APPENDIX H2

Water and sediment quality

APPENDIX H2.1

Water quality field sampling report

CLIENTS | PEOPLE | PERFORMANCE

BHP Billiton

Report for Olympic Dam Expansion Primary Water Supply System

Water Quality Field Sampling Report

December 2008

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Figure Index

Appendices

1. Background

BHP Billiton is currently undertaking a Selection Phase Study for the Primary Water Supply System (PWSS) for the Olympic Dam Expansion Project. The PWSS comprises a seawater reverse osmosis (SWRO) desalination plant, a 326 km long pipeline, four transfer pump stations and various storage facilities located at the desalination plant and at the mine site. The SWRO desalination plant will be located at Port Bonython near Whyalla.

It is widely recognised that the selection of appropriate and adequate seawater pre-treatment processes to minimise RO membrane fouling and scaling is the key to smooth continuous operation of a SWRO plant and maintaining plant availability. To design the pre-treatment process and select operating conditions for a SWRO plant at Port Bonython a seawater quality monitoring program and pilot plant study are currently being implemented. The programs for these are documented in the Water Quality Sampling Program Report [GHD Report No. 33177, 12/10/07] and the Desalination Pilot Plant Testing Program Revision 2 [GHD Report No. 33608, 6/05/08]. The seawater sampling program, along with the information gained during the pilot plant trials on the efficiency of conventional pre-treatment, will provide fundamental information for the design and operation of the full scale SWRO desalination plant and its associated pre-treatment facilities (e.g. range in total suspended solids and seawater salinity).

This report documents the seawater quality data obtained as at 30 November 08.

2. Water Quality Sampling/Monitoring

Reliable information on source seawater quality and an understanding of the factors which influence water quality are critical aspects to the successful design and operation of a SWRO desalination plant and its associated pre-treatment facilities. Arup was commissioned by BHP Billiton to collect relevant historical seawater quality data and conducted monthly seawater sampling from July 2006 until April 2007.

At present the intake site for the full scale plant has not been confirmed. Two potential intake locations are currently under consideration, a map of these two locations is shown in Appendix A. Both intake locations are in a water depth of 11-13 m. Intake location A is situated between Point Lowly and the Santos jetty at Port Bonython, while intake location B is situated in Fitzgerald Bay to the North of Point Lowly. The intake to the pilot plant is located at the Fire Pump on the Santos jetty.

GHD designed a comprehensive seawater quality program in September 2007 to provide site specific seawater quality data for the design of the full scale SWRO desalination plant at Point Lowly. The program has been implemented and samples have been collected monthly for the 12 months from September 2007 to August 2008 (except for November 2007).

In addition, a multiparameter YSI 6600 EDS Sonde was installed by Water Data Services Pty Ltd (WDS Pty Ltd) at the Fire Pump sampling site, close to the intake for the pilot plant, in May 2007 and has been collecting data since this time.

This report provides a review of Arup's seawater quality studies, the comprehensive seawater quality program developed by GHD and results from the samples collected to August 2008.

2.1 Summary of Previous Sampling Results

Arup was commissioned by BHP Billiton to undertake a seawater quality monitoring program for the development of a proposed SWRO plant. This comprised the collection of historical water quality data for the Spencer Gulf and seawater sampling. At the time of sampling the precise location of the seawater intake for the SWRO plant had not yet been identified, although the Point Lowly/Port Bonython region in the Upper Spencer Gulf were potential options.

From July 2006 to April 2007, sampling was undertaken by Arup on seven occasions along the Santos jetty at Port Bonython and within 1570 m of the jetty i.e. at the edge of the outer Zone (2) of the Exclusion Zone surrounding the jetty. Due to the logistical difficulty in sampling at certain sites along the jetty (July–August), the initial sampling sites were changed. From December 2006 monthly samples were collected, five sampling dates in total, for comprehensive analysis at three sites along the jetty at mid depth with the focus on sampling at the Fire Pump site (approximately 13 m total water depth i.e. 6.5 m mid depth) until the end of April 2007. As part of the seawater quality monitoring program a water quality station (YSI 6600 EDS Sonde) was also installed at the Fire Pump site in May 2007 by WDS Pty Ltd to provide continuous water quality data for typical CTD (conductivity, temperature, depth) probe parameters.

The Arup monitoring program was developed to provide information for the design of the SWRO plant (and associated pre-treatment facilities) and to provide environmental baseline data to characterise seawater quality for the return of any waste streams from the SWRO plant. GHD's review of water quality information (historical and analytical results from site specific sampling) provided by Arup focused on the

former objective only.

2.1.1 Seawater Quality Sampling

The Fire Pump site, located 800 m along the Santos jetty, was Arup's primary seawater sampling site. This site also corresponds to the seawater intake abstraction point for the pilot plant and the installation site for the Sonde. A summary of seawater quality data for this site, five sampling dates in total, is provided in Appendix B. The following limitations need to be noted with respect to the data:

- For the first four of the sampling dates only a single sample was collected (duplicate or triplicate samples are preferred).
- Samples were only collected at mid depth. A preferred strategy is to sample 1 m from surface and 2-3 m from seabed as this gives broad information on the variations in the water column. Additionally, the point of intake is likely to be close to the seabed and the information on the quality of the water at that depth is more important.
- For a single sampling point, critical parameters were determined in three different ways. For example TDS is calculated from specific conductance, by summation of ions and via evaporation and gave a wide variation in TDS e.g. the minimum TDS varies from 40 000 mg/L to 43 200 mg/L. This demonstrates that comparing TDS at different locations by different methods would yield false conclusions about spatial variation.

2.1.2 Discussion of Seawater Quality Results

TDS

In general, the water quality results at Port Bonython in terms of ionic composition are typical of that for seawater with a higher salinity. From a review of historical data it is known that seawater in the Spencer Gulf is highly saline, similar to that found in the Arabian Gulf in the most northerly reaches of the estuary. The Spencer Gulf has been described as an "inverted estuary" by Nunes and Lennon [1986] as there is no significant freshwater inflow into the Gulf and because evaporation in the area far exceeds the rainfall. There is limited dispersion and flushing from the estuary north of Point Lowly. These factors result in the salinity increasing with distance from the mouth of the Gulf. From the work of Nunes it is also expected that "Excluding periods of coincident dodge (neap) tides and light winds, tidal and wind mixing normally generate sufficient turbulence to maintain conditions uniform in the vertical". Hence, limited stratification is expected. Field testing data presented by Arup for the Fire Pump site and other sites show no evidence of significant stratification for pH, conductivity and temperature.

Considering the range of variability for the different TDS methods and the accuracy of the preferred method for TDS i.e. summation of ions, the Fire Pump data from Arup's sampling confirmed the range in TDS adopted for the original pre-feasibility (selection) study of 39 000 to 44 000 mg/L.

Suspended Solids and Turbidity

Seawater quality at the Fire Pump appeared to be good with no evidence of pollution, bacteria, volatile organic carbon, pesticides, polyaromatic hydrocarbons, oil and grease as the aforementioned parameters were at or below the detection limit. However, the total suspended solids, a key parameter for the design of the pre-treatment filtration step was found to be elevated with a maximum of 17 mg/L in January 2007. Although this was the result of a single sample, high values were also found at the other sites along the jetty (EL1 and EL3) supporting this value. There is some variability in total suspended solids (TSS) results as replicates were taken in April and results for these samples varied from 2 to 8 mg/L. High TSS (14 mg/L) was also found in an earlier sampling event in July 2006 at another location 500 m along the jetty. Therefore, it appears there is a high suspended solids content in the water column as these samples were taken at mid depth. According to the Arup report the water column is expected to contain significant sediment loads even at depth as the Gulf is generally characterised by sandbanks and seagrass.

The actual TSS is expected to be even higher as the TSS results reported were based on filtration through a 1.2 μm membrane filter. For desalination studies, GHD recommend the use of a smaller pore size filter of 0.45 μm as this coincides with tests for particulate metals, the SDI membrane and particulate organic carbon. With pore sizes almost three times smaller, more particulate matter should be captured in the test. To enable a comparison between previous and new results it was recommended that TSS be measured using both 0.45 μm and 1.2 μm membrane filters.

Turbidity peaked in samples collected in summer (February, 2007) as expected from the Remote Sensing Report carried out by *Oceanique Perspectives*. The latter conducted an analysis of 450 Satellite images over 10 years for Port Bonython. A relationship was developed for seawater from the Adelaide metro area for turbidity *vs* extinction coefficient and this was extrapolated and used for Port Bonython. Hence, the absolute turbidity values are not reliable. In addition, the spectral data from satellite images is only for the upper layers of the water column. Nevertheless, data obtained for Port Bonython indicates a seasonal trend with high turbidities in summer, almost double that of winter. Anecdotal reports from divers also confirms higher turbidity in summer where the visibility is appreciably worse compared to winter. This may be due to southerly winds which are reported to be short term events in summer. Whereas, in winter storms are from the southwest, offshore with less impact on turbidity.

2.1.3 SDI Data

SDI_5, SDI_{10} and SDI_{15} were determined by Arup on four occasions. As the temperature did not vary significantly from January to April 2007 the differences in SDI are due to water quality not temperature. Due to the fouling nature of raw seawater, the SDI_5 will be the most accurate, except for the measurement taken in February where the recommended % plugging factor of the ASTM International Standard (ASTM D 4189 – 07) was exceeded i.e. water was very fouling. The limited results show the fouling potential of the seawater varies significantly over time, where the SDI_5 measured for the Fire Pump site varied from 16.7 to 4.3 and along the jetty (when measured on the same day). More testing is required to confirm the variability of the SDI of the seawater over time to determine any seasonal or hydrodynamic trends, and is being undertaken as part of GHD's scope.

Table 1 Summary of Arup's SDI testing results

Date	10/01/07	07/02/07	20/03/07			25/04/07		
Site	Ex Loop 1 (Jetty)	Fire Pump (Jetty)	Ex Loop 1 (Jetty)	Fire Pump (Jetty)	Ex Loop 3 (Jetty)	Ex Loop 1 (Jetty)	Fire Pump (Jetty)	Ex Loop 3 (Jetty)
Sample Depth (m)	3	6	3	7	3	3	6	8
No. of Replicates	2	2(T=5) 1(T=10)	2	2	2	3	2	2
Volume (mL)	500	500	500	225	500	500	500	500
Av. SDI_5	7.6	16.7	5.5	12.0	9.0	4.5	4.3	7.5
Av. SDI_{10}	-	9.6	5.6	7.6	6.1	4.2	3.1	5.5
Av. SDI_{15}	-	-	4.6	5.7	4.6	3.9	2.8	4.0
Temp (°C)	-	23.5	22.0	22.0	22.0	23.0	23.5	22.0

Note: filter membrane type - Millipore 0.45µm HA

2.2 Summary of Current Sampling Program

Two comprehensive seawater quality monitoring programs were developed by GHD for implementation at the two potential seawater intake sites (Fitzgerald Bay and East of the Santos Jetty) and from the pilot plant intake (Refer Appendix A). One program is to be carried out routinely and the other to be undertaken for events such as pollution incidents, storms and algal blooms which will generally impact water quality. Each sampling program is designed to characterise seawater quality and determine:

» Chemical and biological characteristics (and if possible identify any contamination due to anthropogenic activities)

» Seasonal trends in seawater quality

» The impact of hydrodynamics (where possible)

Seawater samples are taken on a monthly basis (weather permitting). Duplicate samples are collected 1 m from the surface and approximately 2 to 3m from the sea bed at both sites to give information on water quality in the water column. The analytes that are included in the routine sampling program are summarised in Table 2 (for more information refer to the Water Quality Sampling Program Report [GHD Report No. 33177, 12/10/07]). The changes that have been made since the commencement of the program are noted below, with the modified program for sampling events from September 2008 also shown in Table 2 . It is noted that at this stage only the routine monthly sampling program has been implemented (and not the event sampling program).

In December 2007, GHD was requested to consider additional water quality parameters for inclusion in the monitoring program which may be relevant from the "South Australia Environment Water Protection (Water Quality) Policy 2003" for characterising the seawater quality from a discharge standpoint (refer memo titled "Review of Water Quality Policy", 12 December 2007 and subsequent instructions received from BHP Billiton's Simon Hunt on 14/01/08). As a consequence, the following parameters were added to the sampling program for the subsequent sampling events:

- Sulphide
- Silver
- Beryllium
- Chromium VI
- Enterococci
- Tributyltin (one sample + duplicate only, at site A, 2-3 m from sea bed) – January and February only
- PCBs (one sample + duplicate only, at site A, 2-3 m from sea bed) – January and February only

Sampling for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) has not been undertaken at this stage due to the high cost involved (however, this will be required at a later date).

After the February sampling event, GHD undertook a review to determine whether any parameters could be removed from the sampling program. Parameters that had not been detected in the five sampling events from September 2007 to February 2008 were removed from the sampling program. These included:

- Silver
- Chromium VI
- Mercury
- Tin

Following completion of the first twelve months of the sampling program (11 sampling events), GHD again undertook a review of the sampling program. The data collected over the first twelve months was considered to be sufficient for design purposes for some parameters, and therefore these were removed from the sampling program. Those parameters that were considered critical for the design of the full-scale plant were retained as part of the ongoing sampling program. The parameters removed from the sampling program included:

- DOC
- UV_{254}
- BOD_5
- Sulphide
- NO_2
- NO_3
- TAN
- SRP
- Total and faecal coliforms
- Enterococci
- Heterotrophic plate counts
- Dissolved and total heavy metals (except iron)

Table 2 Analytes for the Routine Seawater Quality Monitoring Programs

Parameter	Dimension	Routine - Initial	Routine (from September 2008)
pH	-	**X**	**X**
Temperature	°C	**X**	**X**
Electrical Conductivity at 25°C	mS/cm	**X**	**X**
Turbidity	NTU	**X**	**X**
Dissolved Oxygen	% Saturation & mg/L	**X**	**X**
Physico-chemical			
Total suspended solids	mg/L	**X** (0.45 µm and 1.2 µm	**X** (1.2 µm only)
TDS	mg/L	By calculation & evaporation	By calculation & evaporation
Chloride	mg/L	**X**	**X**
Fluoride	mg/L	**X**	**X**
Bromide	mg/L	**X**	**X**
Sulphate	mg/L	**X**	**X**
Bicarbonate	mg HCO_3/L	**X**	**X**
Carbonate	mg CO_3/L	**X**	**X**
Calcium	mg/L	**X**	**X**
Magnesium	mg/L	**X**	**X**
Potassium	mg/L	**X**	**X**
Sodium	mg/L	**X**	**X**
Barium	ug/L	**X**	**X**
Boron	mg/L	**X**	**X**
Strontium	mg/L	**X**	**X**
Silica SiO_2	mg/L	**X**	**X**
Total alkalinity	mg $CaCO_3$ /L	**X**	**X**
Total Hardness	mg $CaCO_3$ /L	**X**	**X**
TOC	mg/L	**X**	**X**
DOC	mg/L	**X**	
UV_{254}	Abs	**X**	
BOD_5	mg/L	**X**	
Oil and grease	mg/L	**X**	**X**

Total -N	µg/L	X	X
NO2—N	µg/L	X	
NO3-N	µg/L	X	
TAN	µg/L	X	
TKN	µg/L	X	X
Total P	µg/L	X	X
SRP	µg/L	X	
Chlorophyll-a	µg/L	X	X
Total coliforms	Cfu/100 mL	X	
Faecal coliforms	Cfu/100 mL	X	
Heterotrophic (72 h at 20°C)		X	
Heterotrophic (48 h at 37°C)		X	
Total Al	µg/L	X	
Filterable –Al	µg/L	X	
Total Fe	µg/L	X	X
Filterable –Fe	µg/L	X	X
Total Mn	µg/L	X	
Filterable –Mn	µg/L	X	
Total –As	µg/L	X	
Total –Cd	µg/L	X	
Total –Cr	µg/L	X	
Total –Cu	µg/L	X	
Total –Hg	µg/L	X	
Total –Mo	µg/L	X	
Total –Ni	µg/L	X	
Total –Pb	µg/L	X	
Total –Sn	µg/L	X	
Total –Zn	µg/L	X	
SDI_3 and SDI_5	%/T or by convention no units	X	X

2.3 Results from Seawater Sampling (September to June)

The seawater quality monitoring program was implemented mid September and samples have been collected on the dates detailed in Table 3. The results of the eight sampling trips are briefly discussed below.

Table 3 Sampling Dates

Sampling Event	Date
1	18 September 2007
2	24 October 2007
3	18 December 2007
4	24 January 2008
5	20 February 2008
6	1 April 2008
7	29 April 2008
8	3 June 2008
9	3 July 2008
10	5 August 2008
11	26 August 2008
12	24 September 2008
13	28 November 2008

For the first sampling data (September 18th), seawater samples were only submitted to one laboratory (ALS) for the determination of major ions (and all other analytes). No samples were collected at the pilot plant intake on this date. Samples were sent to two labs (AWQC and ALS) in the subsequent October to February sampling events to compare major ions and take advantage of better Limits of Reporting (LOR) where possible. Due to the significant differences in major ions results being observed between the labs, samples were also sent to Sydney Water on 1 April and 29 April. From September 2008 samples were sent to only one lab and AWQC was selected as results received from AWQC have been considered to be the most reliable (see Section 2.4.1 for further discussion).

It is noted that the 18 December 07 and 26 August 08 sampling events were conducted during a dodge tide (i.e. limited tidal movement over a period of a day or two).

2.3.1 Sampling Event No. 1 (18 September 2007)

Results from the laboratories were compiled and are attached in Appendix C. Quality control data from ALS has been checked by GHD and complies for the data in Appendix C. Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the September 18th results:

» Salinity results as measured by conductivity and TDS were high.

» Conductivity of all samples (64 – 65 mS/cm) measured by the probe (Yeo-Kal 611) in the field were higher than the maximum measured by Arup (61 mS/cm) and that measured by the Sonde deployed at the Fire Pump (62 mS/cm)

» TDS supported the high conductivity results with TDS ranging from (42 433 to 44 025 mg/L - calculated from the average of the major ions). The ion balance calculated by GHD of all samples balanced within <5% with the exception of one sample. The balance of the latter sample was 5.2% and this is expected to be due to a higher sodium result, and is highlighted in the results in Appendix C to indicate it needs further verification in long term testing. TDS results from Arup's testing from December 2006 to April 2007 ranged from 40 240 to 42 367 mg/L.

» Erroneous high metal concentrations in some of the duplicate samples compared to the other e.g. zinc concentrations measured in one sample was 14 µg/L compared to 55 µg/L in the duplicate sample. Generally, ALS has proven reliable in measuring low levels of metals in seawater in other marine programs managed by GHD with the occasional spurious result. Longer term trend monitoring generally reveals these results to be outliers.

» Similarly, erroneously high BOD results in one of the duplicate samples compared to the other. Again, longer term trend monitoring generally reveals these results to be outliers.

2.3.2 Sampling Event No. 2 (24 October 2007)

Results from the laboratories were compiled and are attached in Appendix C. Quality control data from ALS has been checked by GHD and complies for the data in Appendix C (Quality control data was not provided by AWQC). Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the October 24th results:

» As for September 18th, salinity results as measured by conductivity and TDS were found to be high.

» Conductivity was measured at similar levels to September at approximately 64 – 65 mS/cm.

» Major ions contributing to TDS were measured by AWQC (previously used in Arup's testing) in addition to ALS. TDS results from both labs were high due to higher sodium and chloride results. Both sodium and chloride are the major ions in seawater, typically comprising 30.5% and 55% of the TDS, respectively. Despite the low limits of reporting for these ions in seawater (1 mg/L), a relatively high variation between duplicates has commonly been found by GHD for these ions in other seawater quality monitoring programs. This is commented on further in Section 2.4.1.

» Dissolved silica was markedly higher in the October (0.5 - 0.7 mg/L) results than previously found in September where it was less than the detection limit (0.1 mg/L). ALS was contacted but cannot repeat the analysis as no more sample was available.

» Some spurious BOD and heterotrophic plate counts were noted and will be verified in longer term trend monitoring.

» The total suspended solids (TSS) was measured using a 1.2 µm and 0.45 µm filter (same manufacturer – Advantec). The TSS results were found to be higher when filtered using the large pore size filter of 1.2 µm. This is the reverse of what is expected as the lower pore size filter should

collect more suspended solids. It has been checked with the lab and it is not the result of a sequential filtration step whereby, the sample is filtered first through the larger size filter followed by the smaller size filter of 0.45 µm.

2.3.3 Sampling Event No. 3 (18 December 2007)

Results from the laboratories were compiled and are attached in Appendix C. Quality control data from ALS has been checked by GHD and generally complies for the data in Appendix C (Quality control data was not provided by AWQC), except for BOD, faecal coliforms, total coliforms and the heterotrophic plate count for which the holding time was exceeded by one day (due to a delay in the courier getting the samples to Sydney). Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the December 18th results:

» As for September 18th and October 24th, salinity results as measured by TDS were found to be high compared to those measured by Arup; however the salinity was slightly lower than that measured on September 18th and October 24th.

» Significantly greater variation between duplicates for chloride was identified in the results from ALS when compared to AWQC.

» Due to the unavailabity of the Yeo-Kal 611 water quality meter used in the previous sampling trips, a TSI 90FLMVAB water quality meter was used. This probe however did not output conductivity (only salinity) and didn't measure turbidity. Using the conversion software between conductivity and salinity provided on the TSI webpage did not produce realistic results; therefore these results have been disregarded. It is noted that the relationship between EC and salinity varies depending on the quality of the water and the ion concentration (more or less of one ion). Additionally, with seawater, ion pairing will occur and this will limit the conductivity.

» Heterotrophic plate count results in some of the samples were significantly higher than previously recorded, indicating that contamination of some of the samples may have occurred. This will be monitored over the upcoming sampling events.

» As for October 24th, the TSS results were found to be higher when filtered using the larger pore size filter of 1.2 µm. This has again been discussed with ALS and they have indicated that it may be an issue with the washing of the salt through the filter. ALS has advised that extra care and attention will be paid to this test on the next sampling event (insufficient sample was available for them to repeat the analysis for this sampling event).

2.3.4 Sampling Event No. 4 (24 January 2008)

Results from the laboratories were compiled and are attached in Appendix C. Quality control data from ALS has been checked by GHD and complies for the data in Appendix C (Quality control data was not provided by AWQC). Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the January 24th results:

» Chloride, sodium and TDS (calculated) varied significantly between ALS and AWQC. ALS chloride results averaged around 26,000 mg/L whereas AWQC chloride results averaged around 21,000 mg/L. ALS sodium results averaged around 15,000 mg/L, whereas AWQC sodium results averaged slightly under 13,000 m/L. The calculated TDS based on ALS results averaged 47,600 mg/L, whereas it averaged 39,700 mg/L based on AWQC results.

» A Troll 9500 water quality meter was used for this sampling event (for field measurements) due to its ability to also measure depth (the Troll 9500 had been unavailable on previous sampling trips). The DO values measured by this meter are considered to be very high, and unlikely to provide a realistic measure of actual DO.

» As for October 24th and December 18th, the TSS results were found to be higher when filtered using the larger pore size filter of 1.2 µm. ALS undertook an investigation to determine the cause of this using artificial seawater samples. They stated that it was an issue with the washing of the salt through the filter, and that they had developed a modified method that would provide more reliable results. An alternative theory is that a dynamic membrane ('cake') was forming on the 1.2 µm filter and filtering out smaller particles, however this theory is unsubstantiated.

» Significant variation in results between duplicates was identified in some cases; these are highlighted in the results presented in Appendix C.

2.3.5 Sampling Event No. 5 (20 February 2008)

Results from the laboratories were compiled and are attached in Appendix C. Quality control data from ALS has been checked by GHD and complies for the data in Appendix C (Quality control data was not provided by AWQC). Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the February 20th results:

» Chloride, sodium and TDS (evaporation and calculated) again varied significantly between ALS and AWQC. ALS chloride results averaged approximately 25,500 mg/L whereas AWQC chloride results averaged approximately 21,700 mg/L. ALS sodium results averaged approximately 13,500 mg/L, whereas AWQC sodium results averaged approximately 12,700 m/L. The calculated TDS based on ALS results averaged 45,000 mg/L, whereas it averaged 40,500 mg/L based on AWQC results.

» As for January 24th, a Troll 9500 water quality meter was used for this sampling event (for field measurements). The DO sensor was not functioning and therefore DO results are not available.

» The modified TSS method developed by ALS was used for this sampling event. The results using both the 0.45 and 1.2 µm filters were found to be comparable (however the 1.2 µm results were still slightly higher), and also comparable to the AWQC results.

» Significant variation in results between duplicates was identified in some cases, these are highlighted in the results presented in Appendix C.

2.3.6 Sampling Event No. 6 (1 April 2008)

Results from the laboratories were compiled and are attached in Appendix C. Quality control data from ALS has been checked by GHD and complies for the data in Appendix C (Quality control data was not provided by AWQC or Sydney Water). Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the April 1st results:

» The calculated TDS based on AWQC and Sydney Water results was found to be similar (average of 42,900 mg/L for AWQC compared to 43,200 mg/L for Sydney Water), however calculated TDS from ALS results was significantly higher (average of 46,700 mg/L). The results are represented graphically in Section 2.4.

» A Horiba water quality meter was used for the field measurements. DO was found to be significantly lower than that recorded during other sampling events (approx 3.8 mg/L). The low readings are considered to most likely be related to an issue with the meter.

» TSS (1.2 µm) results from AWQC and ALS were similar (typically 5 – 8 mg/L); however TSS results from Sydney Water were significantly lower (typically <2 mg/L).

» ALS dissolved silica results are significantly higher (typically around 1.3 mg/L) than those reported by both AWQC and Sydney Water (typically approx 0.1 mg/L).

» Carbonate alkalinity was detected by Sydney Water but not by ALS or AWQC. It is noted that carbonate alkalinity is expected to be zero at pH < 8.3, therefore the result is not expected.

» AWQC recorded incidents against a number of samples, in particular with regard to microbiological samples for A1, A10, INTAKE, QC1, QC2 and QC5 not arriving at the laboratory within 24 hours of the samples being taken. In addition, the test for chlorophyll was not processed within the required holding time for any of the samples.

» Significant variation in results between duplicates was identified in some cases, these are highlighted in the results presented in Appendix C.

2.3.7 Sampling Event No. 7 (29 April 2008)

Results from the laboratories were compiled and are attached in Appendix C. Quality control data from ALS and Sydney Water has been checked by GHD and complies for the data in Appendix C (Quality control data was not provided by AWQC). Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the April 29th results:

» TDS results from ALS, AWQC and Sydney Water were found to be considerably closer than on some previous sampling events. The average calculated TDS was 44,500 mg/L, 43,400 mg/L and 43,200 mg/L based on ALS, AWQC and Sydney Water results respectively. The results are represented graphically in Section 2.4.

» As for January and February sampling events, a Troll 9500 water quality meter was used for the field measurements.

» Coliform detections were considerably higher than has previously been observed. The sampling technique will be evaluated to determine whether contamination may have occurred.

» TSS (1.2 µm and 0.45 µm) was low (typically < 5 mg/L)

» Carbonate alkalinity was detected by Sydney Water but not by ALS or AWQC. It is noted that carbonate alkalinity is expected to be zero at pH < 8.3, therefore the result is not expected.

» AWQC recorded incidents against a number of samples as the test for chlorophyll was not processed within the required holding time for any of the samples.

» Significant variation in results between duplicates was identified in some cases, these are highlighted in the results presented in Appendix C.

2.3.8 Sampling Event No. 8 (3 June 2008)

Results from the laboratories were compiled and are attached in Appendix C. Quality control data from ALS has been checked by GHD and complies for the data in Appendix C (Quality control data was not provided by AWQC). Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the June 3rd results:

» TDS results from ALS were again significantly higher from ALS (average 48,200 mg/L) than from AWQC (average 42,200 mg/L). The results are represented graphically in Section 2.4.

» Significant variance in some duplicate results from AWQC for sodium was observed (up to 7% for samples B1 and QC3).

» As for the previous sampling event, a Troll 9500 water quality meter was used for the field measurements.

» TSS results from ALS (both 1.2 µm and 0.45 µm) were considerably lower than those from AWQC (1.2 µm). ALS TSS results were typically around 1 mg/L whereas AWQC results were greater than 5 mg/L.

» Coliform detections were again found to be high for each sample.

» A significant difference in results for dissolved silica was observed between ALS (approx 1 mg/L) and AWQC (approx 0.1 – 0.2 mg/L).

» AWQC recorded incidents against a number of samples, in particular with regard to microbiological samples for B1, B10, INTAKE, QC3, QC4 and QC5 not arriving at the laboratory within 24 hours of the samples being taken. In addition, the test for chlorophyll was not processed within the required holding time for any of the samples.

» Significant variation in results between duplicates was identified in some cases, these are highlighted in the results presented in Appendix C.

2.3.9 Sampling Event No. 9 (3 July 2008)

Results from the laboratories were compiled and are attached in Appendix C. Quality control data from ALS has been checked by GHD and complies for the data in Appendix C (Quality control data was not provided by AWQC). Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the July 3rd results:

» TDS results from ALS were again significantly higher from ALS (average 43,200 mg/L) than from AWQC (average 40,800 mg/L). The results are represented graphically in Section 2.4.

» A Yeo-Kal 611 water quality meter was used for the field measurements, however the results obtained were very poor and did not represent actual seawater conditions. These results are therefore not reported.

» TSS results from ALS (both 1.2 µm and 0.45 µm) were considerably lower than those from AWQC (1.2 µm). ALS TSS results were typically around 1 mg/L whereas AWQC results were greater than 5 mg/L.

» In order to assist in understanding the high coliforms results being observed in recent results from AWQC, samples were sent to both AWQC and ALS for analysis. ALS found coliforms to be below the detectable limit (<2 CFU/100 mL), whereas coliforms results of 27 – 100 / 100 mL were recorded by AWQC. After discussions with the two laboratories it was determined that they were using different methods for the analysis of coliforms. ALS results were determined using the membrane filtration method (also known as the CFU method). AWQC results were determined using the Most Probable Number (MPN) method. AWQC advised that the membrane filtration method was likely to be more accurate for seawater samples, however that similar results would typically be expected from both methods.

» AWQC recorded incidents against a number of samples as the tests for chlorophyll were not processed within the required holding time for any of the samples.

» Significant variation in results between duplicates was identified in some cases, these are highlighted in the results presented in Appendix C.

2.3.10 Sampling Event No. 10 (5 August 2008)

Results from the laboratories were compiled and are attached in Appendix C. Quality control data from ALS has been checked by GHD and complies for the data in Appendix C (Quality control data was not provided by AWQC). Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the August 5th results:

» TDS results from ALS were found to be similar to those reported by AWQC. The results are represented graphically in Section 2.4.

- Field measurements are not available for this sampling event, as the rental water quality meter did not arrive when scheduled.
- TSS results from ALS (both 1.2 µm and 0.45 µm) were considerably lower than those from AWQC (1.2 µm). ALS TSS results were typically around 1 mg/L whereas AWQC results were 4 - 8 mg/L.
- High coliforms results were again reported by AWQC. Further commentary regarding this issue is detailed above in the comments on the 3rd July sampling event.
- Dissolved silica results reported by ALS are considered to be very high (420 – 485 mg/L), and not to represent the actual seawater quality and have therefore been removed from the results used to calculate averages. By comparison the reactive silica results reported by AWQC were typically less than 0.1 mg/L.
- AWQC recorded incidents against a number of samples, in particular with regard to microbiological samples for A1, A10, INTAKE, QC1, QC2 and QC5 not arriving at the laboratory within 24 hours of the samples being taken. In addition, the test for chlorophyll was not processed within the required holding time for any of the samples.
- Significant variation in results between duplicates was identified in some cases, these are highlighted in the results presented in Appendix C.

2.3.11 Sampling Event No. 11 (26 August 2008)

Results from the laboratories were compiled and are attached in Appendix C. Quality control data from ALS has been checked by GHD and complies for the data in Appendix C (Quality control data was not provided by AWQC). Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the August 26th results:

- TDS results from ALS were found to be similar to those reported by AWQC. The results are represented graphically in Section 2.4.
- A Horiba water quality meter was used for the field measurements. DO was found to be above the saturation level, therefore the results for DO are not considered to be reliable.
- High coliforms results were again reported by AWQC. Further commentary regarding this issue is detailed above in the comments on the 3rd July sampling event.
- AWQC recorded incidents against a number of samples as the tests for chlorophyll were not processed within the required holding time for any of the samples. In addition for a number of samples DOC was reported to be higher than TOC, however was within the method uncertainty.
- Significant variation in results between duplicates was identified in some cases, these are highlighted in the results presented in Appendix C.

2.3.12 Sampling Event No. 12 (24 September 2008)

The results from AWQC were compiled and are attached in Appendix C. It is noted that quality control data is not provided by AWQC. Marine and weather data is supplied on the monthly cover sheet. The

total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the September 24th 2008 results:

» A Horiba water quality meter was used for the field measurements. DO was found to be above the saturation level, therefore the results for DO are not considered to be reliable.

» AWQC recorded incidents against samples INTAKE and QC5 as the tests for chlorophyll were not processed within the required holding time for these two samples.

2.3.13 Sampling Event No. 13 (28 October 2008)

The results from AWQC were compiled and are attached in Appendix C. It is noted that quality control data is not provided by AWQC. Marine and weather data is supplied on the monthly cover sheet. The total dissolved salts (TDS) concentration was calculated independently by GHD and the ion balance of each water sample checked.

Comments

The following observations were noted from the October 28th 2008 results:

» A Yeo-Kal 611 water quality meter was used for the field measurements.

» AWQC recorded incidents against all samples as the tests for chlorophyll were not processed within the required holding time.

2.4 Summary of Results to Date

A summary of the sampling results to date including mean, median, maximum and average values at each sampling location is shown in Table 4. The sample locations are identified as follows:

» A1 and QC1 – Sampling Location A (East of Santos Jetty – West of Point Lowly), 1m depth

» A10 and QC2 – Sampling Location A (East of Santos Jetty – West of Point Lowly), 2-3 m from sea bed

» B1 and QC3 – Sampling Location B (Fitzgerald Bay – North of Point Lowly), 1m depth

» B10 and QC4 – Sampling Location B (Fitzgerald Bay – North of Point Lowly), 2-3 m from sea bed

» INTAKE and QC5 – Pilot plant intake (sampling point on intake pipeline, shortly after intake pump)

Maximum and minimum values are calculated using the average result from duplicate samples. As discussed in Section 2.4.1, some of the results for chloride, sodium and TDS from ALS are considered to be unrealistic and have therefore been excluded from the ranges and averages. It is noted that there are some differences between what has been found during GHD's sampling program when compared to that found by Arup. After exclusion of the results detailed in Section 2.4.1 TDS (by calculation from individual ions) during the current sampling program has averaged 41,600 to 42,400 mg/L compared to 41600 mg/L during Arup's program. The maximum TDS recorded is higher; approximately 44,700 mg/L, compared to 42,600 mg/L during Arup's sampling campaign. It is noted that the results presented are based on an average of results from the various laboratories used for each sampling event (except the sampling events in which ALS chloride, sodium and TDS results have been excluded, see Section 2.4.1).

Individual results in some cases are outside the ranges shown in Table 4. It is noted that typically the TDS calculated from ALS results is higher than that calculated from AWQC and Sydney Water results. Further details of results for each sample are presented in Appendix C.

The variation of chloride, sodium, TDS (by summation of ions), TDS (by evaporation) and TSS (1.2. µm) throughout the sampling program for both sampling location A and B is shown in Figures 6 to 15. The variation in results between both duplicate samples and the various laboratories is shown. Discussions with the laboratories indicate that TDS by summation of ions is considered to provide a more accurate indication of TDS than TDS by evaporation. TDS by evaporation can overstate TDS due to water being trapped within the crust that is formed. Therefore when evaluating results a greater emphasis is placed on the TDS by summation of ions results.

Graphs showing the variation over the sampling program for a number of additional parameters (e.g. anions, cations, metals, nutrients etc.), are presented in Appendix D.

The redox potential measurements are only an indication and are not considered to be very reliable. There are wide differences from one probe to the other and differences can be observed even when the same probe is used. The reliability of the DO results in some cases is also questionable.

The issues associated with the SDI testing experienced in September to December have now been resolved. SDI results for January to October 2008 sampling events are therefore included in Table 4.

Table 15 Summary of Water Sampling Results

Title	**Port Bonython Seawater Monitoring Program - Results Summary**
Project	BHP Billiton ODX PWSS Pilot Plant Works
Job Number	33/14036
File Name	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\[Summary of Sampling Results v3.xls]Summary
Print out	11/12/2008
Source Data	Arup Water Quality Summary Data Report, Results from ALS, AWQC, Sydney Water, Field Results

			ARUP - Santos Jetty Fire Pump			A1				A10				B1				B10				INTAKE			
			Average	Min	Max	Average	Median	Min	Max	Average	Median	Min	Max	Average	Median	Min	Max	Average	Median	Min	Max	Average	Median	Min	Max
	Units																								
Physicochemical Parameters																									
Field Measurements		LOR /probe																							
pH (c) (a)		0.01	8.2	8.1	8.2	8.02	8.05	7.62	8.36	7.97	7.95	7.49	8.36	7.95	7.99	7.59	8.31	7.98	7.99	7.65	8.33				
EC (c) (a)	mS/cm		59.8	58.6	60.6	61.07	61.21	56.30	64.70	61.67	62.03	56.40	64.82	62.09	62.55	56.70	65.30	62.20	62.65	56.80	65.20				
Turbidity (c)	NTU	0.1	3.0	1.1	8	5.85	2.20	0.00	26.00	5.79	2.60	0.00	23.00	5.10	2.40	0.00	20.40	6.44	2.38	0.00	27.00				
Temperature (c)	°C	0.1				18.72	18.73	12.44	23.94	18.69	18.70	12.33	23.43	18.86	18.73	12.72	23.80	18.82	18.78	12.64	23.81				
DO (c)	mg/L	0.1				8.09	8.60	3.81	10.75	7.99	8.55	3.62	10.79	7.89	8.15	3.86	10.60	7.85	8.07	3.82	10.67				
DO (c)	% sat					117.3	120.4	86.5	140.9	117.0	124.0	85.3	135.1	114.2	109.9	88.4	135.0	113.7	109.4	87.0	133.0				
ORP (c)	mV					155.2	169.0	15.0	242.0	173.9	181.0	-26.0	342.0	150.3	174.0	-37.0	345.0	170.5	174.0	-39.0	333.0				
SDI_3						17.9	17.4	13.9	23.7	20.2	20.8	14.9	25.8	20.4	21.3	17.9	21.8	18.8	19.7	13.2	23.7				
SDI_5						13.1	12.8	11.1	16.5	13.7	14.5	11.0	16.8	14.2	14.6	12.6	15.1	13.2	13.7	10.3	15.5				
pH (a)						8.1	8.1	8.0	8.2	8.0	8.1	8.0	8.1	8.1	8.1	8.0	8.1	8.1	8.1	8.0	8.1	8.1	8.1	8.0	8.1
Conductivity (a)	mS/cm					59.96	59.03	58.10	63.10	60.39	59.60	58.15	63.25	60.98	60.05	59.00	64.10	60.88	60.03	58.35	64.10	60.43	59.70	58.15	63.35
Suspended Solids (SS) (1.2 µm)	mg/L	1	10.5	5.3	17	8.2	4.6	2.0	22.0	8.0	5.5	2.2	22.5	7.6	4.4	2.8	23.5	7.1	4.4	2.5	18.0	7.0	4.0	1.3	22.5
Suspended Solids (SS) (0.45 µm)	mg/L	1				5.0	3.5	1.5	12.5	4.5	3.5	1.5	8.5	3.9	3.3	<1	8.5	4.6	4.5	1.5	8.5	4.2	3.0	2.0	7.5
UV Absorbance @ 254 nm	AU	0.01				0.03	0.03	<0.001	0.03	0.02	0.02	<0.001	0.03	0.03	0.03	<0.001	0.04	0.02	0.02	<0.001	0.03	0.04	0.03	<0.001	0.21
Total Hardness as CaCO3	mg/L	1				7768	7680	7215	8905	7784	7788	7285	8555	7803	7713	7390	8605	7833	7855	7365	8755	7761	7735	7455	8220
Alkalinity by PC Titrator																									
Hydroxide Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0.00	<1	<1	<1	0.00	<1	<1	<1	0.00	<1	<1	<1	0.00	<1	<1	<1	0.00	<1
Carbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				2.20	<1	0.00	12.00	2.00	<1	0.00	9.00	1.90	<1	0.00	8.30	2.30	<1	0.00	12.70	2.10	<1	0.00	9.30
Bicarbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				122.6	123.7	115.5	128.2	124.1	124.0	118.0	128.4	124.8	126.1	119.0	130.1	125.4	125.8	117.2	139.5	124.0	123.8	118.7	130.2
Hydroxide Alkalinity	$mgOH^-/L$	1	0	0	0	<0.34	<0.34	0.00	<0.34	<0.34	<0.34	0.00	<0.34	<0.34	<0.34	0.00	<0.34	<0.34	<0.34	0.00	<0.34	<0.34	<0.34	0.00	<0.34
Carbonate Alkalinity	$mgCO_3^{2-}/L$	1	0	0	0	1.30	<0.60	0.00	7.20	1.20	<0.60	0.00	5.40	1.10	<0.60	0.00	4.98	1.40	<0.60	0.00	7.62	1.30	<0.60	0.00	5.58
Bicarbonate Alkalinity	$mgHCO_3^-/L$	1	155	155	157	149.6	150.9	140.9	156.5	151.4	151.3	144.0	156.6	152.2	153.9	145.2	158.7	153.0	153.5	143.0	170.5	151.3	151.1	144.9	158.9
Total Alkalinity as CaCO3	$mgCaCO_3/L$	1	127.4	127	129	124.1	126.0	115.5	128.0	125.3	125.8	118.0	129.5	125.9	127.3	119.0	130.0	127.0	128.3	119.5	139.5	125.4	127.4	119.0	130.3
Dissolved Major Anions																									
Chloride (b)	mg/L	1	23067	22100	23633	22534	22450	20600	24700	22890	22750	21300	24875	23000	23100	21150	24793	22978	23000	21500	24300	22519	22800	20850	23903
Sulfate as SO4 2-	mg/L	1	3246	3150	3300	3398	3375	3235	3555	3404	3450	3253	3488	3435	3436	3295	3550	3455	3435	3310	3580	3397	3394	3270	3572
Bromide	mg/L	0.01	83.1	79.3	85.8	81.3	81.6	78.5	85.2	81.3	80.6	78.2	85.2	82.5	82.5	79.5	86.0	82.2	82.3	77.0	85.8	82.2	82.0	78.3	86.5
Fluoride	mg/L	0.1	0.95	0.94	0.97	0.9	0.9	0.9	1.0	0.9	0.9	0.9	1.1	0.9	0.9	0.9	1.1	0.9	0.9	0.9	1.1	0.9	0.9	0.9	1.0
Dissolved Major Cations																									
Calcium	mg/L	1	468	459	476	487	490	465	513	490	488	473	512	491	488	459	514	494	490	469	517	488	491	471	505
Magnesium	mg/L	1	1527	1500	1557	1574	1560	1495	1678	1585	1595	1523	1660	1585	1578	1533	1663	1595	1582	1540	1683	1576	1568	1530	1620
Sodium (b)	mg/L	1	12560	12300	12900	12986	13025	12350	14050	13136	13025	12600	13900	13038	13100	12600	13650	13127	13125	12650	13700	12906	13000	12300	13350
Potassium	mg/L	1	474	462	480	502	499	478	533	505	506	486	524	511	511	485	545	509	508	490	539	503	502	487	533
GHD Calculations																									
TDS-Calculated by GHD (d) (e) (b)	*mg/L*		41615	40240	42624	41728	41855	39615	44271	42258	42353	40506	44723	42311	42445	40366	44574	42408	42605	40859	43744	41638	41838	39740	43672
Hardness Calculation by GHD																									
Calcium Hardness as $CaCO_3$	$mgCaCO_3/L$		1169	1148	1190	1219	1224	1163	1283	1226	1221	1181	1280	1228	1221	1146	1284	1236	1225	1173	1293	1220	1228	1176	1263
Magnesium Hardness as $CaCO_3$	$mgCaCO_3/L$		6234	6165	6329	6470	6412	6144	6895	6514	6555	6257	6823	6515	6484	6299	6833	6554	6501	6329	6915	6479	6444	6288	6658
Total Hardness as $CaCO_3$	$mgCaCO_3/L$		7399	7355	7477	7689	7641	7315	8177	7740	7767	7443	8095	7744	7704	7529	8117	7789	7725	7543	8208	7699	7675	7484	7916

			ARUP - Santos Jetty Fire Pump			A1				A10				B1				B10				INTAKE			
			Average	Min	Max	Average	Median	Min	Max	Average	Median	Min	Max	Average	Median	Min	Max	Average	Median	Min	Max	Average	Median	Min	Max
	Units																								
Metals																									
Dissolved Metals in Saline Water																									
Dissolved Aluminium	µg/L	10	--	<10	--	13.2	<10	<10	45.0	10.0	<10	<10	10.0	17.3	<10	<10	90.0	16.4	<10	<10	80.0	<10	<10	<10	<10
Dissolved Iron	µg/L	5	--	<5		5.7	<5	<5	9.5	6.1	<5	<5	15.5	5.5	<5	<5	9.0	5.5	<5	<5	15.0	5.2	<5	<5	7.0
Dissolved Barium	µg/L	1	8	8	9	7.7	8.0	<5	8.5	7.9	8.0	6.3	9.0	8.1	8.0	6.9	9.5	8.3	8.0	6.5	10.5	8.0	8.0	6.0	9.0
Dissolved Boron	mg/L	0.1	4.88	3.89	5.27	5.1	5.2	4.4	5.5	5.1	5.2	4.3	5.6	5.2	5.4	4.4	5.5	5.2	5.3	4.3	5.5	5.1	5.2	4.3	5.4
Dissolved Manganese	µg/L	0.5	--	<1	--	1.2	1.1	<0.5	2.1	1.5	1.5	<0.5	3.9	1.3	1.3	<0.5	3.2	1.2	1.1	<0.5	2.7	1.1	1.2	0.6	1.5
Dissolved Strontium	mg/L	0.01	9.1	7.43	11.1	9.0	9.0	8.3	9.6	9.1	9.0	8.5	10.1	9.2	9.2	8.3	10.5	9.3	9.1	8.6	11.0	9.2	8.9	8.5	10.8
Dissolved Silica by ICP-AES	mg/L	0.1				0.2	0.1	0.1	0.6	0.2	0.2	0.1	0.6	0.2	0.1	0.1	0.6	0.2	0.2	<0.1	0.6	0.2	0.2	<0.1	0.6
Total Metals in Saline Water																									
Aluminium	µg/L	10	--	<10	--	17.3	10.0	<10	60.0	18.2	15.0	<10	30.0	15.0	10.0	<10	25.0	16.8	20.0	10.0	30.0	31.5	17.5	<10	110.0
Iron	µg/L	5	6	<5	6	16.9	13.0	<5	80.0	20.7	19.5	6.0	57.5	14.4	14.0	5.5	31.5	15.5	15.5	<5	28.5	14.3	13.0	6.0	38.0
Arsenic	µg/L	0.5	2	<1	2	2.1	2.2	0.7	2.6	2.2	2.2	0.8	2.8	2.1	2.2	0.8	2.8	1.9	2.050	0.6	2.9	2.0	2.200	0.5	2.6
Beryllium	µg/L	0.1				0.1	<0.1	<0.1	0.2	0.1	<0.1	<0.1	0.2	0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	µg/L	0.2	--	<5	--	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium - Hexavalent	mg/L	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium Total	µg/L	0.5	7	7	7	0.5	<0.5	<0.5	0.7	0.6	<0.5	<0.5	1.7	0.5	<0.5	<0.5	0.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper	µg/L	1	11	<10	11	3.8	3.0	<1	12.0	3.5	2.0	<1	11.0	3.3	2.0	<1	8.5	4.5	2.5	1.0	11.0	<1	<1	<1	<1
Lead	µg/L	0.2	--	<5	--	1.1	0.4	<0.2	5.3	0.8	0.4	<0.2	2.9	0.9	0.5	<0.2	2.3	0.9	0.6	<0.2	2.8	0.3	<0.2	<0.2	0.6
Manganese	µg/L	0.5	4	<1	5	2.0	1.5	0.6	4.7	1.9	1.8	0.9	3.8	1.7	1.7	0.7	3.2	1.7	1.7	0.5	4.1	1.5	1.4	0.6	2.9
Mercury	mg/L	0.0001	--	<0.0003	--	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	µg/L	0.1				13.8	13.8	12.9	15.2	13.9	13.9	13.2	15.2	14.1	14.3	13.3	15.6	14.3	14.3	13.2	15.4	14.2	14.0	13.6	16.4
Nickel	µg/L	0.5	--	<5	--	0.5	<0.5	<0.5	0.6	0.5	<0.5	<0.5	0.7	0.7	<0.5	<0.5	2.3	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	0.5
Silver	µg/L	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	5				<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Zinc	µg/L	5	30	<30	32	8.3	<5	<5	34.5	6.4	<5	<5	15.0	6.5	<5	<5	14.0	7.5	5.0	<5	20.0	5.9	<5	<5	10.5
Nutrients																									
Ammonia as N	mgN/L	0.005/0.01	0.007	<0.005	0.01		<0.005	<0.005	<0.1		<0.005	<0.005	<0.1		<0.005	<0.005	<0.1		<0.005	<0.005	<0.1		<0.005	<0.005	<0.1
Ammonia (NH3, unionised) as N	mgN/L	0.005				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ammonia (NH4, ionised) as N	mgN/L	0.005				0.005	<0.005	<0.005	0.006	0.006	<0.005	<0.005	0.013	0.006	<0.005	<0.005	0.009	0.005	<0.005	<0.005	0.0	0.006	<0.005	<0.005	0.012
Nitrite as N	mgN/L	0.005/0.01		<0.005	--		<0.005	<0.005	<0.01	0.0	<0.005	<0.005	<0.01		<0.005	<0.005	<0.01		<0.005	<0.005	<0.01		<0.005	<0.005	<0.01
Nitrate as N	mgN/L	0/0.01	--	0			0.0	0.0	<0.01	0.0	0.0	0.0	<0.01		0.0	0.0	<0.01		0.0	0.0	<0.01		0.000	0.0	<0.01
Nitrite + Nitrate as N	mgN/L	0.005/0.01	0.006	<0.005	0.008		<0.005	<0.005	<0.01		<0.005	<0.005	<0.01		<0.005	<0.005	<0.01		<0.005	<0.005	<0.01		<0.005	<0.005	<0.01
Total Kjeldahl Nitrogen as N	mgN/L	0.05/0.1	0.239	<0.05	0.62	0.17	0.14	0.08	<1.0	0.15	0.14	0.09	<1.0	0.15	0.13	0.10	<1.0	0.17	0.15	0.10	<1.0	0.13	0.12	<0.1	<1.0
Total Nitrogen as N	mgN/L	0.05/0.1	0.247	<0.06	0.62	0.18	0.15	0.1	<1	0.14	0.15	0.1	<1	0.15	0.13	<0.1	<1	0.17	0.15	<0.1	<1	0.13	0.13	<0.1	0.3
Total Phosphorus as P	mgP/L	0.005/0.01	0.017	0.011	0.023	0.011	0.011	0.007	0.015	0.011	0.012	<0.01	0.013	0.014	0.014	0.007	0.020	0.012	0.012	0.007	0.020	0.011	0.011	<0.01	0.013
Reactive Phosphorus as P	mgP/L	0.005/0.01	0.006	<0.005	0.006		0.005	<0.005	0.0		<0.005	<0.005	0.0		<0.005	<0.005	<0.01		<0.005	<0.005	0.020		<0.005	<0.005	<0.01
Dissolved Organic Carbon	mg/L	1	1.1	0.9	1.3	1.6	2.0	0.9	2.5	1.5	1.5	0.9	2.0	1.6	1.9	0.9	2.0	1.4	1.5	0.9	2.0	1.4	1.5	0.9	2.0
Total Organic Carbon	mg/L	1	1.8	0.9	4	1.5	1.5	0.9	2.2	1.6	1.5	0.9	2.9	1.8	1.4	1.0	4.5	1.6	1.5	1.0	2.0	1.4	1.3	0.9	2.0
Biochemical Oxygen Demand	mg/L	2	--	<2	--	2.3	<2	<2	5.0	2.6	<2	<2	7.0	2.2	<2	<2	4.5	2.4	<2	<2	5.0	2.2	<2	<2	3.5
Oil & Grease	mg/L	1/5	--	<1	--		<1	<1	<5		<1	<1	<5		<1	<1	5.0		<1	<1	<5		<1	<1	5.5
Sulphide	µg/L	2				15.1	15.3	8.0	<100	13.9	13.3	7.5	<100	43.8	18.3	9.5	182.0	14.8	12.750	8.5	<100	14.8	13.500	9.5	<100
Tributyltin	ngSn/L	0.1								<2	<2	<2	<2												
Total Polychlorinated biphenyls	µg/L	0.1								<0.1	<0.1	<0.1	<0.1												
Microbiological																									
Chlorophyll a	µg/L	1	1.1	0.77	1.5	0.8	0.8	0.3	2.0	0.7	0.9	0.3	1.1	0.9	<1	0.4	1.4	0.9	<1	0.5	1.4	0.6	0.8	0.3	<1
Heterotrophic Plate Count (36°C)	CFU/mL	1				875	5	<1	9500	10	4	0	46	11	4	3	47	6	3	1	19	32	1	0	260
Heterotrophic Plate Count (21°C)	CFU/mL	1				403	2	0	4400	14	4	0	77	10	5	0	36	12	4	0	36	44	2	0	342
Enterococci	CFU/100mL	1					0.3	0.0	<2		1.3	0.0	<2		0.5	0.0	4.0		1.0	0.0	3.5		0.0	0.0	<2
Escherichia coli	CFU/100mL	1					<1	0.0	<2		<1	0.0	<2		<1	0.0	<2		<1	0.0	<2		<1	0.0	<2
Coliforms	CFU/100mL	1		0	0		3.0	<1	335.0		10.5	<1	415.0		<2	0.0	735.0		18.0	<1	460.0		12.0	<1	520.0

Notes

(a) pH and conductivity are measured both in the field and by AWQC, these results are shown seperately
(b) For some samples the ALS results for sodium and chloride have been excluded from the averages, see Section 3.4.1 of the report for details.
(c) Field Measurements
(d) Averages calculated based on sum of average of an ion.
(e) When no AWQC value was available the average from ALS was used, average based on average of all ion data
(f) Where relevant, average was calculated considering LOR's as values
(g) Minimum and maximums were calculated based on averages of duplicate samples (and duplicates sent to different labs).
Unexpected result which will require further verification

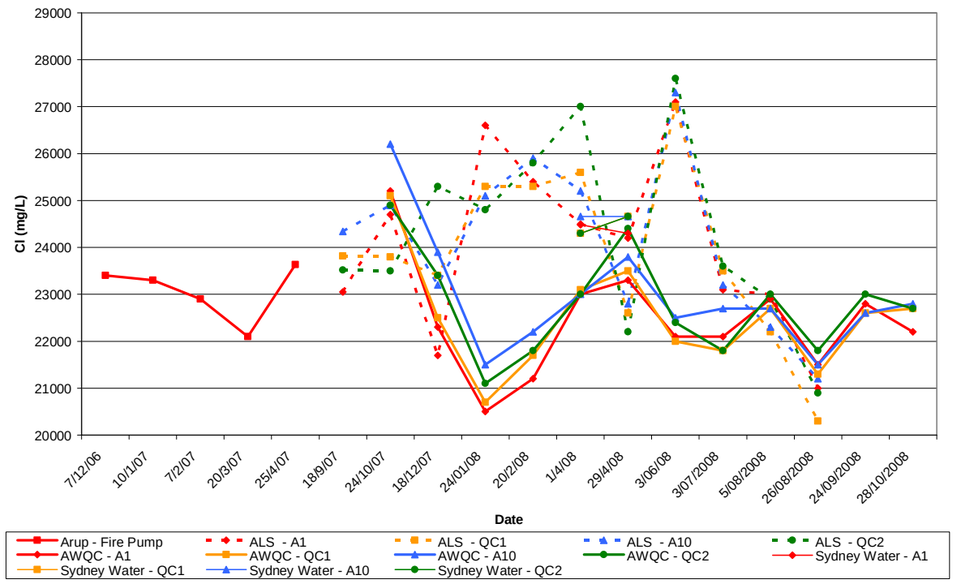


Figure 1 Sampling Location A (West of Point Lowly) – Chloride Results

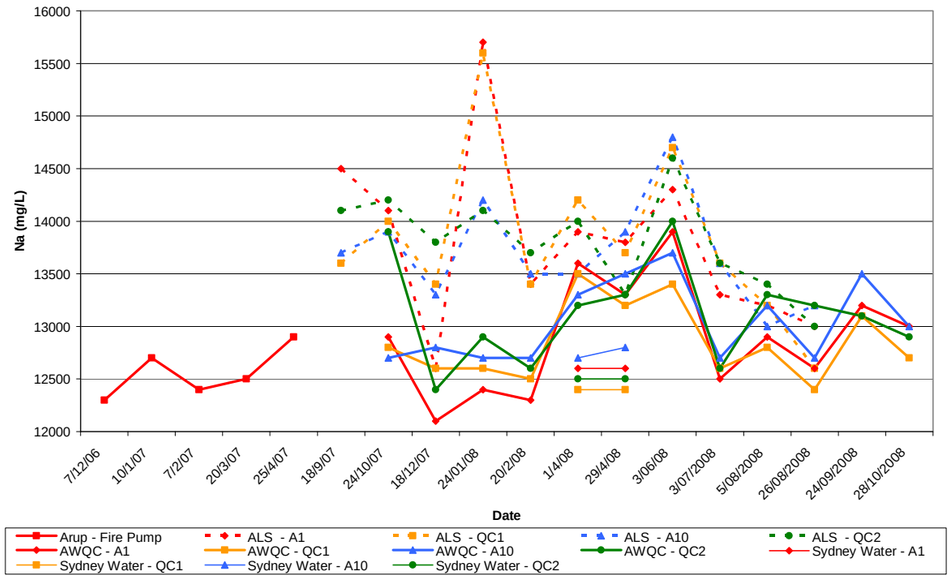


Figure 2 Sampling Location A (West of Point Lowly) – Sodium Results

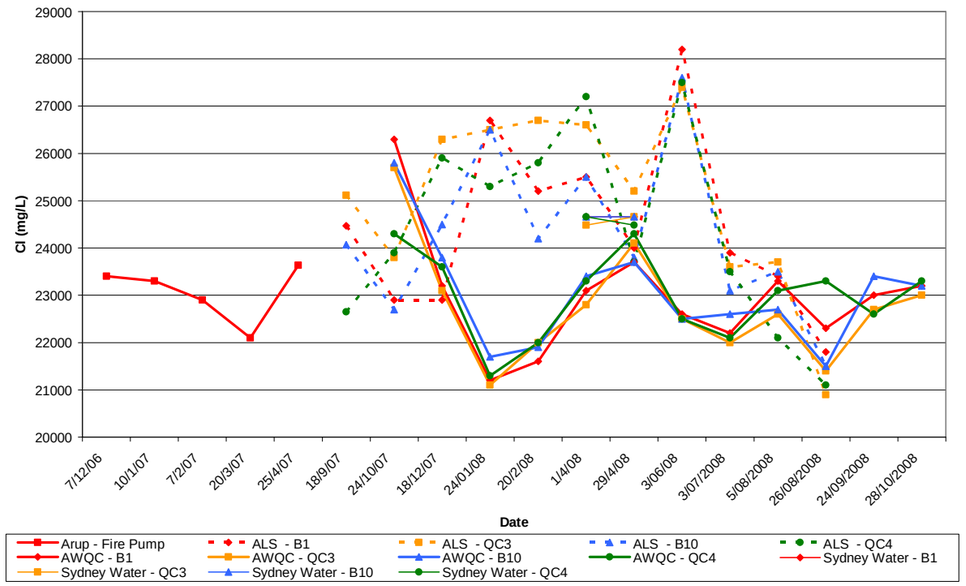


Figure 3 Sampling Location B (North of Point Lowly) – Chloride Results

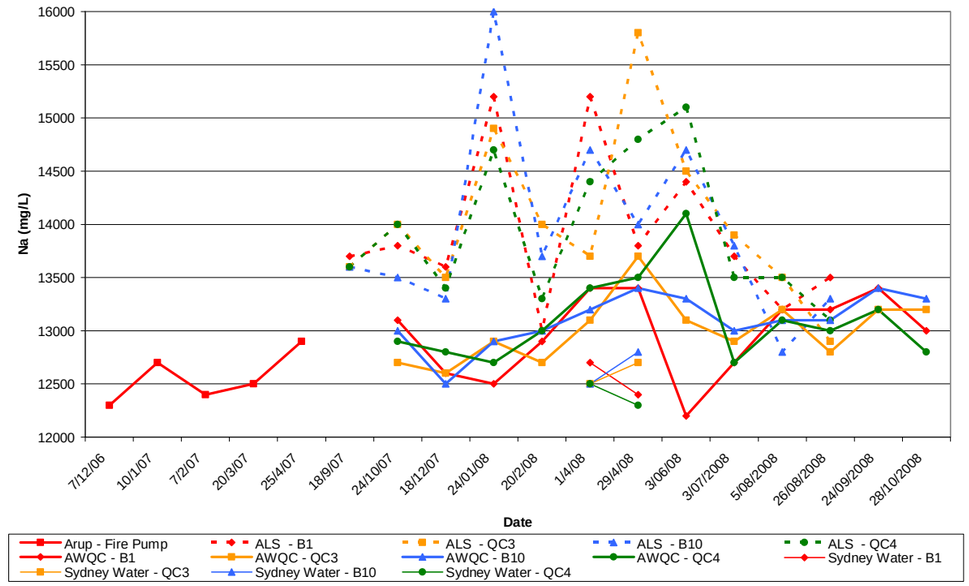


Figure 4 Sampling Location B (North of Point Lowly) – Sodium Results

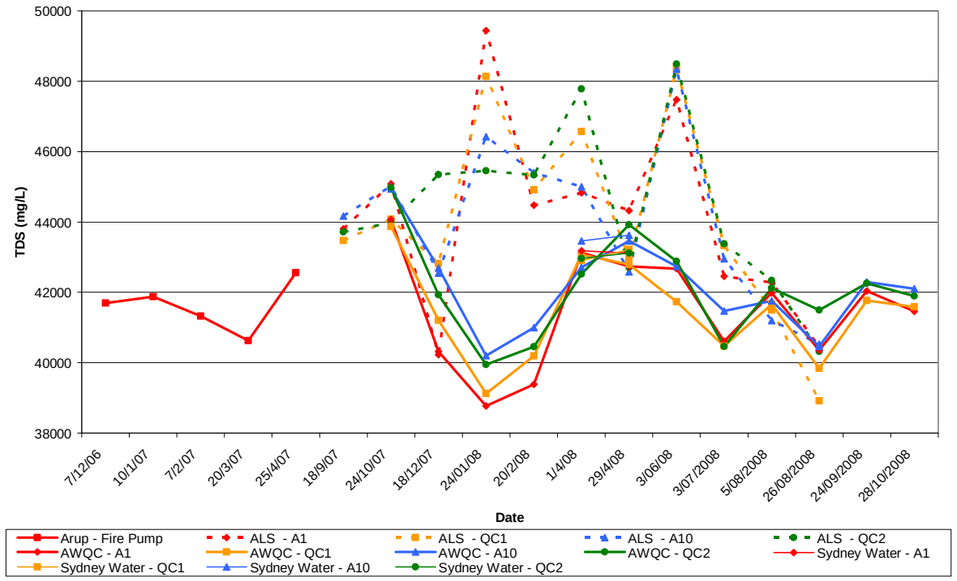


Figure 5 Sampling Location A (West of Point Lowly) – TDS (by summation of ions)

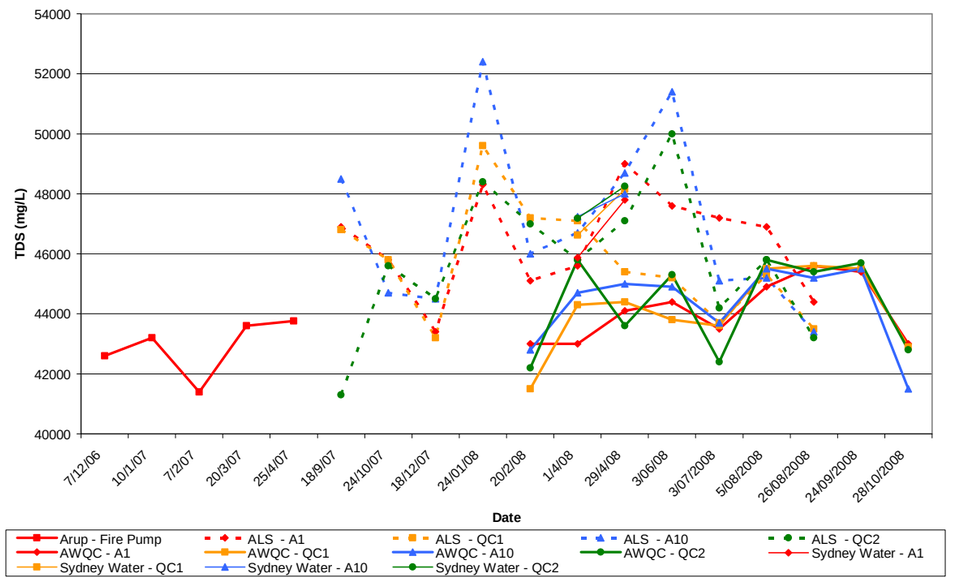


Figure 6 Sampling Location A (West of Point Lowly) – TDS (by evaporation)

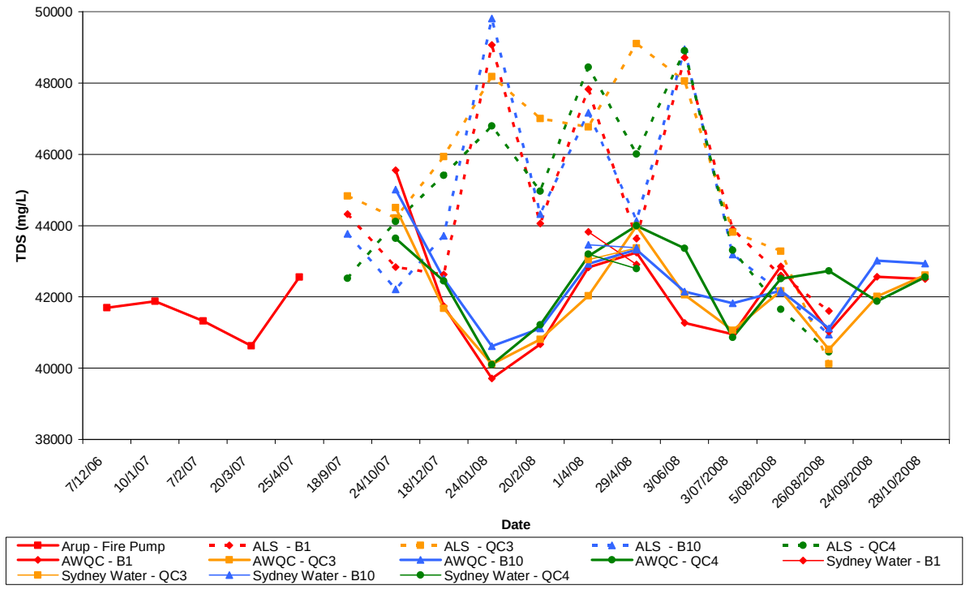


Figure 7 Sampling Location B (North of Point Lowly) – TDS (by summation of ions)

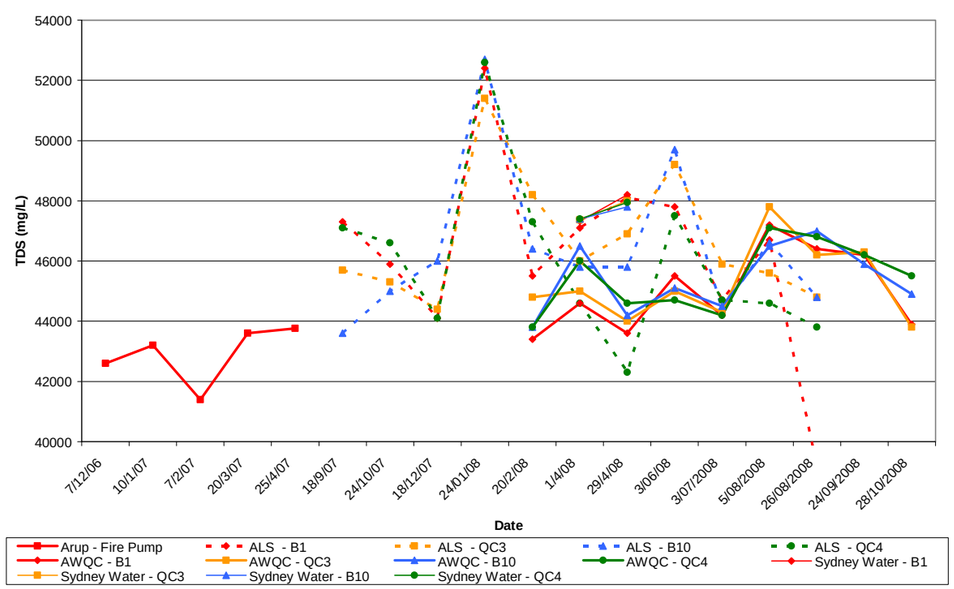


Figure 8 Sampling Location B (North of Point Lowly) – TDS (by evaporation)

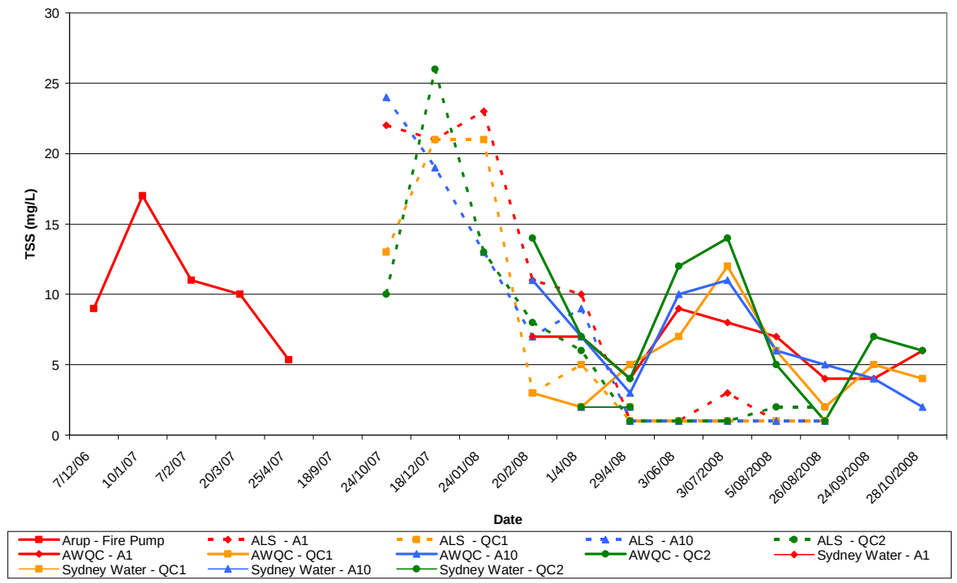


Figure 9 Sampling Location A (West of Point Lowly) – TSS (1.2 µm) Results

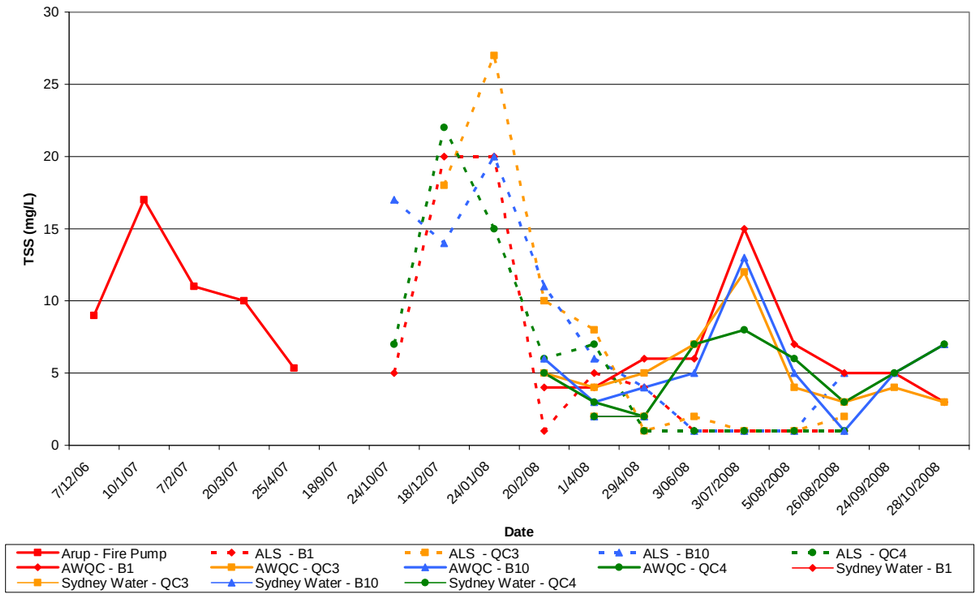


Figure 10 Sampling Location B (North of Point Lowly) – TSS (1.2 µm) Results

2.4.1 Comparison of Results from AWQC and ALS

Variation Between Duplicates

The variation in sodium and chloride ALS and AWQC results for the duplicate samples taken throughout the sampling program were compared. For the October 07 sampling event, AWQC were found to show the highest range in variation between duplicates for both sodium (0.8% to 9.4%) and chloride (0.4 to 6.2%). For the October 07 results, the variation in sodium (0.7% to 3.7%) and chloride (0.5% to 4.2%) results were all less than 5% for ALS. However on subsequent sampling events, there has been significantly more variation in the ALS sodium and chloride duplicate results than the AWQC duplicate results. This was particularly evident on the December 07 sampling event in which there was a 6 – 17 % variation in ALS chloride duplicate results, compared to less than 2% for the AWQC results.

Variation in duplicates and between labs can arise as a result of a variety of factors. For example differences in analytical method, dilution factors, operator and sampling technique can all contribute to variation in results. Following the October 07 sampling event, ALS and AWQC were contacted to obtain details on the methods and dilution factors used to analyse for sodium and chloride.

No difference is expected between the two labs based on the method selected to analyse for sodium as both labs use the same inductively coupled plasma method (APHA 3120). AWQC use a higher dilution prior to analysis (1 in 50) compared to ALS which use 1 in 10. While the higher dilution factor might result in greater error, the higher dilution factor will reduce the overall TDS of the solution being analysed and reduce the error due to high TDS interference.

Similarly, as for sodium, both labs use the same method to determine chloride (APHA 4500 Cl- E) which is based on the ferric thiocyanate colourimetric reaction. According to this method the recommended concentration range is 1 to 200 mg/L. AWQC use a 1 in 50 dilution which is above this recommended range. However, AWQC must have validated their method as they are NATA accredited for a higher range. In contrast, ALS uses a 1 in 100 dilution which will bring them into the recommended range.

ALS have indicated that their quality control criteria allows for a RDP (Relative Percent Deviation) of up to 20%, and that the results from each of the sampling events fell within this criteria. It is however noted that a 20% variation is not considered acceptable considering the importance of the data for the SWRO design. RO feed pressure and product water TDS are impacted significantly by the feed water TDS, and at higher TDS values, a lower recovery rate may be required (therefore increasing the cost of a number of the desalination plant components).

AWQC have advised that the levels of uncertainty in their results are 3% for chloride and 4.5% for sodium. These levels of uncertainty are considered to be more acceptable, provided the stated uncertainty is correct.

Variation between laboratories

For the October and December 07 sampling events it is noted that whilst there was significant variation in results between duplicates and between laboratories for individual chloride and sodium results, the total calculated TDS was overall quite similar.

As discussed in Sections 2.3.4 and 2.3.5, chloride, sodium and TDS (evaporation and calculated) varied significantly between ALS and AWQC for both the January and February 08 sampling events. For the

January sampling event, the calculated TDS averaged 47,600 mg/L based on ALS results, whereas it averaged 39,700 mg/L based on AWQC results. For the February sampling event, the calculated TDS averaged 45,000 mg/L based on ALS results, whereas it averaged 40,500 mg/L based on AWQC results.

Considering the importance of TDS for the design of the RO plant, the decision was made to send samples to a third laboratory (Sydney Water) for the 1 April 2008 and 29 April 2008 sampling events.

Calculated TDS based on both AWQC and Sydney Water results were comparable for both of the April sampling events. ALS results were comparable for the 29 April 2008 sampling event, however considerably higher than both AWQC and Sydney Water for the 1 April 2008 sampling event.

Significant variance in sodium, chloride and TDS results between ALS and AWQC was again recorded for the June and July 08 sampling events, however results from both laboratories were similar for the two August 08 sampling events.

Comparison salinity analysis conducted by BHP Billiton Environmental Impact Statement (EIS) team

The BHP Billiton Environmental Impact Statement (EIS) team have conducted a comprehensive analysis of the various methods available for the measurement of salinity. The following methods were evaluated:

- Estimation from density (undertaken by Rosenstiel School of Marine and Atmospheric Science (RSMAS) at the University of Florida)
- Autolab Salinometer (undertaken by Dr Richard Nunes-Vaz)
- Radiometer CDM92 conductivity meter (undertaken by AWQC)
- Conductivity using YSI meter (undertaken by Geotechnical Services)
- Evaporation (AWQC and Geotechnical Services)
- Summation of Ions (AWQC)
- Refractometer (Geotechnical Services)

Consistently similar results were obtained from the Autolab Salinometer and estimation from density methods. Results from the salinometer were 0.01 g/L lower to 0.11 g/L higher than those from the density based method, whereas results based on conductivity were 1.18 -2.99 g/L lower, results from summation of ions were 0.34 – 1.41 g/L higher and results from evaporation were 2.72 – 3.72 g/L higher. Further investigation into the details of the salinometer and density methods is required, however preliminary indications are that the density based method is likely to provide the most reliable results of all methods evaluated by the BHP Billiton EIS team.

Of the methods currently being used as part of the ongoing sampling program (evaporation, summation of ions and conductivity), it appears that the summation of ions results provide the most accurate indication of salinity. The addition of salinometer analysis to the sampling program is however considered to be beneficial, and could potentially provide valuable information.

In addition to the analysis of the various salinity measurement methods, the BHP Billiton EIS team also prepared a summary of salinity measurements from a range of studies conducted in the Point Lowly area. Salinity results greater than 45 g/L have not been detected by any other studies, with results typically in the 40 – 43 g/L range. Therefore based on this fact and the knowledge that AWQC summation of ions salinity results were within 0.34 – 1.41 g/L of the density based method, it is concluded the ALS salinity results (which were often significantly higher than AWQC, and in some cases

close to 50 g/L) are not reliable. Of the results obtained as part of the ongoing sampling program, the AWQC summation of ions results are considered to provide the best indication of salinity. Where ALS results for TDS (by summation of ions) were significantly greater (i.e. > 2 g/L) than those from AWQC, the corresponding sodium and chloride results (and therefore TDS by summation of ions) have been excluded from the averages presented in Table 4. Full results can be seen in Appendix C. Appendix C also notes where values have been removed from the averages.

2.5 Monitoring Station

The water quality multiparameter YSI 6600 EDS Sonde was installed by WDS Pty Ltd at the Fire Pump sampling site close to the intake for the pilot plant. The parameters recorded included:

» pH;

» Electrical Conductivity (temperature corrected);

» Turbidity;

» Dissolved Oxygen (recording stopped 16/4/08);

» Chlorophyll-a;

» Temperature; and

» Tide levels (recording stopped 24/12/08).

The meteorological parameters recorded included:

» Solar radiation;

» Wind speed; and

» Wind direction.

The above parameters were measured at 3 different depths: 4m, 7m and 10 m ***above*** the seabed. The timing of site visits for undertaking calibration and cleaning of the sensors is shown in Figure 13. The measurements for tide levels were adjusted by –0.16 m in July 2007. In addition GHD have made the following adjustments due to poor quality data:

» Due to very high turbidity results as a result of crustaceans growing on the turbidity sensor, turbidity results were removed from the data set over the following periods:
  – 01/08/07 to 4pm 08/08/07 (7 days)
  – 02/09/07 to 4pm 12/09/07 (10 days)
  – 03/10/07 to 6pm 17/10/07 (14 days)
  – 30/10/07 to 12pm 14/11/07 (15 days)
  – 10am 21/01/08 to 4pm 23/01/08 (2 days)
  – 05/04/08 to 16/04/08 (12 days)
  – 6am 14/06/08 to 2pm 17/07/08 (32 days)
  – 10pm 25/10/08 to 2pm 11/11/08 (17 days)

» Similarly spikes in Chlorophyll-a measurements prior to cleaning of the sensor were removed as follows:
  – 08/10/07 to 6pm 17/10/07 (9 days)

- 05/11/07 to 12pm 14/11/07 (9 days)
- 08/08/08 to 10am 20/08/08 (12 days)
- 24/10/08 to 2pm 6/11/08 (14 days)
- 3am 7/11/08 to 2pm 11/11/08 (5 days)

» Temperature and conductivity data were removed as follows due to spikes in temperature data:

- 9am 21/07/08 to 4pm 09/08/08 (20 days)
- 2am 13/08/08 to 10am 20/08/08 (7 days)

Two failures in the profiler occurred during December, firstly for 2 days on 10-11 December and again on the 24/12/07 at 11pm. A non-routine visit to Port Bonython was undertaken by WDS to determine why the profiler had failed. It was found that the water level reference sonde was not working. The program was changed to enable operation without the reference sonde, the only difference being that it was changed to reference the top water level (tidal) so the 3 points in the water column vary depending on the tide level at the time of the profile.

The logger again stopped working on 28/01/08 for 3 days and again on 6/02/08. The sensor was removed for repairs on 13/02/08, and was not operational again until 13/3/08. The sensor was removed for repairs for a second time on 16/04/08, and was not operational again until 04/06/08. The sensor again failed on 20/08/08, and was not operational again until 11/09/08.

Other issues identified with the monitoring station data include:

» pH skews upwards after site visit on 12/12/07 due to problems calibrating the probe. In addition there is significant scatter on several occasions. This is not as expected as the pH in seawater is normally very constant as seawater has a large buffering capacity.

» On a number of occasions the DO results trend down significantly immediately after calibration. This has improved from December 2007, however the DO results are still questionable.

» Some issues with the EC results have also been identified, particularly with cleaning of the sensor resulting in a large spike or drop at the site visit. A significant drop in EC was recorded prior to the sensor being removed for repairs on 13 February 2008.

The mean, median and range were calculated for the data collected and are presented in Table 5 below.

Table 5 Median, average and range calculated from Sonde water quality data at the Fire Pump (May 2007 to November 2008)

	Distance Above Sea Bed	Minimum	Maximum	Median	Average
Tide Level (m)		11.5	15.6	13.1	13.1
Solar Radiation (W/m^2)		1.5	1155.0	18.9	229.1
Temperature (°C)	4 m	11.3	25.7	16.9	17.3
	7 m	11.3	25.7	16.9	17.3
	10 m	11.9	25.7	17.6	17.8
pH	4 m	7.7	8.9	8.0	8.0
	7 m	7.7	8.9	8.0	8.0
	10 m	7.6	8.9	8.0	8.0
EC (mS/cm)	4 m	52.4	62.6	60.1	59.8
	7 m	52.4	62.4	60.0	59.8
	10 m	52.2	62.3	60.0	59.7
Turbidity (NTU)	4 m	<0.1	33.8	1.1	1.6
	7 m	<0.1	32.2	1.1	1.6
	10 m	<0.1	24.2	1.1	1.6
Chlorophyll-a (µg/L)	4 m	<0.1	11.3	0.9	0.9
	7 m	<0.1	7.9	0.9	1.0
	10 m	<0.1	7.4	0.9	0.9
DO (mg/L)	4 m	3.9	10.0	6.3	6.2
	7 m	3.9	9.8	6.2	6.1
	10 m	3.9	9.7	6.1	6.0

As with the earlier field measurements conducted by Arup at the Fire Pump, no evidence of stratification is observed for pH, temperature and specific conductance over the eight months that the Sonde has been deployed, except for a period between mid September to early November in which the EC at 10m was often 0.5 – 1.5 mS/cm lower than at 4m. There was no significant temperature difference between depths during this time, indicating that the difference may be due to tidal effects. A plot of EC and tide

level from 20/10/07 to 3/11/07 is shown in Figure 11, however it is not conclusive. Further examination of the reasons behind this is required.

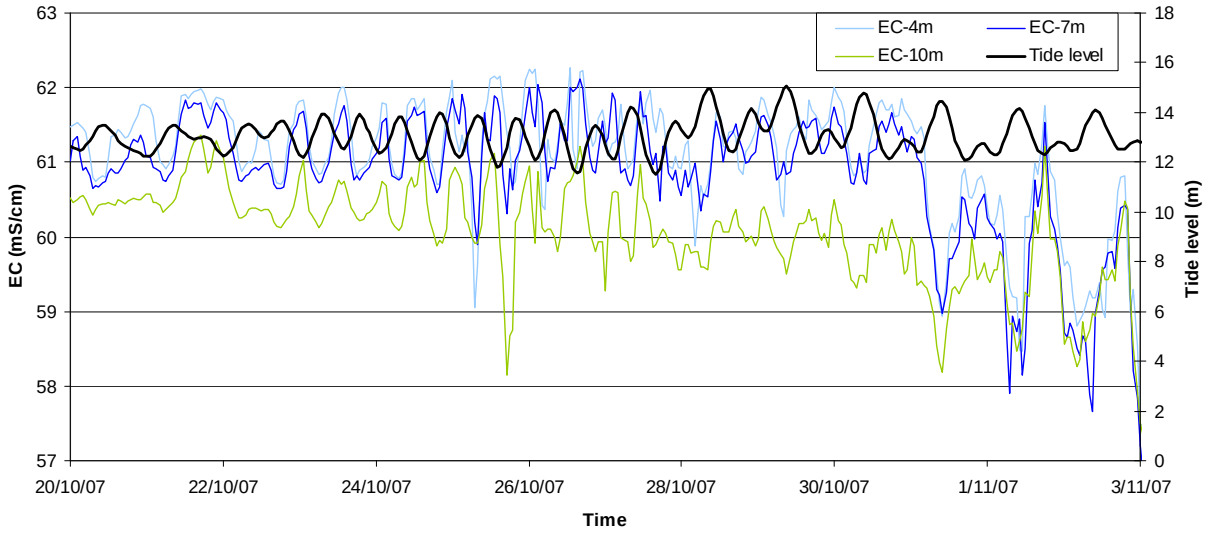


Figure 11 Specific conductance measured at 4m, 7m and 10 m above the seabed and tidal level measured by the Sonde at the Fire Pump site from 20/10/07 to 3/11/07

The median and range reported in Table 5 are similar for the three depths. This is consistent with the modelling carried out by WBM for BHP Billiton (Hydrodynamic and Water Quality Modelling at Port Bonython: Calibration Report" from December 19th 2006) which employed the work of Dr Rick Nunes-Vaz to calibrate their model. WBM interrogated their models for vertical stratification and found temperature and salinity stratification is negligible. Only under extraordinary conditions (e.g. dodge tides, low winds) would any noticeable stratification occur.

During the time the Sonde has been deployed a number of dodge tides occurred (approximately every 2 weeks). A variation in electrical conductivity of up to 0.5 mS/cm between the 4m and 10m readings was observed during these events, which when compared to tidal and seasonal variation in electrical conductivity is not considered to be significant.

The specific conductance (i.e. corrected to 25°C) and tidal level data collected by the Sonde for the three depths is plotted in Figure 12 over time for ten days in early July 2007. The minor variation in conductance observed in Figure 12 correlated with tidal variation (temperature was 12.9 ± 0.3C). The tidal variation in the vicinity of Point Lowly is predominantly diurnal with a tidal range varying from about 1 m during neap (dodge) tides to more than 2.5 m during spring tides [Water technology report Appendix B Brine Dispersion –Feasibility Study August 2005]. Table 5 above details the tide level variation at the Fire Pump.

The specific conductance and temperature data collected by the Sonde for the three depths over the eight months is plotted in Figure 13 and Figure 14. Figure 13 also shows the days in which site visits were undertaken by WBS, and it is noted that in some cases significant drift in the readings occurs between calibrations during site visits. The general decrease observed in specific conductance with the seasonal decrease in temperature (min 12°C) measured by the Sonde during the winter months agrees

with that observed by data recorded by Nunes and modelled by Elcom. The latter work shown in Figure 15 and Figure 16 for two years demonstrates salinity generally decreases seasonally with temperature although, the peak salinity appears to occur in May.

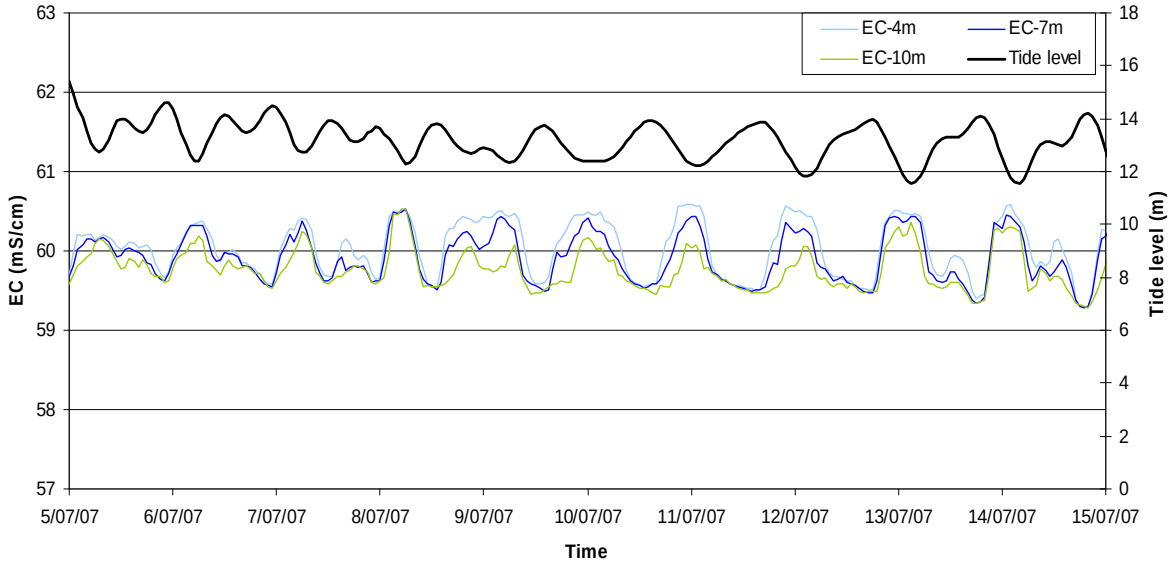


Figure 12 Specific conductance measured at 4m, 7m and 10 m above the seabed and tidal level measured by the Sonde at the Fire Pump site during lowest winter temperature (12.9 ± 0.3°C)

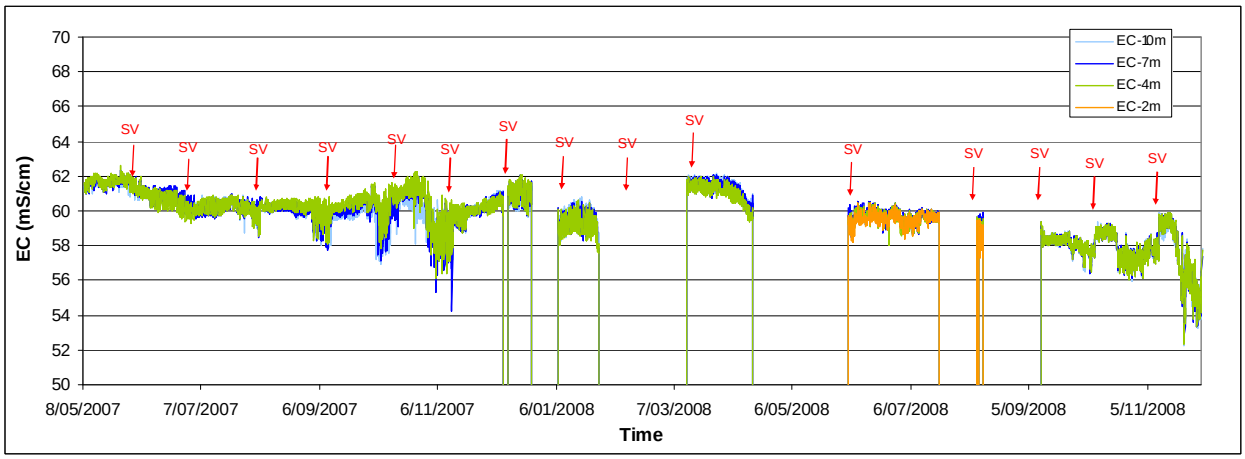


Figure 13 Specific conductance measured by the Sonde at the Fire Pump site (site visits and sonde calibration indicated)

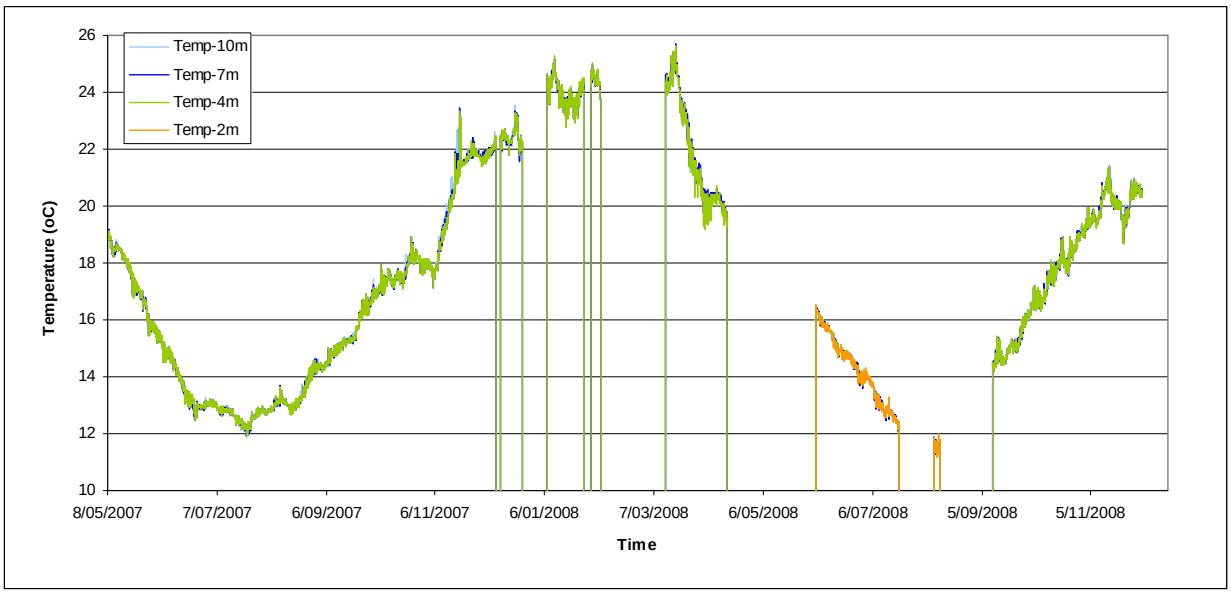


Figure 14 Temperature measured by the Sonde at the Fire Pump site

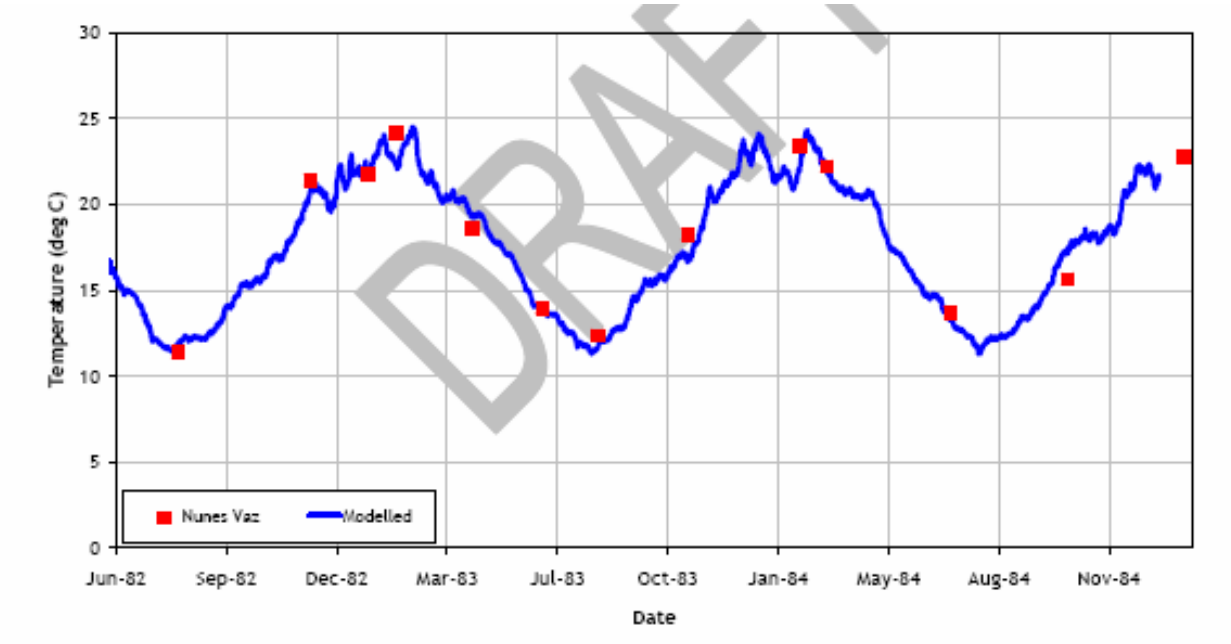


Figure 15 Variation in temperature at Port Bonython from the work of WBM (modelled) and Nunes (experimentally determined)

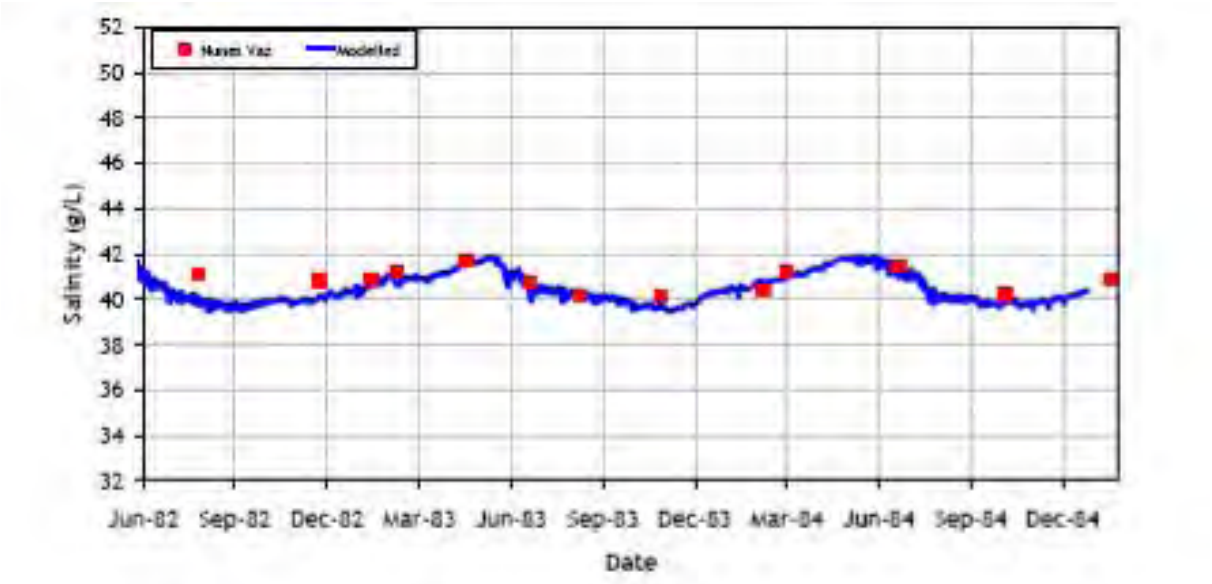


Figure 16 Variation in Salinity at Port Bonython from the work of WBM (modelled) and Nunes (experimentally determined)

The pH data measured by the Sonde generally did not vary considerably through time although there was significant scatter on several occasions. As the pH in seawater is normally very constant (as seawater has a large buffering capacity), the scatter observed here is expected to be related to difficulties with the probe. In addition pH skews upwards after the site visit on 12/12/07 due to a calibration problem.

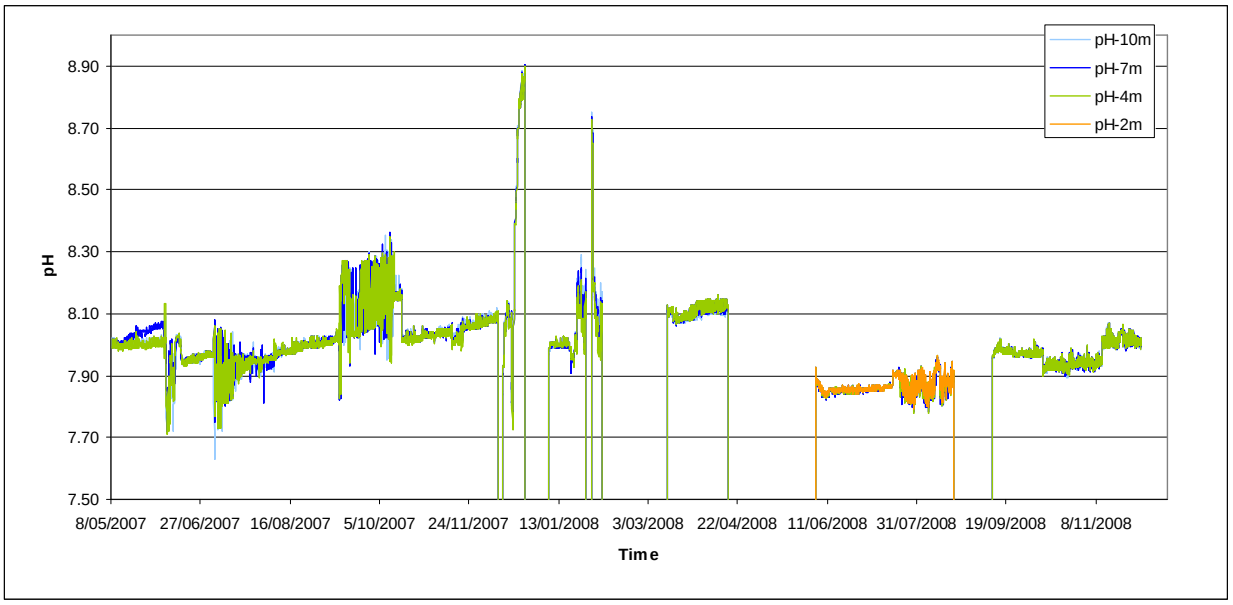


Figure 17 pH over time measured by the Sonde at the Fire Pump site

Chlorophyll is a common indicator of phytoplankton biomass and bioactivity. High levels indicate algal bloom potential and a disturbed ecosystem. The frequency of algal blooms needs to be considered in design of pre-treatment system. All green plants contain chlorophyll-a. Other pigments present in plankton algae are chlorophyll-b and c.

The chlorophyll-a reported by WDS, as shown in Figure 18, should be considered as an estimate. The YSI 6600 EDS Sonde deployed at the Fire Pump measures total chlorophyll by fluorescence and doesn't distinguish chlorophyll-a. The total chlorophyll measurements measured by the Sonde were converted to chlorophyll-a by WDS initially based on 3 monthly lab samples for chlorophyll-a and b. To improve the confidence in results, it is understood that monthly lab testing and calibration of Chlorophyll-a measurements has since been adopted. The YSI in situ method for determining chlorophyll is not as accurate as the extractive determination of samples in the Lab and remains an estimate as differing species of algae with differing shape and size will likely fluoresce differently even if the type and concentration of chlorophyll are identical and this significantly limits the accuracy of in viro measurements.

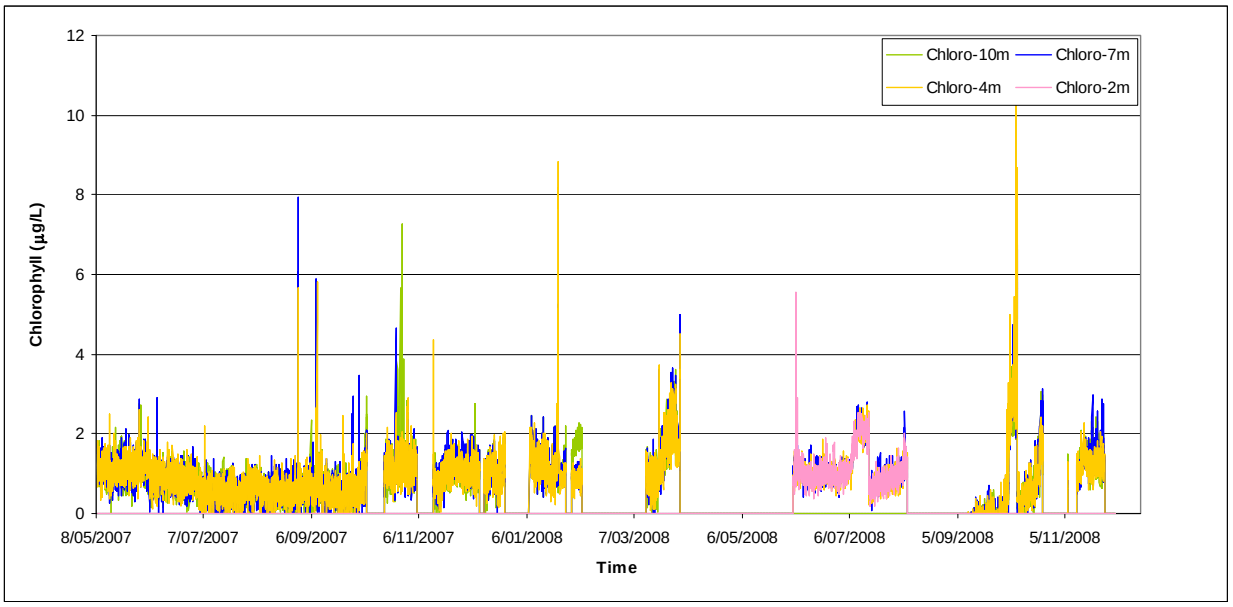


Figure 18 Chlorophyll-a measured at 4m, 7m and 10 m by the Sonde above the seabed *vs* time

The chlorophyll concentration at a location will depend on a variety of factors. The local phytoplankton will vary horizontally, vertically and seasonally. The primary source of this variability is the availability of light, water clarity i.e. low turbidity followed by nutrient availability. The chlorophyll data measured by the Sonde for the three different depths is plotted in Figure 19 and Figure 20 as a function of temperature and solar radiation respectively. These graphs clearly show that there is no difference in chlorophyll-a with depth, indicating that there is still sufficient light close to the seabed to promote growth. It should be noted that some plankton are capable of independent movement and can swim up to several hundreds of meters vertically in a single day and this can also account for no difference in chlorophyll with depth. However, their horizontal position is primarily determined by currents in the body of water they inhabit which means algal blooms can vary significantly spatially.

Higher chlorophyll concentrations are typically expected in spring and summer. Algal blooms were visible on the surface of seawater from the plane south of Whyalla in January 2007 but not at Port Bonython (although they could have occurred at depth). The maximum chlorophyll–a concentration measured from sampling conducted to June 2008 is 2 mg/L (sample A1, September 2007), which is still relatively low compared to the ANZECC/ARMCANZ (2000) water quality guidelines for south central Australia, which specify that chlorophyll-a levels above 5 µg/L are cause for concern in slightly disturbed ecosystems.

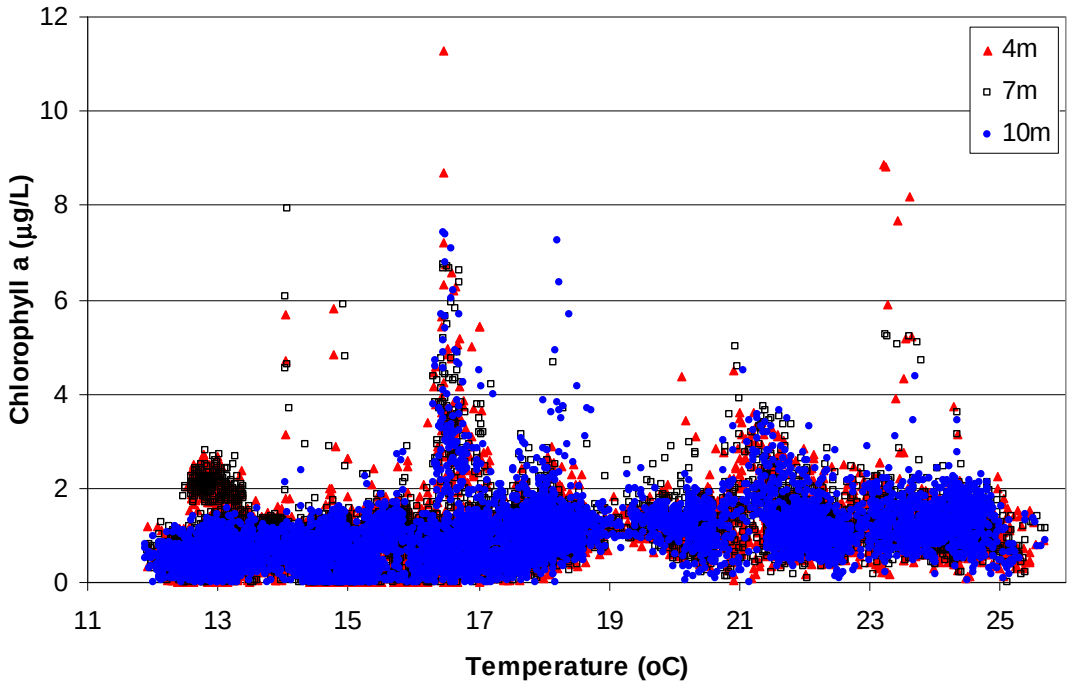


Figure 19 Chlorophyll-a measured at 4m, 7m and 10 m above the seabed *vs* temperature (May 2007 to November 2008)

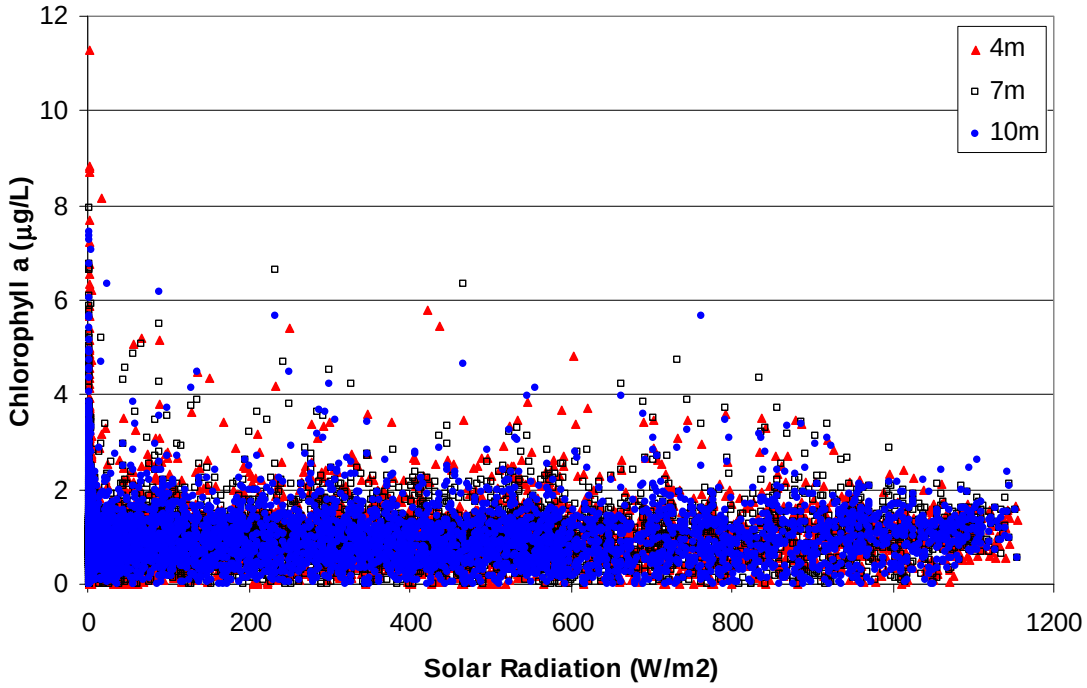


Figure 20 Chlorophyll-a measured at 4m, 7m and 10 m above the seabed *vs* solar radiation (May 2007 to November 2008)

2.6 Summary and Recommendations

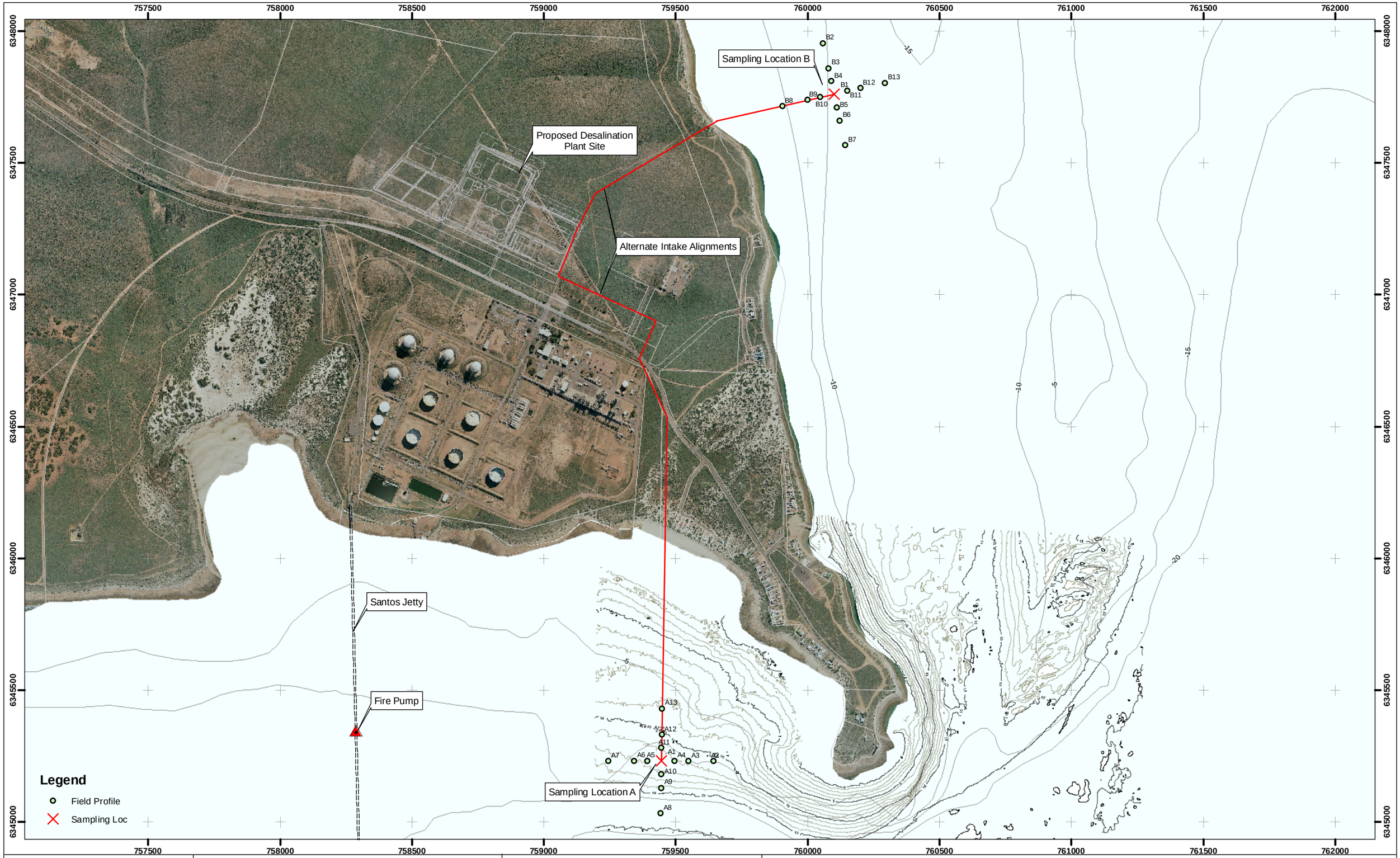
There has been a significant variation in the sodium, chloride and TDS (by summation of ions) results obtained from ALS and AWQC, with ALS often reporting significantly higher results. Of the two laboratories, it is considered that AWQC has provided the most reliable results, and that TDS > 45 g/L is unrealistic. It is therefore recommended that AWQC be adopted as the preferred laboratory for future analysis of major ions. Based on the results to date, a significant increase in maximum TDS since Arup completed their sampling has been identified.

Results from the first eight sampling events do not indicate any significant differences in water quality at any of the sites. In order to firmly establish whether any statistically significant differences exist a full statistical analysis of the results is required.

It is likely that the variability of water quality (in particular TDS) with tidal movement is greater on the northern side of Point Lowly (Fitzgerald Bay), however the monthly grab samples are not sufficient for this to be determined from the results. If the northern location is selected for the full scale desalination plant intake, continuous monitoring of parameters such as conductivity and temperature will be required to ensure the variability of water quality with the tidal cycle is fully understood.

Appendix A

Sampling Locations Plan



Scale: 1:13,000at A1

0 425 850

metres

Data Source: Data supplied by BHPB

Coord. Sys.: MGA53 GDA94

GHD CLIENTS PEOPLE PERFORMANCE

Drawing No.:			
Revision:	C	Date:	17 Sep 2007
Drawn By:	AS	Checked by:	MG
Job No.:	G:\33\14036		

OLYMPIC DAM EXPANSION PRIMARY WATER SUPPLY SYSTEM

BHP BILLITON

Water Quality

Sampling Location Plan

Appendix B

Summary of Arup Sampling Results

Project BHP-Billiton ODX SWRO 33/14036
File Name N:\AU\Adelaide\Projects\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\Summary of Arup Data\[Summary of Arup Data v2.xls]With Calculation
Print out 1/02/2008
Source Data Arup Compilation of Water Quality Testing Data

Fire Pump Site

Notes:

	All cells highlighted in blue are below LOR
	Validity of the data is questionable
NA	Not available
	Holding time rquirement not met
Min, Max, Ave	Data considered included all 5 sampling campaigns but only the average value for the 25/04/07
Average	Average was calculated considering LOR's as values

Parameter	Unit	7 Dec 2006	10-Jan-07	7-Feb-07	20-Mar-07	*25-Apr-07*	*25-Apr-07*	*25-Apr-07*	AVERAGE 25 April 2007	LOR	Min	Max	Average	Number of samples	Number of sampling campaign
Physicochemical Parameters															
pH	pH Units	8.2	8.2	8.2	8.1	8.1	8.1	8.1	8.10	**NA**	8.1	8.2	8.2	7	5
Conductivity	µS/cm	58600	59700	59500	60500	60500	60600	60700	60600	**1**	58600	60600	59780	7	5
Colour - True (456nm)	HU		1			7	2	2	3.67	**1**	1	4	2.3	4	2
Turbidity	NTU	1.4	1.8	8	2.6	0.77	0.92	1.6	1.10	**0.1**	1.1	8.0	3.0	7	5
Suspended Solids	mg/L	9	17	11	10	6	2	8	5.33	**1**	5	17	10.5	7	5
Total Dissolved Solids (by evaporatio	mg/L	42600	43200	41400	43600	43700	43700	43900	43767	**1**	41400	43767	42913	7	5
Total Dissolved Solids (by EC)	mg/L	39000	40000	40000	41000	41000	41000	41000	41000	**1**	39000	41000	40200	7	5
Dissolved Solids by Calculation	mg/L	41500		41322	40624	42800	42500	41800	42367		40624	42367	41453	6	4
Dissolved Solids by GHD Calculation	mg/L			41322	40625	42967	42697	41998	42554		40240	42624	41615		
Alkalinity by PC Titrator															
Hydroxide	mg/L	0	0	0	0	0	0	0	0.00	**NA**	0.0	0.0	0.0	7	5
Carbonate	mg/L	0	0	0	0	0	0	0	0.00	**NA**	0.0	0.0	0.0	7	5
Bicarbonate	mg/L	157	155	155	155	155	155	155	155	**NA**	155	157	155	7	5
Alkalinity as Calcium Carbonate	mgCaCO3/L	129	127	127	127	127	127	127	127	**NA**	127	129	127	7	5
Dissolved Major Anions															
Chloride	mg/L	23400	23300	22900	22100	23700	24000	23200	23633	**4**	22100	23633	23067	7	5
Sulphate	mg/L	3270	3150	3300	3270	3240	3240	3240	3240	**1.5**	3150	3300	3246	7	5
Bromide	mg/L	79.3	NA	81.9	85.5	87.5	84.8	85.1	85.8	**0.1**	79.3	85.8	83.1	6	4
Bromate	mg/L		0.0015							**0.0015**	0.0015	--	--	1	1
Fluoride	mg/L		0.94	0.97	0.94	0.93	0.94	0.94	0.94	**0.1**	0.94	0.97	0.9	6	4
Dissolved Major Cations															
Calcium	mg/L	476	NA	463	459	472	476	470	473	**0.1**	459	476	468	6	4
Magnesium	mg/L	1500	NA	1510	1540	1600	1530	1540	1557	**0.3**	1500	1557	1527	6	4
Potassium	mg/L	475	462	477	480	477	476	473	475	**1**	462	480	474	7	5
Sodium	mg/L	12300	12700	12400	12500	13200	12700	12800	12900	**0.5**	12300	12900	12560	7	5
Ionic Calculation by GHD															
Cations	meq/L	695		699	706	742	715	719	725						
Anions	meq/L	729		716	693	737	746	723	732						
Ion Balance		2.45%		1.18%	0.94%	0.31%	2.13%	0.27%	0.49%						
Hardness Calculation															
Calcium Hardness as $CaCO_3$	mgCaCO3/L	1190		1157.5	1147.5	1180	1190	1175	1182	**2**	1148	1190	1169	6	4
Magnesium Hardness as $CaCO_3$	mgCaCO3/L	6165		6206	6329	6576	6288	6329		**2**	6165	6329	6234	6	3
Total Hardness as $CaCO_3$	mgCaCO3/L	7355		7364	7477	7756	7478	7504			7355	7477	7399	6	3
Nutrients															
Total Ammonia	mgN/L		0.01		0.005	0.005	0.005	0.005	0.005	**0.005**	0.005	--	0.007	5	3
Ammonia (calculated)	mgN/L		0.005			0.005	0.005	0.005	0.005	**0.005**	0.005	--	--	4	2
Ammonium (calculated)	mgN/L		0.009			0.005	0.005	0.005	0.005	**0.005**	0.005	0.009	0.007	4	2
Ammonia	mgN/L					0.1	0.1	0.1	0.1	**0.1**	0.1	--	--	3	1
Nitrate + Nitrite	mgN/L		0.005		0.008	0.005	0.005	0.005	0.005	**0.005**	0.005	0.008	0.006	6	4
Nitrate (by calculation)	mgN/L					0	0	0	0	**NA**	0				
Nitrite	mgN/L					0.005	0.005	0.005	0.005	**0.005**	0.005	--	--	3	1
Nitrogen - Total	mgN/L		0.06		0.06	0.5	0.66	0.7	0.62	**0.05**	0.06	0.620	0.247	5	3
TKN	mgN/L		0.05		0.05	0.5	0.65	0.7	0.62	**0.05**	0.05	0.617	0.239	5	3
Filterable Reactive Phosphorus (Phos	mgP/L		0.005			0.006	0.006	0.006	0.01	**0.005**	0.005	0.006	0.006	4	2
Total Phosphorus	mgP/L		0.018	0.023	0.011	0.014	0.013	0.018	0.02	**0.005**	0.011	0.023	0.017	6	4
Metals															
Aluminium - Soluble	mg/L					0.01	0.01	0.01	0.01	**0.01**	0.01	--	--	3	1
Aluminium - Total	mg/L					0.01	0.01	0.011	0.01	**0.01**	0.01	--	--	3	1
Antimony	mg/L		0.005			0.005	0.005	0.005	0.005	**0.005**	0.005	--	--	4	2
Arsenic - Inorganic	mg/L		0.002			0.001	0.001	0.001	0.001	**0.001**	0.001	0.002	0.002	4	2
Barium - Total	mg/L		0.008	0.009	0.008	0.007	0.008	0.008	0.008	**0.005**	0.008	0.009	0.008	6	4
Beryllium - Total	mg/L		0.005			0.005	0.005	0.005	0.005	**0.005**	0.005	--	--	4	2
Boron - Soluble	mg/L	5.05	3.89	5.04	5.14	5.25	5.23	5.34	5.27	**0.04**	3.89	5.27	4.88	7	5
Cadmium - Total	mg/L		0.005			0.005	0.005	0.005	0.005	**0.005**	0.005	--	--	4	2
Chromium VI	mg/L		0.01							**0.01**	0.01	--	--	1	1
Chromium - Total	mg/L					0.001	0.011	0.008	0.01	**0.001**	0.007	0.007	0.007	3	1
Copper - Total	mg/L		0.011			0.01	0.01	0.01	0.01	**0.01**	0.01	0.011	0.011	4	2
Iron - Soluble	mg/L		0.005	0.005	0.005	0.005	0.005	0.005	0.005	**0.005**	0.005	--	--	6	4
Iron - Total	mg/L				0.005	0.005	0.005	0.008	0.006	**0.005**	0.005	0.006	0.006	4	2
Lead - Total	mg/L		0.005			0.005	0.005	0.005	0.005	**0.005**	0.005	--	--	4	2
Manganese - Soluble	mg/L					0.001	0.001	0.001	0.001	**0.001**	0.001	--	--	3	1
Manganese - Total	mg/L		0.005	0.005	0.005	0.001	0.001	0.001	0.001	**005 and 0.0**	0.001	0.005	0.004	6	4
Mercury - Total	mg/L		0.0003			0.0003	0.0003	0.0003	0.0003	**0.0003**	0.0003	--	--	4	2
Nickel - Total	mg/L		0.005			0.005	0.005	0.005	0.005	**0.005**	0.005	--	--	4	2
Selenium- total	mg/L		0.001			0.001	0.001	0.001	0.001	**0.001**	0.001	--	--	4	2
Silver	mg/L		0.002			0.002	0.002	0.002	0.002	**0.002**	0.002	--	--	4	2
Strontium - Total	mg/L		7.43	8.70	11.10	9.22	9.32	8.82	9.12	**0.005**	7.430	11.1	9.1	6	4
Thallium	mg/L		0.005			0.005	0.005	0.005	0.005	**0.005**	0.005	--	--	4	2
Zinc - Total	mg/L		0.032			0.03	0.03	0.03	0.030	**0.03**	0.03	0.032	0.03	4	2
Silica -Total	mg/L		0.1	0.1	0.1	1	1	1	1.000	**0.1 and 1**	0.1	--	--	6	4
Silica - Reactive	mg/L														
Organic Compounds															
Dissolved Organic Carbon	mg/L			1.3	0.9	1	0.9	1	0.97	**0.3**	0.9	1.3	1.1	5	3
Total Organic Carbon	mg/L		4	1.4	0.9	1	1	1	1.0	**0.3 and 1**	0.9	4.0	1.8	6	4
Biochemical Oxygen Demand- Total	mg/L		2							**2**	2	--	--	1	1
Grease and Oil	mg/L		1			1	1	1	1	**1**	1	--	--	4	2

Project BHP-Billiton ODX SWRO 33/14036
File Name N:\AU\Adelaide\Projects\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\Summary of Arup Data\[Summary of Arup Data v2.xls]With Calculation
Print out 1/02/2008
Source Data Arup Compilation of Water Quality Testing Data

Fire Pump Site

Notes:

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	Validity of the data is questionable
NA	Not available
	Holding time rquirement not met
Min, Max, Ave	Data considered included all 5 sampling campaigns but only the average value for the 25/04/07
Average	Average was calculated considering LOR's as values

Parameter	Unit	7 Dec 2006	10-Jan-07	7-Feb-07	20-Mar-07	*25-Apr-07*	*25-Apr-07*	*25-Apr-07*	AVERAGE 25 April 2007	LOR	Min	Max	Average	Number of samples	Number of sampling campaign
Microbiological Parameters															
Bacteriology															
Colony Count (20C) Aerobic	CFU/mL		0.0			0.0	0.0	0.0	0.0	--	0.000	0.000	0.0	4	2
Colony Count (37C) Aerobic	CFU/mL		0.0			0.0	0.0	0.0	0.0	--	0.000	0.000	0.0	4	2
Enterococci and Faecal Streptococci															
Ent/F.Strep - Presumptive	CFU/100mL		0.0			0.0	0.0	0.0	0.0	--	0.000	0.000	0.0	4	2
Enterococci	CFU/100mL		0.0			0.0	0.0	0.0	0.0	--	0.000	0.000	0.0	4	2
Faecal Coliforms															
Faecal Coliforms	CFU/100mL		0.0			0.0	0.0	0.0	0.0	--	0.000	0.000	0.0	4	2
Faecal coliforms - presumptive	CFU/100mL		0.0			0.0	0.0	0.0	0.0	--	0.000	0.000	0.0	4	2
Iron Bacteria-Heterotrophic	/10ml			10	10					**10**	10	--	--	2	2
Iron Bacteria-Heterotrophic	examination			none	none					--					
Algae															
Chlorophyll a	µg/L	1.16	0.77	1.25	1.50	1.01	1.01	0.96	0.99	**0.1**	0.8	1.5	1.1	7	5
Chlorophyll b	µg/L	0.47	0.31	<0.1	0.41	0.17	0.17	0.15	0.16	**0.1**	0.2	0.5	0.3	6	4
Complex Organic Compounds															
Phenols	mg/L		0.01			0.051	0.012	0.01	0.02	**0.01**	0.01	0.024	0.02	4	2
BTEX															
Benzene	µg/L		1			1	1	1	1	**1**	1	--	--	4	2
Ethylbenzene	µg/L		1			1	1	1	1	**1**	1	--	--	4	2
m-p-xylene	µg/L		1			1	1	1	1	**1**	1	--	--	4	2
o-xylene	µg/L		1			1	1	1	1	**1**	1	--	--	4	2
Toluene	µg/L		1			1	1	1	1	**1**	1	--	--	4	2
OrganoChlorine Pesticides										**All below LOR**					
Aldrin	µg/L		<0.01			<0.01	<0.01	<0.01	<0.01	**0.01**	<0.01	--	--	4	2
Chlordane-a	µg/L		<0.01			<0.01	<0.01	<0.01	<0.01	**0.01**	<0.01	--	--	4	2
Chlordane-g	µg/L		<0.01			<0.01	<0.01	<0.01	<0.01	**0.01**	<0.01	--	--	4	2
Chlorothalonil	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Chlorpyrifos	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Chlorthal-Dimethyl	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
DDD	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
DDE	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
DDT	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Dieldrin	µg/L		<0.01			<0.01	<0.01	<0.01	<0.01	**0.01**	<0.01	--	--	4	2
Endosulfan 1	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Endosulfan 2	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Endosulfan Sulphate	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Endrin	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Heptachlor	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Heptachlor Epoxide	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Lindane	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Methoxychlor	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Trifluralin	µg/L		<0.05			<0.05	<0.05	<0.05	<0.05	**0.05**	<0.05	--	--	4	2
Vinclozolin	µg/L		<0.05							**0.05**	<0.05	--	--	1	1

Project BHP-Billiton ODX SWRO 33/14036
File Name N:\AU\Adelaide\Projects\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\Summary of Arup Data\[Summary of Arup Data v2.xls]With Calculation
Print out 1/02/2008
Source Data Arup Compilation of Water Quality Testing Data

Fire Pump Site

Notes:

	All cells highlighted in blue are below LOR
	Validity of the data is questionable
NA	Not available
	Holding time rquirement not met
Min, Max, Ave	Data considered included all 5 sampling campaigns but only the average value for the 25/04/07
Average	Average was calculated considering LOR's as values

Parameter	Unit	7 Dec 2006	10-Jan-07	7-Feb-07	20-Mar-07	*25-Apr-07*	*25-Apr-07*	*25-Apr-07*	AVERAGE 25 April 2007	LOR	Min	Max	Average	Number of samples	Number of sampling campaign
Volatile Organic Compounds										**All below LOR**					
1 1 1 2-tetrachloroethane	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 1 1-trichloroethane	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 1 2 2-tetrachloroethane	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 1 2-trichloroethane	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 1-dichloropropene	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 2 3-trichlorobenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 2 3-trichloropropane	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 2 4-trichlorobenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 2 4-trimethylbenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 2-dibromo-3-chloropropane	µg/L					4	4	4	4	**4**	4	--	--	3	1
1 2-dibromoethane	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 2-dichlorobenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 2-dichloroethane	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 2-dichloropropane	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 3 5-trimethylbenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 3-dichlorobenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 3-dichloropropane	µg/L					1	1	1	1	**1**	1	--	--	3	1
1 4-dichlorobenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
2-chlorotoluene	µg/L					1	1	1	1	**1**	1	--	--	3	1
4-chlorotoluene	µg/L					1	1	1	1	**1**	1	--	--	3	1
4-isopropyltoluene	µg/L					1	1	1	1	**1**	1	--	--	3	1
Bromobenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
Bromodichloromethane	µg/L					1	1	1	1	**1**	1	--	--	3	1
Bromoform	µg/L					1	1	1	1	**1**	1	--	--	3	1
Carbon tetrachloride	µg/L					1	1	1	1	**1**	1	--	--	3	1
Chlorobenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
Chloroform	µg/L					1	1	1	1	**1**	1	--	--	3	1
Cis-1 3-dichloropropene	µg/L					1	1	1	1	**1**	1	--	--	3	1
Dibromochloromethane	µg/L					1	1	1	1	**1**	1	--	--	3	1
Dibromomethane	µg/L					1	1	1	1	**1**	1	--	--	3	1
Hexachlorobutadiene	µg/L					1	1	1	1	**1**	1	--	--	3	1
Isopropylbenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
N-butylbenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
N-propylbenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
Sec-butylbenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
Styrene 1	µg/L					1	1	1	1	**1**	1	--	--	3	1
Tert-butylbenzene	µg/L					1	1	1	1	**1**	1	--	--	3	1
Tetrachloroethene	µg/L					1	1	1	1	**1**	1	--	--	3	1
Trans-1 3-dichloropropene	µg/L					1	1	1	1	**1**	1	--	--	3	1
Trichloroethene	µg/L					1	1	1	1	**1**	1	--	--	3	1
Organophosphorous and Triazine Pesticides										**All below LOR**					
Atrazine	µg/L		<0.5			<0.5	<0.5	<0.5	<0.5	**0.5**	<0.5	--	--	4	2
Azinphos-methyl	µg/L		<0.5			<0.5	<0.5	<0.5	<0.5	**0.5**	<0.5	--	--	4	2
Diazinon	µg/L		<0.5			<0.5	<0.5	<0.5	<0.5	**0.5**	<0.5	--	--	4	2
Fenitrothion	µg/L		<0.5			<0.5	<0.5	<0.5	<0.5	**0.5**	<0.5	--	--	4	2
Hexazinone	µg/L		<0.5			<0.5	<0.5	<0.5	<0.5	**0.5**	<0.5	--	--	4	2
Malathion	µg/L		<0.5			<0.5	<0.5	<0.5	<0.5	**0.5**	<0.5	--	--	4	2
Parathion	µg/L		<0.5			<0.5	<0.5	<0.5	<0.5	**0.5**	<0.5	--	--	4	2
Parathion methyl	µg/L		<0.3			<0.3	<0.3	<0.3	<0.3	**0.3**	<0.3	--	--	4	2
Prometryne	µg/L		<0.5			<0.5	<0.5	<0.5	<0.5	**0.5**	<0.5	--	--	4	2
Simazine	µg/L		<0.5			<0.5	<0.5	<0.5	<0.5	**0.5**	<0.5	--	--	4	2
Halogenated Phenols										**All below LOR**					
# 2 4 5-trichlorophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 2 4 6-tribromophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 2 4 6-trichlorophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 2 4-dibromophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 2 4-dichlorophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 2 6-dibromophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 2 6-dichlorophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 2-bromophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 2-chlorophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 3 5-dichlorophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 3-bromophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 4-bromophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# 4-chlorophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
# pentachlorophenol	µg/L		<0.1			<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	--	--	4	2
SGS Australia Pty Ltd(NSW)															
Poly Aromatic Hydrocarbons										**All below LOR**					
Acenaphthene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Acenaphthylene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Anthracene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Benzo (b-k) fluoranthene	µg/L		<1.0			<1.0	<1.0	<1.0		**1**	<1.0	--	--	4	2

Project BHP-Billiton ODX SWRO 33/14036
File Name N:\AU\Adelaide\Projects\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\Summary of Arup Data\[Summary of Arup Data v2.xls]With Calculation
Print out 1/02/2008
Source Data Arup Compilation of Water Quality Testing Data

Fire Pump Site

Notes:

	All cells highlighted in blue are below LOR
	Validity of the data is questionable
NA	Not available
	Holding time rquirement not met
Min, Max, Ave	Data considered included all 5 sampling campaigns but only the average value for the 25/04/07
Average	Average was calculated considering LOR's as values

Parameter	Unit	7 Dec 2006	10-Jan-07	7-Feb-07	20-Mar-07	*25-Apr-07*	*25-Apr-07*	*25-Apr-07*	AVERAGE 25 April 2007	LOR	Min	Max	Average	Number of samples	Number of sampling campaign
Benzo(a)anthracene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Benzo(a)pyrene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Benzo(g-h-i)perylene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Chrysene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Dibenzo(a-h)anthracene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Fluoranthene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Fluorene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Indeno(123-cd)pyrene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Naphthalene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Phenanthrene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Pyrene	µg/L		<0.5			<0.5	<0.5	<0.5		**0.5**	<0.5	--	--	4	2
Poly Chlorinated Biphenyls (PCBs)										**All below LOR**					
Arochlor 1016	µg/L		<10			<10	<10	<10		**10**	<10	--	--	4	2
Arochlor 1221	µg/L		<10			<10	<10	<10		**10**	<10	--	--	4	2
Arochlor 1232	µg/L		<10			<10	<10	<10		**10**	<10	--	--	4	2
Arochlor 1242	µg/L		<10			<10	<10	<10		**10**	<10	--	--	4	2
Arochlor 1248	µg/L		<10			<10	<10	<10		**10**	<10	--	--	4	2
Arochlor 1254	µg/L		<10			<10	<10	<10		**10**	<10	--	--	4	2
Arochlor 1260	µg/L		<10			<10	<10	<10		**10**	<10	--	--	4	2
Arochlor 1262	µg/L		<10			<10	<10	<10		**10**	<10	--	--	4	2
Arochlor 1268	µg/L		<10			<10	<10	<10		**10**	<10	--	--	4	2
PCBs total	µg/L					<10	<10	<10		**10**	<10	--	--	4	2

Appendix C

Summary of Sampling Results

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 1st Sampling Event (18 September 2007)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	VL and SC
CHECKED BY	Siobhan Boerlage
Description of spreadsheet	Summary of water quality sampling results from first sampling event
Number of Worksheets (incl. this one)	2
Filename	N:\AU\Adelaide\Projects\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\18 Sep 2007\[Summary of Results 18 Sep 07

Data from Sampling Event

Sample Date	18/09/2007
Time of sampling	Site A - 11:30am - 12pm. Site B - 2:45pm - 3:15pm
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 6 L per sample (10 samples total)
Sampler Names	Daniel Ahrens and Steven Carter
Sampler Equipment	Van-dorn sampler and Yeo-Kal 611 Water Quality Meter
Photos of site etc	
Depth at site (m)	13m at site A and 11.5m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	2.63m @ 9:05am (at Whyalla)
Low Tide (HH_MM	0.69m @ 4:07pm (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	North
Wind Speed (Knots)	approx 20 knots
Wave Height (metres- trough to crest)	
General observations	Site A: Clear Sky, clear water, a few white caps. Site B: Small amount of cloud cover, clear water, rougher (area not as protected)

REVISIONS

Rev.	Date	Checked	Description
A	04/10/07		DRAFT
0	04/01/08	SB	Issue to Client
1	18/01/08	SB	Include TDS by Evap

Title **Port Bonython Seawater Monitoring Program - Results Summary - 1st Sampling Event (18 September 2007)**
Project BHP Billiton ODX PWSS Pilot Plant Works
Job Number 33/14036
File Name N:\AU\Adelaide\Projects\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\18 Sep 2007\[Summary of Results 18 Sep 07 v6.xls]Round 1 Average
Print out 22/04/2008
Source Data Arup Water Quality Summary Data Report, ALS Certificate of Analysis

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)						Site B: Fitzgerald Bay					
			Average	Min	Max	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	Average
ALS reference: ES07129966-		ALS				-001	-005		-002	-006		-003	-007		-004	-008	
	Units	LOR															
Physicochemical Parameters																	
Field Measurements		LOR/Probe															
pH (e)		0.01	**8.2**	**8.1**	**8.2**	8.05		**8.05**	8.15		**8.15**	8.13		**8.13**	8.16		**8.16**
EC (e)	mS/cm		**59.8**	**58.6**	**60.6**	64.2		**64.2**	64.7		**64.7**	65		**65**	65.1		**65.1**
Turbidity (e)	NTU	0.1	**3.0**	**1.1**	**8**												
Temperature (c)	^{o}C	0.1				15.1		**15.1**	15.0		**15.0**	15.3		**15.3**	15.3		**15.3**
DO (c)	mg/L	0.1				6.7		**6.7**	6.6		**6.6**	6.8		**6.8**	6.7		**6.7**
DO (c)	% sat					86.5		**86.5**	85.3		**85.3**	88.4		**88.4**	87		**87**
ORP (c)	mV					227		**227**	195		**195**	120		**120**	122		**122**
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	46900	46800	**46850.0**	48500	41300	**44900.0**	47300	45700	**46500.0**	43600	47100	**45350.0**
Suspended Solids (SS) (ALS 0.45µm)	mg/L	1	**10.5 (a)**	**5.3 (a)**	**17 (a)**	2	2	**2**	3	1	**2**	2	<1	**2**	4	1	**2.5**
UV Absorbance @ 254nm	AU	0.01				0.02	0.02	**0.02**	0.02	0.02	**0.02**	0.02	0.02	**0.02**	0.02	0.02	**0.02**
Total Hardness as $CaCO_3$	mg$CaCO_3$/L	1				7940	7360	**7650**	7700	7430	**7565**	7680	7460	**7570**	7510	7590	**7550**
Alkalinity by PC Titrator																	
Hydroxide Alkalinity as $CaCO_3$	mg$CaCO_3$/L	1				<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**
Carbonate Alkalinity as $CaCO_3$	mg$CaCO_3$/L	1				<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**
Bicarbonate Alkalinity as $CaCO_3$	mg$CaCO_3$/L	1				118	132	**125**	121	125	**123**	131	123	**127**	140	139	**140**
Hydroxide Alkalinity	mg/L	1	**0**	**0**	**0**	<0.34	<0.34	**<0.34**	<0.34	<0.34	**<0.34**	<0.34	<0.34	**<0.34**	<0.34	<0.34	**<0.34**
Carbonate Alkalinity	mg/L	1	**0**	**0**	**0**	<0.60	<0.60	**<0.60**	<0.60	<0.60	**<0.60**	<0.60	<0.60	**<0.60**	<0.60	<0.60	**<0.60**
Bicarbonate Alkalinity	mg/L	1	**155**	**155**	**157**	144	161	**153**	148	153	**151**	160	150	**155**	171	170	**171**
Total Alkalinity as $CaCO_3$	mg$CaCO_3$/L	1	**127**	**127**	**129**	118	132	**125**	121	125	**123**	131	123	**127**	140	139	**140**
Dissolved Major Anions																	
Chloride (c)	mg/L	1	**23067**	**22100**	**23633**	23051	23817	**23434**	24339	23520	**23929.5**	24469	25116	**24792.5**	24068	22646	**23357**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3390	3350	**3370**	3330	3370	**3350**	3360	3370	**3365**	3330	3480	**3405**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	78	79	**78.5**	79	79	**79**	78	81	**79.5**	80	81	**80.5**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
Dissolved Major Cations																	
Calcium	mg/L	1	**468**	**459**	**476**	507	472	**489.5**	499	481	**490**	496	479	**487.5**	487	487	**487**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1620	1500	**1560**	1570	1510	**1540**	1560	1520	**1540**	1530	1550	**1540**
Sodium	mg/L	1	**12560**	**12300**	**12900**	14500	13600	**14050**	13700	14100	**13900**	13700	13600	**13650**	13600	13600	**13600**
Potassium	mg/L	1	**474**	**462**	**480**	505	481	**493**	492	491	**491.5**	480	499	**489.5**	490	490	**490**
Ionic Balance																	
Total Anions	meq/L	0.01				792	747	**769.5**	821	846	**833.5**	795	826	**810.5**	752	722	**737**
Total Cations	meq/L	0.01				801	751	**776**	764	774	**769**	762	754	**758**	753	757	**755**
Ionic Balance	%	0.01				0.54	0.27	**0.405**	3.62	4.41	**4.0**	2.2	4.59	**3.395**	<0.01	2.39	**2.39**
GHD Calculations																	
TDS-Calculated by GHD (g)	*mg/L*		***41615***	***40240***	***42624***	*43809*	*43474*	***43642***	*44171*	*43718*	***43945***	*44318*	*44829*	***44574***	*43770*	*42519*	***43144***
Total Anions calculated by GHD	meq/L					723	744	**734**	758	736	**747**	763	781	**772**	751	714	**733**
Total Cations calculated by GHD	meq/L					803	751	**777**	763	774	**769**	762	754	**758**	755	756	**756**
Ionic Balance calculated by GHD	%					5.20	0.46	**2.85**	0.30	2.53	**1.41**	0.08	1.79	**0.94**	0.23	2.86	**1.53**
Hardness Calculation by GHD																	
Calcium Hardness as $CaCO_3$	mg$CaCO_3$/L		**1169**	**1148**	**1190**	1268	1180	**1224**	1248	1203	**1225**	1240	1198	**1219**	1218	1218	**1218**
Magnesium Hardness as $CaCO_3$	mg$CaCO_3$/L		**6234**	**6165**	**6329**	6658	6165	**6412**	6453	6206	**6329**	6412	6247	**6329**	6288	6371	**6329**
Total Hardness as $CaCO_3$	mg$CaCO_3$/L		**7399**	**7355**	**7477**	7926	7345	**7635**	7700	7409	**7554**	7652	7445	**7548**	7506	7588	**7547**
Metals																	
Dissolved Metals in Saline Water																	
Dissolved Aluminium	µg/L	10	**--**	**<10**	**--**	10	<10	**10**	10	<10	**10**	<10	<10	**<10**	<10	<10	**<10**
Dissolved Iron	µg/L	5	**--**	**<5**		6	8	**7**	25	6	**15.5**	6	7	**6.5**	6	6	**6**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	8	8	**8**	8	8	**8**	8	8	**8**	8	8	**8**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	4.8	4.5	**4.65**	4.9	4.5	**4.7**	5	4.6	**4.8**	4.6	4.7	**4.65**
Dissolved Manganese	µg/L	0.5	**--**	**<1**	**--**	<0.5	1.8	**1.15**	6	1.7	**3.85**	<0.5	2.4	**1.45**	0.6	1.7	**1.15**
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	8.49	9.04	**8.77**	8.6	9.03	**8.82**	8.73	8.89	**8.81**	8.53	9.05	**8.79**
Dissolved Silica by ICP-AES	mg/L	0.1				<0.1	<0.1	**<0.1**	<0.1	<0.1	**<0.1**	<0.1	<0.1	**<0.1**	<0.1	<0.1	**<0.1**
Total Metals in Saline Water																	
Aluminium	µg/L	10	**--**	**<10**	**--**	10	10	**10**	10	10	**10**	10	10	**10**	20	10	**15**
Iron	µg/L	5	**6**	**<5**	**6**	11	16	**13.5**	36	19	**27.5**	46	17	**31.5**	20	20	**20**
Arsenic	µg/L	0.5	**2**	**<1**	**2**	2.1	2.3	**2.2**	2.6	2.4	**2.5**	2.1	2.2	**2.15**	2	2.3	**2.15**
Cadmium	µg/L	0.2	**--**	**<5**	**--**	<0.2	<0.2	**<0.2**	<0.2	0.2	**0.2**	<0.2	<0.2	**<0.2**	<0.2	<0.2	**<0.2**
Chromium Total	µg/L	0.5	**7**	**7**	**7**	<0.5	<0.5	**<0.5**	<0.5	<0.5	**<0.5**	<0.5	<0.5	**<0.5**	<0.5	<0.5	**<0.5**
Copper	µg/L	1	**11**	**<10**	**11**	5	1	**3**	3	2	**2.5**	3	3	**3**	6	14	**10**
Lead	µg/L	0.2	**--**	**<5**	**--**	0.6	<0.2	**0.4**	<0.2	<0.2	**<0.2**	<0.2	0.4	**0.3**	0.3	1.6	**0.95**
Manganese	µg/L	0.5	**4**	**<1**	**5**	5.9	3.5	**4.7**	5.1	1.7	**3.4**	3.6	2.7	**3.15**	4	4.1	**4.05**
Mercury	mg/L	0.0001	**--**	**<0.0003**	**--**	<0.0001	<0.0001	**<0.0001**	<0.0001	<0.0001	**<0.0001**	<0.0001	<0.0001	**<0.0001**	<0.0001	<0.0001	**<0.0001**
Molybdenum	µg/L	0.1				13.4	13.7	**13.55**	13.8	13	**13.4**	13.8	13.5	**13.65**	13.1	13.5	**13.3**
Nickel	µg/L	0.5	**--**	**<5**	**--**	<0.5	<0.5	**<0.5**	<0.5	<0.5	**<0.5**	<0.5	<0.5	**<0.5**	<0.5	<0.5	**<0.5**
Tin	µg/L	5				<5	<5	**<5**	<5	<5	**<5**	<5	<5	**<5**	<5	<5	**<5**
Zinc	µg/L	5	**30**	**<30**	**32**	14	55	**34.5**	8	7	**7.5**	16	12	**14**	14	26	**20**
Nutrients																	
Ammonia as N	mgN/L	0.1 (c)	**0.007**	**<0.005**	**0.01**	<0.100	<0.100	**<0.1**	<0.100	<0.100	**<0.1**	<0.100	<0.100	**<0.1**	<0.100	<0.100	**<0.1**
Nitrite as N	mgN/L	0.01		**<0.005**	**--**	<0.010	<0.010	**<0.01**	<0.010	<0.010	**<0.01**	<0.010	<0.010	**<0.01**	<0.010	<0.010	**<0.01**
Nitrate as N	mgN/L	0.01	**--**	**0**		<0.010	<0.010	**<0.01**	<0.010	<0.010	**<0.01**	<0.010	<0.010	**<0.01**	<0.010	<0.010	**<0.01**
Nitrite + Nitrate as N	mgN/L	0.01	**0.006**	**<0.005**	**0.008**	<0.010	<0.010	**<0.01**	<0.010	<0.010	**<0.01**	<0.010	<0.010	**<0.01**	<0.010	<0.010	**<0.01**
Total Kjeldahl Nitrogen as N	mgN/L	1 (c)	**0.239**	**<0.05**	**0.62**	<1.0	<1.0	**<1.0**	<1.0	<1.0	**<1.0**	<1.0	<1.0	**<1.0**	<1.0	<1.0	**<1.0**
Total Nitrogen as N	mgN/L	0.1 (b)	**0.247**	**<0.06**	**0.62**	<1.0	<1.0	**<1.0**	<1.0	<1.0	**<1.0**	<1.0	<1.0	**<1.0**	<1.0	<1.0	**<1.0**
Total Phosphorus as P	mgP/L	0.01	**0.017**	**0.011**	**0.023**	0.01	<0.01	**0.01**	<0.01	<0.01	**<0.01**	0.01	0.02	**0.015**	0.01	0.01	**0.01**
Reactive Phosphorus as P	mgP/L	0.01	**0.006**	**<0.005**	**0.006**	<0.010	<0.010	**<0.01**	<0.010	<0.010	**<0.01**	<0.010	<0.010	**<0.01**	0.03	<0.010	**0.02**
Dissolved Organic Carbon	mgO_2/L	1	**1.1**	**0.9**	**1.3**	2	2	**2**	2	2	**2**	2	2	**2**	2	1	**1.5**
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**	2	2	**2**	2	2	**2**	2	2	**2**	2	2	**2**
Biochemical Oxygen Demand	mg/L	2	**--**	**<2**	**--**	<2	8	**5**	<2	12	**7**	<2	<2	**<2**	6	4	**5**
Oil & Grease	mg/L	5	**--**	**<1**	**--**	<5	<5	**<5**	<5	<5	**<5**	<5	<5	**<5**	<5	<5	**<5**
Microbiological																	
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**	<1	2	**2**	<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**
Heterotrophic Plate Count (36°C)	CFU/mL	1				~10	~1	**~6**	~3	<1	**~4**	~5	~1	**~3**	<1	~2	**~2**
Heterotrophic Plate Count (21°C)	CFU/mL	1				~3	<1	**~2**	<1	<1	**<1**	~5	~1	**~3**	<1	~2	**~2**
Escherichia coli	CFU/100mL	1				<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**
Coliforms	CFU/100mL	1		**0**	**0**	<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**

Notes

(a) It is likely that the ARUP analysis was done on 1.2 µm
(b) Total Nitrogen LOR was not achieved in the analysis for first sampling event (however has since been achieved in the analysis for the second sampling event)
(c) Modified to represent LOR achieved by ALS, 2nd round of data
(d) Chlorides were reanalysed, this table presents the last results
(e) Field Measurements
(f) Where relevant, average was calculated considering LOR's as values
Unexpected result which will require further verification
(g) Average TDS calculated based on sum of average of an ion

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 2nd Sampling Event (24 October 2007)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	VL and SC
CHECKED BY	Siobhan Boerlage
Description of spreadsheet	Summary of water quality sampling results from first sampling event
Number of Worksheets (incl. this one)	2
Filename	N:\AU\Adelaide\Projects\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\24 Oct 2007\[Summary of results 24th Oct 2007

Data from Sampling Event

Sample Date	24/10/2007
Time of sampling	Site A - 2pm - 2:30pm. Site B - 12pm - 12:30pm. Intake: 11:30pm
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 6 L per sample (8 samples total)
Sampler Names	Daniel Ahrens and Tony Cauchi
Sampler Equipment	Van-dorn sampler and Yeo-Kal 611 Water Quality Meter
Photos of site etc	
Depth at site (m)	11m at site A and 12m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	2.27m @ 6:05am and 2.32 m @ 6:26pm (at Whyalla)
Low Tide (HH_MM	0.61m @ 12:30pm (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Rained earlier in the morning
Wind Direction: (Cardinal)	Site A: From W, Site B: From NW
Wind Speed (Knots)	Site A:15 to 25 knots, Site B: 15 knots
Wave Height (metres- trough to crest)	Site A: 0.75m increasing to 1.5m, Site B: 0.5m
General observations	Site A: Sunny, patchy cloud cover, many white caps. Site B: Overcast, 2m water visibility, few white caps

REVISIONS

Rev.	Date	Checked	Description
0	04/01/08	SB	Issue to Client
1	18/01/08	SB	Include TDS by Evap

Title **Port Bonython Seawater Monitoring Program - Results Summary - 2nd Sampling Event (24 October 2007)**
Project BHP Billiton ODX PWSS Pilot Plant Works
Job Number 33/14036
File Name N:\AU\Adelaide\Projects\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\24 Oct 2007\[Summary of results 24th Oct 2007 v6.xls]Cover
Print out 1/02/2008
Source Data Arup Water Quality Summary Data Report, ALS Certificate of Analysis

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0714740		ALS				0004	0006				0003	0007				0002	0008				0001	0009				0005	0010			
AWQC reference: 2007-006	Units	LOR						-6657	-6662				6658	6663				6659	6664				6660	6665				6661	6666	
Physicochemical Parameters																														
Field Measurements		LOR /probe																												
pH (c)		0.01	**8.2**	**8.1**	**8.2**	8.14				**8.14**	8.15				**8.15**	8.04				**8.04**	8.08				**8.08**					
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**	64.7				**64.7**	64.8				**64.8**	65.3				**65**	65.2				**65**					
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**	2.5				**2.5**	5				**5**	1				**1**	2.1				**2.1**					
Temperature (c)	°C	0.1				18.9				**18.9**	18.8				**18.8**	18.73				**18.73**	18.78				**18.78**					
DO (c)	mg/L	0.1				8.3				**8.3**	8.2				**8.2**	7.7				**7.7**	7.3				**7.3**					
DO (c)	% sat					115.3				**115.3**	114.2				**114.2**	107.7				**107.7**	101.5				**101.5**					
ORP (c)	mV					32				**32**	33				**33**	85				**85**	80				**80**					
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	45800	45800			**45800**	44700	45600			**45150**	45900	45300			**45600**	45000	46600			**45800**	44700	45800			**45250**
Suspended Solids (SS) (ALS 1.2 µm)	mg/L	1	**10.5 (a)**	**5.3 (a)**	**17 (a)**	22	13			**18**	24	10			**17**	5	--			**5**	17	7			**12**	6	20			**13**
Suspended Solids (SS) (ALS 0.45 µm)	mg/L	1				15	10			**13**	10	7			**8.5**	3	14			**8.5**	10	6			**8**	5	10			**7.5**
UV Absorbance @ 254 nm	AU	0.01				0.03	<0.01			**0.03**	0.02	0.02			**0.02**	0.02	0.02			**0.02**	0.02	0.02			**0.02**	0.02	0.03			**0.025**
Total Hardness as CaCO3	mg/L	1				7690	7670			**7680**	7610	7650			**7630**	7520	7890			**7705**	7400	7600			**7500**	7470	7440			**7455**
Alkalinity by PC Titrator																														
Hydroxide Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**
Carbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**
Bicarbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				123	123			**123**	121	127			**124**	120	125			**123**	121	122			**122**	123	123			**123**
Hydroxide Alkalinity	$mgOH^-/L$	1	**0**	**0**	**0**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**
Carbonate Alkalinity	$mgCO_3^{2-}/L$	1	**0**	**0**	**0**	<0.60	<0.60			**<0.60**	<0.60	<0.60			**<0.60**	<0.60	<0.60			**<0.60**	<0.60	<0.60			**<0.60**	<0.60	<0.60			**<0.60**
Bicarbonate Alkalinity	$mgHCO_3^-/L$	1	**155**	**155**	**157**	150	150			**150**	148	155			**151**	146	153			**149**	148	149			**148**	150	150			**150**
Total Alkalinity as CaCO3	$mgCaCO_3/L$	1	**127.4**	**127**	**129**	123	123			**123**	121	127			**124**	120	125			**123**	121	122			**122**	123	123			**123**
Dissolved Major Anions																														
Chloride (g)	mg/L	1	**23067**	**22100**	**23633**	24700	23800	25200	25100	**24700**	24900	23500	26200	24900	**24875**	22900	23800	26300	25700	**24675**	22700	23900	25900	24700	**24300**	22100	22200	25800	24300	**23600**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3420	3400	3210	3210	**3310**	3380	3420	3270	3270	**3335**	3330	3490	3330	3330	**3370**	3260	3380	3330	3270	**3310**	3320	3280	3210	3270	**3270**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	80	85			**83**	81	80			**81**	88	80			**84**	74	80			**77**	81	86			**83.5**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.9	0.9			**0.9**	0.9	0.9			**0.9**	0.9	0.9			**0.9**	0.9	0.9			**0.9**	0.9	0.9			**0.9**
Dissolved Major Cations																														
Calcium	mg/L	1	**468**	**459**	**476**	504	508	462	460	**484**	491	492	470	469	**481**	492	502	480	479	**488**	488	488	474	468	**480**	486	492	464	470	**478**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1560	1560	1580	1580	**1570**	1550	1560	1570	1710	**1598**	1530	1610	1610	1560	**1578**	1500	1550	1590	1590	**1558**	1520	1510	1580	1560	**1543**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	14100	14000	12900	12800	**13450**	13900	14200	12700	13900	**13675**	13800	14000	13100	12700	**13400**	13500	14000	13000	12900	**13350**	13800	13600	12900	12700	**13250**
Potassium	mg/L	1	**474**	**462**	**480**	550	557	465	468	**510**	541	558	478	473	**513**	537	565	480	482	**516**	524	548	477	476	**506**	550	524	472	476	**506**
Ionic Balance																														
Total Anions	meq/L	0.01				770	724			**747**	775	736			**756**	718	744			**731**	711	748			**730**	695	697			**696**
Total Cations	meq/L	0.01				782	783			**783**	769	776			**773**	764	777			**771**	749	785			**767**	766	752			**759**
Ionic Balance	%	0.01				0.76	3.90			**2.33**	0.38	2.68			**1.53**	3.14	2.1			**2.62**	2.62	2.41			**2.52**	4.85	3.76			**4.31**
GHD Calculations																														
TDS-Calculated by GHD (d) (e)	*mg/L*		**41615**	**40240**	**42624**	45079	44075	44064	43865	**44271**	45006	43980	44935	44969	**44723**	42839	44215	45549	44500	**44276**	42209	44110	45012	43645	**43744**	42022	41857	44675	43025	**42895**
Total Anions calculated by GHD	meq/L		**721**			771	745	780	777	**768**	775	737	810	773	**774**	718	747	814	797	**769**	711	747	802	767	**757**	695	697	797	756	**736**
Total Cations calculated by GHD	meq/L		**708**			781	777	727	722	**752**	771	785	718	781	**764**	765	781	739	717	**751**	749	775	732	728	**746**	764	754	727	717	**740**
Ionic Balance calculated by GHD	%		**0.91**			0.69	2.14	3.57	3.69	**1.08**	0.28	3.18	6.02	0.53	**0.64**	3.16	2.27	4.81	5.24	**1.19**	2.61	1.85	4.59	2.63	**0.71**	4.72	3.92	4.62	2.67	**0.27**
Hardness Calculation by GHD																														
Calcium Hardness as $CaCO_3$	$mgCaCO_3/L$		**1169**	**1148**	**1190**	1260	1270	1155	1150	**1209**	1228	1230	1175	1173	**1201**	1230	1255	1200	1198	**1221**	1220	1220	1185	1170	**1199**	1215	1230	1160	1175	**1195**
Magnesium Hardness as $CaCO_3$	$mgCaCO_3/L$		**6234**	**6165**	**6329**	6412	6412	6494	6494	**6453**	6371	6412	6453	7028	**6566**	6288	6617	6617	6412	**6484**	6165	6371	6535	6535	**6401**	6247	6206	6494	6412	**6340**
Total Hardness as $CaCO_3$	$mgCaCO_3/L$		**7399**	**7355**	**7477**	7672	7682	7649	7644	**7661**	7598	7642	7628	8201	**7767**	7518	7872	7817	7609	**7704**	7385	7591	7720	7705	**7600**	7462	7436	7654	7587	**7535**
Metals																														
Dissolved Metals in Saline Water																														
Dissolved Aluminium	µg/L	10	--	**<10**	--	<10	<10			**<10**	<10	10			**10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**
Dissolved Iron	µg/L	5	--	**<5**		6	<5			**5.5**	<5	5			**5**	<5	<5			**<5**	<5	<5			**<5**	7	<5			**7**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	8	8			**8**	8	8			**8**	8	8			**8**	8	8			**8**	8	8			**8**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	4.9	5.1			**5**	5.4	5			**5.2**	5.5	5.2			**5**	5.3	5.1			**5.2**	4.9	5.1			**5**
Dissolved Manganese	µg/L	0.5	--	**<1**	--	2	1.6			**1.8**	1.7	1.8			**1.8**	1.6	1.4			**1.5**	1.5	1.6			**1.55**	1.4	1.5			**1.45**
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	9.01	8.98			**9**	9.04	9.38			**9**	9.56	9.56			**10**	9.25	9.21			**9.23**	9.29	8.94			**9**
Dissolved Silica by ICP-AES	mg/L	0.1				0.6	<0.1			**0.35**	0.6	0.5			**0.55**	0.6	0.5			**0.55**	0.7	0.5			**0.6**	0.6	0.5			**0.55**
Total Metals in Saline Water																														
Aluminium	µg/L	10	--	**<10**	--	100	20			**60**	30	30			**30**	10	<10			**10**	10	<10			**10**	90	20			**55**
Iron	µg/L	5	**6**	**<5**	**6**	111	49			**80**	58	57			**58**	16	16			**16**	16	15			**15.5**	42	34			**38**
Arsenic	µg/L	0.5	**2**	**<1**	**2**	2.4	2.2			**2.3**	2.1	2.2			**2**	2.2	1.9			**2.05**	1.8	2			**1.9**	2.1	2			**2.05**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)									Site B: Fitzgerald Bay									Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0714740		ALS				**0004**	**0006**				**0003**	**0007**				**0002**	**0008**				**0001**	**0009**								
AWQC reference: 2007-006	Units	LOR						-6657	-6662				**6658**	**6663**				**6659**	**6664**				**6660**	**6665**				**6661**	**6666**	
Cadmium	µg/L	0.2	--	**<5**	--	<0.2	<0.2			**<0.2**	<0.2	0.2			**0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**
Chromium Total	µg/L	0.5	**7**	**7**	**7**	<0.5	0.5			**0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Copper	µg/L	1	**11**	**<10**	**11**	6	7			**6.5**	10	12			**11**	11	6			**8.5**	5	7			**6**	<1	<1			**<1**
Lead	µg/L	0.2	--	**<5**	--	0.8	1.4			**1.1**	2	1.6			**1.8**	1.3	0.5			**0.9**	0.5	0.6			**0.55**	0.3	0.3			**0.3**
Manganese	µg/L	0.5	**4**	**<1**	**5**	4	3.5			**3.8**	3.7	3.8			**4**	1.9	1.8			**1.9**	1.8	1.6			**1.7**	3.5	2.3			**2.9**
Mercury	mg/L	0.0001	--	**<0.0003**	--	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**
Molybdenum	µg/L	0.1				14.2	13.4			**14**	13.3	13.5			**13.4**	14.3	14.3			**14.3**	14.2	14.3			**14.25**	14	13.9			**14**
Nickel	µg/L	0.5	--	**<5**	--	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Tin	µg/L	5				<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**
Zinc	µg/L	5	**30**	**<30**	**32**	7	8			**7.5**	17	13			**15**	13	5			**9**	8	10			**9**	8	<5			**6.5**
Nutrients																														
Ammonia as N	mgN/L	0.1 (b)	**0.007**	**<0.005**	**0.01**	<0.100	<0.100			**<0.1**	<0.100	<0.100			**<0.1**	<0.100	<0.100			**<0.1**	<0.100	<0.100			**<0.1**	<0.100	<0.100			**<0.1**
Nitrite as N	mgN/L	0.01		**<0.005**	--	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**
Nitrate as N	mgN/L	0.01	--	**0**		<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**
Nitrite + Nitrate as N	mgN/L	0.01	**0.006**	**<0.005**	**0.008**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**
Total Kjeldahl Nitrogen as N	mgN/L	1 (b)	**0.239**	**<0.05**	**0.62**	<1.0	<1.0			**<1.0**	<1.0	<1.0			**<1.0**	<1.0	<1.0			**<1.0**	<1.0	<1.0			**<1.0**	<1.0	<1.0			**<1.0**
Total Nitrogen as N	mgN/L	0.1	**0.247**	**<0.06**	**0.62**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**
Total Phosphorus as P	mgP/L	0.01	**0.017**	**0.011**	**0.023**	<0.01	<0.01			**<0.01**	<0.01	0.01			**0.01**	0.03	<0.01			**0.02**	<0.01	0.03			**0.02**	<0.01	<0.01			**<0.01**
Reactive Phosphorus as P	mgP/L	0.01	**0.006**	**<0.005**	**0.006**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**	<0.010	<0.010			**<0.01**
Dissolved Organic Carbon	mg/L	1	**1.1**	**0.9**	**1.3**	2	2			**2**	2	2			**2**	2	2			**2**	2	1			**1.5**	2	2			**2**
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**	2	2			**2**	2	2			**2**	2	2			**2**	2	2			**2**	2	2			**2**
Biochemical Oxygen Demand	mg/L	2	--	**<2**	--	<2	<2			**<2**	5	<2			**3.5**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**
Oil & Grease	mg/L	5	--	**<1**	--	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**
Microbiological																														
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**
Heterotrophic Plate Count (36°C)	CFU/mL	1				~5	~4			**~5**	~20	~1			**~11**	~20	~10			**~15**	~8	~8			**~8**	~4	~3			**~4**
Heterotrophic Plate Count (21°C)	CFU/mL	1				~4	~4			**~4**	~10	~1			**~6**	~7	~10			**~9**	~5	~4			**~5**	~6	~9			**~8**
Escherichia coli	CFU/100mL	1				<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<2			**<2**	<1	<1			**<1**
Coliforms	CFU/100mL	1		**0**	**0**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<2			**<2**	<1	<1			**<1**

Notes

(a) It is likely that the ARUP analysis was done on 1.2 µm
(b) Modified to represent LOR achieved by ALS
(c) Field Measurements
(d) Averages calculated based on sum of average of an ion, when no AWQC value was available the average from ALS was used
(e) When no AWQC value was available the average from ALS was used, average based on average of all ion data
(f) Where relevant, average was calculated considering LOR's as values
(g) It is noted that the results for chloride and sodium from ALS and AWQC vary considerably, ALS is on average almost 10% higher for Sodium, however AWQC is on average almost 10% higher for chloride

Unexpected result which will require further verification

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 3rd Sampling Event (18 December 2007)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	SC
CHECKED BY	VL/SB
Description of spreadsheet	Summary of water quality sampling results from third sampling event
Number of Worksheets (incl. this one)	2
Filename	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\18 Dec 07\[Summary of results 18th Dec2007 v2.xls]

Data from Sampling Event

Sample Date	18/12/2007
Time of sampling	Site A - 12:35pm - 2:05pm. Site B - 10:20am - 11:50pm. Intake: 11:30am
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 6 L per sample (10 samples total)
Sampler Names	Daniel Ahrens and Steven Carter
Sampler Equipment	Van-dorn sampler and TPS 90FLMWAB Water Quality Meter
Photos of site etc	
Depth at site (m)	12m at site A and 12m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	1.62m @ 10:26am (at Whyalla)
Low Tide (HH_MM	1.41m @ 6:20am and 1.05m @ 5:23pm (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	Site A: From North, Site B: From North
Wind Speed (Knots)	Site A: 5-8 increasing to 18-22 knots, Site B: 10 to 15 knots
Wave Height (metres- trough to crest)	Site A: 0.2m increasing to 0.5-0.75m, Site B: <0.5m
General observations	Site A: Overcast, 2m water visibility. Site B: Overcast, 3 m water visibility

REVISIONS

Rev.	Date	Checked	Description
0	01/02/08	VL/SB	Issue to Client
1	17/10/08	SC	ALS Sodium and Chloride Results Removed from Averages

Title **Port Bonython Seawater Monitoring Program - Results Summary - 3rd Sampling Event (18 December 2007)**
Project BHP Billiton ODX PWSS Pilot Plant Works
Job Number 33/14036
File Name G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\18 Dec 07\[Summary of results 18th Dec2007 v2.xls]Round3 Average
Print out 3/11/2008
Source Data Arup Water Quality Summary Data Report, ALS Certificate of Analysis

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0717904		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2007-CSR-3	Units	LOR						9497	9502				9498	9503				9499	9504				9500	9505				9501	9506	
Physicochemical Parameters																														
Field Measurements		LOR /probe																												
pH (c)		0.01	**8.2**	**8.1**	**8.2**	8.36				**8.36**	8.36				**8.36**	8.21				**8.21**	8.27				**8.27**					
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**																									
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**																									
Temperature (c)	°C	0.1				22.4				**22.4**	22.3				**22.3**	22.3				**22.3**	22.2				**22.2**					
DO (c)	mg/L	0.1				6.47				**6.47**	5.93				**5.93**	6.6				**6.6**	6.15				**6.15**					
DO (c)	% sat																													
ORP (c)	mV					78				**78**	342				**342**	50				**50**	333				**333**					
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	43400	43200			**43300**	44500	44500			**44500**	44100	44400			**44250**	46000	44100			**45050**	45100	44000			**44550**
Suspended Solids (SS) (ALS 1.2 µm)	mg/L	1	**10.5 (a)**	**5.3 (a)**	**17 (a)**	21	21			**21**	19	26			**22.5**	20	18			**19**	14	22			**18**	14	15			**14.5**
Suspended Solids (SS) (ALS 0.45 µm)	mg/L	1				8	11			**10**	3	12			**7.5**	6	9			**7.5**	7	10			**8.5**	8	7			**7.5**
UV Absorbance @ 254 nm	AU	0.01				0.03	0.03			**0.03**	0.03	0.03			**0.03**	0.03	0.03			**0.03**	0.03	0.03			**0.03**	0.03	0.03			**0.03**
Total Hardness as CaCO3	mg/L	1				7060	7410			**7235**	7430	7660			**7545**	7520	7520			**7520**	7240	7490			**7365**	7610	7420			**7515**
Alkalinity by PC Titrator																														
Hydroxide Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**
Carbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**
Bicarbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				114	117			**115.5**	120	120			**120**	119	119			**119**	120	122			**121**	119	119			**119**
Hydroxide Alkalinity	$mgOH^-/L$	1	**0**	**0**	**0**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**
Carbonate Alkalinity	$mgCO_3^{2-}/L$	1	**0**	**0**	**0**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**
Bicarbonate Alkalinity	$mgHCO_3/L$	1	**155**	**155**	**157**	139	143			**141**	146	146			**146**	145	145			**145**	146	149			**148**	145	145			**145**
Total Alkalinity as CaCO3	$mgCaCO_3/L$	1	**127.4**	**127**	**129**	114	117			**116**	120	120			**120**	119	119			**119**	120	122			**121**	119	119			**119**
Dissolved Major Anions																														
Chloride (g)	mg/L	1	**23067**	**22100**	**23633**	21700	23400	22300	22500	**22400**	23200	25300	23900	23400	**23650**	22900	26300	23200	23100	**23150**	24500	25900	23800	23600	**23700**	22200	25900	23000	22800	**22900**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3320	3320	3210	3330	**3295**	3330	3450	3210	3360	**3337.5**	3380	3410	3180	3210	**3295**	3250	3370	3390	3240	**3312.5**	3420	3320	3300	3270	**3327.5**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	80	80			**80**	80	80			**80**	80	79			**79.5**	80	80			**80**	80	80			**80**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.9	0.9			**0.9**	0.9	0.9			**0.9**	0.9	0.9			**0.9**	0.9	0.9			**0.9**	0.9	0.9			**0.9**
Dissolved Major Cations																														
Calcium	mg/L	1	**468**	**459**	**476**	439	459	462	500	**465**	461	478	469	482	**473**	466	437	462	469	**459**	451	466	486	473	**469**	471	461	481	469	**471**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1450	1520	1530	1580	**1520**	1520	1570	1600	1560	**1562.5**	1540	1560	1590	1580	**1567.5**	1480	1540	1580	1600	**1550**	1560	1520	1540	1550	**1542.5**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	12600	13400	12100	12600	**12350**	13300	13800	12800	12400	**12600**	13600	13500	12600	12600	**12600**	13300	13400	12500	12800	**12650**	13900	13400	12200	12400	**12300**
Potassium	mg/L	1	**474**	**462**	**480**	484	486	479	463	**478**	495	503	472	486	**489**	499	492	473	477	**485.25**	494	491	507	487	**494.75**	505	492	492	474	**490.75**
Ionic Balance																														
Total Anions	meq/L	0.01				650	764			**707**	725	788			**757**	719	816			**768**	761	804			**783**	700	802			**751**
Total Cations	meq/L	0.01				701	743			**722**	739	766			**753**	753	750			**752**	736	746			**741**	769	743			**756**
Ionic Balance	%	0.01				3.82	1.40			**2.61**	0.95	1.43			**1.19**	2.29	4.28			**3.29**	1.67	3.74			**2.71**	4.66	3.87			**4.27**
GHD Calculations																														
TDS-Calculated by GHD (d) (e)	*mg/L*		**41615**	**40240**	**42624**	40227	42823	40317	41209	**40744**	42547	45342	42692	41929	**42353**	42626	45938	41745	41676	**41796**	43717	45411	42506	42443	**42419**	42296	45333	41253	41203	**41271**
Total Anions calculated by GHD	meq/L		**721**			684	732	698	707	**703**	726	788	744	733	**739**	719	815	723	721	**724**	761	803	745	736	**740**	700	802	720	714	**718**
Total Cations calculated by GHD	meq/L		**708**			702	744	688	715	**698**	740	767	724	705	**713**	755	750	715	714	**713**	736	746	711	725	**714**	770	744	694	703	**698**
Ionic Balance calculated by GHD	%		**0.91**			1.33	0.81	0.75	0.62	**0.34**	0.91	1.38	1.31	1.94	**1.79**	2.43	4.14	0.60	0.48	**0.79**	1.69	3.71	2.32	0.74	**1.77**	4.75	3.76	1.81	0.77	**1.37**
Hardness Calculation by GHD																														
Calcium Hardness as $CaCO_3$	$mgCaCO_3/L$		**1169**	**1148**	**1190**	1097.5	1147.5	1155	1250	**1163**	1153	1195	1172.5	1205	**1181**	1165	1092.5	1155	1173	**1146**	1127.5	1165	1215	1182.5	**1173**	1177.5	1152.5	1202.5	1172.5	**1176**
Magnesium Hardness as $CaCO_3$	$mgCaCO_3/L$		**6234**	**6165**	**6329**	5960	6247	6288	6494	**6247**	6247	6453	6576	6412	**6422**	6329	6412	6535	6494	**6442**	6083	6329	6494	6576	**6371**	6412	6247	6329	6371	**6340**
Total Hardness as $CaCO_3$	$mgCaCO_3/L$		**7399**	**7355**	**7477**	7057	7395	7443	7744	**7410**	7400	7648	7749	7617	**7603**	7494	7504	7690	7666	**7589**	7210	7494	7709	7759	**7543**	7589	7400	7532	7543	**7516**
Metals																														
Dissolved Metals in Saline Water																														
Dissolved Aluminium	µg/L	10	**--**	**<10**	**--**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**
Dissolved Iron	µg/L	5	**--**	**<5**		<5	<5			**<5**	<5	9			**7**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	8	8			**8**	8	8			**8**	8	8			**8**	8	8			**8**	8	8			**8**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	5.8	5.2			**5.5**	5.5	5.4			**5.45**	5.6	5.2			**5.4**	5.7	5.1			**5.4**	5.5	5.2			**5.35**
Dissolved Manganese	µg/L	0.5	**--**	**<1**	**--**	2.8	1			**1.9**	1.5	1.6			**1.6**	1.3	1.3			**1.3**	1.3	1.3			**1.3**	0.9	1			**0.95**
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	8.2	8.7			**8.45**	8.25	8.69			**8**	8.85	8.79			**8.82**	8.71	8.83			**8.77**	8.7	8.52			**8.61**
Dissolved Silica by ICP-AES	mg/L	0.1				0.2	0.2			**0.2**	0.2	0.2			**0.2**	0.2	0.2			**0.2**	0.2	0.2			**0.2**	0.2	0.2			**0.2**
Total Metals in Saline Water																														
Aluminium	µg/L	10	**--**	**<10**	**--**	20	10			**15**	10	10			**10**	20	<10			**20**	<10	10			**10**	20	10			**15**
Iron	µg/L	5	**6**	**<5**	**6**	14	11			**12.5**	13	13			**13**	19	9			**14**	10	12			**11**	11	12			**11.5**
Arsenic	µg/L	0.5	**2**	**<1**	**2**	2	2			**2**	2.3	2.4			**2.35**	2.2	2.3			**2.25**	2.1	2.2			**2.15**	2.2	2.3			**2.25**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0717904		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2007-CSR-3	Units	LOR						9497	9502				9498	9503				9499	9504				9500	9505				9501	9506	
Cadmium	µg/L	0.2	--	<5	--	<0.2	<0.2			<0.2	<0.2	<0.2			<0.2	<0.2	<0.2			<0.2	<0.2	<0.2			<0.2	<0.2	<0.2			<0.2
Chromium Total	µg/L	0.5	7	7	7	<0.5	<0.5			<0.5	<0.5	<0.5			<0.5	1.3	<0.5			0.9	<0.5	<0.5			<0.5	<0.5	<0.5			<0.5
Copper	µg/L	1	11	<10	11	10	14			12	5	4			4.5	7	7			7	8	8			8	<1	<1			<1
Lead	µg/L	0.2	--	<5	--	0.7	0.9			0.8	0.2	0.2			0.2	0.4	0.5			0.45	0.3	0.3			0.3	<0.2	<0.2			<0.2
Manganese	µg/L	0.5	4	<1	5	1.8	1.7			1.75	2.2	2.2			2.2	2	1.8			1.9	2.9	1.9			2.4	1.9	2			1.95
Mercury	mg/L	0.0001	--	<0.0003	--	<0.0001	<0.0001			<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	<0.0001			<0.0001
Molybdenum	µg/L	0.1				13.6	12.2			12.9	14.1	12.8			13.45	13.9	13.2			13.55	13	13.4			13.2	13.6	13.5			13.55
Nickel	µg/L	0.5	--	<5	--	<0.5	<0.5			<0.5	<0.5	<0.5			<0.5	<0.5	<0.5			<0.5	<0.5	<0.5			<0.5	<0.5	<0.5			<0.5
Tin	µg/L	5				<5	<5			<5	<5	<5			<5	<5	<5			<5	<5	<5			<5	<5	<5			<5
Zinc	µg/L	5	30	<30	32	8	10			9	<5	5			5	<5	5			5	5	5			5	<5	<5			<5
Nutrients																														
Ammonia as N	mgN/L	0.1 (b)	0.007	<0.005	0.01	<0.015	<0.015			<0.015	<0.015	<0.015			<0.015	<0.015	<0.015			<0.015	<0.015	0.052			0.034	<0.015	0.039			0.027
Nitrite as N	mgN/L	0.01		<0.005	--	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01
Nitrate as N	mgN/L	0.01	--	0		<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01
Nitrite + Nitrate as N	mgN/L	0.01	0.006	<0.005	0.008	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01
Total Kjeldahl Nitrogen as N	mgN/L	1 (b)	0.239	<0.05	0.62	0.2	0.1			0.15	0.3	0.2			0.25	0.2	0.2			0.2	0.3	<0.1			0.2	<0.1	<0.1			<0.1
Total Nitrogen as N	mgN/L	0.1	0.247	<0.06	0.62	0.2	<0.1			0.15	0.2	0.1			0.15	0.2	0.2			0.2	0.2	<0.1			0.15	<0.1	<0.1			<0.1
Total Phosphorus as P	mgP/L	0.01	0.017	0.011	0.023	<0.01	<0.01			<0.01	<0.01	<0.01			<0.01	<0.01	<0.01			<0.01	<0.01	<0.01			<0.01	<0.01	<0.01			<0.01
Reactive Phosphorus as P	mgP/L	0.01	0.006	<0.005	0.006	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01	<0.010	<0.010			<0.01
Dissolved Organic Carbon	mg/L	1	1.1	0.9	1.3	2	2			2	2	2			2	2	2			2	2	2			2	2	1			1.5
Total Organic Carbon	mg/L	1	1.8	0.9	4	2	2			2	2	2			2	2	2			2	2	2			2	2	2			2
Biochemical Oxygen Demand	mg/L	2	--	<2	--	<2	<2			<2	<2	<2			<2	7	<2			4.5	<2	5			3.5	5	<2			3.5
Oil & Grease	mg/L	5	--	<1	--	<5	<5			<5	<5	<5			<5	5	<5			5	<5	<5			<5	6	<5			5.5
Microbiological																														
Chlorophyll a	µg/L	1	1.1	0.77	1.5	2	<1			1.5	<1	<1			<1	<1	<1			<1	<1	<1			<1	<1	<1			<1
Heterotrophic Plate Count (36°C)	CFU/mL	1				2300	~7200			9500	<1	90			46	~14	~2			8	~1	<1			1	~9	510			260
Heterotrophic Plate Count (21°C)	CFU/mL	1				2000	~6800			4400	~3	150			77	45	27			36	65	<1			33	~4	680			342
Escherichia coli	CFU/100mL	1				<1	<1			<1	<1	<1			<1	<1	<1			<1	<1	<1			<1	<1	<1			<1
Coliforms	CFU/100mL	1		0	0	<1	<1			<1	<1	<1			<1	<1	<1			<1	<1	<1			<1	<1	<1			<1

Notes

(a) It is likely that the ARUP analysis was done on 1.2 µm
(b) Modified to represent LOR achieved by ALS
(c) Field Measurements
(d) Averages calculated based on sum of average of an ion, when no AWQC value was available the average from ALS was used
(e) When no AWQC value was available the average from ALS was used, average based on average of all ion data
(f) Where relevant, average was calculated considering LOR's as values
(g) The ALS results for sodium and chloride have been excluded from the averages, see report for details.

Unexpected result which will require further verification
Holding time exceeded

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 4th Sampling Event (24 January 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	SC
CHECKED BY	SB/VL
Description of spreadsheet	Summary of water quality sampling results from fourth sampling event
Number of Worksheets (incl. this one)	2
Filename	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\24 Jan 08\[Summary of results 24th Jan 2008 v3.xls]

Data from Sampling Event

Sample Date	24/01/2008
Time of sampling	Site A - 10:00am - 12pm. Site B - 1pm - 2:30pm. Intake: 11:30am
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 6 - 8 L per sample (10 samples total)
Sampler Names	Steven Carter and Tim Grosser
Sampler Equipment	Van-dorn sampler and Troll 9500 Water Quality Meter
Photos of site etc	
Depth at site (m)	13m at site A and 12m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	2.76m @ 7:29am (at Whyalla)
Low Tide (HH_MM	0.28m @ 3:03pm (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	Site A: S/SSW, Site B: S/SSW
Wind Speed (Knots)	Site A: 1 knot, Site B: 3 knots increasing to 10 knots
Wave Height (metres- trough to crest)	Site A: <0.2m, Site B: 0.2m increasing to 0.5m
General observations	Site A: very calm, clear sky, 2m water visibility. Site B: very calm initially, wind strengthening, 2m water visibility, increased cloud cover (60%)

REVISIONS

Rev.	Date	Checked	Description
A	12/02/08		DRAFT
0	22/04/08	SB/VL	Issue to Client
1	17/10/08	SC	ALS Sodium and Chloride Results Removed from Averages

Title **Port Bonython Seawater Monitoring Program - Results Summary - 4th Sampling Event (24 January 2008)**
Project BHP Billiton ODX PWSS Pilot Plant Works
Job Number 33/14036
File Name G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\24 Jan 08\[Summary of results 24th Jan 2008 v3.xls]Cover
Print out 3/11/2008
Source Data Arup Water Quality Summary Data Report, ALS Certificate of Analysis, AWQC Analytical Report, Sydney Water Analytical Report

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0717904		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2008-CSR-1	Units	LOR																												
Physicochemical Parameters																														
Field Measurements		LOR /probe																												
pH (c)		0.01	**8.2**	**8.1**	**8.2**	7.95				**7.95**	7.95				**7.95**	7.99				**7.99**	7.99				**7.99**	7.96				**7.96**
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**	58.9				**58.9**	60.0				**60**	61.0				**61**	60.9				**60.9**	60.0				**60**
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**	3.7				**3.7**	3.7				**3.7**	3.4				**3.4**	4.0				**4**	4.2				**4.2**
Temperature (c)	^{o}C	0.1				23.26				**23.26**	23.39				**23.39**	23.8				**23.8**	23.81				**23.81**					**#DIV/0!**
DO (c)	mg/L	0.1				8.9				**8.9**	8.9				**8.9**	8.9				**8.9**	8.8				**8.8**	8.0				**8**
DO (c)	% sat					132				**132**	132.4				**132.4**	135				**135**	133				**133**	119.2				**119.2**
ORP (c)	mV					163				**163**	160				**160**	185				**185**	178				**178**	180				**180**
SDI_3											24.8	24.7			**24.7**						22.5				**22.5**					
SDI_5											16.8				**16.8**						15.4				**15.4**					
pH								7.2	6.7	**6.95**			7.1	7.2	**7.15**			7.2	7.0	**7.1**			7.3	6.9	**7.1**			7.1	6.8	**6.95**
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	48300	49600			**48950**	52400	48400			**50400**	52400	51400			**51900**	52700	52600			**52650**	51200	52200			**51700**
Suspended Solids (SS) (1.2 µm)	mg/L	1	**10.5 (a)**	**5.3 (a)**	**17 (a)**	23	21			**22**	13	13			**13**	20	27			**23.5**	20	15			**17.5**	24	21			**22.5**
Suspended Solids (SS) (0.45 µm)	mg/L	1				3	4			**3.5**	3	7			**5**	2	3			**2.5**	4	5			**4.5**	9	6			**7.5**
UV Absorbance @ 254 nm	%	0.01																												
Total Hardness as CaCO3	mg/L	1				8820	8990			**8905**	8930	8180			**8555**	8800	8410			**8605**	9040	8470			**8755**	8580	7860			**8220**
Alkalinity by PC Titrator																														
Hydroxide Alkalinity as CaCO3	mg$CaCO_3$/L	1				<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**
Carbonate Alkalinity as CaCO3	mg$CaCO_3$/L	1				<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**
Bicarbonate Alkalinity as CaCO3	mg$CaCO_3$/L	1				115	119			**117**	127	120			**123.5**	119	120			**119.5**	120	121			**120.5**	119	121			**120**
Hydroxide Alkalinity	mgOH^-/L	1	**0**	**0**	**0**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**
Carbonate Alkalinity	mgCO_3^{2-}/L	1	**0**	**0**	**0**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**
Bicarbonate Alkalinity	mgHCO_3^-/L	1	**155**	**155**	**157**	140	145			**143**	155	146			**151**	145	146			**146**	146	148			**147**	145	148			**146**
Total Alkalinity as CaCO3	mg$CaCO_3$/L	1	**127.4**	**127**	**129**	115	119			**117**	127	120			**123.5**	119	120			**119.5**	120	121			**120.5**	119	121			**120**
Dissolved Major Anions																														
Chloride (g)	mg/L	1	**23067**	**22100**	**23633**	26600	25300	20500	20700	**20600**	25100	24800	21500	21100	**21300**	26700	26500	21200	21100	**21150**	26500	25300	21700	21300	**21500**	26000	25900	20700	21000	**20850**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3940	3980	3180	3120	**3555**	3910	3570	3240	3180	**3475**	3960	3670	3270	3300	**3550**	4030	3700	3240	3330	**3575**	3760	3460	3270	3210	**3425**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	79	79			**79**	82	82			**82**	83	82			**82.5**	82	83			**82.5**	82	82			**82**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.9	0.9			**0.9**	0.9	0.9			**0.9**	0.9	0.9			**0.9**	0.9	0.9			**0.9**	0.9	0.9			**0.9**
Dissolved Major Cations																														
Calcium	mg/L	1	**468**	**459**	**476**	560	577	460	455	**513**	575	525	472	464	**509**	559	536	475	485	**514**	572	544	470	483	**517**	542	508	474	467	**498**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1800	1830	1530	1550	**1678**	1820	1670	1560	1590	**1660**	1800	1720	1540	1590	**1663**	1850	1730	1590	1560	**1683**	1750	1600	1560	1550	**1615**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	15700	15600	12400	12600	**12500**	14200	14100	12700	12900	**12800**	15200	14900	12500	12900	**12700**	16000	14700	12900	12700	**12800**	15100	12900	12700	12500	**12600**
Potassium	mg/L	1	**474**	**462**	**480**	604	605	464	457	**533**	565	545	478	468	**514**	603	607	481	490	**545**	617	577	474	487	**539**	590	490	480	472	**508**
Ionic Balance																														
Total Anions	meq/L	0.01				834	798			**816**	793	777			**785**	839	827			**833**	833	793			**813**	813	805			**809**
Total Cations	meq/L	0.01				874	876			**875**	811	791			**801**	852	832			**842**	893	822			**857.5**	844	729			**786.5**
Ionic Balance	%	0.01				2.3	4.61			**3.46**	1.12	0.89			**1.01**	0.77	0.27			**0.52**	3.46	1.8			**2.63**	1.84	4.95			**3.40**
GHD Calculations																														
TDS-Calculated by GHD (d) (e)	*mg/L*		**41615**	**40240**	**42624**	49438	48132	38771	39119	**39615**	46422	45454	40198	39950	**40506**	49065	48178	39710	40109	**40366**	49813	46798	40620	40106	**40859**	47985	45104	39428	39443	**39740**
Total Anions calculated by GHD	meq/L		**721**			835	799	647	651	**658**	792	776	677	664	**676**	838	826	669	667	**673**	834	793	682	673	**684**	814	805	655	662	**662**
Total Cations calculated by GHD	meq/L		**708**			875	874	700	710	**721**	811	791	717	727	**732**	853	832	707	729	**729**	893	824	728	718	**735**	843	731	717	707	**719**
Ionic Balance calculated by GHD	%		**0.91**			2.34	4.47	3.96	4.33	**4.62**	1.17	0.94	2.89	4.55	**4.00**	0.88	0.36	2.77	4.48	**3.99**	3.41	1.90	3.24	3.23	**3.64**	1.76	4.82	4.55	3.30	**4.13**
Hardness Calculation by GHD																														
Calcium Hardness as $CaCO_3$	mg$CaCO_3$/L		**1169**	**1148**	**1190**	1400	1442.5	1150	1137.5	**1283**	1438	1313	1180	1160	**1273**	1398	1340	1188	1213	**1284**	1430	1360	1175	1208	**1293**	1355	1270	1185	1168	**1244**
Magnesium Hardness as $CaCO_3$	mg$CaCO_3$/L		**6234**	**6165**	**6329**	7398	7521	6288	6371	**6895**	7480	6864	6412	6535	**6823**	7398	7069	6329	6535	**6833**	7604	7110	6535	6412	**6915**	7193	6576	6412	6371	**6638**
Total Hardness as $CaCO_3$	mg$CaCO_3$/L		**7399**	**7355**	**7477**	8798	8964	7438	7508	**8177**	8918	8176	7592	7695	**8095**	8796	8409	7517	7747	**8117**	9034	8470	7710	7619	**8208**	8548	7846	7597	7538	**7882**
Metals																														
Dissolved Metals in Saline Water																														
Dissolved Aluminium	µg/L	10	**--**	**<10**	**--**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**
Dissolved Iron	µg/L	5	**--**	**<5**		<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	8	8			**8**	8	8			**8**	8	8			**8**	8	8			**8**	8	8			**8**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	4.6	4.1			**4.35**	4.3	4.2			**4.25**	4.4	4.4			**4.4**	4.3	4.2			**4.25**	4.3	4.2			**4.25**
Dissolved Manganese	µg/L	0.5	**--**	**<1**	**--**	1.4	1.2			**1.3**	1.4	1.5			**1.45**	1.3	1.5			**1.4**	1.5	1.4			**1.45**	1.5	1.4			**1.45**
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	8.75	10.4			**9.58**	9.57	10.6			**10.09**	10	11			**10.5**	10.5	11.4			**10.95**	10.2	11.4			**10.8**
Dissolved Silica by ICP-AES	mg/L	0.1				<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**
Total Metals in Saline Water																														
Aluminium	µg/L	10	**--**	**<10**	**--**	40	20			**30**	30	20			**25**	30	10			**20**	30	10			**20**	30	20			**25**
Iron	µg/L	5	**6**	**<5**	**6**	14	23			**18.5**	16	25			**20.5**	15	12			**13.5**	18	14			**16**	28	28			**28**
Arsenic	µg/L	0.5	**2**	**<1**	**2**	2.3	2.4			**2.35**	2.6	2.4			**2.5**	2.6	2.9			**2.75**	2.8	2.6			**2.7**	2.6	2.5			**2.55**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)									Site B: Fitzgerald Bay									Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0717904		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2008-CSR-1	Units	LOR																											
Beryllium	µg/L	0.1				0.2	<0.1			**0.15**	0.1	<0.1			**0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**
Cadmium	µg/L	0.2	--	**<5**	--	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**
Chromium - Hexavalent	mg/L	0.002				<0.002	<0.002			**<0.002**	<0.002	<0.002			**<0.002**	<0.002	<0.002			**<0.002**	<0.002	<0.002			**<0.002**	<0.002	<0.002			**<0.002**
Chromium Total	µg/L	0.5	**7**	**7**	**7**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Copper	µg/L	1	**11**	**<10**	**11**	7	6			**6.5**	6	4			**5**	5	5			**5**	18	4			**11**	<1	<1			**<1**
Lead	µg/L	0.2	--	**<5**	--	0.4	0.3			**0.35**	0.2	0.2			**0.2**	<0.2	0.3			**0.25**	0.8	<0.2			**0.5**	<0.2	<0.2			**<0.2**
Manganese	µg/L	0.5	**4**	**<1**	**5**	4.4	1.8			**3.1**	1.8	2.4			**2.1**	1.7	1.8			**1.75**	1.8	1.8			**1.8**	2.1	2.2			**2.15**
Mercury	mg/L	0.0001	--	**<0.0003**	--	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**
Molybdenum	µg/L	0.1				13.6	13.8			**13.7**	14.4	14.1			**14.25**	14.4	14.6			**14.5**	14.8	14			**14.4**	14.1	13.9			**14**
Nickel	µg/L	0.5	--	**<5**	--	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Silver	µg/L	0.1				<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**
Tin	µg/L	5				<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**
Zinc	µg/L	5	**30**	**<30**	**32**	5	5			**5**	<5	<5			**<5**	<5	<5			**<5**	11	<5			**8**	<5	<5			**<5**
Nutrients																													
Ammonia as N	mgN/L	0.005	**0.007**	**<0.005**	**0.01**			0.006	<0.005	**0.0055**			0.01	<0.005	**0.0075**			<0.005	0.006	**0.0055**			<0.005	<0.005	**<0.005**			0.009	<0.005	**0.007**
Ammonia (NH3, unionised) as N	mgN/L	0.005						<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Ammonia (NH4, ionised) as N	mgN/L	0.005						0.006	<0.005	**0.0055**			0.01	<0.005	**0.0075**			<0.005	0.006	**0.0055**			<0.005	<0.005	**<0.005**			0.009	<0.005	**0.007**
Nitrite as N	mgN/L	0.005		**<0.005**	--			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			0.005	<0.005	**0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Nitrate as N	mgN/L	0	--	**0**				0	0	**0**			0.002	0	**0.001**			0	0.001	**0.0005**			0	0	**0**			0	0.001	**0.0005**
Nitrite + Nitrate as N	mgN/L	0.005	**0.006**	**<0.005**	**0.008**			0.005	<0.005	**0.005**			0.007	<0.005	**0.006**			<0.005	0.006	**0.0055**			<0.005	<0.005	**<0.005**			<0.005	0.006	**0.0055**
Total Kjeldahl Nitrogen as N	mgN/L	0.05	**0.239**	**<0.05**	**0.62**			0.47	0.19	**0.33**			0.19	0.11	**0.15**			0.21	0.16	**0.185**			0.28	0.16	**0.22**			0.36	0.13	**0.245**
Total Nitrogen as N	mgN/L	0.05	**0.247**	**<0.06**	**0.62**			0.48	0.2	**0.34**			0.2	0.12	**0.16**			0.22	0.17	**0.195**			0.28	0.16	**0.22**			0.36	0.14	**0.25**
Total Phosphorus as P	mgP/L	0.005	**0.017**	**0.011**	**0.023**			0.014	0.016	**0.015**			0.012	0.013	**0.0125**			0.016	0.014	**0.015**			0.014	0.009	**0.0115**			0.011	0.013	**0.012**
Reactive Phosphorus as P	mgP/L	0.005	**0.006**	**<0.005**	**0.006**			0.005	<0.005	**0.005**			<0.005	<0.005	**<0.005**			<0.005	0.006	**0.0055**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Dissolved Organic Carbon	mg/L	1	**1.1**	**0.9**	**1.3**	2	2			**2**	1	1			**1**	2	2			**2**	1	1			**1**	2	1			**1.5**
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**	2	1			**1.5**	1	1			**1**	2	2			**2**	2	2			**2**	1	1			**1**
Biochemical Oxygen Demand	mg/L	2	--	**<2**	--	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**
Oil & Grease	mg/L	1	--	**<1**	--			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**
Sulphide	µg/L	2				18	13			**15.5**	17	16			**16.5**	17	18			**17.5**	15	14			**14.5**	14	14			**14**
Tributyltin	ngSn/L	0.1									<2	<2			**<2**														
Total Polychlorinated biphenyls	µg/L	0.1									<0.10	<0.10			**<0.1**														
Microbiological																													
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**
Heterotrophic Plate Count (36°C)	CFU/mL	1				5	<1			**~3**	<1	<1			**<1**	~1	~4			**~3**	~2	~3			**~3**	<1	~1			**~1**
Heterotrophic Plate Count (21°C)	CFU/mL	1				~15	<1			**~8**	<1	~10			**~6**	~1	~9			**~5**	~4	<1			**~3**	<1	~1			**~1**
Enterococci	CFU/100mL	1				<2	<2			**<2**	<2	<2			**<2**	~2	<2			**2**	~2	<2			**2**	<2	<2			**<2**
Escherichia coli	CFU/100mL	1				<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**
Coliforms	CFU/100mL	1		**0**	**0**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**

Notes

(a) It is likely that the ARUP analysis was done on 1.2 µm
(b) Sulphide analysis undertaken by Sydney Water
(c) Field Measurements
(d) Averages calculated based on sum of average of an ion, when no AWQC value was available the average from ALS was used
(e) When no AWQC value was available the average from ALS was used, average based on average of all ion data
(f) Where relevant, average was calculated considering LOR's as values
(g) The ALS results for sodium and chloride have been excluded from the averages, see report for details.
Unexpected result which will require further verification

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 5th Sampling Event (20 February 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	SC
CHECKED BY	SB/VL
Description of spreadsheet	Summary of water quality sampling results from fourth sampling event
Number of Worksheets (incl. this one)	2
Filename	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\20 Feb 08\[Summary of results 20th Feb 2008 v3.xls]

Data from Sampling Event

Sample Date	20/02/2008
Time of sampling	Site A - 1:10pm - 3pm. Site B - 9:30am - 12pm. Intake: 11:00am
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 6 - 8 L per sample (10 samples total)
Sampler Names	Steven Carter and Gerald Barrie
Sampler Equipment	Van-dorn sampler and Troll 9500 Water Quality Meter
Photos of site etc	
Depth at site (m)	11-12m at site A and 14-16m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	2.49m @ 6:34am (at Whyalla)
Low Tide (HH_MM	0.17m @ 2:01pm (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	Site A: SSW, Site B: SSW
Wind Speed (Knots)	Site A: 15-20 knots, Site B: 15-20 knots
Wave Height (metres- trough to crest)	Site A: 1m (some higher), Site B: 0.5 - 1m
General observations	Site A: overcast (100% cloud cover), 2m water visibility. Site B: overcast (100% cloud cover), 2m water visibility

REVISIONS

Rev.	Date	Checked	Description
A	11/03/08		DRAFT
0	22/04/08	SB/VL	Issue to Client
1	17/10/08	SC	ALS Sodium and Chloride Results Removed from Averages

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 5th Sampling Event (20 February 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
Job Number	33/14036
File Name	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\20 Feb 08\[Summary of results 20th Feb 2008 v3.xls]Cover
Print out	3/11/2008
Source Data	Arup Water Quality Summary Data Report, ALS Certificate of Analysis, AWQC Analytical Report, Sydney Water Analytical Report

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0717904		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2008-CSR-1	Units	LOR																												
Physicochemical Parameters																														
Field Measurements		LOR /probe																												
pH (c)		0.01	**8.2**	**8.1**	**8.2**	7.92				**7.92**	7.91				**7.91**	7.81				**7.81**	7.85				**7.85**	7.96				**7.96**
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**	61.6				**61.6**	62.4				**62.4**	62.8				**62.8**	62.9				**62.9**	62.0				**62**
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**	2.2				**2.2**	2.6				**2.6**	2.8				**2.8**	3.1				**3.1**	3				**3**
Temperature (c)	^{o}C	0.1				23.94				**23.94**	23.43				**23.43**	23.25				**23.25**	23.23				**23.23**					
DO (c)	mg/L	0.1																												
DO (c)	% sat																													
ORP (c)	mV					211				**211**	209				**209**	185				**185**	187				**187**	197				**197**
SDI_3											22.5				**22.5**	21.3				**21.3**	19.6				**19.6**	23.3	26			**24.65**
SDI_5																14.6				**14.6**	13.7				**13.7**					
pH								8.1	8.1	**8.1**			8.1	8.1	**8.1**			8.1	8.1	**8.1**			8.1	8.1	**8.1**			8.1	8.1	**8.1**
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	45100	47200	43000	41500	**44200**	46000	47000	42800	42200	**44500**	45500	48200	43400	44800	**45475**	46400	47300	43800	43800	**45325**	46600	44800	41400	43200	**44000**
Suspended Solids (SS) (1.2 µm)	mg/L	1	**10.5 (a)**	**5.3 (a)**	**17 (a)**	11	3	7	3	**6**	7	8	11	14	**10**	1	10	4	5	**5**	11	6	6	5	**7**	11	3	4	7	**6.25**
Suspended Solids (SS) (0.45 µm)	mg/L	1				8	1			**4.5**	8	6			**7**	3	4			**3.5**	7	3			**5**	7	2			**4.5**
UV Absorbance @ 254 nm	%	0.01				0.03	0.03			**0.03**	0.03	0.03			**0.03**	0.03	0.04			**0.035**	0.03	0.01			**0.02**	0.02	0.02			**0.02**
Total Hardness as CaCO3	mg/L	1				6910	7520			**7215**	7390	7180			**7285**	7200	7580			**7390**	7780	7190			**7485**	7900	7040			**7470**
Alkalinity by PC Titrator																														
Hydroxide Alkalinity as CaCO3	mg$CaCO_3$/L	1				<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**
Carbonate Alkalinity as CaCO3	mg$CaCO_3$/L	1				<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**
Bicarbonate Alkalinity as CaCO3	mg$CaCO_3$/L	1				116	119			**117.5**	117	119			**118**	118	126			**122**	120	119			**119.5**	119	119			**119**
Hydroxide Alkalinity	mgOH^-/L	1	**0**	**0**	**0**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**	<0.34	<0.34			**<0.34**
Carbonate Alkalinity	mgCO_3^{2-}/L	1	**0**	**0**	**0**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**	<0.6	<0.6			**<0.60**
Bicarbonate Alkalinity	mgHCO_3/L	1	**155**	**155**	**157**	142	145			**143**	143	145			**144**	144	154			**149**	146	145			**146**	145	145			**145**
Total Alkalinity as CaCO3	mg$CaCO_3$/L	1	**127.4**	**127**	**129**	116	119			**117.5**	117	119			**118**	118	126			**122**	120	119			**119.5**	119	119			**119**
Dissolved Major Anions																														
Chloride (g)	mg/L	1	**23067**	**22100**	**23633**	25400	25300	21200	21700	**21450**	25900	25800	22200	21800	**22000**	25200	26700	21600	22000	**21800**	24200	25800	21900	22000	**21950**	25500	25500	21300	21600	**21450**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3050	3410	3210	3270	**3235**	3240	3140	3330	3300	**3252.5**	3160	3460	3360	3330	**3327.5**	3550	3160	3390	3390	**3372.5**	3600	3100	3240	3300	**3310**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	85	85			**85**	84	82			**83**	87	85			**86**	85	86			**85.5**	86	87			**86.5**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.9	0.9			**0.9**	0.9	0.9			**0.9**	0.9	1			**0.95**	1	0.9			**0.95**	0.9	0.9			**0.9**
Dissolved Major Cations																														
Calcium	mg/L	1	**468**	**459**	**476**	444	481	467	481	**468**	471	454	488	484	**474**	459	479	493	488	**480**	494	454	496	495	**485**	503	452	475	483	**478**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1410	1540	1500	1530	**1495**	1510	1470	1560	1550	**1523**	1470	1550	1580	1560	**1540**	1590	1470	1590	1590	**1560**	1610	1440	1520	1550	**1530**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	13400	13400	12300	12500	**12400**	13500	13700	12700	12600	**12650**	13000	14000	12900	12700	**12800**	13700	13300	13000	13000	**13000**	13600	13300	12400	12700	**12550**
Potassium	mg/L	1	**474**	**462**	**480**	533	530	462	470	**499**	535	531	480	476	**506**	524	562	487	479	**513**	538	533	489	489	**512**	536	527	467	478	**502**
Ionic Balance																														
Total Anions	meq/L	0.01				783	788			**785.5**	800	797			**798.5**	780	827			**803.5**	758	796			**777**	796	786			**791**
Total Cations	meq/L	0.01				733	746			**739.5**	748	754			**751**	722	775			**748.5**	765	737			**751**	762	733			**747.5**
Ionic Balance	%	0.01				3.31	2.74			**3.03**	3.38	2.79			**3.09**	3.9	3.27			**3.59**	0.44	3.89			**2.17**	2.16	3.52			**2.84**
GHD Calculations																														
TDS-Calculated by GHD (d) (e)	*mg/L*		**41615**	**40240**	**42624**	44479	44906	39382	40194	**39790**	45398	45338	41000	40452	**40647**	44059	47006	40670	40807	**40711**	44319	44964	41112	41211	**41127**	45595	44567	39649	40358	**40067**
Total Anions calculated by GHD	meq/L		**721**			782	787	668	683	**675**	801	796	698	686	**691**	779	828	682	693	**687**	759	796	691	694	**692**	797	786	671	681	**677**
Total Cations calculated by GHD	meq/L		**708**			735	748	694	706	**699**	749	754	718	712	**713**	723	775	729	718	**721**	766	736	734	734	**732**	763	733	701	717	**709**
Ionic Balance calculated by GHD	%		**0.91**			3.12	2.58	1.95	1.67	**1.74**	3.32	2.72	1.39	1.87	**1.54**	3.73	3.28	3.30	1.79	**2.42**	0.42	3.91	3.02	2.81	**2.77**	2.15	3.48	2.15	2.58	**2.33**
Hardness Calculation by GHD																														
Calcium Hardness as $CaCO_3$	mg$CaCO_3$/L		**1169**	**1148**	**1190**	1110	1202.5	1167.5	1202.5	**1171**	1178	1135	1220	1210	**1186**	1148	1198	1233	1220	**1199**	1235	1135	1240	1238	**1212**	1258	1130	1188	1208	**1196**
Magnesium Hardness as $CaCO_3$	mg$CaCO_3$/L		**6234**	**6165**	**6329**	5795	6329	6165	6288	**6144**	6206	6042	6412	6371	**6257**	6042	6371	6494	6412	**6329**	6535	6042	6535	6535	**6412**	6617	5918	6247	6371	**6288**
Total Hardness as $CaCO_3$	mg$CaCO_3$/L		**7399**	**7355**	**7477**	6905	7532	7333	7491	**7315**	7384	7177	7632	7581	**7443**	7189	7568	7726	7632	**7529**	7770	7177	7775	7772	**7623**	7875	7048	7435	7578	**7484**
Metals																														
Dissolved Metals in Saline Water																														
Dissolved Aluminium	µg/L	10	**--**	**<10**	**--**	40	50			**45**	<10	<10			**<10**	120	60			**90**	80	80			**80**	<10	<10			**<10**
Dissolved Iron	µg/L	5	**--**	**<5**		6	7			**7**	<5	<5			**<5**	12	6			**9**	16	14			**15**	<5	<5			**<5**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	8	8			**8**	8	8			**8**	8	8			**8**	8	8			**8**	8	8			**8**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	5.1	5			**5**	5	4.9			**5**	5	5			**5**	5.1	5			**5**	4.9	5			**5**
Dissolved Manganese	µg/L	0.5	**--**	**<1**	**--**	1.9	2.2			**2**	1.6	1.7			**2**	3.9	2.5			**3**	2.9	2.5			**3**	1.5	1.5			**2**
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	9.07	9.28			**9**	9.01	9.6			**9**	9.12	10			**10**	9.57	10.1			**10**	9.25	9.98			**10**
Dissolved Silica by ICP-AES	mg/L	0.1				<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**
Total Metals in Saline Water																														
Aluminium	µg/L	10	**--**	**<10**	**--**	10	10			**10**	30	30			**30**	10	10			**10**	10	30			**20**	20	20			**20**
Iron	µg/L	5	**6**	**<5**	**6**	10	12			**11**	26	43			**34.5**	14	11			**12.5**	13	12			**12.5**	17	17			**17**
Arsenic	µg/L	0.5	**2**	**<1**	**2**	2.5	2.5			**2.5**	2.5	2.7			**2.6**	2.7	2.7			**2.7**	3	2.7			**2.85**	2.4	2.5			**2.45**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)									Site B: Fitzgerald Bay									Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0717904		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2008-CSR-1	Units	LOR																											
Beryllium	µg/L	0.1				<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**
Cadmium	µg/L	0.2	--	**<5**	--	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**
Chromium - Hexavalent	mg/L	0.002				<0.002	<0.002			**<0.002**	<0.002	<0.002			**<0.002**	<0.002	<0.002			**<0.002**	<0.002	<0.002			**<0.002**	<0.002	<0.002			**<0.002**
Chromium Total	µg/L	0.5	**7**	**7**	**7**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Copper	µg/L	1	**11**	**<10**	**11**	4	5			**4.5**	2	2			**2**	5	4			**4.5**	4	6			**5**	<1	<1			**<1**
Lead	µg/L	0.2	--	**<5**	--	<0.2	0.3			**0.25**	<0.2	0.3			**0.25**	0.6	0.4			**0.5**	0.2	0.5			**0.35**	<0.2	<0.2			**<0.2**
Manganese	µg/L	0.5	**4**	**<1**	**5**	2.1	1.9			**2**	2.1	2.6			**2.35**	2.9	2.1			**2.5**	2.1	2			**2.05**	2.1	2			**2.05**
Mercury	mg/L	0.0001	--	**<0.0003**	--	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**	<0.0001	<0.0001			**<0.0001**
Molybdenum	µg/L	0.1				13.7	13.8			**13.75**	13.9	14.7			**14.3**	14.6	14.9			**14.75**	14.7	14.7			**14.7**	14.2	14.2			**14.2**
Nickel	µg/L	0.5	--	**<5**	--	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	0.5			**0.5**
Silver	µg/L	0.1				<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**
Tin	µg/L	5				<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**
Zinc	µg/L	5	**30**	**<30**	**32**	<5	<5			**<5**	<5	<5			**<5**	6	<5			**5.5**	<5	5			**5**	7	7			**7**
Nutrients																													
Ammonia as N	mgN/L	0.005	**0.007**	**<0.005**	**0.01**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Ammonia (NH3, unionised) as N	mgN/L	0.005						<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Ammonia (NH4, ionised) as N	mgN/L	0.005						<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Nitrite as N	mgN/L	0.005		**<0.005**	--			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Nitrate as N	mgN/L	0	--	**0**				0	0	**0**			0	0	**0**			0	0	**0**			0	0	**0**			0	0	**0**
Nitrite + Nitrate as N	mgN/L	0.005	**0.006**	**<0.005**	**0.008**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Total Kjeldahl Nitrogen as N	mgN/L	0.05	**0.239**	**<0.05**	**0.62**			0.13	0.15	**0.14**			0.13	0.15	**0.14**			0.14	0.11	**0.125**			<0.05	0.16	**0.11**			0.15	0.11	**0.13**
Total Nitrogen as N	mgN/L	0.05	**0.247**	**<0.06**	**0.62**			0.14	0.16	**0.15**			0.14	0.16	**0.15**			0.14	0.12	**0.13**			<0.05	0.16	**0.11**			0.16	0.12	**0.14**
Total Phosphorus as P	mgP/L	0.005	**0.017**	**0.011**	**0.023**			0.012	0.011	**0.0115**			0.011	0.014	**0.0125**			0.012	0.012	**0.012**			0.006	0.012	**0.009**			0.011	0.011	**0.011**
Reactive Phosphorus as P	mgP/L	0.005	**0.006**	**<0.005**	**0.006**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Dissolved Organic Carbon	mg/L	1	**1.1**	**0.9**	**1.3**	2	3			**2.5**	2	2			**2**	2	2			**2**	2	2			**2**	2	2			**2**
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**	2	2			**2**	2	2			**2**	2	7			**4.5**	2	2			**2**	2	2			**2**
Biochemical Oxygen Demand	mg/L	2	--	**<2**	--	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**
Oil & Grease	mg/L	1	--	**<1**	--			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**			1	<1	**<1**
Sulphide	µg/L	2				<100	<100			**<100**	<100	<100			**<100**	<100	<100			**<100**	<100	<100			**<100**	<100	<100			**<100**
Tributyltin	ngSn/L	0.1									<2	<2			**<2**															
Total Polychlorinated biphenyls	µg/L	0.1									<0.10	<0.10			**<0.1**															
Microbiological																													
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**	<1	<1			**<1**
Heterotrophic Plate Count (36°C)	CFU/mL	1				<1	<1			**<1**	~1	<1			**~1**	~2	~6			**~4**	<1	~2			**~2**	~30	55			**~43**
Heterotrophic Plate Count (21°C)	CFU/mL	1				~1	~3			**~3**	~3	~4			**~4**	~15	~5			**~10**	~2	~6			**~4**	~35	130			**~83**
Enterococci	CFU/100mL	1				<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**
Escherichia coli	CFU/100mL	1				<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**
Coliforms	CFU/100mL	1		**0**	**0**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**	<2	<2			**<2**

Notes

(a)	It is likely that the ARUP analysis was done on 1.2 µm
(c)	Field Measurements
(d)	Averages calculated based on sum of average of an ion, when no AWQC value was available the average from ALS was used
(e)	When no AWQC value was available the average from ALS was used, average based on average of all ion data
(f)	Where relevant, average was calculated considering LOR's as values
(g)	The ALS results for sodium and chloride have been excluded from the averages, see report for details.
	Unexpected result which will require further verification

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 6th Sampling Event (1 April 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	SC
CHECKED BY	SB
Description of spreadsheet	Summary of water quality sampling results from sixth sampling event
Number of Worksheets (incl. this one)	2
Filename	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\1 April 08\[Summary of results 1st April 2008 v2.xls]

Data from Sampling Event

Sample Date	1/04/2008
Time of sampling	Site A - 9:15am - 11:35am. Site B - 12:40pm - 2:40pm. Intake: 10:00am
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 20 L per sample (10 samples total)
Sampler Names	Steven Carter and Daniel Ahrens
Sampler Equipment	Van-dorn sampler and Horiba Water Quality Meter
Photos of site etc	
Depth at site (m)	12-14 m at site A and 12-14 m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	2.24m @ 9:06pm (31/3) and 2.11m @ 7:43pm (at Whyalla)
Low Tide (HH_MM	0.71m @ 11:55am (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	Site A: NNE, Site B: NW
Wind Speed (Knots)	Site A: 8-13 knots, Site B: 25 knots
Wave Height (metres- trough to crest)	Site A: approx 0.1m, Site B: approx 1m
General observations	Site A: clear (no cloud cover), 2m water visibility. Site B: clear (no cloud cover), 2m water visibility, dodge tide was 2 days prior

REVISIONS

Rev.	Date	Checked	Description
A	17/04/08		DRAFT
0	17/07/08	SB	Issue to client
1	17/10/08	SC	ALS Sodium and Chloride Results Removed from Averages

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 6th Sampling Event (1 April 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
Job Number	33/14036
File Name	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\1 April 08\[Summary of results 1st April 2008 v2.xls]Round6 Average
Print out	3/11/2008
Source Data	Arup Water Quality Summary Data Report, ALS Certificate of Analysis, AWQC Analytical Report, Sydney Water Analytical Report

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)													Site B: Fitzgerald Bay													Intake						
						ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water						
			Average	SB	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Intake	Intake	Average
ALS reference: ES0804425		ALS				**001**	**006**						**002**	**007**						**003**	**008**						**004**	**009**						**005**	**010**					
AWQC reference: 108686-2008-CSR-3	Units	LOR																																				
Physicochemical Parameters																																						
Field Measurements		LOR /probe																																				
pH (c)		0.01	**8.2**	**8.1**	**8.2**	8.06						**8.06**	8.02						**8.02**	8.03						**8.03**	8.01						**8.01**							
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**	61.6						**61.6**	62.3						**62.3**	62.3						**62.3**	62.4						**62.4**							
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**	0						**0**								0						**0**	0						**0**							
Temperature (c)	°C	0.1				21						**21**	21.4						**21.4**	21.7						**21.7**	21.7						**21.7**							
DO (c)	mg/L	0.1				3.81						**3.81**	3.62						**3.62**	3.86						**3.86**	3.82						**3.82**							
DO (c)	% sat																																						
ORP (c)	mV					186						**186**	181						**181**	113						**113**	116						**116**							
SDI_3 (c)													20.8						**20.8**								23.7						**23.7**							
SDI_5 (c)													14.7						**14.7**																				
pH								8.1	8.1			**8.1**			8	8			**8**			8	8.0			**8**			8	8			**8**			8	8			**8**
Conductivity								58200	58300			**58250**			59200	59100			**59150**			59200	59200			**59200**			58900	59100			**59000**			58800	59100			**58950**
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	45600	47100	43000	44300	45880	46620	**45417**	46700	45800	44700	45800	47240	47180	**46237**	47100	46000	44600	45000	47320	47360	**46230**	45800	44600	46500	46000	47400	47400	**46283**	46000	46700	44600	45600	47180	47160	**46207**
Suspended Solids (SS) (1.2 µm)	mg/L	1	**10.5 (a)**	**5.3 (a)**	**17 (a)**	10	5	7	2	<2	<2	**4.7**	9	6	7	7	2	2	**5.5**	5	8	4	4	<2	<2	**4.2**	6	7	3	3	2	2	**3.8**	10	8	6	2	<2	<2	**5**
Suspended Solids (SS) (0.45 µm)	mg/L	1				9	3					**6**	3	<2					**2.5**	<2	4					**3**	<2	3					**2.5**	<2	<2					**<2**
UV Absorbance @ 254 nm	%	0.01						0.024	0.024			**0.024**			0.026	0.03			**0.028**			0.028	0.027			**0.0275**			0.035	0.026			**0.0305**			0.031	0.025			**0.028**
Total Hardness as CaCO3	mg/L	1				8280	8660	8090	8030	8140	7650	**8142**	8080	8680	7930	7880	8030	7700	**8050**	9130	8320	7940	7720	7990	7740	**8140**	8910	8740	7890	7980	7900	7710	**8188.3333**	8470	8360	8030	8140	8000	7710	**8118.333**
Alkalinity																																							
Hydroxide Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0			**<1**	<1	<1	0	0			**<1**	<1	<1	0	0			**<1**	<1	<1	0	0			**<1**	<1	<1	0	0			**<1**
Carbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0	21	25	**8**	<1	<1	0	0	23	24	**8.2**	<1	<1	0	0	23	20	**7.5**	<1	<1	0	0	24	21	**7.8**	<1	<1	0	0	24	24	**8.3**
Bicarbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				119	122	129	128	113	111	**120**	124	123	129	129	112	113	**122**	122	122	130	129	113	116	**122**	122	123	129	129	112	115	**122**	121	123	129	129	113	112	**121**
Hydroxide Alkalinity	$mgOH^-/L$	1	**0**	**0**	**0**	<0.34	<0.34	0	0			**<0.34**	<0.34	<0.34	0	0			**<0.34**	<0.34	<0.34	0	0			**<0.34**	<0.34	<0.34	0	0			**<0.34**	<0.34	<0.34	0	0			**<0.34**
Carbonate Alkalinity	$mgCO_3^{2-}/L$	1	**0**	**0**	**0**	<0.6	<0.6	0	0	12.6	15	**4.8**	<0.6	<0.6	0	0	13.8	14.4	**4.9**	<0.6	<0.6	0	0	13.8	12	**4.5**	<0.6	<0.6	0	0	14.4	12.6	**4.7**	<0.6	<0.6	0	0	14.4	14.4	**5.0**
Bicarbonate Alkalinity	$mgHCO_3^-/L$	1	**155**	**155**	**157**	145	149	157	156	138	135	**147**	151	150	157	157	137	138	**148**	149	149	158	157	138	142	**149**	149	150	157	157	137	140	**148**	148	150	157	157	138	137	**148**
Total Alkalinity as CaCO3	$mgCaCO_3/L$	1	**127.4**	**127**	**129**	119	122	128	128	134	136	**128**	124	123	129	129	135	137	**130**	122	122	129	129	137	136	**129**	122	123	129	129	136	136	**129**	121	123	129	129	137	136	**129**
Dissolved Major Anions																																							
Chloride (g)	mg/L	1	**23067**	**22100**	**23633**	24500	25600	23000	23100	24480	24300	**23720**	25200	27000	23000	23000	24660	24300	**23740**	25500	26600	23100	22800	24660	24480	**23760**	25500	27200	23400	23300	24660	24660	**24005**	26500	26800	23000	22800	24480	24300	**23645**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3430	3650	3570	3540	3410	3560	**3527**	3360	3670	3510	3450	3401	3466	**3476**	3840	3460	3510	3330	3751	3396	**3548**	3760	3690	3450	3570	3621	3357	**3575**	3510	3470	3510	3570	3570	3425	**3509**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	86	86	91	88.2	72	69	**82**	85	87	89.9	89.3	69	67	**81**	87	87		88.8	75	69	**81**	84	85	90.3	88.4	78	68	**82**	86	86	88.1	87.9	74	70	**82**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	1	1	1	1	1.07	1.14	**1**	1	1	1	<0.1	1.09	1.13	**1**	1	1	1	1	1.11	1.13	**1**	1	1	1	1	1.13	1.12	**1**	1	1	1	1	1.12	1.11	**1**
Dissolved Major Cations																																							
Calcium	mg/L	1	**468**	**459**	**476**	508	535	517	513	444	435	**492**	499	532	505	499	445	450	**488**	558	512	510	485	445	440	**492**	548	536	503	506	439	438	**495**	524	516	512	524	436	444	**493**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1700	1780	1650	1640	1500	1470	**1623**	1660	1780	1620	1610	1510	1500	**1613**	1880	1710	1620	1580	1520	1490	**1633**	1830	1800	1610	1630	1490	1510	**1645**	1740	1720	1640	1660	1460	1500	**1620**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	13900	14200	13600	13500	12600	12400	**13025**	13500	14000	13300	13200	12700	12500	**12925**	15200	13700	13400	13100	12700	12500	**12925**	14700	14400	13200	13400	12500	12500	**12900**	14000	13800	13500	13700	12300	12500	**13000**
Potassium	mg/L	1	**474**	**462**	**480**	536	551	526	519	518	516	**528**	525	541	514	501	523	527	**522**	593	530	513	487	522	514	**527**	574	560	500	489	525	510	**526**	538	535	513	524	511	519	**523**
Ionic Balance																																							
Total Anions	meq/L	0.01				765	800					**783**	784	842					**813**	801	825					**813**	801	845					**823**	823	832					**828**
Total Cations	meq/L	0.01				782	807					**795**	764	798					**781**	857	777					**817**	832	816					**824**	790	784					**787**
Ionic Balance	%	0.01				1.12	0.45	2.73	2.22			**1.6**	1.33	2.68	1.73	1.44			**1.8**	3.31	3.02	1.84	1.47			**2.4**	1.9	1.75	0.67	1.37			**1.4**	2.03	2.99	2.44	3.48			**2.7**
GHD Calculations																																							
TDS-Calculated by GHD (d) (e)	*mg/L*		**41615**	**40240**	**42624**	44825	46570	43125	43070	43177	42900	**43159**	45000	47780	42711	42517	43460	42963	**43010**	47827	46768	42825	42034	43826	43045	**43131**	47165	48441	42924	43156	43464	43198	**43393**	47065	47097	42933	43037	42984	42909	**43036**
Total Anions calculated by GHD	meq/L		**721**			765	801	726	728	764	762	**745**	783	841	725	723	769	760	**745**	802	825	726	715	776	764	**747**	800	847	735	734	773	768	**754**	823	831	725	720	767	759	**743**
Total Cations calculated by GHD	meq/L		**708**			784	805	767	762	707	696	**739**	763	796	751	745	713	704	**733**	859	776	755	737	713	702	**735**	833	816	745	755	702	703	**735**	793	782	761	773	690	703	**737**
Ionic Balance calculated by GHD	%		**0.91**			1.23	0.30	2.75	2.24	3.84	4.54	**0.44**	1.34	2.70	1.75	1.44	3.78	3.85	**0.78**	3.46	3.04	1.94	1.47	4.20	4.21	**0.78**	1.99	1.84	0.69	1.40	4.83	4.38	**1.28**	1.89	3.04	2.45	3.50	5.27	3.83	**0.37**
Hardness Calculation by GHD																																							
Calcium Hardness as $CaCO_3$	$mgCaCO_3/L$		**1169**	**1148**	**1190**	1270	1337.5	1292.5	1282.5	1110	1087.5	**1230**	1248	1330	1263	1248	1113	1125	**1221**	1395	1280	1275	1213	1113	1100	**1229**	1370	1340	1258	1265	1098	1095	**1238**	1310	1290	1280	1310	1090	1110	**1232**
Magnesium Hardness as $CaCO_3$	$mgCaCO_3/L$		**6234**	**6165**	**6329**	6987	7316	6782	6740	6165	6042	**6672**	6823	7316	6658	6617	6206	6165	**6631**	7727	7028	6658	6494	6247	6124	**6713**	7521	7398	6617	6699	6124	6206	**6761**	7151	7069	6740	6823	6001	6165	**6658**
Total Hardness as $CaCO_3$	$mgCaCO_3/L$		**7399**	**7355**	**7477**	8257	8653	8074	8023	7275	7129	**7902**	8070	8646	7921	7865	7319	7290	**7852**	9122	8308	7933	7706	7360	7224	**7942**	8891	8738	7875	7964	7221	7301	**7998**	8461	8359	8020	8133	7091	7275	**7890**
Metals																																							
Dissolved Metals in Saline Water																																							
Dissolved Aluminium	µg/L	10	**--**	**<10**	**--**	<10	<10					**<10**	<10	<10					**<10**	<10	<10					**<10**	<10	<10					**<10**	<10	<10					**<10**
Dissolved Iron	µg/L	5	**--**	**<5**		<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	8	9			8	7	**8.0**	9	8			9	8	**8.5**	9	9			8	7	**8.3**	9	9			10	8	**9.0**	9	9			7	7	**8.0**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	5.4	5.8	6.09	6.07	4.86	4.78	**5.5**	5.5	5.6	6.02	4.04	4.89	4.96	**5.2**	5.8	5.8	6.02	5.44	4.91	4.83	**5.5**	6	5.6	5.81	5.62	4.84	4.82	**5.4**	5.6	5.7	3.97	6.05	4.81	4.9	**5.2**
Dissolved Manganese	µg/L	0.5	**--**	**<1**	**--**	1	1					**1.0**	1.2	1.2					**1.2**	1.3	1.5					**1.4**	1.1	1.1					**1.1**	1.3	1					**1.2**
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	13.2	12.8	6.982	6.403	8.93	8.68	**9.5**	13.4	13.1	7.591	6.305	8.96	8.87	**9.7**	13.3	13.4	6.673	8.97	9	8.64	**10.0**	13.3	13.6	6.665	9.2	8.78	8.64	**10.0**	13	13.6	7.484	7.202	8.72	8.75	**9.8**
Dissolved Silica	mg/L	0.1				1.8	1.2	<0.1	<0.1	0.1	0.1	**0.6**	1.6	1.2	<0.1	<0.1	0.1	0.1	**0.5**	1.6	1.1	<0.1	<0.1	0.2	0.2	**0.6**	1.4	1.2	<0.1	<0.1	0.2	0.2	**0.5**	1.3	<0.1	<0.1	<0.1	0.1	0.1	**0.3**
Total Metals in Saline Water																																							
Aluminium	µg/L	10	**--**	**<10**	**--**	10	10					**10.0**	20	40					**30.0**	30	20					**25.0**	30	30					**30.0**	190	30					**110.0**
Iron	µg/L	5	**6**	**<5**	**6**	16	14					**15.0**	21	23					**22.0**	18	24					**21.0**	26	25					**25.5**	20	19					**19.5**
Arsenic	µg/L	0.5	**2**	**<1**	**2**	0.7	0.7					**0.7**	1	0.6					**0.8**	0.7	0.8					**0.8**	0.6	<0.5					**0.6**	0.5	<0.5					**0.5**
Beryllium	µg/L	0.1				<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**
Cadmium	µg/L	0.2	**--**	**<5**	**--**	<0.2	<0.2					**<0.2**	<0.2	<0.2					**<0.2**	<0.2	<0.2					**<0.2**	<0.2	<0.2					**<0.2**	<0.2	<0.2					**<0.2**
Chromium - Hexavalent	mg/L	0.002				<0.002	<0.002					**<0.002**	<0.002	<0.002					**<0.002**	<0.002	<0.002					**<0.002**	<0.002	<0.002					**<0.002**	<0.002	<0.002					**<0.002**
Chromium Total	µg/L	0.5	**7**	**7**	**7**	<0.5	0.6					**0.6**	<0.5	<0.5					**<0.5**	<0.5	<0.5					**<0.5**	<0.5	<0.5					**<0.5**	<0.5	0.5					**<0.5**
Copper	µg/L	1	**11**	**<10**	**11**	2	2					**2.0**	6	8					**7.0**	2	2					**2.0**	2	2					**2.0**	<1	<1					**<1**
Lead	µg/L	0.2	**--**	**<5**	**--**	0.5	0.7					**0.6**	0.5	0.2					**0.4**	0.4	3.2					**1.8**	0.7	0.9					**0.8**	<0.2	<0.2					**<0.2**
Manganese	µg/L	0.5	**4**	**<1**	**5**	1.2	1.5					**1.4**	1.8	1.8					**1.8**	1.5	1.8					**1.7**	1.8	1.8					**1.8**	1.5	1.5					**1.5**
Mercury	mg/L	0.0001	**--**	**<0.0003**	**--**	<0.0001	<0.0001					**<0.0001**	<0.0001	<0.0001					**<0.0001**	<0.0001	<0.0001					**<0.0001**	<0.0001	<0.0001					**<0.0001**	<0.0001	<0.0001					**<0.0001**
Molybdenum	µg/L	0.1				14.1	14.3					**14.2**	14.2	14.4					**14.3**	14.2	14.3					**14.3**	14.3	13.9					**14.1**	13.9	14.2					**14.1**
Nickel	µg/L	0.5	**--**	**<5**	**--**	<0.5	<0.5					**<0.5**	<0.5	<0.5					**<0.5**	1.8	2.8					**2.3**	<0.5	0.5					**0.5**	<0.5	0.5					**0.5**
Silver	µg/L	0.1				<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**
Tin	µg/L	5				<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**
Zinc	µg/L	5	**30**	**<30**	**32**	<5	<5					**<5**	9	7					**8.0**	<5	5					**<5**	<5	<5					**<5**	<5	<5					**<5**
Nutrients																																							
Ammonia as N	mgN/L	0.005	**0.007**	**<0.005**	**0.01**			0.006	0.006			**0.006**			0.014	0.012			**0.013**			0.012	0.006			**0.009**			<0.005	0.009			**0.007**			0.014	0.011			**0.013**
Ammonia (NH3, unionised) as N	mgN/L	0.005						<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**
Ammonia (NH4, ionised) as N	mgN/L	0.005						0.006	0.006			**0.006**			0.014	0.012			**0.013**			0.012	0.005			**0.009**			<0.005	0.008			**0.007**			0.013	0.011			**0.012**
Nitrite as N	mgN/L	0.005		**<0.005**	**--**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**
Nitrate as N	mgN/L	0	**--**	**0**				0	0			**0.000**			0.006	0.003			**0.005**			0	0			**0.000**			0	0			**0.000**			0.002	0.001			**0.002**
Nitrite + Nitrate as N	mgN/L	0.005	**0.006**	**<0.005**	**0.008**			<0.005	<0.005			**<0.005**			0.011	0.008			**0.010**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			0.007	0.006			**0.007**
Total Kjeldahl Nitrogen as N	mgN/L	0.05	**0.239**	**<0.05**	**0.62**			0.17	0.18			**0.18**			0.15	0.17			**0.16**			0.17	0.19			**0.18**			0.17	0.27			**0.22**			0.15	0.14			**0.15**
Total Nitrogen as N	mgN/L	0.05	**0.247**	**<0.06**	**0.62**			0.18	0.18			**0.2**			0.16	0.18			**0.2**			0.18	0.2			**0.2**			0.18	0.28			**0.2**			0.16	0.15			**0.2**
Total Phosphorus as P	mgP/L	0.005	**0.017**	**0.011**	**0.023**			0.011	0.013			**0.012**			0.013	0.011			**0.012**			0.014	0.013			**0.014**			0.013	0.013			**0.013**			0.011	0.011			**0.011**
Reactive Phosphorus as P	mgP/L	0.005	**0.006**	**<0.005**	**0.006**			0.01	0.01			**0.010**			0.011	0.01			**0.011**			0.01	0.01			**0.010**			0.01	0.012			**0.011**			0.011	0.011			**0.011**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)													Site B: Fitzgerald Bay													Intake						
						ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water		
			Average	SB	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Intake	Intake	Average
ALS reference: ES0804425		ALS				**001**	**006**						**002**	**007**						**003**	**008**						**004**	**009**						**005**	**010**					
AWQC reference: 108686-2008-CSR-3	Units	LOR																																				
Dissolved Organic Carbon	mg/L	1	**1.1**	**0.9**	**1.3**			0.9	0.9			**0.9**			0.9	0.9			**0.9**			1	0.9			**1.0**			0.9	0.9			**0.9**			1	0.9			**1.0**
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**			0.9	0.9			**0.9**			1	4.7			**2.9**			1.1	1			**1.1**			1	1			**1.0**			0.9	1.5			**1.2**
Biochemical Oxygen Demand	mg/L	2	**--**	**<2**	**--**			<2	<2			**<2**			<2	<2			**<2**			<2	<2			**<2**			<2	<2			**<2**			<2	<2			**<2**
Oil & Grease	mg/L	1	**--**	**<1**	**--**			<1	<1			**<1**			<1	<1			**<1**			<1	<1			**<1**			<1	1			**<1**			<1	<1			**<1**
Sulphide	µg/L	2								12	18	**15**					26	19	**23**					52	312	**182**					24	18	**21**					27	21	**24**
Tributyltin	ngSn/L	0.1																																					
Total Polychlorinated biphenyls	µg/L	0.1																																					
Microbiological																																							
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**			0.79	0.79			**0.79**			0.87	0.88			**0.88**			1.31	1.43			**1.37**			1.4	1.31			**1.36**			0.86	0.83			**0.85**
Heterotrophic Plate Count (37°C)	CFU/mL	1						61	61			**61**			1	0			**1**			0	6			**3**			1	2			**2**			0	0			**0**
Heterotrophic Plate Count (20°C)	CFU/mL	1						0	0			**0**			0	0			**0**			0	0			**0**			0	0			**0**			7	0			**4**
Enterococci	CFU/100mL	1						1	0			**1**			0	0			**0**			0	0			**0**			0	0			**0**			0	0			**0**
Faecal Coliforms	CFU/100mL	1						0	0			**0**			0	0			**0**			0	0			**0**			0	0			**0**			0	0			**0**
Coliforms	CFU/100mL	1		**0**	**0**			0	36			**18**			54	0			**27**			0	0			**0**			80	1			**41**			0	2			**1**

Notes

(a) It is likely that the ARUP analysis was done on 1.2 µm
(c) Field Measurements
(d) Averages calculated based on sum of average of an ion, when no AWQC value was available the average from ALS was used
(e) When no AWQC value was available the average from ALS was used, average based on average of all ion data
(f) Where relevant, average was calculated considering LOR's as values
(g) The ALS results for sodium and chloride have been excluded from the averages, see report for details.

Unexpected result which will require further verification

Test not processed with holding time

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 7th Sampling Event (29 April 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	SC
CHECKED BY	SB
Description of spreadsheet	Summary of water quality sampling results from sixth sampling event
Number of Worksheets (incl. this one)	2
Filename	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\29 April 08\[Summary of results 29th April 2008 v2.xls]

Data from Sampling Event

Sample Date	29/04/2008
Time of sampling	Site A - 9:30am - 10:40am. Site B - 11:30am - 1:40pm. Intake: 11:00am
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 20 L per sample (10 samples total)
Sampler Names	Steven Carter and Daniel Ahrens
Sampler Equipment	Van-dorn sampler and Troll 9500 water quality meter
Photos of site etc	
Depth at site (m)	approx 12 m at site A and approx 12 m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	2.13m @ 8:54pm (at Whyalla)
Low Tide (HH_MM	0.91m @ 6:40am (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	Site A: N, Site B: N
Wind Speed (Knots)	Site A: 5-10 knots, Site B: 5-10 knots
Wave Height (metres- trough to crest)	Site A: <0.2 m, Site B: approx 0.5 m
General observations	Site A: clear (no cloud cover), 2-3m water visibility. Site B: clear (no cloud cover), 2-3m water visibility, a few white caps dodge tide

REVISIONS

Rev.	Date	Checked	Description
A	16/05/08		DRAFT
0	17/07/08	SB	Issue to client
1	17/10/08	SC	High ALS Sodium and Chloride Results Removed from Averages

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 7th Sampling Event (29 April 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
Job Number	33/14036
File Name	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\29 April 08\[Summary of results 29th April 2008 v2.xls]Round7 Average
Print out	3/11/2008
Source Data	Arup Water Quality Summary Data Report, ALS Certificate of Analysis, AWQC Analytical Report, Sydney Water Analytical Report

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)													Site B: Fitzgerald Bay													Intake						
						ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water						
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Intake	Intake	Average
ALS reference: ES0804425		ALS				**001**	**006**						**002**	**007**						**003**	**008**						**004**	**009**						**005**	**010**					
AWQC reference: 108686-2008-CSR-3	Units	LOR																																				
Physicochemical Parameters																																						
Field Measurements		LOR /probe																																				
pH (c)		0.01	**8.2**	**8.1**	**8.2**	7.62						**7.62**	7.59						**7.59**	7.66						**7.66**	7.65						**7.65**	7.68						**7.68**
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**	59.66						**59.66**	60.1						**60.13**	59.93						**59.93**	60.2						**60.16**	59.8						**59.81**
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**	1.61						**1.61**	1.82						**1.82**	1.49						**1.49**	2.38						**2.38**	0.83						**0.83**
Temperature (c)	°C	0.1				18.38						**18.38**	18.66						**18.66**	18.62						**18.62**	18.58						**18.58**							
DO (c)	mg/L	0.1				9.1						**9.1**	9.34						**9.34**	8.29						**8.29**	8.13						**8.13**	8.5						**8.49**
DO (c)	% sat					120.4						**120.4**	124						**124**	109.9						**109.9**	107.6						**107.6**	108.9						**108.9**
ORP (c)	mV					220						**220**	220						**220**	246						**246**	242						**242**	255						**255**
SDI_3 (c)													11.2	20.6					**15.9**	21.5						**21.5**	22.7	22.2					**22.5**							
SDI_5 (c)													11.0						**11.0**	15.1						**15.1**	15.7	15.3					**15.5**							
pH								8.1	8.1			**8.1**			8	8			**8**			8.1	8.0			**8.05**			8	8			**8**			8	8			**8**
Conductivity								58900	58800			**58850**			59500	59400			**59450**			59200	59600.0			**59400**			59300	59400			**59350**			59400	59400			**59400**
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	49000	45400	44100	44400	47800	48150	**46475**	48700	47100	45000	43600	48000	48250	**46775**	48100	46900	43600	44000	48200	48000	**46467**	45800	42300	44200	44600	47800	47950	**45442**	46600	46000	44900	44100	47950	47750	**46217**
Suspended Solids (SS) (1.2 µm)	mg/L	1	**10.5 (a)**	**5.3 (a)**	**17 (a)**	1	1	4	5	<2	<2	**2.5**	1	1	3	4	<2	<2	**2.2**	4	1	6	5	<2	<2	**3.3**	4	1	4	2	<2	<2	**2.5**	<1	<1	5	7	<2	<2	**3**
Suspended Solids (SS) (0.45 µm)	mg/L	1				3	6					**4.5**	14	2					**8**	3	6					**4.5**	4	1					**2.5**	2	2					**2**
UV Absorbance @ 254 nm	%	0.01						0.025	0.025			**0.025**			0.026	0.026			**0.026**			0.026	0.028			**0.027**			0.026	0.032			**0.029**			0.027	0.028			**0.0275**
Total Hardness as CaCO3	mg/L	1				8090	7960	7850	7800	7690	7710	**7850**	7380	8100	7930	7920	7680	7720	**7788.33333**	7320	8760	7890	8050	7700	7710	**7905**	7680	8680	7940	7950	7610	7650	**7918.3333**	8080	8340	7900	7860	7690	7680	**7925**
Alkalinity																																						
Hydroxide Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0			**<1**	<1	<1	0	0			**<1**	<1	<1	0	0			**<1**	<1	<1	0	0			**<1**	<1	<1	0	0			**<1**
Carbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0	38	32	**12**	<1	<1	0	0	28	24	**9**	<1	<1	0	0	22	26	**8.3**	<1	<1	0	0	38	36	**12.7**	<1	<1	0	0	26	28	**9.3**
Bicarbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				120	123	128	128	94	100	**115**	122	124	129	129	105	107	**119**	122	124	129	129	111	106	**120**	131	125	129	129	93	97	**117**	123	123	129	129	106	103	**119**
Hydroxide Alkalinity	$mgOH^-/L$	1	**0**	**0**	**0**	<0.34	<0.34	0	0			**<0.34**	<0.34	<0.34	0	0			**<0.34**	<0.34	<0.34	0	0			**<0.34**	<0.34	<0.34	0	0			**<0.34**	<0.34	<0.34	0	0			**<0.34**
Carbonate Alkalinity	$mgCO_3^{2-}/L$	1	**0**	**0**	**0**	<0.6	<0.6	0	0	22.8	19.2	**7.2**	<0.6	<0.6	0	0	16.8	14.4	**5.4**	<0.6	<0.6	0	0	13.2	15.6	**5.0**	<0.6	<0.6	0	0	22.8	21.6	**7.6**	<0.6	<0.6	0	0	15.6	16.8	**5.6**
Bicarbonate Alkalinity	$mgHCO_3^-/L$	1	**155**	**155**	**157**	146	150	156	156	115	122	**141**	149	151	157	157	128	131	**145**	149	151	157	157	135	129	**146**	160	153	157	157	113	118	**143**	150	150	157	157	129	126	**145**
Total Alkalinity as CaCO3	$mgCaCO_3/L$	1	**127.4**	**127**	**129**	120	123	128	128	132	132	**127**	122	124	129	129	133	131	**128**	122	124	129	129	133	132	**128**	131	125	129	128	131	133	**130**	123	123	129	129	132	131	**128**
Dissolved Major Anions																																						
Chloride (g)	mg/L	1	**23067**	**22100**	**23633**	24200	22600	23300	23500	24300	24660	**23760**	22800	22200	23800	24400	24660	24660	**23753**	24000	25200	23700	24100	24660	24660	**24224**	23800	23700	23700	24300	24660	24480	**24107**	24100	22500	23800	23700	24660	24660	**23903**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3370	3720	3300	3270	3607	3543	**3468**	3110	4230	3300	3360	3543	3285	**3471**	3090	4820	3300	3300	3269	3320	**3517**	3460	4320	3360	3330	3287	3408	**3528**	3850	4380	3300	3300	3210	3389	**3572**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	88	86	81.3	82.7	87	86	**85**	86	87	80.9	81.3	87	89	**85**	86	87	81.8	80.3	88	88	**85**	88	86	81.5	81.3	90	88	**86**	89	87	81.5	80.9	87	88	**86**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.9	1	0.97	0.99	1.15	1.16	**1**	1	1	0.99	0.99	1.15	1.17	**1**	1	1	0.99	0.98	1.16	1.17	**1**	1	1	0.99	0.98	1.17	1.17	**1**	1	0.9	0.98	0.98	1.18	1.18	**1**
Dissolved Major Cations																																						
Calcium	mg/L	1	**468**	**459**	**476**	523	515	473	468	461	455	**483**	472	528	473	483	456	460	**479**	468	567	471	471	459	459	**483**	490	564	477	480	468	460	**490**	525	540	477	478	459	465	**491**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1650	1620	1620	1610	1420	1440	**1560**	1510	1650	1640	1630	1440	1470	**1557**	1490	1780	1630	1670	1400	1490	**1577**	1570	1770	1640	1640	1450	1420	**1582**	1640	1700	1630	1620	1470	1410	**1578**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	13800	13700	13300	13200	12600	12400	**13167**	13900	13300	13500	13300	12800	12500	**13217**	13800	15800	13400	13700	12400	12700	**13200**	14000	14800	13400	13500	12800	12300	**13200**	14200	14200	13300	13200	12700	12500	**13350**
Potassium	mg/L	1	**474**	**462**	**480**	525	532	492	486	512	497	**507**	538	546	493	498	497	505	**513**	537	681	490	491	482	510	**532**	548	598	496	492	492	505	**522**	572	619	493	493	506	514	**533**
Ionic Balance																																						
Total Anions	meq/L	0.01				755	719					**737**	710	716					**713**	744	813					**779**	747	761					**754**	764	730					**747**
Total Cations	meq/L	0.01				776	769					**773**	766	756					**761**	759	878					**819**	777	831					**804**	794	802					**798**
Ionic Balance	%	0.01				1.37	3.34	1.31	0.59			**1.7**	3.82	2.69	1.04	-0.8			**1.7**	1.01	3.83	0.87	1.19			**1.7**	1.96	4.42	0.88	0.08			**1.8**	1.92	4.74	0.42	0.27			**1.8**
GHD Calculations																																						
TDS-Calculated by GHD (d) (e)	*mg/L*		**41615**	**40240**	**42624**	44319	42940	42736	42786	43117	43218	**43186**	42582	42709	43458	43923	43626	43115	**43236**	43636	49103	43244	43983	42908	43371	**43779**	44132	46007	43325	43994	43376	42794	**43672**	45143	44192	43252	43043	43236	43167	**43672**
Total Anions calculated by GHD	meq/L		**721**			755	718	729	734	763	772	**745**	711	717	743	761	772	766	**745**	744	814	740	751	766	767	**759**	746	761	741	758	766	764	**756**	763	729	743	740	765	768	**751**
Total Cations calculated by GHD	meq/L		**708**			776	769	748	743	701	694	**739**	767	755	759	750	711	701	**740**	760	880	753	770	690	711	**742**	777	833	755	759	712	688	**743**	794	801	749	744	710	697	**749**
Ionic Balance calculated by GHD	%		**0.91**			1.34	3.45	1.34	0.62	4.18	5.32	**0.43**	3.79	2.58	1.07	0.73	4.08	4.46	**0.30**	1.09	3.90	0.90	1.22	5.21	3.77	**1.14**	2.02	4.52	0.90	0.11	3.63	5.20	**0.90**	2.00	4.72	0.45	0.30	3.74	4.91	**0.14**
Hardness Calculation by GHD																																						
Calcium Hardness as $CaCO_3$	$mgCaCO_3/L$		**1169**	**1148**	**1190**	1307.5	1287.5	1182.5	1170	1152.5	1137.5	**1206**	1180	1320	1183	1208	1140	1150	**1197**	1170	1418	1178	1178	1148	1148	**1206**	1225	1410	1193	1200	1170	1150	**1225**	1313	1350	1193	1195	1148	1163	**1227**
Magnesium Hardness as $CaCO_3$	$mgCaCO_3/L$		**6234**	**6165**	**6329**	6782	6658	6658	6617	5836	5918	**6412**	6206	6782	6740	6699	5918	6042	**6398**	6124	7316	6699	6864	5754	6124	**6480**	6453	7275	6740	6740	5960	5836	**6501**	6740	6987	6699	6658	6042	5795	**6487**
Total Hardness as $CaCO_3$	$mgCaCO_3/L$		**7399**	**7355**	**7477**	8089	7946	7841	7787	6989	7056	**7618**	7386	8102	7923	7907	7058	7192	**7595**	7294	8733	7877	8041	6902	7271	**7686**	7678	8685	7933	7940	7130	6986	**7725**	8053	8337	7892	7853	7189	6958	**7714**
Metals																																						
Dissolved Metals in Saline Water																																						
Dissolved Aluminium	µg/L	10	**--**	**<10**	**--**	<10	<10					**<10**	<10	<10					**<10**	<10	<10					**<10**	<10	<10					**<10**	<10	<10					**<10**
Dissolved Iron	µg/L	5	**--**	**<5**		<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	8	8	<5	10	8	8	**8.4**	8	8	10	11	8	8	**8.8**	8	8	10	11	8	8	**8.8**	8	8	10	10	8	8	**8.7**	8	8	11	10	8	8	**8.8**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	5.1	5.1	5.24	5.22	4.98	4.9	**5.1**	5.3	5.2	5.29	5.19	5.01	5.02	**5.2**	5.3	5.2	5.21	5.19	5	4.97	**5.1**	5.2	5	5.32	5.16	5.02	4.95	**5.1**	5.1	5.1	5.22	5.24	4.98	4.96	**5.1**
Dissolved Manganese	µg/L	0.5	**--**	**<1**	**--**	1.1	1					**1.1**	1	1					**1.0**	1	1.1					**1.1**	1	1					**1.0**	1.1	1					**1.1**
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	10.7	10.8	8.51	8.45	9.04	8.88	**9.4**	10.6	11	8.6	8.57	8.88	8.97	**9.4**	9.94	10.5	8.48	8.54	8.86	8.98	**9.2**	10.4	10.8	8.5	8.45	8.97	8.95	**9.3**	10.5	10.1	8.52	8.47	8.94	9.07	**9.3**
Dissolved Silica	mg/L	0.1				0.2	<0.1	<2	<2	0.1	0.1	**0.1**	0.2	<0.1	<2	<2	0.2	0.2	**0.2**	<0.1	<0.1	<0.1	<0.1	0.2	0.2	**0.1**	<0.1	<0.1	<2	<2	0.2	0.2	**0.2**	<0.1	<0.1	<2	<2	0.2	0.2	**0.2**
Total Metals in Saline Water																																						
Aluminium	µg/L	10	**--**	**<10**	**--**	10	20					**15.0**	10	20					**15.0**	10	10					**10.0**	10	10					**10.0**	10	10					**10.0**
Iron	µg/L	5	**6**	**<5**	**6**	12	14					**13.0**	14	18					**16.0**	10	12					**11.0**	11	14					**12.5**	11	13					**12.0**
Arsenic	µg/L	0.5	**2**	**<1**	**2**	2.2	2.9					**2.6**	3.1	2.5					**2.8**	2.4	2.3					**2.4**	2.4	2.5					**0.6**	2.2	2.5					**2.4**
Beryllium	µg/L	0.1				<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**	<0.1	<0.1					**<0.1**
Cadmium	µg/L	0.2	**--**	**<5**	**--**	<0.2	<0.2					**<0.2**	<0.2	<0.2					**<0.2**	<0.2	<0.2					**<0.2**	<0.2	<0.2					**<0.2**	<0.2	<0.2					**<0.2**
Chromium - Hexavalent	mg/L	0.002																																				
Chromium Total	µg/L	0.5	**7**	**7**	**7**	<0.5	<0.5					**<0.5**	<0.5	<0.5					**<0.5**	<0.5	<0.5					**<0.5**	<0.5	<0.5					**<0.5**	<0.5	<0.5					**<0.5**
Copper	µg/L	1	**11**	**<10**	**11**	<1	5					**3.0**	<1	2					**1.5**	<1	1					**1.0**	<1	2					**1.5**	<1	<1					**<1**
Lead	µg/L	0.2	**--**	**<5**	**--**	<0.2	<0.2					**<0.2**	0.4	0.4					**0.4**	<0.2	<0.2					**<0.2**	<0.2	<0.2					**<0.2**	<0.2	<0.2					**<0.2**
Manganese	µg/L	0.5	**4**	**<1**	**5**	1.4	1.6					**1.5**	1.6	1.6					**1.6**	1.4	1.5					**1.5**	1.3	1.5					**1.4**	1.4	1.3					**1.4**
Mercury	mg/L	0.0001	**--**	**<0.0003**	**--**																																		
Molybdenum	µg/L	0.1				12.7	14.1					**13.4**	13.4	14.4					**13.9**	12.3	14.2					**13.3**	14.4	14.8					**14.6**	13.8	14.5					**14.2**
Nickel	µg/L	0.5	**--**	**<5**	**--**																																		
Silver	µg/L	0.1																																				
Tin	µg/L	5																																				
Zinc	µg/L	5	**30**	**<30**	**32**	<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**	<5	<5					**<5**
Nutrients																																						
Ammonia as N	mgN/L	0.005	**0.007**	**<0.005**	**0.01**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**
Ammonia (NH3, unionised) as N	mgN/L	0.005						<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**
Ammonia (NH4, ionised) as N	mgN/L	0.005						<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**
Nitrite as N	mgN/L	0.005		**<0.005**	**--**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**
Nitrate as N	mgN/L	0	**--**	**0**				0	0			**0.000**			0	0			**0.000**			0	0			**0.000**			0	0			**0.000**			0	0			**0.000**
Nitrite + Nitrate as N	mgN/L	0.005	**0.006**	**<0.005**	**0.008**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**
Total Kjeldahl Nitrogen as N	mgN/L	0.05	**0.239**	**<0.05**	**0.62**			0.12	0.14			**0.13**			0.14	0.14			**0.14**			0.12	0.14			**0.13**			0.14	0.16			**0.15**			0.12	0.13			**0.13**
Total Nitrogen as N	mgN/L	0.05	**0.247**	**<0.06**	**0.62**			0.12	0.14			**0.1**			0.14	0.14			**0.1**			0.12	0.14			**0.1**			0.14	0.16			**0.2**			0.12	0.14			**0.1**
Total Phosphorus as P	mgP/L	0.005	**0.017**	**0.011**	**0.023**			0.006	0.008			**0.007**			0.01	0.012			**0.011**			0.006	0.007			**0.007**			0.006	0.008			**0.007**			0.01	0.008			**0.009**
Reactive Phosphorus as P	mgP/L	0.005	**0.006**	**<0.005**	**0.006**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**			<0.005	<0.005			**<0.005**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)													Site B: Fitzgerald Bay													Intake						
						ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water			ALS		AWQC		Sydney Water		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Intake	Intake	Average
ALS reference: ES0804425		ALS				001	006						002	007						003	008						004	009						005	010					
AWQC reference: 108686-2008-CSR-3	Units	LOR																																					
Dissolved Organic Carbon	mg/L	1	**1.1**	**0.9**	**1.3**			0.9	1.1			**1.0**			1.1	1			**1.1**			1	1			**1.0**			0.9	0.9			**0.9**			1	0.9			**1.0**
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**			1	1			**1.0**			1.1	1.1			**1.1**			1	1			**1.0**			1	1			**1.0**			1	1			**1.0**
Biochemical Oxygen Demand	mg/L	2	**--**	**<2**	**--**			<2	<2			**<2**			<2	<2			**<2**			<2	<2			**<2**			<2	<2			**<2**			<2	<2			**<2**
Oil & Grease	mg/L	1	**--**	**<1**	**--**			2	<1			**1.5**			1	<1			**1.0**			<1	2			**1.5**			<1	2			**1.5**			<1	<1			**<1**
Sulphide	µg/L	2						18	18			**18**			17	17			**17**			19	19			**19**			17	28			**23**			19	18			**19**
Tributyltin	ngSn/L	0.1																																					
Total Polychlorinated biphenyls	µg/L	0.1																																					
Microbiological																																							
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**			0.93	1			**0.97**			1.08	1.1			**1.09**			1.37	1.26			**1.32**			1.25	1.27			**1.26**			0.75	0.7			**0.73**
Heterotrophic Plate Count (37°C)	CFU/mL	1						13	11			**12**			5	17			**11**			7	8			**8**			1	3			**2**			0	0			**0**
Heterotrophic Plate Count (20°C)	CFU/mL	1						0	0			**0**			1	4			**3**			3	8			**6**			1	1			**1**			1	1			**1**
Enterococci	CFU/100mL	1						0	0			**0**			1	2			**2**			1	0			**1**			0	0			**0**			0	0			**0**
Faecal Coliforms	CFU/100mL	1						0	0			**0**			0	1			**1**			0	0			**0**			0	0			**0**			0	0			**0**
Coliforms	CFU/100mL	1		**0**	**0**			340	330			**335**			280	550			**415**			190	330			**260**			370	550			**460**			490	550			**520**

Notes

(a)	It is likely that the ARUP analysis was done on 1.2 µm
(c)	Field Measurements
(d)	Averages calculated based on sum of average of an ion, when no AWQC value was available the average from ALS was used
(e)	When no AWQC value was available the average from ALS was used, average based on average of all ion data
(f)	Where relevant, average was calculated considering LOR's as values
(g)	It is noted that the results for chloride and sodium from ALS and AWQC vary considerably, significant variation between duplicates for chloride is also noted for ALS. The highlighted values for sodium and chloride have been excluded from the averages.
	Unexpected result which will require further verification
	Test not processed within holding time

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 8th Sampling Event (3 June 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	SC
CHECKED BY	SB
Description of spreadsheet	Summary of water quality sampling results from sixth sampling event
Number of Worksheets (incl. this one)	2
Filename	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\3 June 08\[Summary of results 3rd June 2008 v2.xls]

Data from Sampling Event

Sample Date	3/06/2008
Time of sampling	Site A - 12pm - 1:45pm. Site B - 9:45am - 11:15m. Intake: 11:00am
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 10 L per sample (10 samples total)
Sampler Names	Steven Carter and Daniel Ahrens
Sampler Equipment	Van-dorn sampler and Troll 9500 water quality meter
Photos of site etc	
Depth at site (m)	approx 12-13 m at site A and approx 12-13 m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	1.73m @ 7:54am and 3.03m @ 5:52pm (at Whyalla)
Low Tide (HH_MM	0.29m @ 1:28am and 1.4m @ 11:33am (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	Site A: WNW, Site B: WNW
Wind Speed (Knots)	Site A: <5 knots, Site B: <5 knots
Wave Height (metres- trough to crest)	Site A: <0.1 m, Site B: <0.1 m
General observations	Site A: 20% cloud cover, calm, 4-5m water visibility. Site B: 40% cloud cover

REVISIONS

Rev.	Date	Checked	Description
A	30/06/08		DRAFT
0	17/07/08	SB	Issue to client
1	17/10/08	SC	ALS Sodium and Chloride Results Removed from Averages

Title **Port Bonython Seawater Monitoring Program - Results Summary - 8th Sampling Event (3 June 2008)**
Project BHP Billiton ODX PWSS Pilot Plant Works
Job Number 33/14036
File Name G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\3 June 08\[Summary of results 3rd June 2008 v2.xls]Cover
Print out 3/11/2008
Source Data Arup Water Quality Summary Data Report, ALS Certificate of Analysis, AWQC Analytical Report, Sydney Water Analytical Report

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0804425		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2008-CSR-3	Units	LOR																												
Physicochemical Parameters																														
Field Measurements		LOR /probe																												
pH (c)		0.01	**8.2**	**8.1**	**8.2**	7.84				**7.84**	7.88				**7.88**	7.76				**7.76**	7.85				**7.85**					
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**	63.84				**63.84**	64.8				**64.82**	63.85				**63.85**	64.28				**64.28**					
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**	1.6				**1.6**	1.7				**1.7**	2.4				**2.4**	2.1				**2.1**					
Temperature (c)	°C	0.1				16.85				**16.85**	16.68				**16.68**	16.66				**16.66**	16.65				**16.65**					
DO (c)	mg/L	0.1				10.59				**10.59**	10.14				**10.14**	9.09				**9.09**	9.7				**9.7**					
DO (c)	% sat					140.9				**140.9**	135.1				**135.1**	120.3				**120.3**	128.4				**128.4**					
ORP (c)	mV					169				**169**	157				**157**	174				**174**	155				**155**					
SDI_3 (c)						16.8	18.9			**17.9**	16.3	14.7			**15.5**						21.3	20.5			**20.9**					
SDI_5 (c)						12.6				**12.6**	12.4	11.8			**12.1**						15	15.2			**15.1**					
pH								8.1	8.1	**8.1**			8	8.1	**8.05**			8	8.0	**8**			8	8	**8**			8	8.1	**8.05**
Conductivity	µS/cm							61000	61100	**61050**			61700	61900	**61800**			62100	62100.0	**62100**			62300	62200	**62250**			61200	61300	**61250**
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	47600	45200	44400	43800	**45250**	51400	50000	44900	45300	**47900**	47800	49200	45500	45000	**46875**	49700	47500	45100	44700	**46750**	48100	47000	44500	44200	**45950**
Suspended Solids (SS) (1.2 µm)	mg/L	1	**10.5 (a)**	**5.3 (a)**	**17 (a)**	1	<1	9	7	**4.5**	1	<1	10	12	**5.5**	1	2	6	7	**4**	1	<1	5	7	**3.5**	<1	<1	8	6	**4**
Suspended Solids (SS) (0.45 µm)	mg/L	1				0	7			**3.5**	1	3			**2**	0	2			**1**	3	6			**4.5**	2	2			**2**
UV Absorbance @ 254 nm	%	0.01						0.027	0.024	**0.0255**			0.024	0.025	**0.0245**			0.03	0.03	**0.03**			0.026	0.027	**0.0265**			0.026	0.023	**0.0245**
Total Hardness as CaCO3	mg/L	1				7420	8230	8180	7850	**7920**	7710	7750	8060	8160	**7920**	7520	7620	7340	7770	**7562.5**	8310	7640	7920	8270	**8035**	7520	7640	8370	7760	**7822.5**
Alkalinity																														
Hydroxide Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**
Carbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**
Bicarbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				127	127	127	126	**127**	126	132	127	128	**128**	128	129	128	128	**128**	128	129	128	128	**128**	128	129	127	127	**128**
Hydroxide Alkalinity	$mgOH^-/L$	1	**0**	**0**	**0**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**
Carbonate Alkalinity	$mgCO_3^{2-}/L$	1	**0**	**0**	**0**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**
Bicarbonate Alkalinity	$mgHCO_3^-/L$	1	**155**	**155**	**157**	155	155	155	154	**155**	154	161	155	156	**156**	156	157	156	156	**156**	156	157	156	156	**156**	156	157	155	155	**156**
Total Alkalinity as CaCO3	$mgCaCO_3/L$	1	**127.4**	**127**	**129**	127	127	127	126	**127**	126	132	127	128	**128**	128	129	128	128	**128**	128	129	128	128	**128**	128	129	127	127	**128**
Dissolved Major Anions																														
Chloride (g)	mg/L	1	**23067**	**22100**	**23633**	27100	27000	22100	22000	**22050**	27300	27600	22500	22400	**22450**	28200	27400	22600	22500	**22550**	27600	27500	22500	22500	**22500**	27100	27200	21800	22200	**22000**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3310	3680	3690	3480	**3540**	3390	3420	3600	3540	**3488**	3330	3330	3690	3600	**3488**	3660	3430	3480	3750	**3580**	3280	3370	3420	3570	**3410**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	82	84	79.9	80.6	**82**	84	84	82	81.5	**83**	85	87	81.1	80.7	**83**	86	87	81.1	83.5	**84**	84	82	78.8	78.5	**81**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.9	0.9	1	1	**1**	0.9	0.9	1	1	**1**	0.9	0.9	1	1	**1**	0.9	0.9	1	0.99	**1**	0.9	0.9	1	1	**1**
Dissolved Major Cations																														
Calcium	mg/L	1	**468**	**459**	**476**	480	531	520	489	**505**	500	502	506	497	**501**	488	493	516	505	**501**	538	496	502	526	**516**	492	492	482	502	**492**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1510	1680	1670	1610	**1618**	1570	1580	1650	1680	**1620**	1530	1550	1470	1580	**1533**	1690	1560	1620	1690	**1640**	1530	1560	1740	1580	**1603**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	14300	14700	13900	13400	**13650**	14800	14600	13700	14000	**13850**	14400	14500	12200	13100	**12650**	14700	15100	13300	14100	**13700**	13800	14100	13200	13100	**13150**
Potassium	mg/L	1	**474**	**462**	**480**	520	514	539	504	**519**	530	524	525	515	**524**	511	518	539	522	**523**	507	553	493	544	**524**	482	501	501	524	**502**
Ionic Balance																														
Total Anions	meq/L	0.01				837	842			**840**	844	851			**848**	866	844			**855**	858	849			**854**	836	840			**838**
Total Cations	meq/L	0.01				785	818			**802**	813	805			**809**	790	796			**793**	817	824			**821**	761	779			**770**
Ionic Balance	%	0.01				3.24	1.45	5.31	3.93	**3.5**	1.92	2.82	3.91	5.15	**3.5**	4.66	2.93	-1.8	1.79	**1.9**	2.44	1.52	2.72	5.11	**2.9**	4.7	3.72	4.53	2.43	**3.8**
GHD Calculations																														
TDS-Calculated by GHD (d) (e)	*mg/L*		**41615**	**40240**	**42624**	47474	48360	42670	41733	**42134**	48344	48487	42734	42885	**42687**	48716	48052	41267	42059	**41499**	48954	48900	42147	43365	**42716**	46940	47479	41391	41725	**41409**
Total Anions calculated by GHD	meq/L		**721**			836	841	703	696	**698**	843	852	712	708	**709**	867	845	717	712	**712**	857	850	710	716	**712**	835	840	689	703	**694**
Total Cations calculated by GHD	meq/L		**708**			784	818	782	753	**766**	812	804	771	786	**775**	790	797	692	739	**715**	819	825	750	793	**770**	764	780	755	739	**742**
Ionic Balance calculated by GHD	%		**0.91**			3.21	1.39	5.34	3.95	**4.60**	1.89	2.93	3.94	5.17	**4.44**	4.66	2.94	1.81	1.82	**0.26**	2.31	1.51	2.74	5.13	**3.94**	4.49	3.74	4.55	2.46	**3.30**
Hardness Calculation by GHD																														
Calcium Hardness as $CaCO_3$	$mgCaCO_3/L$		**1169**	**1148**	**1190**	1200	1327.5	1300	1222.5	**1263**	1250	1255	1265	1243	**1253**	1220	1233	1290	1263	**1251**	1345	1240	1255	1315	**1289**	1230	1230	1205	1255	**1230**
Magnesium Hardness as $CaCO_3$	$mgCaCO_3/L$		**6234**	**6165**	**6329**	6206	6905	6864	6617	**6648**	6453	6494	6782	6905	**6658**	6288	6371	6042	6494	**6299**	6946	6412	6658	6946	**6740**	6288	6412	7151	6494	**6586**
Total Hardness as $CaCO_3$	$mgCaCO_3/L$		**7399**	**7355**	**7477**	7406	8232	8164	7840	**7910**	7703	7749	8047	8147	**7911**	7508	7603	7332	7756	**7550**	8291	7652	7913	8261	**8029**	7518	7642	8356	7749	**7816**
Metals																														
Dissolved Metals in Saline Water																														
Dissolved Aluminium	µg/L	10	**--**	**<10**	**--**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**
Dissolved Iron	µg/L	5	**--**	**<5**		<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	8	7	<5	8	**7.7**	8	8	9	8	**8.3**	8	8	9	9	**8.5**	8	8	9	<5	**8.3**	8	8	8	9	**8.3**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	5.6	5.4	5.63	5.33	**5.5**	5.5	5.2	5.56	5.4	**5.4**	5.4	5.4	5.69	5.51	**5.5**	5.4	5.3	5.6	5.72	**5.5**	5.2	5.4	5.26	5.5	**5.3**
Dissolved Manganese	µg/L	0.5	**--**	**<1**	**--**	1	0.8			**0.9**	3.7	0.9			**2.3**	1.1	1			**1.1**	1.2	0.9			**1.1**	1.6	0.9			**1.3**
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	10.1	10.1	8.97	8.93	**9.5**	10.1	9.56	9.17	8.96	**9.4**	9.83	10.6	8.39	9.02	**9.5**	10.2	10.2	8.78	8.47	**9.4**	10.1	9.97	8.26	8.7	**9.3**
Dissolved Silica	mg/L	0.1				1.3	0.9	0.12	0.12	**0.6**	0.8	1	0.16	0.16	**0.5**	0.9	1	0.18	0.17	**0.6**	0.8	0.9	0.17	0.2	**0.5**	1	0.9	0.12	0.12	**0.5**
Total Metals in Saline Water																														
Aluminium	µg/L	10	**--**	**<10**	**--**	<10	<10			**<10**	10	<10			**10.0**	20	20			**20.0**	20	20			**20.0**	<10	<10			**<10**
Iron	µg/L	5	**6**	**<5**	**6**	<5	<5			**<5**	19	10			**14.5**	16	16			**16.0**	19	30			**24.5**	9	9			**9.0**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0804425		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2008-CSR-3	Units	LOR																												
Arsenic	µg/L	0.5	**2**	**<1**	**2**	2.3	2.2			**2.3**	2.4	2			**2.2**	2.7	2.3			**2.5**	2.6	2.4			**2.5**	2.4	2.4			**2.4**
Beryllium	µg/L	0.1				<0.1	0.1			**<0.1**	0.2	<0.1			**0.2**	0.2	<0.1			**0.2**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**
Cadmium	µg/L	0.2	**--**	**<5**	**--**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**
Chromium - Hexavalent	mg/L	0.002																												
Chromium Total	µg/L	0.5	**7**	**7**	**7**	<0.5	<0.5			**<0.5**	1	<0.5			**0.8**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Copper	µg/L	1	**11**	**<10**	**11**	<1	<1			**<1**	<1	<1			**<1**	1	<1			**1.0**	1	1			**1.0**	<1	<1			**<1**
Lead	µg/L	0.2	**--**	**<5**	**--**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	0.2			**0.2**	<0.2	<0.2			**<0.2**
Manganese	µg/L	0.5	**4**	**<1**	**5**	1.3	1.1			**1.2**	1.7	1			**1.4**	1.7	1.1			**1.4**	1.2	1.3			**1.3**	1.3	1			**1.2**
Mercury	mg/L	0.0001	**--**	**<0.0003**	**--**																									
Molybdenum	µg/L	0.1				14.9	14.4			**14.7**	14.7	14.7			**14.7**	14.8	14.7			**14.8**	15	15.8			**15.4**	15.2	14.6			**14.9**
Nickel	µg/L	0.5	**--**	**<5**	**--**																									
Silver	µg/L	0.1																												
Tin	µg/L	5																												
Zinc	µg/L	5	**30**	**<30**	**32**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	6	14			**10.0**	<5	<5			**<5**
Nutrients																														
Ammonia as N	mgN/L	0.005	**0.007**	**<0.005**	**0.01**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			0.006	0.006	**0.006**
Ammonia (NH3, unionised) as N	mgN/L	0.005						<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Ammonia (NH4, ionised) as N	mgN/L	0.005						<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			0.006	0.006	**0.006**
Nitrite as N	mgN/L	0.005		**<0.005**	**--**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Nitrate as N	mgN/L	0	**--**	**0**				0	0	**0.000**			0	0	**0.000**			0	0	**0.000**			0	0	**0.000**			0	0	**0.000**
Nitrite + Nitrate as N	mgN/L	0.005	**0.006**	**<0.005**	**0.008**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Total Kjeldahl Nitrogen as N	mgN/L	0.05	**0.239**	**<0.05**	**0.62**			0.08	0.1	**0.09**			0.09	0.09	**0.09**			0.1	0.12	**0.11**			0.09	0.1	**0.10**			0.1	0.1	**0.10**
Total Nitrogen as N	mgN/L	0.05	**0.247**	**<0.06**	**0.62**			0.08	0.1	**0.1**			0.1	0.1	**0.1**			0.1	0.12	**0.1**			0.1	0.1	**0.1**			0.1	0.1	**0.1**
Total Phosphorus as P	mgP/L	0.005	**0.017**	**0.011**	**0.023**			0.009	0.006	**0.008**			0.007	0.008	**0.008**			0.012	0.014	**0.013**			0.01	0.01	**0.010**			0.008	0.01	**0.009**
Reactive Phosphorus as P	mgP/L	0.005	**0.006**	**<0.005**	**0.006**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Dissolved Organic Carbon	mg/L	1	**1.1**	**0.9**	**1.3**			0.9	0.9	**0.9**			0.9	0.9	**0.9**			0.9	0.8	**0.9**			0.9	1	**1.0**			0.9	0.9	**0.9**
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**			0.9	0.9	**0.9**			0.9	0.9	**0.9**			1	0.9	**1.0**			0.9	1	**1.0**			0.9	0.9	**0.9**
Biochemical Oxygen Demand	mg/L	2	**--**	**<2**	**--**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**
Oil & Grease	mg/L	1	**--**	**<1**	**--**			<1	<1	**<1**			1	<1	**1.0**			<1	<1	**<1**			1	<1	**1.0**			<1	<1	**<1**
Sulphide (h)	µg/L	2						8	12	**10**			8	12	**10**			9	12	**11**			12	10	**11**			10	10	**10**
Tributyltin	ngSn/L	0.1																												
Total Polychlorinated biphenyls	µg/L	0.1																												
Microbiological																														
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**			0.41	0.41	**0.41**			0.54	0.69	**0.62**			0.73	0.63	**0.68**			0.67	0.78	**0.73**			0.26	0.24	**0.25**
Heterotrophic Plate Count (37°C)	CFU/mL	1						10	44	**27**			1	0	**1**			59	34	**47**			1	14	**8**			1	0	**1**
Heterotrophic Plate Count (20°C)	CFU/mL	1						0	0	**0**			0	0	**0**			2	0	**1**			1	2	**2**			0	0	**0**
Enterococci	CFU/100mL	1						0	0	**0**			0	0	**0**			0	0	**0**			0	0	**0**			0	0	**0**
Faecal Coliforms	CFU/100mL	1						0	0	**0**			0	0	**0**			0	0	**0**			0	0	**0**			0	0	**0**
Coliforms	CFU/100mL	1		**0**	**0**			66	46	**56**			120	130	**125**			920	550	**735**			140	200	**170**			180	280	**230**

Notes

(a) It is likely that the ARUP analysis was done on 1.2 µm
(c) Field Measurements
(d) Averages calculated based on sum of average of an ion, when no AWQC value was available the average from ALS was used
(e) When no AWQC value was available the average from ALS was used, average based on average of all ion data
(f) Where relevant, average was calculated considering LOR's as values
(g) The ALS results for sodium and chloride have been excluded from the averages, see report for details.
Unexpected result which will require further verification
(h) Sulphide measurements by Sydney Water
Test not processed within holding time

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 9th Sampling Event (3 July 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	SC/YL
CHECKED BY	SC
Description of spreadsheet	Summary of water quality sampling results from ninth sampling event
Number of Worksheets (incl. this one)	2
Filename	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\3 July 2008\[Summary of results 3rd July 2008 v2.xls]

Data from Sampling Event

Sample Date	3/07/2008
Time of sampling	Site A - 9:15am - 11am. Site B - 11:20am - 1:10pm. Intake: 11:15am
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 10 L per sample (10 samples total)
Sampler Names	Steven Carter and Daniel Ahrens
Sampler Equipment	Van-dorn sampler and Yeo-Kal water quality meter
Photos of site etc	
Depth at site (m)	approx 12-13 m at site A and approx 12-13 m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	1.7m @ 9:05am and 3.01m @ 6:26pm (at Whyalla)
Low Tide (HH_MM	0.15m @ 2:25am and 1.56m @ 11:42am (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	Site A: NW?, Site B: NW?
Wind Speed (Knots)	Site A: <5 knots, Site B: <5 knots
Wave Height (metres- trough to crest)	Site A: <0.1 m, Site B: <0.1 m
General observations	Site A: cloudy, calm, 3m water visibility. Site B: cloudy, calm

REVISIONS

Rev.	Date	Checked	Description
A	17/07/08		DRAFT
0	03/11/08	SC	Issue to Client

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 9th Sampling Event (3 July 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
Job Number	33/14036
File Name	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\3 July 2008\[Summary of results 3rd July 2008 v2.xls]Cover
Print out	3/11/2008
Source Data	Arup Water Quality Summary Data Report, ALS Certificate of Analysis, AWQC Analytical Report, Sydney Water Analytical Report

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
				SC/YL		ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0809502		ALS				**001**	**006**				**002**	**007**				**003**	**008**				**004**	**009**				**005**	**010**			
AWQC reference: 108686-2008-CSR-6	Units	LOR																												
Physicochemical Parameters																														
Field Measurements		LOR /probe																												
pH (c)		0.01	**8.2**	**8.1**	**8.2**																									
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**																									
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**																									
Temperature (c)	^{o}C	0.1																												
DO (c)	mg/L	0.1																												
DO (c)	% sat																													
ORP (c)	mV																													
SDI_3 (c)						13.9				**13.9**	21.6				**21.6**	19	17.9				14.6	12.3			**13.5**					
SDI_5 (c)						11.1				**11.1**	15				**15.0**	13.4	13.2				11.6	10.5			**11.05**					
pH								8.1	8.1	**8.1**			8.1	8.1	**8.1**			8	8.1	**8.05**			8.1	8.1	**8.1**			8.1	8.1	**8.1**
Conductivity	µS/cm							63000	63000	**63000**			63300	63200	**63250**			64100	64100	**64100**			64100	64100	**64100**			63200	63400	**63300**
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	47200	43700	43500	43600	**44500**	45100	44200	43700	42400	**43850**	44700	45900	44200	44300	**44775**	44400	44700	44500	44200	**44450**	45000	44900	43800	43600	**44325**
Suspended Solids (SS) (1.2 µm)	mg/L	1	**10.5**	**5.3**	**17**	3	1	8	12	**4.5**	<1	<1	11	14	**5.5**	<1	<1	15	12	**13.5**	1	1	13	8	**3.5**	1	<1	11	16	**4**
Suspended Solids (SS) (0.45 µm)	mg/L	1				2	1			**1.5**	2	1			**1.5**	1	2			**1.5**	1	2			**1.5**	2	2			**2**
UV Absorbance @ 254 nm	%	0.01						0.021	0.026	**0.0235**			0.021	0.024	**0.0225**			0.029	0.022	**0.0255**			0.025	0.024	**0.0245**			0.023	0.017	**0.02**
Total Hardness as CaCO3	mg/L	1				7380	7620	7450	7540	**7498**	7520	7560	7540	7510	**7532.5**	7700	7710	7490	7640	**7635**	7680	7740	7730	7540	**7672.5**	7650	7640	7490	7300	**7520**
Alkalinity																														
Hydroxide Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**
Carbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**
Bicarbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				124	126	127	127	**126**	124	128	127	120	**125**	127	128	127	127	**127**	127	128	128	128	**128**	127	129	126	126	**127**
Hydroxide Alkalinity	$mgOH^-/L$	1	**0**	**0**	**0**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**
Carbonate Alkalinity	$mgCO_3^{2-}/L$	1	**0**	**0**	**0**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**
Bicarbonate Alkalinity	$mgHCO_3^-/L$	1	**155**	**155**	**157**	151	154	155	155	**154**	151	156	155	147	**152**	155	156	155	155	**155**	155	156	156	156	**156**	155	157	154	154	**155**
Total Alkalinity as CaCO3	$mgCaCO_3/L$	3/11/2008	**127.4**	ssue to Clier	**129**	124	126	127	127	**126**	124	128	127	121	**125**	127	128	127	127	**127**	127	128	128	128	**128**	127	129	126	126	**127**
Dissolved Major Anions																														
Chloride (g)	mg/L	1	**23067**	**22100**	**23633**	23100	23500	22100	21800	**21950**	23200	23600	22700	21800	**22250**	23900	23600	22200	22000	**22100**	23100	23500	22600	22100	**22350**	22600	23200	21800	21800	**21800**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3300	3400	3300	3330	**3333**	3350	3370	3330	3330	**3345**	3440	3440	3330	3390	**3400**	3430	3450	3420	3330	**3408**	3410	3410	3300	3270	**3348**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	85	83	79.3	82.7	**83**	85	80	78.8	78.7	**81**	87	87	79.7	81.1	**84**	86	83	82	80.4	**83**	85	86	79.1	80.3	**83**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.9	0.9	0.94	0.92	**1**	0.9	0.9	0.92	0.95	**1**	0.9	0.9	0.97	0.86	**1**	0.9	0.9	0.89	0.97	**1**	0.9	0.9	0.89	0.97	**1**
Dissolved Major Cations																														
Calcium	mg/L	1	**468**	**459**	**476**	455	473	476	479	**471**	467	471	479	485	**476**	479	478	478	486	**480**	475	482	492	478	**482**	472	473	478	467	**473**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1520	1560	1520	1540	**1535**	1540	1550	1540	1530	**1540**	1580	1580	1530	1560	**1563**	1580	1590	1580	1540	**1573**	1570	1570	1530	1490	**1540**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	13300	13600	12500	12600	**12550**	13600	13600	12700	12600	**12650**	13700	13900	12700	12900	**12800**	13800	13500	13000	12700	**12850**	13900	13500	12600	12300	**12450**
Potassium	mg/L	1	**474**	**462**	**480**	527	539	465	470	**500**	543	539	469	476	**507**	541	557	469	478	**511**	548	532	482	468	**508**	556	532	466	455	**502**
Ionic Balance																														
Total Anions	meq/L	0.01				722	736			**729**	728	738			**733**	748	741			**745**	726	738			**732**	711	729			**720**
Total Cations	meq/L	0.01				740	758			**749**	756	758			**757**	765	775			**770**	769	755			**762**	772	755			**764**
Ionic Balance	%	0.01				1.25	1.46	0.69	1.7	**1.3**	1.92	1.37	0.19	1.68	**1.3**	1.12	2.19	1.13	2.26	**1.7**	2.87	1.16	1.45	1.38	**1.7**	4.06	1.76	1.68	0.5	**2.0**
GHD Calculations																														
TDS-Calculated by GHD (d)	*mg/L*		**41615**	**40240**	**42624**	42454	43324	40609	40471	**40589**	42951	43382	41466	40460	**41015**	43898	43814	40956	41064	**41108**	43189	43309	41826	40866	**41423**	42763	42945	40421	40030	**40364**
Total Anions calculated by GHD	meq/L		**721**			723	736	695	687	**691**	727	739	712	687	**700**	749	740	698	694	**697**	726	737	712	696	**704**	711	728	686	686	**687**
Total Cations calculated by GHD	meq/L		**708**			740	758	705	711	**709**	756	757	715	711	**714**	764	773	715	726	**723**	768	756	733	715	**726**	772	754	710	693	**705**
Ionic Balance calculated by GHD	%		**0.91**			1.17	1.43	0.71	1.72	**1.26**	1.96	1.22	0.22	1.71	**1.00**	1.03	2.18	1.15	2.28	**1.82**	2.85	1.25	1.47	1.41	**1.51**	4.09	1.74	1.70	0.52	**1.27**
Hardness Calculation by GHD																														
Calcium Hardness as $CaCO_3$	$mgCaCO_3/L$		**1169**	**1148**	**1190**	1137.5	1182.5	1190	1197.5	**1177**	1167.5	1177.5	1197.5	1212.5	**1189**	1197.5	1195	1195	1215	**1201**	1187.5	1205	1230	1195	**1204**	1180	1182.5	1195	1167.5	**1181**
Magnesium Hardness as $CaCO_3$	$mgCaCO_3/L$		**6234**	**6165**	**6329**	6247	6412	6247	6329	**6309**	6329	6371	6329	6288	**6329**	6494	6494	6288	6412	**6422**	6494	6535	6494	6329	**6463**	6453	6453	6288	6124	**6329**
Total Hardness as $CaCO_3$	$mgCaCO_3/L$		**7399**	**7355**	**7477**	7385	7594	7437	7527	**7486**	7497	7548	7527	7501	**7518**	7691	7689	7483	7627	**7623**	7681	7740	7724	7524	**7667**	7633	7635	7483	7291	**7511**
Metals																														
Dissolved Metals in Saline Water																														
Dissolved Aluminium	µg/L	10	**--**	**<10**	**--**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**
Dissolved Iron	µg/L	5	**--**	**<5**		14	<5			**9.5**	9	<5			**7**	7	<5			**6**	<5	<5			**<5**	<5	<5			**<5**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	7	7	11	7	**8.0**	8	8	10	8	**8.5**	8	8	8	7	**7.8**	8	8	9	7	**8.0**	8	8	8	7	**7.8**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	5.2	4.6	5.11	5.12	**5.0**	4.9	4.6	5.37	5.15	**5.0**	4.9	4.8	5.16	5.22	**5.0**	4.8	4.7	5.32	5.1	**5.0**	4.6	4.7	5.08	5.04	**4.9**
Dissolved Manganese	µg/L	0.5	**--**	**<1**	**--**	0.6	0.6			**0.6**	0.5	0.7			**0.6**	0.8	0.7			**0.8**	0.7	0.8			**0.8**	0.6	0.7			**0.7**
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	9.41	9.76	7.73	7.77	**8.7**	9.26	10	7.5	7.64	**8.6**	10.5	9.98	7.71	7.48	**8.9**	9.68	10.3	7.57	7.76	**8.8**	9.37	10.6	7.5	7.54	**8.8**
Dissolved/Reactive Silica	mg/L	0.1				<0.1	<0.1	0.24	0.27	**0.18**	<0.1	<0.1	0.24	0.24	**0.17**	<0.1	<0.1	0.24	0.24	**0.17**	<0.1	<0.1	0.24	0.24	**0.17**	<0.1	<0.1	0.23	0.23	**0.17**
Total Metals in Saline Water																														
Aluminium	µg/L	10	**--**	**<10**	**--**	<10	<10			**<10**	10	20			**15.0**	20	20			**20.0**	20	20			**20.0**	90	<10			**50.0**
Iron	µg/L	5	**6**	**<5**	**6**	<5	<5			**<5**	5	8			**6.5**	10	18			**14.0**	10	11			**10.5**	7	5			**6.0**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
				SC/YL		ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0809502		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2008-CSR-6	Units	LOR																												
Arsenic	µg/L	0.5	**2**	**<1**	**2**	2.1	1.9			**2.0**	1.8	2.1			**2.0**	2	1.9			**2.0**	1.9	2.2			**2.1**	2.3	2			**2.2**
Beryllium	µg/L	0.1				<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**
Cadmium	µg/L	0.2	**--**	**<5**	**--**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**
Chromium - Hexavalent	mg/L	0.002																												
Chromium Total	µg/L	0.5	**7**	**7**	**7**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Copper	µg/L	1	**11**	**<10**	**11**	<1	<1			**<1**	1	1			**1.0**	2	1			**1.5**	1	<1			**1.0**	<1	<1			**<1**
Lead	µg/L	0.2	**--**	**<5**	**--**	<0.2	<0.2			**<0.2**	1	1.4			**1.2**	1.5	3.1			**2.3**	1.6	2.1			**1.9**	1	<0.2			**0.6**
Manganese	µg/L	0.5	**4**	**<1**	**5**	0.7	0.7			**0.7**	0.7	1			**0.9**	1.1	1.5			**1.3**	1	1.2			**1.1**	0.7	0.8			**0.8**
Mercury	mg/L	0.0001	**--**	**<0.0003**	**--**																									
Molybdenum	µg/L	0.1				12.9	13.1			**13.0**	12.9	13.8			**13.4**	13.3	13.6			**13.5**	13.5	14.7			**14.1**	13.9	13.2			**13.6**
Nickel	µg/L	0.5	**--**	**<5**	**--**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Silver	µg/L	0.1																												
Tin	µg/L	5																												
Zinc	µg/L	5	**30**	**<30**	**32**	<5	<5			**<5**	<5	<5			**<5**	5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**
Nutrients																														
Ammonia as N	mgN/L	0.005	**0.007**	**<0.005**	**0.01**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Ammonia (NH3, unionised) as N	mgN/L	0.005						<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Ammonia (NH4, ionised) as N	mgN/L	0.005						<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Nitrite as N	mgN/L	0.005		**<0.005**	**--**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Nitrate as N	mgN/L	0	**--**	**0**				0	0	**0.000**			0	0	**0.000**			0	0	**0.000**			0	0	**0.000**			0	0	**0.000**
Nitrite + Nitrate as N	mgN/L	0.005	**0.006**	**<0.005**	**0.008**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Total Kjeldahl Nitrogen as N	mgN/L	0.05	**0.239**	**<0.05**	**0.62**			0.12	0.11	**0.12**			0.13	0.15	**0.14**			0.12	0.13	**0.13**			0.13	0.13	**0.13**			0.11	0.11	**0.11**
Total Nitrogen as N	mgN/L	0.05	**0.247**	**<0.06**	**0.62**			0.12	0.12	**0.1**			0.14	0.16	**0.2**			0.12	0.14	**0.1**			0.14	0.14	**0.1**			0.12	0.12	**0.1**
Total Phosphorus as P	mgP/L	0.005	**0.017**	**0.011**	**0.023**			0.014	0.012	**0.013**			0.012	0.012	**0.012**			0.013	0.013	**0.013**			0.012	0.012	**0.012**			0.013	0.013	**0.013**
Reactive Phosphorus as P	mgP/L	0.005	**0.006**	**<0.005**	**0.006**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Dissolved Organic Carbon	mg/L	1	**1.1**	**0.9**	**1.3**			1.4	2.8	**2.1**			1.7	1.6	**1.7**			1.8	2	**1.9**			1.4	2.2	**1.8**			1.5	1.6	**1.6**
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**			1.4	2.9	**2.2**			2	1.8	**1.9**			1.8	2.5	**2.2**			1.5	2.3	**1.9**			2	1.8	**1.9**
Biochemical Oxygen Demand	mg/L	2	**--**	**<2**	**--**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**
Oil & Grease	mg/L	1	**--**	**<1**	**--**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**
Sulphide (h)	µg/L	2				8	8			**8**	7	8			**8**	10	9			**10**	8	9			**9**	13	13			**13**
Tributyltin	ngSn/L	0.1																												
Total Polychlorinated biphenyls	µg/L	0.1																												
Microbiological																														
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**			0.45	0.46	**0.46**			0.51	0.57	**0.54**			0.7	0.76	**0.73**			0.63	0.74	**0.69**			0.35	0.36	**0.36**
Heterotrophic Plate Count (37°C)	CFU/mL	1				~10	~1	0	2	**3**	~20	50	18	39	**32**	~25	~15	46	20	**27**	~10	25	12	18	**16**	<1	<1	0	0	**<1**
Heterotrophic Plate Count (20°C)	CFU/mL	1				~2	<1	0	0	**1**	40	65	49	57	**53**	30	~19	43	12	**26**	25	40	17	62	**36**	~1	~2	0	0	**1**
Enterococci	CFU/100mL	1						0	1	**1**			0	2	**1**			1	0	**1**			3	4	**4**			0	2	**1**
Faecal Coliforms	CFU/100mL	1				<2	<2	0	0	**<2**	<2	<2	0	0	**<2**	<2	<2	2	1	**<2**	<2	<2	1	0	**<2**	<2	<2	0	1	**<2**
Coliforms	CFU/100mL	1		**0**	**0**	<2	<2	27	27	**15**	<2	<2	50	78	**33**	<2	<2	36	36	**19**	<2	<2	34	34	**18**	<2	<2	59	100	**41**

Notes

(c)	Field Measurements
(d)	Averages calculated based on sum of average of an ion
(f)	Where relevant, average was calculated considering LOR's as values
(g)	The ALS results for sodium and chloride have been excluded from the averages, see report for details.
(h)	Sulphide measurements by Sydney Water
	Unexpected result which will require further verification
	Test not processed within holding time

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 10th Sampling Event (5 August 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	YL
CHECKED BY	
Description of spreadsheet	Summary of water quality sampling results from tenth sampling event
Number of Worksheets (incl. this one)	2
Filename	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\5 August 2008\[Summary of results 5th August 2008 v1.xls]

Data from Sampling Event

Sample Date	5/08/2008
Time of sampling	Site A - 9:05am - 11am. Site B - 11:30am - 1:20pm. Intake: 1:00pm
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 10 L per sample (10 samples total)
Sampler Names	Steven Carter and Daniel Ahrens
Sampler Equipment	Van-dorn sampler
Photos of site etc	
Depth at site (m)	approx 13-14 m at site A and approx 13 m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	2.16m @ 9:03am and 2.54m @ 8:30pm (at Whyalla)
Low Tide (HH_MM	0.48m @ 3:09am and 0.78m @ 2:53pm (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	Site A: SW, Site B: SW
Wind Speed (Knots)	Site A: 10-15 knots, Site B: 10-15 knots
Wave Height (metres- trough to crest)	Site A: 1-1.5 m, Site B: 0.5-1 m
General observations	Site A: 90% cloud cover. Site B: 50% cloud cover

REVISIONS

Rev.	Date	Checked	Description
A	14/10/08		DRAFT
0	03/11/08	SC	Issue to Client

Title **Port Bonython Seawater Monitoring Program - Results Summary - 10th Sampling Event (5 August 2008)**
Project BHP Billiton ODX PWSS Pilot Plant Works
Job Number 33/14036
File Name G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\5 August 2008\[Summary of results 5th August 2008 v1.xls]Cover
Print out 3/11/2008
Source Data Arup Water Quality Summary Data Report, ALS Certificate of Analysis, AWQC Analytical Report, Sydney Water Analytical Report

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0811237		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2008-CSR-8	Units	LOR																												
Physicochemical Parameters																														
Field Measurements		LOR /probe																												
pH (c)		0.01	**8.2**	**8.1**	**8.2**																									
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**																									
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**																									
Temperature (c)	^{o}C	0.1																												
DO (c)	mg/L	0.1																												
DO (c)	% sat																													
ORP (c)	mV																													
SDI_3 (c)						16				**16**	12.1	17.6			**14.85**	17.6	18.1			**17.85**	16.1	12.7			**14.4**					
SDI_5 (c)						11.9				**11.9**	10.4	12.7			**11.6**	12.6				**12.6**	11.1	9.8			**10.5**					
pH								8.1	8.1	**8.1**			8.1	8.1	**8.1**			8.1	8.1	**8.1**			8.1	8.1	**8.1**			8.1	8.1	**8.1**
Conductivity	µS/cm							63100	63100	**63100**			63200	63100	**63150**			63900	64000	**63950**			64000	64000	**64000**			63400	63300	**63350**
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	46900	45300	44900	45500	**45650**	45200	45800	45500	45800	**45575**	46700	45600	47200	47800	**46825**	46600	44600	46500	47100	**46200**	46000	44100	46000	46400	**45625**
Suspended Solids (SS) (1.2 µm)	mg/L	1	**10.5**	**5.3**	**17**	1	1	7	6	**3.8**	<1	2	6	5	**3.5**	1	1	7	4	**3.25**	1	<1	5	6	**3.25**	<1	1	5	8	**3.75**
Suspended Solids (SS) (0.45 µm)	mg/L	1				<1	6			**3.5**	1	2			**1.5**	<1	<1			**<1**	5	7			**6**	1	3			**2**
UV Absorbance @ 254 nm	%	0.01						0.023	0.025	**0.024**			0.02	0.022	**0.021**			0.028	0.022	**0.025**			0.016	0.023	**0.0195**			0.2	0.21	**0.205**
Total Hardness as CaCO3	mg/L	1				7610	7640	7600	7590	**7610**	7410	7550	7840	7840	**7660**	7530	7610	7830	7880	**7712.5**	7290	7630	7850	7790	**7640**	7350	7730	7750	7650	**7620**
Alkalinity																														
Hydroxide Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**
Carbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**
Bicarbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				128	129	128	128	**128**	128	129	129	128	**128**	133	130	129	129	**130**	130	129	129	129	**129**	127	139	128	127	**130**
Hydroxide Alkalinity	$mgOH^-/L$	1	**0**	**0**	**0**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**
Carbonate Alkalinity	$mgCO_3^{2-}/L$	1	**0**	**0**	**0**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**
Bicarbonate Alkalinity	$mgHCO_3^-/L$	1	**155**	**155**	**157**	156	157	156	156	**156**	156	157	157	156	**157**	162	159	157	157	**159**	159	157	157	157	**157**	155	170	156	155	**159**
Total Alkalinity as CaCO3	$mgCaCO_3/L$	1	**127.4**	**127**	**129**	128	129	128	127	**128**	128	129	129	128	**129**	133	130	129	128	**130**	130	129	129	128	**129**	127	139	128	127	**130**
Dissolved Major Anions																														
Chloride	mg/L	1	**23067**	**22100**	**23633**	23000	22200	22900	22700	**22700**	22300	22900	22700	23000	**22725**	23400	23700	23300	22600	**23250**	23500	22100	22700	23100	**22850**	23000	23600	22900	22600	**23025**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3270	3280	3420	3390	**3340**	3140	3250	3510	3480	**3345**	3220	3260	3510	3510	**3375**	3120	3240	3510	3480	**3338**	3150	3300	3510	3420	**3345**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	85	85	83.1	82.7	**84**	84	86	83.8	82.6	**84**	85	86	85	84.5	**85**	85	85	85.5	84.2	**85**	87	85	82.8	85.6	**85**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.9	0.9	0.99	1	**1**	0.9	0.9	1	1	**1**	0.9	1	1	1	**1**	0.9	1	1	1	**1**	0.9	0.9	1	1	**1**
Dissolved Major Cations																														
Calcium	mg/L	1	**468**	**459**	**476**	474	472	487	485	**480**	461	472	501	502	**484**	465	479	498	499	**485**	451	480	523	497	**488**	458	481	497	490	**482**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1560	1570	1550	1550	**1558**	1520	1550	1600	1600	**1568**	1550	1560	1600	1610	**1580**	1500	1560	1590	1590	**1560**	1510	1580	1580	1560	**1558**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	13200	13200	12900	12800	**13025**	13000	13400	13200	13300	**13225**	13200	13500	13200	13200	**13275**	12800	13500	13100	13100	**13125**	13000	13600	13100	12900	**13150**
Potassium	mg/L	1	**474**	**462**	**480**	519	518	477	477	**498**	520	504	490	492	**502**	502	520	490	491	**501**	488	513	491	487	**495**	498	517	485	482	**496**
Ionic Balance																														
Total Anions	meq/L	0.01				720	698			**709**	696	715			**706**	731	738			**735**	731	695			**713**	716	737			**727**
Total Cations	meq/L	0.01				739	743			**741**	728	745			**737**	736	755			**746**	714	753			**734**	724	758			**741**
Ionic Balance	%	0.01				1.28	3.04	0.37	0.5	**1.3**	2.22	2.02	1.87	1.62	**1.9**	0.32	1.09	0.69	2.11	**1.1**	1.16	4.02	1.59	0.76	**1.9**	0.51	1.39	1.05	1.03	**1.0**
GHD Calculations																														
TDS-Calculated by GHD (d)	*mg/L*		**41615**	**40240**	**42624**	42280	41498	41987	41655	**41855**	41198	42335	42256	42627	**42104**	42600	43281	42854	42166	**42725**	42118	41652	42171	42510	**42113**	41873	43348	42325	41707	**42313**
Total Anions calculated by GHD	meq/L		**721**			720	697	720	714	**713**	697	716	716	724	**713**	730	739	733	713	**729**	731	694	716	727	**717**	717	737	722	712	**722**
Total Cations calculated by GHD	meq/L		**708**			740	741	726	721	**732**	727	747	744	748	**742**	738	753	744	745	**745**	716	753	740	738	**737**	726	759	737	727	**737**
Ionic Balance calculated by GHD	%		**0.91**			1.39	3.01	0.39	0.52	**1.32**	2.11	2.11	1.89	1.64	**1.94**	0.56	0.94	0.71	2.14	**1.08**	1.04	4.11	1.61	0.78	**1.36**	0.59	1.46	1.07	1.06	**1.05**
Hardness Calculation by GHD																														
Calcium Hardness as $CaCO_3$	$mgCaCO_3/L$		**1169**	**1148**	**1190**	1185	1180	1217.5	1212.5	**1199**	1152.5	1180	1252.5	1255	**1210**	1162.5	1197.5	1245	1247.5	**1213**	1127.5	1200	1307.5	1242.5	**1219**	1145	1202.5	1242.5	1225	**1204**
Magnesium Hardness as $CaCO_3$	$mgCaCO_3/L$		**6234**	**6165**	**6329**	6412	6453	6371	6371	**6401**	6247	6371	6576	6576	**6442**	6371	6412	6576	6617	**6494**	6165	6412	6535	6535	**6412**	6206	6494	6494	6412	**6401**
Total Hardness as $CaCO_3$	$mgCaCO_3/L$		**7399**	**7355**	**7477**	7597	7633	7588	7583	**7600**	7400	7551	7829	7831	**7652**	7533	7609	7821	7865	**7707**	7293	7612	7842	7777	**7631**	7351	7696	7736	7637	**7605**
Metals																														
Dissolved Metals in Saline Water																														
Dissolved Aluminium	µg/L	10	**--**	**<10**	**--**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**
Dissolved Iron	µg/L	5	**--**	**<5**		<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	7	8	<5	<5	**6.3**	7	8	<5	<5	**6.3**	8	8	6.5	<5	**6.9**	8	8	<5	<5	**6.5**	7	7	<5	<5	**6.0**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	5.1	5.1	5.24	5.22	**5.2**	5.2	5.2	5.29	5.34	**5.3**	5.2	5.3	5.29	5.51	**5.3**	5.2	5.3	5.26	5.35	**5.3**	5.2	5.1	5.32	5.42	**5.3**
Dissolved Manganese	µg/L	0.5	**--**	**<1**	**--**	0.7	0.6			**0.7**	0.6	0.7			**0.7**	0.8	0.8			**0.8**	0.8	0.8			**0.8**	0.6	0.6			**0.6**
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	9.96	9.73	7.27	8.07	**8.8**	10.4	9.36	8.14	8.03	**9.0**	9.56	10.6	8.14	8.3	**9.2**	9.66	10.5	8.15	8.14	**9.1**	9.39	9.62	7.97	8.1	**8.8**
Dissolved/Reactive Silica	mg/L	0.1				460	478	0.11	0.04	**0.2**	420	485	0.06	0.04	**0.1**	453	446	0.05	0.05	**0.1**	465	435	0.05	0.05	**0.1**	453	454	0.04	0.05	**0.1**
Total Metals in Saline Water																														
Aluminium	µg/L	10	**--**	**<10**	**--**	10	10			**10**	20	10			**15.0**	10	10			**10.0**	20	20			**20.0**	10	10			**10.0**
Iron	µg/L	5	**6**	**<5**	**6**	14	15			**14.5**	19	20			**19.5**	13	13			**13.0**	15	16			**15.5**	14	14			**14.0**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0811237		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2008-CSR-8	Units	LOR																												
Arsenic	µg/L	0.5	**2**	**<1**	**2**	2.1	2			**2.1**	2.1	1.8			**2.0**	2	2			**2.0**	2	1.9			**2.0**	2	1.9			**2.0**
Beryllium	µg/L	0.1				<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**
Cadmium	µg/L	0.2	**--**	**<5**	**--**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**
Chromium - Hexavalent	mg/L	0.002																												
Chromium Total	µg/L	0.5	**7**	**7**	**7**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Copper	µg/L	1	**11**	**<10**	**11**	<1	<1			**<1**	1	1			**1.0**	<1	<1			**<1**	1	2			**1.5**	<1	<1			**<1**
Lead	µg/L	0.2	**--**	**<5**	**--**	5.2	5.3			**5.3**	3.1	2.7			**2.9**	1.2	1.2			**1.2**	1.4	1.9			**1.7**	<0.2	<0.2			**<0.2**
Manganese	µg/L	0.5	**4**	**<1**	**5**	0.9	0.9			**0.9**	0.9	0.8			**0.9**	0.9	0.9			**0.9**	1	1			**1.0**	0.8	0.9			**0.9**
Mercury	mg/L	0.0001	**--**	**<0.0003**	**--**																									
Molybdenum	µg/L	0.1				15.3	15.1			**15.2**	15.1	15.3			**15.2**	15.2	16			**15.6**	15.6	15.2			**15.4**	16.9	15.8			**16.4**
Nickel	µg/L	0.5	**--**	**<5**	**--**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Silver	µg/L	0.1																												
Tin	µg/L	5																												
Zinc	µg/L	5	**30**	**<30**	**32**	<5	<5			**<5**	5	<5			**5.0**	<5	<5			**<5**	5	<5			**5.0**	<5	<5			**<5**
Nutrients																														
Ammonia as N	mgN/L	0.005	**0.007**	**<0.005**	**0.01**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Ammonia (NH3, unionised) as N	mgN/L	0.005						<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Ammonia (NH4, ionised) as N	mgN/L	0.005						<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Nitrite as N	mgN/L	0.005		**<0.005**	**--**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Nitrate as N	mgN/L	0	**--**	**0**				0	0	**0.000**			0	0	**0.000**			0	0	**0.000**			0	0	**0.000**			0	0	**0.000**
Nitrite + Nitrate as N	mgN/L	0.005	**0.006**	**<0.005**	**0.008**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Total Kjeldahl Nitrogen as N	mgN/L	0.05	**0.239**	**<0.05**	**0.62**			0.06	0.1	**0.08**			0.06	0.12	**0.09**			0.07	0.13	**0.10**			0.14	0.1	**0.12**			0.1	0.1	**0.10**
Total Nitrogen as N	mgN/L	0.05	**0.247**	**<0.06**	**0.62**			0.06	0.1	**0.08**			0.06	0.12	**0.09**			0.08	0.14	**0.11**			0.14	0.1	**0.12**			0.1	0.1	**0.10**
Total Phosphorus as P	mgP/L	0.005	**0.017**	**0.011**	**0.023**			0.006	0.009	**0.008**			0.008	0.011	**0.010**			0.012	0.009	**0.011**			0.009	0.012	**0.011**			0.01	0.009	**0.010**
Reactive Phosphorus as P	mgP/L	0.005	**0.006**	**<0.005**	**0.006**			0.005	<0.005	**0.0**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Dissolved Organic Carbon	mg/L	1	**1.1**	**0.9**	**1.3**			1.3	1.3	**1.3**			1.3	1.5	**1.4**			1.3	1.4	**1.4**			1.3	1.4	**1.4**			1.3	1.3	**1.3**
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**			1.3	1.3	**1.3**			1.3	1.4	**1.4**			1.4	1.3	**1.4**			1.4	1.4	**1.4**			1.3	1.3	**1.3**
Biochemical Oxygen Demand	mg/L	2	**--**	**<2**	**--**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**
Oil & Grease	mg/L	1	**--**	**<1**	**--**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**
Sulphide (h)	µg/L	2				25	23			**24**	9	11			**10.0**	23	25			**24.0**	12	10			**11.0**	8	11			**10**
Tributyltin	ngSn/L	0.1																												
Total Polychlorinated biphenyls	µg/L	0.1																												
Microbiological																														
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**			0.4	0.39	**0.40**			0.41	0.21	**0.31**			0.68	0.63	**0.66**			0.65	0.61	**0.63**			0.41	0.51	**0.46**
Heterotrophic Plate Count (37°C)	CFU/mL	1						3	0	**2**			0	0	**0**			0	8	**4**			9	9	**9**			1	1	**1**
Heterotrophic Plate Count (20°C)	CFU/mL	1						1	0	**1**			1	2	**2**			0	0	**0**			4	9	**7**			0	0	**0**
Enterococci	CFU/100mL	1						0	0	**0**			2	2	**2**			1	0	**1**			1	0	**1**			0	0	**0**
Faecal Coliforms	CFU/100mL	1						0	0	**0**			0	0	**0**			0	0	**0**			1	1	**1**			0	0	**0**
Coliforms	CFU/100mL	1		**0**	**0**			17	19	**18**			14	20	**17**			23	30	**27**			31	26	**29**			41	83	**62**

Notes

(c)	Field Measurements
(d)	Averages calculated based on sum of average of an ion
(f)	Where relevant, average was calculated considering LOR's as values
(h)	Sulphide measurements by Sydney Water
	Unexpected result which will require further verification
	Test not processed within holding time

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 11th Sampling Event (26 August 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	YL
CHECKED BY	SC
Description of spreadsheet	Summary of water quality sampling results from sixth sampling event
Number of Worksheets (incl. this one)	2
Filename	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\26 August 2008\[Summary of results 26 August 2008 v1.xls]

Data from Sampling Event

Sample Date	26/08/2008
Time of sampling	Site A - 9:30am - 11:20am. Site B - 11:40am - 1:40pm. Intake: 2:15m
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 10 L per sample (10 samples total)
Sampler Names	Steven Carter and Daniel Ahrens
Sampler Equipment	Van-dorn sampler and Troll 9500 water quality meter
Photos of site etc	
Depth at site (m)	approx 14 m at site A and approx 14 m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	2.37m @ 10:17am (at Whyalla)
Low Tide (HH_MM	0.76m @ 1:16am and 0.52m @ 12:49am on 27th (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	Site A: NW?, Site B: NW?
Wind Speed (Knots)	Site A: <5 knots, Site B: 5 knots
Wave Height (metres- trough to crest)	Site A: 0.1 m, Site B: 0.1 m
General observations	Site A: no cloud cover, calm, 2m water visibility, dodge tide 27th. Site B: no cloud cover, calm, 2m water visibility, dodge tide 27th

REVISIONS

Rev.	Date	Checked	Description
A	14/10/08		DRAFT
0	03/11/08	SC	Issue to Client

Title **Port Bonython Seawater Monitoring Program - Results Summary - 11th Sampling Event (26 August 2008)**
Project BHP Billiton ODX PWSS Pilot Plant Works
Job Number 33/14036
File Name G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\26 August 2008\[Summary of results 26 August 2008 v1.xls]Round11 Average
Print out 3/11/2008
Source Data Arup Water Quality Summary Data Report, ALS Certificate of Analysis, AWQC Analytical Report

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0804425		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2008-CSR-9	Units	LOR																												
Physicochemical Parameters																														
Field Measurements		LOR /probe																												
pH (c)		0.01	**8.2**	**8.1**	**8.2**	8.24				**8.24**	8.29				**8.29**	8.31				**8.31**	8.33				**8.33**					
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**	60.81				**60.81**	61.75				**61.75**	63.69				**63.69**	63.99				**63.99**					
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**	1.4				**1.4**	1.3				**1.3**	1.4				**1.4**	1.3				**1.3**					
Temperature (c)	^{o}C	0.1				12.44				**12.44**	12.33				**12.33**	12.72				**12.72**	12.64				**12.64**					
DO (c)	mg/L	0.1				10.75				**10.75**	10.79				**10.79**	10.6				**10.6**	10.67				**10.67**					
DO (c)	% sat					127.8				**127.8**	128.3				**128.3**	128.4				**128.4**	129				**129**					
ORP (c)	mV					15				**15**	-26				**-26**	-37				**-37**	-39				**-39**					
SDI_3 (c)						18.9				**18.9**	20.5				**20.5**	19	19.9			**19.5**	18.3				**18.3**					
SDI_5 (c)						13.4				**13.4**	14.5				**14.5**	13.9	14.2			**14.1**	13.4				**13.4**					
pH								8	8	**8**			8	8	**8**			8	8	**8**			8	8	**8**			8	8	**8**
Conductivity	µS/cm							58300	57900	**58100**			57700	59200	**58450**			59700	59200	**59450**			60000	58500	**59250**			59300	58800	**59050**
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	44400	43500	45600	45600	**44775**	43400	43200	45200	45400	**44300**	39200	44800	46400	46200	**44150**	44800	43800	47000	46800	**45600**	43800	43200	45100	45200	**44325**
Suspended Solids (SS) (1.2 µm)	mg/L	1	**10.5**	**5.3**	**17**	1	1	4	2	**2**	1	2	5	1	**2**	<1	2	5	3	**2.75**	5	<1	<1	3	**2.5**	1	1	1	2	**1.3**
Suspended Solids (SS) (0.45 µm)	mg/L	1				4	3			**3.5**	3	4			**3.5**	3	6			**4.5**	7	4			**5.5**	3	3			**3**
UV Absorbance @ 254 nm	%	0.01						<0.001	<0.001	**<0.001**			<0.001	<0.001	**<0.001**			<0.001	<0.001	**<0.001**			<0.001	<0.001	**<0.001**			<0.001	<0.001	**<0.001**
Total Hardness as CaCO3	mg/L	1				7840	7430	7760	7600	**7658**	7510	7860	7800	8140	**7827.5**	7720	7750	8100	7900	**7867.5**	7600	7760	8060	8000	**7855**	7630	7500	7750	7710	**7647.5**
Alkalinity																														
Hydroxide Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**
Carbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**	<1	<1	0	0	**<1**
Bicarbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				121	123	125	126	**124**	124	128	125	126	**126**	126	126	126	126	**126**	124	126	127	126	**125.8**	122	125	126	125	**124.7**
Hydroxide Alkalinity	$mgOH^-/L$	1	**0**	**0**	**0**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**	<0.34	<0.34	0	0	**<0.34**
Carbonate Alkalinity	$mgCO_3^{2-}/L$	1	**0**	**0**	**0**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**	<0.6	<0.6	0	0	**<0.6**
Bicarbonate Alkalinity	$mgHCO_3^-/L$	1	**155**	**155**	**157**	148	150	152	154	**151**	151	156	153	154	**154**	154	154	154	154	**154**	151	154	155	154	**154**	149	153	154	153	**152**
Total Alkalinity as CaCO3	$mgCaCO_3/L$	1	**127.4**	**127**	**129**	121	123	125	126	**124**	124	128	125	126	**126**	126	126	126	126	**126**	124	126	127	126	**126**	122	125	126	126	**125**
Dissolved Major Anions																														
Chloride	mg/L	1	**23067**	**22100**	**23633**	21000	20300	21500	21300	**21025**	21200	20900	21500	21800	**21350**	21800	20900	22300	21400	**21600**	21500	21100	21500	23300	**21850**	21000	21000	21300	21500	**21200**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3570	3280	3450	3390	**3423**	3340	3540	3450	3570	**3475**	3450	3460	3600	3510	**3505**	3410	3470	3600	3540	**3505**	3390	3330	3420	3390	**3383**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	77	77	80.4	80.7	**78.8**	76	76	80.4	80.3	**78.2**	78	78	82.3	82.2	**80**	79	79	83.1	82.5	**81**	76	75	81.1	81.1	**78**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.9	0.9	0.93	0.89	**0.91**	0.9	0.9	0.86	0.81	**0.87**	0.9	0.9	0.89	0.88	**0.89**	0.9	0.9	0.85	0.88	**0.88**	0.9	0.9	0.87	0.86	**0.88**
Dissolved Major Cations																														
Calcium	mg/L	1	**468**	**459**	**476**	496	481	502	488	**492**	482	507	501	524	**504**	494	503	524	508	**507**	487	502	525	515	**507**	497	486	497	497	**494**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1600	1510	1580	1550	**1560**	1530	1600	1590	1660	**1595**	1580	1580	1650	1610	**1605**	1550	1580	1640	1630	**1600**	1550	1530	1580	1570	**1558**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	13000	12600	12600	12400	**12650**	13200	13000	12700	13200	**13025**	13500	12900	13200	12800	**13100**	13300	13100	13100	13000	**13125**	13000	12900	12700	12500	**12775**
Potassium	mg/L	1	**474**	**462**	**480**	540	505	472	461	**495**	531	521	471	494	**504**	537	525	491	479	**508**	531	530	498	487	**512**	515	515	471	467	**492**
Ionic Balance																														
Total Anions	meq/L	0.01				669	644			**657**	669	666			**668**	689	665			**677**	681	671			**676**	664	665			**665**
Total Cations	meq/L	0.01				736	708			**722**	736	734			**735**	754	731			**743**	745	740			**743**	729	724			**727**
Ionic Balance	%	0.01				4.71	4.77	2.45	2.1	**3.5**	4.75	4.89	2.81	4	**4.1**	4.47	4.72	2.88	3.37	**3.9**	4.48	4.9	4.17	0.28	**3.5**	4.64	4.24	3.2	2.16	**3.6**
GHD Calculations																														
TDS-Calculated by GHD (d)	*mg/L*		**41615**	**40240**	**42624**	40446	38919	40351	39838	**39889**	40526	40316	40460	41496	**40699**	41608	40115	42017	40558	**41075**	41024	40531	41117	42723	**41349**	40192	40004	40217	40173	**40147**
Total Anions calculated by GHD	meq/L		**721**			669	644	681	674	**667**	670	666	681	692	**677**	690	664	707	680	**685**	680	670	684	734	**692**	666	664	675	680	**671**
Total Cations calculated by GHD	meq/L		**708**			736	710	716	704	**716**	738	736	721	750	**736**	756	730	749	727	**741**	744	739	744	738	**741**	731	725	720	710	**722**
Ionic Balance calculated by GHD	%		**0.91**			4.75	4.88	2.48	2.13	**3.56**	4.82	5.00	2.83	4.02	**4.17**	4.61	4.72	2.91	3.40	**3.90**	4.51	4.88	4.20	0.31	**3.44**	4.71	4.36	3.22	2.18	**3.62**
Hardness Calculation by GHD																														
Calcium Hardness as $CaCO_3$	$mgCaCO_3/L$		**1169**	**1148**	**1190**	1240	1202.5	1255	1220	**1229**	1205	1267.5	1252.5	1310	**1259**	1235	1257.5	1310	1270	**1268**	1217.5	1255	1312.5	1287.5	**1268**	1242.5	1215	1242.5	1242.5	**1236**
Magnesium Hardness as $CaCO_3$	$mgCaCO_3/L$		**6234**	**6165**	**6329**	6576	6206	6494	6371	**6412**	6288	6576	6535	6823	**6555**	6494	6494	6782	6617	**6597**	6371	6494	6740	6699	**6576**	6371	6288	6494	6453	**6401**
Total Hardness as $CaCO_3$	$mgCaCO_3/L$		**7399**	**7355**	**7477**	7816	7409	7749	7591	**7641**	7493	7844	7787	8133	**7814**	7729	7751	8092	7887	**7865**	7588	7749	8053	7987	**7844**	7613	7503	7736	7695	**7637**
Metals																														
Dissolved Metals in Saline Water																														
Dissolved Aluminium	µg/L	10	**--**	**<10**	**--**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**
Dissolved Iron	µg/L	5	**--**	**<5**		<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**	<5	<5			**<5**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	7	7	9	8	**7.8**	7	7	8	8	**7.5**	8	7	8	9	**8.0**	7	8	9	9	**8.3**	7	7	9	9	**8.0**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	5	5.4	5.2	5.33	**5.2**	5	5.1	5.27	5.44	**5.2**	5.4	5.2	5.53	5.39	**5.4**	5.5	5.5	5.72	5.42	**5.5**	5.1	5.4	5.26	5.36	**5.3**
Dissolved Manganese	µg/L	0.5	**--**	**<1**	**--**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	9.63	9.73	8.23	8.26	**9.0**	9.42	9.39	8.75	7.67	**8.8**	9.32	9.19	9.67	8.82	**9.3**	9.56	9.45	9.14	8.33	**9.1**	9.31	9.21	7.59	8.81	**8.7**
Dissolved/Reactive Silica	mg/L	0.1				<0.1	<0.1	0.07	0.07	**0.09**	<0.1	0.1	0.07	0.1	**0.09**	<0.1	0.1	0.1	0.08	**0.10**	0.1	<0.1	0.1	16.2	**0.10**	<0.1	<0.1	0.07	0.08	**0.09**
Total Metals in Saline Water																														
Aluminium	µg/L	10	**--**	**<10**	**--**	<10	<10			**<10**	<10	<10			**<10**	<10	<10			**<10**	<10	10			**10.0**	<10	<10			**<10**
Iron	µg/L	5	**6**	**<5**	**6**	<5	10			**7.5**	18	<5			**11.5**	6	<5			**5.5**	<5	<5			**<5**	8	<5			**6.5**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)										Site B: Fitzgerald Bay										Intake				
						ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC			ALS		AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Intake	Intake	Average
ALS reference: ES0804425		ALS				001	006				002	007				003	008				004	009				005	010			
AWQC reference: 108686-2008-CSR-9	Units	LOR																												
Arsenic	µg/L	0.5	**2**	**<1**	**2**	2.4	2			**2.2**	2.4	1.5			**1.95**	1.6	1.7			**1.65**	1.6	1.8			**1.7**	1.6	1.7			**1.7**
Beryllium	µg/L	0.1				<0.1	<0.1			**<0.1**	0.1	<0.1			**0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**	<0.1	<0.1			**<0.1**
Cadmium	µg/L	0.2	**--**	**<5**	**--**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**	<0.2	<0.2			**<0.2**
Chromium - Hexavalent	mg/L	0.002																												
Chromium Total	µg/L	0.5	**7**	**7**	**7**	<0.5	0.9			**0.7**	2.9	<0.5			**1.7**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Copper	µg/L	1	**11**	**<10**	**11**	2	<1			**1.5**	1	<1			**1.0**	2	2			**2.0**	2	3			**2.5**	<1	<1			**<1**
Lead	µg/L	0.2	**--**	**<5**	**--**	2.9	2.1			**2.5**	0.6	0.6			**0.6**	2.4	2.1			**2.3**	3	2.5			**2.8**	<0.2	<0.2			**<0.2**
Manganese	µg/L	0.5	**4**	**<1**	**5**	0.6	<0.5			**0.6**	1.2	0.5			**0.9**	0.9	0.5			**0.7**	<0.5	0.5			**0.5**	0.7	<0.5			**0.6**
Mercury	mg/L	0.0001	**--**	**<0.0003**	**--**																									
Molybdenum	µg/L	0.1				15	12.9			**14.0**	13.2	13.1			**13.2**	13.6	13.5			**13.6**	12.9	14.2			**13.6**	13.4	13.9			**13.65**
Nickel	µg/L	0.5	**--**	**<5**	**--**	0.6	<0.5			**0.6**	0.9	<0.5			**0.7**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**	<0.5	<0.5			**<0.5**
Silver	µg/L	0.1																												
Tin	µg/L	5																												
Zinc	µg/L	5	**30**	**<30**	**32**	<5	<5			**<5**	<5	<5			**<5**	8	8			**8.0**	<5	5			**5.0**	16	<5			**10.5**
Nutrients																														
Ammonia as N	mgN/L	0.005	**0.007**	**<0.005**	**0.01**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Ammonia (NH3, unionised) as N	mgN/L	0.005						<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Ammonia (NH4, ionised) as N	mgN/L	0.005						<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Nitrite as N	mgN/L	0.005		**<0.005**	**--**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Nitrate as N	mgN/L	0	**--**	**0**				0	0	**0**			0	0	**0**			0	0	**0**			0	0	**0**			0	0	**0**
Nitrite + Nitrate as N	mgN/L	0.005	**0.006**	**<0.005**	**0.008**			<0.005	<0.005	**<0.005**			<0.0085	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Total Kjeldahl Nitrogen as N	mgN/L	0.05	**0.239**	**<0.05**	**0.62**			0.09	0.07	**0.08**			0.15	0.08	**0.12**			0.1	0.12	**0.11**			0.11	0.11	**0.11**			0.07	0.12	**0.10**
Total Nitrogen as N	mgN/L	0.05	**0.247**	**<0.06**	**0.62**			0.09	0.08	**0.1**			0.15	0.08	**0.1**			0.1	0.12	**0.1**			0.11	0.11	**0.1**			0.08	0.12	**0.1**
Total Phosphorus as P	mgP/L	0.005	**0.017**	**0.011**	**0.023**			0.011	0.011	**0.011**			0.012	0.011	**0.012**			0.013	0.015	**0.014**			0.012	0.012	**0.012**			0.013	0.013	**0.013**
Reactive Phosphorus as P	mgP/L	0.005	**0.006**	**<0.005**	**0.006**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**			<0.005	<0.005	**<0.005**
Dissolved Organic Carbon	mg/L	1	**1.1**	**0.9**	**1.3**			1.4	1.4	**1.4**			1.4	1.5	**1.5**			1.4	1.4	**1.4**			1.7	1.5	**1.6**			1.4	1.5	**1.5**
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**			1.4	1.3	**1.4**			1.4	1.4	**1.4**			1.4	1.4	**1.4**			1.6	1.4	**1.5**			1.4	1.4	**1.4**
Biochemical Oxygen Demand	mg/L	2	**--**	**<2**	**--**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**			<2	<2	**<2**
Oil & Grease	mg/L	1	**--**	**<1**	**--**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**			<1	<1	**<1**
Sulphide	µg/L	2																												
Tributyltin	ngSn/L	0.1																												
Total Polychlorinated biphenyls	µg/L	0.1																												
Microbiological																														
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**			0.27	0.24	**0.26**			0.28	0.32	**0.30**			0.51	0.45	**0.48**			0.66	0.56	**0.61**			0.31	0.29	**0.30**
Heterotrophic Plate Count (37°C)	CFU/mL	1						1	1	**1**			10	5	**8**			3	5	**4**			21	17	**19**			9	1	**5**
Heterotrophic Plate Count (20°C)	CFU/mL	1						29	4	**17**			2	6	**4**			8	12	**10**			53	19	**36**			1	3	**2**
Enterococci	CFU/100mL	1						0	0	**0**			0	1	**1**			2	6	**4**			2	1	**2**			0	0	**0**
Faecal Coliforms	CFU/100mL	1						0	0	**0**			0	0	**0**			1	1	**1**			0	0	**0**			0	2	**1**
Coliforms	CFU/100mL	1		**0**	**0**			4	2	**3**			11	10	**11**			9	11	**10**			23	15	**19**			35	8	**22**

Notes

(c)	Field Measurements
(d)	Averages calculated based on sum of average of an ion
(f)	Where relevant, average was calculated considering LOR's as values
	Unexpected result which will require further verification

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 12th Sampling Event (24 September 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	YL
CHECKED BY	SC
Description of spreadsheet	Summary of water quality sampling results from sixth sampling event
Number of Worksheets (incl. this one)	2
Filename	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\24 September 08\[Summary of results 24 September 2008 v1.xls]

Data from Sampling Event

Sample Date	24/09/2008
Time of sampling	Site A - 10:00am - 11:30am. Site B - 11:30am - 1:20pm. Intake: 11:45m
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 10 L per sample (10 samples total)
Sampler Names	Steven Carter and Daniel Ahrens
Sampler Equipment	Van-dorn sampler and Troll 9500 water quality meter
Photos of site etc	
Depth at site (m)	approx 13 m at site A and approx 13 m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	2.27m @ 8:51am (at Whyalla)
Low Tide (HH_MM	0.76m @ 12:38am and 0.63m @ 12:18am on 25th (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	Site A: SE, Site B: SE
Wind Speed (Knots)	Site A: 5-10 knots, Site B: 5-10 knots
Wave Height (metres- trough to crest)	Site A: 0.2 m, Site B: <0.2 m
General observations	Site A: no cloud cover, calm, 2-3m water visibility. Site B: no cloud cover, calm, 2-3m water visibility

REVISIONS

Rev.	Date	Checked	Description
A	04/11/08		DRAFT
0	19/12/08	SC	Issue to Client

Title **Port Bonython Seawater Monitoring Program - Results Summary - 12th Sampling Event (24 September 2008)**
Project BHP Billiton ODX PWSS Pilot Plant Works
Job Number 33/14036
File Name G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\24 September 08\[Summary of results 24 September 2008 v1.xls]Round12 Average
Print out 19/12/2008
Source Data Arup Water Quality Summary Data Report, AWQC Analytical Report

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)						Site B: Fitzgerald Bay								
						AWQC			AWQC			AWQC			AWQC			AWQC		
AWQC reference: 108686-2008-CSR-10	Units	LOR	Average	Min	Max	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Average
Physicochemical Parameters																				
Field Measurements		LOR /probe																		
pH (c)		0.01	**8.2**	**8.1**	**8.2**	7.83		**7.83**	7.84		**7.84**	7.89		**7.89**	7.9		**7.9**			
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**	56.3		**56.3**	56.4		**56.4**	56.7		**56.7**	56.8		**56.8**			
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**	26		**26**	23		**23**	13		**13**	16		**16**			
Temperature (c)	^{o}C	0.1				14.9		**14.9**	14.9		**14.9**	15.3		**15.3**	15.1		**15.1**			
DO (c)	mg/L	0.1				9.1		**9.1**	9.1		**9.1**	9.1		**9.1**	9.2		**9.2**			
DO (c)	% sat																			
ORP (c)	mV					164		**164**	164		**164**	187		**187**	174		**174**			
SDI_3 (c)						22.2	25.2	**23.7**	25.7	25.8	**25.8**	21.8		**21.8**	13.2		**13.2**			
SDI_5 (c)						16.0	17.0	**16.5**				14.7		**14.7**	10.3		**10.34**			
pH						7.9	8.1	**8**	7.9	8	**7.95**	8.1	8.1	**8.1**	8.1	8	**8.05**	8	8.1	**8.05**
Conductivity	µS/cm					58500	57800	**58150**	57900	58400	**58150**	58700	59300	**59000**	58000	58700	**58350**	58200	58100	**58150**
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	45400	45500	**45450**	45500	45700	**45600**	46200	46300	**46250**	45900	46200	**46050**	44600	44900	**44750**
Suspended Solids (SS) (1.2 µm)	mg/L	1	**10.5**	**5.3**	**17**	4	5	**5**	4	7	**6**	5	4	**4.5**	5	5	**5.0**	4	3	**3.5**
Suspended Solids (SS) (0.45 µm)	mg/L	1																		
UV Absorbance @ 254 nm	%	0.01																		
Total Hardness as CaCO3	mg/L	1				7810	7830	**7820**	8000	7900	**7950**	7900	7850	**7875**	7990	7840	**7915**	7840	7940	**7890**
Alkalinity																				
Hydroxide Alkalinity as CaCO3	$mgCaCO_3/L$	1				0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Carbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Bicarbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				128	128	**128**	128	128	**128**	129	129	**129**	129	129	**129**	128	128	**128**
Hydroxide Alkalinity	$mgOH^-/L$	1	**0**	**0**	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Carbonate Alkalinity	$mgCO_3^{2-}/L$	1	**0**	**0**	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Bicarbonate Alkalinity	$mgHCO_3^-/L$	1	**155**	**155**	**157**	156	157	**157**	157	156	**157**	158	157	**158**	158	158	**158**	156	157	**157**
Total Alkalinity as CaCO3	$mgCaCO_3/L$	1	**127.4**	**127**	**129**	128	128	**128**	128	128	**128**	129	129	**129**	129	129	**129**	128	128	**128**
Dissolved Major Anions																				
Chloride	mg/L	1	**23067**	**22100**	**23633**	22800	22600	**22700**	22600	23000	**22800**	23000	22700	**22850**	23400	22600	**23000**	22500	22900	**22700**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3360	3390	**3375**	3450	3450	**3450**	3450	3420	**3435**	3480	3390	**3435**	3390	3420	**3405**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	79.3	79.8	**79.6**	79.9	79.6	**79.75**	80.7	80.6	**80.7**	80.5	80.9	**80.7**	79.5	79.9	**79.7**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.95	0.95	**0.95**	0.95	0.95	**0.95**	0.97	0.97	**0.97**	0.96	0.97	**0.97**	0.95	0.93	**0.94**
Dissolved Major Cations																				
Calcium	mg/L	1	**468**	**459**	**476**	505	496	**501**	514	510	**512**	510	504	**507**	511	500	**506**	502	508	**505**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1590	1600	**1595**	1630	1610	**1620**	1610	1600	**1605**	1630	1600	**1615**	1600	1620	**1610**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	13200	13100	**13150**	13500	13100	**13300**	13400	13200	**13300**	13400	13200	**13300**	13300	13300	**13300**
Potassium	mg/L	1	**474**	**462**	**480**	490	486	**488**	506	496	**501**	498	492	**495**	498	493	**496**	496	496	**496**
Ionic Balance																				
Total Anions	meq/L	0.01																		
Total Cations	meq/L	0.01																		
Ionic Balance	%	0.01				1.85	1.92	**1.9**	3.25	1.17	**2.2**	2.04	2.01	**2.0**	1.34	2.24	**1.8**	2.74	2.04	**2.4**
GHD Calculations																				
TDS-Calculated by GHD (d)	*mg/L*		**41615**	**40240**	**42624**	42195	41924	**42059**	42452	42417	**42434**	42722	42168	**42445**	43173	42037	**42605**	42039	42496	**42267**
Total Anions calculated by GHD	meq/L		**721**			716	711	**713**	712	723	**718**	723	714	**719**	735	711	**723**	708	720	**714**
Total Cations calculated by GHD	meq/L		**708**			743	739	**741**	760	741	**751**	754	744	**749**	756	744	**750**	748	750	**749**
Ionic Balance calculated by GHD	%		**0.91**			1.87	1.95	**1.91**	3.28	1.20	**2.24**	2.07	2.04	**2.05**	1.37	2.26	**1.81**	2.77	2.07	**2.42**
Hardness Calculation by GHD																				
Calcium Hardness as $CaCO_3$	$mgCaCO_3/L$		**1169**	**1148**	**1190**	1262.5	1240	**1251**	1285	1275	**1280**	1275	1260	**1268**	1277.5	1250	**1264**	1255	1270	**1263**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)						Site B: Fitzgerald Bay								
						AWQC			AWQC			AWQC			AWQC			AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Average
AWQC reference: 108686-2008-CSR-10	Units	LOR																		
Magnesium Hardness as $CaCO_3$	mg$CaCO_3$/L		**6234**	**6165**	**6329**	6535	6576	**6555**	6699	6617	**6658**	6617	6576	**6597**	6699	6576	**6638**	6576	6658	**6617**
Total Hardness as $CaCO_3$	mg$CaCO_3$/L		**7399**	**7355**	**7477**	7797	7816	**7807**	7984	7892	**7938**	7892	7836	**7864**	7977	7826	**7901**	7831	7928	**7880**
Metals																				
Dissolved Metals in Saline Water																				
Dissolved Aluminium	µg/L	10	--	**<10**	--															
Dissolved Iron	µg/L	5	--	**<5**		<5	<5	**<5**	<5	<5	**<5**	<5	<5	**<5**	<5	<5	**<5**	<5	<5	**<5**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	9	8	**9**	8	10	**9**	7	8	**8**	8	8	**8**	10	8	**9**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	5.28	5.45	**5.37**	5.34	5.91	**5.63**	5.4	5.5	**5.45**	5.51	5.36	**5.44**	5.4	5.48	**5.44**
Dissolved Manganese	µg/L	0.5	--	**<1**	--															
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	8.17	8.52	**8.35**	8.77	8.32	**8.55**	8.6	8.21	**8.41**	8.99	8.29	**8.64**	8.79	8.59	**8.69**
Dissolved/Reactive Silica	mg/L	0.1				0.08	0.08	**0.08**	0.07	0.08	**0.08**	0.08	0.08	**0.08**	0.08	0.08	**0.08**	0.08	0.2	**0.14**
Total Metals in Saline Water																				
Aluminium	µg/L	10	--	**<10**	--															
Iron	µg/L	5	**6**	**<5**	**6**	5	<5	**5**	7	<5	**6**	<5	<5	**<5**	<5	<5	**<5**	<5	<5	**<5**
Arsenic	µg/L	0.5	**2**	**<1**	**2**															
Beryllium	µg/L	0.1																		
Cadmium	µg/L	0.2	--	**<5**	--															
Chromium - Hexavalent	mg/L	0.002																		
Chromium Total	µg/L	0.5	**7**	**7**	**7**															
Copper	µg/L	1	**11**	**<10**	**11**															
Lead	µg/L	0.2	--	**<5**	--															
Manganese	µg/L	0.5	**4**	**<1**	**5**															
Mercury	mg/L	0.0001	--	**<0.0003**	--															
Molybdenum	µg/L	0.1																		
Nickel	µg/L	0.5	--	**<5**	--															
Silver	µg/L	0.1																		
Tin	µg/L	5																		
Zinc	µg/L	5	**30**	**<30**	**32**															
Nutrients																				
Ammonia as N	mgN/L	0.005	**0.007**	**<0.005**	**0.01**															
Ammonia (NH3, unionised) as N	mgN/L	0.005																		
Ammonia (NH4, ionised) as N	mgN/L	0.005																		
Nitrite as N	mgN/L	0.005		**<0.005**	--															
Nitrate as N	mgN/L	0	--	**0**																
Nitrite + Nitrate as N	mgN/L	0.005	**0.006**	**<0.005**	**0.008**	0.005	0.005	**0.005**	<0.005	<0.005	**<0.005**	<0.005	<0.005	**<0.005**	<0.005	<0.005	**<0.005**	0.005	<0.005	**0.005**
Total Kjeldahl Nitrogen as N	mgN/L	0.05	**0.239**	**<0.05**	**0.62**	0.34	0.33	**0.34**	0.15	0.14	**0.15**	0.16	0.16	**0.16**	0.33	0.31	**0.32**	0.14	0.13	**0.135**
Total Nitrogen as N	mgN/L	0.05	**0.247**	**<0.06**	**0.62**	0.34	0.34	**0.34**	0.16	0.14	**0.15**	0.16	0.16	**0.16**	0.34	0.32	**0.33**	0.14	0.14	**0.14**
Total Phosphorus as P	mgP/L	0.005	**0.017**	**0.011**	**0.023**	0.016	0.014	**0.02**	0.017	0.013	**0.015**	0.011	0.01	**0.011**	0.014	0.013	**0.014**	0.014	0.01	**0.012**
Reactive Phosphorus as P	mgP/L	0.005	**0.006**	**<0.005**	**0.006**															
Dissolved Organic Carbon	mg/L	1	**1.1**	**0.9**	**1.3**															
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**	1.5	1.5	**1.50**	1.3	1.3	**1.30**	1.4	1.4	**1.40**	1.5	1.3	**1.40**	1.3	1.3	**1.30**
Biochemical Oxygen Demand	mg/L	2	--	**<2**	--															
Oil & Grease	mg/L	1	--	**<1**	--	<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**		<1	**<1**	<1	<1	**<1**
Sulphide	µg/L	2																		
Tributyltin	ngSn/L	0.1																		
Total Polychlorinated biphenyls	µg/L	0.1																		
Microbiological																				
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**	0.42	0.43	**0.43**	0.43	0.47	**0.45**	0.42	0.41	**0.42**	0.48	0.49	**0.49**	0.42	0.43	**0.43**
Heterotrophic Plate Count (37°C)	CFU/mL	1																		
Heterotrophic Plate Count (20°C)	CFU/mL	1																		
Enterococci	CFU/100mL	1																		
Faecal Coliforms	CFU/100mL	1																		
Coliforms	CFU/100mL	1		**0**	**0**															

Notes

(c)	Field Measurements
(d)	Averages calculated based on sum of average of an ion
(f)	Where relevant, average was calculated considering LOR's as values
	Unexpected result which will require further verification
	Test not processed within holding time

Title	**Port Bonython Seawater Monitoring Program - Results Summary - 13th Sampling Event (28 October 2008)**
Project	BHP Billiton ODX PWSS Pilot Plant Works
JOB NUMBER	33/14036
MADE BY	YL
CHECKED BY	SC
Description of spreadsheet	Summary of water quality sampling results from sixth sampling event
Number of Worksheets (incl. this one)	2
Filename	G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\28 October 2008\[Summary of results 28 October 2008 v1.xls]

Data from Sampling Event

Sample Date	28/10/2008
Time of sampling	Site A - 9:45am - 11:30am. Site B - 12:30am - 1:15pm. Intake: 1:15m
Latitude: (Deg,Min)	Site A: 137,46.613, Site B: 137,46.990
Longitude: (Deg,Min)	Site A: -33,0.030, Site B: -32,58.654
Sample Volume (L)	Approx 10 L per sample (10 samples total)
Sampler Names	Steven Carter and Daniel Ahrens
Sampler Equipment	Van-dorn sampler and Troll 9500 water quality meter
Photos of site etc	
Depth at site (m)	approx 13 m at site A and approx 13 m at site B
Depth of sample (m)	approx. 1 m below the surface and 2 – 3 m from the seabed
High Tide (HH_MM)	2.54m @ 5:59am and 2.10m @ 7:00pm (at Whyalla)
Low Tide (HH_MM	0.94m @ 12:12am and 0.32m @ 1:01pm (at Whyalla)
Swell Direction (Cardinal)	
Rainfall (mm)	Nil
Wind Direction: (Cardinal)	Site A: SSE, Site B: SSE
Wind Speed (Knots)	Site A: 10 - 15 knots, Site B: 15 knots
Wave Height (metres- trough to crest)	Site A: 1 m, Site B: 1 m
General observations	Site A: no cloud cover, few white caps. Site B: no cloud cover, few white caps

REVISIONS

Rev.	Date	Checked	Description
0	19/12/08	SC	Issue to Client

Title **Port Bonython Seawater Monitoring Program - Results Summary - 13th Sampling Event (28 October 2008)**
Project BHP Billiton ODX PWSS Pilot Plant Works
Job Number 33/14036
File Name G:\33\14036\Tech - Pilot Plant Works\Water Quality Sampling\28 October 2008\[Summary of results 28 October 2008 v1.xls]Round13 Average
Print out 19/12/2008
Source Data Arup Water Quality Summary Data Report, AWQC Analytical Report

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)						Site B: Fitzgerald Bay								
						AWQC			AWQC			AWQC			AWQC			AWQC		
AWQC reference: 108686-2008-CSR-11	Units	LOR	Average	Min	Max	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Average
Physicochemical Parameters																				
Field Measurements		LOR /probe																		
pH (c)		0.01	**8.2**	**8.1**	**8.2**	8.25		**8.25**	7.49		**7.49**	7.59		**7.59**	7.69		**7.69**			
EC (c)	mS/cm		**59.8**	**58.6**	**60.6**	59.1		**59.1**	59.37		**59.37**	60.32		**60.32**	60.31		**60.31**			
Turbidity (c)	NTU	0.1	**3.0**	**1.1**	**8**	13.6		**13.6**	13		**13**	20.4		**20.4**	27		**27**			
Temperature (c)	^{o}C	0.1				18.73		**18.73**	18.7		**18.7**	19.08		**19.08**	19.03		**19.03**			
DO (c)	mg/L	0.1				7.2		**7.2**	7.3		**7.3**	8		**8**	8		**8**			
DO (c)	% sat					97.9		**97.9**	99.5		**99.5**	109.7		**109.7**	109.4		**109.4**			
ORP (c)	mV					242		**242**	278		**278**	345		**345**	328		**328**			
SDI_3 (c)						18.1	15.6	**16.9**							19.7		**19.7**			
SDI_5 (c)						13.5	12.4	**13.0**							14		**14**			
pH						8.2	8.1	**8.15**	8.1	8.1	**8.1**	8	8.1	**8.05**	8.1	8.1	**8.1**	8.1	8.1	**8.1**
Conductivity	µS/cm					59000	59400	**59200**	59700	59800	**59750**	60400	60900	**60650**	60500	60900	**60700**	59900	60100	**60000**
TDS @ 180 deg C	mg/L	1	**42913**	**41400**	**43767**	43000	42900	**42950**	41500	42800	**42150**	43900	43800	**43850**	44900	45500	**45200**	40500	44400	**42450**
Suspended Solids (SS) (1.2 µm)	mg/L	1	**10.5**	**5.3**	**17**	6	4	**5**	2	6	**4**	3	3	**3.0**	7	7	**7.0**	5	2	**3.5**
Suspended Solids (SS) (0.45 µm)	mg/L	1																		
UV Absorbance @ 254 nm	%	0.01																		
Total Hardness as CaCO3	mg/L	1				7880	7730	**7805**	7890	7880	**7885**	7890	8020	**7955**	8120	7790	**7955**	8030	7830	**7930**
Alkalinity																				
Hydroxide Alkalinity as CaCO3	$mgCaCO_3/L$	1				0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Carbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Bicarbonate Alkalinity as CaCO3	$mgCaCO_3/L$	1				127	128	**128**	128	128	**128**	129	130	**130**	130	130	**130**	129	129	**129**
Hydroxide Alkalinity	$mgOH^-/L$	1	**0**	**0**	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Carbonate Alkalinity	$mgCO_3^{2-}/L$	1	**0**	**0**	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Bicarbonate Alkalinity	$mgHCO_3^-/L$	1	**155**	**155**	**157**	155	156	**156**	157	156	**157**	158	158	**158**	158	158	**158**	157	158	**158**
Total Alkalinity as CaCO3	$mgCaCO_3/L$	1	**127.4**	**127**	**129**	127	128	**128**	128	128	**128**	129	130	**130**	130	130	**130**	129	129	**129**
Dissolved Major Anions																				
Chloride	mg/L	1	**23067**	**22100**	**23633**	22200	22700	**22450**	22800	22700	**22750**	23200	23000	**23100**	23200	23300	**23250**	23200	23100	**23150**
Sulfate as SO4 2-	mg/L	1	**3246**	**3150**	**3300**	3420	3390	**3405**	3450	3450	**3450**	3450	3510	**3480**	3510	3630	**3570**	3510	3420	**3465**
Bromide	mg/L	0.01	**83.1**	**79.3**	**85.8**	78	79.6	**78.8**	80.8	79.4	**80.10**	80.9	82.3	**81.6**	79.9	82.4	**81.2**	79.9	81.1	**80.5**
Fluoride	mg/L	0.1	**0.95**	**0.94**	**0.97**	0.89	0.89	**0.89**	0.89	0.89	**0.89**	0.91	0.91	**0.91**	0.89	0.9	**0.90**	0.9	0.9	**0.90**
Dissolved Major Cations																				
Calcium	mg/L	1	**468**	**459**	**476**	500	490	**495**	506	502	**504**	503	508	**506**	515	498	**507**	510	496	**503**
Magnesium	mg/L	1	**1527**	**1500**	**1557**	1610	1580	**1595**	1610	1610	**1610**	1610	1640	**1625**	1660	1590	**1625**	1640	1600	**1620**
Sodium (g)	mg/L	1	**12560**	**12300**	**12900**	13000	12700	**12850**	13000	12900	**12950**	13000	13200	**13100**	13300	12800	**13050**	13200	12800	**13000**
Potassium	mg/L	1	**474**	**462**	**480**	485	476	**481**	488	483	**486**	487	497	**492**	499	483	**491**	493	480	**487**
Ionic Balance																				
Total Anions	meq/L	0.01																		
Total Cations	meq/L	0.01																		
Ionic Balance	%	0.01				2.45	0.38	**1.4**	1.24	1.12	**1.2**	0.44	1.53	**1.0**	1.57	-0.7	**0.4**	1.15	0	**0.6**
GHD Calculations																				
TDS-Calculated by GHD (d)	*mg/L*		**41615**	**40240**	**42624**	41463	41586	**41524**	42107	41895	**42001**	42503	42610	**42557**	42937	42557	**42747**	42805	42150	**42477**
Total Anions calculated by GHD	meq/L		**721**			700	714	**707**	718	715	**716**	729	725	**727**	730	736	**733**	730	726	**728**
Total Cations calculated by GHD	meq/L		**708**			736	720	**728**	736	731	**734**	736	748	**742**	754	725	**740**	748	726	**737**
Ionic Balance calculated by GHD	%		**0.91**			2.48	0.41	**1.44**	1.26	1.14	**1.20**	0.47	1.56	**1.02**	1.60	0.71	**0.46**	1.18	0.02	**0.60**
Hardness Calculation by GHD																				
Calcium Hardness as $CaCO_3$	$mgCaCO_3/L$		**1169**	**1148**	**1190**	1250	1225	**1238**	1265	1255	**1260**	1257.5	1270	**1264**	1287.5	1245	**1266**	1275	1240	**1258**

			ARUP - Santos Jetty Fire Pump			Site A: East of the Santos Jetty (and west of Point Lowly)						Site B: Fitzgerald Bay								
						AWQC			AWQC			AWQC			AWQC			AWQC		
			Average	Min	Max	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	Average	1 m from surface	1 m from surface	Average	2-3 m from bottom	2-3 m from bottom	Average	Intake	Intake	Average
AWQC reference: 108686-2008-CSR-11	Units	LOR																		
Magnesium Hardness as $CaCO_3$	mg$CaCO_3$/L		**6234**	**6165**	**6329**	6617	6494	**6555**	6617	6617	**6617**	6617	6740	**6679**	6823	6535	**6679**	6740	6576	**6658**
Total Hardness as $CaCO_3$	mg$CaCO_3$/L		**7399**	**7355**	**7477**	7867	7719	**7793**	7882	7872	**7877**	7875	8010	**7943**	8110	7780	**7945**	8015	7816	**7916**
Metals																				
Dissolved Metals in Saline Water																				
Dissolved Aluminium	µg/L	10	--	**<10**	--															
Dissolved Iron	µg/L	5	--	**<5**		<5	<5	**<5**	<5	<5	**<5**	<5	<5	**<5**	<5	<5	**<5**	<5	<5	**<5**
Dissolved Barium	µg/L	1	**8**	**8**	**9**	<5	<5	**<5**	8	<5	**6.5**	9	10	**9.5**	9	12	**10.5**	10	7	**8.5**
Dissolved Boron	mg/L	0.1	**4.88**	**3.89**	**5.27**	5.24	5.19	**5.2**	5.37	5.29	**5.3**	5.32	5.48	**5.4**	5.55	5.22	**5.4**	5.43	5.3	**5.4**
Dissolved Manganese	µg/L	0.5	--	**<1**	--															
Dissolved Strontium	mg/L	0.01	**9.1**	**7.43**	**11.1**	8.54	8.41	**8.48**	8.67	8.49	**8.58**	8.33	8.22	**8.28**	8.73	9.37	**9.1**	8.52	8.46	**8.5**
Dissolved/Reactive Silica	mg/L	0.1				0.14	0.15	**0.15**	0.2	0.15	**0.18**	0.16	0.11	**0.14**	0.11	0.19	**0.2**	0.17	0.17	**0.2**
Total Metals in Saline Water																				
Aluminium	µg/L	10	--	**<10**	--															
Iron	µg/L	5	**6**	**<5**	**6**	19	20	**19.5**	28	13	**20.5**	15	14	**14.5**	26	31	**28.5**	<5	<5	**<5**
Arsenic	µg/L	0.5	**2**	**<1**	**2**															
Beryllium	µg/L	0.1																		
Cadmium	µg/L	0.2	--	**<5**	--															
Chromium - Hexavalent	mg/L	0.002																		
Chromium Total	µg/L	0.5	**7**	**7**	**7**															
Copper	µg/L	1	**11**	**<10**	**11**															
Lead	µg/L	0.2	--	**<5**	--															
Manganese	µg/L	0.5	**4**	**<1**	**5**															
Mercury	mg/L	0.0001	--	**<0.0003**	--															
Molybdenum	µg/L	0.1																		
Nickel	µg/L	0.5	--	**<5**	--															
Silver	µg/L	0.1																		
Tin	µg/L	5																		
Zinc	µg/L	5	**30**	**<30**	**32**															
Nutrients																				
Ammonia as N	mgN/L	0.005	**0.007**	**<0.005**	**0.01**															
Ammonia (NH3, unionised) as N	mgN/L	0.005																		
Ammonia (NH4, ionised) as N	mgN/L	0.005																		
Nitrite as N	mgN/L	0.005		**<0.005**	--															
Nitrate as N	mgN/L	0	--	**0**																
Nitrite + Nitrate as N	mgN/L	0.005	**0.006**	**<0.005**	**0.008**	<0.005	<0.005	**<0.005**	<0.005	<0.005	**<0.005**	<0.005	<0.005	**<0.005**	<0.005	<0.005	**<0.005**	<0.005	<0.005	**0.005**
Total Kjeldahl Nitrogen as N	mgN/L	0.05	**0.239**	**<0.05**	**0.62**	0.13	0.4	**0.27**	0.2	0.19	**0.20**	0.16	0.19	**0.18**	0.15	0.32	**0.24**	0.09	0.09	**0.090**
Total Nitrogen as N	mgN/L	0.05	**0.247**	**<0.06**	**0.62**	0.14	0.4	**0.27**	0.2	0.2	**0.20**	0.16	0.2	**0.18**	0.16	0.32	**0.24**	0.1	0.1	**0.10**
Total Phosphorus as P	mgP/L	0.005	**0.017**	**0.011**	**0.023**	0.01	0.015	**0.01**	0.014	0.012	**0.013**	0.014	0.016	**0.015**	0.016	0.016	**0.016**	0.009	0.012	**0.011**
Reactive Phosphorus as P	mgP/L	0.005	**0.006**	**<0.005**	**0.006**															
Dissolved Organic Carbon	mg/L	1	**1.1**	**0.9**	**1.3**															
Total Organic Carbon	mg/L	1	**1.8**	**0.9**	**4**	1.3	1.4	**1.35**	1.4	1.5	**1.45**	1.4	1.4	**1.40**	1.4	1.4	**1.40**	1.3	1.2	**1.25**
Biochemical Oxygen Demand	mg/L	2	--	**<2**	--															
Oil & Grease	mg/L	1	--	**<1**	--	<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**	<1	<1	**<1**
Sulphide	µg/L	2																		
Tributyltin	ngSn/L	0.1																		
Total Polychlorinated biphenyls	µg/L	0.1																		
Microbiological																				
Chlorophyll a	µg/L	1	**1.1**	**0.77**	**1.5**	0.27	0.26	**0.27**	0.45	0.12	**0.29**	0.6	0.61	**0.61**	0.58	0.48	**0.53**	0.31	0.31	**0.31**
Heterotrophic Plate Count (37°C)	CFU/mL	1																		
Heterotrophic Plate Count (20°C)	CFU/mL	1																		
Enterococci	CFU/100mL	1																		
Faecal Coliforms	CFU/100mL	1																		
Coliforms	CFU/100mL	1		**0**	**0**															

Notes

(c)	Field Measurements
(d)	Averages calculated based on sum of average of an ion
(f)	Where relevant, average was calculated considering LOR's as values
	Unexpected result which will require further verification
	Test not processed within holding time

Appendix D

Graphical Summary of Sampling Results

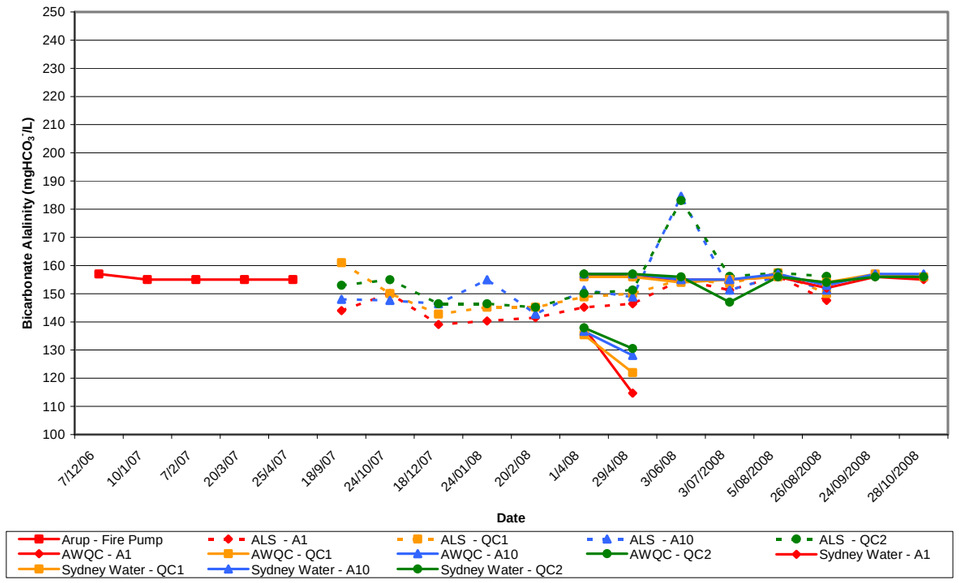


Figure 21 Sampling Location A (West of Point Lowly) – Bicarbonate Alkalinity Results

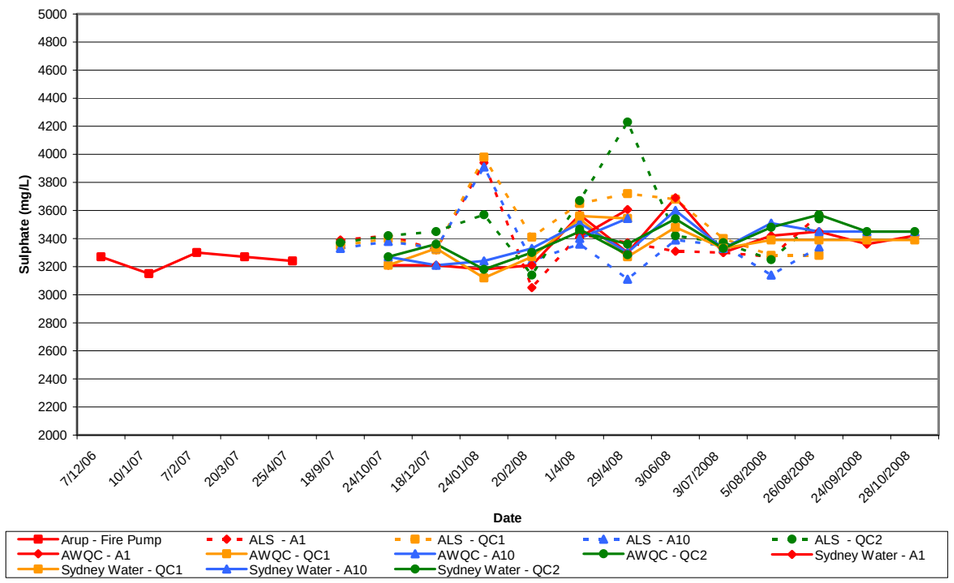


Figure 22 Sampling Location A (West of Point Lowly) – Sulphate Results

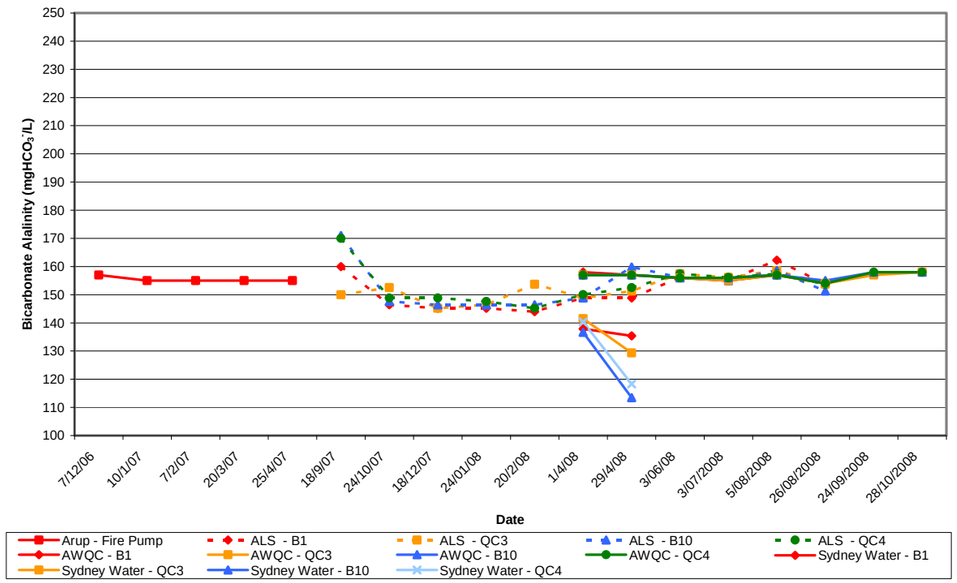


Figure 23 Sampling Location B (North of Point Lowly) – Bicarbonate Alkalinity Results

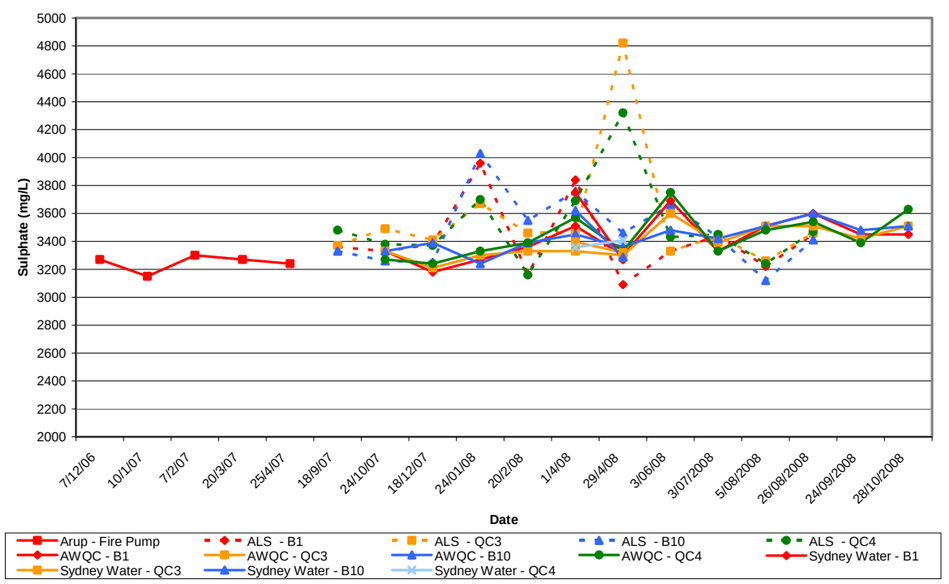


Figure 24 Sampling Location B (North of Point Lowly) – Sulphate Results

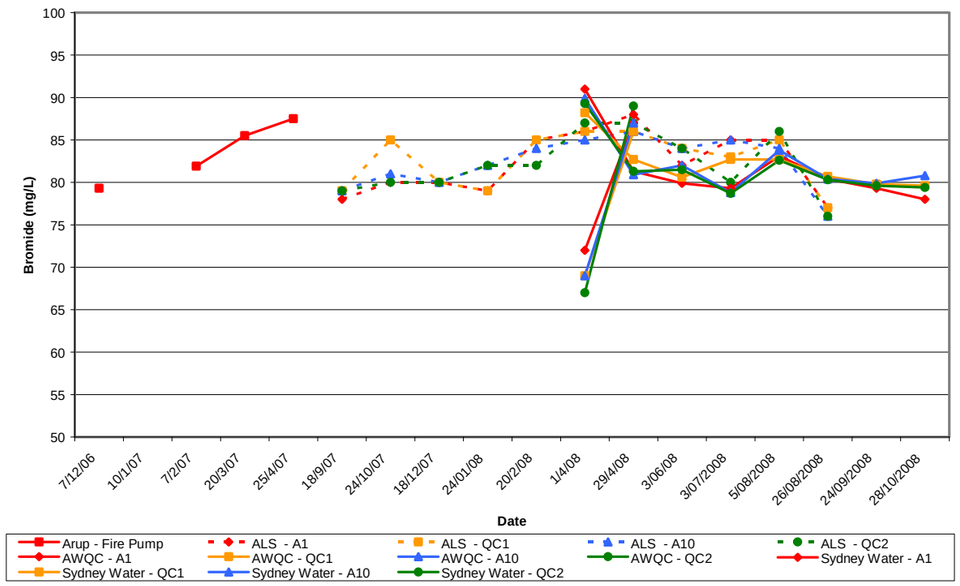


Figure 25 Sampling Location A (West of Point Lowly) – Bromide Results

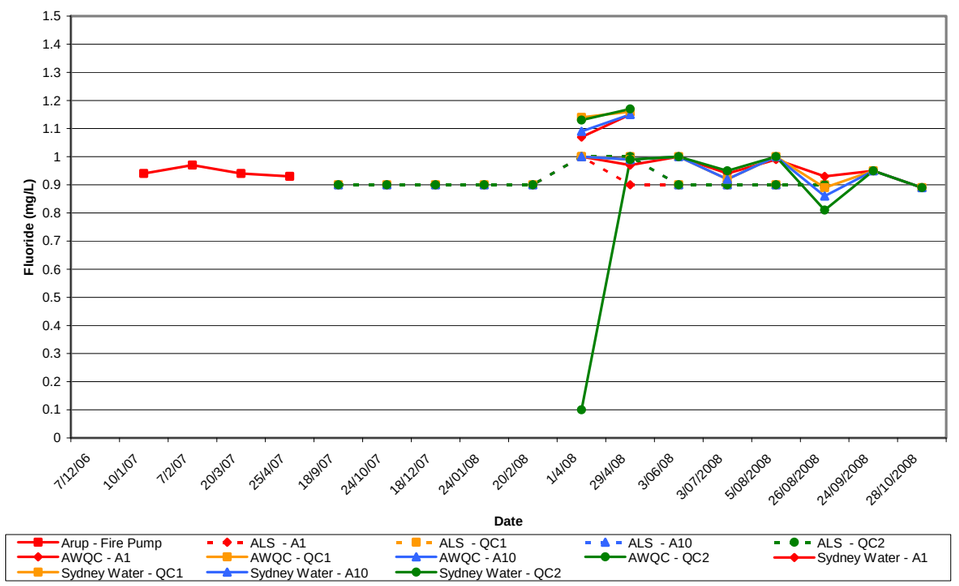


Figure 26 Sampling Location A (West of Point Lowly) – Fluoride Results

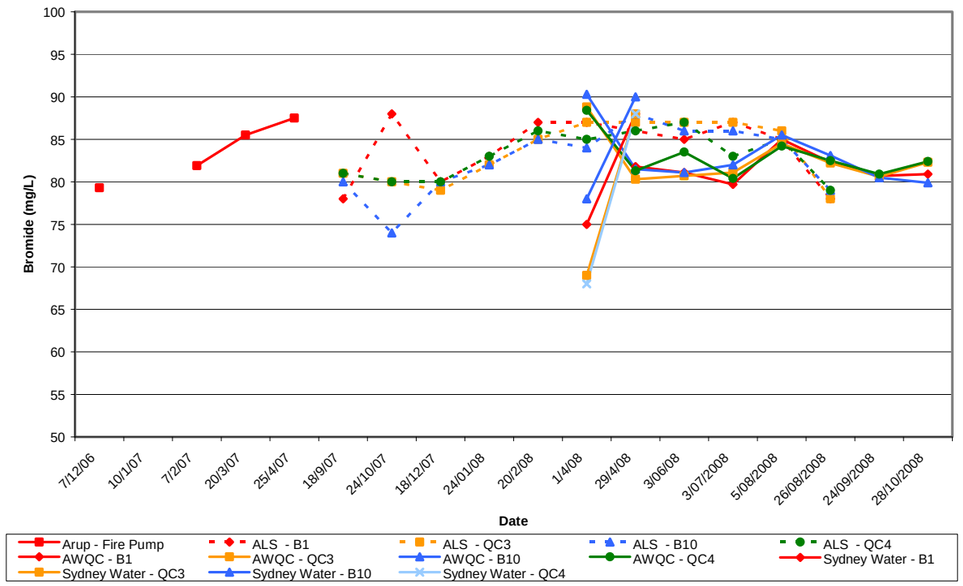


Figure 27 Sampling Location B (North of Point Lowly) – Bromide Results

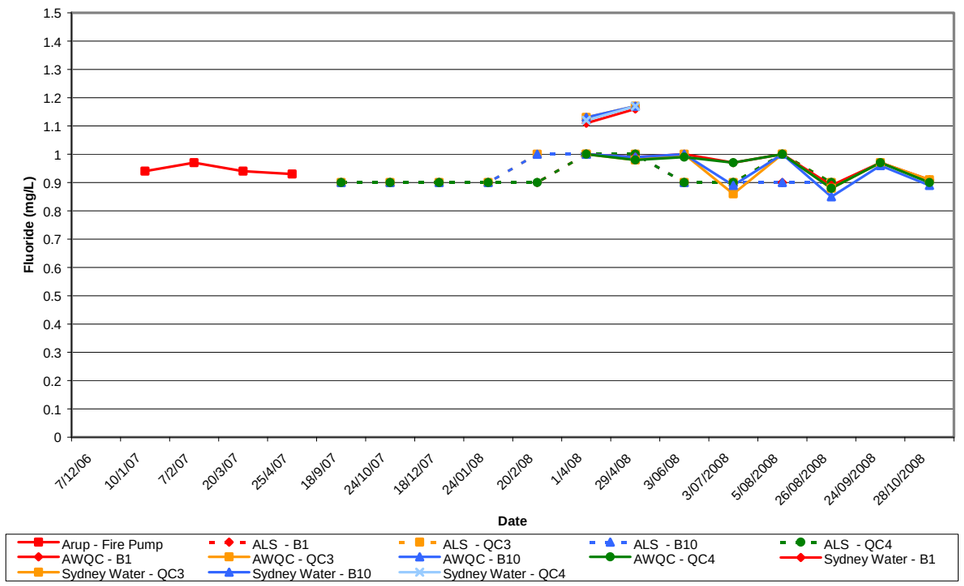


Figure 28 Sampling Location B (North of Point Lowly) – Fluoride Results

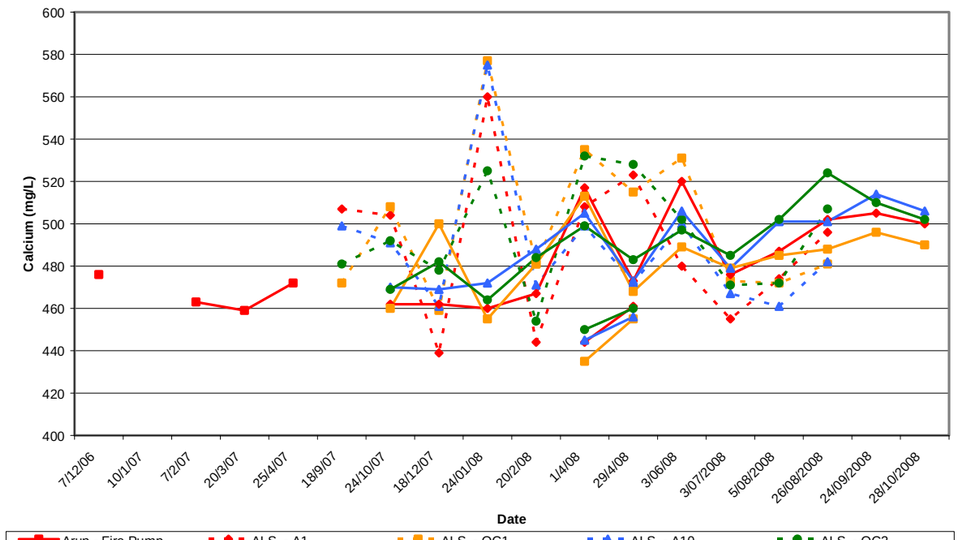


Figure 29 Sampling Location A (West of Point Lowly) – Calcium Results

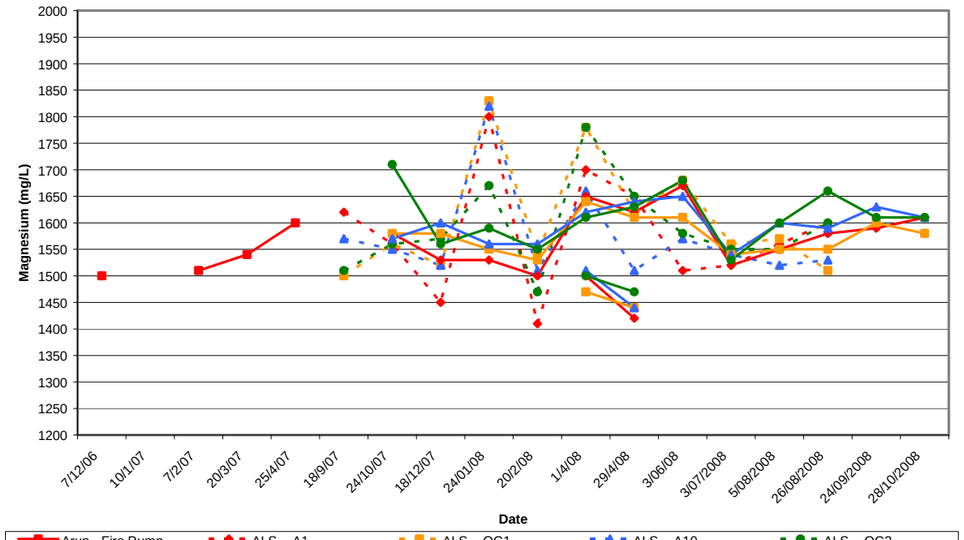


Figure 30 Sampling Location A (West of Point Lowly) – Magnesium Results

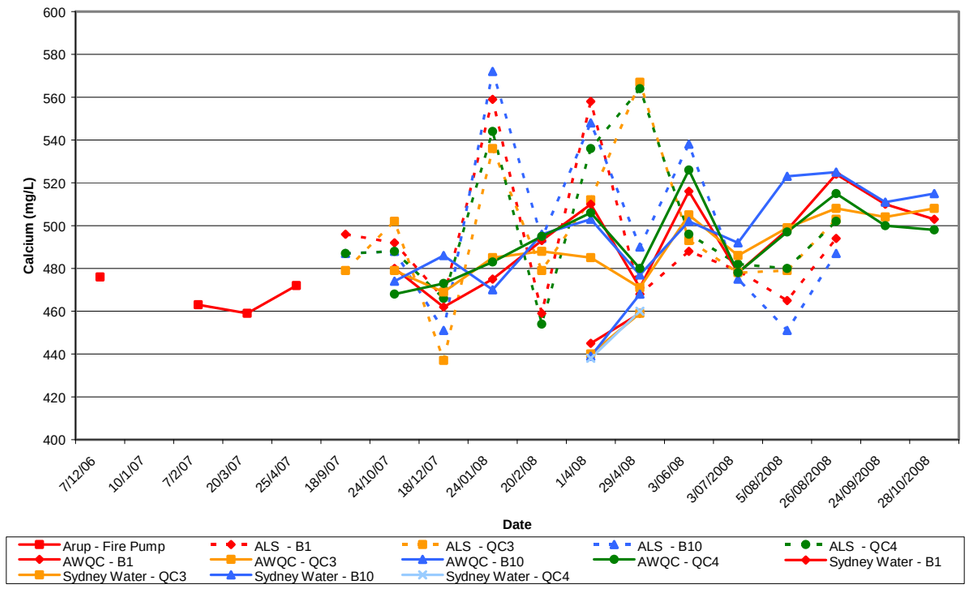


Figure 31 Sampling Location B (North of Point Lowly) – Calcium Results

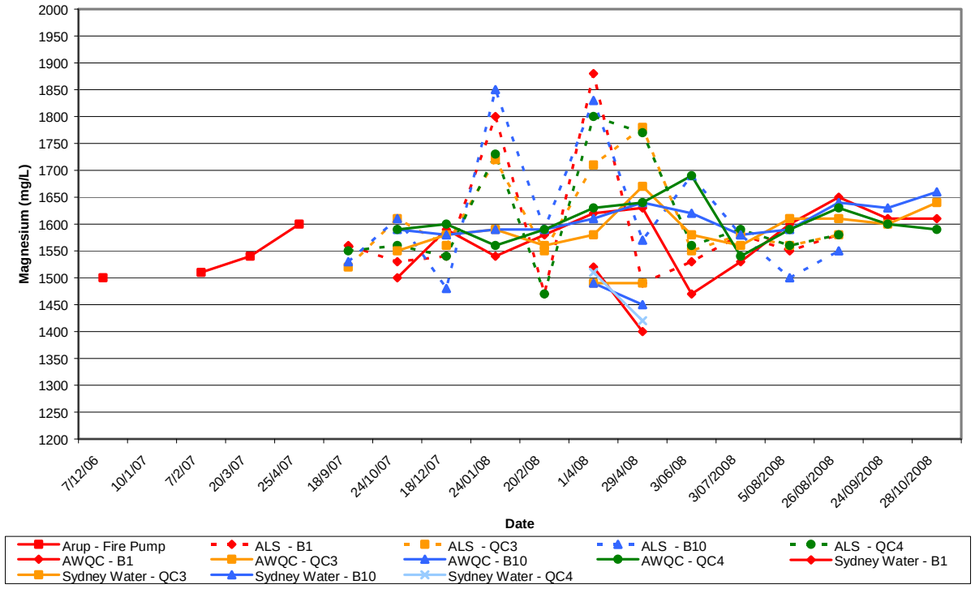


Figure 32 Sampling Location B (North of Point Lowly) – Magnesium Results

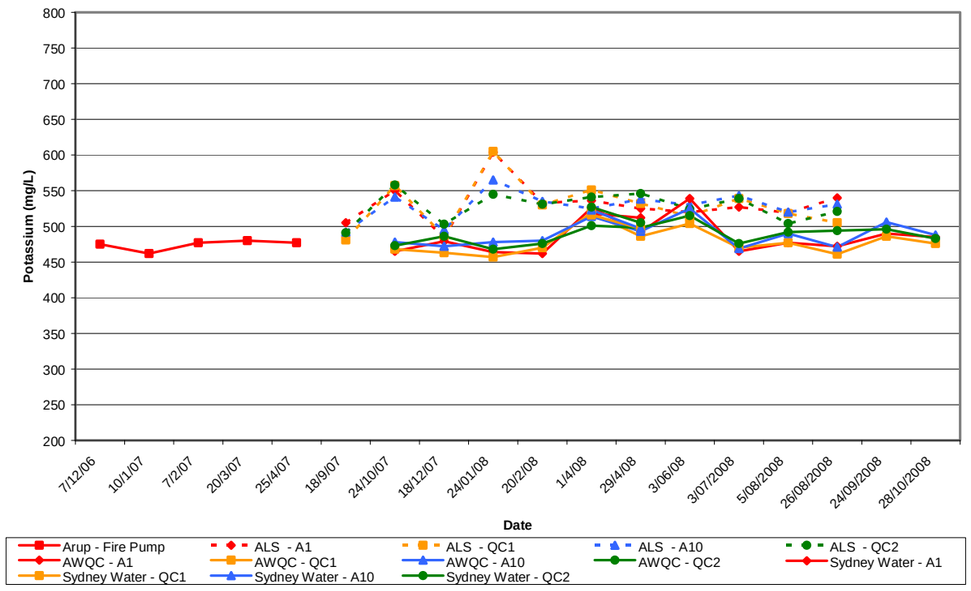


Figure 33 Sampling Location A (West of Point Lowly) – Potassium Results

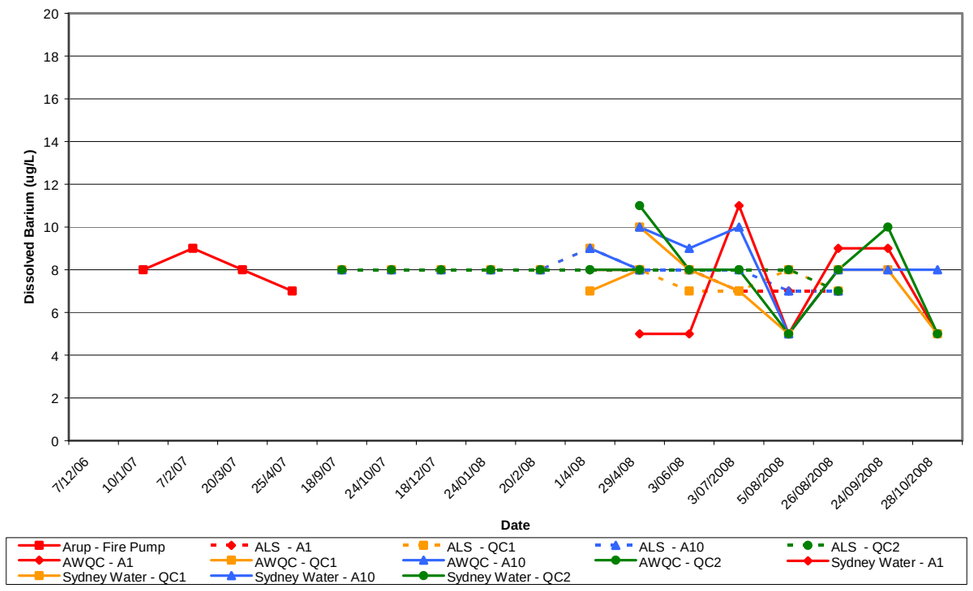


Figure 34 Sampling Location A (West of Point Lowly) – Barium Results

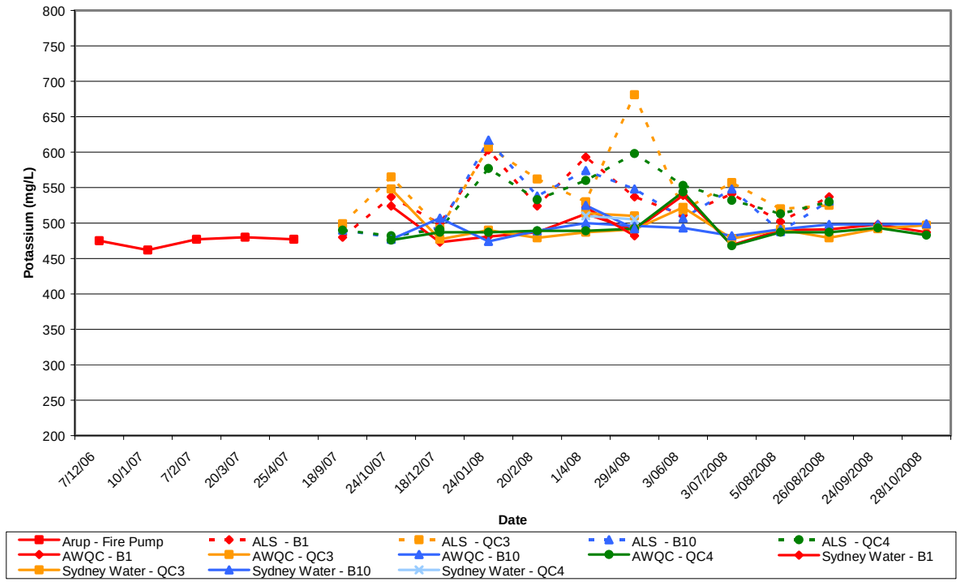


Figure 35 Sampling Location B (North of Point Lowly) – Potassium Results

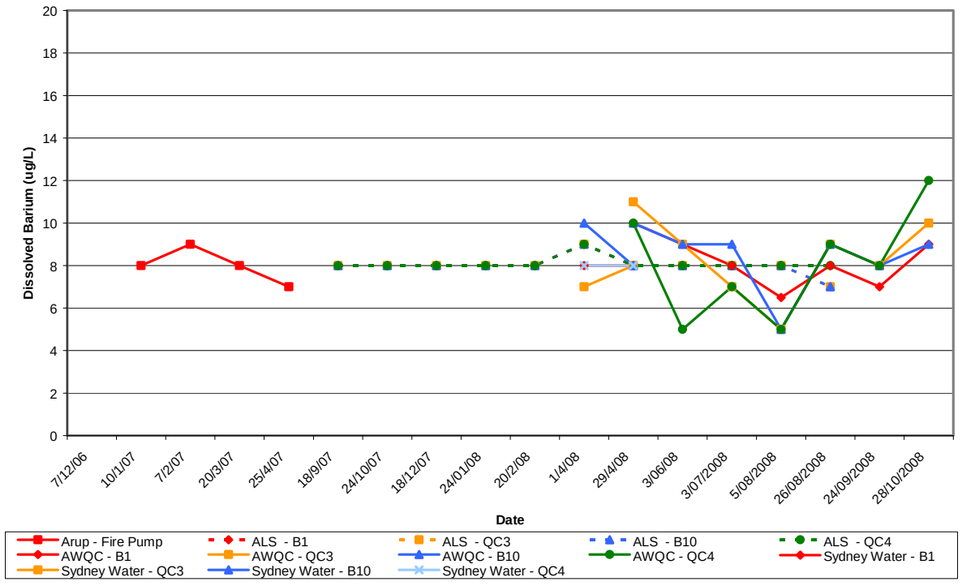
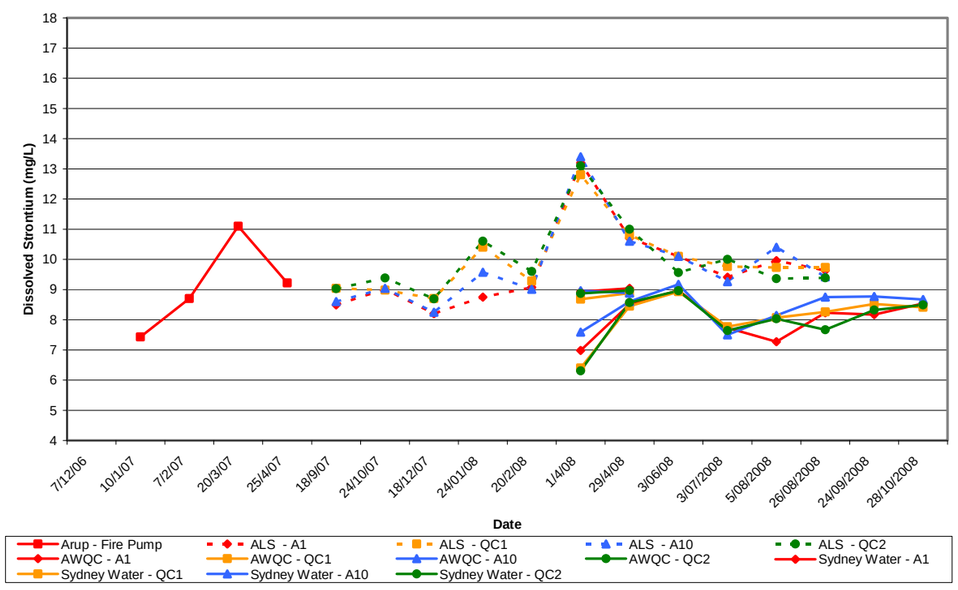


Figure 36 Sampling Location B (North of Point Lowly) – Barium Results



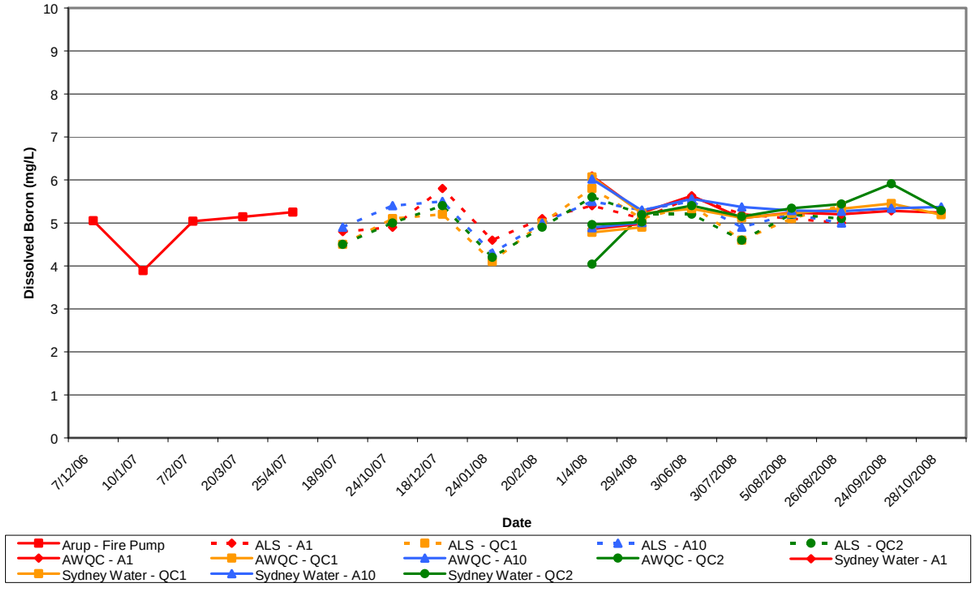
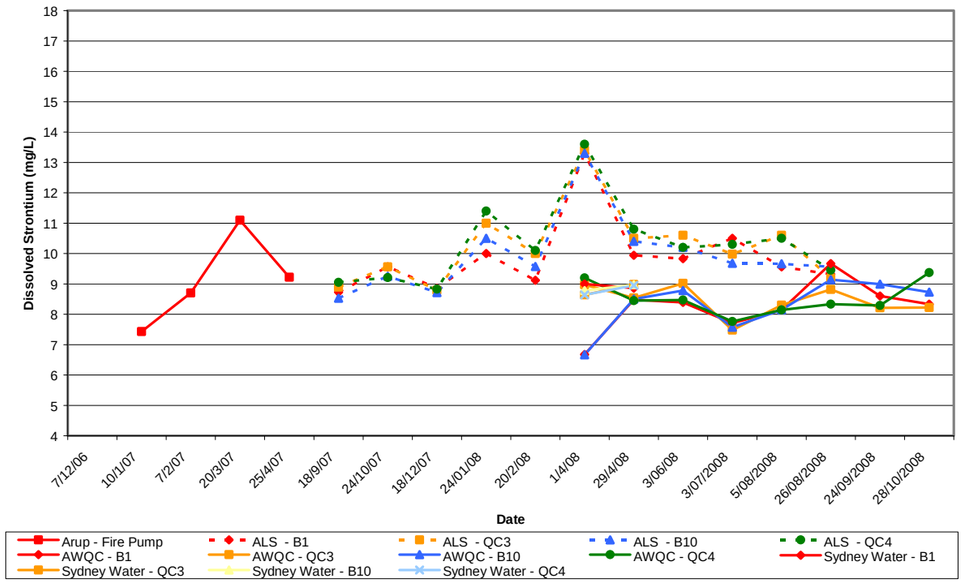


Figure 37 Sampling Location A (West of Point Lowly) – Strontium Results

Figure 38 Sampling Location A (West of Point Lowly) – Boron Results



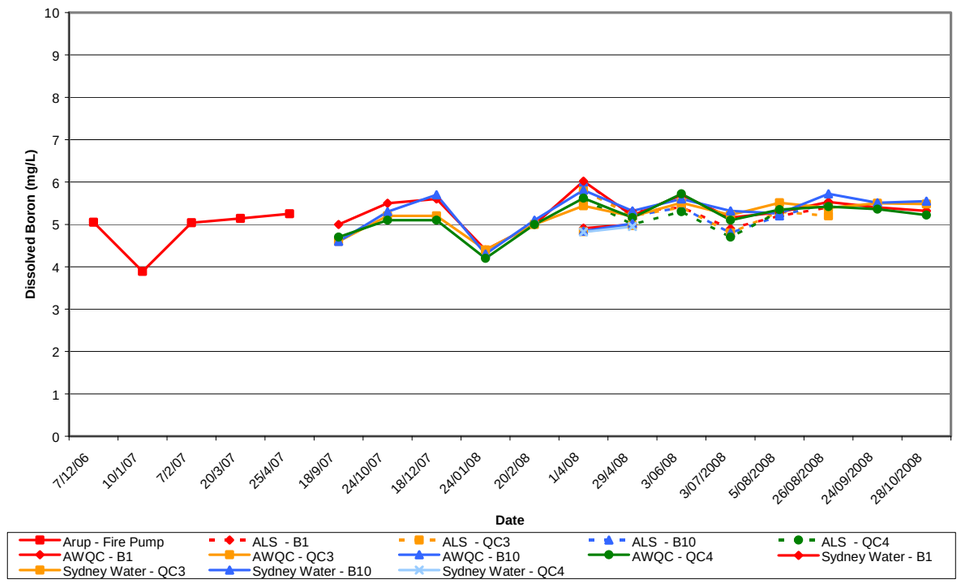


Figure 39 Sampling Location B (North of Point Lowly) – Strontium Results

Figure 40 Sampling Location B (North of Point Lowly) – Boron Results

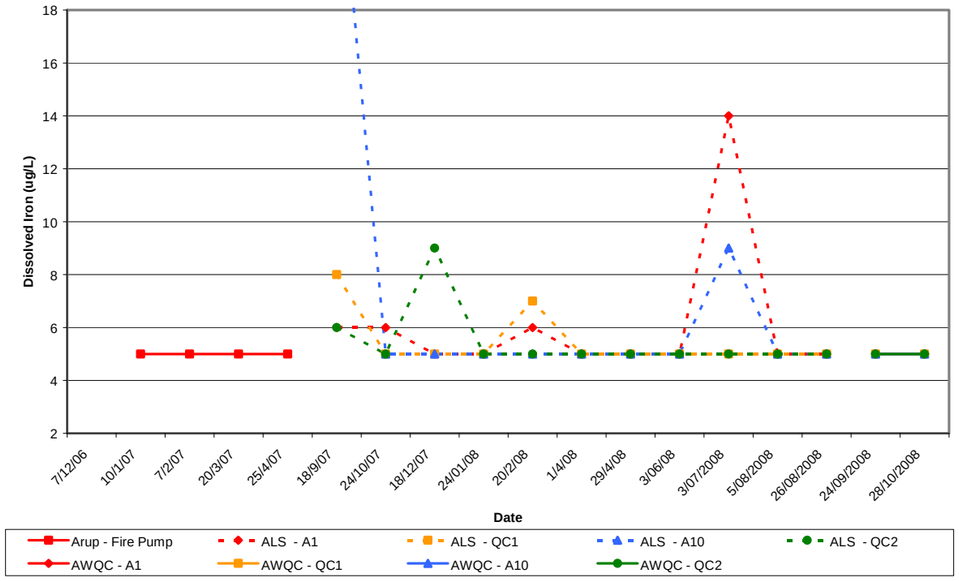


Figure 41 Sampling Location A (West of Point Lowly) – Dissolved Iron Results

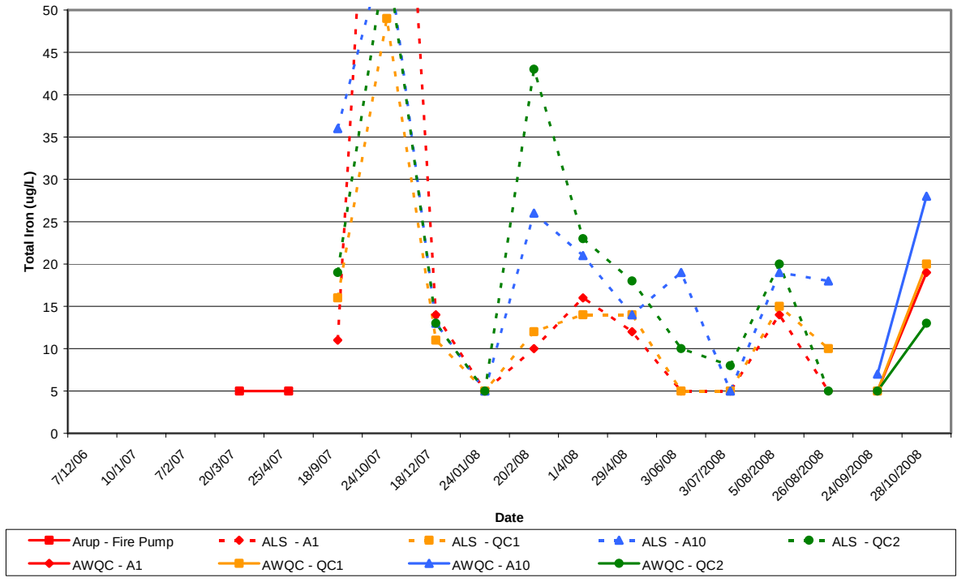


Figure 42 Sampling Location A (West of Point Lowly) – Total Iron Results

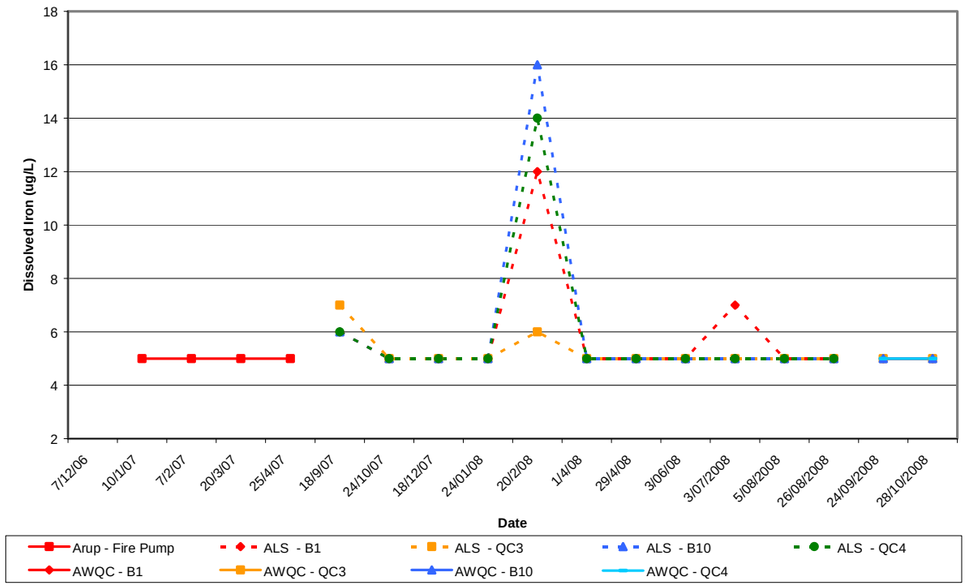


Figure 43 Sampling Location B (North of Point Lowly) – Dissolved Iron Results

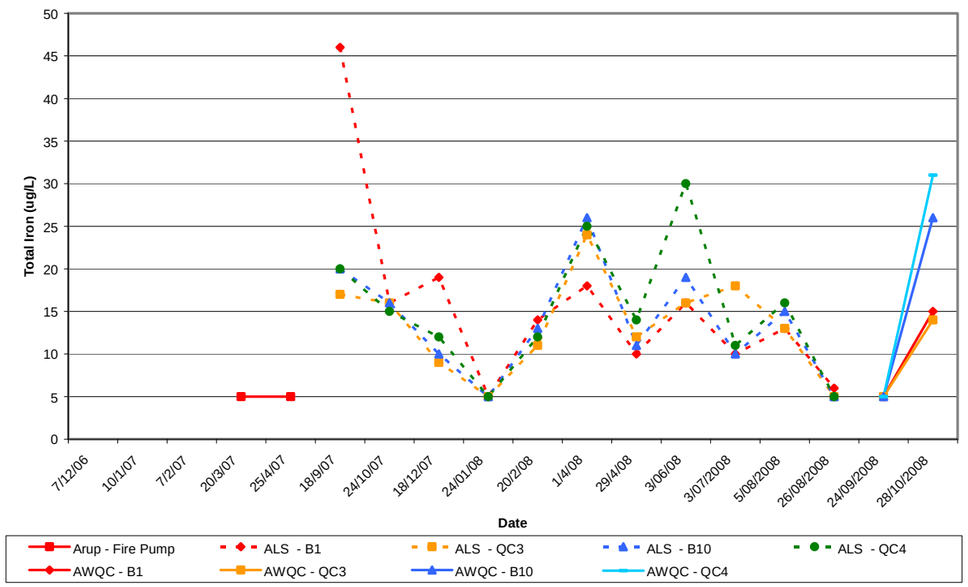


Figure 44 Sampling Location B (North of Point Lowly) – Total Iron Results

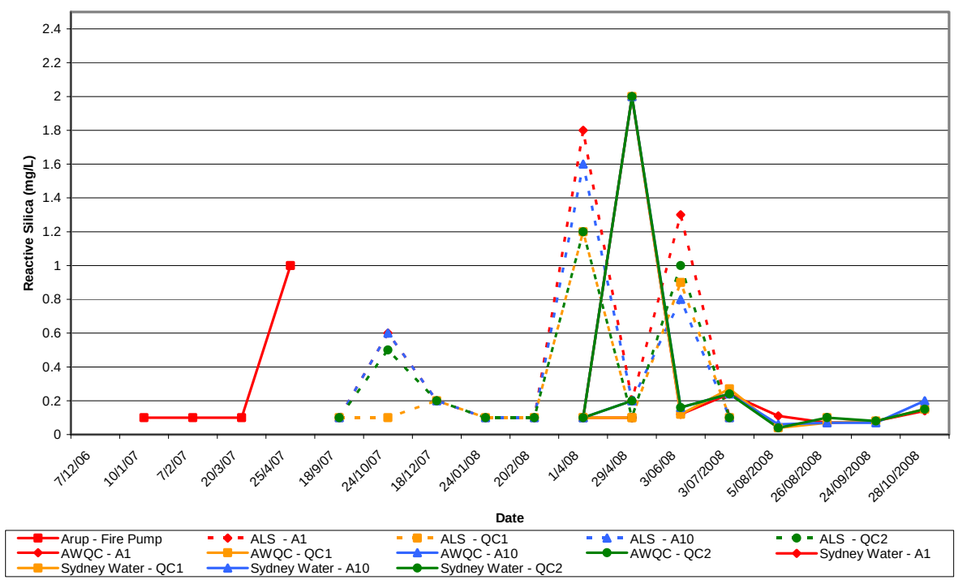


Figure 45 Sampling Location A (West of Point Lowly) – Silica Results

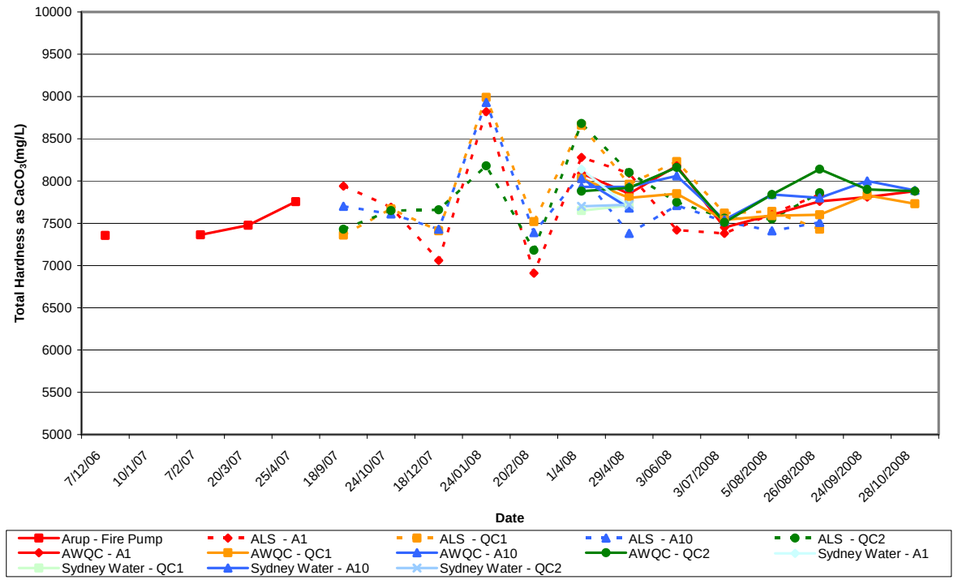


Figure 46 Sampling Location A (West of Point Lowly) – Total Hardness Results

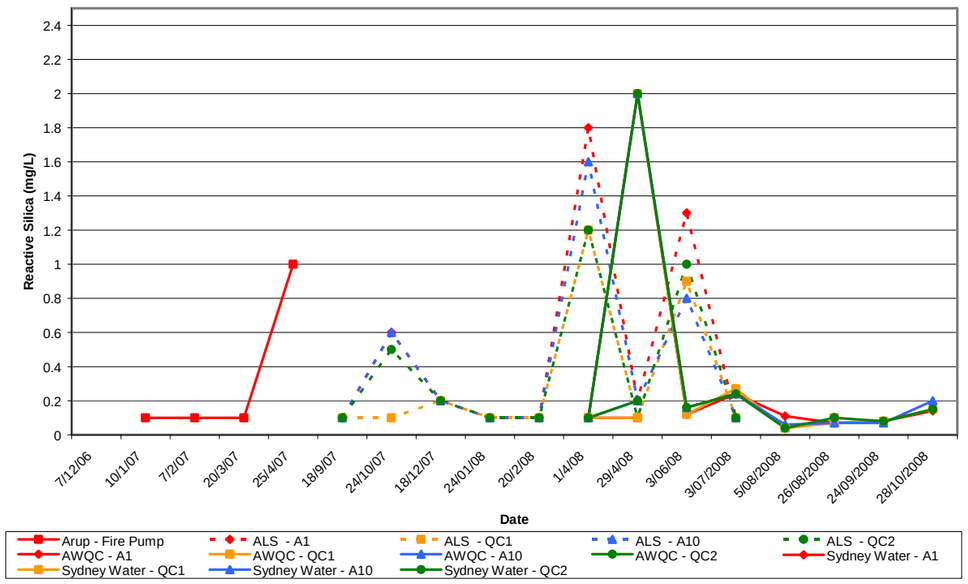


Figure 47 Sampling Location B (North of Point Lowly) – Silica Results

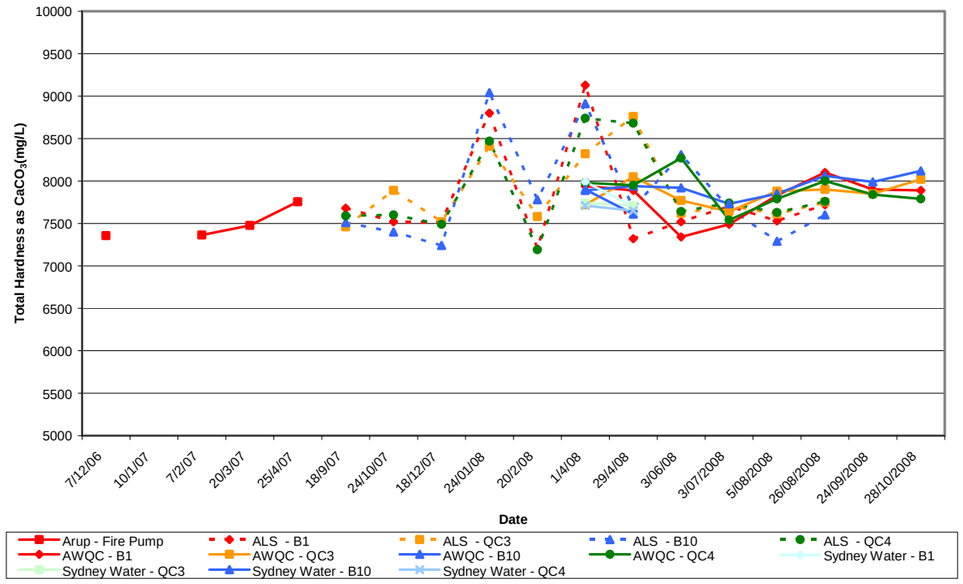


Figure 48 Sampling Location B (North of Point Lowly) – Total Hardness Results

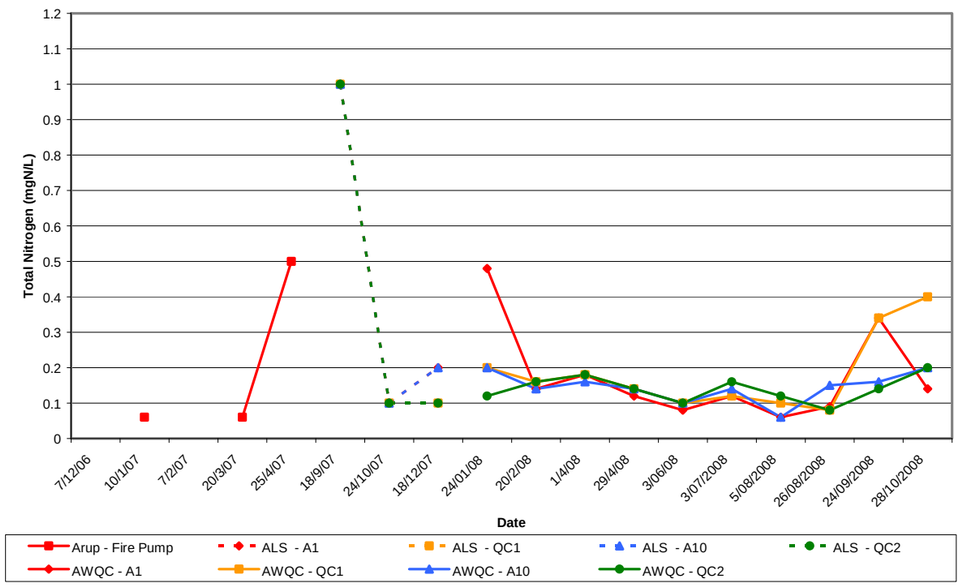


Figure 49 Sampling Location A (West of Point Lowly) – Total Nitrogen Results

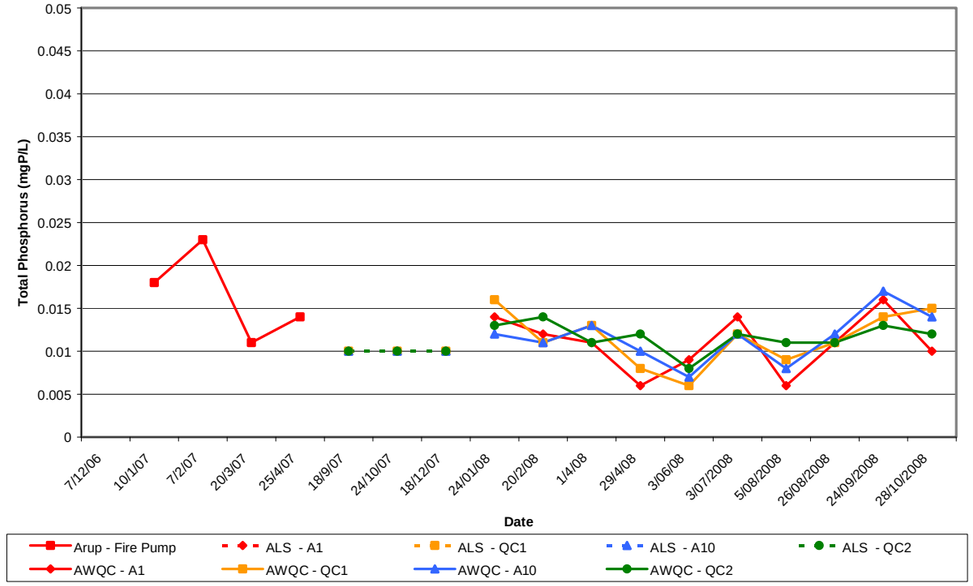


Figure 50 Sampling Location A (West of Point Lowly) – Total Phosphorus Results

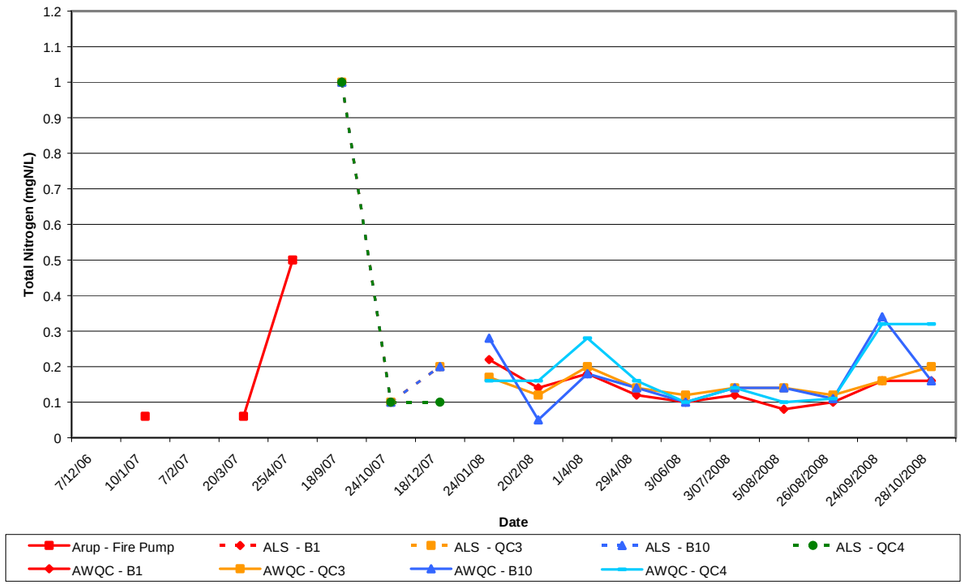


Figure 51 Sampling Location B (North of Point Lowly) – Total Nitrogen Results

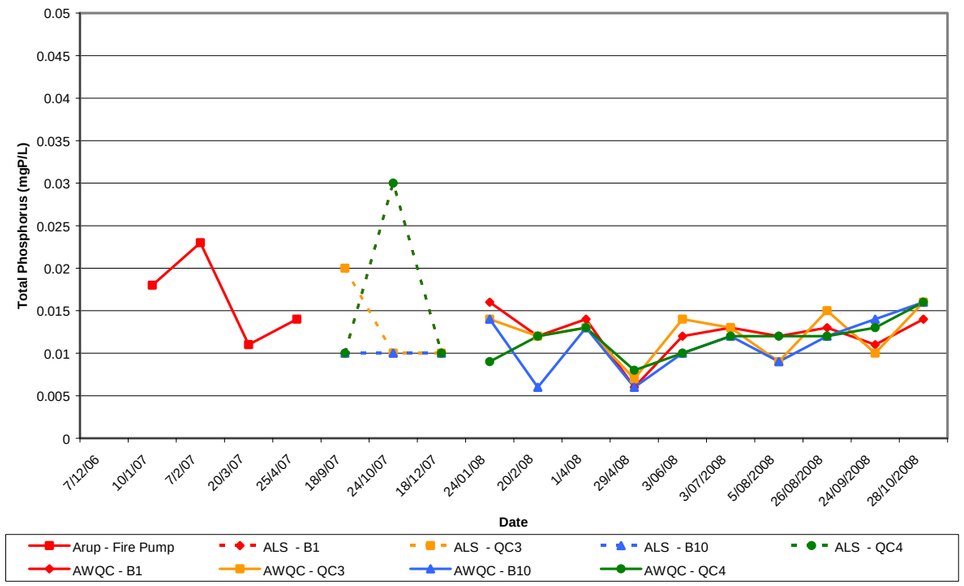


Figure 52 Sampling Location B (North of Point Lowly) – Total Phosphorus Results

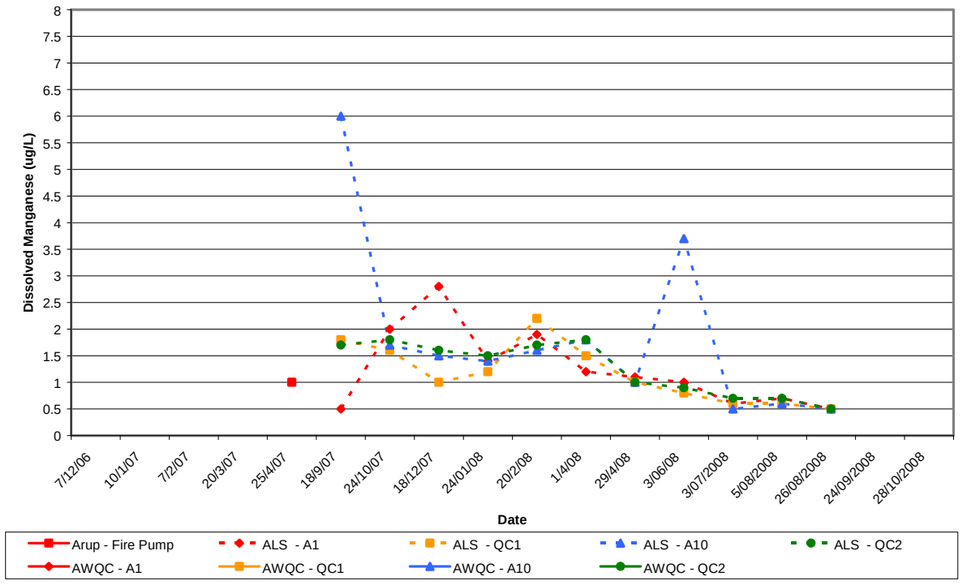


Figure 53 Sampling Location A (West of Point Lowly) – Dissolved Manganese

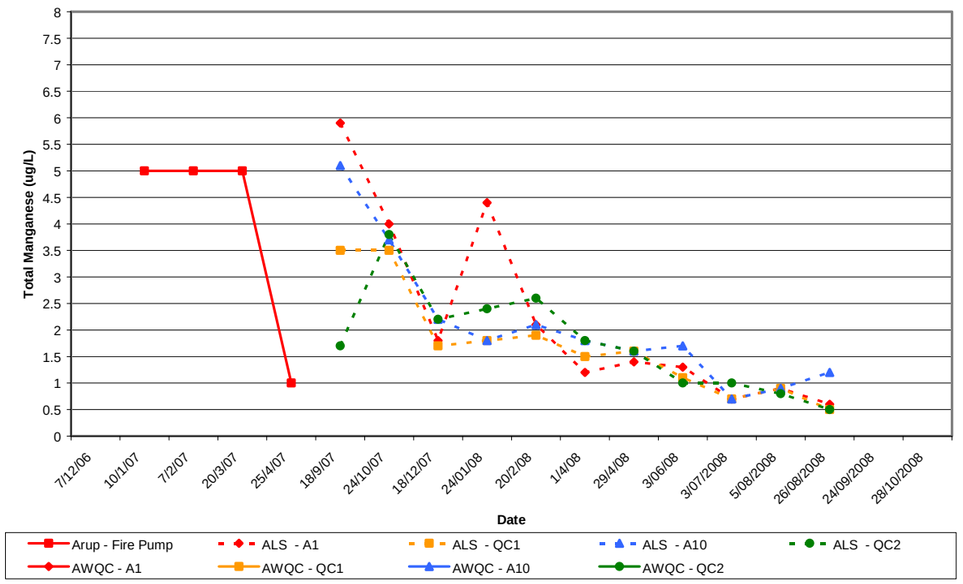


Figure 54 Sampling Location A (West of Point Lowly) – Total Manganese Results

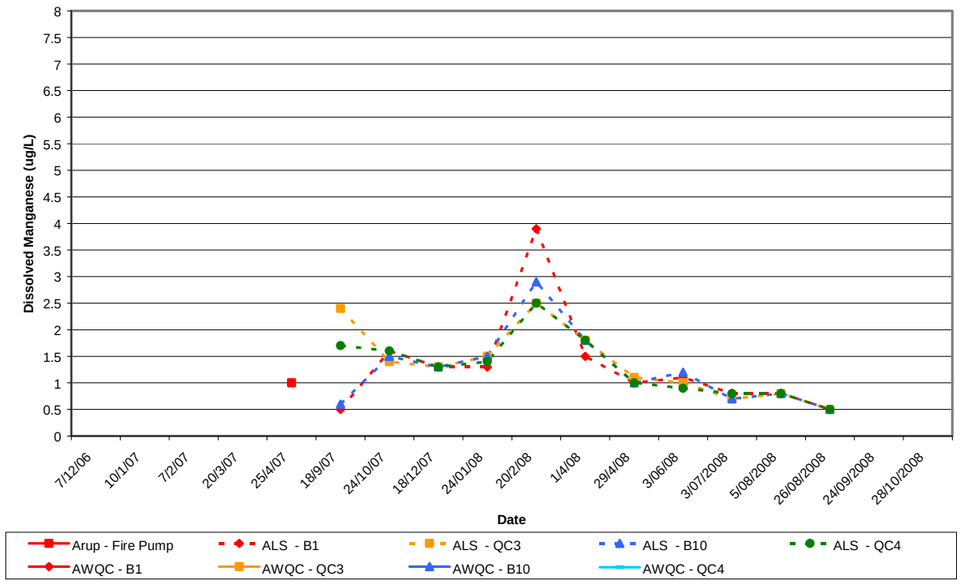


Figure 55 Sampling Location B (North of Point Lowly) – Dissolved Manganese

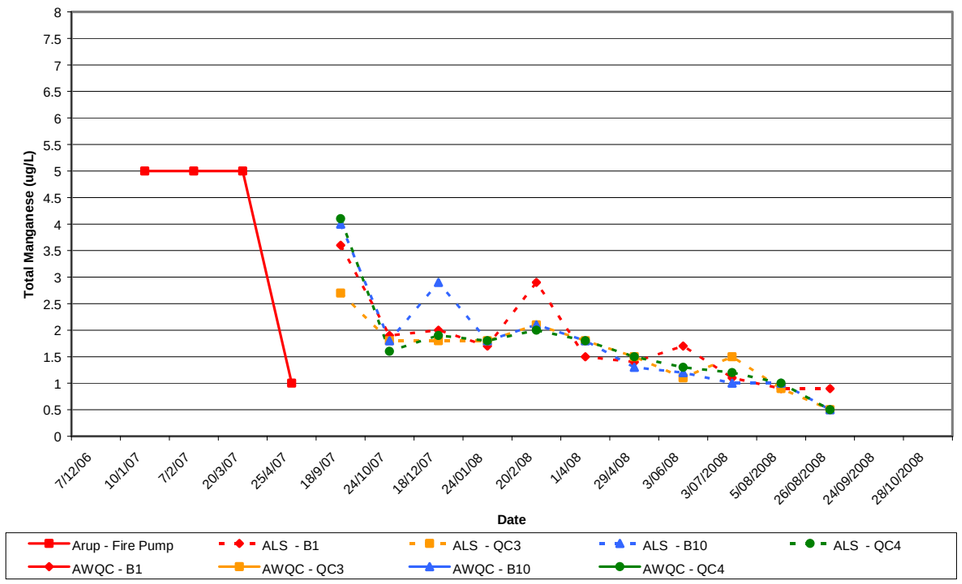


Figure 56 Sampling Location B (North of Point Lowly) – Total Manganese Results

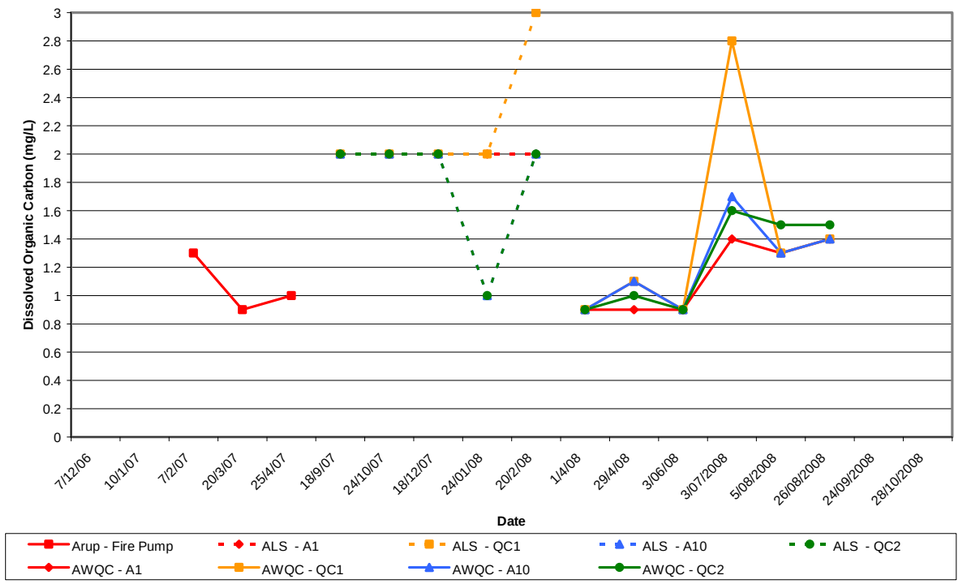


Figure 57 Sampling Location A (West of Point Lowly) – DOC Results

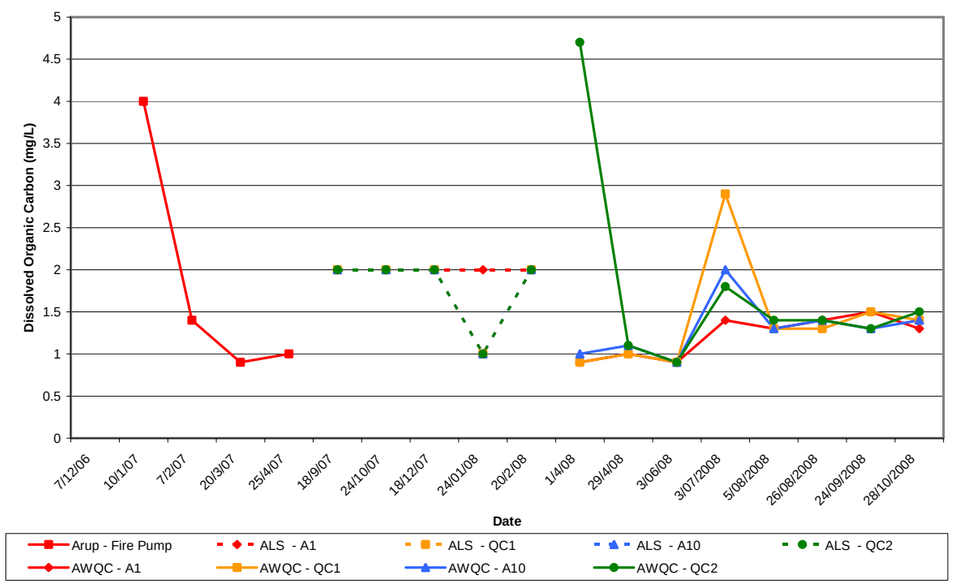


Figure 58 Sampling Location A (West of Point Lowly) – TOC Results

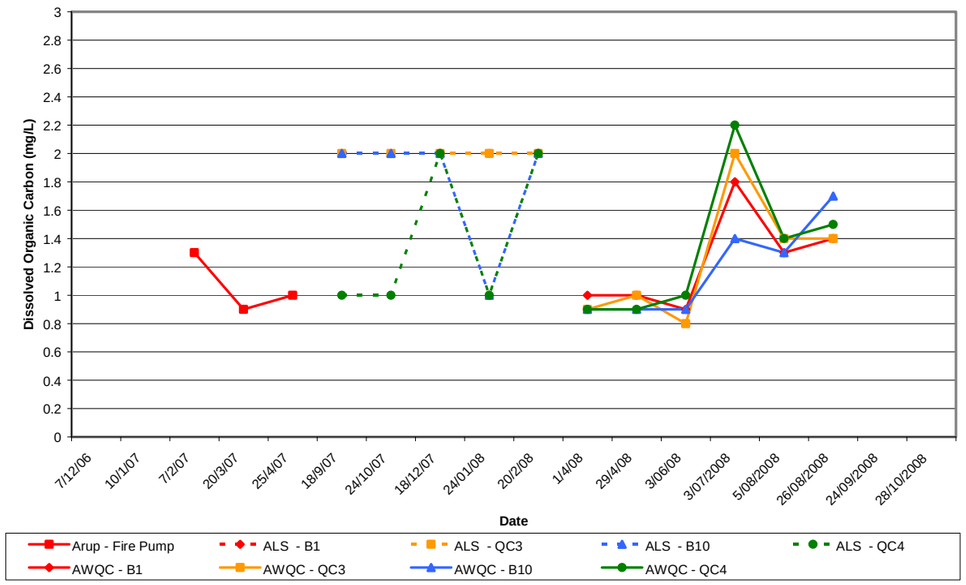


Figure 59 Sampling Location B (North of Point Lowly) – DOC Results

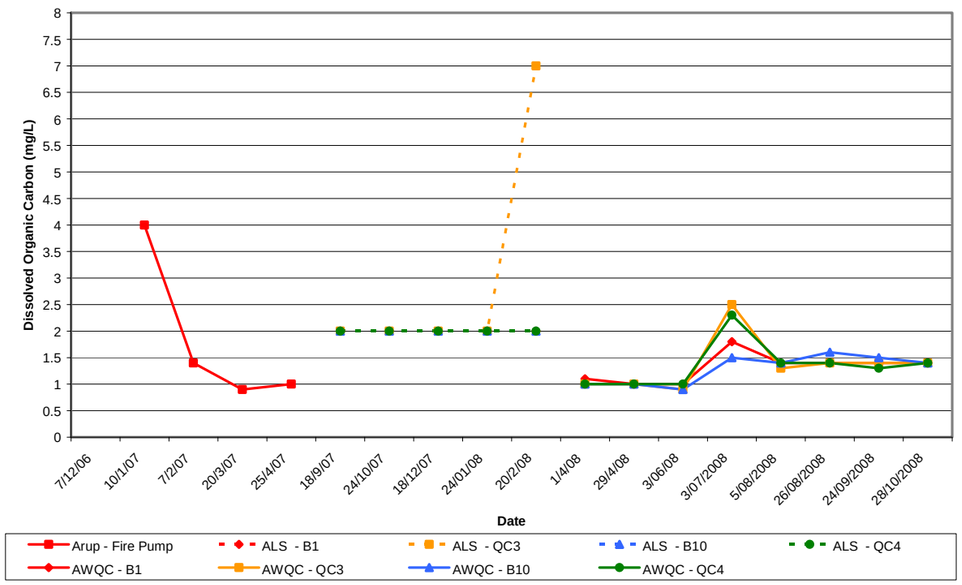


Figure 60 Sampling Location B (North of Point Lowly) – TOC Results

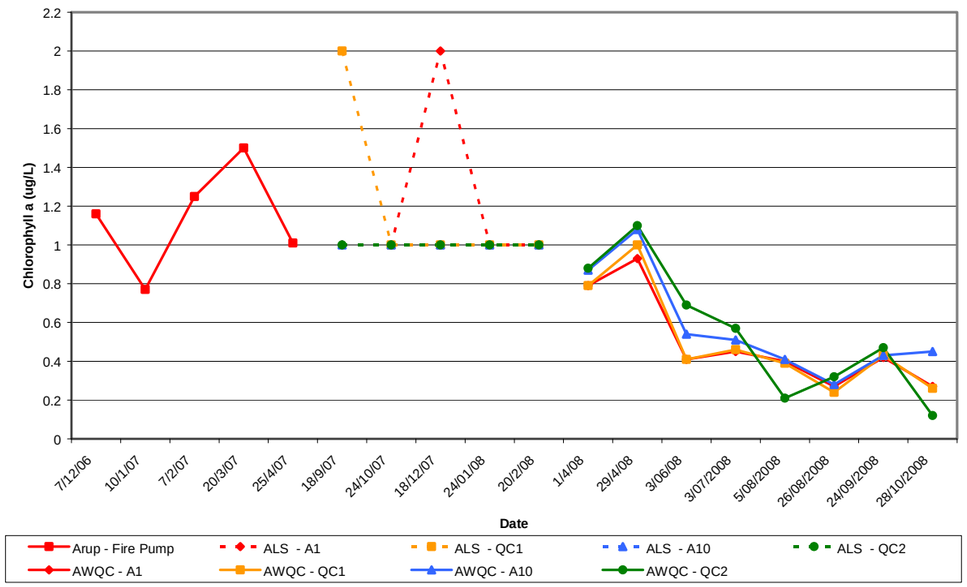


Figure 61 Sampling Location A (West of Point Lowly) – Chlorophyll-a Results

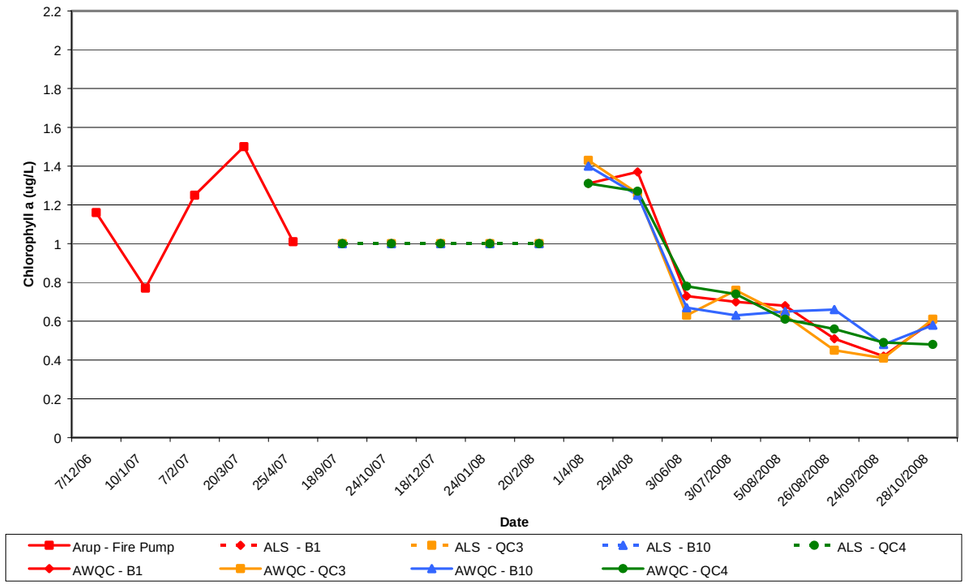


Figure 62 Sampling Location B (North of Point Lowly) – Chlorophyll-a Results

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Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	S Carter	G Wood	G Wood	G Wood	G Wood	19.12.08

APPENDIX H2.2

Additional water quality data

H2.2 ADDITIONAL WATER QUALITY DATA

Appendix H2.2 provides information on water quality parameters (from the continuous water quality monitoring station) to December 2009, including and following on from that reported in Appendix H2.1 (May 2007 to November 2008).

Ambient water quality

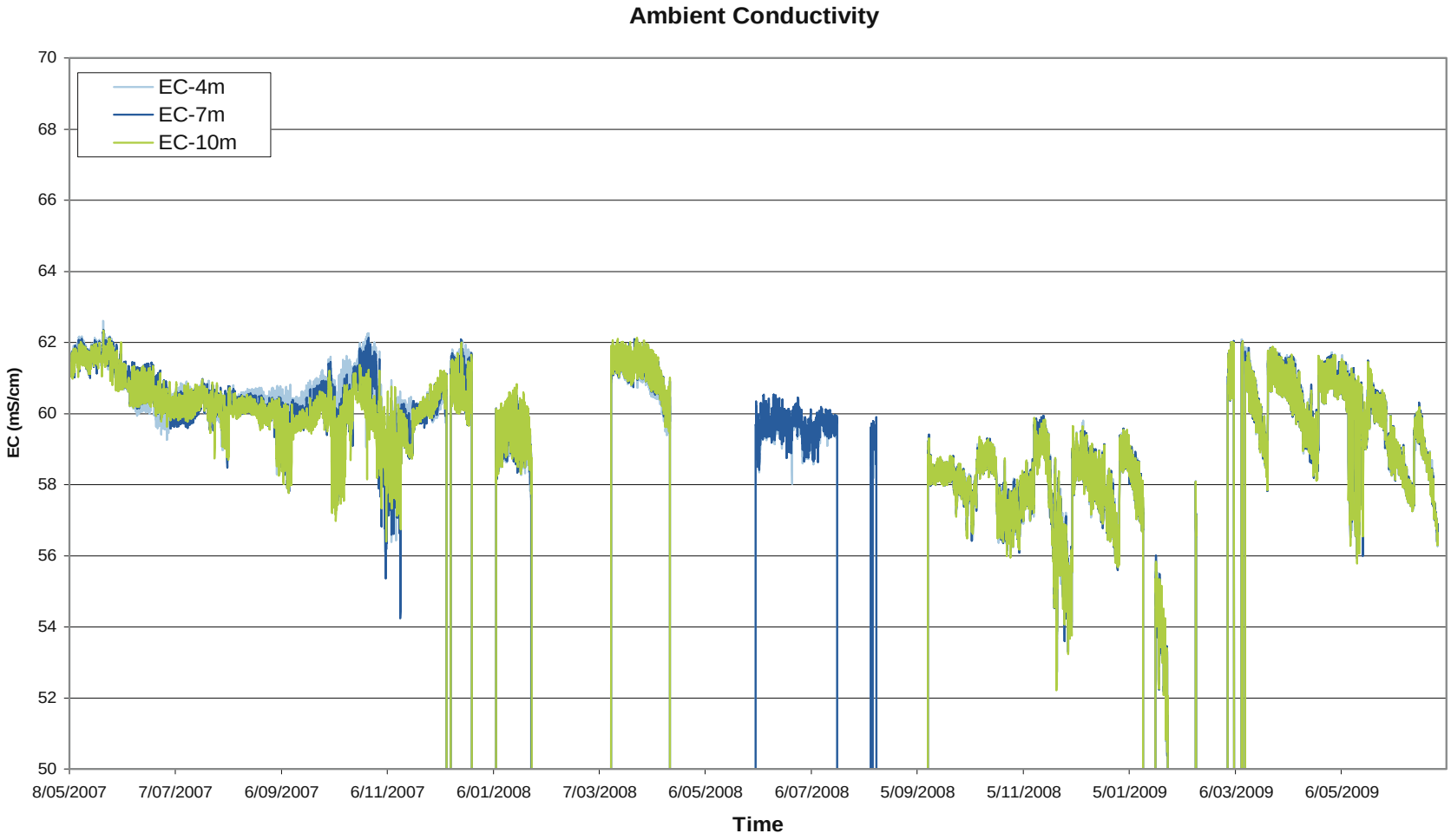


Figure H2.2.1 Conductivity measured over the reporting period

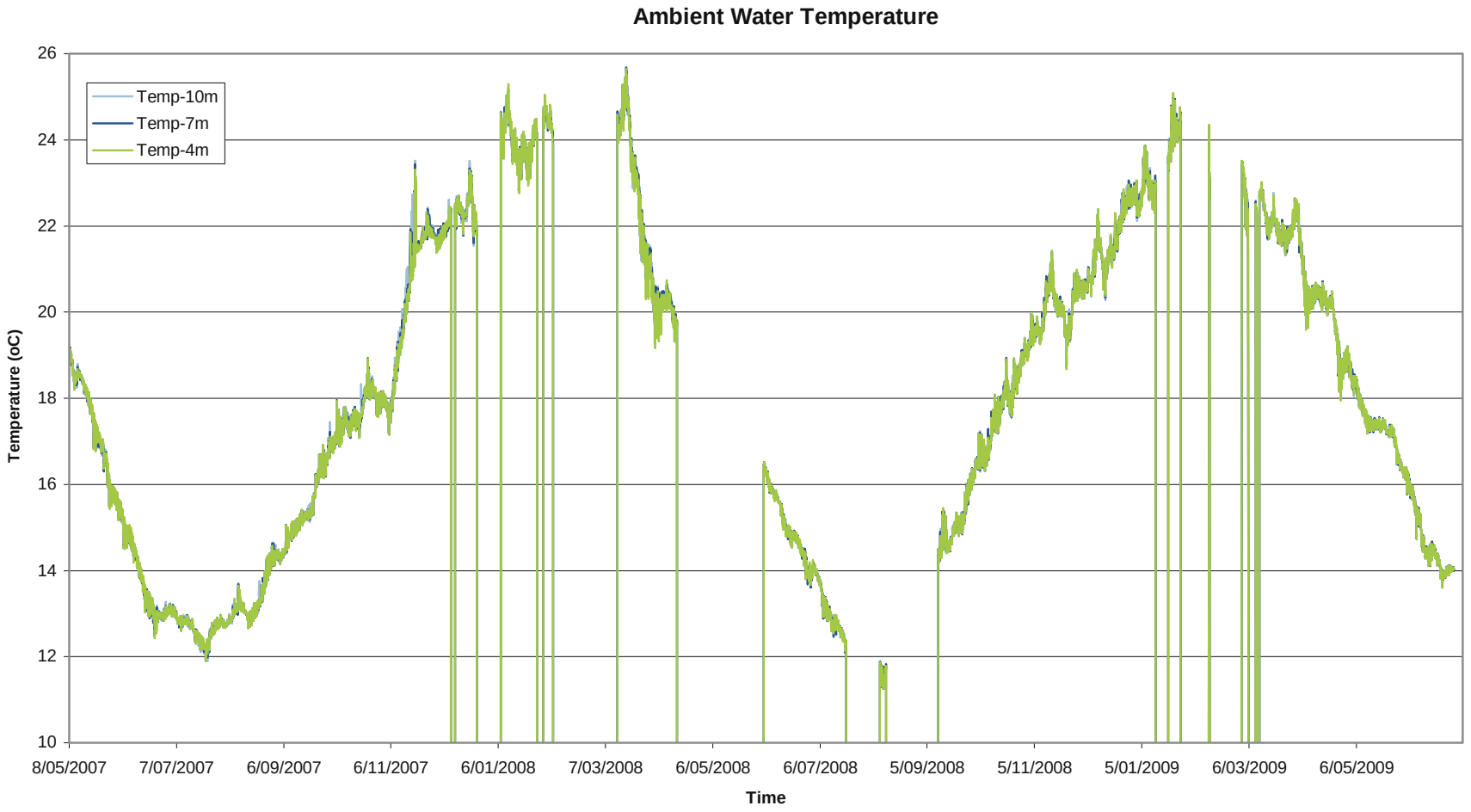


Figure H2.2.2 The temperature of the water for the reporting period

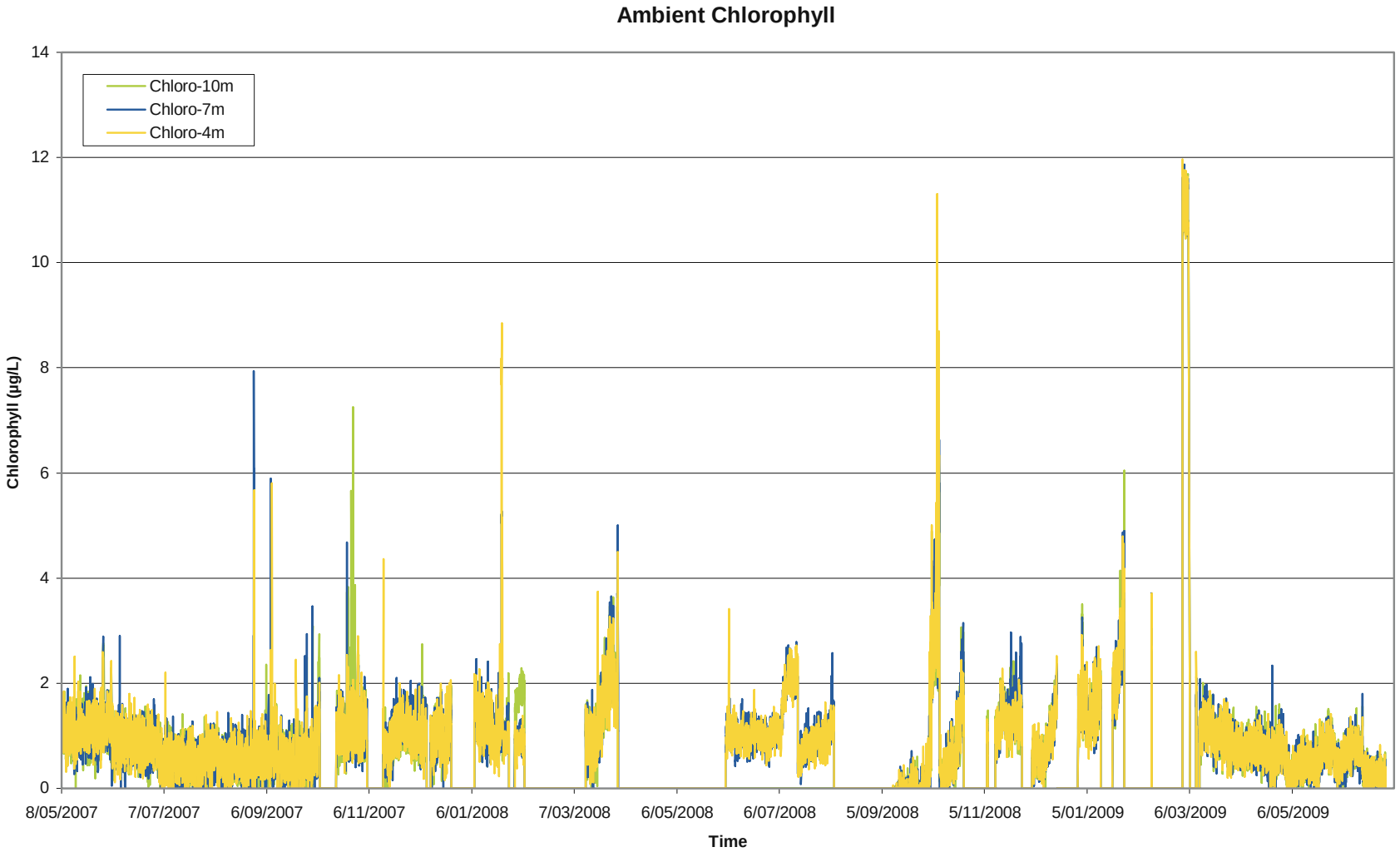


Figure H2.2.3 Recorded chlorophyll over the reporting period

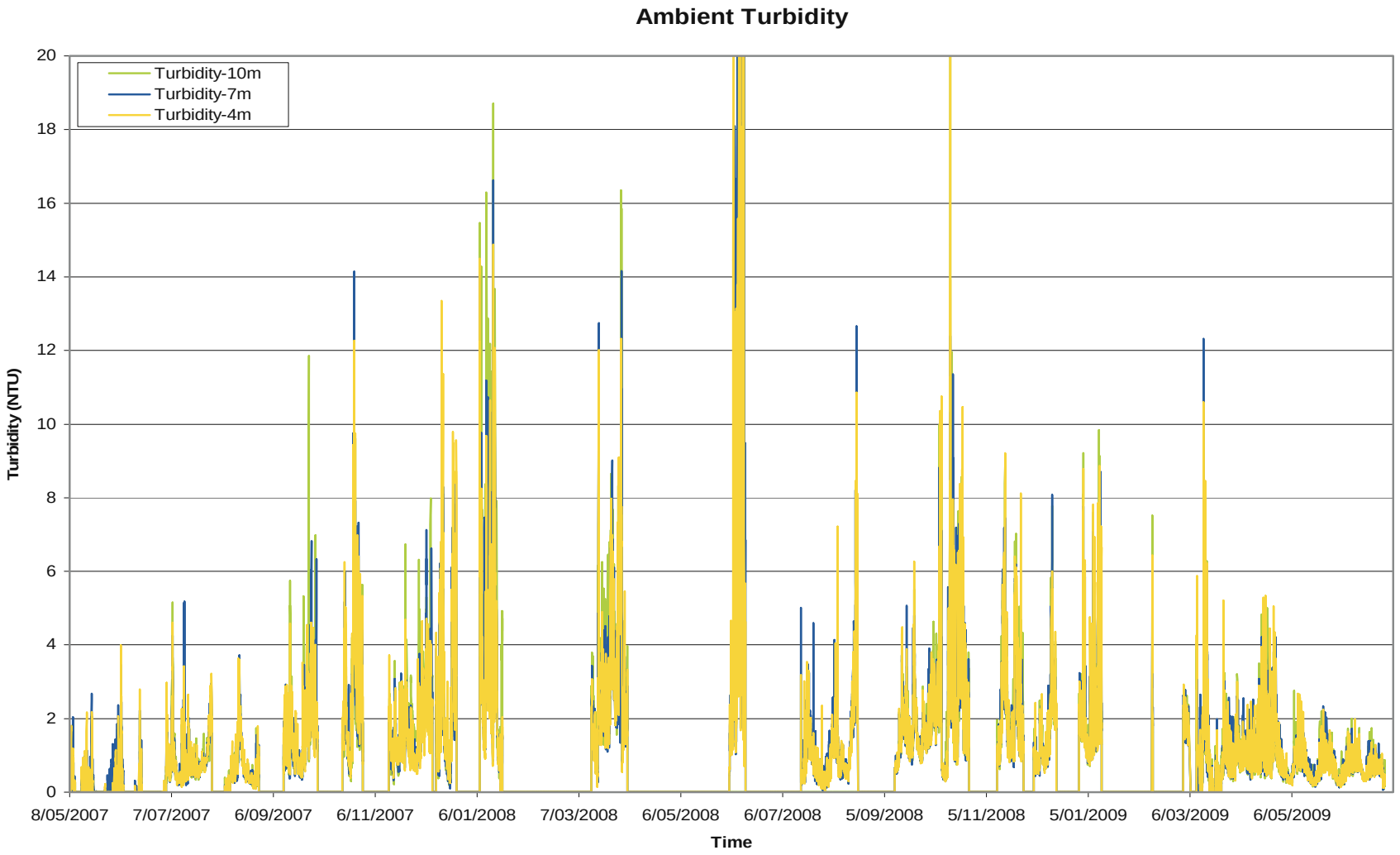


Figure H2.2.4 Turbidity recorded during the reporting period

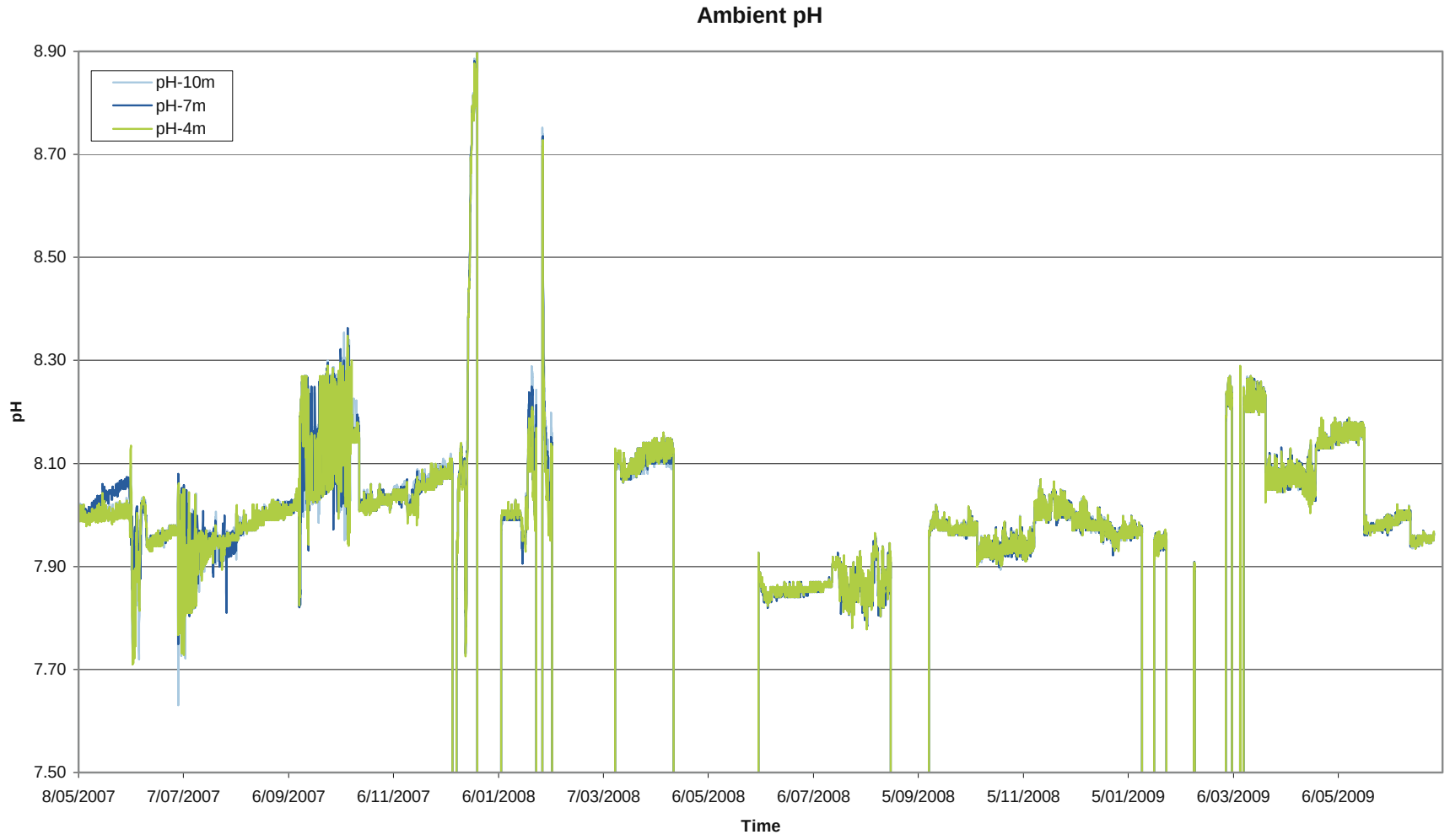


Figure H2.2.5 pH as recorded over the reporting period

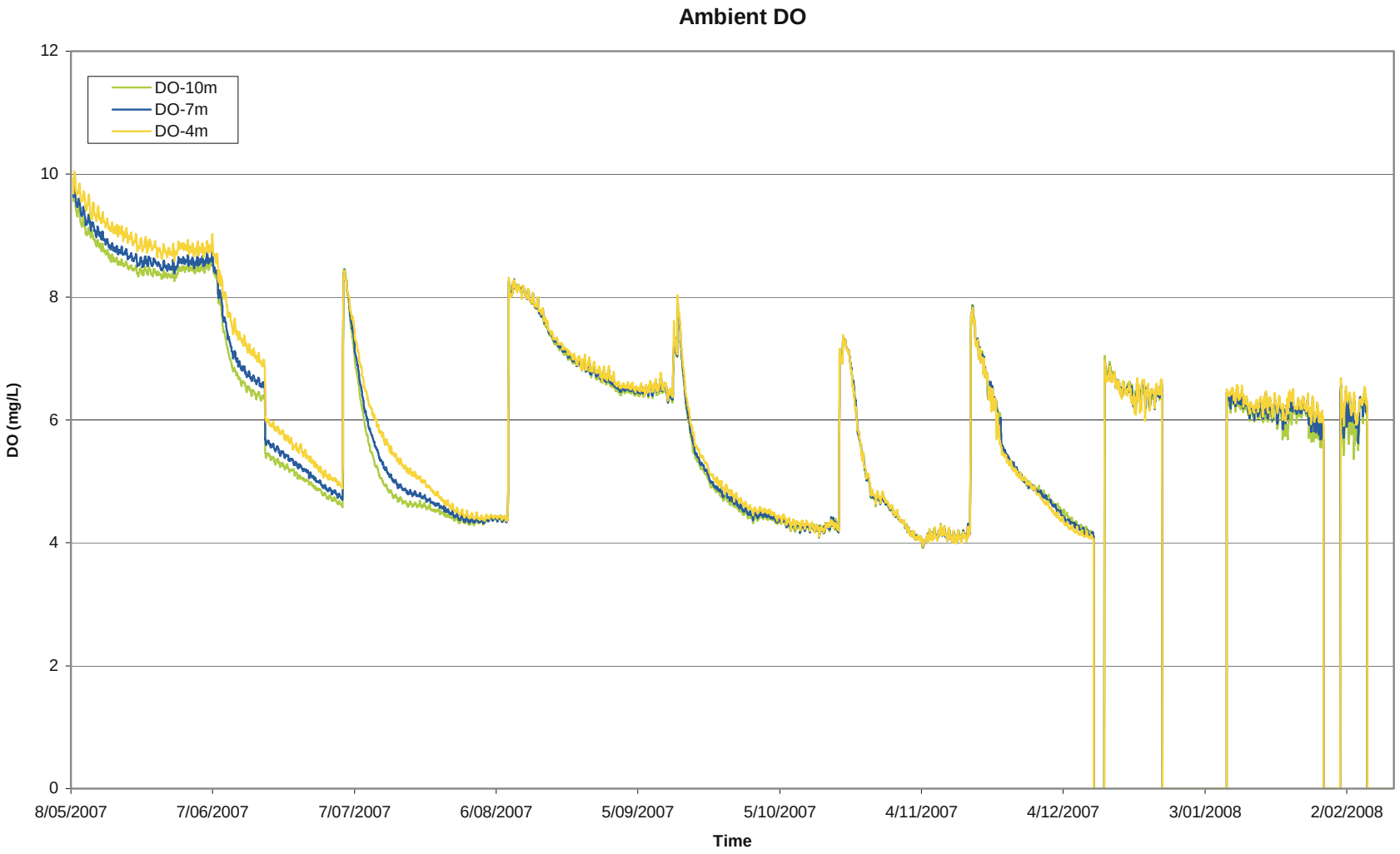


Figure H2.2.6 Dissolved oxygen (DO) measured by the monitoring station (Note instrument drift immeadiately after calibration, resulting in the only reliable data being each peak when the instrument was serviced)

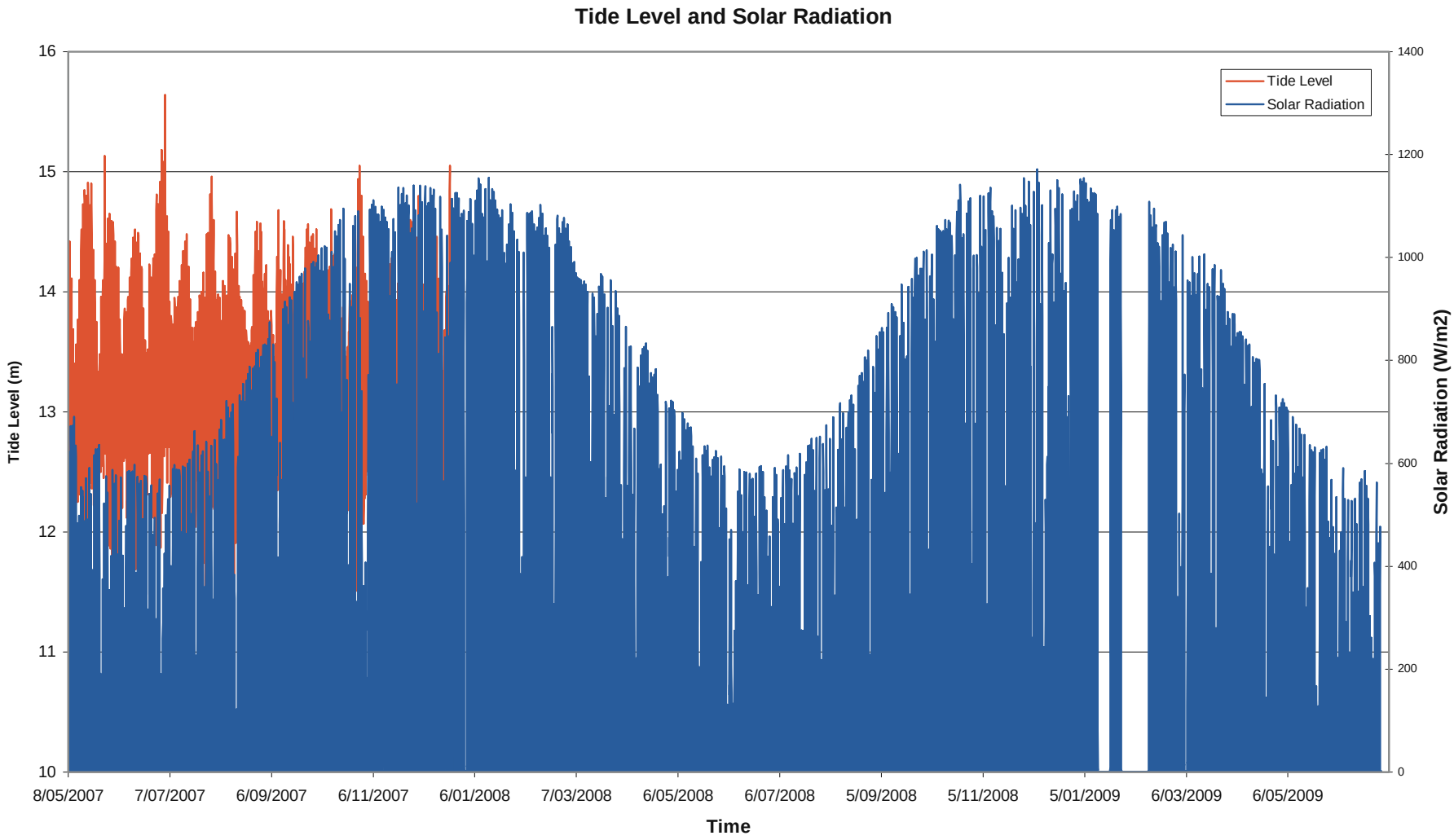


Figure H2.2.7 The tide level and solar radiation measured by the monitoring station

Ambient water quality

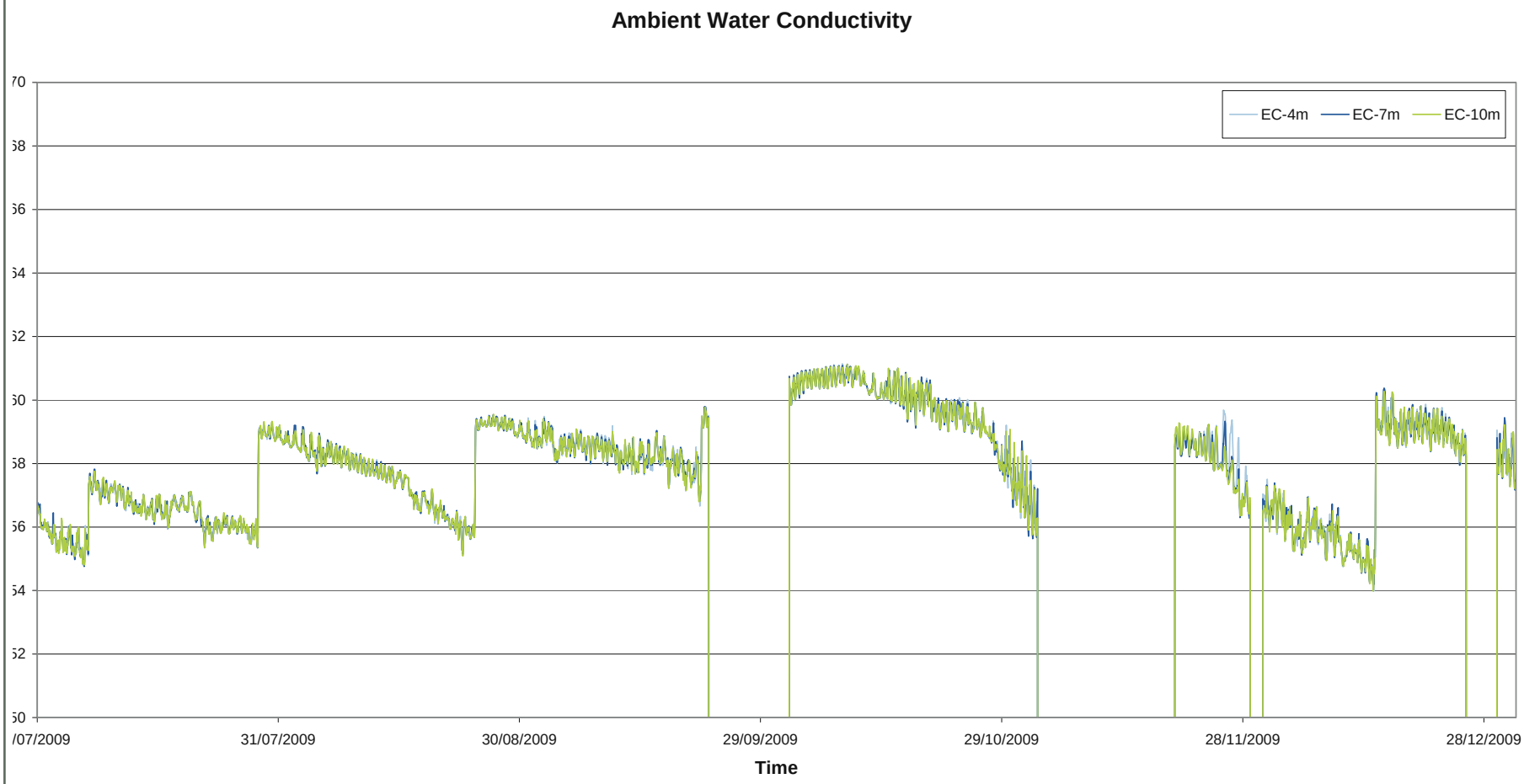


Figure H2.2.8 Conductivity measured over the reporting period

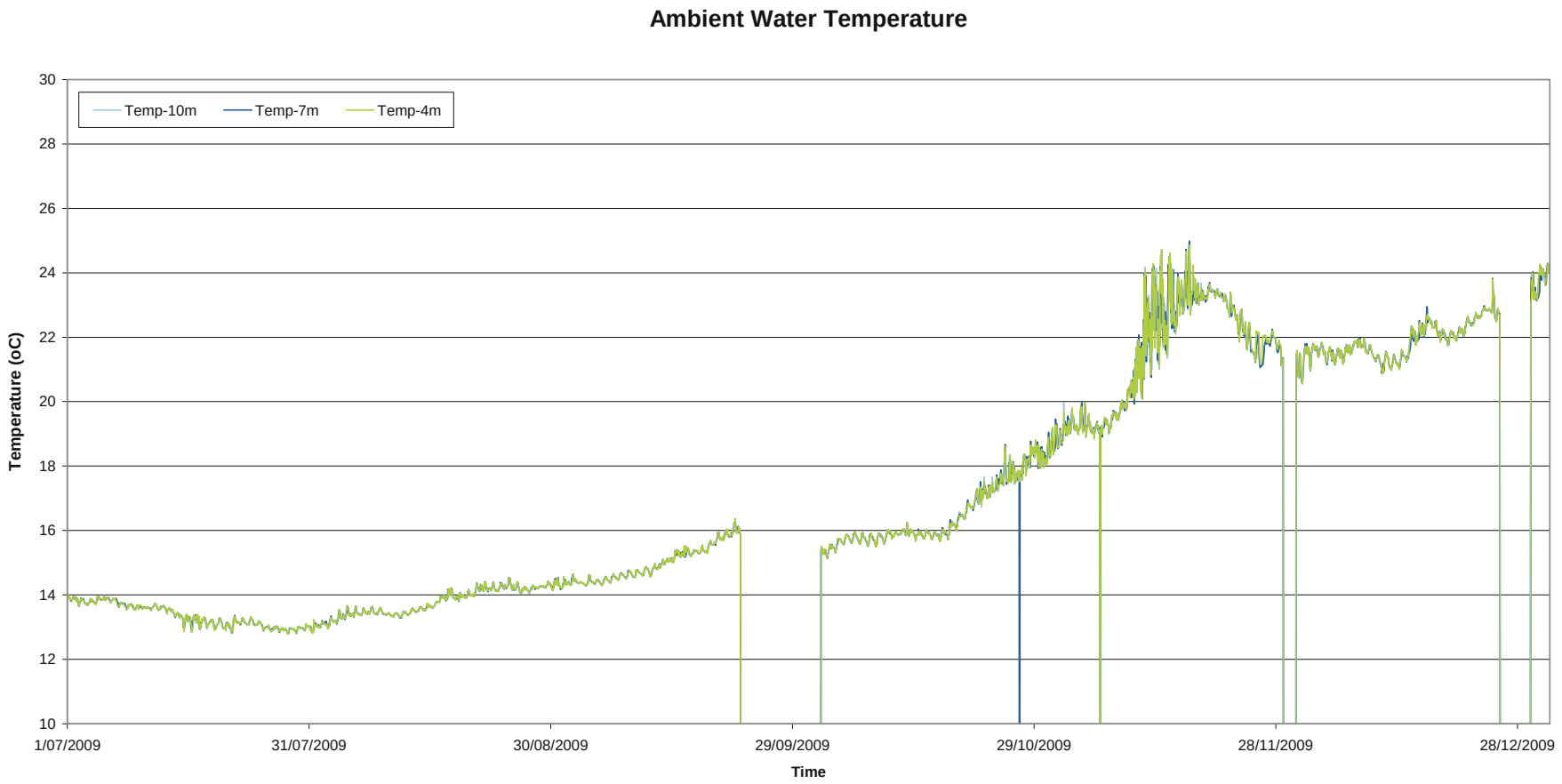


Figure H2.2.9 The temperature of the water for the reporting period

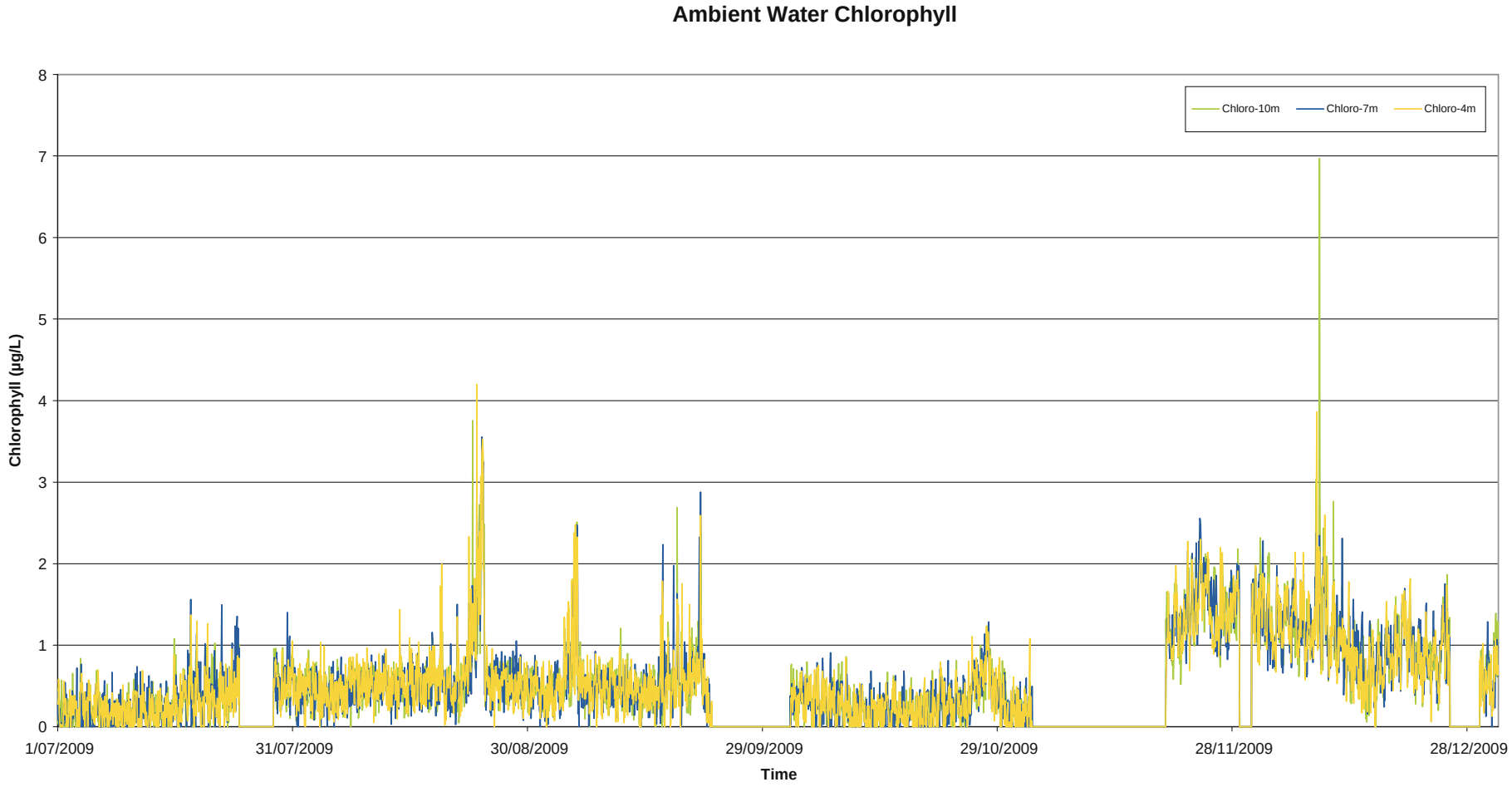


Figure H2.2.10 Reported chlorophyll over the reporting period

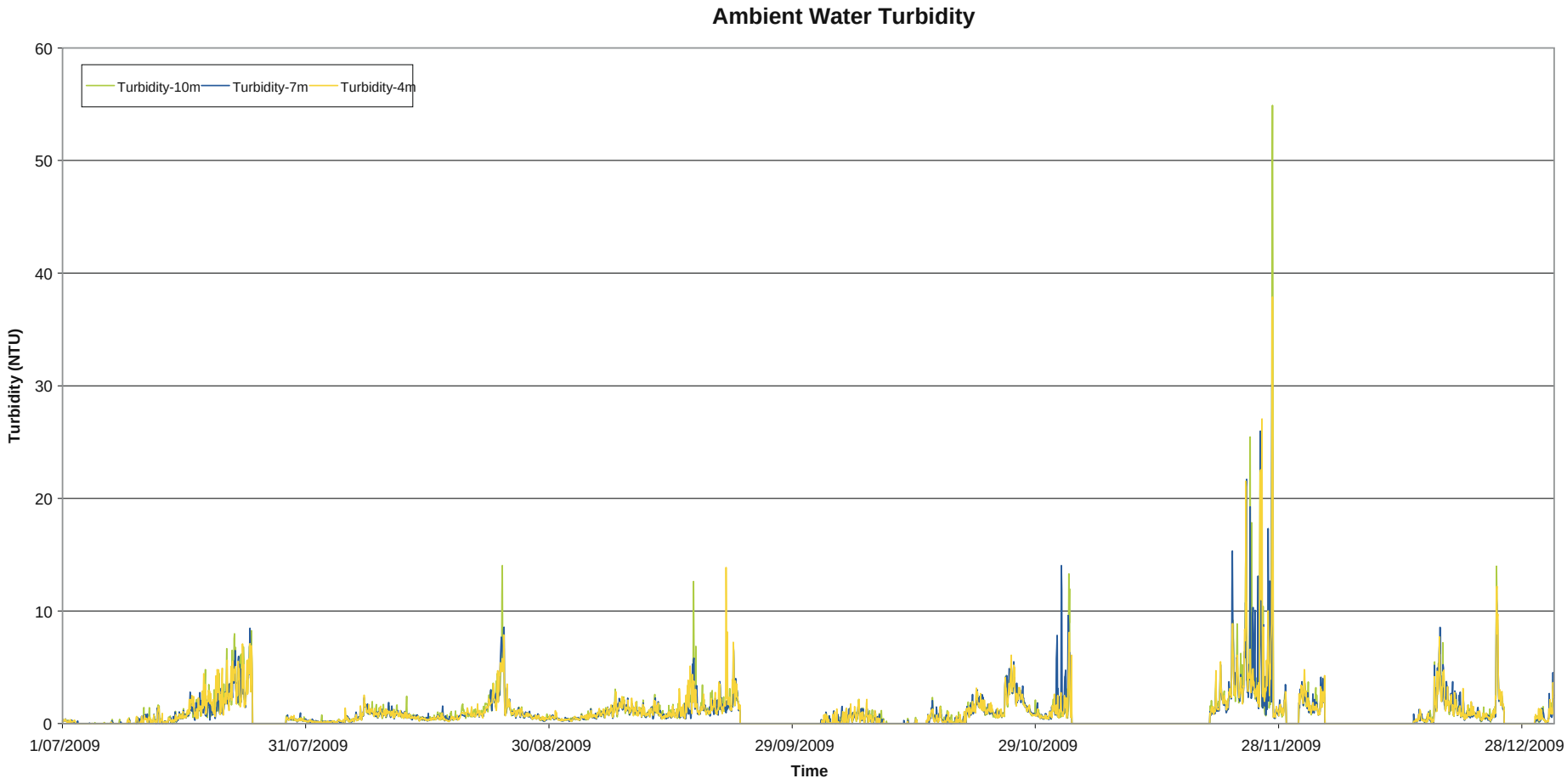


Figure H2.2.11 Turbidity recorded during the reporting period

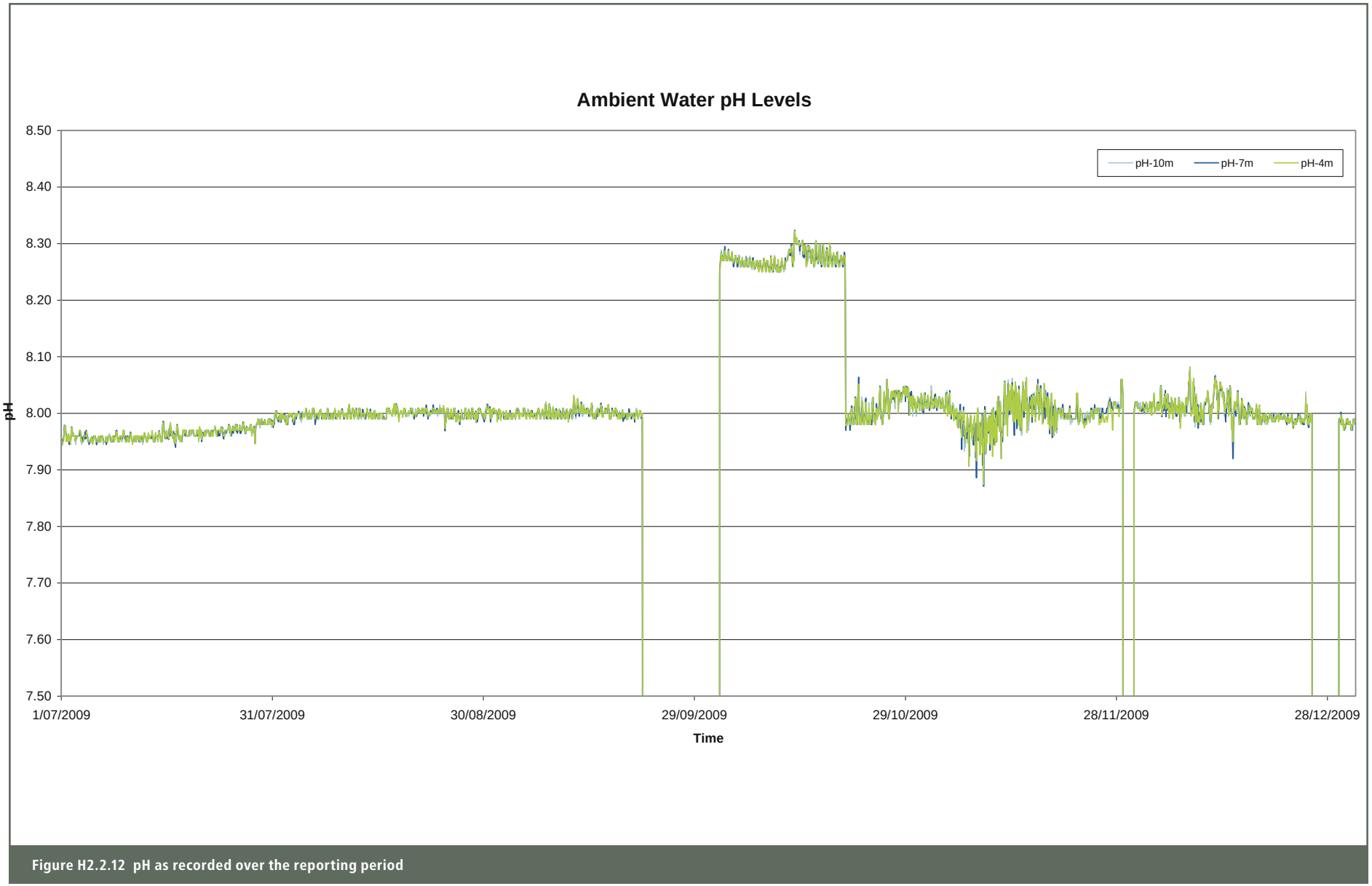


Figure H2.2.12 pH as recorded over the reporting period

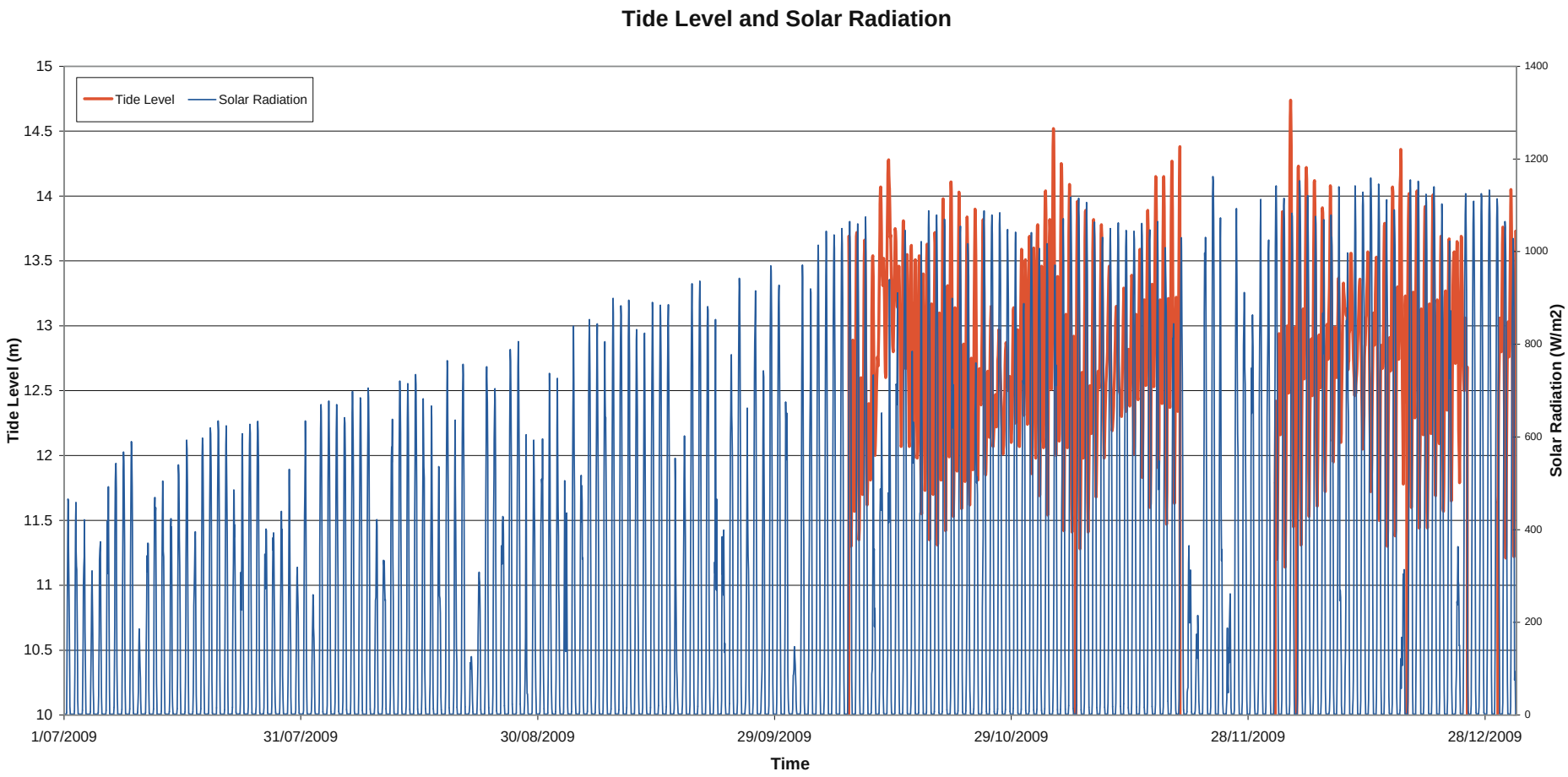


Figure H2.2.13 The tide level and solar radiation measured by the monitoring station

APPENDIX H2.3

Pilot desalination plant water quality

H2.3 PILOT DESALINATION PLANT WATER QUALITY

A pilot desalination plant was established on the Port Bonython jetty from November 2007 to May 2010 to provide information to assist with the design of the proposed desalination plant at Point Lowly.

The pilot plant program was designed to complete a series of trials to test different parameters that will influence the design of a full-scale plant. These parameters included the media filter flow rates, chemical dosing rates, reverse osmosis recovery rate, and long-term membrane fouling rates. A series of parameters was also measured to satisfy the requirements of the marine discharge licence granted by the South Australian Environment Protection Authority (EPA) for the purpose of these trials. These parameters include the feed water temperature, conductivity, pH and turbidity as well as the return conductivity, turbidity and temperature. These parameters were measured via online and inline sensors, with the data collected and stored by a Citect system.

A series of trials with varying concentrations of typical and likely water processing chemicals (ferric chloride, polymer, sulphuric acid, anti-scalant), were completed to optimise the desalination process. Manual additions of chlorine (biocide) as a method of cleaning the intake pipeline of biological growth, and sodium metabisulphite (chlorine neutraliser) occurred on one occasion.

The pilot plant uses ferric chloride and polymer to help coagulate suspended particles and remove them from the raw seawater before the water enters the media filters. During a backwash, the material that has been removed from the feed water, including the ferric chloride and polymer, is removed from the filters and exits the plant with the return water. In the full-scale plant, this material would be removed and disposed of in a licensed landfill. The typical dosing rates of chemicals are presented in Table H2.3.1. These are the theoretical dosing rates that would be used in ideal conditions, however it was found that the actual rates did vary based on feed water quality variations, particularly with respect to rough weather and storms.

Table H2.3.1: Typical dosing rates of main processing chemicals (for the period July to December 2009)

Parameter	Average daily volume (kg/d)	Average return water concentration (mg/L)
Ferric chloride	1.39	5.00
Polydadmac polymer	0.05	0.18
Sulphuric acid	0.97	3.52
Anti-scalant	0.02	0.08

In addition to the chemicals listed in Table H2.3.1, small quantities of the reverse osmosis (RO) membrane cleaning chemicals, sodium hypochlorite and sodium metabisulphite were used. RO membrane cleaning chemical usage amounted to 7.2 kg for the reporting period. The intake line was manually chlorinated on one occasion to test the procedure. Sodium hypochlorite was used as the dosing agent and was dosed at 2.5 litres per hour for an hour. The water that had been chlorinated was held in tanks and dosed with sodium metabisulphite to remove any remaining chlorine. Water was not returned to the ocean until there was no measurable concentration of chlorine.

All water streams (stages of processing) were reconstituted and returned to sea in compliance with the marine discharge licence requirements.

Water was sampled for chemical analysis in June and August 2008 and in April 2010 from the various stages of the desalination processing streams: raw feedwater, filtered seawater, RO feedwater, RO reject water (return water), filter backwash and RO permeate. Samples consisted of two replicates and collection complied with quality assurance/quality control (QA/QC). Water samples were analysed for a suite of quality parameters by a NATA-accredited laboratory and are presented in Table H2.3.2.

A comparison of the raw feedwater (ambient seawater), RO reject water (return water) and filter backwash indicate that:

- the concentration of ions is approximately doubled in the RO reject water due to the removal of freshwater by the RO membranes
- some metals are removed through coagulation and filtration and contained in the filter backwash (which would be disposed of in licensed landfill for the full-scale desalination plant). The elevated iron content in the filter backwash is the coagulant ferric chloride. In the full-scale plant this would be settled out in the lagoons before being discharged into the sea.

All samples of the return water were found to be within the Environment Protection (Water Quality) Policy of 2003 (WQEPP) and the South Australian Environment Water Protection (Water Quality) Policy 2003 (GHD 2008).

In addition to the above, daily measurements were recorded of water temperature and conductivity (by online instruments) and the pH and turbidity (by hand-held meters) of the feed and return water from the pilot desalination plant. The return water included reconstituted streams, so conductivity and turbidity are not indicative of the return water of the full-scale pilot plant. Return water

pH and temperature are summarised in Figure H2.3.1 and H2.3.2.

Average return temperatures were approximately 2°C greater than feed temperatures. Intake and return pH values were recorded daily from the seawater storage and return water tanks. Return pH was approximately 0.2 pH units less than the intake pH. This small difference between the feed and return pH should have little effect due to the ocean's large buffering capacity. Conductivity determined from the chemical water quality analysis was approximately double that of the intake conductivity (Table H2.3.2), as is predicted for the full-scale desalination plant. The turbidity of the return water of the full-scale plant would be less than the intake turbidity owing to the removal of suspended solids by flocculation and filtration and disposal in licensed landfill. Dissolved oxygen (DO) was also recorded for the period May 2007 to June 2009, however instrument drift resulted in these measurements being unreliable. The return water DO would be saturated because of mixing and aeration before discharge, however its greater salinity (75 mg/L) and temperature (+1°C) would result in oxygen saturation values of approximately 5.5–7 mg/L (Table H2.3.2).

Table H2.3.2: Water quality of pilot desalination plant water streams

Port Bonython pilot plant sampling event

Numbers are range for three sampling events (June 2008, August 2008, April 2010) where in bold type, or one sampling event (filtered seawater, RO feed and filter backwash, April 2010) where not in bold type, with two replicates (primary and QC) per sampling event. Means are presented in parenthesis.

Ion	Units	LOR	Raw feedwater	Filtered seawater	RO Feed	RO reject	Filter backwash	RO permeate	Comments
Location of Sample			*Jetty platform SP*	*Filter 1 outlet SP*	*RO feed SP (post cart filters)*	*RO reject SP*	*Plant sump inlet*	*RO permeate SP*	
METALS									
Aluminium – soluble	mg/L	0.01	<0.01			<0.01	<0.01	<0.01	
Aluminium – total	mg/L	0.01	<0.01			<0.01	0.025–0.047	<0.01	
Arsenic	mg/L	0.003	<0.003			<0.003	<0.003		
Boron – soluble	mg/L	0.2	3.94–5.31 (4.8)	4.46–4.56	3.24–4.54	5.39–8.29 (7.2)	4.05–4.12	0.983–1.32	
Cadmium	mg/L	0.001	<0.001			<0.001	<0.001		
Calcium	mg/L	0.4	478–488 (483.3)	451–454	456	732–891 (813.5)	488–496	0.3–0.5	
Chromium	mg/L	0.001	<0.001			0.001–0.002	0.001		
Copper	mg/L	0.001	0.002–0.004			0.001–0.002	0.004–0.009		
Iron – soluble	mg/L	0.005	<0.005	<0.005	<0.005–0.017	0.001–0.01 (0.005)	0.018–0.021	<0.005	
Iron – total	mg/L	0.005	<0.005	0.033–0.116	0.025	<0.005–0.014 (0.01)	4.86–5.59	<0.005	High insoluble iron in backwash is coagulant (ferric chloride)
Lead	mg/L	0.001	<0.001				0.001–0.003		
Magnesium	mg/L	0.4	1,470–1,560	1,480–1,510	1,480–1,550	2,360–2,700 (2533)	1,530	1	
Manganese	mg/L	0.001	0.001	0.001–0.002	<0.001–0.003		0.036–0.04		
Mercury	mg/L	0.0003	<0.0003				<0.0003		
Molybdenum	mg/L	0.001	0.011				0.013		
Nickel	mg/L	0.001	0.065–0.144				0.023–0.042		
Potassium	mg/L	0.4	469–478 (473.8)	452–461	455–543	726–823 (772)	492–493	3.5–4.37	
Sodium	mg/L	0.4	11,200–12,900 (12,467)	12,600	12,700–13,000	19,500–22,800 (20,883)	11,500–13,000	75–108	

Table H2.3.2: Water quality of pilot desalination plant water streams (cont'd)

Ion	Units	LOR	Raw feedwater	Filtered seawater	RO Feed	RO reject	Filter backwash	RO permeate	Comments
Location of Sample			*Jetty platform SP*	*Filter 1 outlet SP*	*RO feed SP (post cart filters)*	*RO reject SP*	*Plant sump inlet*	*RO permeate SP*	
METALS									
Strontium	mg/L	0.001	7.98–12.1 (9.57)	7.64–7.66	7.65	13.4–20.6 (16.6)	9.02–9.18	0.006–0.026	
Sulfate	mg/L	1.5	3,090–3,450 (3,330)	3,030	3,000–3,060	4,860–5,850 (5,400)	3,030–3,090	<1.5–4	
Tin	mg/L	0.005	<0.005			<0.005	<0.005		
Zinc	mg/L	0.003	0.13			0.129	0.083–0.128		
INORGANIC CHEMISTRY – nutrients									
Bromide	mg/L	0.10	79.2–82.7 (81.2)	80.9	81.1–8,104	126–141 (135)	80–81.4	0.54–0.78	
Chloride	mg/L	4.0	21,700–22,600 (22,033)	21,400–21,700	21,000–21,100	34,500–40,100 (37,000)	22,000–21,600	124–170	
Fluoride	mg/L	0.10	0.96–1.1 (1.02)	1.1	1.1	1.2–1.4 (1.3)	1.1	<0.10	
Ammonia	m/L as N	0.005		0.005–0.007	0.006–0.008		<0.005–.072	0.005–0.008	
Nitrate + Nitrite	mg/L as N	0.005		0.041–0.042	0.033–0.034		0.06-0.063	<0.005	
Nitrogen	mg/L	0.06		0.14–0.15	0.12–0.13		0.3	<0.06	
TKN	mg/L as N	0.05		0.11	0.09–0.1		0.24	<0.05	
Phosphorus – Filterable Reactive	mg/L	0.05					<0.005		
Phosphorus – total	mg/L	0.05					0.018–0.021		Elevated phosphorus in reject indicates presence of anti-scalant
INORGANIC CHEMISTRY - physical									
Total hardness	mg/L as CaCO3	2.0	7,260–7,640 (7,495)	7,220–7,350	7,230–7,890	11,500–13,300 (12,467)	7,560	5–6	
Alkalinity	mg/L as CaCO3		106–129 (114)	110	108–109	161–188 (176.8)	110	40,333.00	
Bicarbonate	mg/L as CaCO3		129–157 (139)	134	132–133	196–229 (215.7)	135	5–7	
Carbonate	mg/L as CaCO3		0	0	0	0	0	0.00	

Table H2.3.2: Water quality of pilot desalination plant water streams (cont'd)

Ion	Units	LOR	Raw feedwater	Filtered seawater	RO Feed	RO reject	Filter backwash	RO permeate	Comments
Location of Sample			*Jetty platform SP*	*Filter 1 outlet SP*	*RO feed SP (post cart filters)*	*RO reject SP*	*Plant sump inlet*	*RO permeate SP*	
METALS									
pH			7.4–8.2 (7.7)	7.4–7.5	7.6	7.3–7.6 (7.4)	7.6	6.2–6.8	
Sodium absorption ratio	-		57.1–58.2	52.8	52.7–63.7	76–78	55.6–57.7	19.8–20.6	
Total dissolved solids by calc	mg/L		39,900–41,500 (40,650)	37,600–39,500	39,200–39,900	64,300–70,300 (67,100)	39,100–40,300	208–288	
Conductivity	uS/cm		62,300–63,800 (63,033)	63,300–63,400	63,200	90,800–103,000 (98,767)	63,300	434–588	
Total dissolved solids by EC	mg/L	1.0	42,000–43,000 (42,667)	43,000	43,000	66,000–78,000 (73,833)	43,000	240–320	
Total dissolved solids by evap	mg/L	1.0	44,000–47,000	47,000–47,100	43,200–43,500	76,500–80,600	42,100–44,400	283–340	
Total suspended solids	mg/L	1.0	<1–5	<1–3	1–6	3–5	20	<1	
FIELD SAMPLES									
Temperature	degC		24.5	25.4	24.5	25.8	25	24.7	
Conductivity	uS/cm		67,100	67,200	67,400	103,800	50,700	1,822	
Dissolved oxygen	ppm		5.14	5.6	6.05	6	6.8	6.87	
pH			7.98	6.75	7.56	7.18	7.56	8.39	
ORP	mV		67	67	49	54	27	66	

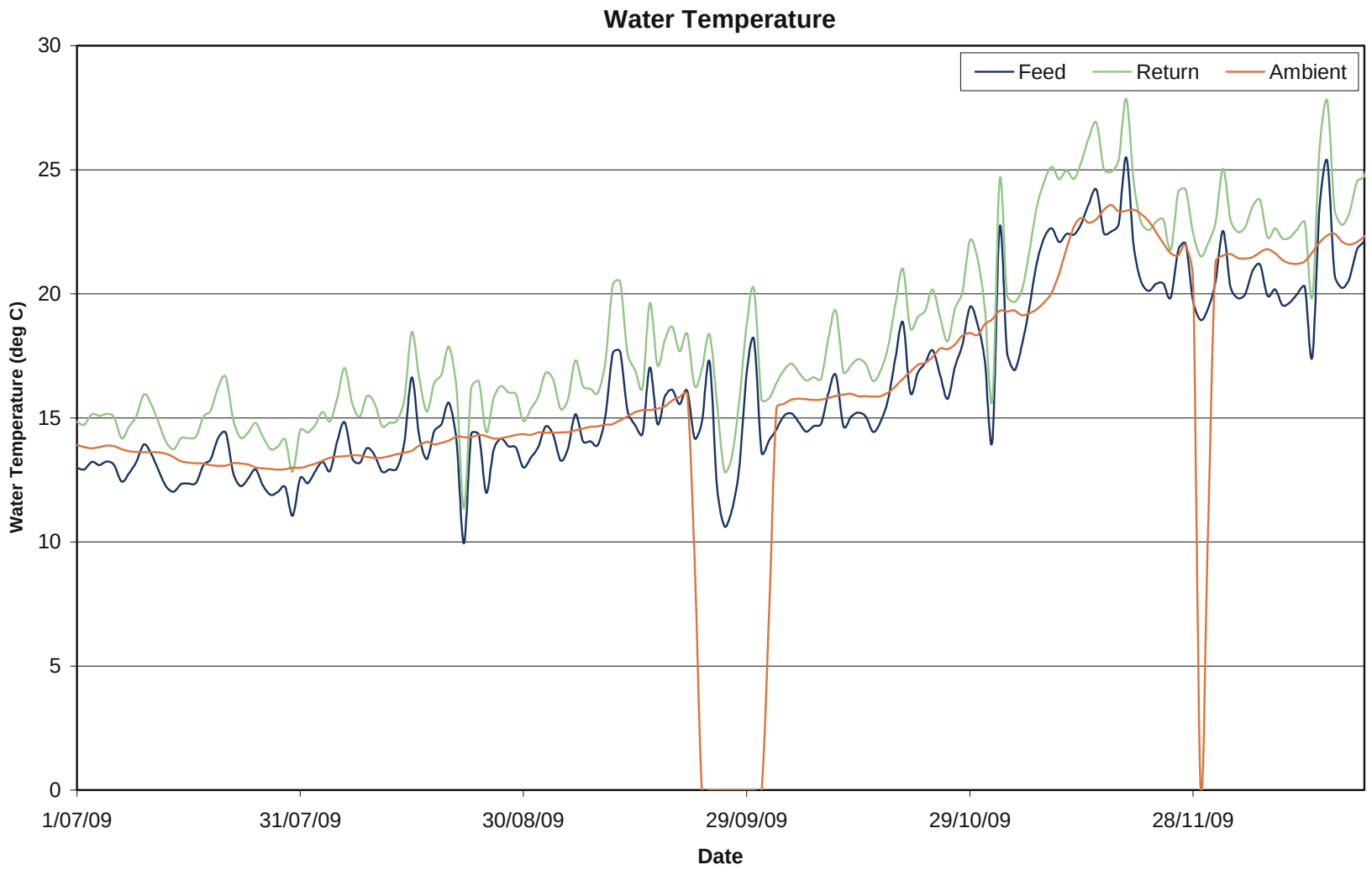


Figure H2.3.1 Temperature of the intake and return water

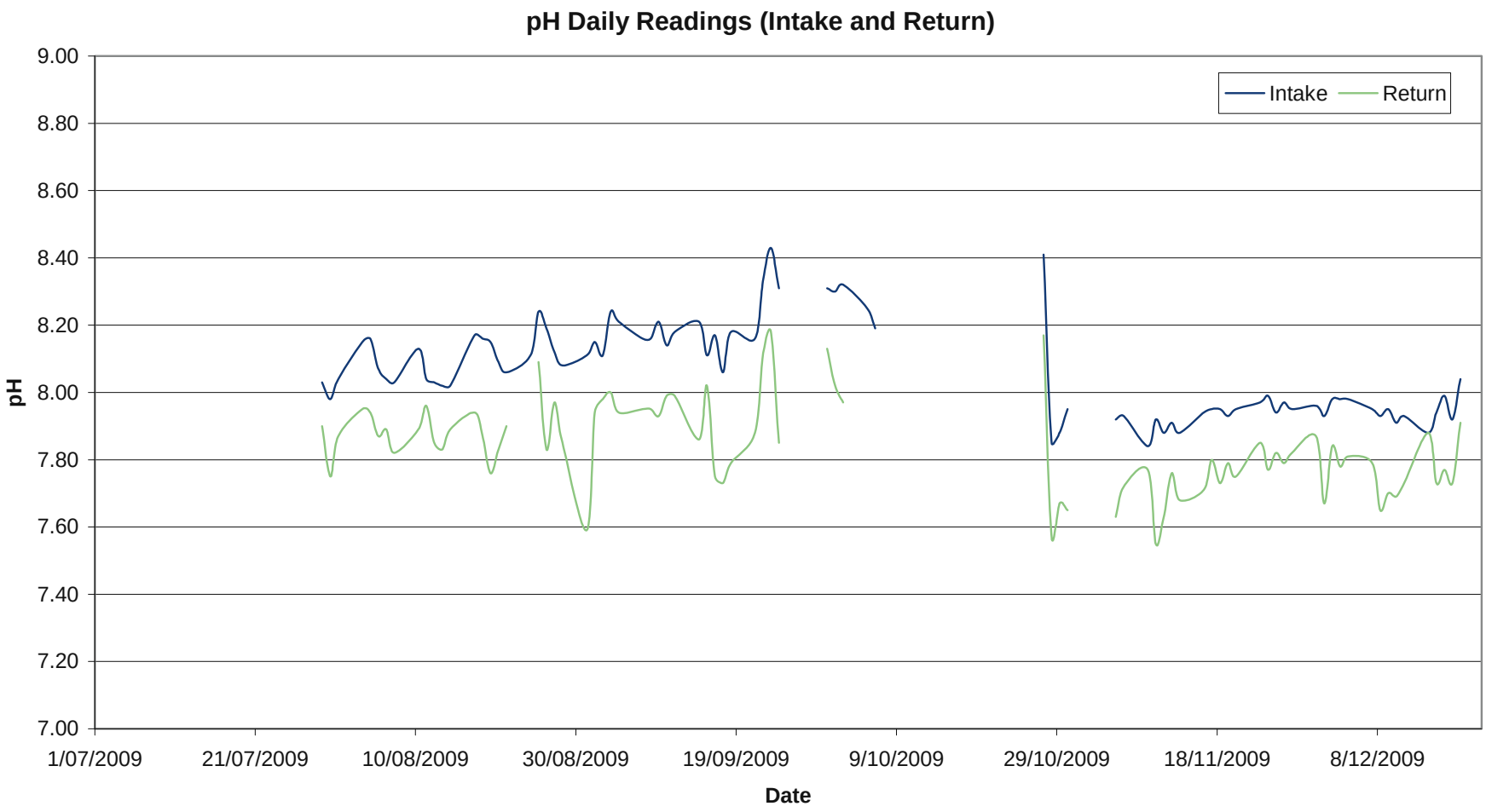


Figure H2.3.2 pH of intake and return water

APPENDIX H2.4

Marine sediment sampling at Point Lowly

Cooe

Care Of Our Environment

Formerly Natural Resource Services Pty Ltd

ARUP-HLA on behalf of BHP BILLITON

Report

Marine Sediment Sampling - Point Lowly South Australia

11th and 12th of March 2008.

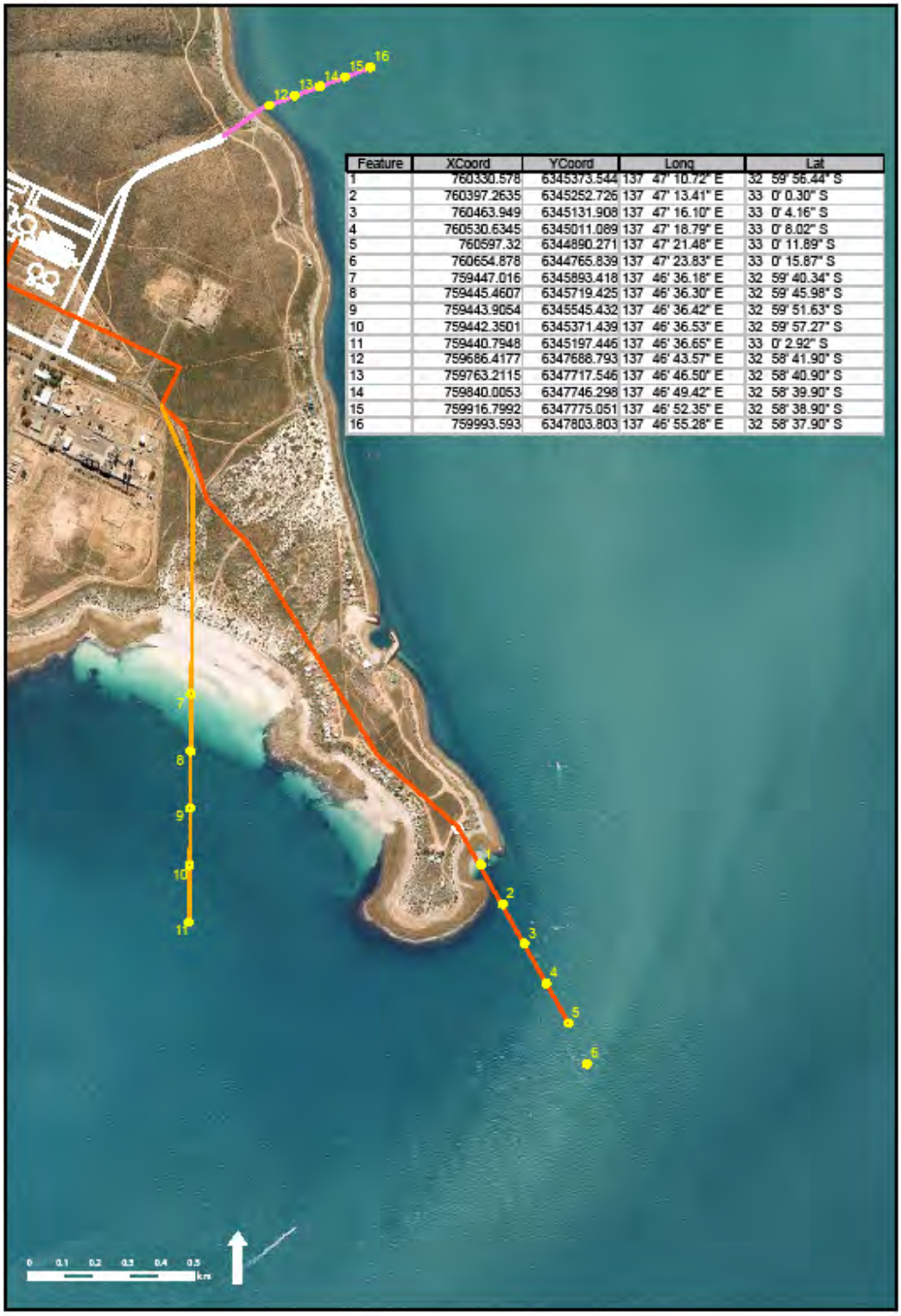
Table of Contents

1 Introduction

On 27 of February 2008 Cooe was commissioned by Arup to undertake marine sediment core sampling at Point Lowly for BHP Billiton.

Arup is investigating potential inlet and outlet pipe locations for a BHP Billiton desalination plant at Point Lowly approximately 34km north east of Whyalla South Australia. The proposed desalination plant will supply water to Olympic Dam mine and Roxby Downs township.

The aim of the sampling program was to provide particle size distribution data (PSD) and relative depth of underlying bedrock to model (ELCOM 3D model) the effects of dredging at two potential inlets and one outlet location for the desalination plant.



Feature	XCoord	YCoord	Long	Lat
1	760330.578	6345373.544	137° 47' 10.72" E	32° 59' 56.44" S
2	760397.2635	6345252.726	137° 47' 13.41" E	33° 0' 0.30" S
3	760463.949	6345131.908	137° 47' 16.10" E	33° 0' 4.16" S
4	760530.6345	6345011.089	137° 47' 18.79" E	33° 0' 8.02" S
5	760597.32	6344890.271	137° 47' 21.48" E	33° 0' 11.89" S
6	760654.878	6344765.839	137° 47' 23.83" E	33° 0' 15.87" S
7	759447.016	6345893.418	137° 46' 36.18" E	32° 59' 40.34" S
8	759445.4607	6345719.425	137° 46' 36.30" E	32° 59' 45.98" S
9	759443.9054	6345545.432	137° 46' 36.42" E	32° 59' 51.63" S
10	759442.3501	6345371.439	137° 46' 36.53" E	32° 59' 57.27" S
11	759440.7948	6345197.446	137° 46' 36.65" E	33° 0' 2.92" S
12	759686.4177	6347688.793	137° 46' 43.57" E	32° 58' 41.90" S
13	759763.2115	6347717.546	137° 46' 46.50" E	32° 58' 40.90" S
14	759840.0053	6347746.298	137° 46' 49.42" E	32° 58' 39.90" S
15	759916.7992	6347775.051	137° 46' 52.35" E	32° 58' 38.90" S
16	759993.593	6347803.803	137° 46' 55.28" E	32° 58' 37.90" S

Figure 1. Site map of inlet and outlet pipe sampling areas and GPS coordinates.

2 Method

16 samples were taken at the three potential inlet and outlet pipe locations. 5 each at the two inlet site location (totalling 10) and 6 samples at the outlet pipe location (refer to Figure 1). Also 10 sites from within the 16 sites were randomly nominated (generated via Microsoft Excel) for testing via the settleable solids analysis described in the section below.

Sampling was undertaken on 11 and 12 March 2008 by Whyalla Diving Services and all cores were logged photographed and sampled by Cooe environmental scientists.

2.1 Materials list.

The list of equipment below were used in the process of sampling marine benthic sediments for PSD or total settleable/ non-settleable solids.

- 16 Corers: 2m long, 50mm diameter PVC corer, with two end caps to retain sample.
- Steel bar: 16mm rod, 2.1m long, one end sharpened to a point and the other has a 16mm BSP nut welded to it.
- Compression Rod: 10mm steel rod fitted with a machined and tapped Teflon cap (49.1mm diameter), used to push samples out of cores.
- Imhoff cone: 1L cone used in determining settleable solids.
- 125mm Bosch grinder with stainless steel tile cutting blade.
- 48x250ml glass sample jars.
- Stainless steel spatula.

2.2 Field method

Each of the 16 sample points were sampled and recorded using the procedures stated below.

- Arrive at GPS location (anchor).
- Diver descend to benthos with corer.
- Corer is driven into the benthos until the diver meets reasonable resistance with a maximum core depth being 2m. Once at 2 metres depth caps were screwed on to retain the core sample (depth reached by core was recorded).
- In cases where the corer could not be driven to a depth of 2m a steel bar was driven sharp end down into the sediment until significant resistance was met (depth results were recorded).

2.3 Core extraction

Once cores were taken and returned to shore, cores were logged, photographed and sampled as follows below.

- Cores were stored on a flat level area and any excess water trapped in the corer was drained slowly over a 3 hours period to ensure small particle sizes were not lost.

- Cores were then either pushed out manually using a compression rod or cores were manually cut open.
- Cores were then split, logged and a sample was taken from the surface level of the core, the deepest point of the core and the exact middle of the core. Each sample was labelled and chilled in an esky before sending to ASLE Laboratories for analysed for PSD via the Australian Standard Hydrometer method (Australian Standard, 1994).

2.4 Settleable solids analysis

Surface samples of marine sediment were taken from the top 5 to 10cm of sediment in 10 randomly selected cores (methods reference, Fischer & Symons 1944).

- 10 samples of approximately 250ml of sediment were taken from the surface level section of each nominated core.
- A Imhoff cone was filled to the one litre point, sample was then mixed into the cone and was settled for 45 minutes.
- Sample was then gently agitated and let settle for a further 15 minutes, then the volume of settleable solids was recorded.
- The non-settleable solids are determined by extracting 250ml of liquid from between the surface of the settled solids and the surface of the water. The 250ml is then allowed to settle for a further hour and level recorded.

Figure 2. Imhoff cone with settleable solids on the right and non-settleable solids on the left.

3 Results

3.1 Particle Size Distribution

Table 1: Particle size distribution

Sample ID	Percent Gravel (+ 2 mm)	Percent Sand (2 mm – 0.060 mm)	Percent Silt (0.060 – 0.002 mm)	Percent Clay (-0.002 mm)
CS01/1 PSD	0	98	2	
CS01/2 PSD	0	98	2	
CS01/3 PSD	1	93	2	4
CS03/1 PSD	35	59	3	3
CS03/2 PSD	79	19	2	
CS03/3 PSD	54	35	4	7
CS04/OM PSD	29	62	7	2
CS05/1 PSD	62	22	10	6
CS05/2 PSD	60	29	5	6
CS05/3 PSD	51	26	11	12
CS06/1 PSD	24	32	22	22
CS06/2 PSD	17	35	22	26
CS06/3 PSD	19	42	19	20
CS07/1 PSD	0	98	2	
CS07/2 PSD	7	89	4	
CS07/3 PSD	2	94	4	
CS08/1 PSD	1	92	3	4
CS08/2 PSD	21	72	3	4
CS08/3 PSD	1	90	3	6
CS09/1 PSD	3	81	10	6
CS09/2 PSD	19	53	11	17
CS09/3 PSD	1	42	19	38
CS010/1 PSD	11	67	9	13
CS010/2 PSD	10	53	15	22
CS010/3 PSD	35	42	9	14
CS011/1 PSD	8	46	20	26
CS011/2 PSD	9	56	15	20
CS011/3 PSD	5	54	17	24
CS012/1 PSD	10	79	4	7
CS012/2 PSD	33	57	5	5
CS012/3 PSD	4	75	9	12
CS013/1 PSD	16	53	15	16
CS013/2 PSD	12	51	16	21
CS013/3 PSD	18	48	16	18
CS014/1 PSD	12	50	18	20
CS014/2 PSD	23	40	17	20
CS014/3 PSD	9	49	19	23
CS015/1 PSD	12	43	20	25
CS015/2 PSD	7	45	22	26
CS015/3 PSD	8	37	27	28
CS016/1 PSD	14	48	18	20
CS016/2 PSD	13	36	25	26
CS016/3 PSD	14	28	25	33

3.2 Settle Solids

Table 2. Settleable solids and non-settleable solids results

Sites	Settleable solids (ml/L)	Non-Settleable solids (ml/L)
TS01	114	0
TS03	110	0
TS05	115	0.5
TS06	110	0.5
TS09	130	0
TS10	126	0
TS11	194	0.5
TS12	110	1
TS14	196	1.2
TS15	220	0.5

4 References

- Australian Standards, 1994. Standard method of fine analysis using a hydrometer, AS 1289.3.6.3-1994. Standards Association of Australia.
- Fischer, A.J. & G.E. Symons, 1944, The determination of settleable sewage solids by weight. *Water Sewage Works,* 91:37.

Appendix A

Core ID CS01

GPS- 137 47 10.72E, 32 59 56.44S

Full Core length Photo

CS01 was characterised by large grain sand to approximately 0.9m deep, then the core consisted of detritus material and orange to red coloured sand.

Surface to 0.75m deep.

0.75m to 1.35m deep.

Fibrous material can be seen at the 0.9m mark mixed with smaller particles of sand then the sample found above.

Sample codes for analysis,

Surface= CS01/1 (taken at 0m)

Mid= CS01/2 (taken at 0.7m)

Bottom= CS01/3 (taken at 1.3m)

Core reached a depth of 1.3m and the steel rod also went to a depth of 1.3m, sample was taken in 2m of water.

Core ID CS02

GPS- 137 47 13.41E, 33 00 00.43S.

No sample was taken at this GPS point as the bottom consisted of broken rock, sand stone and large particle size shell grit. Diver used the anchor rope as the location guide and travelled in a radius of 5 to 10m around the area and the bottom was rock ledge and broken rock in a water depth of 5 metres. Steel rod also could not be driven into the benthos.

Core ID CS03

GPS- 137 47 16.10E, 33 00 04.16S

Full core length photograph, from 0m to 0.6m deep.

CS03 was characterised by sand stone and rocky material throughout the core, also large shell particles were evident in entire the length of the core. Corer was manually pushed to a depth of 0.6m below the benthos before reaching significant resistance.

Sample codes for analysis,

Surface= CS03/1 (taken at 0m)

Mid= CS03/2 (taken at 0.3m)

Bottom= CS03/3 (taken at 0.6m)

Corer reached a depth of 0.6 steel rod reached 0.65, the benthos was covered in sponge and was intermittent rocky bottom, sampling was conducted in 14m of water.

Core ID CS04

GPS- 137 47 18.79E, 33 00 08.02S

No core was taken at this site, although a sample of the surface material was collect, the surface material consisted of sponge material, large shell grit material and a thin layer of mud under the sponge layer (between the bottom of the sponge and the bedrock).

Core would not retain such a small amount of material so manual collection of sample was undertaken by the diving personal. Diver tried to take sample in 26m of water.

Sample ID sent for analysis was CS04/0.

Core ID CS05

GPS- 137 47 21.48E, 33 00 11.89S

Full Core length Photo, 0 to 0.45m

CS05 was characterised by fine particle mud trapped between large bivalve shells, the deepest section of the core consisted of sandstone and rocks that had been cut by the corer.

Sample codes for analysis,

Surface= CS05/1 (taken at 0m)

Mid= CS05/2 (taken at 0.25m)

Bottom= CS05/3 (taken at 0.45m)

Core reached a depth of 0.45m and the steel rod also went to a depth of 0.6m, sample was taken in 27m of water.

Core ID CS06

GPS- 137 47 23.83E, 33 00 15.87S

Full Core length Photo, 0m to 0.95m

CS06 was characterised by sponge material in the top 0.05m of the core, then the core consisted small particle grey brown smelly mud from 0.05m to 0.55m, then the core consist of fine grey mud with broken *Pinna bicolour* and *Chlamys asperrimus* shells from 0.55 to 0.95m.

Sample codes for analysis,

Surface= CS06/1 (taken at 0m)

Mid= CS06/2 (taken at 0.47m)

Bottom= CS06/3 (taken at 0.95m)

Core reached a depth of 1.0m and the steel rod also went to a depth of 1.3m, sample was taken in 24m of water at low tide.

Core ID CS07 (start of potential inlet pipe 2)

GPS- 137 46 36.18E, 32 59 40.34S

Full Core length Photo, 1.02m to 0m

CS07 was characterised by fine grain beach sand was found in the top 0.3m of the core, below the 0.3m mark to the 1.02m mark to the core consisted of beach sand that was an orange colour (which can be clearly seen from the photo above).

Sample codes for analysis,

Surface= CS07/1 (taken at 0m)

Mid= CS07/2 (taken at 0.5m)

Bottom= CS07/3 (taken at 1.02m)

Core reached a depth of 1.1m and the steel rod also went to a depth of 1.1m, sample was taken in 2m of water.

Core ID CS08

GPS- 137 46 36.30E, 32 59 45.98S

Full Core length Photo, 0m to 1.7m (although went to 2m deep)

0m to 1m

1m to 1.7m

CS08 was characterised by fine grain beach sand in the top 0.1m, from 0.1m to 0.5m core consisted of seagrass detritus and fine grain sand, between 0.5m and 1.7m the core sample had a mixture of compacted fine grain sand and *Katelysia scalarina and Katelysia rhytiphora* shells (dead), sand was generally the same size throughout the core.

Sample codes for analysis,

Surface= CS08/1 (taken at 0m)

Mid= CS08/2 (taken at 0.85m)

Bottom= CS08/3 (taken at 1.7m)

Core reached a depth of 2m and the steel rod also went to a depth of 2m, sample was taken in 5m of water.

Core ID CS09

GPS- 137 46 36.42E, 32 59 51.63S

Full Core length Photo, 0m to 1.8m (although went to 2m deep)

0m to 0.8m

0.8m to 1.8m

CS09 was characterised by small grain beach sand in the top 0.2m, between 0.2m and 1.1m the core consisted of sticky compacted grey mud and between 1.1m and 1.8m was fine grain mud material which was grey, sticky and had a clay consistency.

Surface= CS09/1 (taken at 0m)

Mid= CS09/2 (taken at 0.9m)

Bottom= CS09/3 (taken at 1.8m)

Core reached a depth of 2m and the steel rod also went to a depth of 2m, sample was taken in 9m of water.

Core ID CS10

GPS- 137 46 36.53E, 32 59 57.27S

Full Core length Photo, 0m to 1.1m

CS10 was characterised by shell grit and grey mud in the top 0.2m of the core sample, between 0.2m and 1.1m the core was fine sticky grey mud, although the very end of the core was orange (consistent with bedrock).

Surface= CS10/1 (taken at 0m)

Mid= CS10/2 (taken at 0.55m)

Bottom= CS10/3 (taken at 1.1m)

Core reached a depth of 1.75m and the steel rod also went to a depth of 2m, sample was taken in 11.5m of water. Core sample compressed down to 1.1m in length.

Core ID CS11

GPS- 137 46 36.65E, 32 00 02.92S

Full Core length Photo, 0m to 1.4m (core reached a depth of 2m)

CS11 was characterised by dark grey sticky mud throughout the core sample with fine grain shell grit material.

Surface= CS11/1 (taken at 0m)

Mid= CS11/2 (taken at 0.7m)

Bottom= CS11/3 (taken at 1.4m)

Core reached a depth of 2m and the steel rod also went to a depth of 2m, sample was taken in 12.5m of water. Sample was taken in a *Pinna bicolour* bed and core sample compressed 0.6m in the act of sampling.

Core ID CS12 (potential inlet pipe 1)

GPS- 137 46 43.57E, 32 58 41.90S

Full Core length Photo, 0m to 0.8m (corer reach 1m deep)

CS12 was characterised by sand and seagrass detritus in the top 0.2m of the core, grey soft mud was found between 0.2m and 0.6m and the bottom 0.2m of core was thick black/grey mud.

Surface= CS12/1 (taken at 0m)

Mid= CS12/2 (taken at 0.4m)

Bottom= CS12/3 (taken at 0.8m)

Core reached a depth of 1m and the steel rod also went to a depth of 1.5m, sample was taken in 4m of water. Sample was taken in a seagrass bed.

Core ID CS13

GPS- 137 46 46.50E, 32 58 40.90S

Full Core length Photo, 0m to 1.4m (corer reach 2m deep)

CS13 was characterised by seagrass and seagrass detritus between 0m and 0.2m, from 0.2m to 0.85 fine grain grey mud was found and the bottom section of the core consisted of large particle size sand with shell grit material (0.85 to 1.4m)

Surface= CS13/1 (taken at 0m)

Mid= CS13/2 (taken at 0.7m)

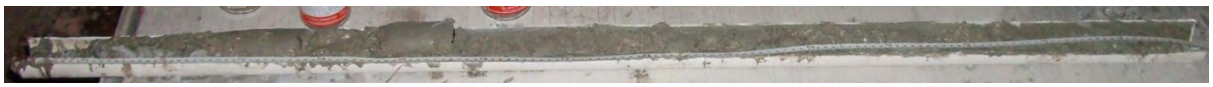
Bottom= CS13/3 (taken at 1.4m)

Core reached a depth of 2m and the steel rod also went to a depth of 2m, sample was taken in 4m of water. Sample was taken in a seagrass bed.

Core ID CS14

GPS- 137 46 49.42E, 32 58 39.90S

Full Core length Photo, 0m to 1.7m (corer reach 2m deep)



0m to 0.8m

0.8m to 1.7m

CS14 was characterised by grey sticky mud between 0m and 0.5m, thick firm grey mud mixed with shell grit was found between 0.5m and 1.5m and the bottom section of the core consisted of firm clay mud with a slight orange colour between 1.5m and 1.7m

Surface= CS14/1 (taken at 0m)

Mid= CS14/2 (taken at 0.85m)

Bottom= CS14/3 (taken at 1.7m)

Core reached a depth of 2m and the steel rod also went to a depth of 2m, sample was taken in 6m of water. Sample was taken in a broken rocky/ mud area.

Core ID CS15

GPS- 137 46 52.35E, 32 58 38.90S

Full Core length Photo, 0m to 1.3m (corer reach 1.5m deep)

0m to 0.5m

0.5m to 1.3m

CS15 was characterised by heavy grey mud throughout the length of the core sample, large shell particles were randomly found in the sample.

Surface= CS15/1 (taken at 0m)

Mid= CS15/2 (taken at 0.65m)

Bottom= CS15/3 (taken at 1.3m)

Core reached a depth of 1.5m and the steel rod also went to a depth of 1.5m, sample was taken in 7m of water. Sample was taken in a broken rocky/ mud area.

Core ID CS16

GPS- 137 46 55.28E, 32 58 37.90S

Full Core length Photo, 0m to 1.65m (corer reach 2m deep)

0m to 0.85m

0.85m to 1.65m

CS16 was characterised by heavy grey mud throughout the length of the core sample, shell grit was found randomly in the entire sample, mainly *Katelysia spp* and *Chlamys asperrimus* (dead).

Surface= CS15/1 (taken at 0m)

Mid= CS15/2 (taken at 0.65m)

Bottom= CS15/3 (taken at 1.3m)

Core reached a depth of 2m and the steel rod also went to a depth of 2m, sample was taken in 10.5m of water. Sample was taken in a seagrass/ muddy benthic area.

APPENDIX H2.5

Marine sediment chemistry at Point Lowly

ARUP-HLA

PORT BONYTHON MARINE SEDIMENT CHEMISTRY

FINAL REPORT (Accepted 17 August 2010)

Cooe
Care Of Our Environment

Cooe
Care Of Our Environment

ARUP-HLA

Port Bonython Marine Sediment Chemistry

Final Report - Accepted 17 August 2010

Prepared for
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Document code: COOE_ODE.SED.2_170810

EXECUTIVE SUMMARY

In May 2009 marine sediment chemistry analysis and measurements of mud depth to resistance were conducted to the north of Point Lowly in support of investigations on potential inlet and outlet pipe locations for a proposed desalination plant.

Three composite samples from three sites along the proposed pipeline corridor were collected and analysed for contaminants.

Laboratory results indicate that all contaminants tested are below Interim Sediment Quality Guidelines – Low (trigger values) established in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000).

Mud probe analysis indicates a gradual increase in mud thickness with distance from shore, from 0.8 m at site PB12 to 3.3 m at site PB16.

TABLE OF CONTENTS

1 INTRODUCTION

This report provides results of a marine sediment sampling program together with a sediment thickness analysis conducted by COOE in May 2009.

The sampling and analysis program was conducted along a transect incorporating five sample sites (Figure 1) to the North of Point Lowly, 34 km North East of Whyalla, South Australia.

Arup-HLA commissioned the project in support of investigations on potential inlet and outlet pipe locations for a proposed desalination plant at the location.

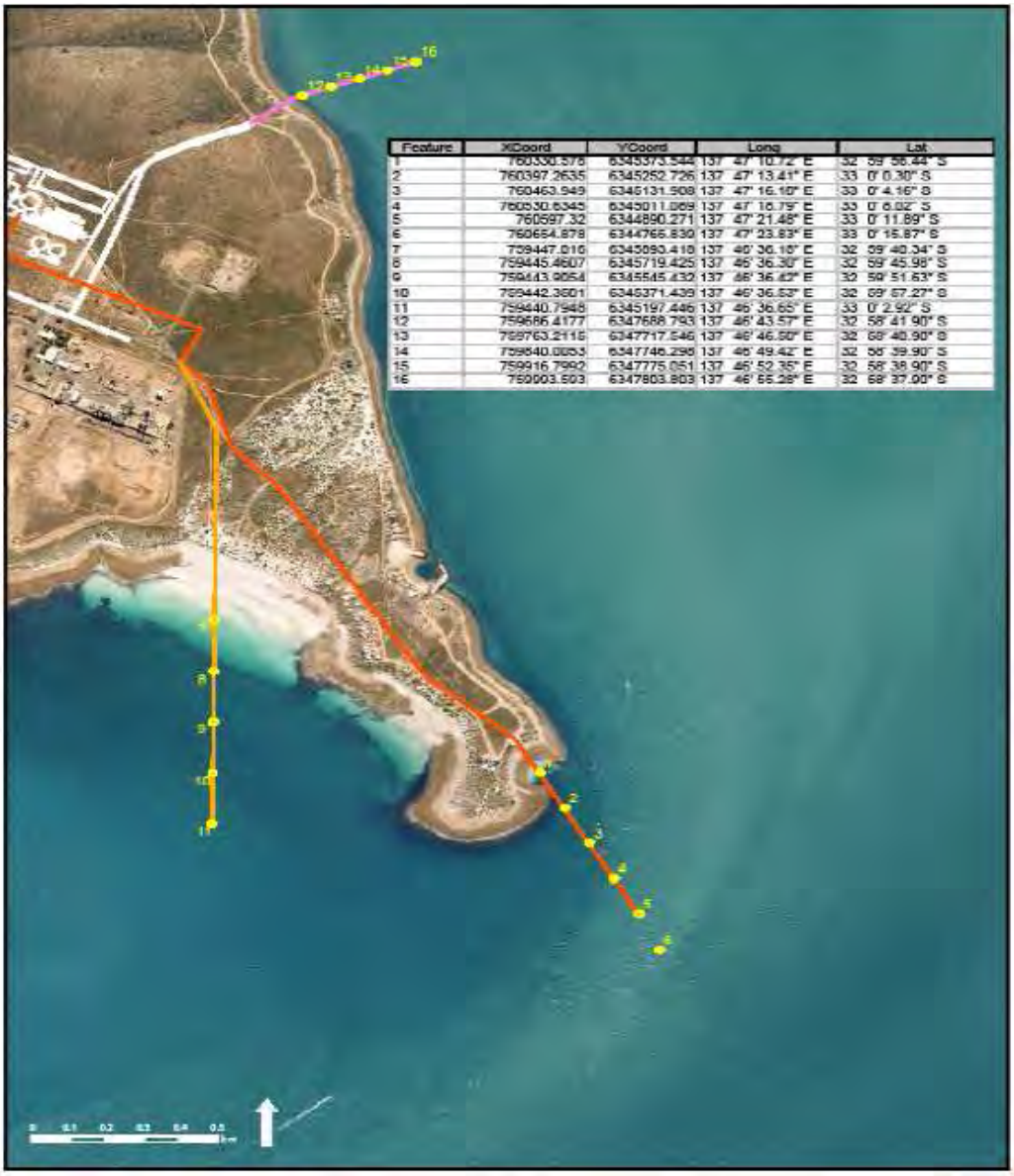

Figure 1: Site map including sample locations 12-16, and grid reference.

2 SAMPLING METHODOLOGY

2.1 Guidelines

Sediment sampling, storage and transport was conducted in accordance with the relevant ANZECC guidelines (ANZECC/ARMCANZ 2000).

Chemical analysis was conducted by ALS Laboratory Group Environmental division, a NATA accredited laboratory.

2.2 Sample location

COOE was requested to collect marine sediment samples from three locations and probe thickness of sediment at sites PB12 to PB16 noted in Figure 1.

Marine sediment composite samples for chemical analysis were collected from locations PB12, PB14 & PB16.

Marine sediment sampling consisted of:

1. Notation of site datum using GPS
2. Notation of collection time
3. Notation of surface water temperature and salinity
4. Collection of composite samples from PB12, PB14 & PB16; and
5. Notation of sediment pH.

Sampling was undertaken on 26 May 2009 by Whyalla Diving Services. Sediment samples were handled by COOE environmental scientists.

2.3 Materials list

The equipment listed below was used in the process of sampling marine benthic sediments.

- 20 x1 m steel rod assemblies
- 6 x 250 ml glass sample jars.
- 2 x Stainless steel spade.
- Nitrile gloves; and
- 3 x 1 L clean plastic containers.

2.4 Field methods

Each of the five sample locations were identified and sampled using the procedures stated below.

2.4.1 Sediment thickness measurements

- Arrive & anchor at GPS location.
- Diver descended to seabed with steel rods
- Steel rods were driven into the mud until the diver meet reasonable resistance.
- Thickness of sediment was measured and recorded (note the maximum thickness measured with this method is 4 m).
- The process was repeated at five locations, labelled PB12 to PB16

2.4.2 Sediment sampling

- Three 1L plastic containers were filled with marine mud at each site; each sub-sample was taken from 1m of the steel rod driven into the benthos.
- On the surface, the sub-samples were mixed together in a stainless bucket to create a composite sample.
- 2 x 250 ml glass jars were filled with the composite sample
- Samples were then labelled and placed in an ice filled esky for transit to the laboratory.
- Sediment samples were collected from sites PB12, PB14 and PB16

2.5 Laboratory analysis

The composite sediment samples were analysed for the potential contaminants noted in table 1.

Table 1: Laboratory analysis

Description	Limit of Reporting (LOR)
Moisture Content	1%
Total Metals by ICP-AES	1-5 mg/kg
Total Recoverable Mercury by FIMS	0.1 mg/kg
Total Petroleum Hydrocarbons/BTEX	0.2-100 mg/kg
Organophosphorus Pesticides (Ultra-trace)	10 µgSn/kg
Organochlorine Pesticides	0.5 µgSn/kg
Polychlorinated Biphenyls (as Aroclors)	5 µgSn/kg
Polynuclear Aromatic Hydrocarbons	10-100 µgSn/kg
Total Organic Carbon (TOC)	0.02%
Organotin Compounds	0.5-1 µgSn/kg

3 RESULTS

3.1 Sediment thickness

The field data and results of sediment thickness measurements at sites PB12 to PB16 are shown in Table 2.

Table 2: Field data and sediment thickness

Sample reference	Datum (WGS84)		25 May 2009 Time (24 hr)	Sediment pH	Surface water temp (°C)	Salinity $mScm^{-1}$	Sediment thickness (m)	Water depth (m)
	Easting	Southing						
PB12	137 46 43.57	32 58 41.90	1130	8.24	17.9	61.8	0.8	2
PB13	137 46 46.50	32 58 40.90	1103		17.9		3.2	4
PB14	137 46 49.42	32 58 39.90	1040	8.06	17.9	63.8	3.1	6
PB15	137 46 52.35	32 58 38.90	1015		17.9		4	6
PB16	137 46 55.28	32 58 37.90	1010	8.03	17.9	63.9	3.3	9

3.2 Sediment chemical analysis

Full chemical analyses are presented in Appendix A. Certificate of Analysis and ALS Laboratory results are documented in Appendix B.

Analytical results were compared to the Interim Sediment Quality Guideline - Low trigger values (ANZECC/ARMCANZ 2000).

3.2.1 Historical analysis

In 2007, HLA (2007) conducted a similar monitoring program along a transect in close proximity to that of PB12 - PB16. Chemical analysis results from this project were comparable to those found by HLA.

3.2.2 Analysis results

All analysed samples returned results lower than the ISGQ-Low trigger levels established by ANZECC for sediment contaminants.

Chromium, Lead, Zinc and Mercury returned results slightly above the Limit Of Reporting (LOR) with remaining heavy metals below LOR. HLA (2007) attributes this to coarse textured sediments providing fewer exchange sites.

All other contaminants were noted as being below LOR.

3.2.3 Environmental risk

Based on existing use of the area in question, results from this sampling program do not indicate a significant environmental risk.

4 CONCLUSION

Sediment depth probing found that sediment thickness increases with distance from the shore the shallowest was 0.8 m. The maximum sediment thickness was not established because one site was deeper then the 4 m extension rod.

Chemical analysis of the three composite sediment samples has not provided any indication of environmental risk based on the existing use of the area investigated.

5 REFERENCES

ANZECC/ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council, and Agriculture and Resource Management Council of Australia and New Zealand, October 2000.

HLA-Environmental services Pty Ltd. 2007, *Sediment Investigation at proposed Desalinisation Plant, Port Bonython and Spencer Gulf Olympic Dam Expansion*, Fortitude Valley, Qld.

Appendix A – Marine Sediment Chemistry analysis

Analyte grouping/Analyte	Units	LOR	ISGC-low (trigger value)	Sample locations		
				PB-12	PB-14	PB-16
EA055: Moisture Content						
Moisture Content (dried @ 103°C)	%	1		24.3	31.7	38
EG005T: Total Metals by ICP-AES						
Arsenic	mg/kg	5	20	<5	<5	<5
Cadmium	mg/kg	1	1.5	<1	<1	<1
Chromium	mg/kg	2	80	<2	4	5
Copper	mg/kg	5	65	<5	<5	<5
Lead	mg/kg	5	50	<5	11	13
Nickel	mg/kg	2	21	<2	<2	<2
Zinc	mg/kg	5	200	<5	18	23
EG035T: Total Recoverable Mercury by FIMS						
Mercury	mg/kg	0.1		0.1	<0.1	<0.1
EP075(SIM)S: Phenolic Compound Surrogates						
Phenol-d6	%	0.5		--	--	--
2-Chlorophenol-D4	%	0.5		--	--	--
2.4.6-Tribromophenol	%	0.5		--	--	--
EP075(SIM)T: PAH Surrogates						
2-Fluorobiphenyl	%	0.5		--	--	--
Anthracene-d10	%	0.5		--	--	--
4-Terphenyl-d14	%	0.5		--	--	--
EP080: BTEX						
Benzene	mg/kg	0.2		<0.2	<0.2	<0.2
Toluene	mg/kg	0.5		<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	0.5		<0.5	<0.5	<0.5
meta- & para-Xylene	mg/kg	0.5		<0.5	<0.5	<0.5
ortho-Xylene	mg/kg	0.5		<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons						
C6 - C9 Fraction	mg/kg	10		<10	<10	<10
C10 - C14 Fraction	mg/kg	50		<50	<50	<50
C15 - C28 Fraction	mg/kg	100		<100	<100	<100
C29 - C36 Fraction	mg/kg	100		<100	<100	<100
EP080S: TPH(V)/BTEX Surrogates						
1.2-Dichloroethane-D4	%	0.2		106	101	106
Toluene-D8	%	0.2		85.1	82.9	86.1

Analyte grouping/Analyte	Units	LOR	ISGC-low (trigger value)	Sample locations		
				PB-12	PB-14	PB-16
4-Bromofluorobenzene	%	0.2		96.6	93.1	96.2
EP130A: Organophosphorus Pesticides (Ultra-trace)						
Bromophos-ethyl	µgSn/kg	10		<10	<10	<10
Carbophenothion	µgSn/kg	10		<10	<10	<10
Chlorfenvinphos (E)	µgSn/kg	10		<10.0	<10.0	<10.0
Chlorfenvinphos (Z)	µgSn/kg	10		<10	<10	<10
Chlorpyrifos	µgSn/kg	10		<10	<10	<10
Chlorpyrifos-methyl	µgSn/kg	10		<10	<10	<10
Demeton-S-methyl	µgSn/kg	10		<10	<10	<10
Diazinon	µgSn/kg	10		<10	<10	<10
Dichlorvos	µgSn/kg	10		<10	<10	<10
Dimethoate	µgSn/kg	10		<10	<10	<10
Ethion	µgSn/kg	10		<10	<10	<10
Fenamiphos	µgSn/kg	10		<10	<10	<10
Fenthion	µgSn/kg	10		<10	<10	<10
Malathion	µgSn/kg	10		<10	<10	<10
Azinphos Methyl	µgSn/kg	10		<10	<10	<10
Monocrotophos	µgSn/kg	10		<10	<10	<10
Parathion	µgSn/kg	10		<10	<10	<10
Parathion-methyl	µgSn/kg	10		<10	<10	<10
Pirimphos-ethyl	µgSn/kg	10		<10	<10	<10
Prothiofos	µgSn/kg	10		<10	<10	<10
EP130S: Organophosphorus Pesticide Surrogate						
DEF	%	10		54.7	40.7	41.7
EP131A: Organochlorine Pesticides						
Aldrin	µgSn/kg	0.5		<0.50	<0.50	<0.50
alpha-BHC	µgSn/kg	0.5		<0.50	<0.50	<0.50
beta-BHC	µgSn/kg	0.5		<0.50	<0.50	<0.50
delta-BHC	µgSn/kg	0.5		<0.50	<0.50	<0.50
4.4`-DDD	µgSn/kg	0.5	2	<0.50	<0.50	<0.50
4.4`-DDE	µgSn/kg	0.5	2.2	<0.50	<0.50	<0.50
4.4`-DDT	µgSn/kg	0.5		<0.50	<0.50	<0.50
DDT (total)	µgSn/kg	0.5	1.6	<0.50	<0.50	<0.50
Dieldrin	µgSn/kg	0.5	0.02	<0.50	<0.50	<0.50
alpha-Endosulfan	µgSn/kg	0.5		<0.50	<0.50	<0.50
beta-Endosulfan	µgSn/kg	0.5		<0.50	<0.50	<0.50
Endosulfan sulfate	µgSn/kg	0.5		<0.50	<0.50	<0.50
Endosulfan (sum)	µgSn/kg	0.5		<0.50	<0.50	<0.50
Endrin	µgSn/kg	0.5	0.02	<0.50	<0.50	<0.50
Endrin aldehyde	µgSn/kg	0.5		<0.50	<0.50	<0.50
Endrin ketone	µgSn/kg	0.5		<0.50	<0.50	<0.50
Heptachlor	µgSn/kg	0.5		<0.50	<0.50	<0.50
Heptachlor epoxide	µgSn/kg	0.5		<0.50	<0.50	<0.50

Analyte grouping/Analyte	Units	LOR	ISGC-low (trigger value)	Sample locations		
				PB-12	PB-14	PB-16
Hexachlorobenzene (HCB)	µgSn/kg	0.5		<0.50	<0.50	<0.50
gamma-BHC	µgSn/kg	0.5		<0.50	<0.50	<0.50
Methoxychlor	µgSn/kg	0.5		<0.50	<0.50	<0.50
cis-Chlordane	µgSn/kg	0.5		<0.50	<0.50	<0.50
trans-Chlordane	µgSn/kg	0.5		<0.50	<0.50	<0.50
Total Chlordane (sum)	µgSn/kg	0.5	0.5	<0.50	<0.50	<0.50
EP131B: Polychlorinated Biphenyls (as Aroclors)						
Total Polychlorinated biphenyls	µgSn/kg	5	23	<5.0	<5.0	<5.0
Aroclor 1016	µgSn/kg	5		<5.0	<5.0	<5.0
Aroclor 1221	µgSn/kg	5		<5.0	<5.0	<5.0
Aroclor 1232	µgSn/kg	5		<5.0	<5.0	<5.0
Aroclor 1242	µgSn/kg	5		<5.0	<5.0	<5.0
Aroclor 1248	µgSn/kg	5		<5.0	<5.0	<5.0
Aroclor 1254	µgSn/kg	5		<5.0	<5.0	<5.0
Aroclor 1260	µgSn/kg	5		<5.0	<5.0	<5.0
EP131S: OC Pesticide Surrogate						
Dibromo-DDE	%	0.5		70.5	66.3	78
EP131T: PCB Surrogate						
Decachlorobiphenyl	%	5		61.4	52.4	68.2
EP132B: Polynuclear Aromatic Hydrocarbons						
3-Methylcholanthrene	µgSn/kg	10		<10	<10	<10
2-Methylnaphthalene	µgSn/kg	10	70	<10	<10	<10
7.12-Dimethylbenz(a)anthracene	µgSn/kg	10		<10	<10	<10
Acenaphthene	µgSn/kg	10	16	<10	<10	<10
Acenaphthylene	µgSn/kg	10	44	<10	<10	<10
Anthracene	µgSn/kg	10	85	<10	<10	<10
Benz(a)anthracene	µgSn/kg	10	261	<10	<10	<10
Benzo(a)pyrene	µgSn/kg	10	430	<10	<10	<10
Benzo(b)fluoranthene	µgSn/kg	10		<10	<10	<10
Benzo(e)pyrene	µgSn/kg	10		<10	<10	<10
Benzo(g.h.i)perylene	µgSn/kg	10		<10	<10	<10
Benzo(k)fluoranthene	µgSn/kg	10		<10	<10	<10
Chrysene	µgSn/kg	10	384	<10	<10	<10
Coronene	µgSn/kg	10		<10	<10	<10
Dibenz(a.h)anthracene	µgSn/kg	10	63	<10	<10	<10
Fluoranthene	µgSn/kg	10	600	<10	<10	<10
Fluorene	µgSn/kg	10	19	<10	<10	<10
Indeno(1.2.3.cd)pyrene	µgSn/kg	10		<10	<10	<10
N-2-Fluorenyl Acetamide	µgSn/kg	100		<100	<100	<100
Naphthalene	µgSn/kg	10	160	<10	<10	<10
Perylene	µgSn/kg	10		<10	<10	<10
Phenanthrene	µgSn/kg	10	240	<10	<10	<10

Analyte grouping/Analyte	Units	LOR	ISGC-low (trigger value)	Sample locations		
				PB-12	PB-14	PB-16
Pyrene	µgSn/kg	10	665	<10	<10	<10
EP132S: Acid Extractable Surrogates						
2-Fluorophenol	%	10		--	--	--
Phenol-d6	%	10		--	--	--
2-Chlorophenol-D4	%	10		--	--	--
2.4.6-Tribromophenol	%	10		--	--	--
EP132T: Base/Neutral Extractable Surrogates						
2-Fluorobiphenyl	%	10		86.6	66.7	92.3
Anthracene-d10	%	10		82.6	67.4	92.2
4-Terphenyl-d14	%	10		78.6	68.2	93.9
Total Organic Carbon (TOC)						
Total Organic Carbon	%	0.02		0.67	0.45	0.46
Organotin Compounds						
Monobutyltin	µgSn/kg	1		<1	<1	<1
Dibutyltin	µgSn/kg	1		<1	<1	<1
Tributyltin	µgSn/kg	0.5	5	<0.5	<0.5	<0.5
Organotin Surrogate						
Tripropyltin	%	0.5		89.5	82.4	105

Appendix B: ALS Certificate of Analysis and Laboratory results

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: ES0907589	Page	: 1 of 5
Client	: COOE (CARE OF OUR ENVIRONMENT)	Laboratory	: Environmental Division Sydney
Contact	: MR JOE MIFSUD	Contact	: Charlie Pierce
Address	: UNIT 14 19 NORTH TCE HOUSE HACKNEY SA 5069	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: joe@cooe.com.au	E-mail	: charlie.pierce@alsenviro.com
Telephone	: +61 08 83624262	Telephone	: +61-2-8784 8555
Facsimile	: —	Facsimile	: +61-2-8784 8500
Project	: PORT BONYTHON MARINE SEDIMENT CHEMISTRY ODE SED 2	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: —		
C-O-C number	: ADBQ/016/09	Date Samples Received	: 26-MAY-2009
Sampler	: —	Issue Date	: 09-JUN-2009
Site	: —		
		No. of samples received	: 3
Quote number	: —	No. of samples analysed	: 3

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	Position	Accreditation Category
Stephen Hislop	Senior Inorganic Chemist	Inorganics Organics Stafford Minerals - AY

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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 insuffient 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 date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

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

- **Organotins: Poor recovery of MBT in matrix spike due to matrix interference. Confirmed by re-extraction and re-analysis.**

Page : 4 of 5
Work Order : ES0907589
Client : COOE (CARE OF OUR ENVIRONMENT)
Project : PORT BONYTHON MARINE SEDIMENT CHEMISTRY ODE SED 2

Analytical Results

Sub-Matrix: SOIL				Client sample ID	PB-12	PB-14	PB-16	---	---
				Client sampling date / time	25-MAY-2009 12:40	25-MAY-2009 12:55	25-MAY-2009 13:20	---	---
Compound	CAS Number	LOR	Unit		ES0907589-001	ES0907589-002	ES0907589-003	---	---
EA055: Moisture Content									
* Moisture Content (dried @ 103°C)	---	1.0	%		28.7	36.6	38.6	---	---
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	---	0.02	%		0.87	0.46	0.48	---	---
EP090: Organotin Compounds									
Monobutyltin	78763-54-9	1	µgSn/kg		<1	<1	<1	---	---
Dibutyltin	1002-53-5	1	µgSn/kg		<1	<1	<1	---	---
Tributyltin	56573-85-4	0.5	µgSn/kg		<0.5	<0.5	<0.5	---	---
EP090S: Organotin Surrogate									
Tripropyltin	---	0.1	%		89.5	82.4	106	---	---

Page	: 5 of 5
Work Order	: ES0907589
Client	: COOE (CARE OF OUR ENVIRONMENT)
Project	: PORT BONYTHON MARINE SEDIMENT CHEMISTRY ODE SED 2

Surrogate Control Limits

Sub-Matrix: SOIL		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP080S: Organotin Surrogate			
Tripropyltin	---	34	108

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: ES0907590	Page	: 1 of 8
Client	: COOE (CARE OF OUR ENVIRONMENT)	Laboratory	: Environmental Division Sydney
Contact	: MR JOE MIFSUD	Contact	: Charlie Pierce
Address	: UNIT 14 19 NORTH TCE HOUSE HACKNEY SA 5069	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: joe@cooe.com.au	E-mail	: charlie.pierce@alsenviro.com
Telephone	: +61 08 83624282	Telephone	: +61-2-8784 8555
Facsimile	: ---	Facsimile	: +61-2-8784 8500
Project	: PORT BONYTHON MARINE SEDIMENT CHEMISTRY ODE SED 2	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ---		
C-O-C number	: ---	Date Samples Received	: 26-MAY-2009
Sampler	: ---	Issue Date	: 04-JUN-2009
Site	: ---		
		No. of samples received	: 3
Quote number	: ---	No. of samples analysed	: 3

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

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- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	Position	Accreditation Category
Alex Rossi	Organic Chemist	Organics
Celine Conceicao	Spectroscopist	Inorganics
Edwandy Fadjar	Senior Organic Chemist	Organics
Pabi Subba	Senior Organic Chemist (Semi-Volatile)	Organics
Sanjeshni Jyoti Mala	Senior Chemist Volatile	Organics
Sarah Millington	Senior Inorganic Chemist	Inorganics

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Page	: 3 of 8
Work Order	: ES0907590
Client	: COOE (CARE OF OUR ENVIRONMENT)
Project	: PORT BONYTHON MARINE SEDIMENT CHEMISTRY ODE SED 2

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.

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Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient 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 date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

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

- **EP132: Poor duplicate precision due to sample heterogeneity. Confirmed by re-extraction and re-analysis.**
- **LCS recovery for some samples falls outside ALS Dynamic Control Limit. However, it is within the acceptance criteria based on ALS DQO. No further action is required.**

Page : 4 of 8
Work Order : ES0907590
Client : COOE (CARE OF OUR ENVIRONMENT)
Project : PORT BONYTHON MARINE SEDIMENT CHEMISTRY ODE SED 2

Analytical Results

Sub-Matrix: SOIL			Client sample ID	PB-12	PB-14	PB-16	---	---
			Client sampling date / time	25-MAY-2009 12:40	25-MAY-2009 12:50	25-MAY-2009 13:20	---	---
Compound	CAS Number	LOR	Unit	ES0907590-001	ES0907590-002	ES0907590-003	---	---
EA055: Moisture Content								
* Moisture Content (dried @ 103°C)	---	1.0	%	24.3	31.7	38.0	---	---
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	---	---
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	---	---
Chromium	7440-47-3	2	mg/kg	<2	4	5	---	---
Copper	7440-50-8	5	mg/kg	<5	<5	<5	---	---
Lead	7439-92-1	5	mg/kg	<5	11	13	---	---
Nickel	7440-02-0	2	mg/kg	<2	<2	<2	---	---
Zinc	7440-66-6	5	mg/kg	<5	18	23	---	---
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.1	<0.1	<0.1	---	---
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	---	10	mg/kg	<10	<10	<10	---	---
C10 - C14 Fraction	---	50	mg/kg	<50	<50	<50	---	---
C15 - C28 Fraction	---	100	mg/kg	<100	<100	<100	---	---
C29 - C36 Fraction	---	100	mg/kg	<100	<100	<100	---	---
EP080: BTEX								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	---	---
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	---	---
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	---	---
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	---	---
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	---	---
EP130A: Organophosphorus Pesticides (Ultra-trace)								
Bromophos-ethyl	4824-78-6	10	µg/kg	<10	<10	<10	---	---
Carbophenothion	786-19-6	10	µg/kg	<10	<10	<10	---	---
Chlorfenvinphos (E)	470-90-6	10.0	µg/kg	<10.0	<10.0	<10.0	---	---
Chlorfenvinphos (Z)	470-90-6	10	µg/kg	<10	<10	<10	---	---
Chlorpyrifos	2921-88-2	10	µg/kg	<10	<10	<10	---	---
Chlorpyrifos-methyl	5598-13-0	10	µg/kg	<10	<10	<10	---	---
Demeton-S-methyl	919-86-8	10	µg/kg	<10	<10	<10	---	---
Diazinon	333-41-5	10	µg/kg	<10	<10	<10	---	---
Dichlorvos	62-73-7	10	µg/kg	<10	<10	<10	---	---
Dimethoate	60-51-5	10	µg/kg	<10	<10	<10	---	---
Ethion	563-12-2	10	µg/kg	<10	<10	<10	---	---
Fenamiphos	22224-92-6	10	µg/kg	<10	<10	<10	---	---
Fenthion	55-38-9	10	µg/kg	<10	<10	<10	---	---
Malathion	121-75-5	10	µg/kg	<10	<10	<10	---	---

Page : 5 of 8
Work Order : ES0907590
Client : CODE (CARE OF OUR ENVIRONMENT)
Project : PORT BONYTHON MARINE SEDIMENT CHEMISTRY ODE SED 2

Analytical Results

Sub-Matrix: SOIL				Client sample ID	PB-12	PB-14	PB-16	---	---
				Client sampling date / time	25-MAY-2009 12:40	25-MAY-2009 12:50	25-MAY-2009 13:20	---	---
Compound	CAS Number	LOR	Unit		ES0907590-001	ES0907590-002	ES0907590-003	---	---
EP130A: Organophosphorus Pesticides (Ultra-trace) - Continued									
Azinphos Methyl	86-50-0	10	µg/kg		<10	<10	<10	---	---
Monocrotophos	6923-22-4	10	µg/kg		<10	<10	<10	---	---
Parathion	56-38-2	10	µg/kg		<10	<10	<10	---	---
Parathion-methyl	298-00-0	10	µg/kg		<10	<10	<10	---	---
Pirimphos-ethyl	23505-41-1	10	µg/kg		<10	<10	<10	---	---
Prothiofos	34643-46-4	10	µg/kg		<10	<10	<10	---	---
EP131A: Organochlorine Pesticides									
Aldrin	309-00-2	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
alpha-BHC	319-84-6	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
beta-BHC	319-85-7	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
delta-BHC	319-86-8	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
4.4`-DDD	72-54-8	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
4.4`-DDE	72-55-9	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
4.4`-DDT	50-29-3	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
^ DDT (total)	---	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
Dieldrin	60-57-1	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
alpha-Endosulfan	959-98-8	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
beta-Endosulfan	33213-65-9	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
Endosulfan sulfate	1031-07-8	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
^ Endosulfan (sum)	115-29-7	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
Endrin	72-20-8	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
Endrin aldehyde	7421-93-4	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
Endrin ketone	53494-70-5	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
Heptachlor	76-44-8	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
Heptachlor epoxide	1024-57-3	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
Hexachlorobenzene (HCB)	118-74-1	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
gamma-BHC	58-89-9	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
Methoxychlor	72-43-5	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
cis-Chlordane	5103-71-9	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
trans-Chlordane	5103-74-2	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
^ Total Chlordane (sum)	---	0.50	µg/kg		<0.50	<0.50	<0.50	---	---
EP131B: Polychlorinated Biphenyls (as Aroclors)									
^ Total Polychlorinated biphenyls	---	5.0	µg/kg		<5.0	<5.0	<5.0	---	---
Aroclor 1016	12974-11-2	5.0	µg/kg		<5.0	<5.0	<5.0	---	---
Aroclor 1221	11104-28-2	5.0	µg/kg		<5.0	<5.0	<5.0	---	---
Aroclor 1232	11141-16-5	5.0	µg/kg		<5.0	<5.0	<5.0	---	---
Aroclor 1242	53469-21-9	5.0	µg/kg		<5.0	<5.0	<5.0	---	---
Aroclor 1248	12672-29-6	5.0	µg/kg		<5.0	<5.0	<5.0	---	---

Page : 6 of 8
Work Order : ES0907590
Client : COOE (CARE OF OUR ENVIRONMENT)
Project : PORT BONYTHON MARINE SEDIMENT CHEMISTRY ODE SED 2

Analytical Results

Sub-Matrix: SOIL				Client sample ID	PB-12	PB-14	PB-16	---	---
				Client sampling date / time	25-MAY-2009 12:40	25-MAY-2009 12:50	25-MAY-2009 13:20	---	---
Compound	CAS Number	LOR	Unit		ES0907590-001	ES0907590-002	ES0907590-003	---	---
EP131B: Polychlorinated Biphenyls (as Aroclors) - Continued									
Aroclor 1254	11097-69-1	5.0	µg/kg		<5.0	<5.0	<5.0	---	---
Aroclor 1260	11096-82-5	5.0	µg/kg		<5.0	<5.0	<5.0	---	---
EP132B: Polynuclear Aromatic Hydrocarbons									
3-Methylcholanthrene	56-49-5	10	µg/kg		<10	<10	<10	---	---
2-Methylnaphthalene	91-57-6	10	µg/kg		<10	<10	<10	---	---
7.12-Dimethylbenz(a)anthracene	57-97-6	10	µg/kg		<10	<10	<10	---	---
Acenaphthene	83-32-9	10	µg/kg		<10	<10	<10	---	---
Acenaphthylene	208-96-8	10	µg/kg		<10	<10	<10	---	---
Anthracene	120-12-7	10	µg/kg		<10	<10	<10	---	---
Benz(a)anthracene	56-55-3	10	µg/kg		<10	<10	<10	---	---
Benzo(a)pyrene	50-32-8	10	µg/kg		<10	<10	<10	---	---
Benzo(b)fluoranthene	205-99-2	10	µg/kg		<10	<10	<10	---	---
Benzo(e)pyrene	192-97-2	10	µg/kg		<10	<10	<10	---	---
Benzo(g.h.i)perylene	191-24-2	10	µg/kg		<10	<10	<10	---	---
Benzo(k)fluoranthene	207-08-9	10	µg/kg		<10	<10	<10	---	---
Chrysene	218-01-9	10	µg/kg		<10	<10	<10	---	---
Coronene	191-07-1	10	µg/kg		<10	<10	<10	---	---
Dibenz(a.h)anthracene	53-70-3	10	µg/kg		<10	<10	<10	---	---
Fluoranthene	206-44-0	10	µg/kg		<10	<10	<10	---	---
Fluorene	86-73-7	10	µg/kg		<10	<10	<10	---	---
Indeno(1.2.3.cd)pyrene	193-39-5	10	µg/kg		<10	<10	<10	---	---
N-2-Fluorenyl Acetamide	53-96-3	100	µg/kg		<100	<100	<100	---	---
Naphthalene	91-20-3	10	µg/kg		<10	<10	<10	---	---
Perylene	198-55-0	10	µg/kg		<10	<10	<10	---	---
Phenanthrene	85-01-8	10	µg/kg		<10	<10	<10	---	---
Pyrene	129-00-0	10	µg/kg		<10	<10	<10	---	---
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		108	101	108	---	---
Toluene-D8	2037-26-5	0.1	%		86.1	82.9	86.1	---	---
4-Bromofluorobenzene	460-00-4	0.1	%		98.8	93.1	96.2	---	---
EP130S: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.1	%		64.7	40.7	41.7	---	---
EP131S: OC Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.1	%		70.5	86.3	78.0	---	---
EP131T: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		61.4	52.4	68.2	---	---
EP132T: Base/Neutral Extractable Surrogates									

Page : 7 of 8
Work Order : ES0907590
Client : CDOE (CARE OF OUR ENVIRONMENT)
Project : PORT BONYTHON MARINE SEDIMENT CHEMISTRY ODE SED 2

Analytical Results

Sub-Matrix: SOIL				Client sample ID	PB-12	PB-14	PB-16	---	---
				Client sampling date / time	25-MAY-2009 12:40	25-MAY-2009 12:50	25-MAY-2009 13:20	---	---
Compound	CAS Number	LOR	Unit		ES0907590-001	ES0907590-002	ES0907590-003	---	---
EP132T: Base/Neutral Extractable Surrogates - Continued									
2-Fluorobiphenyl	321-60-8	0.1	%		86.6	86.7	92.3	---	---
Anthracene-d10	1719-06-8	0.1	%		82.6	87.4	92.2	---	---
4-Terphenyl-d14	1718-51-0	0.1	%		78.6	88.2	93.8	---	---

Page	: 8 of 8
Work Order	: ES0907590
Client	: COOE (CARE OF OUR ENVIRONMENT)
Project	: PORT BONYTHON MARINE SEDIMENT CHEMISTRY ODE SED 2

Surrogate Control Limits

Sub-Matrix: SOIL		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	80	120
Toluene-D8	2037-26-5	81	117
4-Bromofluorobenzene	460-00-4	74	121
EP130S: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	51.3	136.9
EP131S: OC Pesticide Surrogate			
Dibromo-DDE	21655-73-2	10	136
EP131T: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	10	164
EP132T: Base/Neutral Extractable Surrogates			
2-Fluorobiphenyl	321-60-8	30	115
Anthracene-d10	1719-06-8	27	133
4-Terphenyl-d14	1718-51-0	18	137