

# Environmental Impact Monitoring Program (EIMP) - Spring 2014

Lot 1 on RP804106, Trent Road via Ayr

PREPARED FOR

Pacific Reef Fisheries (Australia) Pty Ltd

December, 2014



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<b>Gassman Development Perspectives</b>	
PO Box 392 Beenleigh QLD 4207	Document Number: 4541-01
Telephone: (07) 38073333 Fax: (07) 32875461 Email mail@gassman.com.au	Job Number: <b>4541</b>
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Principal Author:	M Spears
Project Manager:	M Spears
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Client Contact:	Wayne DiBartolo

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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 Sustainability, Environment, Water, Population and Communities (DSEWPaC).

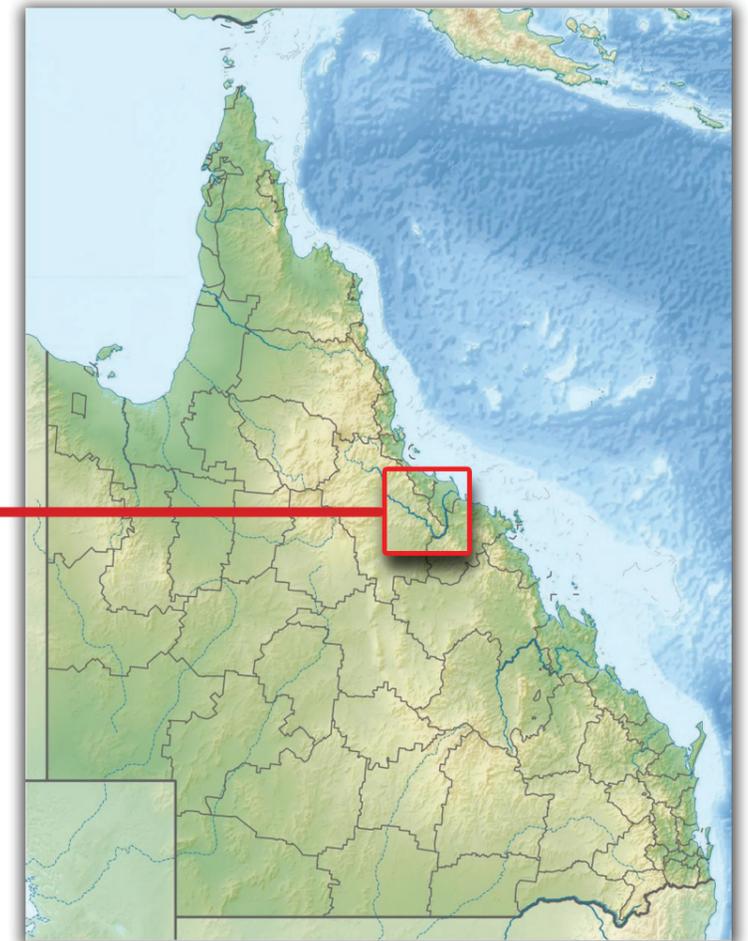
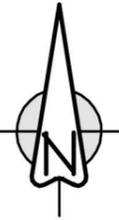
This report outlines the results for this sampling event which continued the ongoing monitoring program. This monitoring occurred on 20<sup>th</sup> and 21<sup>st</sup> of November, 2014. The purpose of the annual monitoring program is to determine any changes that occur to the receiving environment 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
- DSEWPC – 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 75 operational ponds covering 68 hectares for the production of Marine prawns (*Penaeus monodon*). 30 additional ponds covering 30 hectares have also recently been brought online and are in use. 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 measurable 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 spatial extent of epiphytic algae;
- 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.

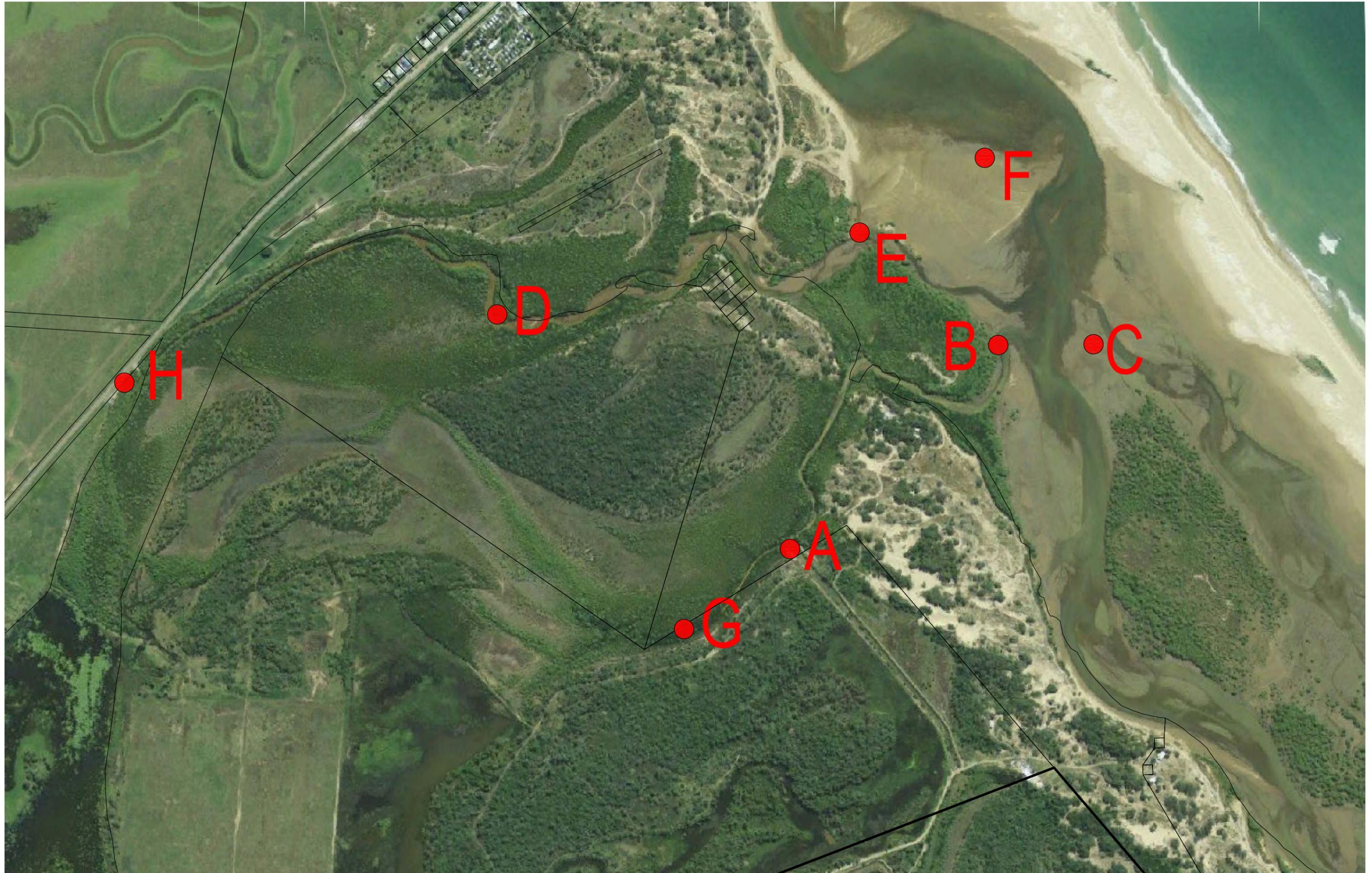
All sites were accessible on this monitoring occasion.

### 2.2 Mangrove health monitoring

Mangrove health was monitored at sites A, B, D, E, G and H. At each site, permanent 400m<sup>2</sup> (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.



Scale 1:7500 - Lengths are in Metres.



planning  
design  
environment  
surveying

Brisbane Office  
Level 13  
97 Creek Street Brisbane Q. 4000  
t: (07) 32216732  
f: (07) 32217308  
Gold Coast and Logan Office  
Access Business Park  
76 Business Street Yatala Q. 4207  
t: (07) 38073333  
f: (07) 32875461  
e: mall@gassman.com.au  
w: www.gassman.com.au

Figure 1 - EIMP Sampling Locations

ALVA Beach  
Pacific Reef Fisheries

**NOTE:**

The details of this plan have been prepared based on the most current Digital Cadastral Data Base (DCDB) information available from Queensland Department of Environment and Resource Management and is subject to survey.

date: 19-12-14  
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plan: 4541 E 00 03

### 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 have remained the same since last monitoring occasion. Densities over trees under 3m slightly increased for sites A, B and D. No substantial changes were observed visually across all sites in comparison to last monitoring occasion.

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 <sup>2</sup> )	Density of trees <3m (per m <sup>2</sup> )	GPS coordinates
A	<i>Ceriops australis</i> ; <i>Avicennia marina</i> ; <i>Rhizophora stylosa</i> ; <i>Aegiceras corniculatum</i>	0.0625	0.75	-19.469, 147.486
B	<i>Avicennia marina</i> ; <i>Rhizophora stylosa</i>	0.02	0.175	-19.4654, 147.49
D	<i>Avicennia marina</i> ; <i>Rhizophora stylosa</i> ; <i>Ceriops australis</i> ; <i>Aegialitis annulata</i>	0.4	1.25	-19.4655, 147.473
E	<i>Avicennia marina</i> ; <i>Rhizophora stylosa</i> ; <i>Aegialitis annulata</i>	0.035	0.8	-19.4632, 147.487
G	<i>Avicennia marina</i> ; <i>Rhizophora stylosa</i>	0.8	0.75	-19.4703, 147.4837

Quadrat	Species Present	Density of trees >3m (per m <sup>2</sup> )	Density of trees <3m (per m <sup>2</sup> )	GPS coordinates
H	<i>Rhizophora stylosa</i> ; <i>Avicennia marina</i> ; <i>Aegialitis annulata</i> ; <i>Osbornia octodonta</i>	0.5	0.05	-19.4644, 147.4802

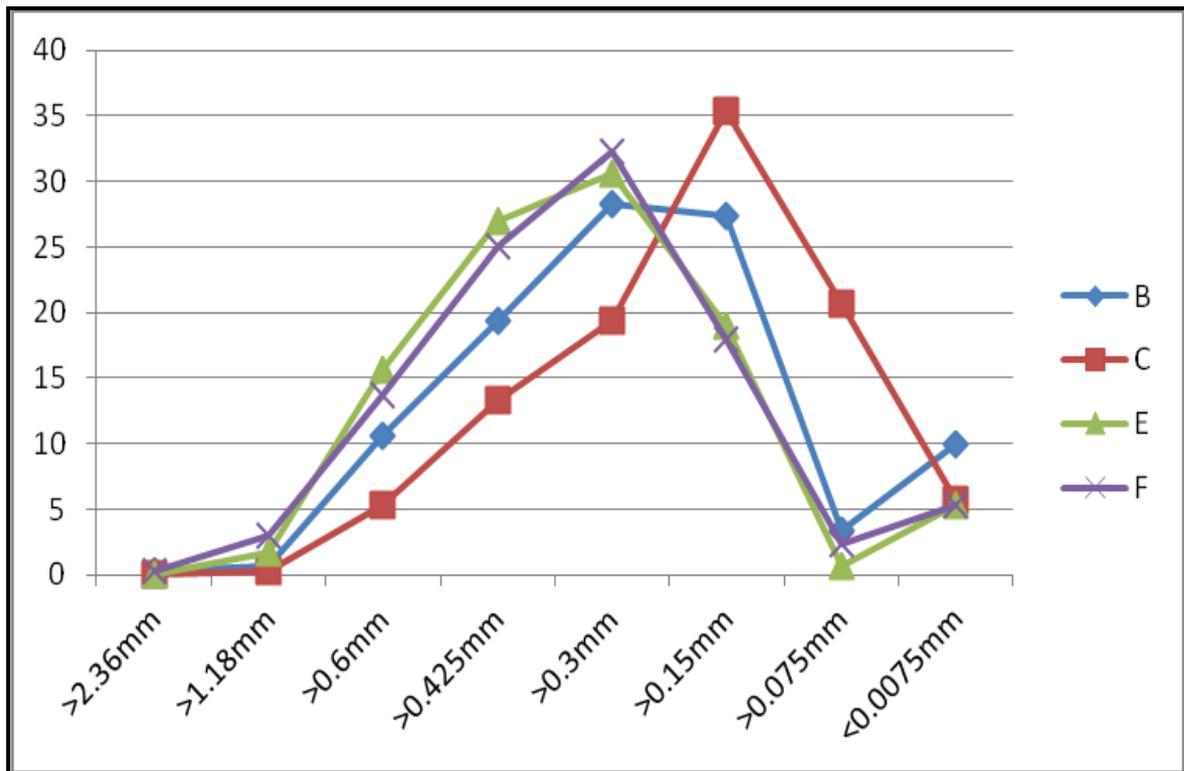
### 3.2 Sediment biogeochemistry

#### 3.2.1 Particle size distribution

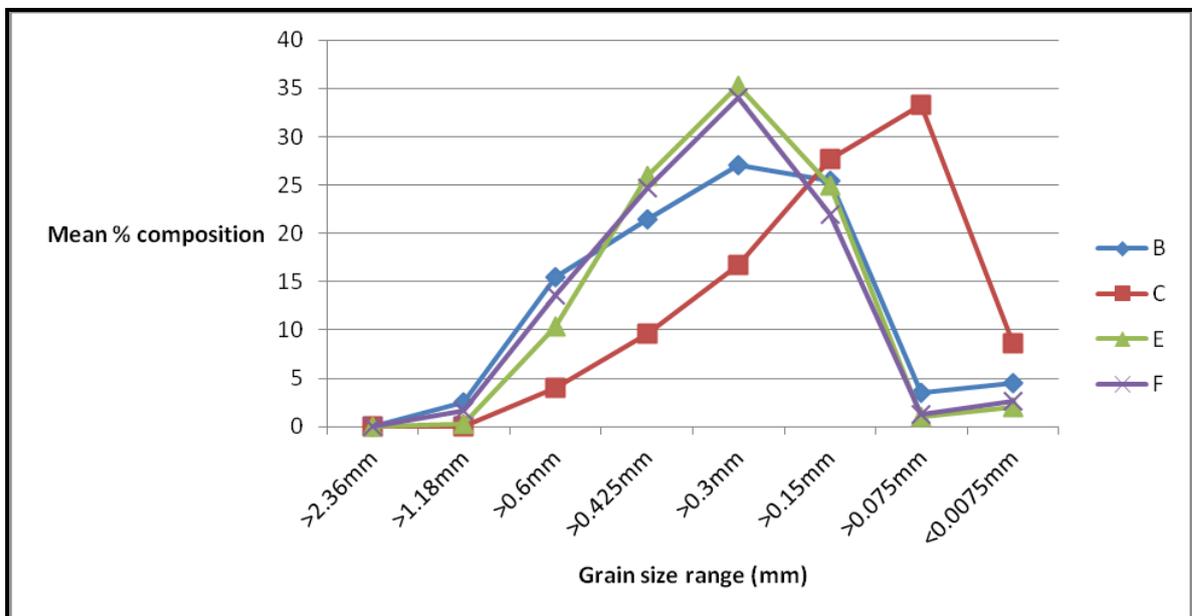
The results of the particle size distribution (PSD) analysis are presented in Figure 4 and Table 2. On this occasion, sites B, C and F displayed high levels of uniformity. On this occasion Site C displayed a higher concentration of finer grained sediments which is consistent with 2013 monitoring results. This indicates that the neither 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 C 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 2013.



**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 2013 sampling

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

Size parameter	Sampling site											
	B1	B2	B3	C1	C2	C3	E1	E2	E3	F1	F2	F3
%												
<2.36 >1.18mm Coarse sand	1	0	0	0	0	0	0	0	0	1	0	0
<1.18 >0.6mm Coarse sand	1	1	0	1	0	0	1	2	2	3	3	3
<0.6 >0.425mm Medium sand	15	11	6	8	4	4	11	16	20	13	14	14
<0.425 >0.3mm Medium sand	24	21	13	20	9	11	23	25	33	24	26	25
<0.3 >0.15mm Fine sand	29	31	25	28	13	17	33	27	32	32	32	33
<0.15 >0.075mm Fine sand	22	26	34	33	31	42	22	24	11	18	19	17
<0.075mm Silt and clay	1	2	7	9	33	20	2	0	0	2	2	3

### 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 exhibited the highest proportion of TOC in the sediment which is in contrast to last monitoring occasion when site C was highest. The monitoring occasion before in Spring 2012 also had site B exhibiting the highest concentration of TOC. The remainder of the samples continued to exhibit low concentrations of TOC.

**Table 3 – Total Organic Carbon**

Site	Total Organic Carbon (%)
B1	0.44
B2	0.06
B3	0.26
C1	0.15
C2	0.12
C3	0.17
E1	0.09
E2	0.05
E3	0.05
F1	0.08
F2	0.12
F3	0.18

### 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 autumn sampling and this occasion. Diversity between Spring 2013 and Spring 2014 at site B had noticeably decreased (from 7 taxa to 1 taxon), 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**

Sample Code	Taxa	Family	Order	Class	Phylum	Count
B2	Mollusca	Bivalvia	Veneroida	Mactridae	Mactridae	2
C1	Mollusca	Bivalvia	Veneroida	Mactridae	Mactridae	2
C1	Mollusca	Bivalvia	Veneroida	Veneridae	Veneridae	1
C1	Mollusca	Gastropoda	Neotaenioglossa	Cerithiidae	Cerithiidae	4
C2	Mollusca	Bivalvia	Veneroida	Mactridae	Mactridae	17
C2	Mollusca	Bivalvia	Veneroida	Veneridae	Veneridae	4
C2	Mollusca	Gastropoda	-	Epitoniidae	Epitoniidae	1
C3	Echinodermata	Echinoidea	Clypeasteroida	Clypeasteridae	Clypeasteridae	1
C3	Mollusca	Bivalvia	Veneroida	Mactridae	Mactridae	18
C3	Mollusca	Bivalvia	Mytiloida	Mytilidae	Mytilidae	1
C3	Mollusca	Bivalvia	Veneroida	Veneridae	Veneridae	3
C3	Mollusca	Bivalvia	Veneroida	Mactridae	Mactridae	18
E1	Arthropoda	Malacostraca	Tanaidacea	Tanaidacea	Tanaidacea	1
E2	Arthropoda	Malacostraca	Isopoda	Cirrolanidae	Cirrolanidae	1
E2	Mollusca	Bivalvia	Veneroida	Tellinidae	Tellinidae	1
F1	Mollusca	Gastropoda	Neogastropoda	Buccinidae	Buccinidae	1
F3	Echinodermata	Echinoidea	Clypeasteroida	Clypeasteridae	Clypeasteridae	1
F3	Annelida	Polycheata	-	Sigalionidae	Sigalionidae	1
F3	Annelida	Polycheata	Canalipalpata	Oweniidae	Oweniidae	1
F3	Annelida	Polycheata	-	Capitellidae	Capitellidae	1



**Table 5 – Comparison of diversity in taxa between sampling occasions**

<b>Spring 2013 sampling</b>	<b>Spring 2014 sampling</b>
B = 7 taxa collected	B = 1 taxa collected
C = 8 taxa collected	C = 6 taxa collected
E = 2 taxa collected	E = 3 taxa collected
F = 3 taxa collected	F = 5 taxa collected

## 4 Conclusion

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On this sampling occasion, all sites were accessible and were sampled. For all parameters including mangrove densities, particle size distribution, total organic carbon, no substantial variances were observed between sampling occasions. In contrast 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.

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 in diversity to last monitoring occasion with the exception of site B. The next sampling event will be around November/December, 2015.

## Appendix 1 – Photoplates

Quadrat A – three photos





Quadrat B – four photos







Quadrat D – three photos





Quadrat E – two photos





Quadrat G – Three Photographs





Quadrat H – three photos





## Appendix 2 – Monthly Water Quality Monitoring Data

Pacific Reef Fisheries Pty Ltd  
 Monthly Water Quality Sampling at W1  
 2013-14

Discharge (W1)

Parameter	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Mean	80th Percentile	Maximum	EPA mean	EPA 80th p	EPA max	EA mean	EA max
Total Suspended Solids (mg/L)	25	37	30	30	23	27	27	34	28	20	43	6.7	27.56	33.2	43					
Chlorophyll <i>a</i> ( $\mu$ g/L)	33.11	30.86	82.78	4.51	9.52	3.54	14.08	49.05	50.76	43.13	88.49	11.8	35.14		88.49	EXC				
Total Nitrogen (mg N/L)	1.112	0.994	1.256	0.256	0.435	0.41	0.494	0.976	1.193	2.329	2.249	1.144	1.07	1.2	2.329					
Total Phosphorus (mg P/L)	0.319	0.331	0.435	0.114	0.155	0.11	0.145	0.256	0.178	0.473	0.415	0.123	0.25	0.4	0.473	EXC	EXC	EXCEED	EXC	
Turbidity (NTU)	18	17	22	13	14	16	16	21	18	97	17	9.1	23.18		97					

Intake

Parameter	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Mean	80th Percentile	Maximum	EPA mean	EPA 80th p	EPA max	EA mean	EA max
Total Suspended Solids (mg/L)	32	25	30	14	45	17	38	51	34	22	31	26	30.42	37.2	51					EXC
Chlorophyll <i>a</i> ( $\mu$ g/L)	1.3	3.39	7.28	1.9	2.79	5.31	2.79	4.24	3.83	2.39	1.37	0.98	3.13		7.28					
Total Nitrogen (mg N/L)	0.345	0.671	0.444	0.237	0.283	0.265	0.289	0.211	0.361	0.668	0.255	0.414	0.37	0.4	0.671					
Total Phosphorus (mg P/L)	0.082	0.105	0.102	0.055	0.089	0.048	0.072	0.092	0.067	0.471	0.15	0.072	0.12	0.1	0.471	EXC		EXCEED	EXC	
Turbidity (NTU)	22	16	28	6	26	11	24	35	21	29	14	21	21.08		35					

Mean 80th Percentile Maximum

Total Suspended Solids (mg/L)	40	65	100
Chlorophyll <i>a</i> ( $\mu$ g/L)	15		200
Total Nitrogen (mg N/L)	1.1	2.5	3.5
Total Phosphorus (mg P/L)	0.11	0.35	0.45

Mean 80th Percentile Maximum

Total Suspended Solids (mg/L)	30		75
Total Nitrogen (mg N/L)			3.0
Total Phosphorus (mg P/L)			0.30

Pacific Reef Fisheries Pty Ltd  
 Monthly Water Quality Sampling at W1  
 2014-15

Discharge (W1)

Parameter	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-14	Feb-14	Mar-13	Apr-13	May-13	Jun-13	Mean	80th Percentile	Maximum	EPA mean	EPA 80th p	EPA max	EA mean	EA max
Total Suspended Solids (mg/L)	22	9	115	69	31	14							43.33	69.0	115	EXC	EXC	EXC	EXC	EXC
Chlorophyll <i>a</i> ( $\mu$ g/L)	22	8.6	12.5	12	37.61	54.23							24.49		54.23	EXC				
Total Nitrogen (mg N/L)	0.99	1.3	0.21	0.99	1.801	2.175							1.24	1.8	2.175	EXC				
Total Phosphorus (mg P/L)	0.16	0.17	0.099	0.11	0.327	0.411							0.21	0.3	0.411	EXC				EXC
Turbidity (NTU)	9.32	9.98	12.3	14.5	27	14							14.52		27					

Intake

Parameter	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-14	Feb-14	Mar-13	Apr-13	May-13	Jun-13	Mean	80th Percentile	Maximum	EPA mean	EPA 80th p	EPA max	EA mean	EA max
Total Suspended Solids (mg/L)	26	15	151	97	25	26							56.67	97.0	151	EXC	EXC	EXC	EXC	EXC
Chlorophyll <i>a</i> ( $\mu$ g/L)	1	2.2	3.8	11	3.91	3.78							4.28		11					
Total Nitrogen (mg N/L)	0.99	0.099	0.6	0.99	1.045	0.357							0.68	1.0	1.045					
Total Phosphorus (mg P/L)	0.09	0.11	0.08	0.07	0.072	0.07							0.08	0.1	0.11					
Turbidity (NTU)	8.44	11.8	17.8	16	22	24							16.67		24					

	Mean	80th Percentile	Maximum
Total Suspended Solids (mg/L)	40	65	100
Chlorophyll <i>a</i> ( $\mu$ g/L)	15		200
Total Nitrogen (mg N/L)	1.1	2.5	3.5
Total Phosphorus (mg P/L)	0.11	0.35	0.45

	Mean	80th Percentile	Maximum
Total Suspended Solids (mg/L)	30		75
Total Nitrogen (mg N/L)			3.0
Total Phosphorus (mg P/L)			0.30