FINAL REPORT (DEVELOPMENT AWARD)

AWARD CODE and TITLE

2008/328.14 **FRDC Visiting Experts – Australian Prawn Farmers Association (APFA): Water Quality Experts**

AWARD RECIPIENT: Helen Jenkins of the Australian Prawn Farming Association

ADDRESS: P O Box 392, Clayfield QLD 4011.

HOST ORGANISATION: Australian Prawn Farmers Association

DATE: January 2012

ACTIVITY UNDERTAKEN

Through a 2010 FRDC Visiting Expert bursary, the Australian Prawn Farmers Association (APFA) facilitated a visit to Australia by Associate Professor Niels Jorgensen of the University of Copenhagen and Professor Claude Boyd of Auburn University.

Professor Jorgensen provided a key note address at the APFA and Australian Barramundi Farmers Association (ABFA) conference, and then undertook co-operative work with Southeast Queensland Water and Griffith University, as well as undertaking technical tours of selected Barramundi farms in the Cairns region to provide advice on water quality and tainting of fish.

Professor Boyd undertook a tour of aquaculture farms throughout the Townsville region and participated in a science forum with APFA members and relevant Federal and State Government agencies to discuss the way forward with water discharge licensing in the Queensland aquaculture industry.

OUTCOMES ACHIEVED TO DATE

Two global experts in their respective fields came to Australia and were able to communicate to a wide audience that consisted of farmer managers, farm owners, key regulators, scientists and other researchers. The project reinforced that aquaculture is not an exact science, and that industry is burdened with regulations not supported by science. Professor Claude Boyd's expertise has empowered industry with information to counter the argument for "nil net discharge."

Acknowledgments

The APFA would like to thank and acknowledge the following for their support of this funding.

Firstly to Professor Niels Jorgensen thank you, he was willing to travel from Denmark and engage with our industry as part of an existing travel arrangement with SE Queensland Water.

1 Disseminate to all stakeholder groups advancement in water quality treatment technology

Methods

1. Professor Niels Jorgensen's presented to approximately 80 delegates at the prawn and barramundi conference.

2. Professor Claude Boyd - DEEDI Science Forum - below is a list of key personnel invited to attend.

Various presentations and minutes from the Science Forum day are attached to this report.

Science & Policy Forum September 29, 2010 target audience.

Organisation	Invited Attendees
GBRMPA	Russell Reichelt, Chief Executive GBRMPA Hugh Yorskton, Director Coastal Ecosystems and Water Quality Leigh Gray, Manager Water Quality Operations
DEWHA	Veronica Ritchie, Strategic Approvals
NAC	Justin Fromm
DAFF	Bruce Wallner
FRDC	Patrick Hone
DERM	John Lane, Director, Environment Planning Branch Stephanie Hardy, A/Principal Advisor Environment Planning Mark Gough, Team Leader Marine Policy James Fewings, Project Manager Healthy Waters Policy John Womersley, Director Environmental Services
DEEDI	Jim Groves, Managing Director Fisheries Qld Robin Hansen, General Manager (Industry Development) Kerrod Beattie, Manager Aquaculture Policy/Industry Development Sue Pillans, Senior Industry Development Officer John Dexter, Senior Industry Development Officer Samantha Miller, Principal Planning Officer

Minutes

Science & Policy Forum

29th September 2010
9.00am – 2.00pm
DEEDI – PIB, Ann St, Brisbane.

Meeting called by: APFA

Type of meeting: Science forum "The way forward with discharge licensing for the Queensland aquaculture industry."

Facilitator: Dr Nigel Preston – CSIRO Food Futures Flagship.

Note taker: Helen Jenkins - APFA

Attendees: Professor Claude Boyd, Dr Nigel Preston CSIRO, Leigh Grey GBRMPA, Dr Richard Smullen Ridley Aquafeed, John Lane DERM, Ian Eskdale DERM, Bob Hoey DERM, Kerrod Beattie DEEDI, Robin Hansen DEEDI, Aimee Moore Office of Minister for Primary Industries, Fisheries and Rural and Regional Queensland, Grahame Byron Premiers Department, Alistair Dick Pacific Reef Fisheries (PRF), Maria Mitris PRF, Kevin Smythe PRF,, Kylie Giles – FRDC, Michael Heidenreich DEEDI, Marty Phillips ABFA, Graham Dalton QAIF, Lindsay Trott AIMS, Warwick Nash DEEDI, Peter Lee DEEDI, Max Wingfield DEEDI, Sam Miller DEEDI, John Dexter DEEDI, Rebecca Schofield DEEDI, Kylie Wells SEWPAC, David Rhind SEWPAC.

APOLOGIES: Nick Moore Gold Coast Marine Aquaculture, Dr Trevor Anderson Seafarm, Liz Evans Primo Aquaculture, Mark Oliver Aquaculture Support Services.

Agenda topics

Dr Preston introduced the forum and the purpose, he thanked the participants and noted that Marty Phillips President of the Barramundi Farmers Association was present and offered an opportunity for him to speak to the forum.

9.20 – 9.30am	Reef Water Quality Protection Plan (Reef Plan)	Grahame Byron – Department of the Premier & Cabinet

Discussion:

Grahame has 30 years experience in marine environment and fishing industry.

Reef Rescue plan was developed because inshore water quality for GBRMPA was declining and there was a need to know why and where were the main sources of nutrient and sediment inputs. It was determined that 80%, if not more, was from agriculture areas and that this was on the increase. The plan was first introduced in 2003 then upgraded in 2009 and supports actions of government, industry and community. The reef generates $6 billion to the Queensland economy and reef rescue has allocated $200 million, matched by industry. Farmers must implement a full ERMP that is independently audited. There are specific targets by:

2013 - 50% reduction in nitrogen & phosphorus loads, 50% reductions in pesticides, 80% of landholders (cane, grazing, cotton, dairy, cereal crops, fruit & vegetables) to adopt improved soil management practices.

Two key priorities are improving the environmental conditions and social change. There is change happening, this reef plan has strong partnerships with regional bodies, industry sectors who sit collectivel with policy makers to agree on the best way forward.

Copies of Reef Water Quality Protection Plan were available for attendees.

Questions:

Kerrod Beattie – Was aquaculture ever considered when the Reef Plan was introduced?

Grahame – No and next big battle is the mining sector.

Dr Richard Smullen – Understand that cane farmers have to reduce discharge loads but to they have to operate to nil net discharge?

Grahame – No.

Conclusions:

Action items:	Person responsible:	Deadline:

9.40 – 10.00am	Science behind prawn farming in Queensland	Dr Nigel Preston – CSIRO Food Futures Flagship

Discussion:

Dr Preston explained that the science for water quality started in the late 1990's as a response to all stakeholders, sediment & nutrient discharge and the impacts to the environment. A brief summary of the research undertaken from 1994 – 2004 has been prepared. Copies of this report are attached to these minutes. The value of this research is estimated to be $5 million, has provided 42 peer reviewed papers, 3 final reports and various media releases.

As a result of this research all farms have adopted the practice of using between 10% and 35% of their farm as treatment ponds where the sediment settles prior to water discharge. Some research has been recently done on biofloc system which is almost a closed system but despite significant advances still cannot achieve zero net discharge.

Prawn farms have operated adjacent to GBRMPA for more than 20 years and in this time there have been no adverse impacts. Ideally the environmental management of the GBR lagoon system should be on a whole-of-catchment basis. For example, the proposed Guthalungra discharge environment is a region that is also impacted by the activities of a major coal terminal to the south and major sugar cane production areas to the north. Dr Preston emphasised that the role of CSIRO, and other research organisations, is to provide science to regulators and industry and not in advocacy or policy making. Dr Preston advised that and zero net discharge of sediment and nutrients is currently not achievable for any commercial prawn farm in the world. However, over the past 10 years there has been progressive reduction in nutrient and sediment discharge from Australian prawn farms and no adverse impacts from the current farms that are adjacent to the GBR. Queensland has ~ 0.5 million hectares of sugar cane production and ~ 1,000 hectares of prawn farm production. There are several published studies of the discharge from prawn farms into costal waters but no equivalent studies of the discharges from cane farms.

Conclusions:

Action items:	Person responsible:	Deadline:

12.30 – 2.00pm	White Board Issues & Solutions	Group discussions

Discussion:

Post lunch this discussion seemed to initially focus on the Guthalungra development until there was objection form Leigh Gray and the DEWHA people. Kerrod confirmed that it was industry based and with difficulty in getting higher levels to attend it is expected that those who have attended will report back to their hierarchy what the industry is trying to cope with.

Dr Preston bought the discussions back to industry development level.

Critical question – Is there a likely prospect of achieving permissible level of discharge to allow new ventures to proceed in the area of GBR?

Questions were raised about all industries having to comply with the same regulation of zero net discharge and it appears that aquaculture has been targeted to meet this level while other sectors have not but must meet conditions of the Reef Plan and Reef Outlook Report 2009.

There is a distinct disconnect between what is being imposed and how to achieve and some thought that there was current technology available to reduce waste drastically a primary driver for new developments is to be "site specific and the ability of the environment to assimilate".

John Lane responded that zero net discharge could be answered: yes, no and don't know. What is the objective of the regulation? Is it acceptable that effluent causes net increase in sediment and nutrients in the receiving environment?

Leigh Gray responded that the assimilative capacity is different from nutrient indicator – an increase in algae can potentially change the ecosystem health. He suggested that zero net is achievable through drum filters and vertical triple filters that are used in Israel and if adopted would give farms back the 30% of land used for settlement ponds and turn them into production areas. However, there was consensus among all participants that there are currently no commercial prawn pond operations in the world that are operating with zero net sediment and nutrient discharges.

It was agreed that there is currently a lack of validations into non tidal creek environment impacts therefore not known what the acceptable nutrient discharge limits could be.

Warwick Nash suggested there could be an option to trade off nutrient loads with cane farmers.

Kerrod Beattie responded that when considering new developments each government department has a requirement to consider economics – triple bottom line and that if science supports new farms then economics must come into considerations as well. Prawn return can be as high as $250,000 per hectare of aquaculture a figure not matched by other agriculture sectors.

In moving forward Nigel identified that the following are the major issues for the aquaculture industry:

- Where can the next farm go and what can it discharge?
- Assimilative capacity of new developments.
- Process for quantifying permissible discharge loads.
- Offsets.
- Scientific summary and consensus on the science.
- Summarise approvals process within a framework.

A smaller representative group should be formed to take the above issues forward, where discussion needs to get down to technical levels.

Those involved in this discussion should include – GBRMPA, SEWPAC (formerly DEWHA), DERM, DEEDI, AIMS, CSIRO and Industry. This is subject to senior managers within each of these departments approving further facilitation.

Shrimp Farm Effluents

Claude E. Boyd
Department of Fisheries and Allied Aquacultures
Auburn University, Alabama 36849 USA

CALCULATED INPUTS, OUTPUTS, AND LOADINGS OF CARBON, NITROGEN, AND PHOSPHORUS FOR THE PRODUCTION OF 1,000 KG LIVE *PENAEUS VANNAMEI* AT A FEED CONVERSION RATIO OF 2:1 (AIR DRY WEIGHT OF FEED:LIVE WEIGHT OF SHRIMP).

Input	(%)	Amount (kg)	Output	(%)	Amount (kg)	Loading (kg)
Feed[A]		2,000	Live shrimp		1,000	
Dry matter[B]	92	1,840		25.5	255	1,585
C[C]	52.1	959		43.0	110	849
N[C]	3.47	64		11.2	29	35
P[C]	0.82	15		1.25	3.2	11.8

[A]Air dry basis
[B]Oven dry basis
[C]Oven dry basis

Annual Effluent Volume

Equation 1

Farm discharge in m^3/yr = pump discharge in m^3/min × average time of pump operation in hr/day × 60 min/hr × 365 days/yr.

Equation 2

Farm discharge in m^3/yr = [volume of ponds in m^3 × number of crops/yr] + [volume of ponds in m^3 × average daily water exchange rate as fraction of pond volume × crop in days × number of crops/yr].

Water Use and Load Indices

Water use index (m^3/kg shrimp) = annual effluent volume (m^3) ÷ annual shrimp production (kg).

Load index (kg variable/ton shrimp) = annual load of variable (kg/yr) ÷ annual shrimp production (ton/yr).

$$\text{Effluent N} = \frac{(\text{Feed N} + \text{Fertilizer N}) - \text{Shrimp N} - [(\text{Sediment N} + \text{Gaseous N}) \times \text{F}]}{\text{Shrimp production}}$$

$$\text{Effluent P} = \frac{\text{Feed P} + \text{Fertilizer P} - \text{Shrimp P} - \text{Sediment P} \times \text{F}}{\text{Shrimp production}}$$

Water exchange factors.

Daily water exchange rate (% of pond volume	Factor F
0	1
< 2.5	0.95
2.6 – 5.0	0.90
5.1 – 10	0.85
11 – 20	0.75
21 – 50	0.30
> 50	0.00

Pond management inputs and shrimp harvest data for three study ponds.

Variable	Mean	Variable	Mean
Pond area	9.94 ha	Lime	11,040 kg
Pond volume	105,033 m^3	Feed	40,842 kg
Water used	1,952,026 m^3	Crop duration	154 days
Shrimp stocked	1,211 kg	Shrimp harvested	20,642 kg
Triple superphosphate	69 kg	Net shrimp production	19,552 kg

Fate of phosphorus applied to ponds in fertilizer and feed.

Fraction	kg	% of P applied
Phosphorus contained in shrimp (P in harvested shrimp – P in larvae)	50.9	7.68
Phosphorus discharged (Effluent P – Influent P)	162.2	24.5
Phosphorus adsorbed by soil (ΣP inputs - ΣP outputs)	449.2	67.8

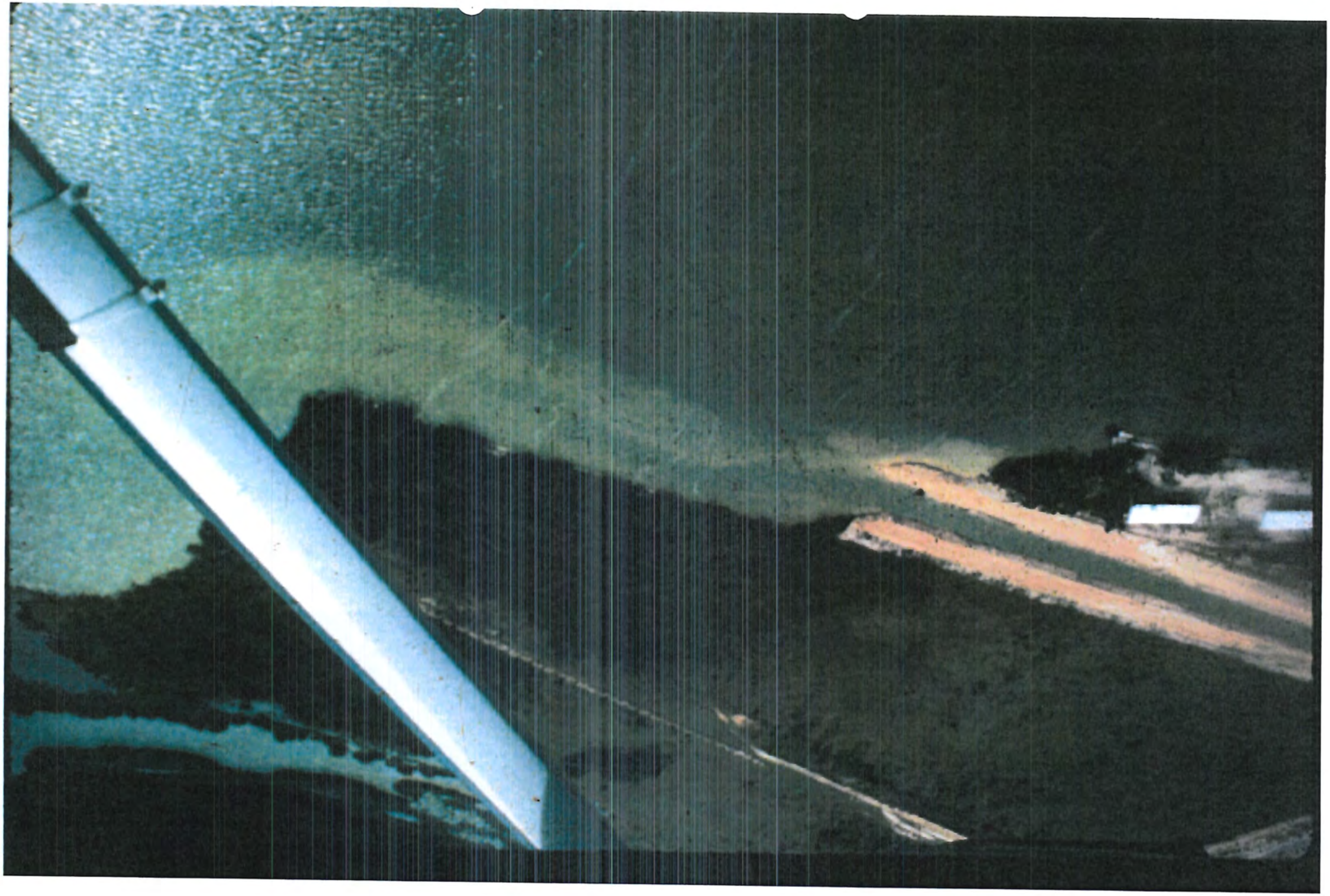
Data related to 2008 study of discharge of major pollutants from a shrimp farm in Alabama.	
Ponds	17
Total area	21.8 ha
Total water volume	307,380 m^3
Volume discharged (2008)	154,826 m^3
Shrimp production (2008)	77.8 tonne

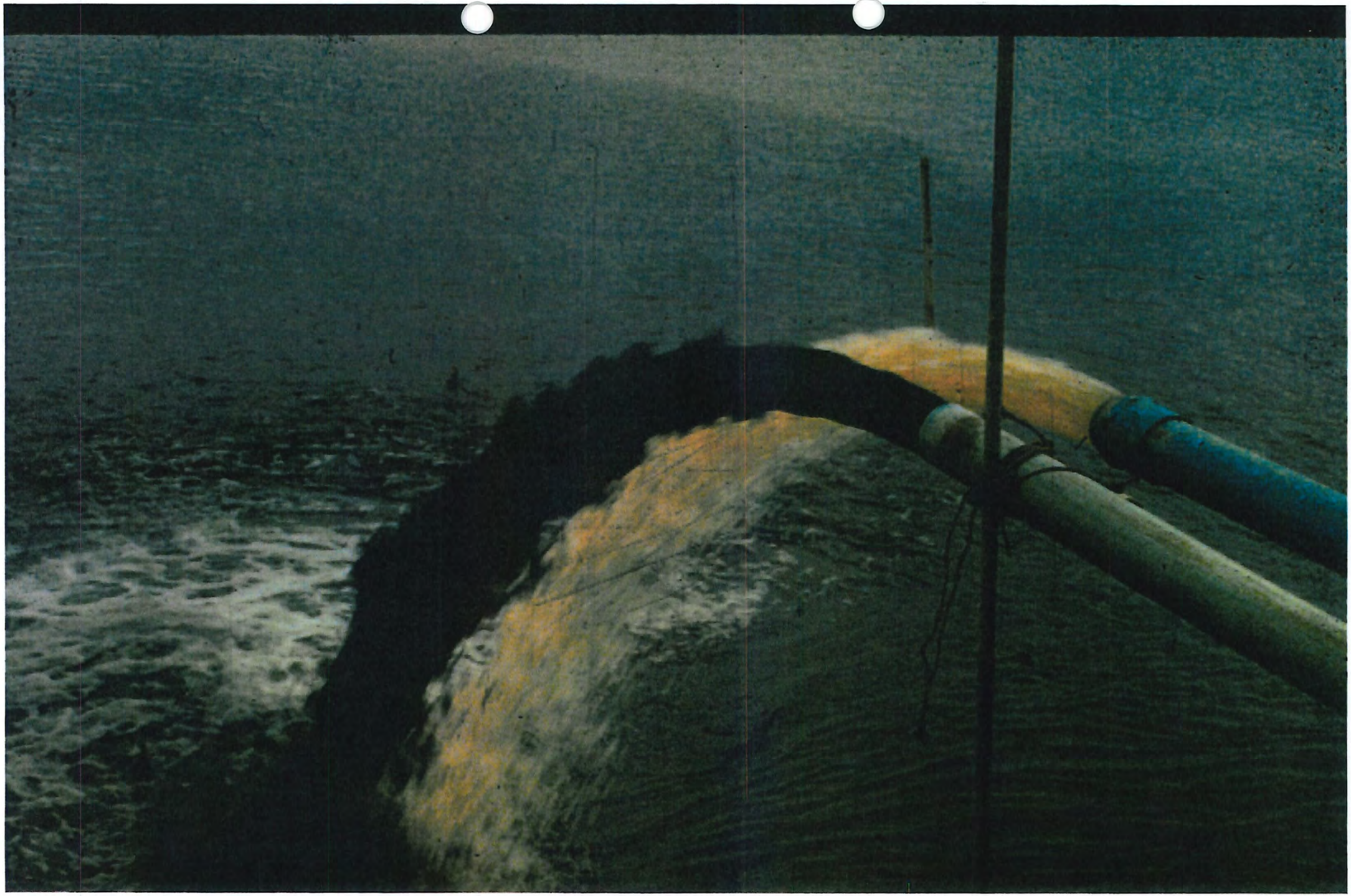
Quote from WWF Document related to shrimp farm effluent

"Water discharged from shrimp farms cannot be expected to have equal or better quality than receiving water bodies. Thus, there must be allowance in certification standards for discharge of a portion of the N/P applied to ponds."

Proposed effluent load limit versus WWF "Ecolabel" program load limits and measured loads for two shrimp farms

	Load limits (kg/tonne shrimp)		**Actual loads (kg/tonne shrimp)**	
	Proposed	WWF	Madagascar	Alabama
TSS	99.8	-	-	480
TN	7.35	28.5	Approx 70	14.5
TP	0.75	5.5	7.84	1.1





Oxidation of Ammonia Nitrogen from Feed

$$NH_4^+ + 2O_2 \longrightarrow NO_3^- + 2H^+ + H_2O$$

$$\frac{2O_2}{NH_4\text{-}N} = \frac{64}{14} = \frac{4.57}{1}$$

O_2 used = (Feed N – Shrimp N) 4.57

Biochemical Oxygen Demand of Feed

Feed BOD = (Feed C – Shrimp C) 2.67 + (Feed N – Shrimp N) 4.57

Feed: 45% C and 5.6% N

Shrimp: 11% C and 2.86% N

Effect of average, early morning, DO concentrations on shrimp survival, yield, and FCR in ponds stocked at 33 postlarvae/m^2. Source: McGraw et al. (2001).

Early morning dissolved oxygen (mg/L)	Survival (%)	Shrimp yield (kg/ha)	FCR
2.32	42	2,976	2.64
2.96	55	3,631	2.21
3.89	61	3,975	1.96

The environmental management of prawn farming in Queensland – worlds best practice

Research Summary

The environmental management of prawn farming in Queensland – worlds best practice

The emergence of prawn farming as an economically successful industry in coastal regions of Queensland over the past two decades prompted a comprehensive, multi-disciplinary study of intensive prawn pond ecosystems, their ecological impacts on downstream environments and the development of cost-effective effluent treatment systems.

The seven year study (1995-2002) focussed on the largest prawn farms in Queensland and New South Wales throughout the production cycle for several successive years. The study encompassed a range of latitudes, discharge environments (e.g. tidal creeks and estuaries) and both flow through and recirculating water management systems.

The study integrated the research skills of 30 scientists from several institutions including CSIRO, Australian Institute of Marine Science, University of Queensland, Queensland Department of Environment and Heritage, New South Wales Environment Protection Authority, Griffith University, University of Sydney, University of Technology, Marine and Freshwater Resources Institute, Victoria and the University of Maryland, U.S.A.

The multidisciplinary study was the most comprehensive analysis of the environmental management of prawn farming ever conducted. The team developed rigorous techniques for sampling eutrophic pond ecosystems including sediment and water column nutrients and microorganisms, pond biota and abiotic variables. The application of enriched isotope nutrient labeling techniques, pioneered by the team, permitted the first accurate quantification of the fate of feed nutrients in an intensive prawn farming system and downstream from the farm. The integrated approach adopted throughout the study also permitted the team to produce a multi-author synthesis of the dominant ecological processes in intensive shrimp ponds and adjacent coastal environments. Beyond developing a quantitative understanding of these processes the team analysed pond effluent composition and designed a cost-effective effluent treatment system based on sedimentation processes. The introduction of settlement ponds has also provided industry the opportunity to recapture water nutrients using natural biological filters.

The results of the project have been communicated via 42 refereed scientific publications and four final reports (see references).

Scientific publications and reports - Prawn pond nutrient process, downstream impacts and environmental management options

In ponds

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4. Burford, M. A. and Longmore, A.R., 2001. High ammonium production from sediments in hypereutrophic shrimp ponds. Marine Ecology Progress Series 224, 187-195.
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6. Burford, M. A., 1997. Phytoplankton dynamics in shrimp ponds. Aquaculture Research 28, 351-3
7. Burford, M. A., 2001. Fate and transformation of dietary nitrogen in penaeid prawn aquaculture ponds. PhD Thesis, University of Queensland, Australia, 162 pp.
8. Burford, M. A., Peterson, E. L., Baiano, J. C. F. and Preston, N. P., 1998. Bacteria in shrimp pond sediments: their role in mineralizing nutrients and some suggested sampling strategies. Aquaculture Research 29, 843-849.
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10. Burford, M.A., Preston, N.P., Glibert, P.M., Dennison, W.C., 2002. Tracing the fate of 15N-enriched feed in an intensive shrimp system. Aquaculture 206, 199–216.
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13. Coman, F.E., Connolly, R.M., Bunn S.E., Preston, N.P., 2006. Food sources of the sergestid crustacean, *Acetes sibogae*, in shrimp ponds. Aquaculture 259: 222–233.
14. Coman, F.E., Connolly, R.M., Preston N.P., 2006. Effects of water exchange and abiotic factors on zooplankton and epibenthic fauna in shrimp ponds. Aquaculture Research 37: 1387-1399.
15. Gao, J. and Merrick, N.P., 1996. Simulation of temperature and salinity in a fully mixed pond. Environmental Software, 11(1-3): I73-8.
16. Jackson, C.J. and Wang, Y.G., 1998. Modelling growth rate of *Penaeus monodon* Fabricius in intensively managed ponds: effects of temperature, pond age and stocking density. Aquaculture Research 29: 27-36.
17. Peterson, E.L., 2000. Observations of pond hydrodynamics. Aquacultural Engineering 21: 247-269.
18. Peterson, E.L., Harris, J.A. and Wadhwa, L.C., 2000. CFD modelling pond dynamic processes. Aquacultural Engineering 23: 61-93.
19. Peterson, E.L., Wadhwa, L.C. and Harris, J.A., 2001. Arrangement of aerators in an intensive prawn growout pond having a rectangular shape. Aquacultural Engineering, 25: 51-65.

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Synthesis documents

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Land-based mapping

46. McLeod, I., Pantus, F. & Preston, N.P. (2002) The use of a geographical information system for land-based aquaculture planning. Aquaculture Research 33: 1-10.

Australian Government

Great Barrier Reef
Marine Park Authority

Management of water quality in the Great Barrier Reef World Heritage Area

Management of potential pollution

Australian Government
Great Barrier Reef Marine Park Authority

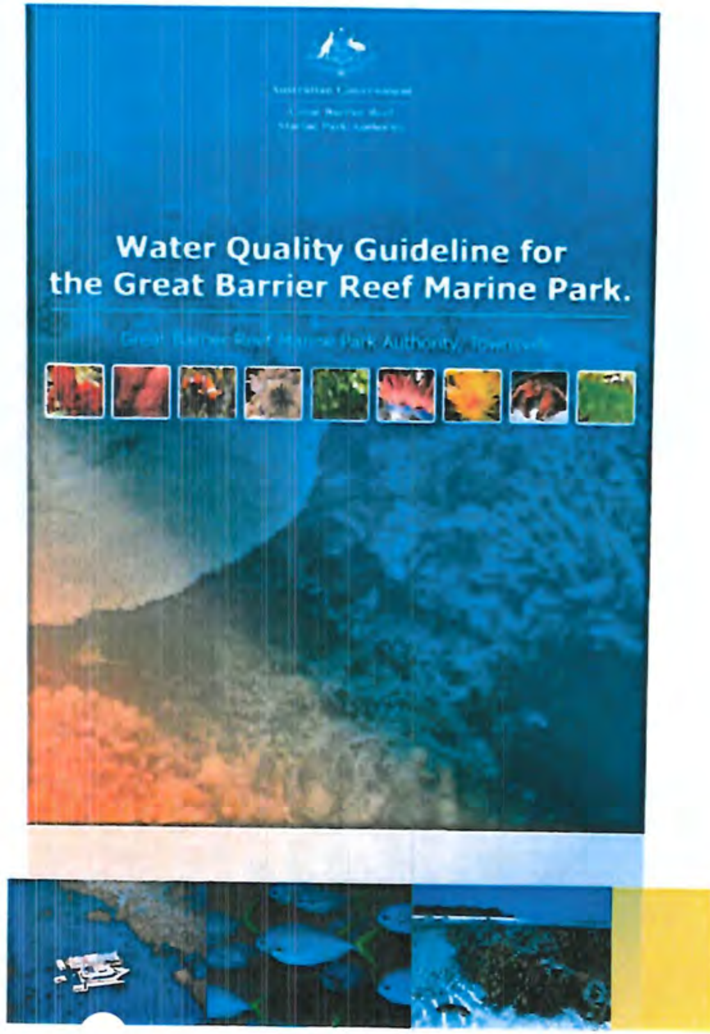
- **Existing facilities**
  (Continual improvement)

- **New facilities**
  (Based on the capacity of the receiving environment and facility design)

Assessment of potential impacts

Australian Government
Great Barrier Reef Marine Park Authority

- **ANZECC, Qld and GBRMPA water quality guidelines**
- **Licensing wastewater releases from existing marine prawn farms in Qld**
- **Wastewater discharge to Qld waters and associated procedural guidelines**



Exceedance

Australian Government
Great Barrier Reef
Marine Park Authority

NRM Region	Location	Turbidity	Secchi	PN Wet	PN Dry	PP Wet	PP Dry
Wet Tropics	Snapper Island						
	Fitzroy Island						
	Russell Island						
	High Island						
	Dunk Island						
Burdekin	Pelorus Island						
	Pandora Reef						
	Geoffrey Bay						
Mackay Whitsunday	Double Cone Island						
	Daydream Island						
	Pine Island						
Fitzroy	Barren Island						
	Humpy Island						
	Pelican Island						
		Logger					

Direct sampling data: Based on 1-2 sampling occasions per season per site over 4 years

Considerations for expansion of industry

Australian Government
Great Barrier Reef
Marine Park Authority

- Site selection
- Capacity of the receiving environment
- Design standards
- Treatment standards
- Environmental offsets

Management of waste discharges to the Great Barrier Reef Marine Park – a World Heritage Area

Leigh Gray
Manager Water Quality Operations, Great Barrier Reef Marine Park Authority

The Great Barrier Reef Marine Park Authority has as its primary goal to maintain, enhance and protect aquatic ecosystems in the Great Barrier Reef Marine Park. In order to meet this goal, good water quality is vital. Because it is a World Heritage Property there are both national and international obligations that must be met with regard to any potential development of this property.

In 2009 the Great Barrier Reef Marine Park Authority released the *Great Barrier Reef Outlook Report 2009*. The Outlook Report is an important stock take of the Great Barrier Reef, its management and its future.

The primary aim of the Outlook Report is to provide a regular and reliable report on the management of the Great Barrier Reef Marine Park, the overall condition of the ecosystem of the Great Barrier Reef Region (including the ecosystem outside the Region where it affects the Region), social and economic factors, as well as a risk-based assessment of the longer-term outlook for the Region.

Regular reporting through the Outlook Report is crucial in the ongoing monitoring of the Great Barrier Reef and its management. It is a summary of the past and present condition of the environmental, economic and social values of the Great Barrier Reef and presents its possible future.

This first Outlook Report highlights that the Great Barrier Reef is one of the most diverse and remarkable ecosystems in the world and remains one of the most healthy coral reef ecosystems. **Climate change, continued declining water quality** from catchment runoff, **loss of coastal habitats** from coastal development and a small number of impacts from fishing are identified as the priority issues reducing the resilience the Great Barrier Reef.

The Outlook Report highlights that over the last 150 years, the land catchment areas adjacent to the Reef have undergone extensive modification for urban infrastructure, agricultural production, tourism and mining. This modification has led to significant increases in pollutant loads in the rivers since the beginning of European settlement, such that now the major sources of pollutants entering the Reef are the result of land use activities in the catchment areas. Scientific consensus states that there has been a 5 – 10 fold increase in sediment loads, a 2 – 5 fold increase in nitrogen loads, and a 2 – 10 fold increase in the phosphorus loads incident on the inshore waters of the Great Barrier Reef.

Current monitoring of the inshore coastal waters of the Great Barrier Reef indicate that these waters generally exceed the healthy values for chlorophyll *a* and water clarity, with half of these samples exceeding the healthy value for total suspended solids. It must be understood that there is scientific consensus that the inshore coastal waters of the Great Barrier Reef Marine Park are currently being impacted by elevated concentrations of nutrients, sediments and pesticides and that adding additional loads of sediment and nutrient will only further exacerbate the existing problem.

does not however, mean that the discharge of waste is environmentally acceptable. These standards are based on agreed best current farm practices at the time (2004) and do not account for the assimilative capacity of the receiving environment in the proposed discharge location. Standards for new prawn farm facilities have not been agreed at this time.

Critical factors in potential future development of the industry include;

- Determination of site suitability based on the assimilative capacity of the receiving environment
- Physical site characteristics
- Opportunities for Environmental Offsets on a like for like basis and in the same location as the proposed discharge
- Design and treatment standards – there is an urgent need for research into new and innovative practices that reduce the need to discharge aquaculture waste at current levels rather than continue to make minor improvements in existing practices.

Existing situation

Future best pract…

solutions - case study
- subject to legal action

EP requirements
- site-specificity
- agreed standard in place - continual improvement
- primary driver - based on assimilative capacity of receiving waters - i.e. site specificity

issues -industry
- standard in place (zero net discharge) is unattainable at present time

Reef plan - requirements
- discussion driven by reef plan

GBRMPA requirements

what is acceptable?
- what is acceptable discharge?
- site-specific ability of the receiving waters to assimilate
- inshore waters of the reef already have critical levels of nutrients and sediments

50% reduction in nutrients by 2013 to GBR WHA
- reduction is overall, not per industry
- reduction in aquaculture will have an insignificant difference to this goal
- however may make a large difference at the scale of the locality
- another type of offset is offset across industries

…rch providers (CSIRO / AIMS)
- …ence is mature, but no system is …charging into nontidal discharge

Claude - research
- …ndards (low but more stringent than …d) or global …tion based)

solutions - Qld industry level

Qld offset policy - federal govt has draft offset policy
- offset prawn trawling against aquaculture?

smaller working group to address solutions in detail
- bring relevant people together - attempt a more coordinated / standardised approach
- agencies represented:GBRMPA, DERM, DEEDI, industry, SEWPAC (former DEWHA). (proposed only)
- brief
  - need surrogate for assimilative capacity / ecosystem health
  - interpretation of offset policies for aquaculture
  - "what will it take to get a farm approved?"
  - concise summary of the science from a whole-of-govt perspective
  - framework for assessment - criteria for approval and context for the various components of the approval process - lot of uncertainty about this process (evolving process based on science)
  - zoning process - can quantify permissible loads up front, cf other states
    - subset of zoning is a framework for assessment for water quality (however zoning requires water quality data)

effluent treatment to achieve zero net discharge
- research proposal - invest in next level of treatment technology

Consensus - Qld industry level

currently lack of validation of discharge into non tidal creek? - yes
- monitoring / compliance requirements - how do they vary from known quantities
- current legislation requires investigation into whether it is possible to discharge on site-specific basis
- water quality guidelines recently reviewed - up to date

requirement to consider triple bottom line, including economics?
- aquaculture is highly productive relative to its impacts
- legislation includes triple bottom line approach, however statutory standards must be achieved (Qld, EPBC)
- mechanism for achieving balance?

zoning process - can quantify permissible loads up front, cf other states
- process for going forward - identifying permissible loads on strategic basis? balance economic and environmental needs
- how to identify inshore waters that have lesser or greater existing stress / assimilative capacity
- how well can different bodies of water be compartmentalised - mixing etc. need to consider whole-of-catchment to answer questions at local scale, information needs to be collected at large scale

are there barriers to new aquaculture farms using nutrient trading? - offsets

currently impossible to achieve zero net discharge?
- commercial viability? (have not explored all possible technological solutions)
- net load over growing season vs no discharge (zero waste system necessary to achieve regulatory standards)
- no commercially operating shrimp farm in the world currently has zero net discharge

agreement that inshore GBR lagoon areas are currently stressed?
- cf. AIMS data presented by GBRMPA
- under what circumstances could new aquaculture operate adjacent to these waters? given that it is currently stressed and there is a requirement to reduce by 50%

process for assessment is in place (no statutory prohibition)
- not clear cut - need ability to measure assimilative capacity of adjacent waters
- use of creeks for disposal vs open waters of GBR lagoon
- what is the basis for determining assimilative capacity?
  - ANZECC guidelines, approximations in use, what more researchable issues must be resolved to take this forward
- degree of difficulty is higher in areas where there is a knowledge gap, however approximations should be possible based on existing science
  - what is being asked in terms of reduction - is this equivalent across other primary industry sectors?
  - tools available to measure assimilative capacity may use different criteria- and basis for acceptability remains unresolved
    - need surrogate for assimilative capacity
      - is there a set of assessment criteria? S.A and Tas more advanced, Qld working on more detailed assessment criteria and criteria for site selection, framework for considering effluent disposal is an acknowledged gap. Need to determine assimilative capacity on a strategic basis (it's too late after the property is nominated for aquaculture).

Is it acceptable that effluence causes a measurable change in the receiving environment?
- assimilation vs detection
- assimilation may change function, difficulty defining the point at which ecological health is adversely affected
  - similarly adjacent land uses need to be taken into account in planning

Previous research
- CSIRO
- AIMS

Future research

Policy / Legislation

Water quality

Future policy actions

Current industry practice
- Up to 95% recirc

Future industry practice

Continuous improvement model