

# **SOUTHERN SEAWATER DESALINATION PLANT - MARINE INVESTIGATIONS**

## **Water Quality Monitoring - Stage 1**

*Prepared for:*

### **WATER CORPORATION**

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### Limitations Statement

The sole purpose of this report and the associated services performed by Kellogg Brown & Root Pty Ltd (KBR) is to provide a review water quality data at the proposed Southern Seawater Desalination Plant site in accordance with the scope of services set out in the contract between KBR and the Water Corporation of Western Australia. That scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

KBR derived the data in this report primarily from field monitoring and laboratory analyses on the dates indicated. The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.

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### Revision History

Revision	Date	Comment	Signatures		
			Originated by	Checked by	Approved by
A	21/11/07	Issued for Technical Review	DC	DL	KZ
0	27/11/07	Issued to Client	DC	DL	KZ
1	08/02/08	Incorporation of Client Comments	DC	DL	KZ

# Executive Summary

## INTRODUCTION

The Water Corporation of Western Australia is progressing with the development of the Southern Seawater Desalination Plant (SSDP) located at Binningup, Western Australia. The SSDP has been selected as the preferred option to produce 100 GL/a of drinking water to meet the forecasted increase in demand. The plant will require the construction of a marine inlet to source influent seawater and an outfall to dispose of the brine reject.

Kellogg Brown and Root Pty Ltd was commissioned by the Water Corporation to undertake a series of marine investigations to determine the precise locations of the proposed SSDP inlet and outfall. A component of the marine investigations is the water quality monitoring program which aims to serve the following purposes:

- To provide information relating to the quality and variation of seawater that will be used in the desalination plant. This information will be used in the design and operation of the plant.
- To provide information on environmental conditions in the area that will be receiving the brine discharge from the desalination plant. This information will be used to assist in determining the likelihood and extent of any influences on the receiving environment.

The complete water quality monitoring program will consist of six discrete monitoring events including autumn, winter, winter/spring, spring, spring/summer and summer. Water quality data shall be reported in three phases, a preliminary report presenting data obtained during the March (autumn) and July (winter) 2007 monitoring surveys, this, the Stage 1 report presenting data from the March (autumn), July (winter), September (winter/spring) and October (spring) 2007 monitoring surveys and the final Stage 2 report presenting data from all six monitoring events.

The baseline water quality data presented in this Stage 1 report relate to parameters that could potentially be affected due to the receipt of desalination brine via enrichment (nutrients and biologically available organic materials) and contamination (persistent organics and heavy metals) and impact desalination plant design and/or operations.

## **SAMPLING METHODOLOGY**

Water sampling, water column profiling and silt density index (SDI) testing were conducted over three consecutive days each during the March, July, September and October sampling events. Integrated water samples, collected across the entire water column, were obtained over each day of monitoring. Due to equipment failure, water column profiling was conducted on two days only during the March and July monitoring events and SDI was measured on two days during the March monitoring event.

Water monitoring was conducted at five monitoring sites located along a 10 m isobath. Site BY-0 represents the approximate location of the proposed outfall. Sites BY-500N and BY-500S are located 500 m to the north and south of BY-0 respectively. Control sites, BY-1250N and BY-5000S are located well beyond the anticipated impact zone of the proposed outfall.

## **PHYSICOCHEMICAL PARAMETERS**

Physicochemical parameters including temperature, pH, salinity, dissolved oxygen and turbidity were monitored throughout the entire water column at each site on each day of monitoring. This monitoring did not detect any significant stratification during any of monitoring events. The continued use of integrated water samples was supported. High turbidity was observed throughout the water column during both the October and September monitoring events.

## **WATER QUALITY PARAMETERS**

All water samples were analysed for a wide range of parameters grouped as general, nutrients, contaminants and biological parameters. They were selected in accordance with ASTM D 4195-88 'Standard Guide for Water Analysis for Reverse Osmosis Application'.

General water quality parameters were found to be comparable with those of typical seawater. Slight enrichments in calcium, magnesium and sulfate were observed during various monitoring events.

Seasonal variation was observed for water-soluble nutrients (ammonium, nitrite & nitrate and orthophosphorous), total (insoluble) aluminium and microbial content (heterotrophic plate count and faecal streptococci). These analytes were significantly greater in July, which was attributed to increased runoff and groundwater entering the sea due to winter rain events, especially prior to the July monitoring event and are consistent with an influx of agricultural run-off as a result of increased rainfall. The high microbial content of marine waters could adversely affect desalination plant operations due to biofouling and should be considered when developing an inlet chlorination strategy. Mean concentrations of water-soluble nutrients and chlorophyll-a exceeded ANZECC/ARMCANZ (2000) default trigger values under pre-operational conditions.

The area is one of high primary productivity and, as seen from preliminary habitat mapping results, likely to be high in secondary productivity. It is expected that there will be considerable variability in many parameters, especially after storm events.

## **SILT DENSITY INDEX**

Silt density index (SDI) testing was performed in accordance with ASTM D 4189-1995, 'Standard test method for silt density index (SDI) of water'.

SDI results for marine waters at Binningup during the March, July, September and October monitoring events indicate that the water generally has a low fouling potential. Day 3 of the July produced an SDI of 19.4, indicating a very high fouling potential. Visual inspection of the filter paper revealed a green colouration, presumably due to algae, however algal concentrations (measured as chlorophyll-a) were no greater on this day at this site than on the previous two days. It was apparent that the high turbidity and suspended solid content observed in September and October did not significantly contribute to the fouling potential of the waters.

There seems to be little correlation between the three individual measures for suspended material in the water column, namely turbidity, total suspended solids, and SDI. These measurements are based on optical, gravimetric and empirical measurements respectively. This relationship shall be investigated further in the Stage 2 report.

## **RECOMMENDATIONS**

Mean concentrations of water-soluble nutrients and chlorophyll-a exceeded ANZECC/ARMCANZ (2000) default trigger values under pre-operational conditions. As such these default trigger values should not be applied for operational monitoring.

The nutrient and microbial source(s) which resulted in increased concentrations during the July monitoring event should be identified to assist with plant operations. It is recommended that the Harvey River Diversion Drain, a likely source of these species, be monitored to confirm or exclude it as a possible nutrient and microbial source.

It is recommended that the determination of heterotrophic plate count at 37°C cease. This temperature is well above ambient water temperatures at this location. A temperature of 21°C is closer to ambient water temperatures at this location and is considered more applicable in determining the potential for microbiological growth.

Water quality at site BY-5000S (which is to the south of Binningup) is measurably different under pre-operational conditions to that at the other sites. It is recommended that monitoring at this site be continued and that an additional monitoring site located closer to site BY-0 be

instated so that the water quality at the new site is comparable with the other monitoring sites used in this program.