Environmental Impact Monitoring Program (EIMP) - Spring 2017

Lot 1 on RP804106, Trent Road via Ayr

PREPARED FOR

Pacific Reef Fisheries (Australia) Pty Ltd

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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 8th to 9th of November, 2017. 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

Appendix 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**. One new species was observed at site A, although only represented by one individual. 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 of trees under 3m have generally continued to increase from last monitoring occasion, with the most significant increases at sites D, E and H. These sites showed a significant amount of new growth. The landward edges of the mangrove areas appeared to be wetter than last years monitoring occasion, however this could not be reliably confirmed as the area received rainfall before and during the mangrove monitoring surveys.

No general observable differences were detected across the sites in the two creek systems.

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 Lumnitzera racemosa** (1 individual)	0.0625	0.72	-19.469, 147.486
B	*Avicennia marina; Rhizophora stylosa*	0.02	0.163	-19.4654, 147.49
D	*Avicennia marina; Rhizophora stylosa; Ceriops australis; Aegalitis annulata*	0.4	1.2	-19.4655, 147.473

Quadrat	Species Present	Density of trees >3m (per m^2)	Density of trees <3m (per m^2)	GPS coordinates
E	*Avicennia marina; Rhizophora stylosa; Aegalitis annulata; Aegiceras corniculatum*	0.035	1.2	-19.4632, 147.487
G	*Avicennia marina; Rhizophora stylosa*	0.8	0.75	-19.4703, 147.4837
H	*Rhizophora stylosa; Avicennia marina; Aegalitis annulata; Osbornia octodonta; Bruguiera gymnorrhiza* (1 individual)	0.45	0.1	-19.4644, 147.4802

* new species observed on this monitoring occasion

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, all sites, B, C, E and F displayed high levels of uniformity across the majority of size ranges. Site C and Site B displayed larger variation in concentration of sediment within the 0.03mm range, with C higher than the other sites, and B lower than the other sites. However, the distribution does not appear to vary substantially from the previous years results for C and B, and does not appear to vary substantially from the remaining sites. Site B again displayed slightly higher levels in the 0.0075mm range; however this variation from Sites C, E and F has reduced compared to the previous monitoring occasion. The results indicate 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 the differences between 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 2016.

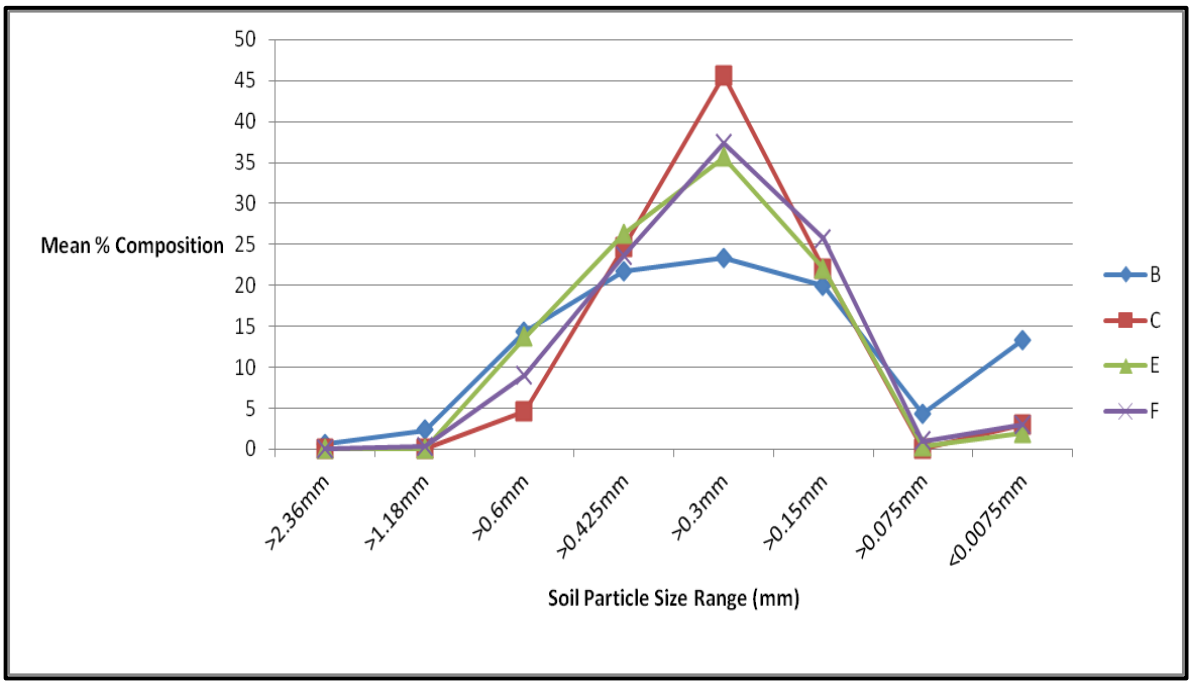


Figure 4 – Particle size distribution chart for sites B, C, E and F

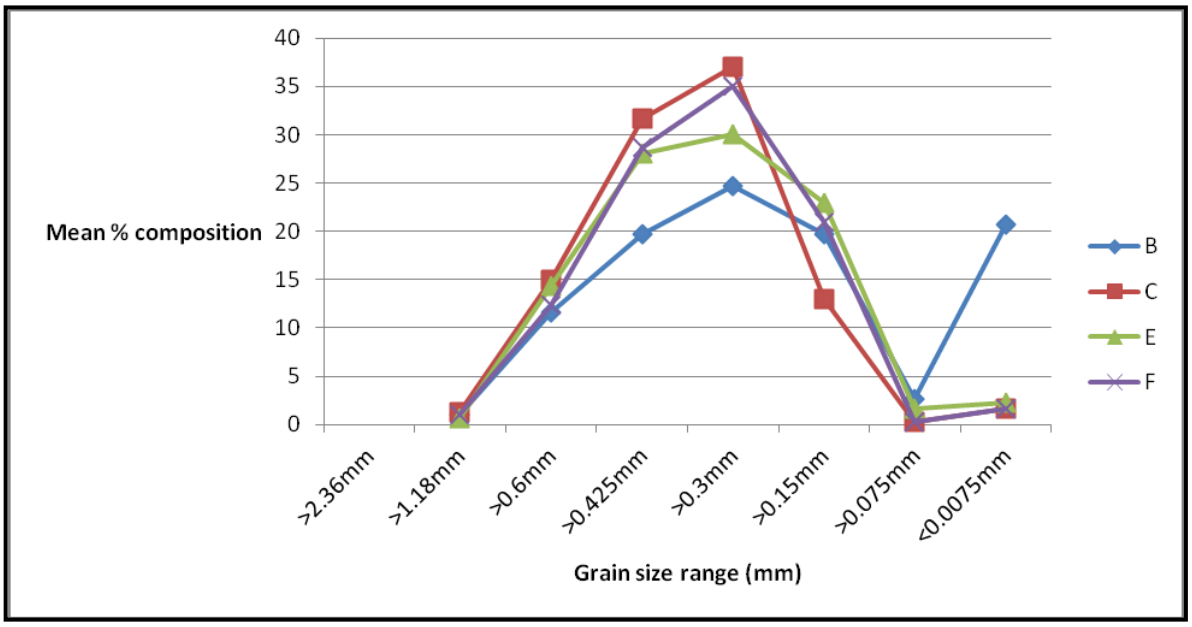


Figure 5 – Comparative Particle size distribution chart for sites B, C, E and F from Spring 2016 sampling

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
<4.75mm >2.36mm Fine gravel	0	0	2	0	0	0	0	0	0	0	0	0
<2.36mm >1.18 Fine gravel	1	3	3	0	0	0	0	0	0	0	0	1
<1.18 >0.6mm Coarse sand	6	14	23	4	5	5	11	16	14	8	8	11
<0.6 >0.425mm Medium sand	13	22	30	25	25	24	25	28	26	21	23	27
<0.425 >0.3mm Medium sand	19	28	23	47	46	44	37	35	35	35	39	38
<0.3 >0.15mm Fine sand	27	24	9	21	22	23	25	19	22	31	26	20
<0.15 >0.075mm Fine sand	9	3	1	0	0	0	0	0	1	2	1	0
<0.075mm Silt and clay	25	6	9	3	2	4	2	2	2	3	3	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 again exhibited the highest proportion of TOC in the sediment which is consistent with the last three monitoring occasions. The remainder of the samples continued to exhibit relatively low concentrations of TOC, indicating no significant differences between the two creeks.

Table 3 – Total Organic Carbon

Site	Total Organic Carbon (%)
B1	0.85
B2	0.48
B3	0.33
C1	0.04
C2	0.04
C3	0.06
E1	0.03
E2	0.05
E3	0.04
F1	0.05
F2	0.04
F3	0.02

3.2.3 Benthic macro invertebrate assemblages

Communities of benthic macro invertebrates 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 macro invertebrate communities.

The results of the macro invertebrate species composition for sites B, C, E and F can be found in **Table 4**. Changes in the diversity and abundance of benthic macro invertebrates 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. Whilst Site B indicated one (1) less taxa than last year's monitoring occasion (8 to 7), the other three sites displayed a higher number of taxa present. Site C had one (1) more taxa, while sites E had and F had two (2), and three (3) additional taxa respectively. The relative abundance of individual taxa collected was also notably higher. Site B had one less taxa than the previous year, but the number of 7 observed taxa is still an increase from previous results observed at Site B. Pacific Reef Fisheries is not likely to be causing a significant impact on the diversity of benthic macro invertebrates in the receiving environment because the observed taxa were consistent across all sites in both Little Alva Creek and Alva Creek, and relative abundance and diversity across taxa has rebounded from last years decrease.

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	Opheliidae			1										1
Arthropoda / Crustacea	Amphipoda	Ischyroceridae						1			1				2
Arthropoda / Crustacea	Amphipoda	Melitidae									5	1		1	7
Arthropoda / Crustacea	Anomura	Diogenidae						1							1
Arthropoda / Crustacea	Anomura	Paguridae									1				1
Arthropoda / Crustacea	Brachyura	Grapsidae	1		1										2
Arthropoda / Crustacea	Isopoda	Corallanidae				1			5	8					14
Mollusca	Bivalvia	Mactridae	1	1	1	15	8	6				13	2	1	48
Mollusca	Bivalvia	Mesodesmatidae						3	2		1	1	1		8
Mollusca	Bivalvia	Solecurtidae	2									1			3
Mollusca	Gastropoda	Nassariidae		1											1
Mollusca	Gastropoda	Naticidae	1												1
Mollusca	Gastropoda	Potamididae	1									1			2

Table 5 – Comparison of diversity in taxa between sampling occasions

Spring 2016 sampling	Spring 2017 sampling
B = 8 taxa collected	B = 7 taxa collected
C = 4 taxa collected	C = 5 taxa collected
E = 3 taxa collected	E = 5 taxa collected
F = 2 taxa collected	F = 5 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 has increased across the majority of the sample sites, while densities for trees over 3m remained comparable to the last monitoring occasion. Soil particle analysis showed slight differences between sites E and F and sites C and B in isolated particle size ranges, but overall the results did not show substantial variation from the last monitoring 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. The mangrove health and abundance appears to have increased, particularly in new growth under 3m, compared to the last monitoring occasion. Macroinvertebrate assemblages were higher in diversity and abundance in comparison to the last monitoring occasion, with consistent observations made across both creeks. The next sampling event will be around November/December, 2018.

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 – three photographs

Appendix 2 – Monthly Water Quality Monitoring Data

Monthly Boat Sampling

Date:	Jul-16									
Site		**Temp**	**pH**	**DO**	**Turbidity (NTU)**	**Sal**	**TSS(mg/L)**	**Turbidity**	**TN(mg/L)**	**TP(mg/L)**
A	1									
	2									
	3									
B	1									
	2									
	3				Site inaccessable					
H	1									
	2									
	3									
E	1									
	2									
	3									

Date:	Aug-16									
Site		**Temp**	**pH**	**DO**	**Turbidity (NTU)**	**Sal**	**TSS(mg/L)**	**Turbidity**	**TN(mg/L)**	**TP(mg/L)**
A	1									
	2									
	3									
B	1									
	2									
	3				Site inaccessable					
H	1									
	2									
	3									
E	1									
	2									
	3									

Date:	Sep-16									
Site		**Temp**	**pH**	**DO**	**Turbidity (NTU)**	**Sal**	**TSS(mg/L)**	**Turbidity**	**TN(mg/L)**	**TP(mg/L)**
A	1									
	2									
	3									
B	1									
	2									
	3				Boat Issues					
H	1									
	2									
	3									
E	1									
	2									
	3									

Date:	18-Oct-16									
Site		**Temp**	**pH**	**DO**	**Turbidity (NTU)**	**Sal**	**TSS(mg/L)**	**Turbidity**	**TN(mg/L)**	**TP(mg/L)**
A	1	28.5	8.04	6.18	5.9	36.5	11	7.6	0.14	<0.1
	2	28.4	8.03	6.2	5.7	36.4				
	3	28.5	8.09	6.14	5.8	36.5				
B	1	28.5	8.04	6.2	6	36.4	11	4.3	0.14	<0.1
	2	28.2	8.07	6.29	5.5	36.4				
	3	28.4	8.06	6.28	5.8	36.5				
H	1	28.3	8.09	6.39	4.6	36.3	13	10.4	0.19	<0.1
	2	28.4	8.10	6.4	4.8	36.3				
	3	28.4	8.09	6.41	4.9	36.4				
E	1	28.1	8.12	6.5	2.9	36.4	8	4.6	0.15	<0.1
	2	28.3	8.10	6.67	5.3	36.4				
	3	28.4	8.10	6.69	4.9	36.4				

Date:	16-Nov-16									
Site		**Temp**	**pH**	**DO**	**Turbidity (NTU)**	**Sal**	**TSS(mg/L)**	**Turbidity**	**TN(mg/L)**	**TP(mg/L)**
A	1	27.5	8.34	6.08	10.94	36.71	6	12.1	0.38	<0.1
	2				Unable to access site due to tide rescrictions					
	3									
B	1	28.4	8.39	6.24	5.21	36.49	3	5.7	0.14	<0.1
	2				Unable to access site due to tide rescrictions					
	3									
H	1	26.5	8.04	5.28	36.45	37.75	11	7.1	0.13	<0.1
	2				Unable to access site due to tide rescrictions					
	3									
E	1	28.3	8.38	6.15	7	36.47	14	38.4	0.39	0.13
	2				Unable to access site due to tide rescrictions					
	3									

Date:	10-Dec-16									
Site		**Temp**	**pH**	**DO**	**Turbidity (NTU)**	**Sal**	**TSS(mg/L)**	**Turbidity**	**TN(mg/L)**	**TP(mg/L)**
A	1	26.4	7.85	5.9	16.72	36.3	29	15.3	0.2	<0.1
	2				Unable to access site due to tide rescrictions					
	3									
B	1	27	7.97	6.21	13.84	36.4	36	14.4	<0.1	<0.1
	2				Unable to access site due to tide rescrictions					
	3									
H	1	26.5	7.96	5.9	37.7	36.5	76	42.6	0.2	0.25
	2				Unable to access site due to tide rescrictions					
	3									
E	1	27.2	8.05	6.1	11.4	36.4	48	14	<0.1	<0.1
	2				Unable to access site due to tide rescrictions					
	3									

Date:	26-Jan-17									
Site		**Temp**	**pH**	**DO**	**Turbidity (NTU)**	**Sal**	**TSS(mg/L)**	**Turbidity**	**TN(mg/L)**	**TP(mg/L)**
A	1	27.6	7.52	4.26	8.48	34.47	27	11.3	0.31	<0.1
	2	27.8	7.81	5.98	9.94	34.24				
	3	28	7.83	5	8.55	34.22				
B	1	28.7	7.94	5.9	6.62	33.79	25	7.4	0.13	<0.1
	2	29.1	8.00	6	5.76	33.71				
	3	29.3	8.01	6.04	3.89	33.74				
H	1	28.3	6.97	3.3	26.88	38.42	22	7.2	0.15	<0.1
	2	28.1	7.05	3.21	18.91	37.48				
	3	27.7	7.31	3.97	21.65	36.11				
E	1	29.2	8.00	5.98	5.06	33.75	56	22.1	0.51	<0.1
	2	29.4	8.01	5.96	3.39	33.73				
	3	29.5	8.01	5.93	2.63	33.71				

Date:	13-Feb-16									
Site		**Temp**	**pH**	**DO**	**Turbidity (NTU)**	**Sal**	**TSS(mg/L)**	**Turbidity**	**TN(mg/L)**	**TP(mg/L)**
A	1	30.1	7.85	5.66	8.65	34.81	17	10.2	0.48	>0.1
	2	30	7.95	6.06	6.12	34.98				
	3	30.3	7.86	5.68	7.75	35.06				
B	1	30	7.94	6.04	6.64	34.95	15	9.4	0.12	>0.1
	2	30.3	7.96	6.13	5.25	34.92				
	3	30.2	7.96	6.18	5.62	34.96				
H	1	30.7	7.14	3.86	9.69	23	15	15.1	0.38	>0.1
	2	30.6	7.53	4.79	11.75	35.72				
	3	30.6	7.49	4.56	10.39	35.71				
E	1	29.9	7.94	5.95	6.46	34.94	13	9.4	0.12	>0.1
	2	30.1	7.96	6.05	5.49	34.97				
	3	30	7.95	6.09	5.48	34.96				

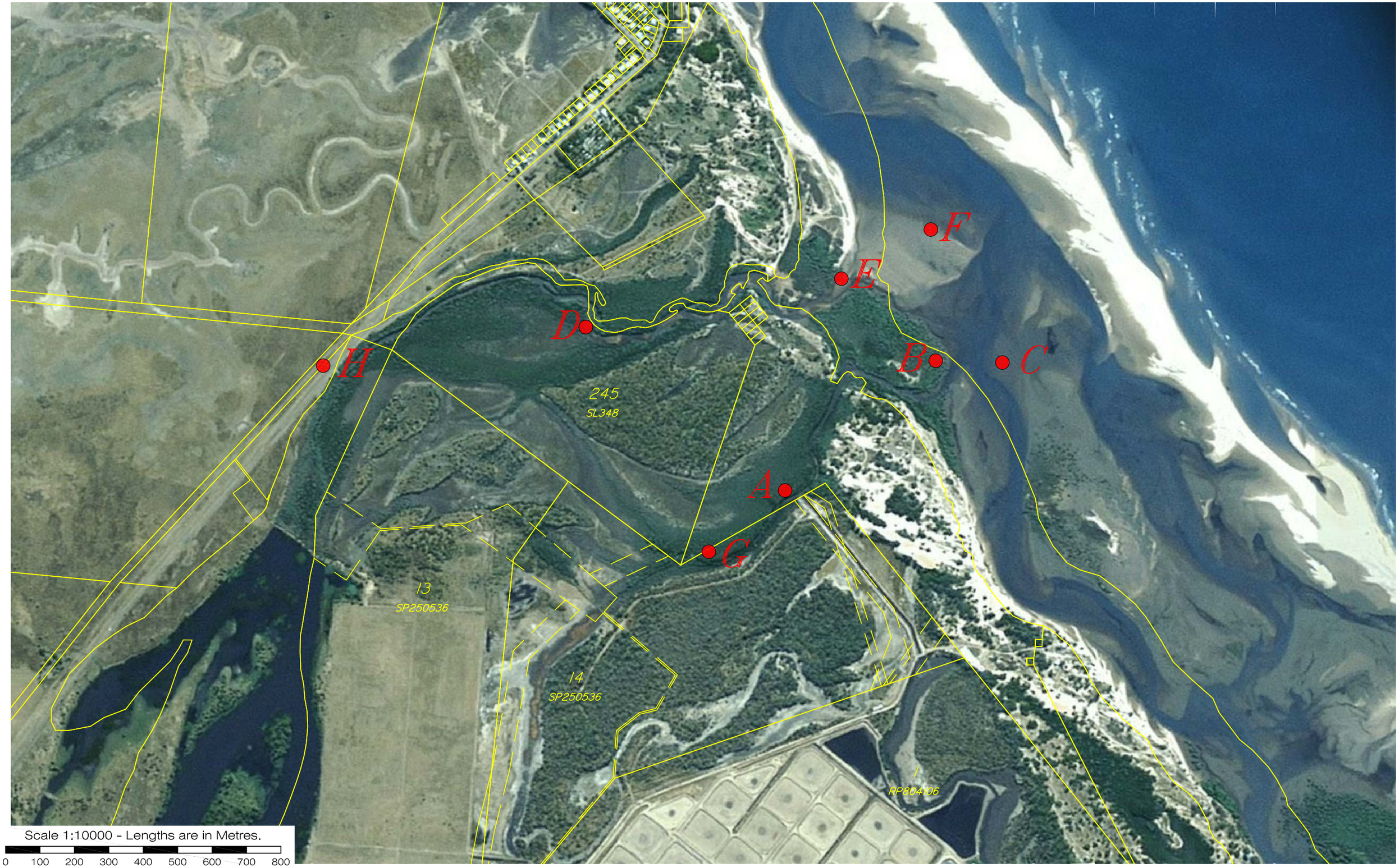
Date:	08-Mar-16									
Site		Temp	pH	DO	Turbidity (NTU)	Sal	TSS(mg/L)	Turbidity	TN(mg/L)	TP(mg/L)
A	1	28.3	8.10	5.02			19	26.2	1.4	<0.1
	2	27.9	7.72	4.59						
	3	28	7.59	4.48						
B	1	28.5	8.20	5.49		Salinity probe malfunction	35	15.8	0.43	<0.1
	2	28.2	8.12	5.12						
	3	28	8.06	4.69						
H	1	28.1	7.95	5.42			33	13.4	0.36	<0.1
	2	27.1	7.63	4.73						
	3	27.4	7.77	4.55						
E	1	28.3	8.24	5.89			26	14.7	0.12	<0.1
	2	28.2	8.20	5.72						
	3	28.1	8.25	5.65						

Date:	26-Apr-16									
Site		Temp	pH	DO	Secchi	Sal	TSS(mg/L)	Turbidity	TN(mg/L)	TP(mg/L)
A	1	24.4	8.11	5.66	45		16	8.3	0.36	<0.1
	2	24.5	8.06	6.61	50					
	3	24.7	8.05	6.48	55					
B	1	24.7	8.21	6.76	60	Salinity probe malfunction	9	4.6	0.22	<0.1
	2	25	8.19	6.78	55					
	3	25.1	8.17	6.89	55					
H	1	24.4	7.46	3.43	35		6	13.8	0.47	<0.1
	2	24.2	7.66	3.84	40					
	3	7.82	7.82	4.84	50					
E	1	24.9	8.23	6.58	80		1	3.4	0.18	<0.1
	2	25	8.27	6.61	80					
	3	25.1	8.14	6.48	80					

Date:	23-May-16									
Site		Temp	pH	DO	Secchi	Sal	TSS(mg/L)	Turbidity	TN(mg/L)	TP(mg/L)
A	1	23.5	7.59	6.18	30	23.5	<1	10.3	0.4	<0.1
	2	23.4	7.70	6.22	35					
	3	23.6	7.77	6.11	35					
B	1	23.7	7.91	7.14	40	27.3	12	6.6	0.35	<0.1
	2	23.7	7.90	6.7	35					
	3	23.8	7.95	6.81	35					
H	1	22.8	7.11	3.91	15	0.81	2	10.9	1.3	0.36
	2	22.7	7.33	3.84	25					
	3	22.7	7.43	3.82	25					
E	1	23.7	7.88	6.74	40	27.7	<1	8.7	0.17	<0.1
	2	23.8	7.91	6.65	40					
	3	23.5	7.95	6.76	40					

Date:	12-Jun-16									
Site		Temp	pH	DO	Secchi	Sal	TSS(mg/L)	Turbidity	TN(mg/L)	TP(mg/L)
A	1	19.7	7.86	5.61	50	32	20	14.8	0.82	0.12
	2				Unable to access site due to tide rescrictions					
	3									
B	1	19.6	8.04	6.79	50	33.1	24	4.1	0.13	0.11
	2				Unable to access site due to tide rescrictions					
	3									
H	1	20.2	7.36	3.55	35	32	35	14.4	0.3	0.1
	2				Unable to access site due to tide rescrictions					
	3									
E	1	19.9	8.21	7.78	50	36.2	18	6.2	0.1	0.1
	2				Unable to access site due to tide rescrictions					
	3									

Appendix 3 – Sampling Locations



Scale 1:10000 - Lengths are in Metres.

0 100 200 300 400 500 600 700 800

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Issue	Date	Description	DRN	CHK
-	09-12-13	ORIGINAL ISSUE	SJH	MDS

Project: Trent Road, Alva Beach
Lot 1 on RP804106

Client: 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.

N

Scale at A3: 1:10,000
Date: 22-01-14
Design: MDS
Drawn: SJH
Checked: MDS

Drawing Title:
Figure 2
EIMP sampling locations

Drawing No: FIGURE2
Revision No: