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Dear Senator Urquhart,

Please find attached a submission from Aquenal Pty Ltd to the Senate Standing Committee on Environment and Communications inquiry into the regulation of the finfish aquaculture industry in Tasmania.

Established in 1996, Aquenal was originally formed to meet the needs of an expanding marine farming industry in Tasmania. Today, Aquenal comprises a team of marine environmental practitioners specialising in the assessment of marine, estuarine and coastal environments.

Our primary applications include:

- Environmental baseline surveys (field surveys of biological communities and their habitats)
- Environmental risk and impact assessments
- Marine natural values assessments
- Marine biodiversity analysis (including threatened species assessments)
- Invasive marine pest surveys and management plans.

The types of environments we have assessed range from coastal, offshore and near-shore marine and estuarine habitats throughout Australia, on small and large projects. Our clients include large companies (I.e. BHP Billiton) to State and Commonwealth Government Agencies, Local Governments, Industry Associations (i.e. Tasmanian Salmon Growers Association), private companies in Tasmania (i.e. shellfish and finfish aquaculture companies), research institutions (i.e. IMAS, CSIRO and AAD) and ENGOs (i.e. WWF and Environment Tasmania).

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Aquenal has also undertaken significant environmental impact assessment work and monitoring for 2 Tasmanian Projects of State Significance – the Lauderdale Quay Development (Walker Corporation 2010) and the proposed Pulp Mill Development at Bell Bay (Gunns Limited 2002-2009).

Aquenal's experience in marine environmental assessments also extends to the mainland. Between 2009 and 2011, Aquenal lead a significant marine environmental monitoring program in Western Australia as part of the Gorgon Project. Aquenal was contracted by DOF Subsea Australasia to undertake these works on behalf of Chevron Australia. This project involved a significant field component where the company was required to supervise approximately 25 scientists from a range of other scientific consulting firms (e.g. Oceanica and MScience), Universities (University of WA and Murdoch University), and museums (Australian Museum and Museum of Tropical Queensland) on multiple ecological surveys off the Pilbara coast.

Aquenal Pty Ltd is listed on the Tasmanian Environment Protection Authority (EPA) Consultants Register, and is independently certified by SAI Global to meet the requirements of AS/NZ ISO 9001:2008 Quality Management Systems (Quality Certificate No. QEC26995) – and this forms the basis for our quality planning systems, monitoring and evaluation of the services we provide to our clients. Our business processes and systems are externally audited annually.

One of Aquenal's specialist fields lies in marine taxonomy – we house a comprehensive database of marine organisms recorded around Tasmania and on the mainland (solely collected from Aquenal surveys and monitoring), and our marine reference collection of invertebrates and fishes exceeds 3 000 specimens.

This submission has been prepared on the basis that Aquenal has an extensive background in undertaking a significant number of environmental baseline surveys and monitoring programs for each of the major finfish aquaculture companies in Tasmania over the last nineteen years. Aquenal has a strong background in undertaking environmental baseline surveys and follow-up monitoring in Macquarie Harbour from 1999 to 2010. In March 2009, Aquenal was contracted by the Tasmanian Salmon Growers Association to undertake the field sampling component of the Broadscale Environmental Monitoring Program (BEMP) in the D'Entrecasteaux Channel and Huon Estuary. To date, Aquenal has completed field sampling for 96 monthly/bi-monthly sampling events to May 2015.

This submission addresses TORs (a), (b) and (c) in respect of this Senate Inquiry.

Yours sincerely

Sean Riley
(GENERAL MANAGER)

TOR (a) The adequacy and availability of data on waterway health

Evolution of environmental research and monitoring of finfish aquaculture in Tasmania

Prior to the enactment of the *Marine Farming Planning Act 1995* (MFPA), the early development and expansion of the Tasmanian salmonid industry occurred under a legislative framework that was not suited towards progressive aquaculture in Tasmania. A moratorium on the allocation of marine farming leases was introduced in the early 1990s to prevent the unsustainable expansion of marine farm leases in Tasmanian coastal and estuarine waters. Prior to this time, leases could be established with limited public input or engagement with community groups and other stakeholders with legitimate interests in the social, economic or environmental values associated with Tasmania's unique coastal environment. The *Marine Farming Planning Act 1995* was introduced specifically to provide for orderly and sustainable development of the salmon farming industry.

Simultaneously, the *Fisheries Act 1959* was revised to the *Living Marine Resources Act (1995)*, which included provisions for the licensing of marine farms with licence-specific environmental management controls. As this legislation was being prepared in the early to mid 1990s, marine scientists from the Tasmanian Department of Primary Industry and Fisheries (DPIF) developed environmental monitoring requirements and monitoring guidelines to determine the impact of organic pollution from intensive salmon farming. This research was undertaken at the Marine Research Laboratories at Taroona (now IMAS), a dedicated Government marine research facility that supported the initial Atlantic salmon development trials in 1984.

The development of a new legislative framework to manage marine farming in Tasmania also lead to the development of a more strategic approach by research institutions, particularly DPIF and the CSIRO, to measure and determine the impacts of finfish aquaculture on both ecosystems and their habitats. With the CSIRO Marine laboratories located in Hobart, south eastern Tasmanian waters became the focus of significant research efforts.

Research and management personnel subsequently developed environmental monitoring guidelines specific to Tasmanian conditions that extended to a range of prescribed management controls included as specific conditions and schedules on marine farming licences. This approach to environmental monitoring was formalised in 1997 in consultation with a range of stakeholders including industry, the CSIRO, the Tasmanian Conservation Trust, and the community.

From 1996, the CSIRO Huon Estuary Study (HES) (2000) assessed the sources, distribution and cycling of nutrients (including those derived from finfish farming) in the Huon Estuary. These studies were then extended to include the waters of the D'Entrecasteaux Channel as part of the CRC for Sustainable Aquaculture of Finfish (Aquafin CRC) - a seven year strategic research grant funded by industry and the Commonwealth Government.

A whole of ecosystem assessment of environmental issues for salmonid aquaculture undertaken by Volkman et al. (2009) as part of the Aquafin CRC provided a comprehensive assessment of the key oceanographic attributes, ecological features, and nutrient sources and cycling in the Huon Estuary and D'Entrecasteaux Channel, and descriptions of how these parameters are affected by nutrient inputs from fish farming. The focus of this work was to determine the overall assimilative capacity of

these waterways in respect of nutrient emissions, organic loading and associated changes to ecosystem structure and function.

A vast amount of data was generated from this research program; in particular it was used to develop a characterisation of impact/recovery stages of organic enrichment from salmon farms based on a variety of indicators. Additionally, a range of techniques was also assessed for their suitability for industry based management of sediment condition.

A major achievement of the Aquafin CRC was the development (by the Tasmanian Aquaculture and Fisheries Institute – now IMAS) of a "*Guide to the assessment of sediment conditions at marine finfish farms in Tasmania*" by Macleod and Forbes (2004). This guide continues to be used as the basis for monitoring the near-field impacts of finfish aquaculture in Tasmania, particularly in respect of compliance surveys of the seafloor, and assists in understanding the ecological and chemical stages of sediment condition at various levels of impact (and recovery).

Field data collected as part of the Aquafin CRC between the years 2002-2005 was also used by the CSIRO to calibrate and validate a complex three-dimensional hydrodynamic, sediment and biogeochemical model to capture major physical and biological processes occurring in the D'Entrecasteaux Channel and Huon Estuary. This work formed the basis for simulating the environmental consequences of anticipated growth in the salmonid farming industry in south east Tasmania. The 2009 scenario simulation, based on proposed maximum expansion of the industry, predicted a shift from oligotrophic (i.e. low nutrient concentrations) to mesotrophic (i.e. moderate nutrient concentrations) conditions within the Channel and Huon Estuary - there was no evidence of eutrophic conditions in any of the CSIRO model simulations.

The modelling undertaken as part of the Aquafin CRC provided the means for managing system-wide environmental impacts associated with salmonid culture in the D'Entrecasteaux Channel and Huon and Port Esperance Marine Farming Development Plans (MFDPs) through the imposition of a primary regulatory management tool - referred to as the Total Permissible Dissolved Nitrogen Output (TPDNO) or nitrogen cap.

The TPDNO was implemented in the D'Entrecasteaux Channel and Huon and Port Esperance MFDPs by the Secretary of DPIPWE in 2008 - effectively placing a cap on the production of salmonids in these plan areas, considered to be set at sustainable levels of feed input, and able to be adjusted where there is evidence that production is exceeding the assimilative capacity of surrounding marine and estuarine ecosystems.

The Broadscale Environmental Monitoring Program (BEMP)

The Aquafin CRC also proposed a number of recommendations on the design of a monitoring system and adaptive management strategies for future management of the marine environment in the south east region. The salmonid industry operating in the Huon River and Port Esperance, and D'Entrecasteaux Channel MFDP areas now participates in an ongoing broadscale environmental monitoring program (BEMP) which is based on these recommendations. Aquenal was contracted in 2009 to undertake the the field sampling for the BEMP on behalf of the Tasmanian Salmon Growers Association.

This program has now completed six years of monitoring covering 96 sampling events at 15 sampling stations located within the D'Entrecasteaux Channel and Huon Estuary (including a control site at Recherche Bay). A review of the first three years of monitoring program data was undertaken by IMAS in 2013. This review provided a comprehensive summary of both the water and sediment quality data collected from 2009-2012 and evaluated these data in the context of the major system drivers, previous environmental data sets and broader ecosystem performance measures (Ross & Macleod 2013).

The IMAS evaluation of the BEMP data from 2009-2012 found that the monitoring design was sensitive enough to detect environmental change at the broadscale level and that no significant "high-risk" adverse environmental affects (as described in Thompson et al.) had been detected at any of the sites for water quality condition parameters.

The BEMP dataset includes a vast amount of data records relating to nutrient concentrations (i.e. ammonia), biological communities (i.e. benthic infauna and phytoplankton) and physical parameters (i.e. sediment chemistry and water quality data). It is complex and can easily be misinterpreted if not considered within the context of the temporal and spatial nature of the dataset. Aquenal supports the ongoing evaluation and assessment of the BEMP dataset by IMAS (or another recognised research facility) but urges caution in respect of making the raw data publicly available.

As an example, when the analysis of nutrient samples transferred to an alternative NATA accredited laboratory after sampling event 51 (May 2012), a different analytical technique was used to determine nutrient concentrations – one that introduced an inherent increase of approximately 5 parts per billion to ammonia analyses. An analysis of the raw data (without understanding the change in analytical methodologies) could misinterpret this increase as relating to changes in the marine ecosystem as a result of environmental impacts.

Nevertheless, the BEMP continues to provide important information on long term changes occurring within the ecosystem – not solely from the impacts of aquaculture, but from both natural (i.e. southern ocean influx during winter and climate variability) and anthropogenic (catchment run-off and wastewater treatment plants) influences affecting ecological assemblages and water quality in the D'Entrecasteaux Channel and Huon Estuary.

Filling the Gap

An acknowledged limitation in the current approach to the BEMP framework is the information gap on potential broadscale impacts from aquaculture emissions on rocky reef communities. Commercial and recreational fishing groups along with other stakeholders have expressed concerns that rocky reef systems may be impacted by nutrient emissions released through marine farming activities. These concerns have been raised in recent times as the finfish aquaculture industry seeks to make amendments to existing lease areas and reposition some of their farming operations in waters better suited (in terms of hydrology and current flow) to intensive salmonid farming operations.

In response to this identified gap in our knowledge, Aquenal (in collaboration with Marine Solutions) sought funds from the Fisheries Research and Development Corporation (FRDC) to undertake a study aimed at characterising macroalgal community assemblages, including an assessment of the status and health of rocky reef communities. This application for funding was supported by

individual finfish aquaculture companies and the industry association (TSGA). Whilst this study has only just commenced in May 2015, the objectives are to:

- Undertake an analysis of subtidal macroalgal community survey data (1996-2014) at the Ninepin point and Tinderbox Marine Protected Areas (updating the study undertaken by Crawford et al. 2006);

- characterise macroalgal community assemblages within south eastern Tasmanian waters to determine potential broadscale impacts from salmon farm developments in south eastern Tasmanian waters; and

- communicate the status and health of rocky reef communities to broad industry and recreational stakeholder groups.

This study complements an additional FRDC Project (to be undertaken by IMAS) that seeks to provide important information on variability in broadscale rocky reef conditions in south east Tasmanian waters. This three year research program entitled "*Managing ecosystem interactions across differing environments: building flexibility and risk assurance into environmental management strategies*" was developed by IMAS to specifically address key concerns of industry (both aquaculture and fisheries), regulators and other stakeholder groups on how finfish farming in new areas might change environmental interactions. A key objective of this project (due to commence in mid-2015) is to evaluate the potential for interactions between local reef systems and salmon farming, and recommend to industry and Government appropriate monitoring and assessment approaches based on risk mitigation strategies.

Summary

The evolution of research and monitoring programs as the Tasmanian salmonid industry has developed since the mid 1990s provides an impressive account of wide-ranging and scientifically robust work aimed at providing both regulators and industry with the means by which to sustainably shape salmon production in Tasmania, within the bounds of acceptable impacts. The research and monitoring programs described above represent significant (and costly) bodies of work that have contributed greatly to the development of best practice monitoring programs to assess the impacts (fine-scale and broadscale) of finfish aquaculture on the marine environment.

TOR (b) The impact on waterway health, including to threatened and endangered species

Waterway health

Aquaculture has the potential to impact negatively on the marine environment, both near-field and broadscale, affecting water quality and sediments. The severity of these impacts is influenced by such factors as the type and intensity of the farming activity and the capacity of the receiving environment to assimilate any impact.

There have been a range of significant improvements over the last 20 years in the management of impacts from finfish aquaculture in Tasmania, resulting in improved water quality and sediment health. This has been observed through improvements in feeding practices, feed formulation and

better understanding fish behaviour through improved technology (i.e. underwater cameras and water quality sensors). In addition, siting marine farm leases in waters of suitable depth, with sufficient flushing rates is also known to lessen impacts on the environment.

The release of nutrients into the environment from finfish farming is largely associated with feed input. Approximately 5% of the total feed input from salmon farming is released into the receiving environment as a form of nitrogen (Wild-Allen 2005), of which 85% is released as dissolved nitrogen (predominantly ammonium) and 15% in particulate form.

One of the main environmental concerns relating to fish farming in Tasmania is the potential for nutrient inputs to cause eutrophication, or organic enrichment of the ecosystem to the extent that this enrichment causes changes to ecosystem structure and function. In south east Tasmania, the primary management (and regulatory) tool for ensuring that eutrophication of the D'Entrecasteaux Channel and Huon Estuary does not occur is through the Total Permissible Dissolved Nitrogen Output (TPDNO) described in TOR (a) above. In addition, a range of Management Controls are also included as Marine Farming Licence Conditions to ensure that impacts from finfish farming are maintained at acceptable levels.

Both near-field monitoring (i.e. ROV compliance surveys) and broadscale monitoring (i.e. the BEMP) activities are also undertaken routinely to provide knowledge of how well the ecosystem is functioning with an increased nutrient load and to allow any significant temporal and spatial trends to be detected. This work has recently been augmented by studies (Aquenal and IMAS) aimed at extending our understanding of potential broadscale impacts from finfish aquaculture to rocky reef communities.

Whilst there are conflicting reports in the global scientific literature as to whether nutrients from salmon farming adversely affect macroalgal communities on rocky reefs, studies undertaken locally suggest that the complex nature of the structure and function of macroalgal assemblages makes it difficult to discern any direct influence of aquaculture.

In a study of subtidal macrolagal assemblages at the Ninepin Point and Tinderbox Marine Reserves in the D'Entrecasteaux Channel between 1992 and 2002, Crawford et al. (2006 unpublished) found that no consistent pattern of change in community composition was apparent. No impact of increased nutrients as a result of expansion of salmon farming in the area could be detected. Once again, this study is currently being updated by Aquenal to include the years 2003-2015 in this assessment.

Summary

Environmental impacts from finfish aquaculture emissions in Tasmanian waterways do occur – and these impacts are visible at the near-field spatial scale (predominantly on the seafloor within marine farm lease areas). Management and regulatory controls are in place to ensure that there are no unacceptable environmental impacts extending beyond 35 metres outside the boundary of marine farming leases. If a significant impact is detected within or outside the lease areas from annual compliance monitoring surveys, targeted management responses may be required, in addition to possible further investigation and depositional modelling.

The management of benthic impacts from salmon farming activities using the regulatory approach described above has been in place for all marine farming operations in Tasmania for the last 17 years. During this period, and through the adoption of adaptive management strategies, organic loading effects from marine farming operations have been effectively managed using the environmental monitoring framework as well as specific environmental assessment guides developed by Macleod and Forbes (2004).

In terms of broadscale impacts from finfish aquaculture, particularly soluble emissions, these are less obvious as there are a range of natural and anthropogenic drivers influencing temporal and spatial patterns of nutrient concentrations within the D'Entrecasteaux Channel and Huon Estuary. However, ongoing monitoring through the BEMP, as well as monitoring rocky reef communities in south east Tasmania will continue to improve our knowledge of both the extent of impacts from finfish aquaculture, and other potential drivers affecting ecosystem structure and function in these waterways.

The monitoring of salmon farms in Tasmania is more comprehensive than most other parts of the world and is based on rigorous and broad-ranging research and monitoring that has been ongoing for over 20 years. The success of this integrated research framework has been enhanced through very strong links between government, industry and researchers.

Threatened and endangered species

A range of threatened and endangered species (and one threatened ecological community) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBCA) and the Tasmanian *Threatened Species Protection Act* (TSPA) occur within waterways in which marine farming occurs. These include birds (i.e. the White-bellied Sea Eagle), marine mammals (i.e. Southern Right Whale), fishes (i.e. Spotted Handfish), and communities (Giant Kelp).

General potential impacts (from aquaculture activities) on threatened or endangered species within Tasmanian waterways may include the following.

- Entanglement - marine farming equipment such as bird netting and mooring lines have the potential to entangle birds and marine mammals resulting in injury or death.
- Habitat loss - the deployment of marine farming equipment within a lease area may degrade suitable habitat for some marine species. Some examples of direct impact on habitat may include the deployment of mooring blocks (benthic species), rows of pens restricting access (pelagic species), or smothering from solid waste (benthic species).
- Behavioural change - the presence of marine farms may cause some threatened species to alter their behaviour, particularly foraging behaviour in species such as seals and birds.
- Predation – potential predation of threatened species and/or threatened species prey by escaped salmonids.
- Alteration of breeding behaviour – the presence and intensity of marine farming activities may interrupt breeding and reduce breeding success.
- Reduction of the integrity of an ecological community – assisting invasive species that are harmful to listed ecological communities to become established or causing the mobilisation of pollution into an ecological community that kills or inhibits the growth of species within the community.

- Other effects - noise, lighting, waste and vessel movements all have the potential to impact on threatened species through potential behavioural changes, direct interactions or by the physical presence of artificial structures and associated infrastructure.

Aquenal has undertaken threatened species assessments and surveys as part of the environmental impact assessment process for amendments to lease areas, and believes that the process for determining the level of risk to these species provides for their adequate protection and prevention of habitat loss. The following tools provide valuable information on listed threatened species and communities under the EPBCA and TSPA.

- the Australian Government's online EPBC Protected Matters Report
- the Tasmanian Government's Natural Values Atlas
- the Tasmanian Government's online list of Threatened Species.

For both the EPBC Protected Matters Report and the report generated using the Tasmanian Natural Values Atlas, Aquenal includes a buffers of 5 km to encompass potential habitats where listed threatened or migratory species are likely to occur, breed, or where listed threatened or migratory species are known to forage for food. This conservative buffer accounts for the area of potential direct impacts from farming op rations plus a 5 km buffer to include potential indirect impacts.

Aquenal also liaises with recognised experts when undertaking threatened species assessments, and finds this to be an invaluable component to the overall assessment process in terms of developing mitigation measures and understanding the exact nature of threatening processes.

An assessment of potential significant impacts to listed threatened species and communities also involves extensive liaison with both State and Federal Agencies (i.e. Threatened Species Assessment Units). One area where a more effective framework could be developed for better understanding the potential impacts to listed threatened species could include a more consistent approach to listing species under both State and Federal legislation (i.e. some species listed under the EPBCA are not listed under the TSPA and vice versa), and a more consistent (i.e. with confidence and a high level of repeatability) approach to applying significant impact criteria under the EPBCA.

Aquenal considers that an industry workshop focusing on listed threatened species assessments (including representatives from State and Federal Agencies) would provide a useful forum for developing a more comprehensive, industry-wide understanding of the assessment process, when and if a referral under the EPBC is required, significant impact criteria, and the tools available to collect information on listed threatened species and their habitats.

TOR (c) The adequacy of current environmental planning and regulatory mechanisms

The Tasmanian Government has taken a very proactive approach to the management of marine farming in Tasmania. Because of rapid expansion of mariculture for Pacific oysters and Atlantic salmon in Tasmania in the 1980's and 1990's, the Government developed new legislation to manage these new and expanding industries.

Through development of the *Living Marine Resources Management Act (1995)* and the *Marine Farming Planning Act (1995)*, a more rigorous and comprehensive approach to the sustainable management of natural resources and the environment was established in Tasmania.

All marine farming operations must be licensed under the *Living Marine Resources Management Act.* Each licence includes environmental conditions specific to that licence to ensure that the marine farming operation is sustainable and does not have an unacceptable impact on the marine environment. The MFPA established a mechanism for the development and approval of marine farming development plans, which allocate zones for marine farming and lease areas within these zones. These plans document mandatory management controls for each planning area, including those related to nitrogen outputs, environmental controls related to carrying capacity, monitoring requirements, and chemical controls and usage.

The structured and integrated nature of these regulatory processes provides reasonable controls on marine farming operations in Tasmania because they:

- Integrate marine farming activities with other marine users
- Minimise the adverse impacts of marine farming operations
- Take account of land uses, and
- Take account of the community's right to have an interest in those activities.
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Aquenal considers that the legislative framework and processes for regulating marine farming in Tasmania is one that provides security and certainty for industry, input and consultation with the community and stakeholder groups, and the environmental protection required to maintain the integrity of marine ecosystems.

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