5 Description of the Existing Environment

5.1 Water quality

This section addresses issues raised in four comments. Further information regarding impacts on water quality are contained in Section 7.

The current state of water quality was dealt with in Section 6.4.7 GAPDE, 2003 Estuarine and near-shore water quality. In that section, data collected from January 2002 to November 2002 was presented. That data indicated that water quality in Abbot Bay adjacent to the intake and outfall sites (Ocean) was poorer than ANZECC guideline values. However, due to the short period of data collection, ANZECC values were used in impact monitoring and modelling. GAPDE, 2003 referred to ANZECC 1992. For clarity, it should be noted that all references are to ANZECC 2000.

A number of respondents pointed out that because the water quality is poorer in Abbot Bay than ANZECC Guideline values, comparison with ANZECC 2000 values is inappropriate. Additional data (focussed around the times of the growing season for prawns) was collected to provide a greater understanding of temporal effects on present water quality in Abbot Bay and to obtain a greater understanding of the impact of weather events on water quality in Abbot Bay. This will in turn, allow more accurate assessment of potential impacts of this project. Additional data was not collected for sites in the Elliott River as a decision was taken to neither draw from nor discharge into the Elliott River. In addition, the data collected was for a more limited number of parameters generally considered to provide an adequate assessment of current status and potential future impacts. These parameters were Total Nitrogen, Total Phosphorus and Total Suspended Solids, Chlorophyll a, pH and dissolved oxygen. Sampling was as previously described (GAPDE, 2003) and analysis for nutrients and chlorophyll a was conducted by James Cook University Centre for Freshwater Research, a NATA accredited laboratory. pH and dissolved oxygen were measured using a TPS hand held meter calibrated prior to each sampling period. No outlying were found or discarded.

The site referred to as Ocean has the GPS coordinates of 147° 52' 6.29" E, -19° 51'6.62" S, effectively the end of the proposed discharge pipe.

The completed data set shows two particularly relevant characteristics.

- That the 50th percentile of values is above that listed in the ANZECC Guidelines (2000) (see Table 5.1).
- That there is considerable impact of rainfall/flooding and wind events on the water quality of Abbot Bay, which result in a high level of variability.

5.1.1 Climate

As stated in Section 6.2 Climate in GAPDE, 2003, the site is located in the Dry Tropics. Rainfall is highly variable and unpredictable and while there is an increased likelihood of rainfall in the “wet season”, such rainfall does not necessarily occur each year, nor in the same months each year. The rainfall as recorded in GAPDE, 2003, is made up of years with very high rainfall events and years of no rainfall in that particular month. Figure 5.1 shows the difference in rainfall between January 2005 and January 2004. This shows a 200 – 400 mm increase in rainfall in January between 2005 and 2004. Conversely, Figure 5.2 shows the

difference in rainfall between February 2005 and February 2004. This shows a 100 – 200 mm decrease in rainfall in February between 2005 and 2004.

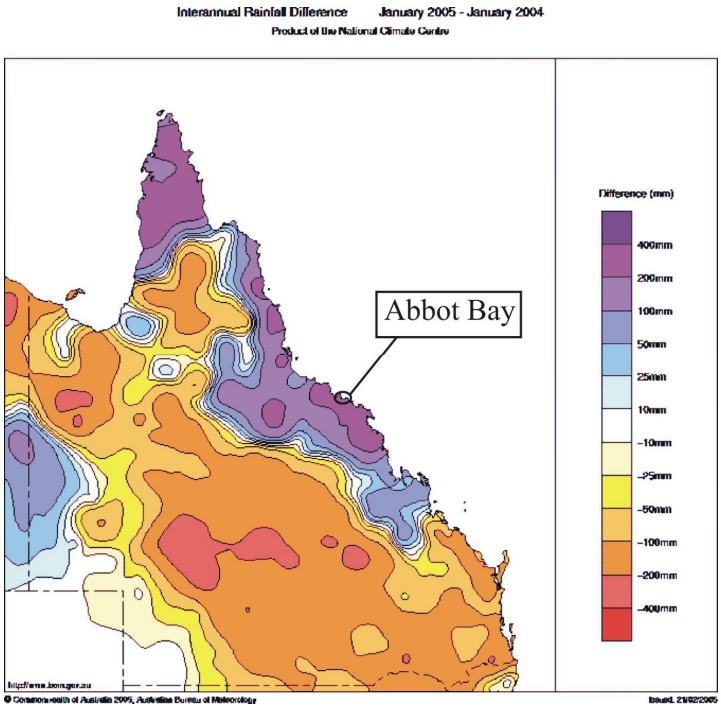

Figure 5.1 Difference in January rainfall 2005 over 2004. Source: Australian Bureau of Meteorology.

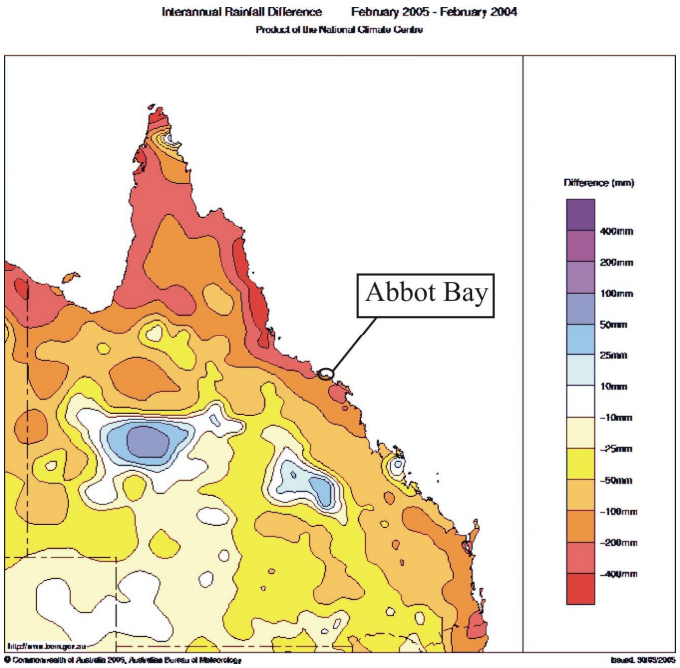

Figure 5.2 Difference in February rainfall 2005 over 2004. Source: Australian Bureau of Meteorology.

The relatively large individual climatic events, both rainfall and wind events, do impact on water quality in Abbot Bay and some of these effects are discussed below.

5.1.2 Total Phosphorus

Data for total phosphorus for the period January, 2002 to May, 2005 collected at various intervals is presented in Figure 5.3. The concentration of total phosphorus fluctuated approximately 6 fold and the 80th percentile point of the data was 0.044 mg.L^{-1}. The 50th percentile value for phosphorus is 0.014 mg.L^{-1}.

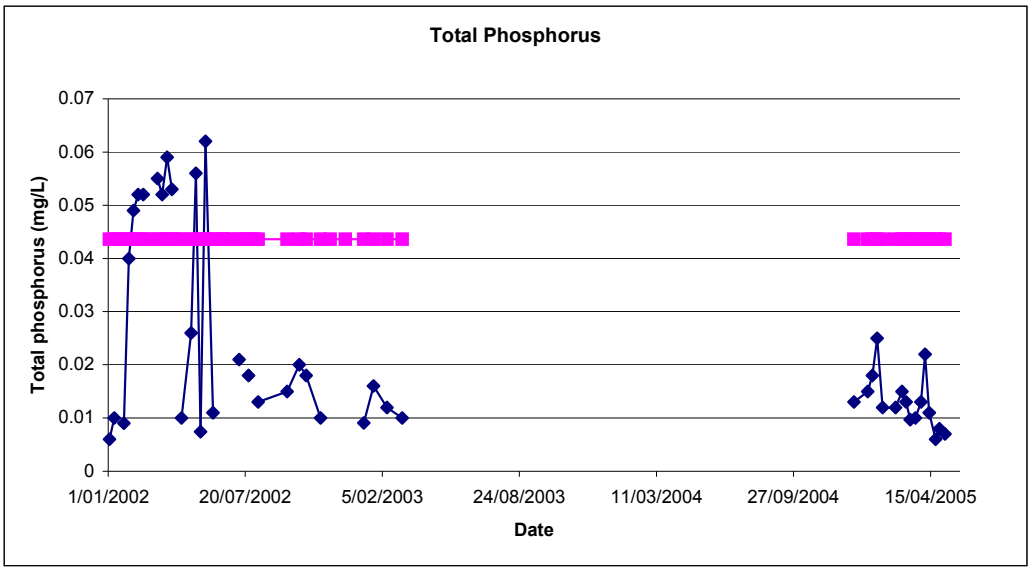

Figure 5.3. Total Phosphorus measured at the Ocean outfall site over a discontinuous 40 month period from January, 2002 to May 2005. The purple line shows the 80th percentile value.

During the wet season of 2002 (Jan to May), high concentrations (between 0.05 and 0.06 mg.L^{-1}) of total phosphorus was recorded. This level was not repeated in the wet season of 2003 or 2005. The initiation of the high levels of phosphorus coincided with the onset of rainfall and flooding in the region (http://www.bom.gov.au/inside/services_policy/public/sigwxsum/sigw0202.shtml#flood) demonstrating that severe flooding can cause large pulses of nutrients to flow into the sea in this region. Whilst the floods apparently cleared during February, high levels of phosphorus continued at the sample site until May in that year.

Floods in the region were also reported by the Bureau of Meteorology in February 2003 (http://www.bom.gov.au/inside/services_policy/public/sigwxsum/sigw0203.shtml#flood) but were described as "extremely coastal" and were not associated with high phosphorus concentrations at the Ocean sampling site.

In subsequent years, the total phosphorus fluctuated between 0.01 and 0.025 mg.L^{-1}. The highest value recorded (0.025 mg.L^{-1}) was recorded on 27th January, 2005, immediately after a rainfall event 22-24 January, 2005, during which 442 mm was recorded at Guthalungra over 3 days.

If the data recorded in the wet season of 2002 is excluded as abnormally high, the 80th percentile value for phosphorus is 0.018 mg.L^{-1}.

5.1.3 Total Nitrogen

Data for total nitrogen for the period January, 2002 to May, 2005 collected at various intervals at the Ocean site is presented in Figure 5.4. The 80th percentile point of the data is 0.318 mg.L^{-1}. The 50th percentile value for nitrogen is 0.211 mg.L^{-1}.

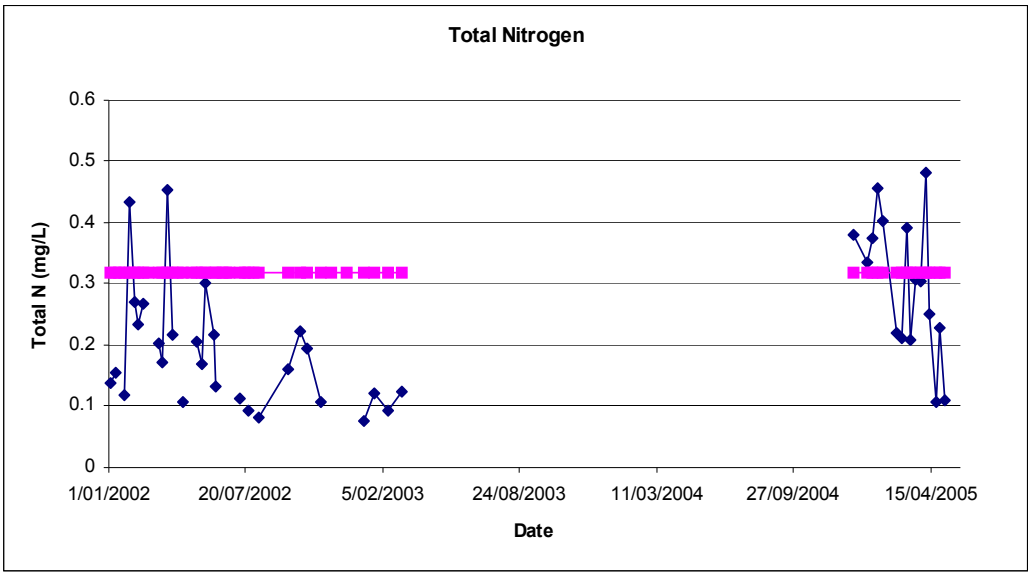

Figure 5.4. Total Nitrogen measured at the Ocean outfall site over a discontinuous 40 month period from January, 2002 to May 2005. The purple line shows the 80th percentile value.

Total nitrogen fluctuated 5 fold during the sampling period from about 0.1 mg.L^{-1} to about 0.5 mg.L^{-1}. Peak concentration of total nitrogen occurred in January and March, 2002, and January and April, 2005. Unlike total phosphorus, the samples taken in the first half of 2002 did not show particularly different levels of total nitrogen to that measured at other periods.

5.1.4 Total Suspended Solids (TSS)

Data for total suspended solids for the period January, 2002 to May, 2005 collected at various intervals is presented in Figure 5.5. Total suspended solids fluctuated 16 fold over the sample period and the 80th percentile point of the data is 6.5 mg.L^{-1}. The 50th percentile value for TSS is 3.25 mg.L^{-1}.

Highest values were found in February, 2002, October 2002 and January, 2005. October 2002 was unusually dry but windy and the high value in January, 2005 was recorded two days before the onset of the rain fall. It seems from these data that wind rather than rainfall impacts on the TSS but that again the environment is highly variable.

5.1.5 Total Chlorophyll *a*

Data for total chlorophyll a for the period January, 2002 to May, 2005 collected at various intervals is presented in Figure 5.6. Total chlorophyll a also fluctuated 16 fold over the sample period with the 80th percentile point of the data is 1.3 µg.L^{-1}. The 50th percentile value for chlorophyll a is 0.80 µg.L^{-1}.

Highest values were found in February, 2002 and January, 2005.

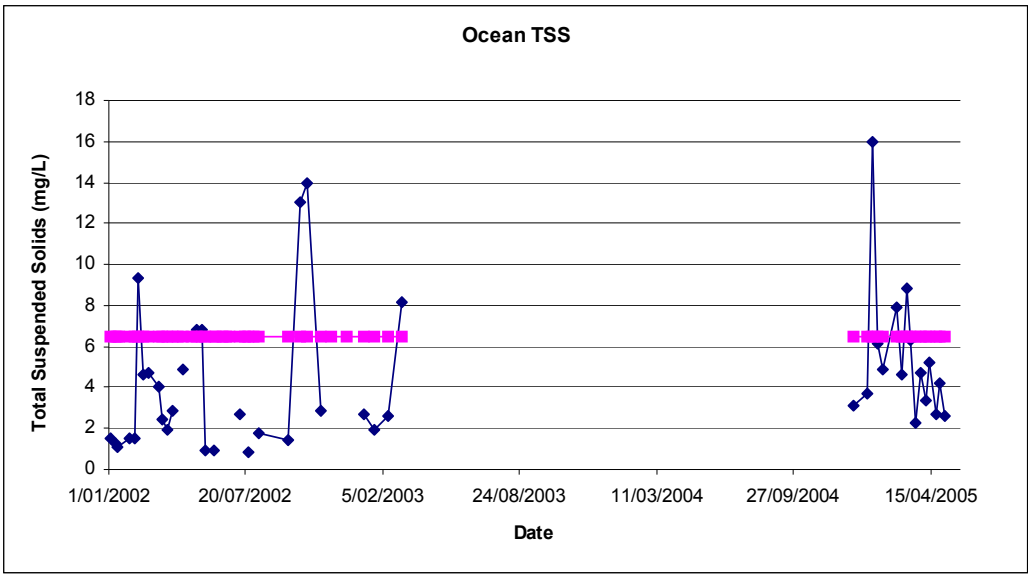

Figure 5.5. Total Suspended Solids measured at the Ocean outfall site over a discontinuous 40 month period from January, 2002 to May 2005. The purple line shows the 80th percentile value.

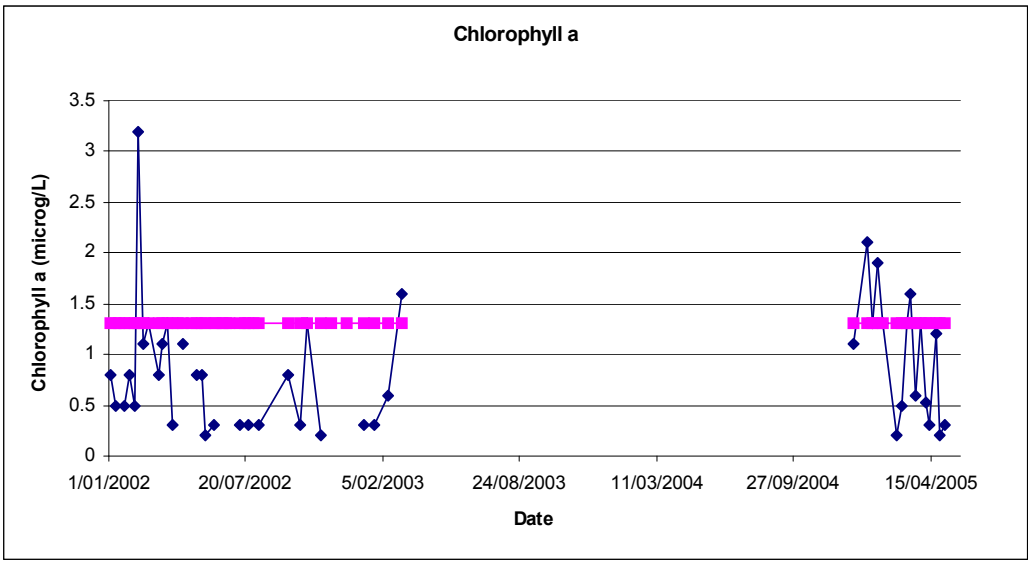

Figure 5.6. Total Chlorophyll *a* measured at the Ocean outfall site over a discontinuous 40 month period from January, 2002 to May 2005. The purple line shows the 80th percentile value.

5.1.6 pH

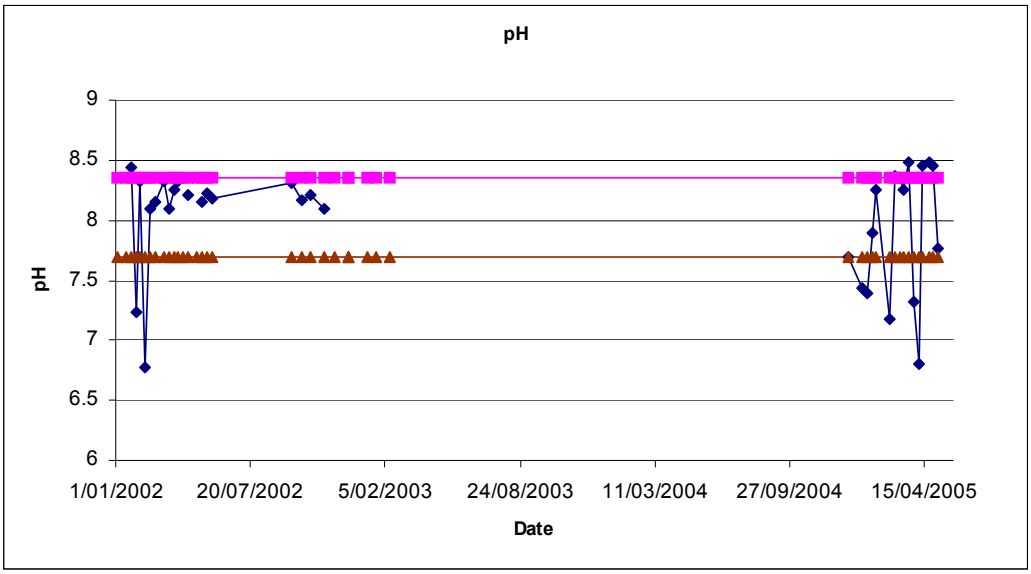

Figure 5.7. Water pH measured at the Ocean outfall site over a discontinuous 40 month period from January, 2002 to May 2005. The upper (purple) line shows the 80th percentile of the data and the lower (brown) line shows the 20th percentile of data.

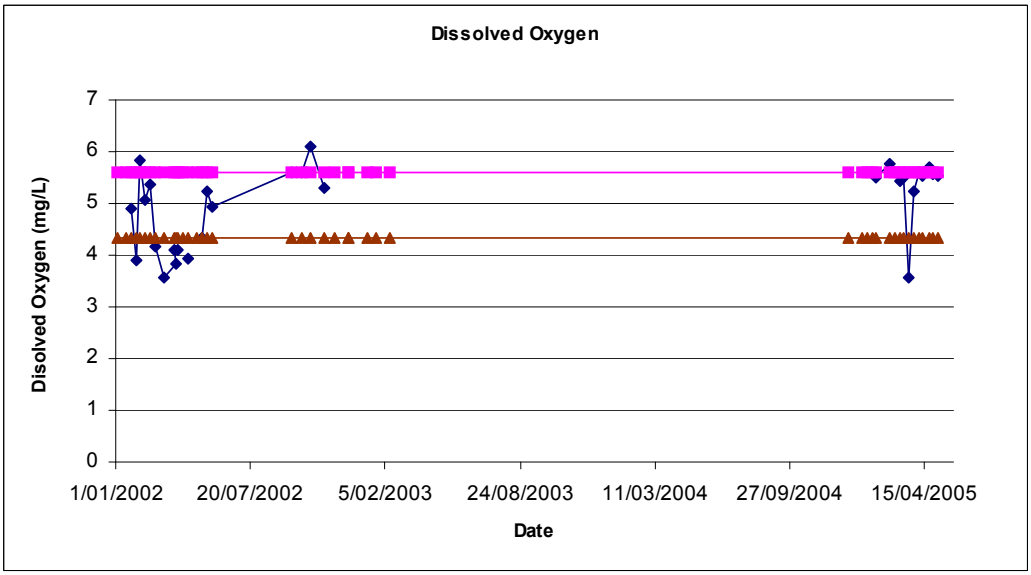

Figure 5.8. Water DO measured at the Ocean outfall site over a discontinuous 40 month period from January, 2002 to May 2005. The upper (purple) line shows the 80th percentile of the data and the lower (brown) line shows the 20th percentile of data.

Data for pH for the period January, 2002 to May, 2005 collected at various intervals is presented in Figure 5.7. Abbot Bay water pH fluctuated widely over the period studied. The

upper 80th percentile of data was 8.35 but no value was recorded over 8.5. The 20th percentile value was 7.69 but on a number of occasions, pH was recorded well below this value and as low as 6.79. Abbot Bay water pH did not appear to correlate with particular weather events.

5.1.7 Dissolved Oxygen

Data for water dissolved oxygen (DO) for the period January, 2002 to May, 2005 collected at various intervals is presented in Figure 5.8. Abbot Bay water DO fluctuated widely over the period studied. The upper 80th percentile of data was 5.59 mg.L^{-1} and the 20th percentile value was 4.35 mg.L^{-1}. Again, on a number of occasions, DO was recorded well below the 20th percentile value with the lowest value of 3.56 mg.L^{-1} equal to 57% saturation recorded on two occasions. Abbot Bay water DO did not appear to correlate with particular weather events.

5.1.8 Salinity

Data for water salinity for the period January, 2002 to May, 2005 collected at various intervals is presented in Figure 5.9. Abbot Bay water salinity did not vary greatly over the period studied, although there were a number of occasions where the salinity decreased rapidly. These occasions were 14-21/2/2002, 19-27/2/2005 and 23/2-2/3/2005. Each was associated with periods of high rainfall. Note that the hypersaline reading obtained in February, 2002, was observed before the onset of rain. The data from 2005 particularly correlates closely with the increase in phosphorus described above.

The upper 80th percentile of salinity was 38.5 g.L^{-1} and the 20th percentile value was 35.9 mg.L^{-1}. The lowest salinity value recorded was 34.4 g.L^{-1} and the highest 40.4 g.L^{-1}.

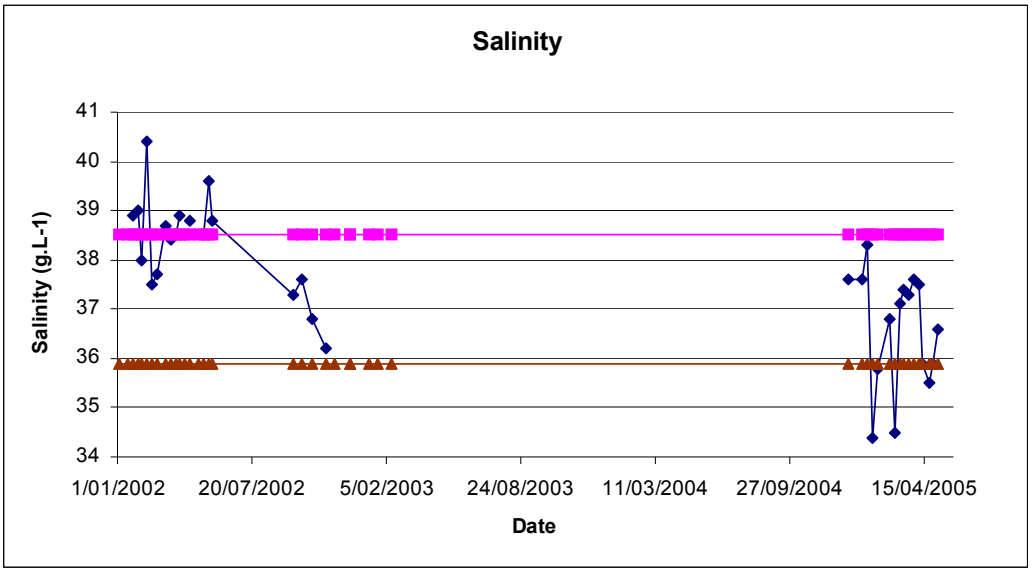

Figure 5.9. Water salinity measured at the Ocean outfall site over a discontinuous 40 month period from January, 2002 to May 2005. The upper (purple) line shows the 80th percentile of the data and the lower (brown) line shows the 20th percentile of data.

5.1.9 Comparison with ANZECC (2002) values

Table 5.1 shows a comparison of values from ANZECC, 2000 and the 80th percentile values obtained by sampling water quality in Abbot Bay. It is apparent from these data that the water

quality of Abbot Bay is inferior to that proposed to be found in tropical marine habitats. While TSS and Chla are within the range proposed in ANZECC, 2000, Total N and Total P are higher while pH and dissolved oxygen are lower.

Table 5.1 Comparison of water quality values listed in ANZECC, 2000, for tropical marine habitats with those measured at the ocean outfall site proposed for the Guthalungra project by Pacific Reef Fisheries.

Parameter	TSS $mg.L^{-1}$	Chl a $\mu g.L^{-1}$	TN $mg.L^{-1}$	TP $mg.L^{-1}$	pH	DO
ANZECC, 2000	1-20	0.7-1.4	0.100	0.015	8-8.4	>90% saturation
QWQG, 2005 (Enclosed coastal)	15	2.0	0.200	0.020	8-8.4	>90% saturation
Abbot Bay (50^{th} percentile value/s)	3.25	0.80	0.210	0.014	7.69-8.35	>76% saturation
Elliot River Qld DNRM median data	10.5	n.a.	0.703	0.060	7.92	~100%

5.1.10 Relationship between parameters

Table 5.2 shows the correlation coefficient (r) and significance (p) of the correlation between water quality parameters. A significant ($p<0.05$) correlation in water quality parameters in Abbot Bay water was found between TSS and chlorophyll a, Total N and chlorophyll a and Total P and Total N. Total P was not correlated with chlorophyll a, or TSS and Total N was not correlated with TSS in the water samples from Abbot Bay.

Table 5.2 Values for the correlations between various water quality parameters in water sampled from Abbot Bay.

Comparison	r	p<
Total P vs Chla	0.163	0.5
TSS vs Chla	0.398	0.01
Total N vs Chla	0.346	0.02
Total P vs Total N	0.303	0.05
Total P vs TSS	0.057	1.0
Total N vs TSS	0.192	0.5

These relationships differ from those of prawn farm discharge water. Values for similar correlations in prawn farm discharge water are shown in Table 5.3 and it is clear that TN, TP, TSS and chlorophyll *a* are highly correlated with each other in discharge water.

Table 5.3 Values for the correlations between water quality parameters in water discharged from a prawn farm at Alva Beach.

Comparison	r	p<
Total P vs Chla	0.634	0.001
TSS vs Chla	0.607	0.001
Total N vs Chla	0.805	0.001
Total P vs Total N	0.795	0.001
Total P vs TSS	0.486	0.001
Total N vs TSS	0.504	0.001

5.2 Groundwater

This section directly addresses concerns raised by one respondent.

Further to the studies described in Section 7.1.5 and Appendix O, GAPDE, 2003, additional groundwater investigations have been undertaken. These involved sinking 8 bores across the site.

The bore level data is shown in Figure 5.10. The water level in the bores fluctuates within a range of 0.6 m over the sampling period.

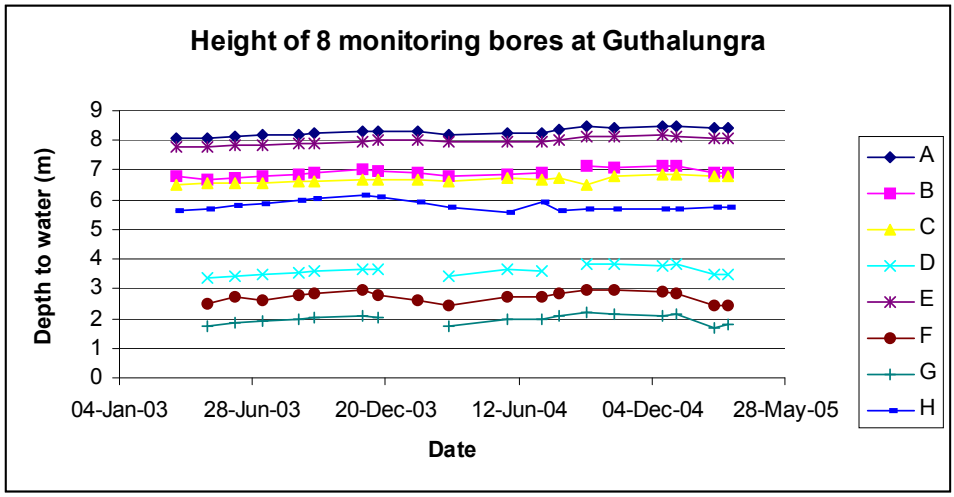

Figure 5.10 Depth to water in 8 monitoring bores at Guthalungra.

Further details regarding groundwater quality will be provided to the Department of Natural Resources, Mines and Water prior to construction.