Aquenal Pty Ltd
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To Whom it May Concern,

Thank you for the opportunity to provide feedback on the Consultation Draft of the Environmental Standards for Tasmanian Marine Finfish Farming 2023.

Aquenal is a marine consultancy based in Tasmania who has worked closely with the Tasmanian Marine Finfish Farming Industry for several decades. During this time Aquenal has been – and continues to be - responsible for a wide range of monitoring and marine survey work associated with the current Environmental Licences. For example, we have carried out numerous Baseline Environmental Assessments and we lead the the Tasman, Huon/Channel and Mercury Passage Broadscale Environmental Monitoring Programs. Given this experience, we are well placed to comment on aspects of the Environmental Standards Consultation Draft.

We note that our knowledge and experience lend themselves to detailed comments on the technical standards that are in development. We look forward to contributing to those documents in due course.

We have limited submission to those aspects of the Environmental Standards in which we have direct experience and expertise (e.g. assessments and monitoring of the water column, soft sediment, rocky reefs and seagrass). We do not comment on aspects of therapeutant management, wastewater management, light attenuation management or noise considerations.

We have itemised our general and specific comments below and hope that our feedback is constructive and helps to improve the environmental standards.

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(1) General Comments

Aquenal supports the initiative to bring together the previously disparate set of environmental management requirements into one Environmental Standards framework. This process should promote a greater degree of consistency across the regulatory provisions for Marine Finfish Farming. The Environmental Standards are an important step toward ironing out the differences in environmental management requirements between regions and leases across the state.

The Draft Environmental Standards step through the logic of environmental management requirements in a way that has not been articulated clearly before. Aquenal views this as a welcome development in environmental management in Tasmania.

Interpreting the Environmental Standards would have been easier if the material in the Explanatory Paper was integrated into the Environmental Standards document. For example, we noted some inconsistencies between the Explanatory Paper and the Standards document (i.e. dispersal zone terminology) and a map of the different zones is pivotal to the Environmental Standards and would be better placed in the Standards document.

Whilst we acknowledge the role of the Environmental Standard as an overarching document, it is difficult to provide thorough assessment without accompanying Technical Standards. Some of the concepts and ideas articulated in the Environmental Standards can only be understood properly with the technical detail that will be provided in subsequent Technical Standards. We note that this staged approach also delays the completion and application of the Environmental Standards.

(2) Purpose and application of management zones

The clear articulation of management zones (farm, depositional, dispersal, regional) is an important development in the regulatory framework and aligns with management approaches in other marine farming regions around the world. They are a key organising principal for the application of compliance points and monitoring site locations which has been lacking in previous regulatory frameworks.

However, we have several concerns surrounding the purpose and application of proposed zones as they relate to the regulatory framework, in particular the dispersal and regional zones.

2.1. Lack of clarity surrounding dispersal zone purpose.

In the explanatory paper and in the glossary of the Environmental Standard, the Dispersal zone is defined as "….*the area that extends 100 metres from the outer boundary of the Depositional Zone for that lease, or a distance otherwise specified by the Director, within which environmental responses from dissolved nutrients discharged from within the Farm Zone are likely to be measurable*".

On page 13 of the draft Environmental Standard (Division 4 Seabed), there is wording "…..*standards related to the dispersal zone are intended to ensure that particulate wastes do not significantly impact the health and biodiversity of the benthic ecosystem within the dispersal zone and that the environmental effects from dissolved nutrients discharged from within the Farm Zone remain within established benchmarks"*.

Reference to particulate waste and benthic effects within the dispersal zone on page 13 is confusing. The sediment compliance points are on the depositional zone boundary (35 m), rather than within the 'dispersal zone'.

For clarity, Aquenal recommends that it would be better to restrict the narrative to depositional impacts within the farm and depositional zone and dissolved nutrient related impacts within the dispersal zone. For example, "*…..depositional impacts should not extend beyond the farm and depositional zone*", rather than "*……..depositional impacts should not be evident in the dispersal zone*".

2.2. Justification for size and definitions for dispersal and regional zones.

According to the explanatory paper, the definition of the dispersal zone is "….*the area that extends 100 meters from the outer boundary of the depositional zone for that lease, or a distance otherwise specified by the Director*……" (pp. 6). Current literature regarding the diminishing effect of marine farms with distance from cages, does not appear to cite 100 m as an applicable distance. Aquenal suggests that a default 100 m distance is too small, based on current understanding of dissolved nutrient footprints arising from finfish aquaculture leases. Aquenal's experience indicates that a compliance water quality site on the edge of a 100 m dispersal zone may regularly exceed water quality benchmarks for typical marine farm leases. This may not be useful from a regulatory perspective.

The regional zone is an important management zone in the draft Environmental Standard. There are significant implications for monitoring requirements depending on the regional zone size. It is unclear in the Environmental Standard how the regional zone will be determined. It is important the regional zone determination is backed by robust science.

Aquenal recommend that a default distance in the realm of 500 m would be more realistic for the dispersal zone. We note that (a) 'near scale' monitoring sites within the Storm Bay BEMP are defined as <500 m from a lease; and (b) 'near scale' sites in Mercury Passage are located 700 m (M7) and 800 m (M2) from the lease. Better still, scientifically robust hydrodynamic/nutrient dispersion models could be employed to provide estimates of the dispersal zone.

2.3 Compliance zone terminology.

We recommend that a different term for the water quality 'compliance' site should be considered in some cases. In some scenarios in the Draft Environmental Standards, an exceedance of water quality indicator values at this site is not a 'non-compliance' but rather triggers 'further investigation'. We believe this is confusing for the public and a more suitable terminology would help.

(3) Water Column and Soft Sediment Monitoring

Aquenal are supportive of the provisions in the Environmental Standards relating to the monitoring of (a) the water column and (b) soft sediments. For these components of the system, the Environmental Standards appear to closely mirror the current Environmental Licences, which – in our opinion – are working relatively well because they are based on considerable applied research over several decades and have well developed protocols relating to their assessment and monitoring.

(4) Rocky Reefs and Seagrass

Rocky reefs and seagrass are important components of the marine ecosystem in Tasmania. Their biodiversity values are well established and there is considerable public interest in the health and resilience of these communities.

Aquenal understand the motivation for inclusion of these two ecosystems in the Environmental Standards for Marine Finfish Farming. However, Aquenal would like to raise a series of issues related to inclusion of seagrass and reef monitoring in the draft Environmental Standards.

4.1. Seagrass ecosystems are understudied and require further research.

There is a long and strong history of the study of rocky reefs in Tasmania, which has recently been reviewed by Hurd et al. (2022). This includes a suite of recent applied research into reef ecosystems in the vicinity of marine farms (e.g. Oh et al. 2015; Valentine et al. 2016; White et al. 2021; White et al. 2022). There are well defined protocols for their measurement (Edgar and Barret; Reef Life Survey; White et al 2022). This research provides an excellent foundation from which to monitor and measure reefs, detect changes in cover and condition, and interpret results against our understanding of the complexity and variability of Tasmanian reef ecosystems.

By contrast, seagrass ecosystems and their dynamics are understudied in Tasmania. The recent review of seagrass dynamics in temperate Australia by Connolly et al. (2018) includes research on seagrass beds from NSW, WA, Victoria and Queensland, but does not cite research from Tasmania. Since the unpublished thesis of Rees (1993) there have been few detailed ecological studies of seagrass beds, with seagrass research instead focussing on broad scale changes from remote sensing (Mount and Otera 2011), once-off mapping of seagrass beds (SeaMap 2007), broad scale monitoring programs (Aquenal 2022; IMAS 2021) and applied research in relation to marine farms (Crawford 2006). Of the most recent studies, only Crawford et al. (2006) attempts to elucidate the ecological drivers of changes in seagrass beds. All studies in Tasmania - and indeed elsewhere in temperate Australia (Connolly et al. 2018) - highlight the complexity of seagrass beds and the paucity of knowledge about the environmental drivers of their dynamics.

It is recommended that a literature review of seagrass is conducted to identify the extent of knowledge about the ecology of seagrass in temperature Australia (and Tasmania in particular) and its appropriateness as an indicator for the effects of marine finfish farming (e.g. Crawford et al. 2006). Knowledge gaps about seagrass ecology and monitoring methods should be identified in this review along with potential applied research approaches. Prescriptions in the Environmental Standards relating to seagrass may need to be deferred until a more detailed understanding of seagrass dynamics and their drivers is established.

4.2 Attribution of observed change to marine finfish farms in complex, dynamic ecosystems.

The Environmental Standards stipulate biodiversity assessments that essentially aim to (a) detect change in the cover and condition of seagrass and reefs; (b) assess if change is significant by comparing changes at reference sites; and (c) use this information to make inferences about the relative impact of marine fish farms on these changes.

Aquenal is relatively optimistic that it is possible to detect change in the cover and condition of seagrass and reefs (i.e. (a), albeit with some technical issues and some uncertainty, particularly for seagrass) but has significant misgivings about the attribution step (i.e. (b) and (c)). The challenge of the attribution step is to partition out changes related to marine finfish farming and changes related to a suite of other natural and anthropogenic factors. Partitioning out changes is exceptionally difficult in variable and complex systems with high background rates of change. Aquenal believe that many of these characteristics apply to seagrass and reef ecosystems in Tasmania. We provide some background below.

Studies of temperate seagrass ecosystems outside of Tasmania (reviewed by Connolly et al. 2018) show that seagrass beds are highly dynamic. Tasmanian seagrass beds have also been shown to be highly dynamic at decadal and annual scales. Across Tasmania, Rees (1993) suggested that seagrass beds have declined by 25% between 1950's and the 1990's. The Storm Bay BEMP (IMAS 2021) has documented significant changes in seagrass beds between 2007 and 2018 including (a) significant expansion offshore at Bull Bay and Adventure Bay; and (b) complete replacement of seagrass beds by macroalgae at Wedge Bay. In Mercury Passage, there has been decreases, increases or fluctuations in seagrass cover between 2018 and 2021 (Aquenal and Marine Solutions 2021). In Northwest Bay, there was a long-term decline, characterised by frequent short-term irregular fluctuations in seagrass distributions between 1948 and 2009 (Mount and Otera 2011).

Authors of this body of seagrass research note the complexity in attributing these changes in seagrass beds to ecological drivers such as nutrient availability, temperature, salinity, light availability and seasonality of algal reproduction (Crawford, 2006; see also Section 4.1). For example, Crawford et al. (2006, pp. 106) note that *"it is often difficult to definitively assess the impacts of increased nutrients on seagrass habitats due to the relatively frequent natural variations of these habitats, the lack of historical monitoring data, the lack of suitable controls for comparison; and a poor understanding of the fate and fluxes of nutrients in the system."*

Rocky reef research highlights the variability and complexity of reef ecosystems along gradients of exposure and depth (Edgar 1984; White et al. 2022, Hurd et al. 2023) and has documented changes in reefs over time (e.g. Valentine et al. 2016; White et al. 2021; Sonder et al. 2022). For example, Soler et al. (2022) recently showed that macroalgal cover across 94 repeat measured sites in Tasmania decreased by -14% between 1990 and 2017 and -20% in the last decade. None of the explanatory covariates (temperature, exposure, herbivory) explained this decline and the authors attributed the change to the Southern Oscillation Index and associated shifts in oceanography (Soler et al. 2022). This example highlights the challenges in for attributing change to key drivers in the natural environment.

Aquenal believe that it may be unrealistic to partition out the significance of potentially subtle shifts in habitat extent, cover and composition at impact sites (particularly in the regional zone; see section 4.3) against a background of complex, variable and rapidly changing seagrass and reefs at reference sites. We echo the conclusions of Crawford et al. (2006, pp. 206), in their assessment of seagrass as a monitoring tool for marine finfish farms (which also applies to rocky reefs): that *"…….the varying extent of natural variation in seagrass distribution and abundance means that it is difficult to separate the indirect human induced impacts (ie high nutrients and turbidity) from these natural fluctuations*".

Aquenal recommends that the challenges in the attribution of observed changes in reef and seagrass habitats to marine farming activities are taken into account when generating compliance measures within the Environmental Standard. We recommend that the Technical Standards include a clear and scientifically robust analytical framework for attributing *'significant change' to marine farming activities over-and-above those attributable to natural variability.*

4.3. Seagrass and reef compliance sites should be in the dispersal zone, not the regional zone.

The inclusion of rocky reef and seagrass compliance sites in the regional zone is not considered logical from a regulatory perspective (see Figure 2 of explanatory paper; see also pp. 15 of Environmental Standards). The regional zone extends outwards from the outer boundary of the dispersal zone and includes the area where the environmental responses from dissolved nutrients discharged from the Farm Zone are *unlikely to be measurable*. As such, the amount of change in reef and seagrass ecosystems *attributable* to almost unmeasurable concentrations of dissolved nutrients from marine farms at sites >500m away in the regional zone is likely to be extremely low, particularly in comparison to the myriad natural and anthropogenic factors influencing change in reef and seagrass ecosystems. This is discussed further below (Section 4).

We recommend only considering compliance monitoring (e.g. impact site vs reference site) of reef and seagrass habitats when they occur within the dispersal zone of leases (modelled, or ~500m as discussed above) where nutrients discharged from the Farm Zone are likely to be measurable.

In the absence of seagrass and reef habitat in the dispersal zone, seagrass and reef monitoring may still be appropriate in the regional zone. However, monitoring sites in the regional zone would be better suited to a 'sentinel site' approach, rather than impact site vs reference site model (see Section 4.4).

4.4 Locating suitable reference sites

In scenarios where reef or seagrass sites are within the dispersal zone, Aquenal is supportive of the impact site vs reference site model for compliance (see section 4.3). However, we caution that that locating a suitable suite of reference seagrass and reef monitoring sites will be challenging in environments where their distribution is patchy and their variability is large.

Comparisons between impact sites and reference sites are made under the assumption that the reference sites have the same environmental conditions as the test site (e.g. matched for depth, exposure, rock type, aspect, proximity to river systems, nutrient availability, light, herbivory, predation, other biological interactions). A robust statistical design, capable of making inferences about cause and effect in reef and seagrass ecosystems will likely require multiple (>3) reference sites. Any environmental differences between reference and impact sites will reduce the ability to robustly attribute the possible effect of marine finfish farms.

It is Aquenal's view that given the complexity and variability of seagrass and reef ecosystems in Tasmania (see section 4.2), it may not be possible to establish an adequate number of well-matched reefs and seagrass beds in the regional zone to complement impact sites in the dispersal zone. This will have an impact on the level of inference the regulator can make on the relative effects of marine finfish farms.

Aquenal recommends that any similarities and differences between test sites and reference sites should be thoroughly documented and explicitly acknowledged when assessing 'significant impacts' (i.e. "no significant impact on the health of rocky reef and seagrass ecosystems………when compared to reference values at reference sites in relation to the lease" (Env. Standards, pp. 15).

Aquenal also recommends the early engagement of a '……scientific panel to provide advice to support the Directors determination of reference values' (Env. Standards, pp. 8).

4.5. Regional zone broad-scale 'sentinel' monitoring: an alternative to the impact-reference site design.

If there are no reef and seagrass sites in the dispersal zone (see section 4.3) and sites are only measured in the regional zone (as stipulated in the draft Environmental Standards), *then Aquenal suggests that this model may be more suited to so-called 'Sentinel Site' monitoring of broad scale changes of seagrass and reef habitats across the entire region, rather than the prescribed impact-reference site design.* From our understanding, this is the current scenario for Storm Bay.

The sentinel site model is related to the design philosophy underpinning the broadscale water column and sediment monitoring in the Huon/Channel BEMP, which has no compliance sites nor consideration of distances to particular leases, but rather measures broad changes across regions and sub-regions. It follows that observed changes at broad-scale seagrass and reef sites would not be relatable to a specific lease. Instead, observed changes would be related collectively to the suite of leases in a region or sub-region and management responses would be organised accordingly (perhaps through changes to the TPDNO).

Ideally, these sites would form a subset of a state-wide monitoring program spanning multiple regions (e.g. Reef Life Survey; https://reeflifesurvey.com/; Sonder et al. 2023), including those without fish farms. Comparing changes of sentinel sites in regions with marine finfish farms, with regions without finfish farms would provide some inference as to whether broadscale changes are attributable to finfish farming. We acknowledge that this may be outside the scope of the Environmental Standards and would be an expensive and resource intensive approach. A shared funding model for such a monitoring program appears sensible, including contributions not only by the aquaculture industry but also from other industries, along with non-government and government organisations.

4.6. Requirements for recovery in the absence of well-established guidelines.

If a significant impact on the health of rocky reef and seagrass ecosystems is measured in the regional zone, the Environmental Standards stipulate the licence holder to "*achieve appropriate rocky reef or seagrass recovery" (Env. Standards, pp. 15).*

Aquenal is not aware of well-established guidelines for the recovery of reef and seagrass ecosystems in Tasmania. We are aware of some attempts to recover *Macrocystis pyrifera* kelp forests on the East Coast (Layton and Johnson 2021), but this project is in its infancy. In the absence of demonstrated recovery projects, it is difficult to envisage how licence holders would achieve this directive.

(5) References

Aquenal (2022) MF236 Okehampton Bay Annual Seagrass monitoring Report 2021, July 2022, Report to Tassal Group Limited, 24pp.

Connolly, R.M., Jackson, E., Macreadie, P., Maxwell, P., O'Brien, K. (2018) Seagrass Dynamics and Resilience. Chapter 7, in Seagrasses of Australia: Structure, Ecology and Conservation. Edited by Larkum, W.D., Kendrick, G.A., Ralph, P.J. Springer, 2018.

Crawford, C., Thompson, P., Jordan, A., Foster, S., Mitchell, I., Bonham, P. and Willcox, S. (2006). Development of broad scale environmental monitoring and baseline surveys in relation to sustainable salmon aquaculture in the D'Entrecasteaux Channel region. Aquafin CRC Project 4.4., Aquafin Cooperative Research Centre, Fisheries Research and Development Corporation, Commonwealth Scientific and Industrial Research Organisation. Tasmanian Aquaculture and Fisheries Institute, University of Tasmania.

Edgar, GJ (1984) General features of the ecology and biogeography of Tasmanian subtidal rocky shore communities, Papers and Proceedings of the Royal Society of Tasmania, vol. 118, pp. 173-186.

Hurd, Catriona L., Jeffrey T. Wright, Cayne Layton, Elisabeth MA Strain, Damon Britton, Wouter Visch, Neville Barrett et al. "From Tasmania to the world: long and strong traditions in seaweed use, research, and development." *Botanica Marina* 66, no. 1 (2023): 1-36.

IMAS (2021) Annual Broadscale Environmental Monitoring Program 2020/2021 for Environmental License 10180/1 Marine Farming Lease No. 281 at Yellow Bluff 2020/2021 & Environmental License 10211/1 Marine Farming Lease No. 279 at West of Wedge Island, Report to Huon Aquaculture Company Pty Ltd & Tassal Operations Pty Ltd.

Layton C & Johnson CR (2021). Assessing the feasibility of restoring giant kelp forests in Tasmania. Report to the National Environmental Science Program, Marine Biodiversity Hub. Institute for Marine and Antarctic Studies, University of Tasmania.

Mount, R., Otera, K. The status of seagrass extent in North West Bay. A technical repot for the Kingborough Council by the Blue Wren Group, School of Geography and Environmental Studies, UTAS, Hobart, Tasmania.

Oh, E.S., Edgar, G.J., Kirkpatrick, J.B., Stuart-Smith, R.D. and Barrett, N.S., 2015. Broad-scale impacts of salmon farms on temperate macroalgal assemblages on rocky reefs. *Marine Pollution Bulletin*, *98*(1-2), pp.201-209.

Rees, C. G. (1994). *Tasmanian seagrass communities* (Doctoral dissertation, University of Tasmania).

Soler GA, Edgar GJ, Barrett NS, Stuart-Smith RD, Oh E, Cooper A, Ridgway KR, Ling SD. 2022 Warming signals in temperate reef communities following more than a decade of ecological stability. Proc. R. Soc. B 289: 0221649.

Valentine, J.P., Jensen, M., Ross, D.J., Riley, S., Ibbott, S., Organisation, 2016, Understanding broad scale impacts of salmonid farming on rocky reef communities, Hobart, September, 2016.]

White, C., McAllister, J., Johnson, O., Mundy, C., Ross, J. (2021) Assessment of reef condition in the southern D'Entrecasteaux Channel. Institute for Marine and Antarctic Studies, University of Tasmania

White, C., Hartog, M., Brasier, M., Ross., J. (2022) Rapid visual assessment of rocky reef assemblages in Port Arthur. Institute for Marine and Antarctic Studies, University of Tasmania