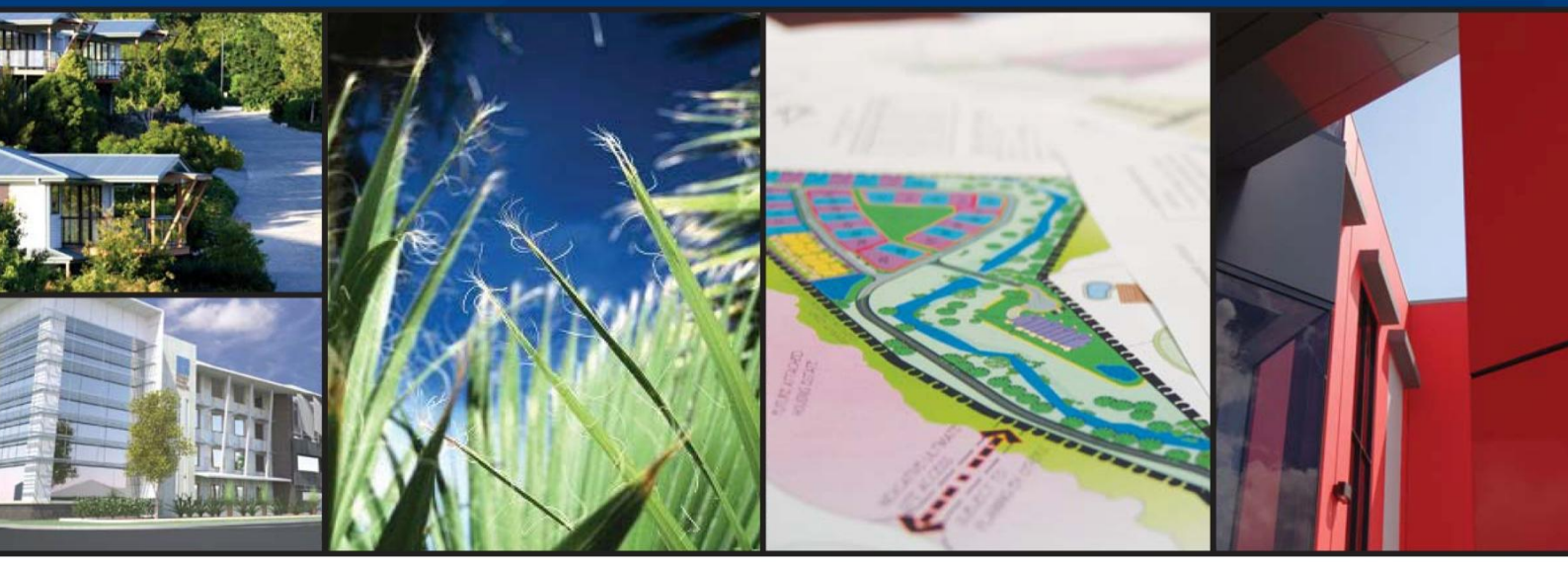
Environmental Impact Monitoring Program (EIMP) - Spring 2015

Lot 1 on RP804106, Trent Road via Ayr

PREPARED FOR

Pacific Reef Fisheries (Australia) Pty Ltd

December, 2015



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1 Introduction

1.1 Background

This report has been prepared for Pacific Reef Fisheries (Australia) Pty Ltd (PRF) by Gassman Development Perspectives to fulfil the requirements of the Environmental Impact Monitoring Program (EIMP) developed by BTEQ in March, 2005 and updated by Gassman Development Perspectives in November, 2013. This monitoring program was developed in part to satisfy ongoing licensing requirements determined by the Department of Environment and Heritage Protection (DEHP), Great Barrier Reef Marine Park Authority (GBRMPA) and the federal Department of Environment.

This report outlines the results for this sampling event which continued the ongoing monitoring program. This monitoring occurred on 24th and 25th of November, 2015. The purpose of the annual monitoring program is to determine any changes that occur to the receiving environment as a result of adjacent prawn farm activities by comparing various environmental parameters.

PRF has the following approvals which allow for the discharge of aquaculture of aquaculture waste to the surrounding environments:

- DEHP – Integrated Authority NR0280
- GBRMPA – Permit no. G01/352.2
- Department of Environment – EPBC 2001/402

1.2 Site description

The farm is located on Trent Road, Alva Beach which is 15km east of Ayr, Queensland (Figure 1). The site consists of 105 operational ponds covering 98 hectares for the production of Marine prawns (*Penaeus monodon*). The facility also has a hatchery, processing plant, 10.3 hectares of settlement-treatment ponds and 7 hectares of constructed mangrove wetland designed to reduce contaminants in the aquaculture waste prior to release into the receiving environment. Aquaculture waste generated on-site is treated prior to discharge into Little Alva Creek. An aerial image of the site can be found in Figure 2.

Figure 2 – Aerial photograph of the Pacific Reef Fisheries Prawn Farm

1.3 Objectives of the monitoring program

The purpose of this monitoring program is to detect any measureable environmental effects on the receiving waters of Little Alva Creek by regularly monitoring sites on both Little Alva Creek and nearby reference sites along Alva Creek. Observed intra-site differences in the following parameters will determine any measurable impacts that aquaculture waste discharge is having upon Little Alva Creek:

- Mangrove health including species composition, canopy cover, canopy height, density of mature trees and density of saplings;
- Abundance and diversity of benthic macro-invertebrates;
- Total organic carbon and grain-size distribution of benthic sediments; and
- Monthly water quality monitoring for the past 12 months.

2 Methodology

2.1 Sampling locations

Eight (8) locations have been selected for sampling. They are identified as follows:

A Discharge point into Little Alva Creek
B 500m downstream in Little Alva Creek
C 250m north of mouth of Little Alva Creek
D Location in Alva Creek corresponding with G
E Location in Alva Creek corresponding with B
F 250m north of mouth of Alva Creek
G 250m upstream of discharge point in Little Alva Creek
H Location in Alva Creek corresponding with A

Figure 3 shows the locations of all sampling sites.

All sites were accessible on this monitoring occasion.

2.2 Mangrove health monitoring

Mangrove health was monitored at sites A, B, D, E, G and H. At each site, permanent 400m^2 (20m x 20m) quadrats were established at the water extent of the mangrove edge and extended back into the mangrove stands. At each location the following parameters were measured:

- Species composition;
- Density of mature trees (over 3m);
- Density of saplings and small trees (under 3m).

Additionally, three to four permanent photographic reference points were established at each monitoring location on the first monitoring occasion (photographs in Appendix 1). These reference points continue to be utilised.

2.3 Sediment sampling methods

At locations B, C, E and F sediments were sampled for the following parameters:

- Total organic carbon;
- Grainsize distribution; and
- Species composition and abundance of benthic macroinvertebrates.

Three samples were taken and analysed for each parameter at each site. Averages were calculated from the three samples and this average value used for analysis. All results from each sample of macroinvertebrates collected are presented.

2.4 Water quality monitoring

Each month, water quality is measured at sites A, B, D and E as per procedures outlined in the EIMP document and in accordance with licence conditions. The following parameters are measured:

- Temperature
- pH
- Dissolved oxygen
- Salinity
- Total Suspended Solids
- Turbidity
- Total Nitrogen
- Total Phosphorous

The results from the previous 12 months of monitoring are included in Appendix 2 of this report.

3 Results and Discussion

3.1 Mangrove health

The results of the mangrove quadrats for the four sites monitored are summarised in **Table 1**. The same species at each site were detected consistent with last monitoring occasion. Trees and saplings under 3m in height continue to outnumber mature trees at all sites. Densities of trees over 3m in height remain generally consistent with last monitoring occasion. Densities over trees under 3m noticeably decreased for sites A, B, D and H. Declines in trees under 3m in height were observed across both the discharge creek and the reference creek so are unlikely to be attributable to activities resulting from the prawn farm's operations. The landward edges of the mangrove areas appeared to be particularly dry in comparison to previous years' monitoring.

Photographs of the quadrats are found in **Appendix 1**.

Table 1 – Mangrove observations for permanent quadrats

Quadrat	Species Present	Density of trees >3m (per m^2)	Density of trees <3m (per m^2)	GPS coordinates
A	*Ceriops australis; Avicennia marina; Rhizophora stylosa; Aegiceras corniculatum*	0.0625	0.72	-19.469, 147.486
B	*Avicennia marina; Rhizophora stylosa*	0.02	0.1625	-19.4654, 147.49
D	*Avicennia marina; Rhizophora stylosa; Ceriops australis; Aegalitis annulata*	0.4	0.8	-19.4655, 147.473
E	*Avicennia marina; Rhizophora stylosa; Aegalitis annulata*	0.035	0.8	-19.4632, 147.487
G	*Avicennia marina; Rhizophora stylosa*	0.8	0.75	-19.4703, 147.4837

Quadrat	Species Present	Density of trees >3m (per m^2)	Density of trees <3m (per m^2)	GPS coordinates
H	*Rhizophora stylosa; Avicennia marina; Aegalitis annulata; Osbornia octodonta*	0.45	0.0375	-19.4644, 147.4802

3.2 Sediment biogeochemistry

3.2.1 Particle size distribution

The results of the particle size distribution (PSD) analysis are presented in Figure 4 and Table 2**.** On this occasion, sites B, C and E displayed high levels of uniformity. Site F displayed a higher concentration of sediments within the 0.03mm range but the distribution does not appear to vary substantially from the remaining sites. This indicates that the neither creek system has substantially changed between monitoring occasions.

Because of the uniformity among the other samples, it is not likely that the differences are related to aquaculture activities. Various seasonal and environmental factors, including possible sampling anomalies are likely to be responsible for this difference with site F from the other sites. However, if this pattern continues on the next monitoring occasion, further investigations may be required to determine the potential source of the variation.

A minimum of eight (8) samples per site would be required to analyse the data statistically, however visual trends observed from charts such as Figure 4 are considered to be sufficiently indicative of changing trends over time. Figure 5 contains the comparison plot from the spring sampling occasion from 2014.

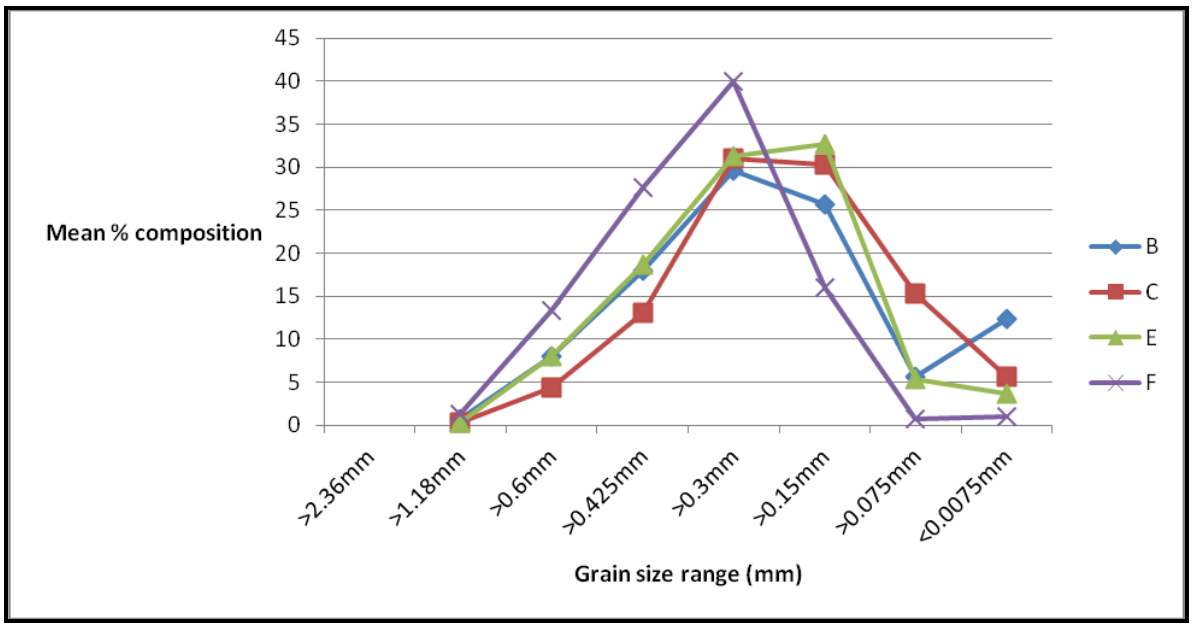

Figure 4 – Particle size distribution chart for sites B, C, E and F

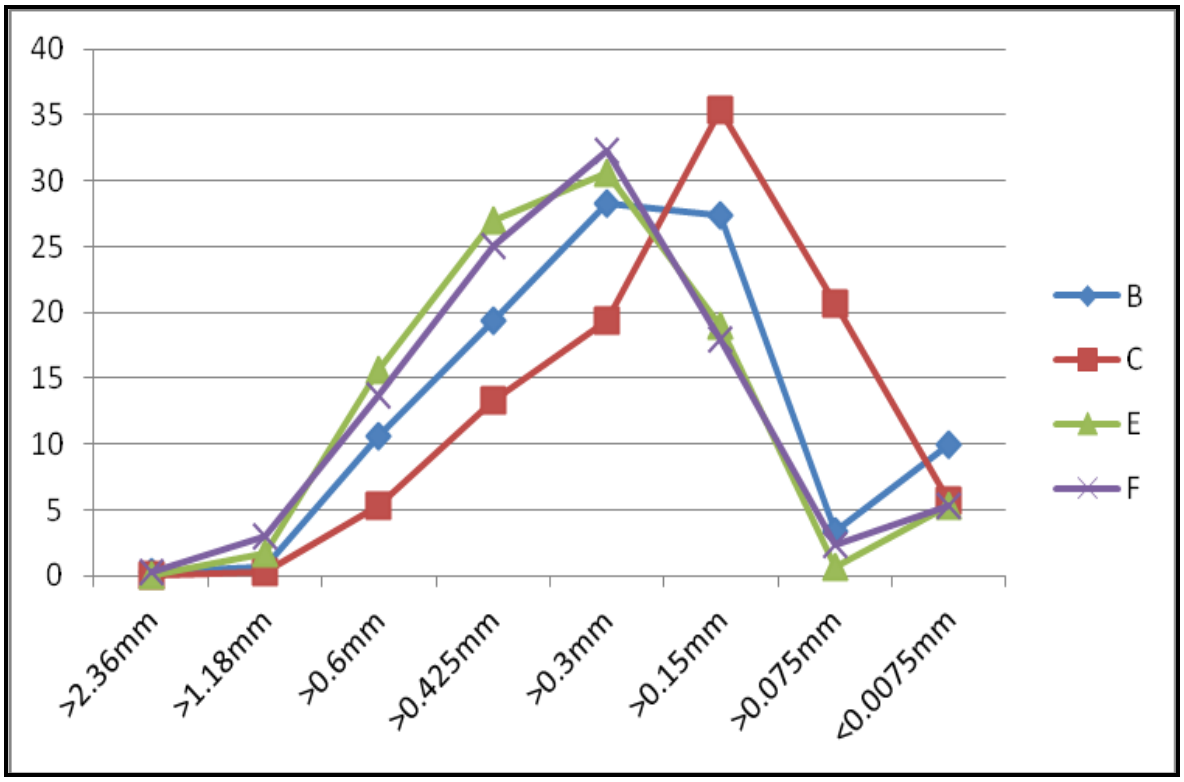

Figure 5 – Comparative Particle size distribution chart for sites B, C, E and F from Spring 2014 sampling

Table 2 –Particle Size Analysis of Sediments from sites B, C, E and F

Size parameter	Sampling site											
%	B1	B2	B3	C1	C2	C3	E1	E2	E3	F1	F2	F3
<1.18 >0.6mm Coarse sand	0	0	2	1	0	0	0	0	1	1	1	2
<0.6 >0.425mm Medium sand	5	10	9	4	7	2	10	8	6	12	15	13
<0.425 >0.3mm Medium sand	13	22	19	11	20	8	25	21	10	29	27	27
<0.3 >0.15mm Fine sand	31	33	25	17	39	37	38	33	23	41	38	41
<0.15 >0.075mm Fine sand	35	22	20	30	28	33	23	33	42	15	18	15
<0.075mm Silt and clay	6	2	9	26	4	16	1	2	13	1	0	1

3.2.2 Total Organic Carbon

Total Organic Carbon (TOC) is an indicator of organic matter preserved within sediment. Organic matter has a high propensity to be retained in finer grained sediments. In **Table 3** it is represented as a percentage of the total weight of sediment collected. On this occasion, site B again exhibited the highest proportion of TOC in the sediment which is consistent with last monitoring occasion. Site C also displayed higher concentrations of TOC in comparison to the other sites. The remainder of the samples continued to exhibit relatively low concentrations of TOC.

Table 3 – Total Organic Carbon

Site	Total Organic Carbon (%)
B1	0.30
B2	0.70
B3	0.30
C1	0.21
C2	0.13
C3	0.07
E1	0.19
E2	0.04
E3	0.14
F1	0.02
F2	0.02
F3	0.03

3.2.3 Benthic macroinvertebrate assemblages

Communities of benthic macroinvertebrates are a robust indicator of the relative health of an aquatic ecosystem. As they often have narrow environmental tolerances, even minor anthropogenic changes to a receiving environment are reflected in changes to macroinvertebrate communities.

The results of the macroinvertebrate species composition for sites B, C, E and F can be found in **Table 4**. Changes in the diversity and abundance of benthic macroinvertebrates over time are considered to be a reliable indicator of changing environmental conditions which may be attributable to discharge from the prawn farm.

Table 5 provides a comparison in diversity between the previous spring sampling and this occasion. Diversity between Spring 2014 and Spring 2015 at site B had returned to previously observed diversity (from 1 taxon to 5 taxa), which is again consistent with earlier records. However the other three sites remained relatively consistent with previous occasions. The relative consistency of all the sites appear to indicate that Pacific Reef Fisheries is not likely to be causing a significant impact on the diversity of benthic macroinvertebrates in the receiving environment.

Table 4 – Macroinvertebrates detected at sites B, C, E and F

Phylum	Class/Order	Family	B1	B2	B3	C1	C2	C3	E1	E2	E3	F1	F2	F3	Total
Annelida	Polychaeta	Capitellidae	1												**1**
Arthropoda / Crustacea	Amphipoda	Lysianassidae								1	2				**3**
Arthropoda / Crustacea	Brachyura	Hymenosomatidae				1									**1**
Arthropoda / Crustacea	Brachyura	Ocypodidae	3												**3**
Arthropoda / Crustacea	Ispopoda	Corallanidae								5	2			2	**9**
Mollusca	Bivalvia	Haminoeidae		1											**1**
Mollusca	Bivalvia	Mactridae	25	19	6	21	1	2					1		**75**
Mollusca	Bivalvia	Mesodesmatidae					10	33	3	5		23	24	32	**130**
Mollusca	Bivalvia	Solecurtidae	1												**1**
Mollusca	Bivalvia	Tellinidae										2			**2**
Mollusca	Bivalvia	Veneridae						2				1			**3**
Mollusca	Gastropoda	Nassariidae				3	1								**4**
Mollusca	Gastropoda	Naticidae										1			**1**
Mollusca	Gastropoda	Potamididae							1						**1**

Table 5 – Comparison of diversity in taxa between sampling occasions

Spring 2014 sampling	Spring 2015 sampling
B = 1 taxa collected	B = 5 taxa collected
C = 6 taxa collected	C = 5 taxa collected
E = 3 taxa collected	E = 4 taxa collected
F = 5 taxa collected	F = 6 taxa collected

4 Conclusion

On this sampling occasion, all sites were accessible and were sampled. For parameters including particle size distribution and total organic carbon, no substantial variances were observed between sampling occasions. Similar to last sampling occasion, TOC was higher at site B than the other sites, and for all other sites TOC were comparable to last occasion. Mangrove densities for trees under 3m in height had reduced across the majority of the sample sites.

Comparisons between all sample sites did not detect significant differences between the two sampling occasions and no environmental impacts were detected that could be attributed to activities relating to prawn production. Macroinvertebrate assemblages were similar or higher in diversity to last monitoring occasion. The next sampling event will be around November/December, 2016.

Appendix 1 – Photoplates

Quadrat A – Four photographs

Quadrat B – Four photographs

Quadrat D – four photographs

Quadrat E – four photographs

Quadrat G – four photographs

Quadrat H – two photographs

Appendix 2 – Monthly Water Quality Monitoring Data