Pacific Reef Fisheries Pty Ltd

Alva Beach Sediments EIMP Report Spring 2019

December 2019

WILD environmental consultants

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Document Control

Alva Beach Sediment EIMP Monitoring

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Client Name	Pacific Reef Fisheries (Australia) Pty Ltd
Project Manager	Dr James Sadler

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Wild Environmental Consultants Pty Ltd

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Document history and status

Revision	Date	Description	By	Review
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0.2	05/12/2019	Final Draft for submission to Client	James Sadler	Nicholas Baker
1.0	17/12/2019	Final for submission to Client	James Sadler	

Approval for Issue

Name and position	Signature	Date
Nicholas Baker, Director		17/12/2019

Permits and approvals

Wild Environmental Consultants operate in accordance with the following permits and approvals:

Scientific Use Registration Certificate (*Animal Care and Protection Act 2001*) – Registration Number 600

Scientific Purposes Permit (*Nature Conservation (Administration) Regulation 2006*) – Permit number WISP17791316

Animal Ethics Approval (Animal Ethics Committee) – AEC Application Reference Number CA 2016/08/997

Marine Parks Permit (*Great Barrier Reef Marine Park Regulations 1983* and *Marine Park Regulation 2006*) – G16/38539.1

Wildlife Authority (Rehabilitation Permit) (*Nature Conservation (Administration) Regulation 2017 – WA0002733*

Wildlife Authority (Damage Mitigation Permit) (*Nature Conservation (Administration) Regulation 2017 – WA0005146*

Executive summary

Sediment and macroinvertebrate monitoring for the Alva Beach aquaculture facility Environmental Impact Monitoring Program (EIMP) was completed on 30 October 2019. Sediment samples were collected by a benthic grab for identification of the macroinvertebrate community composition, total organic carbon (TOC) content and particle size distribution.

Sediments across the sampling area were predominately classed as sands with high concentrations of fine particles (>20%) observed at the mouth of Alva Creek and at the southern edge of the Little Alva Creek mouth. Elevated concentrations of TOC were typically associated at these sites containing greater concentrations of fine particles, likely a representation of the larger surface area for the concentration of organics.

Sixty-nine (69) macroinvertebrate individuals across nine (9) different families were recorded during the Spring 2019 monitoring program. Molluscs within the bivalve and gastropod orders dominated the monitoring locations, with Tellinidae observed as the most abundant family (46 individuals), particularly at F1. Taxonomic diversity remained relatively similar across the four monitoring locations; however, the lowest abundance of macroinvertebrates was observed at the control location E. Spatial trends in macroinvertebrates do not indicate an impact associated with the release of wastewater from the aquaculture facility. Physicochemical parameters such as flow velocity and dissolved oxygen concentration are likely to be the dominant factor controlling macroinvertebrate distribution.

It should be noted that no Arthropoda/ Crustacea were recorded during the Spring 2019 monitoring event, however, this may be an artefact of the heterogeneity of benthic macroinvertebrates within the local sediments. The use of a 1 mm mesh sieve may also impact the abundance data of benthic macroinvertebrates, with smaller individuals likely to pass through the mesh and avoid identification.

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1. Introduction

1.1 Background

Pacific Reef Fisheries (Australia) Pty Ltd (PRF) operate an aquaculture facility in Alva Beach (Ayr, Queensland) producing Black Tiger Prawns (*Penaeus monodon*) and Cobia (*Rachycentron canadum*). The prawn farm (the Project) has been operating since 1994 in accordance with Environmental Authority (EA) EPPR00864913 and EPBC approval 2001/402, with PRF conducting regular monitoring of their activities and the receiving environment to ensure compliance with the limits and regulations set by the Department of Environment and Science (DES). Wild Environmental Consultants (Wild) was commissioned to complete the sediment and macroinvertebrate components of the EIMP for the spring 2019 event.

1.2 Purpose

This sediment based Environmental Impact Monitoring Program (EIMP) report is designed to assist PRF in the identification of any environmental effects induced by aquaculture operations at the Alva Beach facility. Physical (particle size distribution) and chemical (total organic carbon concentration) analyses provide an indication as to whether changes to the physical environment have occurred at the mouth of the discharge creek. Analysis of macroinvertebrates recovered from the sediments provide an integrated indicator of potential effects on the receiving environment through the local biological systems.

1.3 Project location and description

The PRF Alva Beach aquaculture facility is located at Lot 1, Trent Road, 15 km east of Ayr, North Queensland (Figure 1). The Project consists of 98 hectares of grow-out ponds (approximately 1.5 m deep[1]) for the production of Black Tiger Prawns (*Penaeus monodon*) and Cobia (*Rachycentron canadum*) (Figure 1). In addition, the facility consists of a processing facility, 10.3 hectares of settlement-treatment ponds and twenty-three (23) hectares of constructed mangrove wetland[2], which has been implemented to reduce the concentration of contaminants (nutrients and sediments) in the discharge waters prior to release into the receiving environment.

[1] Gassman Development Perspectives. 2017. Alva Beach Aquaculture Facility Draft Biodiversity and Environmental Impact Assessment. Prepared for Pacific Reef Fisheries. 124 pp.

[2] Gassman Development Perspectives. 2017. Environmental Impact Monitoring Program – Spring 2017, Pacific Reef Fisheries, Alva Beach. 44 pp.

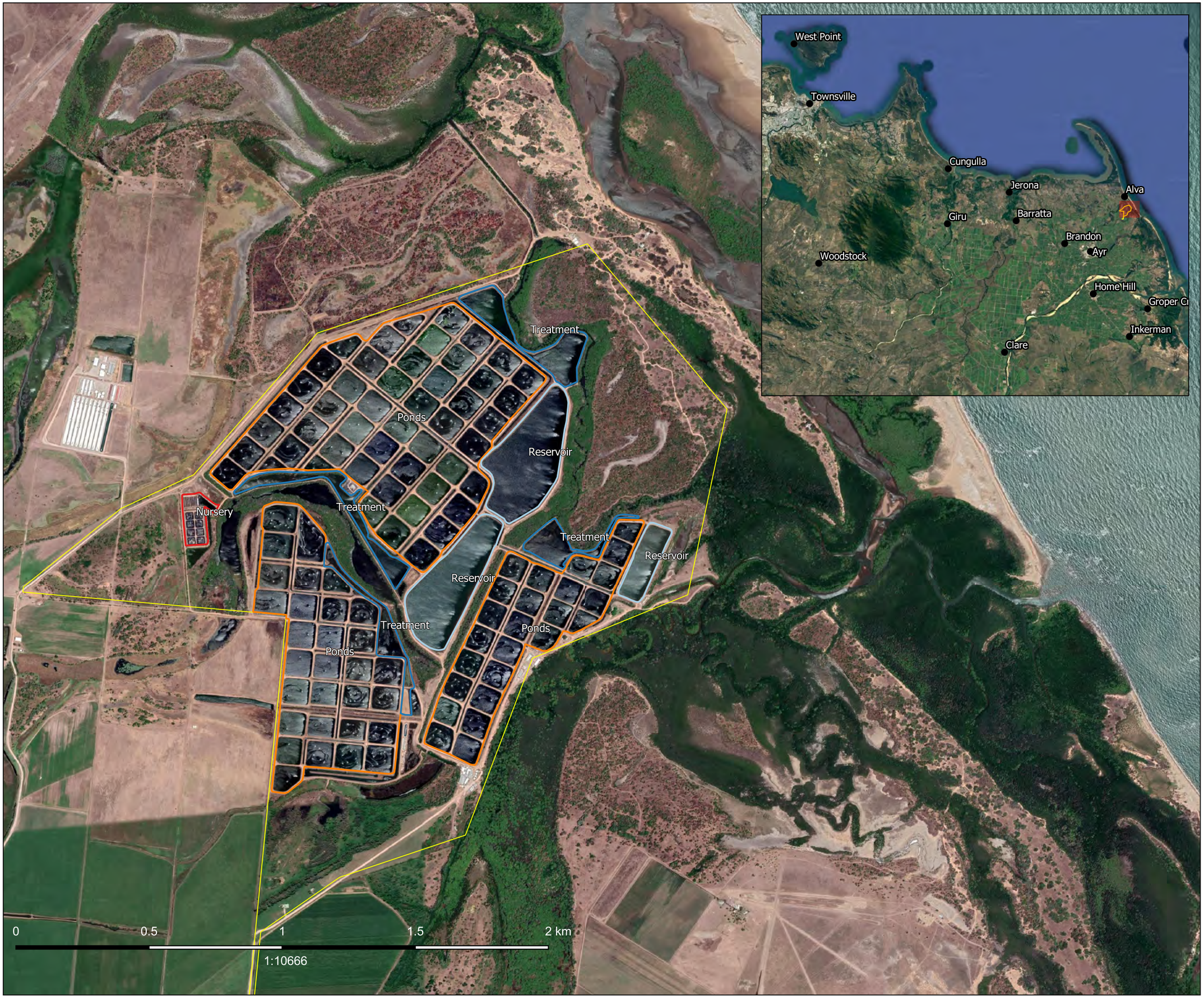
Pacific Reef Fisheries (Aust) Pty Ltd

Alva Beach Sediments Monitoring

Figure 1: Location of the Alva Beach aquaculture facility

Legend

- Existing Facility
- Discharge
- Nursery
- Ponds
- Reservoir
- Treatment



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Coordinate reference system: GDA2020
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2. Methodology

Sediment and macroinvertebrate monitoring was conducted around the daytime high tide on 30 October 2019, two days after a new moon. The Alva Beach weather station (Station 033295) measured 4.8 mm of rainfall on 30 October, with 1.2 mm recorded on the previous day (29 October). Wind speeds during sampling were slightly elevated, with 28 km/h easterly winds recorded at both 09:00 and 15:00.

Sampling was conducted in accordance with the approved EIMP prepared by Gassman Development Perspectives[3] at sites B, C, E and F (Table 1, Figure 2). At each location, three subsamples were collected in a spatial pattern across the creek/ mouth of the creek, i.e., one sample from the middle of the channel and one sample collected towards each bank. Numerical nomenclature of the subsamples progressed from 1 to 3 in an east to west direction at each sampling location specified within the EIMP design documentation. Sediment samples were collected by a 1 litre stainless steel ponar grab, which was deployed twice at each subsampling location. Samples were collected for the analysis of:

- total organic carbon (TOC);
- particle size distribution;
- species composition of macroinvertebrates; and
- abundance of macroinvertebrates.

[3] Gassman Development Perspectives, 2013. Environmental Impact Monitoring Program. Alva Beach Prawn Farm. Prepared for Pacific Reef Fisheries. 15 pp.

Table 1: Sampling locations.

Site	Description	Latitude	Longitude
B	Little Alva Creek mouth	19.46540° S	147.49000° E
	B1	*19.46598° S*	*147.49019° E*
	B2	*19.46593° S*	*147.49002° E*
	B3	*19.46586° S*	*147.48992° E*
C	Little Alva Creek mixing zone	19.46510° S	147.49160° E
	C1	*19.46516° S*	*147.49174° E*
	C2	*19.46523° S*	*147.49145° E*
	C3	*19.46535° S*	*147.49215° E*
E	Alva Creek mouth	19.46320° S	147.48700° E
	E1	*19.46298° S*	*147.48753° E*
	E2	*19.46304° S*	*147.48737° E*
	E3	*19.46275° S*	*147.48720° E*
F	Alva Creek mouth mixing zone	19.46160° S	147.49000° E
	F1	*19.46236° S*	*147.48858° E*
	F2	*19.46179° S*	*147.48911° E*
	F3	*19.46208° S*	*147.49048° E*

Sediments were photographed and physicochemical parameters were stored in the appropriate containers provided by the National Association of Testing Authorities (NATA) certified analysing laboratory (Australian Laboratory Services – ALS) (Table 2). Sediment samples were passed through a 1 cm mesh sieve and any macroinvertebrates present were transferred into a labelled plastic jar containing 70% ethanol for sample preservation and identification.

Table 2: Sample containers.

Analyte	Grab	Container
Total organic carbon (TOC)	1	250 ml solvent washed, acid rinsed glass jar with a Teflon lined lid.
Particle size distribution	1	Plastic bag to hold a minimum of 500 g sample.
Macroinvertebrates species composition and abundance	2	Plastic bag/ plastic jar containing 70% ethanol.

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Alva Beach Sediments Monitoring

Figure 2: Location of sediment monitoring sites

Legend

- Sediment Sites 2019

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Coordinate reference system: GDA2020
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3. Results

3.1 Particle size distribution

Particle size analysis was conducted by Australian Laboratory Services (ALS) in Townsville using an in-house methodology referenced to AS 1289.3.6.1 – 2009: Determination of the particle size of distribution of a soil – Standard method of analysis by sieving. No sites contained particle sizes greater than 4.75 mm (Table 3), with the majority of particles (≥ 60% composition) within each subsample classified as sand, i.e., 75 µm – 2 mm (Table 4).

Sediment samples collected at B1, B3 and E3 contained notably higher concentrations (>20%) of fine particles, classified as <75 µm, than the remaining monitoring sites (Table 4). Only subsample B2, collected in the middle of Little Alva Creek contained >1% gravel, defined as particles 2 mm to 6 cm in size.

Table 3: Sediment particle size distribution

Particle Sizing	B1 (%)	B2 (%)	B3 (%)	C1 (%)	C2 (%)	C3 (%)	E1 (%)	E2 (%)	E3 (%)	F1 (%)	F2 (%)	F3 (%)
+75 µm	73	91	60	98	99	98	98	98	76	95	97	98
+150 µm	67	89	56	98	98	97	98	98	67	92	93	98
+300 µm	40	75	40	66	78	73	74	74	38	61	64	76
+425 µm	19	50	23	26	31	33	41	39	19	29	30	36
+600 µm	7	26	10	7	8	10	14	13	7	10	11	11
+1180 µm	<1	6	1	<1	<1	<1	<1	1	<1	<1	1	1
+2.36 mm	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
+4.75 mm	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
+9.5 mm	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
+19.0 mm	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
+37.5 mm	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
+75.0 mm	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Table 4: Sediment classification

Particle Sizing	B1 (%)	B2 (%)	B3 (%)	C1 (%)	C2 (%)	C3 (%)	E1 (%)	E2 (%)	E3 (%)	F1 (%)	F2 (%)	F3 (%)
Fines (<75 µm)	27	9	40	2	1	2	2	2	24	5	3	2
Sand (75 µm – 2 mm)	73	88	60	98	99	98	98	98	76	95	97	97
Gravel (2 mm – 6 cm)	<1	3	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Cobbles (>6 cm)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

3.2 Total organic carbon

Analysis of the total organic carbon (TOC) incorporated with the collected sediments was also determined by ALS in Townsville using the in-house methodology C-IR17. Samples were dried, pulverised, reacted with acid to remove inorganic carbonates and combusted in a furnace with strong oxidants/catalysts. Carbon dioxide (evolved organic carbon) generated by this process was measured by an infra-red detector.

Total organic carbon concentrations ranged from 0.04% (subsample C3) to 0.65% (subsample B1). Elevated concentrations of TOC were observed across Site B (0.28 – 0.65% TOC), located at the mouth of Little Alva Creek. However, within the downstream mixing zone (Site C), sediment TOC concentrations were reduced to 0.04 – 0.07%. Elevated TOC concentrations of 0.46% were also recorded at the westerly bank of Alva Creek (subsample E3), especially when compared to the 0.06% TOC reported for E1 and E2. Similarly, low concentrations of TOC were reported at F1 and F2 (0.08%), with slightly elevated carbon content recorded at F3 (0.17%).

Table 5: Total organic carbon

Particle Sizing	B1 (%)	B2 (%)	B3 (%)	C1 (%)	C2 (%)	C3 (%)	E1 (%)	E2 (%)	E3 (%)	F1 (%)	F2 (%)	F3 (%)
TOC (%)	0.65	0.28	0.41	0.05	0.07	0.04	0.06	0.06	0.46	0.08	0.08	0.17

3.3 Macroinvertebrates

Benthic macroinvertebrates picked from the collected sediment samples were identified, to the lowest possible taxonomic level, and counted (Table 6). Overall, 69 individuals belonging to nine (9) different taxa were identified across the four sites: five (5) Gastropoda families, three (3) Bivalvia families and one (1) class of Polychaeta. The Polychaete could not be identified down to Family, and as such has been included within the assessment of taxa richness, but not within the total abundance. Tellinidae were observed to be the most abundant family across the four sampling sites (46 individuals total, equating to 66% of the total individuals identified), with 25 individuals recorded at F1. Cerithiidae were the second most abundant Family, appearing in five (5) samples with a total abundance of 10 individuals. No benthic macroinvertebrates were recorded at site E3 (Table 6).

Table 6: Macroinvertebrate taxonomic composition and abundance

Phylum	Class/Order	Family	B1	B2	B3	C1	C2	C3	E1	E2	E3	F1	F2	F3
Anellida	Polychaeta	N/A				*								
Mollusca	Bivalvia	Mactridae				1							1	1
Mollusca	Bivalvia	Pharidae		1										
Mollusca	Bivalvia	Tellinidae		4	5	4	2	1		2		25	2	1
Mollusca	Gastropoda	Cerithiidae		3	3	2				1			1	
Mollusca	Gastropoda	Haminoeidae												1
Mollusca	Gastropoda	Littorinidae							2			1		1
Mollusca	Gastropoda	Neritidae	1				1						1	
Mollusca	Gastropoda	Pyramidellidae								1				

*Polychaete recorded in sample C1 was unable to be identified to Family and was excluded from abundance counts.

All samples were comprised uniquely by Mollusca, with the sole exception of C1—which contained a single Polychaete individual—and E3 where no macroinvertebrates were collected. Excluding site E3, taxonomic richness ranged from one taxa per sample at sites B1, C3 and E1, to four taxa per sample recorded at F2 and F3 (Table 6). When considering the collective samples for each of the four monitoring locations, little difference was observed in the number of taxa recorded (four taxa at sites B, C and E, six taxa at site F), however, variations in taxonomic composition and abundance were recorded between sites. The greatest abundance of benthic macroinvertebrates was observed at Site F, with a total of 35 individuals identified within the triplicate grab samples. 17 individuals were identified within the grab samples collected from Site B, located at the mouth of Alva Creek. Sites C (the mixing zone of Alva Creek) and E (mouth of Little Alva Creek) contained 11 and 6 individuals, respectively (Table 7).

Table 7: Macroinvertebrate abundance and diversity

Site	Abundance	Taxonomic Diversity
B	17	4
C	11	4
E	6	4
F	35	6

4. Discussion

4.1 Sediments physicochemical parameters

Variations in sediment particle size distribution across the four monitoring sites can be largely explained by the physical environmental conditions observed within the receiving environment. Sites C and F, located within the downstream mixing zones of Little Alva Creek and Alva Creek are relatively exposed, higher energy environments that are capable of maintaining particle suspension within the water column. This higher level of energy in the system prevents the settlement of fine particles, resulting in sediments that are dominated (≥95% composition) by sand sized particles.

Within the mouth of Little Alva Creek, samples collected from either bank (B1 and B3) contain a higher proportion of fine particles. Reduced flow velocities associated with shallower waters outside the main channel and increased shear associated with the banks allow finer particles to settle out of the water column into the underlying sediments. At the wider mouth of Alva Creek, this effect is less pronounced, with sediment from subsamples E1 and E2 dominated by sand sized particles (98%). However, subsample E3, which was in close proximity to mangrove trees contains 24% fines within the sediment. Baffling by the mangrove trees is expected to reduce flow velocity that in turn facilitates the settlement of fine particles through the water column.

Spatial variability in sediment TOC content mirrored the reported concentrations of fines (Figure 3), with low TOC concentrations recorded across the downstream mixing sites C and F. Similarly, low sediment TOC was also reported from subsamples E1 and E2, where the sediments were dominated by sand sized particles. Total organic carbon concentrations greater than 0.4% were recorded at B1, B3 and E3; sites that also displayed the highest proportion of fine particles. An inverse relationship between particle size and organic matter content has been previously documented[4] [5] and is likely attributed to the larger surface area associated with smaller particles that allows for the concentration of contaminants.

[4] Longbottom, M. R. 1970. The distribution of *Areicola marina* (L.) with particular reference to the effects of particle size and organic matter of the sediments. Journal of Experiment al Marine Biology and Ecology. 5(2). 138–157.

[5] Thomson-Becker, E. A., and Luoma, S. N. 1985. Temporal fluctuations in grain size, organic materials and iron concentrations in intertidal surface sediment of San Francisco Bay. Hydrobiologia. 129(1), 91–107.

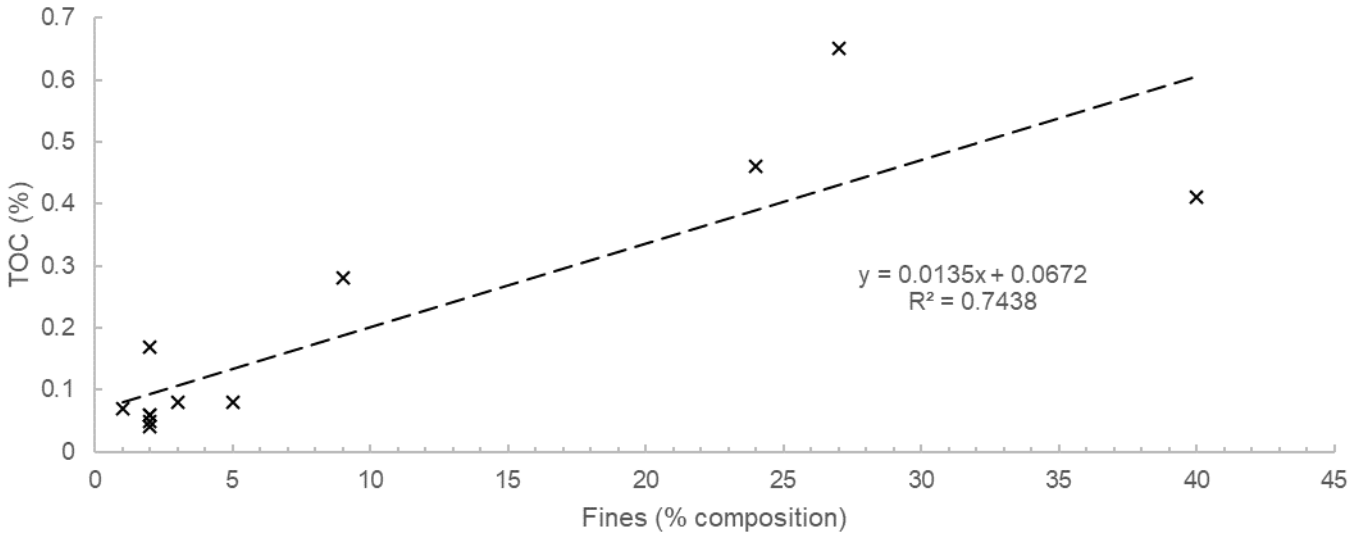

Figure 3: Total organic carbon and sediment fines composition.

4.2 Receiving environment benthic macroinvertebrate communities

Abundance and taxonomic diversity of benthic macroinvertebrates did not appear to display any spatial trends that were likely associated with the release of surplus waters from the Project. Monitoring locations B and C are located downstream of the facilities discharge location, at the mouth of Alva Creek and approximately 200 m downstream in the mixing zone. Taxonomic diversity was recorded at 4 families for both locations, with a slightly higher abundance of individuals recorded at location B (17 individuals) than at location C (11 individuals). The lowest abundance of macroinvertebrate individuals was observed at location E (6 individuals across 4 taxa), a control site within Alva Creek. Approximately 200 m downstream of location E, the greatest macroinvertebrate abundance and taxonomic diversity (35 individuals and 6 families, respectively) was observed at location F (Table 6) within the larger channel.

Benthic macroinvertebrate distribution and density does appear to correlate well with the collected particle size distribution data, or sedimentary total organic carbon content. Physicochemical parameters such as flow velocity and dissolved oxygen concentrations may play a greater control in determining benthic macroinvertebrate distributions.

Taxonomic diversity in previous monitoring programs ranged from two (2) to eight (8) taxa in 2016[6], five (5) to seven (7) taxa in 2017[7] and six (6) to 13 in 2018[8] (*note that replicate grabs were conducted at each site in 2018. To maintain consistency with previous datasets only the first three grabs were used in the data presented within this report*), with the greatest diversity recorded at Site B during 2016/2017 and Site C during 2018. Monitoring in 2019 revealed a similar range of taxa (four to six) as recorded during 2016 and 2017, with the greatest diversity recorded at Site F. No Arthropoda/ Crustacea were observed within the 2019 monitoring round. Whilst these phyla were identified following previous monitoring the abundance of individuals ranged from three (3) in 2016 to 27 in 2017. The absence in the 2019 sampling may be representative of natural population cycles and/ or the heterogeneity of benthic macroinvertebrates within the local sediments.

In keeping with the previous EIMP design associated with the aquaculture facility, benthic macroinvertebrates were collected from sediments passed through a 1 mm sieve. This sieve sizing is relatively large, and it should be noted that many smaller individuals may have passed through the mesh and not been included in the collected material for identification.

[6] Gassman Development Perspectives, 2016. Environmental Impact Monitoring Program (EIMP) – Spring 2016 Lot 1 on RP804106, Trent Road via Ayr. Prepared for Pacific Reef Fisheries (Australia) Pty Ltd. 41 pp.

[7] Gassman Development Perspectives, 2017. Environmental Impact Monitoring Program (EIMP) – Spring 2016 Lot 1 on RP804106, Trent Road via Ayr. Prepared for Pacific Reef Fisheries (Australia) Pty Ltd. 44 pp.

[8] Wild Environmental Consultants, 2018. Environmental Impact Monitoring Program (EIMP) – Spring 2018, Alva Beach Prawn Farm, Alva Beach. Prepared by Wild Environmental Consultants for Pacific Reef Fisheries. 22 pp.

5. Conclusions

Sediment based environmental monitoring as part of the Project's EIMP was completed on 30 October 2019, two days after a new moon. Sediment samples were collected with a 1 litre ponar grab at four monitoring locations for the identification of TOC, particle size distribution and macroinvertebrate abundance and composition. Within each monitoring location, three replicate samples were collected progressing from the centre of the channel towards each bank.

Total organic carbon and particle size distribution were analysed at the NATA accredited laboratory ALS. Sediments across the sampling area were predominately defined as sand, i.e., 75 µm – 2 mm, with only subsample B2 containing >1% particles greater than 2 mm. Sites B1, B3 and E3 displayed the highest concentrations of fines (<75 µm) ranging from 24 to 40%. Elevated concentrations of total organic carbon were observed across Site B, ranging from 0.28 to 0.65% across the three subsampling sites, and at subsite E3 (0.46%). Variations in TOC display a positive correlation with the concentration of sedimentary fines, likely attributed to the large surface area of small particles that allows for the concentration of contaminants.

Sediment samples for the determination of macroinvertebrate composition and abundance were passed through a 1 mm sieve and preserved in 70% ethanol for identification by a taxonomic specialist. Sixty-nine (69) individuals across nine (9) different families were recorded during the Spring 2019 monitoring program. One damaged polychaete was observed from C1, however, could not be identified down to Family. The remaining individuals were molluscs from the bivalve and gastropod orders. Tellinidae were observed as the most abundant family across the sampling sites (46 individuals), particularly at F1. Taxonomic diversity remained relatively similar across the four monitoring locations; however, the lowest abundance of macroinvertebrates was observed at location E – a control location within Alva Creek. These patterns do not indicate a spatial trend associated with the release of wastewater from the Project, with physicochemical parameters such as flow velocity and dissolved oxygen concentration likely to play a controlling factor.

It should be noted that contrasting previous results, no Arthropoda/ Crustacea were recorded during the Spring 2019 monitoring, however, this may be an artefact of natural population cycles and/ or the heterogeneity of benthic macroinvertebrates within the local sediments. The use of a 1 mm mesh sieve may also impact the abundance data of benthic macroinvertebrates, with smaller individuals likely to pass through the mesh and avoid identification.

6. ALS Laboratory Data

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ET1903315**	Page	: 1 of 5
Client	: **WILD ENVIRONMENTAL**	Laboratory	: Environmental Division Townsville
Contact	: JAMES SADLER	Contact	: Joy Morgan
Address	: Suite 3, 175 Sturt Street PO Box 55 TOWNSVILLE QLD 4810	Address	: 13 Carlton Street, Kirwan Townsville QLD Australia 4814
Telephone	: ----	Telephone	: +61 7 4773 0030
Project	: JW191257 Alva Beach Sediments	Date Samples Received	: 30-Oct-2019 16:00
Order number	: -	Date Analysis Commenced	: 11-Nov-2019
C-O-C number	: 5010	Issue Date	: 12-Nov-2019 17:12
Sampler	: ELOISE SETCH, JAMES SADLER		
Site	: PRF Alva Beach 20191030		
Quote number	: TV/111/19		
No. of samples received	: 12		
No. of samples analysed	: 12		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- All analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818.

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Client sample ID	Site B 1	Site B 2	Site B 3	Site C 1	Site C 2
			Client sampling date / time	30-Oct-2019 12:34	30-Oct-2019 12:38	30-Oct-2019 12:36	30-Oct-2019 12:34	30-Oct-2019 12:35
Compound	CAS Number	LOR	Unit	ET1903315-001	ET1903315-002	ET1903315-003	ET1903315-004	ET1903315-005
				Result	Result	Result	Result	Result
EA150: Particle Sizing								
+75µm	----	1	%	60	91	73	99	98
+150µm	----	1	%	56	89	67	98	98
+300µm	----	1	%	40	75	40	78	66
+425µm	----	1	%	23	50	19	31	26
+600µm	----	1	%	10	26	7	8	7
+1180µm	----	1	%	1	6	<1	<1	<1
+2.36mm	----	1	%	<1	1	<1	<1	<1
+4.75mm	----	1	%	<1	<1	<1	<1	<1
+9.5mm	----	1	%	<1	<1	<1	<1	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	40	9	27	1	2
Sand (>75 µm)	----	1	%	60	88	73	99	98
Gravel (>2mm)	----	1	%	<1	3	<1	<1	<1
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.41	0.28	0.65	0.07	0.05

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Client sample ID	Site C 3	Site E 1	Site E 2	Site E 3	Sute F 1
			Client sampling date / time	30-Oct-2019 12:37	30-Oct-2019 12:36	30-Oct-2019 12:33	30-Oct-2019 12:37	30-Oct-2019 12:31
Compound	CAS Number	LOR	Unit	ET1903315-006	ET1903315-007	ET1903315-008	ET1903315-009	ET1903315-010
				Result	Result	Result	Result	Result
EA150: Particle Sizing								
+75µm	----	1	%	98	76	98	98	95
+150µm	----	1	%	97	67	98	98	92
+300µm	----	1	%	73	38	74	74	61
+425µm	----	1	%	33	19	39	41	29
+600µm	----	1	%	10	7	13	14	10
+1180µm	----	1	%	<1	<1	1	<1	<1
+2.36mm	----	1	%	<1	<1	<1	<1	<1
+4.75mm	----	1	%	<1	<1	<1	<1	<1
+9.5mm	----	1	%	<1	<1	<1	<1	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	2	24	2	2	5
Sand (>75 µm)	----	1	%	98	76	98	98	95
Gravel (>2mm)	----	1	%	<1	<1	<1	<1	<1
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.04	0.46	0.06	0.06	0.08

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Client sample ID	Site F 2	Site F 3	----	----	----
			Client sampling date / time	30-Oct-2019 12:35	30-Oct-2019 12:33	----	----	----
Compound	CAS Number	LOR	Unit	ET1903315-011	ET1903315-012	--------	--------	--------
				Result	Result	----	----	----
EA150: Particle Sizing								
+75µm	----	1	%	**97**	**98**	----	----	----
+150µm	----	1	%	**93**	**98**	----	----	----
+300µm	----	1	%	**64**	**76**	----	----	----
+425µm	----	1	%	**30**	**36**	----	----	----
+600µm	----	1	%	**11**	**11**	----	----	----
+1180µm	----	1	%	**1**	**1**	----	----	----
+2.36mm	----	1	%	<1	<1	----	----	----
+4.75mm	----	1	%	<1	<1	----	----	----
+9.5mm	----	1	%	<1	<1	----	----	----
+19.0mm	----	1	%	<1	<1	----	----	----
+37.5mm	----	1	%	<1	<1	----	----	----
+75.0mm	----	1	%	<1	<1	----	----	----
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	**3**	**2**	----	----	----
Sand (>75 µm)	----	1	%	**97**	**97**	----	----	----
Gravel (>2mm)	----	1	%	<1	**1**	----	----	----
Cobbles (>6cm)	----	1	%	<1	<1	----	----	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	**0.08**	**0.17**	----	----	----