An evaluation of the options for the expansion of salmonid aquaculture in Tasmanian waters:

Phase 1. Options Analysis (Commercial in Confidence)
Phase 2. Keeping ahead of the game: A framework for effective aquaculture decision-making.

Andrew King[1], Catriona Macleod[1], Nick Elliott[2], Adam Main[3]

Phase 3. Information assessment/decision support framework (Pilot Study – Storm Bay)

Catriona Macleod[1], Bronagh Kelly[1], Mick Hortle[3], Justin Hulls[1], Nick Elliott[2], Adam Main[3].

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Seafood CRC/ FRDC Project No **2011-735**

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This project was conducted by researchers from the Institute for Marine and Antarctic Studies (IMAS), University of Tasmania, Fisheries and Aquaculture Centre and CSIRO, with collaboration of researchers from the Tasmanian Salmonid Growers Association.

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Project Objectives:

The original project comprised three main objectives:

1. To review existing and emerging options for industry expansion
2. To develop a holistic risk based model to assess the viability of production expansion options and undertake an options analysis; making recommendations for further evaluation
3. With stakeholder approval and financial support, test the analysis recommendations by employing engineering / environmental modelling, and then evaluate the preferred option(s) in pilot sites applications.

A project variation was proposed in January 2015 to include two further objectives:

1. A simple industry targeted user guide to the decision support and economic modelling outputs from the project – prepared in conjunction with the Seafood CRC Communication, Education, Training and Extension Program team.

   This document would be targeted specifically at industry users, outlining the pros and cons of the various decision support approaches and modelling, and specifically identifying how to use the tools and apply the model outputs.

   This report provides the output material that can be used by the Seafood CRC.

2. Targeted stakeholder workshops

   To provide stakeholders with a clear understanding of the research package (i.e. decision support tools, economic modelling outputs and user guide) and how this can benefit their operations.

   The workshops were originally proposed for April/ May 2015 but the announcement of the senate enquiry into aquaculture with submission closing 1st June, has delayed the hosting of the proposed workshops – will aim to reschedule these for after June.

EXECUTIVE SUMMARY

An evaluation of the options for the expansion of salmonid aquaculture in Tasmanian waters.

Phase I – Options Analysis

Background

The Tasmanian Atlantic salmon industry has a strategic aspiration to more than double production and to expand, in an ecologically sustainable manner, to a 79,000 tonnes HOG industry by 2030.

Given that expansion options for the industry are currently constrained by limited availability of inshore marine farming sites around the State, the Australian Seafood Cooperative Research Centre (CRC) and Tasmanian Salmonid Growers Association (TSGA), commissioned a project to examine the alternate production farming technologies and strategies available to help address the resource and environmental challenges associated with such an expansion.

Approach

In the initial stage of this project a desk-top review of the alternative production technology options for industry expansion was conducted. The data gathered was synthesised, and key trends and initial observations were presented in project milestone report 3 [22].

The follow-on phase of the CRC project (Stage 2) – the subject of this report – has used this data, together with the associated preliminary findings, to develop a conceptual framework for objectively evaluating expansion options and considering the specific constraints relevant to the Tasmanian Atlantic salmon industry. This includes an assessment of economic performance for each of the down-selected production scenarios and identification of key research and development questions that result.

Summary of Key Findings

- Increased demand for ‘quality’ seafood in the domestic and emerging S.E Asia markets, coupled with limitations to wild seafood supply and changing consumer habits, will combine to present the Tasmanian salmon industry with a significant opportunity for growth.
- By 2030 the industry will face a production expansion challenge of circa 35,000 tonnes HOG if it is to maintain its share of the domestic market (This is some 20,000 beyond TSGA’s current business plan targets and is due to revised per capita consumption and population growth forecasts).
- Failure to capitalise on this opportunity by the Tasmanian industry would probably result in increased imports of ‘commodity’ Atlantic salmon, substitution of other seafood or protein products for salmon, or the emergence of Atlantic salmon production on mainland Australia.
- Cost of production reductions, development of brand equity and retaining bio-security legislation will be key considerations to underpin continued growth. Any expansion will need to maintain the social license to operate on the Tasmanian coastline, and as such will need to be cognisant of (ideally reduce) environmental impacts, complement the industry’s current reputation as a quality food producer and be mindful of the State’s clean and green cachet;
- Growth will require access to significant financial resources, and a key factor in the success and cost associated with any strategic growth plan will be how individual companies choose to address amoebic gill disease (AGD), and the associated timelines to develop a solution.

- Expanding production into higher energy domains / more exposed sites would appear to be the best option to deliver Tasmanian industry's strategic production growth objectives. Commercial scale land-based closed containment recirculating aquaculture systems (RAS) is technologically achievable, although to-date not commercially proven.
- A forecast of the economic performance of 6,000 tonnes HOG steady state production, against a south east Tasmanian operating baseline, for three alternative production scenarios was undertaken.
    - High Energy / Remote Site Sea Pens
    - Onshore Freshwater Recirculation Aquaculture Systems
    - Combined Seawater RAS & High Energy / Remote Sea Pens
- The analysis identified that:
    - all scenarios show a significant advantage over the current baseline setting (inshore sea pens) in terms of both 3rd year net income, cost of production and reduction in growout duration / associated risk;
    - the greatest return (61.9%) and the shortest pay-back period (3 years) would be achieved by developing the high-energy / remote site sea pens production scenario; and
    - the initial capital investment for an onshore RAS system would be approximately three times that of sea pens, and ranged from around $15 million (HE sea pens) to $41 million (RAS).
- Based on these findings it is proposed that the key research and development questions for Stage 3 of the project will include determination of the presence or otherwise of AGD in target expansion waters, confirmation of growth rates for Tasmanian Atlantic salmon stocks when cultured at high density in RAS systems, and identification and evaluation of potential options to create revenue streams from waste effluence.

An evaluation of the options for the expansion of salmonid aquaculture in Tasmanian waters.

Phase 2 - Keeping ahead of the game: A framework for effective aquaculture decision-making

Background & Approach

Globally, Atlantic salmon aquaculture is faced with a critical challenge: How best to deliver long-term sustainable growth? This study presents a framework of complementary decision support approaches to enable decision-makers to better understand the factors influencing aquaculture development, and examine alternative production (growout) technologies that more effectively address the challenges associated with intensification and expansion. This was achieved through a combination of fieldwork (international data-gathering), key stakeholder discussions, and the application of targeted qualitative and quantitative analytical approaches; using the Tasmanian industry as a Case Study. The initial research focused on shorter-term (tactical) decision support. A situational analysis defined the business environment, and appraised viable expansion options (offshore, closed-containment and extractive bio-remediation). An economic analysis of selected options provided a comparison of financial performance and risk. The outcomes of this initial component were then used to inform strategic decision-making approaches; employing scenario analysis to explore plausible strategies for the adoption of land-based recirculating aquaculture systems; and qualitative modelling to understand the causal dynamics driving and regulating the industry, and their impact on technology selection.

Summary of Key Findings

Whilst it was clear that economic viability is paramount, the findings suggested that societal acceptance is becoming increasingly important in shaping the operational context. There is no single 'right' technological solution; social acceptance, in particular considerations regarding human wellbeing, trust, and animal welfare concerns, will shape the business environment and therefore technology selection. The research emphasised the importance of employing a balance of tactical and strategic decision-making techniques, and of engaging with a broad range of industry stakeholders. It also highlighted the complexity and dynamic nature of the industry and that key variances (economic, regional, strategic, technological, and temporal), must be included in decision-making. Whilst the study was based on the Tasmanian salmon industry, the decision support framework would be applicable to other aquaculture sectors and geographic regions. This study examined a number of key areas both with respect to farming operations (i.e. salmon farming generally (business environment), selection of new production technology) and key business drivers, and examined these using a novel combination of analytical techniques to provide a more all-inclusive decision making approach. The main outcomes from each element are summarised below, and the specific industry benefits are highlighted.

Business Environment

By applying a structured approach to characterising the business environment, both globally and locally, several broad-based factors essential to the development of salmon industry were identified. The study showed that there is high degree of commonality in the technologies, challenges and issues facing salmon producers globally. Economic, societal and political factors currently have the strongest influence on selection of production approaches, and these factors will be crucial in shaping the future development of the industry. Whilst the factors driving industry development varied, both between and within countries, there is potential to influence

many of these and thereby steer decision-making. Regional variability in the operating environment is a key factor and must be taken into account when considering expansion options and strategies. SWOT and PESTEL analyses in conjunction with case-studies were useful in characterising the business environments and identifying specific regional issues.
This analysis showed that the Tasmanian industry still has significant growth potential, and a number of structural advantages that may help insulate it from the negatives of globalised business environment. The market forecasts suggest that there is likely to be a significant shortfall in salmon production relative to demand and unless expansion options can address this, the shortfall is likely to be met by imports or through product substitution. The critical 'regional' issues underpinning Tasmanian decision-making with respect to expansion were: domestic (Australian) population growth and salmon consumption rates; international trade levels; maintaining bio-security (legislation); development of a differentiable brand equity; amoebic gill disease; and maintaining social acceptability.

Specific Take Home Messages for Industry
Potential for expansion will be particularly influenced by:

- Economic viability of the production coupled with the availability of capital;
- An ability to demonstrate / enhance sustainability (i.e. environmental and societal), with increasing emphasis placed on certification.
- A supportive political environment.
- Stable legislative/ regulatory domain with strategies for development integrated at local, state and federal (country) levels.
- Incentives that encourage (at least do not hinder) R&D investment into new production development projects.

Technology Selection
Determining which production (grow-out) technology would be best suited to the expansion of the Tasmanian industry was a central theme of a situational analysis. This was achieved by first understanding the technological characteristics of the various options, identifying the respective adoption drivers and challenges (global and local), and then defining the key decision points and criteria that would allow for a particular technology selection. This information would allow for a structured assessment framework, to guide production technology selection and inform strategic decision-making. This decision approach was then validated using the Tasmanian industry as a case study.
Technology selection is influenced by a combination of i) the business environment (including economic, societal and political drivers), ii) the technology's characteristics, and iii) the industry/ company's strategic intent, and any decisions will require a careful consideration of all three factors. No production technology suited all circumstances. On the whole industry tended to favour an evolutionary, rather than transformational, approach to adoption of new production technology, with new production strategies being implemented as the technologies become simpler and cheaper. However, the location and scale of the farming operation, and the ability of any new technology to provide market differentiation were also key elements in the decision process. Application of a red, amber and green (RAG) assessment process for prioritisation of risk, increased the transparency of the screening and identified lower risk options in decision-making process.
The results suggested that in the future a broader mix of grow-out technologies based on individual company circumstances might be employed. For the Tasmanian salmon industry the framework assessment identified three promising production technology options for "near-term" expansion:
i) current sea-pen technology in an offshore environment,

ii) recirculating aquaculture systems (RAS) to deliver larger post-smolt to sea or,
iii) RAS to complete full production cycle growout on land.
Which technology is adopted is ultimately contingent upon the comparative economic performance (viability and variability) of the various options with respect to the individual company's business plan.

Specific Take Home Messages for Industry
Considerations when contemplating adopting or need for new technology:

- Understand the overarching economic, social and political climate.
- Build upon existing skills, experience and infrastructure.
- Step change, to reduce technology adoption risk.
- Optimise production size to deliver economies of scale.
- Adequately resource projects (financial and human capital).
- Consider geography (location cost and target markets)
- Optimise differentiation premium - build on brand equity wherever possible, but forecast economic performance on a conservative basis.
- Be cautious when benchmarking performance (biological, financial and market), particularly from vanguard projects.

Economic Analysis

The risk associated with technology selection decisions was assessed by applying a bio-economic investment model for Australian salmon production. The results indicate that there is a considerable level of economic risk underlying salmon aquaculture operations.
Understanding the input variability is critical to evaluating alternative production scenarios. Monte Carlo simulations were undertaken to develop an appreciation of economic performance variation; quantifying the trade-offs associated with decisions allows the variance and risk associated with different options to be fully (quantitatively) assessed. This in turn allows decisions to include risk mitigation strategies.
In Australia the economic impact of AGD is a key determinant in any technology selection. The optimal "near-term" economic investment strategy would be to expand into new 'offshore' sea-pen sites, where AGD impact is markedly reduced / eliminated. However, if it is not possible to eliminate AGD impacts with offshore production then it may be worth considering land based RAS, even allowing for the higher initial investment costs, as the potential benefits that could theoretically be achieved (i.e. reduced AGD incidence, increased production flexibility, and potentially premium returns) are considerable.
The economic modelling provides a clearer understanding of "near-term" decision process but, as the decision-making timeline extends choices regarding technology adoption and investment again become uncertain. Companies will need to consider a complex matrix of changing factors in order to realise their strategic aspirations, including; technology efficiency developments, changes in environmental regulations, and changes in consumer attitudes.

Specific Take Home Messages for Industry
In evaluating alternative grow-out technologies it is critical to obtain a thorough understanding of the variance (risk) associated with aquaculture production. This enables realistic investment scenarios to be developed that reflect the risk profile with and without the proposed technology.

Scenario Analysis

In longer-term decision making companies need to consider a complex matrix of changing factors in order to realise their strategic aspirations, including; technology efficiency developments, changes in environmental regulations, and changes in consumer attitudes. Scenario planning provides a powerful tool to explore uncertainty and risk in these factors.

Plausible scenarios for the adoption of land-based RAS growout of Atlantic salmon were framed, and an appreciation of the relative ranking of the underpinning change factors was achieved by integrating context scenario analysis and a Delphi approach to stakeholder engagement; together this provided and assessment of both the likelihood of adoption and an adoption timeframe. Integrating a Delphi style phased approach to stakeholder engagement and scenario development was extremely productive, it fostered proactive engagement amongst the stakeholders, and ensured that the proposed scenarios reflected ‘real-world’ contexts. The technique could readily be applied to other emerging aquaculture production technologies, however like all foresight studies, it is important to acknowledge the limitations with the approach and ensure that appropriate caveats are applied to any predictive outcomes.

The results identified that economic drivers (e.g. costs of technology, land and ongoing operational costs) represent both the greatest limitation and the greatest opportunity for a paradigm shift towards the adoption of land-based RAS. The results suggest that the emotional context of decision-making will play an increasingly significant role in whether society supports (purchases) salmon produced in a particular way. Societal acceptability of RAS technologies was primarily based on concerns regarding human wellbeing, human autonomy and ethical considerations but there were many competing trends and counter trends in these areas that would ultimately shape the societal acceptability of this technology. However, there were two clear anti-land based RAS sentiments that would need to be overcome for this technology to be generally acceptable, these are ‘it is not natural’ and ‘it is cruel’. Nonetheless, it was largely believed that the likelihood of RAS technology being adopted would increase with time, with the two most likely scenarios for adoption of commercial-scale land-based RAS by 2030 being: adaptive growth by mainstream production companies (to balance supply and enhance sustainability credentials); or differentiated niche production by a new producer.

Some of the key trends, events and potential change factors can be scanned for in the real world, and if these could be included in the decision making process could indicate whether one particular version of the future is more unlikely to unfold than another, and where future opportunities and conflicts are likely to occur. Qualitative analysis provides an approach to address this and is discussed in the next section.

<u>Specific Take Home Messages for Industry</u>

The research provides some important insights into the decision making process for industry, as well as some key considerations regarding the adoption of RAS for future production. Whilst societal preferences and many of the other factors which might influence (support or discourage) the adoption of a particular aquaculture technology will be very application specific, however, there are some generalities from the scenario analysis process that would apply regardless of approach, these include:.

- Understand what the consumer considers “natural and healthy” as these were key concerns.
- The product’s natural / healthy position statement will be associated with where it comes from, therefore consider the location of production facilities and in new developments consider locating in an area associated with natural beauty, and associate brand production with this region.

- Design the production facility to address any possible negative perception associated with salmon from a ‘factory style’ land-based RAS system (for example consider an eco-style building which blends into the landscape and takes advantage of renewable energy cf an industrial site).
- Create knowledge, and engender trust and transparency by engaging, and consulting with the community (local and target markets) well in advance of any facility construction. Where appropriate build upon the currency of established ‘baby salmon’ (egg, fry and smolt) rearing knowledge;
- Build support through identifying “hot buttons” (i.e. those issues that elicit a strong emotional response or reaction), opinion leaders and ensuring that communication is under-taken through a broad range of channels to ensure all stakeholders are engaged (I.e. including social non-traditional media mechanisms).
- Create a simple vision and an emotional hook for the development; do not promote adoption of technology purely on its technical and/ or environmental merits.
- Address potential animal welfare concerns through obtaining (or positioning to obtain) international certifications associated with fish welfare.
- Finally, enhance or build social licence by commercially structuring the enterprise in order to start with a good reputational advantage.

Qualitative Modelling

Qualitative signed digraph modelling provided a causal understanding of the interactions and feedbacks that drive and regulate the Atlantic salmon aquaculture industry, particularly in relation to expansion and adoption of alternative grow-out technologies. This analysis specifically examined the interaction of technology and socio-economic variables. The findings underlined the strategic benefits of understanding the drivers of demand and growth, and the developmental life-cycle. The results showed that addressing societal concerns early is critical to both maintaining demand and ensuring that the industry doesn’t develop a ‘boom and bust’ culture. It was clear that with respect to strategic decision making, that the levels of uncertainty were lower with offshore expansion than with adoption of land-based RAS grow-out technology. However, it is worth noting that these uncertainty levels are dynamic and therefore can be refined, for instance improvements in RAS technology would change this balance and potentially reduce the level of uncertainty. The greatest benefits from qualitative modelling can be obtained when the approach is used in conjunction with quantitative modelling to resolve areas of uncertainty in the production/ business model, as this approach can not only identify non-quantitative interactions but can also allow exploration of the impact/ dynamics of such interactions. The outcomes of the modelling (the behavioural dynamics and response predictions) have been shown to be consistent with industry behaviour, empirical evidence, the country and technology case-studies, and were aligned with the results from the previous research. Consequently, we are confident in the findings and can advocate the utility of this approach to support strategic aquaculture development decision-making.

<u>Specific Take Home Messages for Industry</u>

Whilst the discussion of this approach has been principally directed towards the grow-out production of Atlantic salmon in an Australian business environment, the processes underpinning the generic model could be readily applied to the culture of other finfish species, or even to the farming of prawns, bivalves and macro-algae. Broader adoption of signed digraph qualitative models could greatly assist aquaculture policy makers, strategic planners and practitioners in evaluating alternative production strategies and technologies, and in providing predictions as to how such changes might affect the overall aquaculture production business environment.

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Phase 3 - Information assessment/decision support framework (Pilot Study – Storm Bay)

This project represents the final stage of the evaluation of the options for the expansion of salmonid aquaculture in Tasmanian waters and was undertaken subsequent to the main study (Keeping ahead of the game: A framework for effective aquaculture decision-making) in response to an identified need for improved decision support processes in relation to spatial planning. The research comprised an initial desktop evaluation of the information required to support new aquaculture development but also considered approaches to both evaluate and communicate that information and tested the resultant recommendations using data from a pilot site (Storm Bay); the overarching aim being to provide a framework to support decisions regarding spatial development of aquaculture in Tasmania. In the first instance the study characterizes the information required to assess whether an area would be suitable for farming (from both a farming and community perspective), and then (using Storm Bay as a test case) identifies various avenues by which that information can be sourced. It provides a review of options for presentation and interrogation of spatial data, and shows how this information can be used to facilitate community discussion and engagement. The study considers how various factors might be weighted depending on stakeholder perspective, and how this weighting might be used to show both differences and similarities between stakeholder needs and expectations, and to optimise site selection. As part of the process any information gaps or problems with respect to data handling and analysis were identified, and any issues with respect to data interpretation were highlighted.

Ultimately, the study provides a ready reference of the key factors to consider with respect to spatial planning for aquaculture development, and aims to ensure that decision making is most effective. The resultant simple planning and decision support framework provides a functional but effective mechanism for community engagement and communication, which will hopefully be useful in supporting future aquaculture development application processes and improve planning outcomes.

The project comprised four major elements:

1. Identification of the information needs - taking into account any specific constraints likely to be encountered by a new development proposal and including assessment of issues that might be affected by the scale/ form of the development.

2. Gap analysis - identification of any missing data/knowledge relevant to the development of the decision support tool.

3. Assessment of information systems that can be used to collect, filter, overlay and review the various datasets – this may include integration of various geographical information systems (GIS) (e.g. Land Information System Tasmania (LIST)), as well as risk assessment and data visualisation tools.

4. Identification of specific trigger points (e.g. limiting criteria and key decision points) and any notable information gaps.

An additional component was added after completion of the initial draft final report. It was requested that the final report be updated to an interactive report to show the value for public engagement (attached). That report was well received and the project was extended further still to include the development of a demonstration website "**salmonintas**" (access details listed in outputs below). The industry is currently discussing how to make this publically available.

OUTCOMES ACHIEVED

PHASE 1 (Completed - August 2013) This component of the research has provided a comprehensive review of alternative production technology options for expansion of the Tasmanian salmonid industry, identifying key trends drivers and opportunities relevant to Tasmania.

PHASE 2 Developed a conceptual framework for objectively evaluating expansion options and considering the specific constraints relevant to the Tasmanian Atlantic salmon industry.

PHASE 3 Developed an approach for spatial planning and decision support which allows differing stakeholder perspectives to be presented and reviewed, and which can be used to improve community engagement and support future aquaculture development applications.
Interactive Report and website "Salmon in Tas" developed.

LIST OF OUTPUTS PRODUCED

- Phase 1. Options Analysis Report in 2013 using data specific to the Tasmanian industry to assess the economic performance of a sub-set of potential production scenarios and as a result identify likely research and development questions.

- Phase 2. Thesis submitted and accepted March 2016.

- Phase 3. Draft final report identifying content provided in May 2015.
  Final report provided as an interactive pdf and demonstration website in September 2015, reviewed in December 2015.

  Website can be found at the following address:
  www.salmonintas.com
  Username: access
  Password: *2JrW@rJc5nFPREL*2i6jcK9

- Final report submitted June 2016

- Communication Outcomes for the Project as a whole are summarised below.

Communication type:	Title:
Salmonid Round Table Meeting, Hobart (30th November 2011)	Salmon Farming and the Environment – Metals, Organic Enrichment and Planning (Current IMAS Collaborations) (CMacleod – incl brief project overview) Options For Expansion Of Salmonid Aquaculture Within Tasmania (Andrew King)
Coastcare Week - Coastal Conversations' Regional presentations (6th December 2011)	Overview of IMAS Environmental Initiatives in Aquaculture Research & Management (Invited Presentation CMacleod – incl brief project overview)
Coastal Research Forum, Hobart (5th March 2012)	Tasmanian Salmonid Aquaculture – An Exploration Of Options For Development (Andrew King)
Managing Marine Farming: Have we Achieved Best Practice? Hobart (8th March 2012)	Overview of IMAS Environmental Initiatives in Aquaculture Research & Management (Invited Presentation C. Macleod – incl brief project overview)
Australasian Aquaculture, Melbourne (2nd May 2012)	Up-Scaling Salmonid Aquaculture in Tasmania: An Exploration of Options (Andrew King)
National Estuaries Network - Tasmanian Estuaries Symposium, Hobart (10th May 2012)	Environmental Research in Support of Sustainable Aquaculture (CMacleod – incl brief project overview)
50th Estuarine and Coastal Science Association (ECSA) Conference: Today's science for tomorrow's Management 3-7 June 2012, Venice, Italy.	Macleod, C.**,** Eriksen, R., Kelly, B., and Ross, J. (2012) Managing organic enrichment in estuarine and coastal systems - Evaluation of strategies for increasing sediment remediation rate and response. Although this particular presentation was in somewhat different area from the SFCRC research, I used the opportunity to discuss issues associated with this project with colleagues working in similar areas and to identify possible synergies and collaborations.
Australian Marine Science Association (AMSA) Conference,2 – 6th July, Hobart, Australia.	Macleod, C. and Ross, J. (2012) Environmental Management – How can modelling harmonise the needs and expectations of multiple stakeholders? Australian Marine Science Association (AMSA) Conference,2 – 6th July, Hobart, Australia. Once again although the presentation was on a different area of aquaculture management I was able to use the opportunity to discuss the specific research issues associated with this project more generally with colleagues in related research areas.
MASTS Annual Science Meeting (12th September 2012)	Research project overview (Andrew King)
Fieldwork (6th August 2012 to 10th November 2012)	Increased project awareness though various discussions as part of conferences / workshops

	(Section 5 - participants (Andrew King)) and as a result of targeted conversations with organisations identified in Milestone Report 3.
DIPIPWE (20th February 2013)	Briefing re Stage 1 findings and way ahead re Stage 2. (Andrew King)
Huon, TSGA, Tassal (22nd March 2013)	Project steering group briefing re Stage 1 findings and agreement / confirmation of way ahead re Stage 2. (MacLeod C and Andrew King)
Petuna (29th April 2013)	Stage 1 briefing and update on Stage 2 progress. (Andrew King)
SfCRC Marketing CRAM Conference (1st May 2013)	Update on Australian seafood marketing initiatives in support of situational analysis (Andrew King)
Attendance at the Seafood Executive Programme (7th – 12th July 2013)	Informal networking and briefing on the overarching SfCRC project. Development of a short article on alternative technology options for inclusion on the Seafood Executive Program Alumni linkedin site.
Fieldwork (21st July 2013 to 8th November 2013)	Increased project awareness though various discussions with UK, US and Danish industry. Particular focus on recirculation risks and economics through targeted conversations. (Andrew King)
Aquaculture Innovations Workshop, Shepherdstown, Virginia, USA, (3rd – 6th Sep 2013)	Presentation on Evaluation of Production Expansion Options – Including Land-Based Closed-Containment Systems – for the Tasmanian Salmon Industry (Andrew King)
MASTS Annual Science Meeting (12th September 2013)	Research project overview (Andrew King)
Trans-Tasman Salmon Industry Workshop (3rd – 5th February 2014)	Participation in the inaugural trans-Tasman salmon industry workshop. Focus stakeholder community engagement. Opportunity provided for in-margin briefings. (CMacleod)
TSGA Technical Committee Briefing (5th March 2014)	Options analysis briefing and discussions on pilot project (CMacleod)
Pallisade @Risk Training Course (6th – 8th February 2014)	Training in stochastic financial analysis. Opportunity taken to brief Pallisade commercial team on the project and research remits. (Andrew King)
"What's Hatching" Australian Seafood CRC Aquaculture Production Innovation Hub (SfCRC Aquaculture Hub). May 2014	Dr Catriona Macleod contributing to the inaugural edition of the talking news, :What's Hatching", in which she provided an overview of this project.

World Aquaculture 2014 (8th – 11th June 2014)	Presentation on Evaluation of Production Expansion Options – Including Land-Based Closed-Containment and Offshore Expansion – for the Tasmanian Salmon Industry (Andrew King)
Fieldwork (Jul 2014 to Oct 2014)	Increased project awareness though discussions with thirty-one stakeholder, as the second phase of data gathering in support of the scenario analysis element of the PhD research (Andrew King))
SfCRC Project Update (1 Aug 2014)	Project update briefing for L. Stephens (Andrew King)
Participation in QM course, Barcelona (22nd – 26th June 2014)	Project briefing presented as a component of a Signed digraph qualitative modelling course (Andrew King)
Aquaculture Innovations Workshop, Vancouver, Canada (27th – 29th Oct 2014)	Project update presented and 1:1 data gathering interviews completed (Andrew King)
Phase 3 – Stakeholder Engagement Workshop to present project outcomes.	DPIPWE – 2nd April 2015 TSGA & Huon Aquaculture – 1st April 2015 Tassal – 14th May 2015
Phase 3 – Stakeholder workshops to showcase project outcomes (Report and website). Presentation to TSGA Technical Committee prior to industry discussion on how to proceed.	Tassal – 18th December 2015 Huon Aquaculture – 21st December 2015 TSGA/ Petuna – 22nd December 2015 1st June 2016