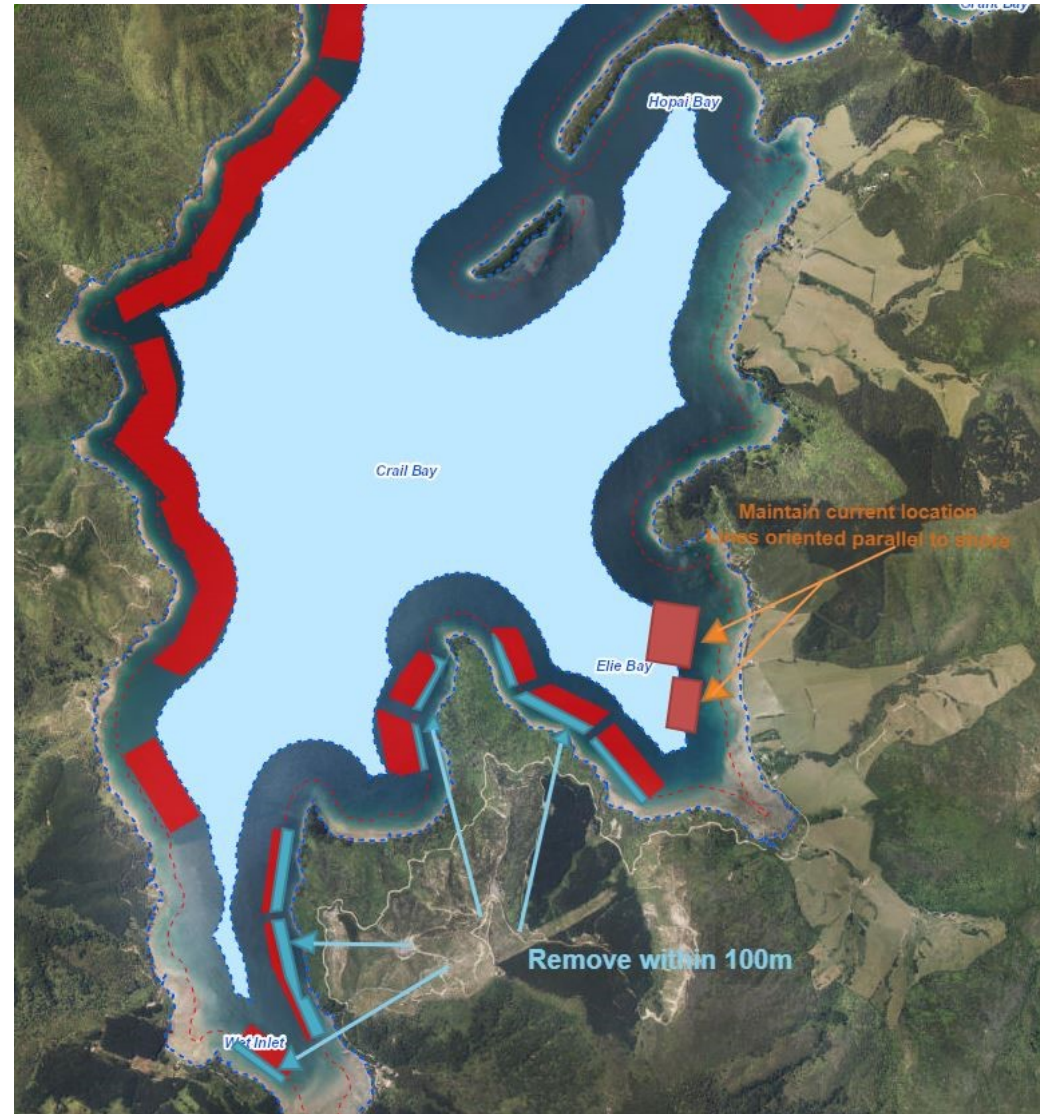
Crail Bay - AMA's As Proposed Under V1



Crail Bay

AMAs as Proposed by Associations – Ribbon Contained to 100m – 300m

- Sites 8537 and 8538 as proposed by V1. Lines required to orient parallel to shore.
- No structures within 100m for Sites 8529, 8530, 8531, 8532-8536

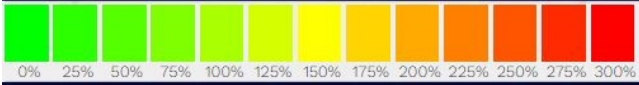


Aquaculture Stewardship Council Bivalve Pelagic Standard

Crail Bay – As Proposed by Associations with Ribbon Contained to 100m – 300m

ASC Standard - Pelagic Effects

Legend



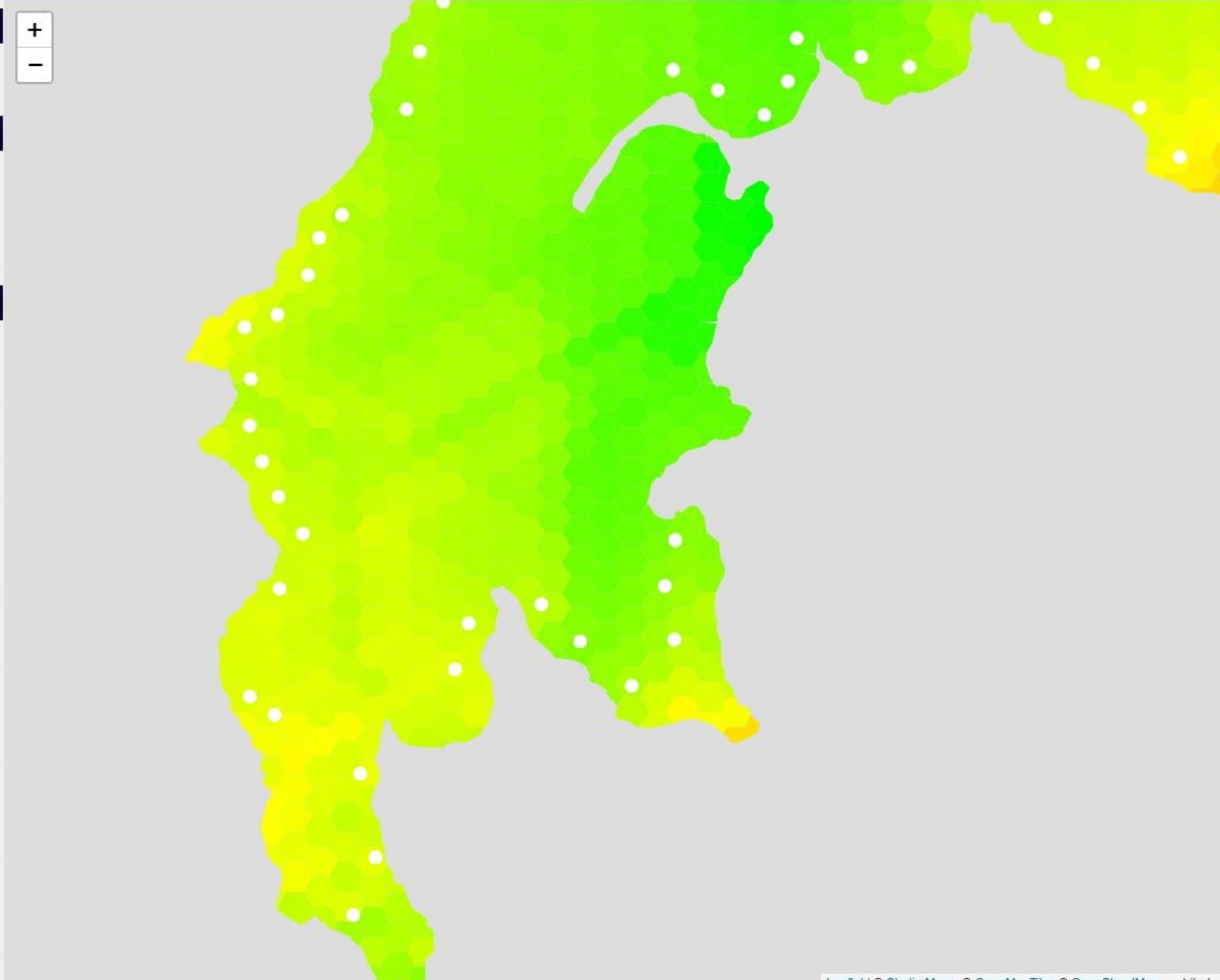
Cell Inspector

Cell Area:	23,259 m ²	<div style="background-color: yellow; width: 20px; height: 10px; margin: 0 auto;"></div> <p style="font-size: 24px; margin: 5px 0;">146%</p> <p style="font-weight: bold; margin: 0;">CRITICAL</p>
AOI Area:	4,909,602 m ²	
AOI Volume:	98,192,046 m ³	
Influencing Farm Hectares:	65 Ha	
Primary Production Time:	2 days	
Retention Time:	7.35 days	
Clearance Time:	41 days	

Marine Farms

Save Farm Data		Load Farm Data	
		Choose File	Beatrix and ...00 farms.csv
#8547:	1.53	1.53	Ha
#8548: Sanford	6.96	6.96	Ha
#8549: Clearwater	4	4	Ha
#8550: Sanford	7.86	7.86	Ha
#8551: Two M F	4.56	3.65	Ha
#8552: Talley's	6.03	6.03	Ha
#8553: MFA (spat)	0	0	Ha
#8555: Sanford	16.78	11.57	Ha
#8556: Wakatu	8.354	6.19	Ha
#8557: Talley's	6.43	5.04	Ha
#8558: Sanford	5	3.57	Ha
#8559: MFA (spat)	0	0	Ha
#8560: Sea Health Foods	9.2	9.2	Ha
#8265: Ngai Tahu Seafood Resources Limited	8.254	5.33	Ha
#8264: MFA	31.966	23.25	Ha
#8263: Treble Tree	2.74	2.19	Ha
#8511: Sanford Limited	5.23	5.23	Ha
#8512: Sanford Limited	4.84	4.84	Ha
#8513: NZKS	5.59	5.59	Ha
#8514: Wakatu Resources Limited	4	4	Ha
#8515: Crail Bay Trust (farm 1)	13.199	13.19	Ha
#8516: Talley's Group Limited (MOT)	5.82	5.82	Ha
#8517: Sanford Limited	2.5	2.5	Ha

+
-



Controls

Average Water Depth (m)

Average Tidal Movement (m)

Average Dropper Line Length (m)

Mussels per Hectare of Consented Space (millions)

Adult mussel filtration rate (litres per day)

Primary Production Time (days)

Area of Influence (km)

Diminishnig Distance

RUN CALCULATION

Aquaculture Stewardship Council Bivalve Pelagic Standard

Model Inputs

Harvest Mussel Filtration Rate

The harvest size mussel filtration rate is based on a filtration rate adopted by NIWA and Cawthron at Table 3-4 on page 108 of their report *Provision of ecological and ecosystem services by mussel farming in the Marlborough Sounds* February 2019 - with reference to this being derived from unpublished NIWA data. This is considered conservative as the rate for that purpose may be an average filtration rate across different age classes, not necessarily that of harvest sized mussels. It is considerably less than the rate of 214 litres per day applied by Ben Knight (Cawthron Institute) when undertaking an ASC calculation for a single farm as expert evidence in *RJ Davidson Family Trust v Marlborough District Council (ENV-2014-CHC-34) (EIC Ben Knight [55] which references: Gibbs MM, Pickmere SE, Woods PH, Payne GW, James MR, Hickman RW, Illingworth J 1992. Nutrient and chlorophyll a variability at six stations associated with mussel farming in Pelorus Sound, 1984–85.*

A rate of 200 litres per hour was considered by NIWA in 2017 where it was found to be reasonable but potentially high.

Mussel filtration rates will range with different environmental factors, such as nutrient quality or quantity. Rates as low as 100 litres per day can be observed in certain environmental conditions. The adopted filtration rate needs to be sufficient to protect the natural ecosystem across different environmental cycles. As such, the higher of a range of filtration rates found across different environmental cycles should be preferred.

Mussels Per Hectare

The number of mussels per hectare is determined from data provided by the Marine Farming Association and Table 3-4 of the NIWA and Cawthron Institute report noted above.

More particularly, proposed Policy 13.22.7 facilitates gaps between backbones of 15m-20m. A typical 3 hectare marine farm will have 110m long backbones and will be 200m wide. A backbone row is around 1.5m wide. As such, a 200m wide consent area will accommodate 12 backbones. That is, 12 x 1.5m wide backbones + 11 x 16m spacing between the lines will extend to 194 meters.

The same table affirms that each 110m backbone will accommodate 3,500 – 4,000 of growing rope and that each meter of growing rope will accommodate 140 mussels. Thus, over 3 hectares a typical mussel farm will facilitate 6,720,000 mussels. This gives 2,240,000 mussels per hectare.

Water Depth and Tidal Movement

Water depths and tidal movement are used to calculate the retention time. Averages from reviews of bathymetric and tidal charts are used in this model run. These inputs are used to calculate Clearance Time under the model. If Clearance Time is faster than Retention Time then the model proceeds to compare Clearance Time to Primary Production Time.

Aquaculture Stewardship Council Bivalve Pelagic Standard

Model and Inputs

Clearance Time

Clearance time is calculated by reference to the volume of water in the relevant area, the daily filtration rate of harvest sized mussels within that relevant area, and the number of adult mussels consented within that relevant area.

Primary Production Time (PPT)

This is the time it takes the system to naturally replenish phytoplankton. The model default is 2 days. This is considered very conservative as the Beatrix Complex is mesotrophic-oligotrophic with some data suggesting that PPT could be as high as 5 days (for example, see *Gibbs MT (2007) Sustainability performance indicators for suspended bivalve aquaculture activities* Ecol Indic 7:94–10).

The ASC standard looks to ensure that filtration of the water body does not occur any quicker than 3 times the time it takes the system to naturally replenish. The model reports 100% of the Standard if the clearance time is equal to 3 x PPT. If clearance time is *less* than 3 x PPT then the model will report a *higher* percentage. So a water body being filtered in (say) 2 days will report as being farmed at 300% of the ASC standard intensity.

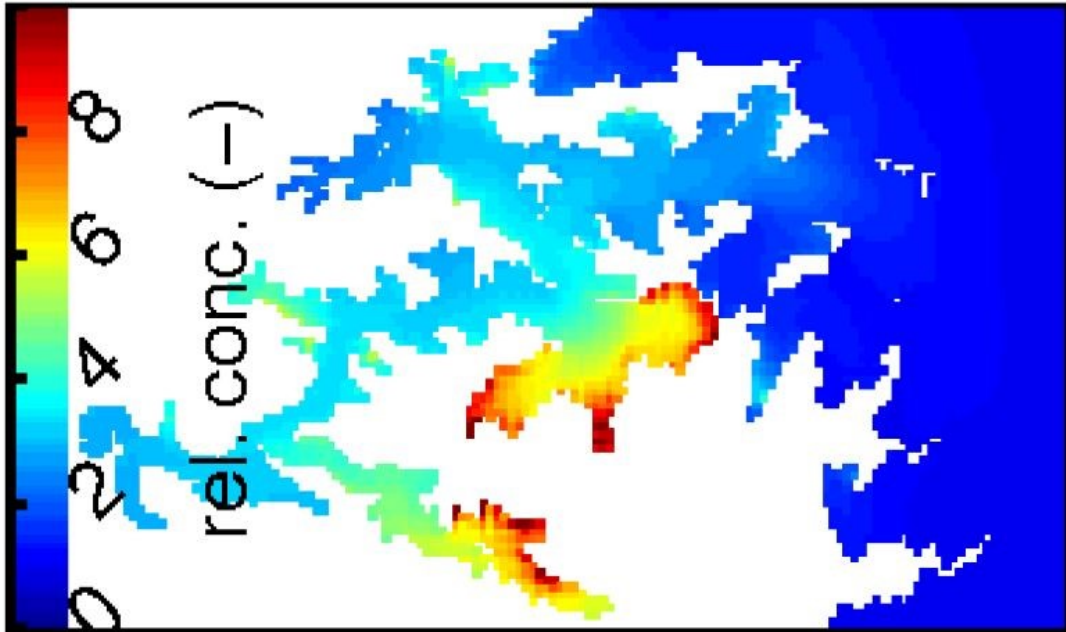
Area of Influence

This is the body of water that is most relevant for the calculations. It should be determined by reference to geographic boundaries and in more complex areas with reference to carrying capacity. The standard anticipates that excess filtration does not occur within any time scale. For this run the model adopts a default radius of 2.25km – which assumes a 24 hour period (two tidal cycles) of water diffusing omnidirectionally at a net rate of 2.5 cm/sec. This is considered conservative. Beatrix Bay flush time is estimated at around 13 days (refer *Gibbs* above), which equates to a diffusion rate of around 0.5 cm/second and water will not diffuse omnidirectionally. Adopting a smaller time scale/area of influence produces worse results in areas that are geographically contained, such as Clova Bay and Kauauroa Bay.

Comparison of Outputs

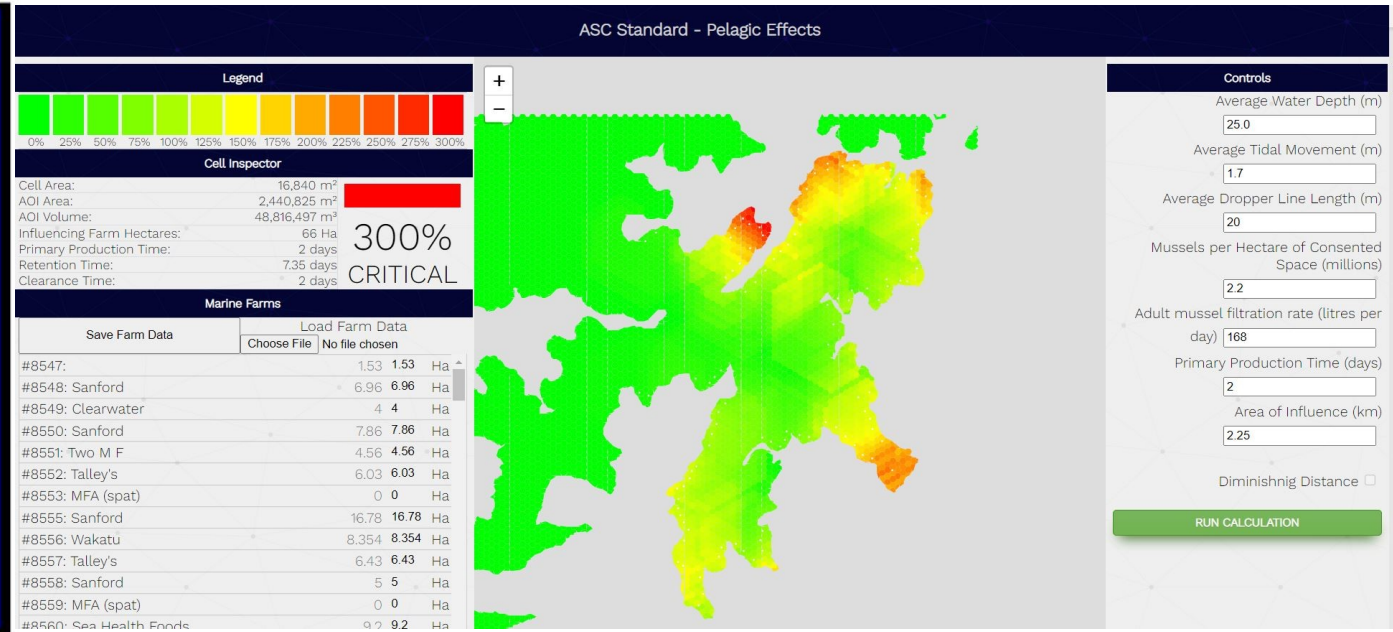
NIWA Biophysical Model and Aquaculture Stewardship Council Bivalve Model

Beatrix Complex



NIWA Biophysical Model 2015

Central Panel, Figure 5-14: Comparison of summer time-averaged surface-layer concentrations in the EM-EF-WD and NM-EF-WD scenarios. This panel illustrates the time-averaged relative concentration (alternative scenario relative to reference). Red indicates that zooplankton level without existing mussel farms would be at a level ten times greater than it is with them. This was based on mussel farms as at 2012.



Aquaculture Stewardship Council (ASC) Bivalve Standard – Pelagic Effects
Current Aquaculture – Beatrix Complex

Red indicates activity that is 3 times (300%) over the ASC standard