

# ADELAIDE DESALINATION PROJECT



## WATER QUALITY CHARACTERISATION STUDY

February 2011

Report prepared by



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## 1 Introduction

The scope of this study is to characterise the ambient water quality in the Port Stanvac region, before the desalination plant becomes operational.

Specific aims for the study are:

1. To conduct monthly water column profiling 100 m, 500 m and 5 km north and south of the Adelaide Desalination Plant outfall, at a water depth of 5 m, 10 m, 15 m, 20 m and 25 m; and
2. To conduct monthly water column profiling of three offshore reference sites to determine natural changes in background concentrations in Gulf St Vincent.

The results presented in this report are from a water quality survey conducted on 15<sup>th</sup> February, 2011.

## 2 Results and Discussion

### 2.1 Salinity (Specific Conductivity and TDS)

TDS concentrations in the region ranged between 36.8 g/L and 37.2 g/L ( $\pm 0.1$  g/L).

There is a general trend of higher TDS concentrations, on the seafloor, in shallow water (<20 metres) when compared to deeper depths (Figure 1). The difference observed is 0.4 g/L. The maximum concentration (37.2 g/L) observed is in the shallow water adjacent to Noarlunga (south of outfall).

A halocline appears to exist inshore, at a depth of 12 metres, where TDS concentrations increase by approximately 0.3 g/L (Figure 11; 15m and 20m sampling sites). It is not clear whether this halocline persisted across changes in the tidal cycle.

### 2.2 Water temperature

Water temperature in the region ranged between 21.4 °C and 22.2 °C ( $\pm 0.15$ °C).

Seawater temperature was generally cooler offshore when compared to inshore (Figure 2), with a temperature change of up 0.9 °C across the region. The maximum water temperature observed on the seafloor (22.2 °C) occurred in the shallow water (<5 m) off the coast of Port Stanvac (east of the outfall).

There appeared to be strong stratification occurring in the water column between 5 m and 15 m, in the deeper sites along the coast (10m, 15m and 20m; Figure 6). The temperature difference between the layer was approximately 0.4 °C and it was not clear whether the stratified layer persisted across changes in the tidal cycle. Stratification was not observed at the reference sites (Figure 6).

## 2.3 Dissolved Oxygen

Dissolved oxygen (DO) concentration in the region ranged between 6.9 mg/L and 7.4 mg/L ( $\pm 0.1$  mg/L), which equates to an oxygen saturation of 96%-105% (Figure 4).

Oxygen concentrations are generally greater on the surface than on the seafloor, due to surface disturbance (wind and waves) oxygenating the water (Figure 7). At the seafloor, oxygen concentrations are generally greater inshore than offshore (Figure 3). This is due to a mixture of surface disturbance and macroalgal communities associated with local reefs, oxygenating the seawater.

## 2.4 Chlorophyll

Chlorophyll concentrations in the region ranged between 0.3  $\mu\text{g/L}$  and 1.9  $\mu\text{g/L}$  ( $\pm 1$   $\mu\text{g/L}$ ).

There is a general trend of higher chlorophyll concentrations closer inshore when compared to deeper water (>25 m; Figure 5).

Water samples were collected to verify chlorophyll *a* concentrations measured using the YSI sonde (6600 series V4). The samples were collected one metre below the surface, at sites where water depth was 15 m. The average chlorophyll *a* concentration was 0.39  $\mu\text{g/L}$  and ranged between 0.36 – 0.43  $\mu\text{g/L}$  (Table 1).

Table 1 Chlorophyll *a* concentrations at 15 m sites along the coast. Seawater samples were collected one metre below the surface and analysed by AWQC laboratories.

Direction	Distance from ADP Diffuser (metres)	Chlorophyll a ( $\mu\text{g/L}$ )
North	5000	0.39
North	500	0.36
North	100	0.37
South	100	0.43
South	500	0.43
South	5000	0.38

## 2.5 Turbidity

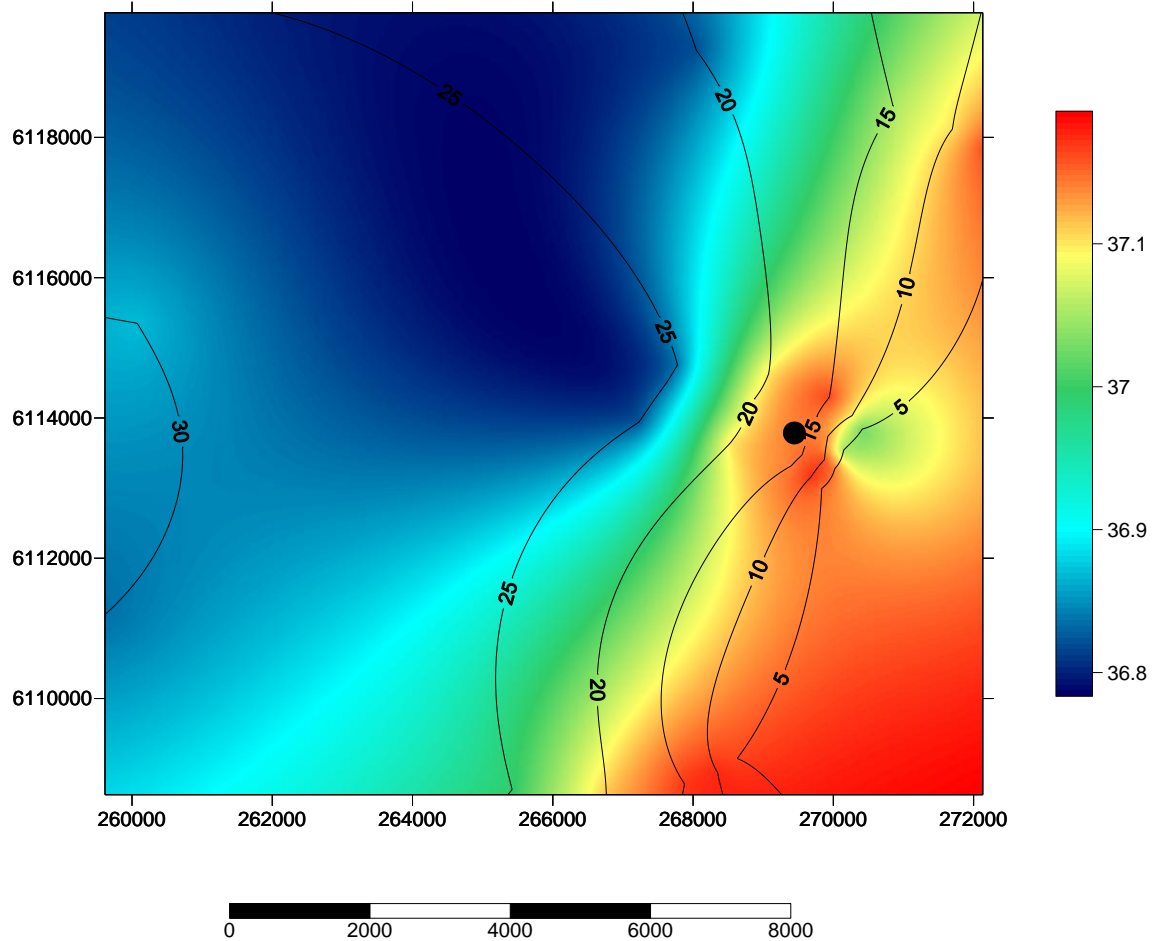
Turbidity in the water column was less than 2 NTU, throughout the region.

The sensor's accuracy is  $\pm 2$  NTU, therefore when turbidity concentrations are less than 2 NTU the sensor may provide a reading that falls between -2 and 2 NTU. This was observed at all sites (Figure 8).

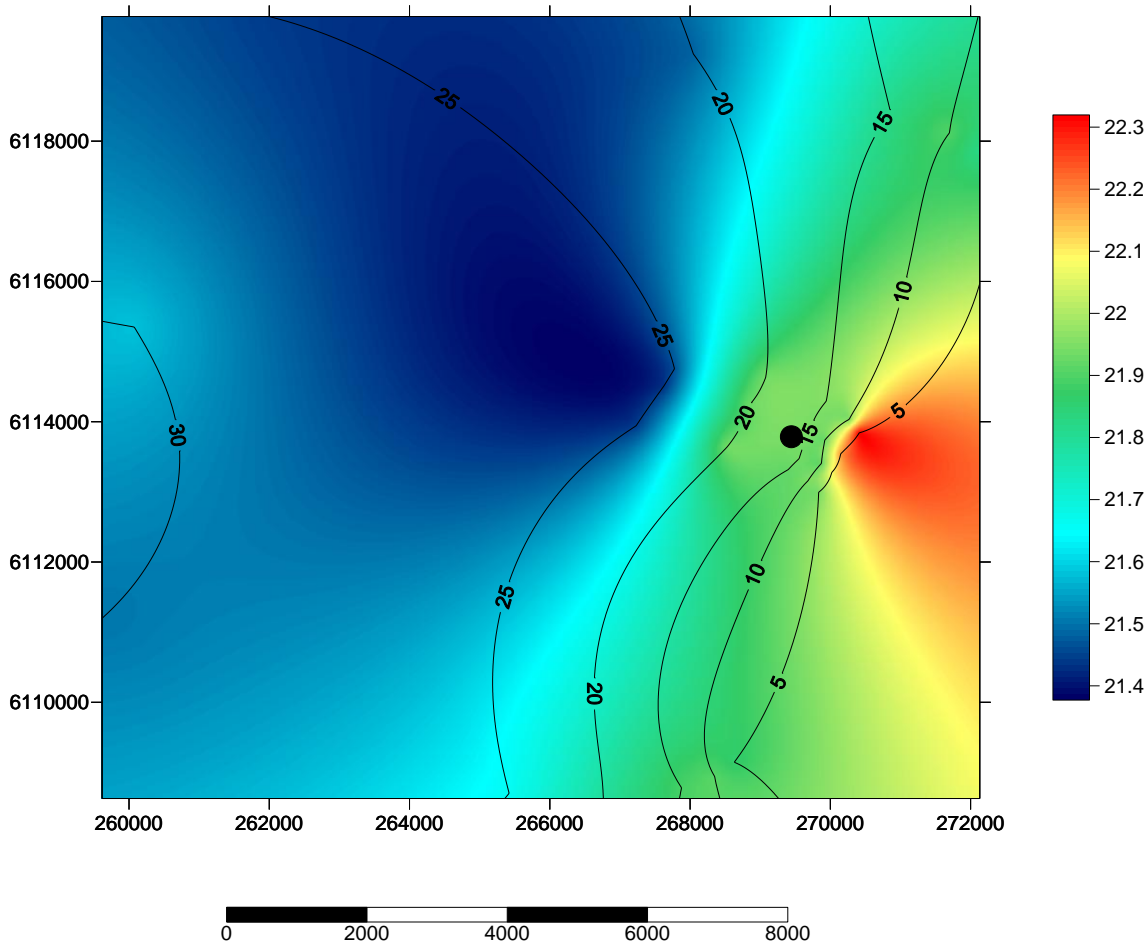
## 2.6 pH

pH in the water column was a constant 8.1 ( $\pm 0.2$  pH unit). Seawater is highly buffered due to high concentrations of bicarbonate ions in solution and as a consequence pH remains a constant 8.1 (Figure 9).

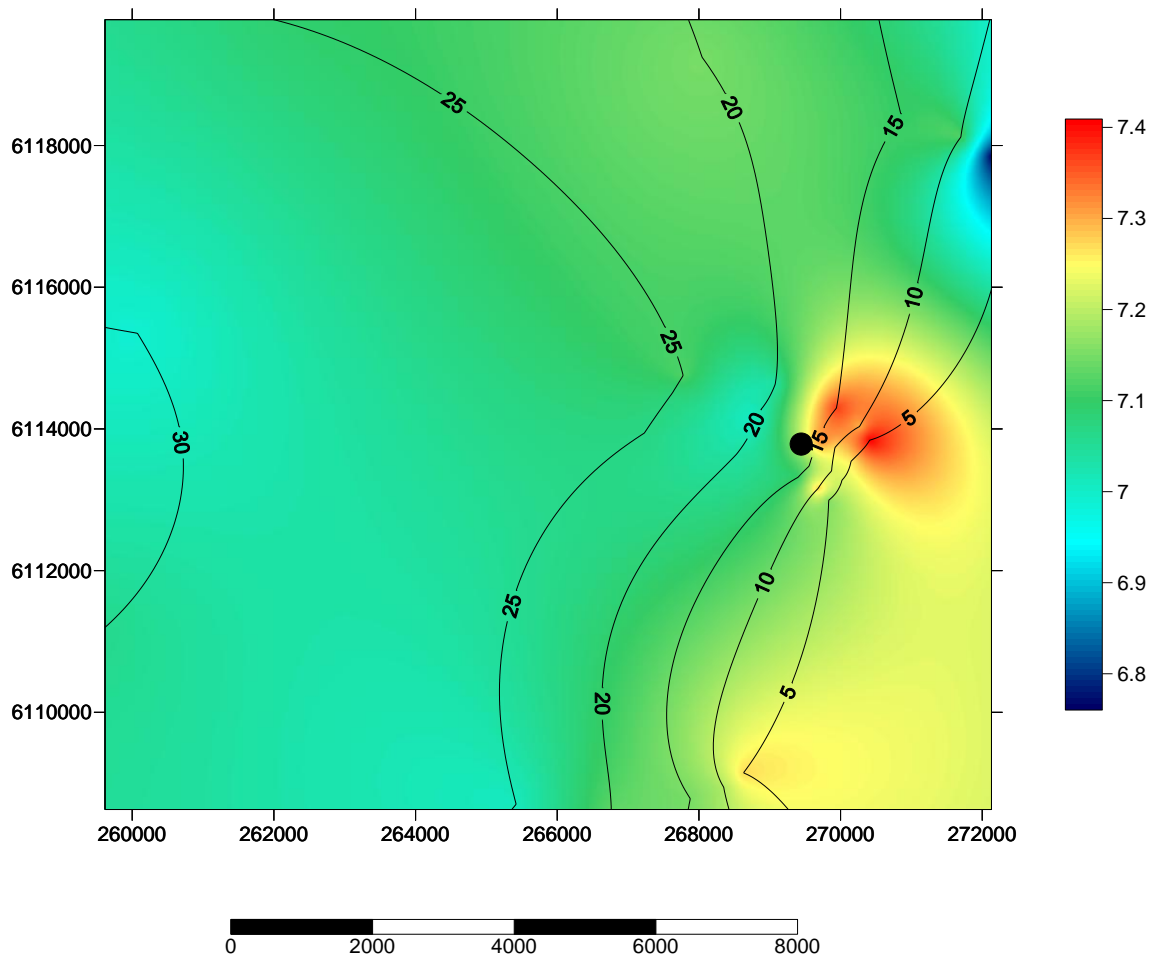
### 3 Appendix A – Spatial Plots



**Figure 1** Spatial change in TDS (g/L) concentration, on the seafloor, in the Port Stanvac region. The coloured scale bar represents changes in TDS concentration between 36.8 g/L and 37.2 g/L. Contour lines denote a five metre change in depth. The bottom scale bar represents distance in metres across the region. X coordinates refer to eastings and Y coordinates refer to northings measured in metres. Black dot represents position of ADP outfall.



**Figure 2** Spatial change in water temperature, on the seafloor, in the Port Stanvac region. The coloured scale bar represents temperature changes between 21.4 °C and 22.2 °C. Contour lines denote a five metre change in depth. The bottom scale bar represents distance in metres across the region. X coordinates refer to eastings and Y coordinates refer to northings measured in metres. Black dot represents position of ADP outfall.



**Figure 3** Spatial change in dissolved oxygen concentration, on the seafloor, in the Port Stanvac region. The coloured scale bar represents a change in the dissolved oxygen concentration between 6.9 mg/L and 7.4 mg/L. Contour lines denote a five metre change in depth. The bottom scale bar represents distance in metres across the region. X coordinates refer to eastings and Y coordinates refer to northings measured in metres. Black dot represents position of ADP outfall.

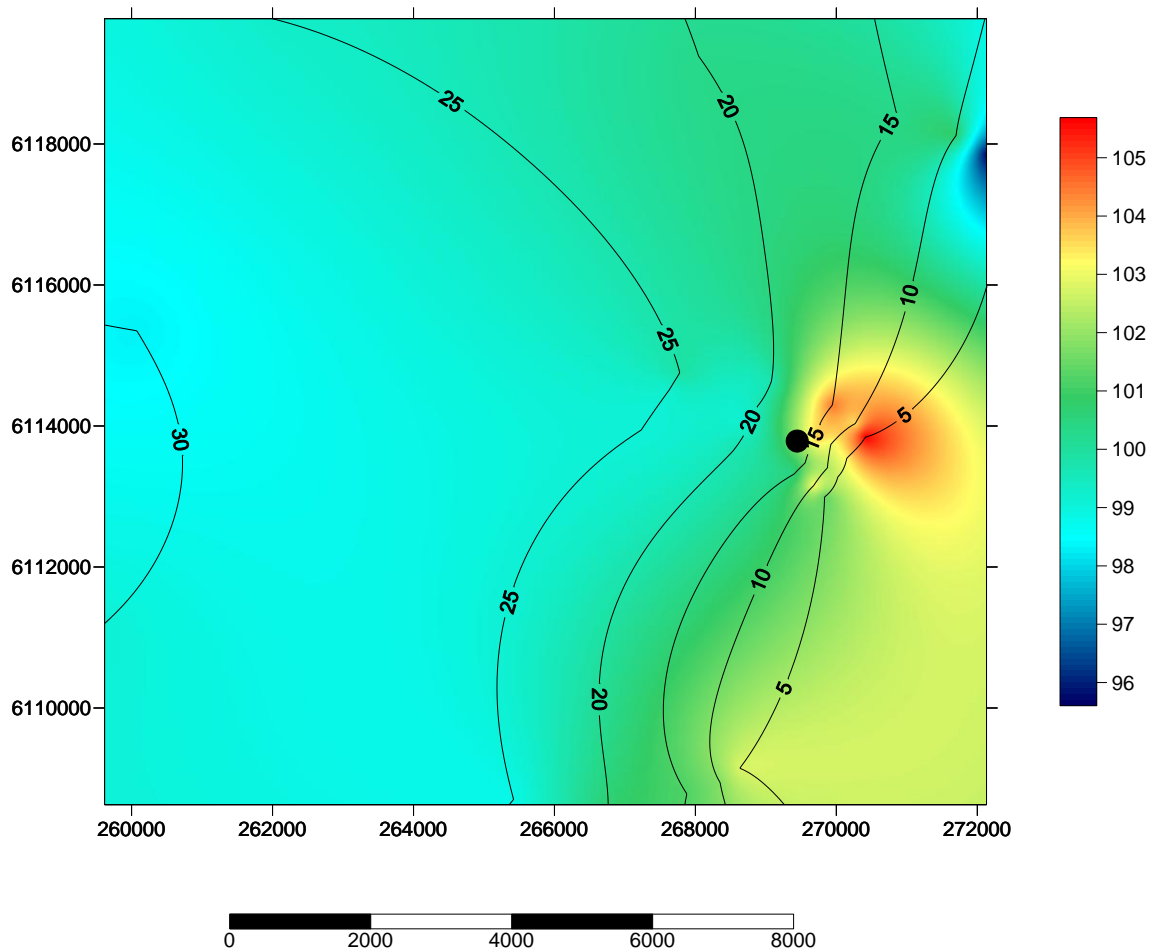


Figure 4 Spatial change in dissolved oxygen concentration (expressed as percentage saturation), on the seafloor, in the Port Stanvac region. The coloured scale bar represents a change in the dissolved oxygen concentration between 96% and 105 %. Contour lines denote a five metre change in depth. The bottom scale bar represents distance in metres across the region. X coordinates refer to eastings and Y coordinates refer to northings measured in metres. Black dot represents position of ADP outfall.



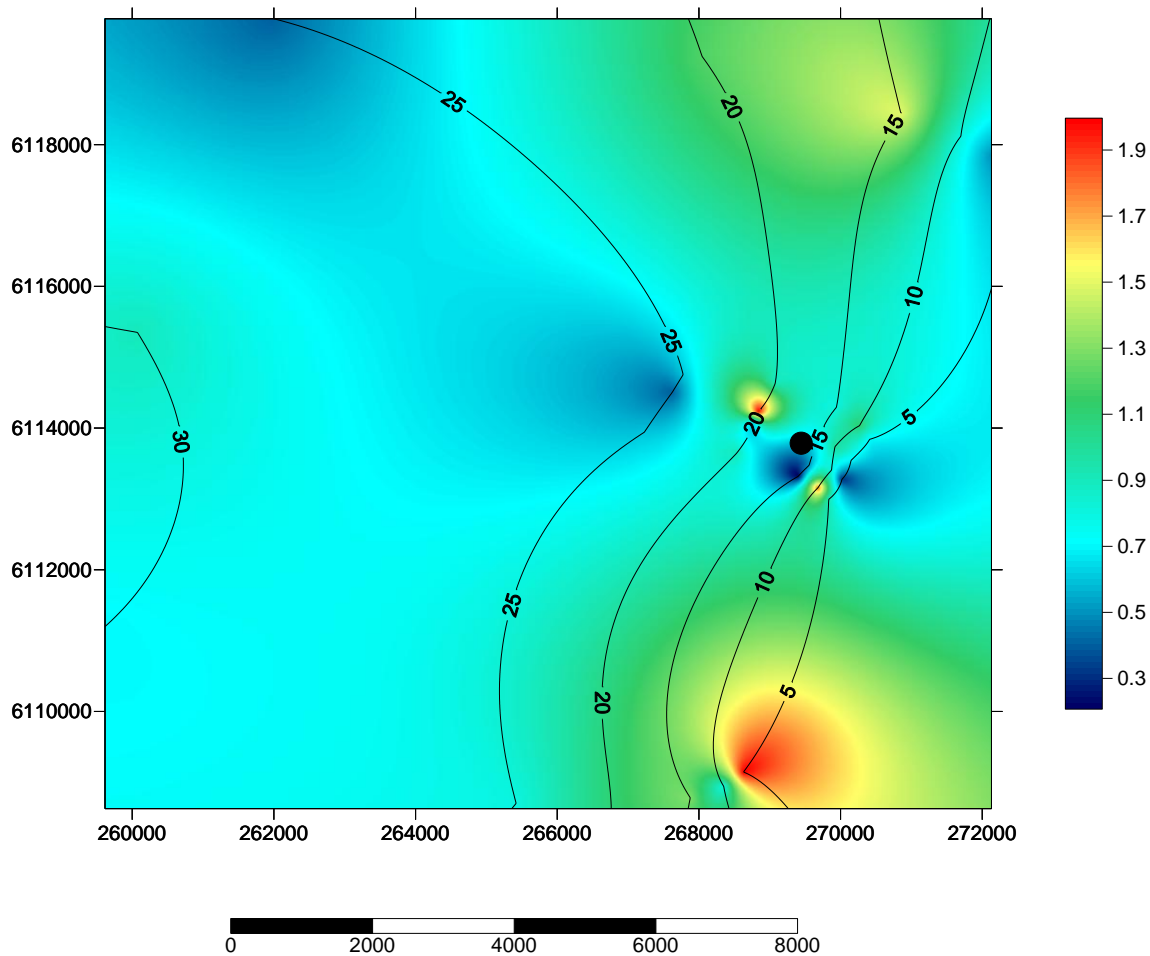
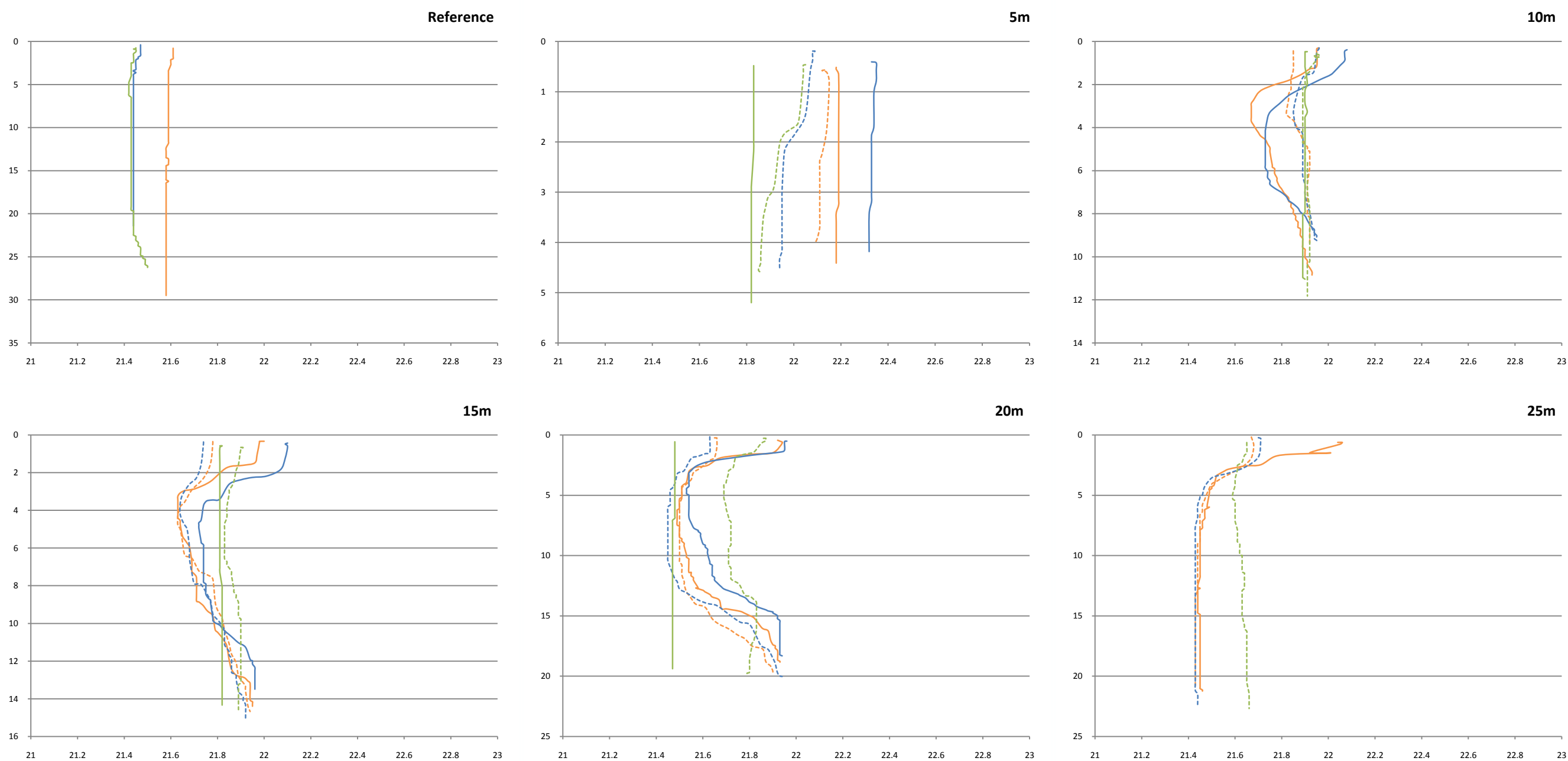


Figure 5 Spatial change in chlorophyll a concentration, one metre below the surface, in the Port Stanvac region. The coloured scale bar represents a change in chlorophyll concentration between 0.3 µg/L and 1.9 µg/L. Contour lines denote a five metre change in depth. The bottom scale bar represents distance in metres across the region. X coordinates refer to eastings and Y coordinates refer to northings measured in metres. Black dot represents position of ADP outfall.

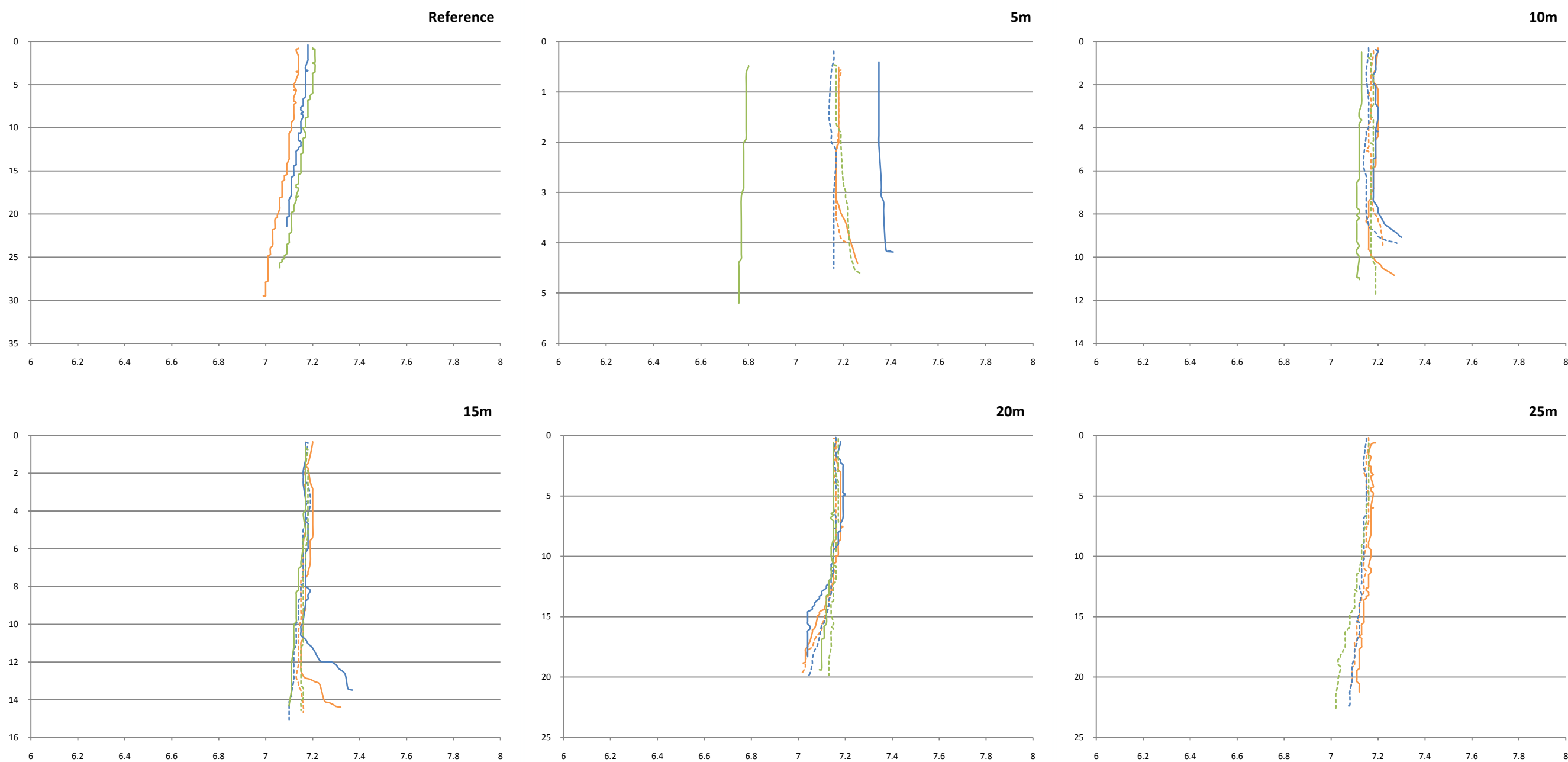
## 4 Appendix B - Vertical profiles

The following graphs illustrate specific conductivity ( $\mu\text{S}/\text{cm}$ ), total dissolved solids (g/L) temperature (degrees Celsius), dissolved oxygen (mg/L), turbidity (NTU) and pH, relative to depth for January 2011. Water column profiles were undertaken 5km, 500m and 100m north and south of the outfall diffusers at water depths of 5m, 10m, 15m, 20m and 25m. Water column profiles were also undertaken at three control sites, approximately 10 km offshore adjacent to Hallett Cove, Port Stanvac and Noarlunga. The legend below applies to all graphs.

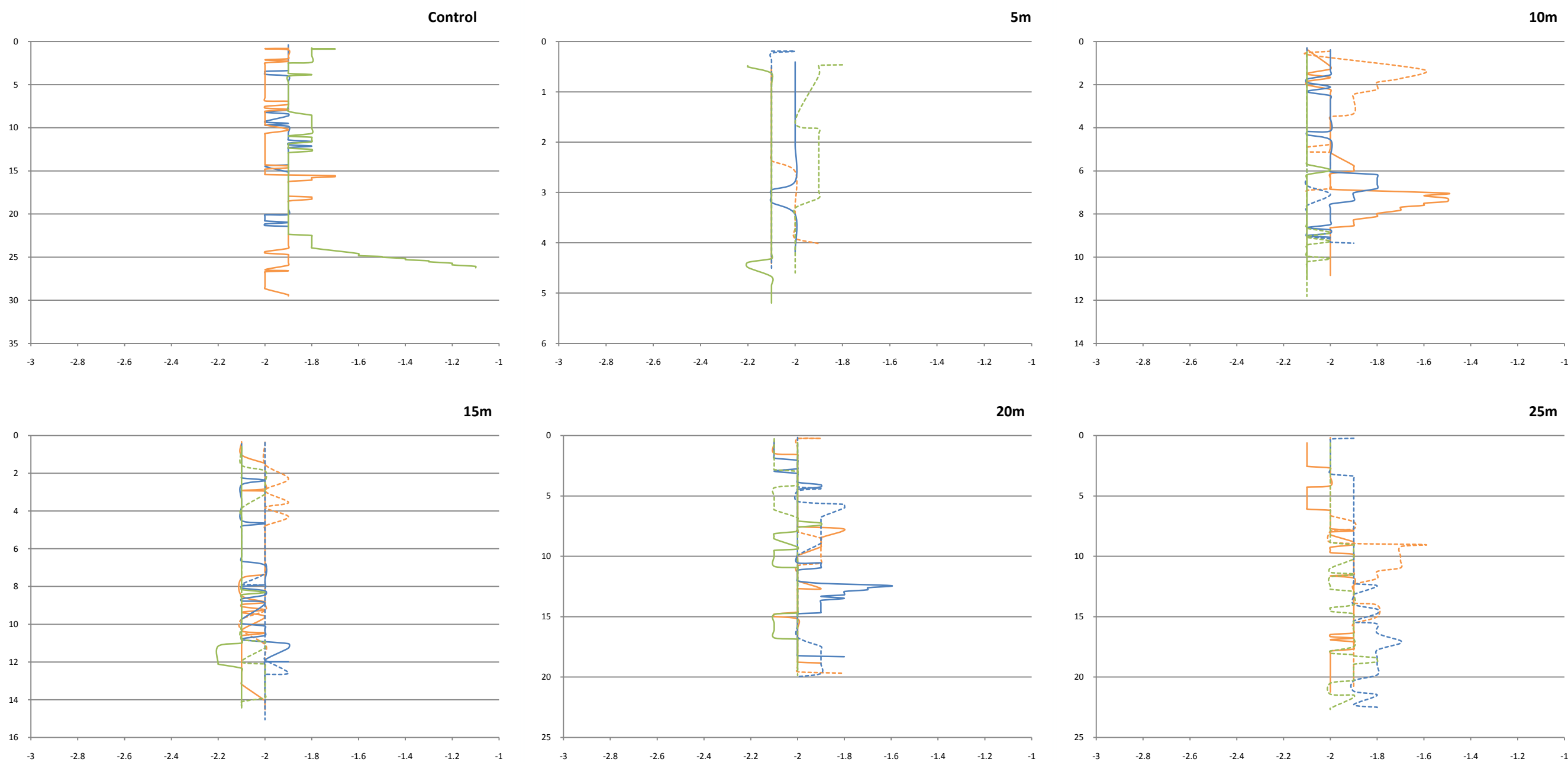
Dotted lines represent water quality profiles conducted south and solid lines are sites north of the diffuser location. Orange represents 100 m, blue 500 m and green 5 km either north or south of the diffuser. Water quality profiles were conducted at a depth of 5 m, 10 m, 20 m and 25 m. There were no 25 m profiles undertaken north of the diffuser due to insufficient water depth. Control sites were located approximately 10 km offshore, adjacent to Hallett Cove (blue), Port Stanvac (orange) and Noarlunga (green).



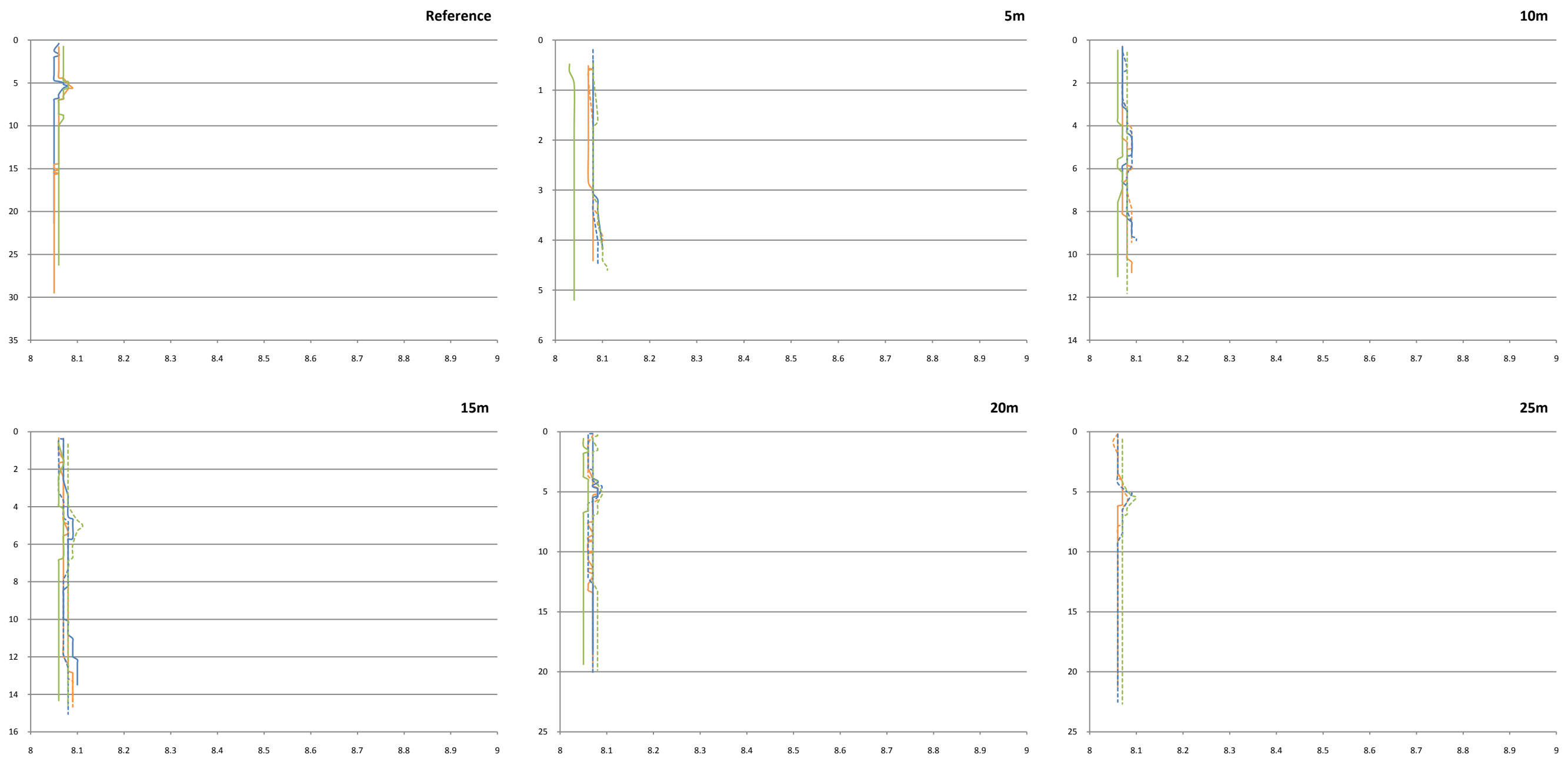
**Figure 6** Change in water temperature (x axis; degrees Celsius) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15 m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line) of the ADP diffuser. Orange represents 100 m, blue 500 m and green 5 km either north or south of the diffuser.



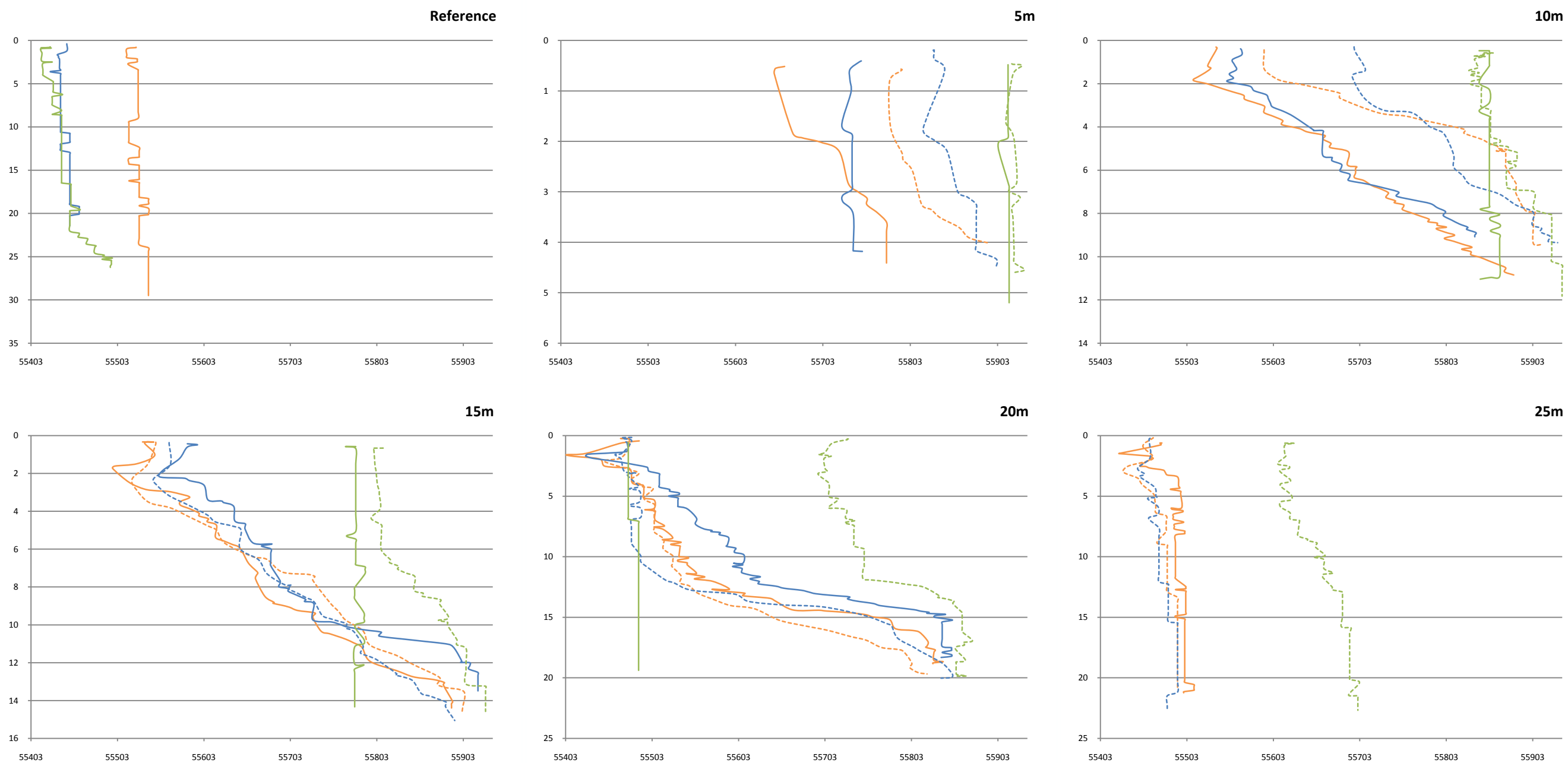
**Figure 7** Change in dissolved oxygen (x axis; mg/L) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15 m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line) of the ADP diffuser. Orange represents 100 m, blue 500 m and green 5 km either north or south of the diffuser.



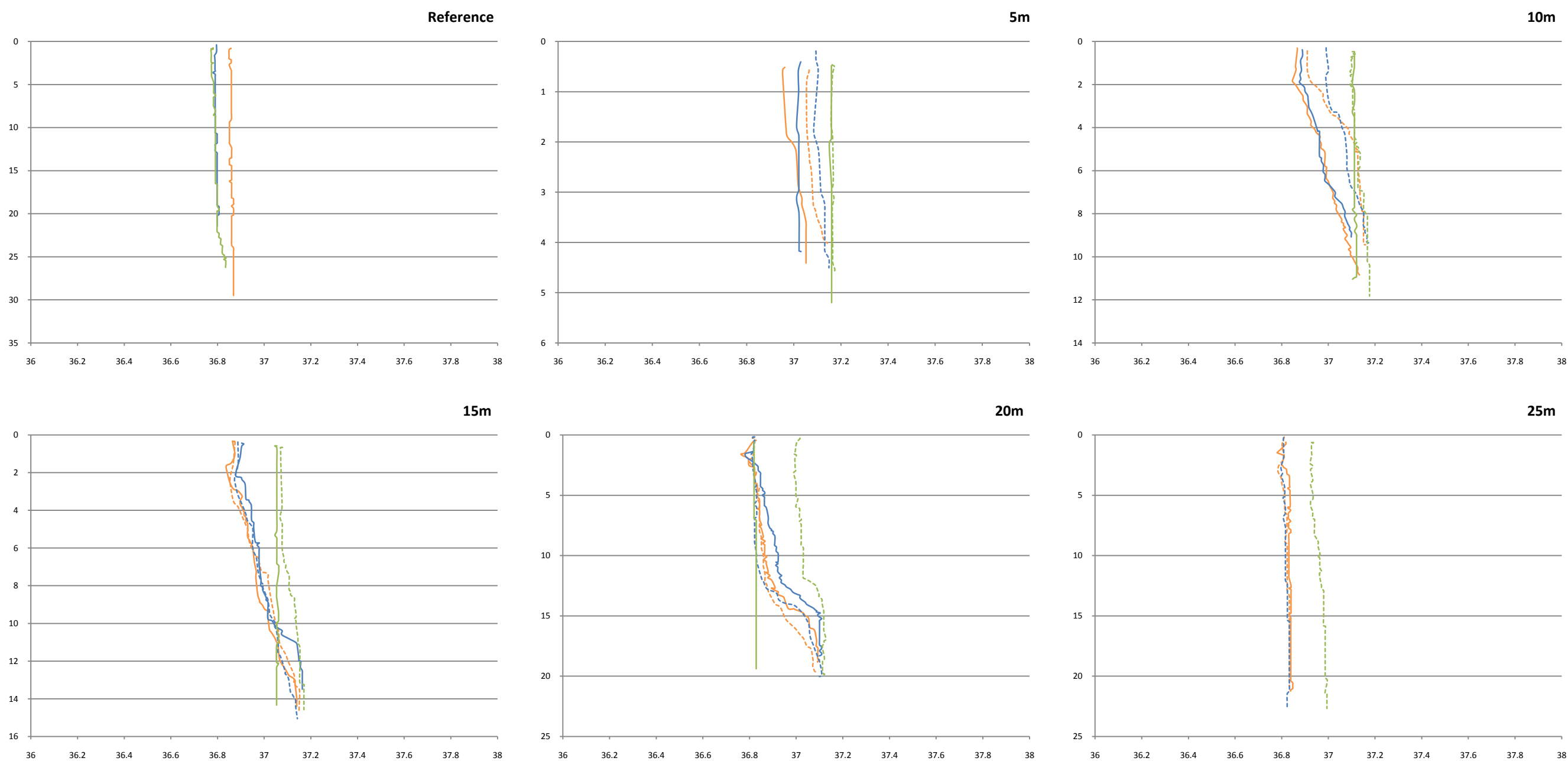
**Figure 8** Change in turbidity (x axis; NTU) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15 m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line) of the ADP diffuser. Orange represents 100 m, blue 500 m and green 5 km either north or south of the diffuser.



**Figure 9** Change in pH (x axis; pH units) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15 m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line) of the ADP diffuser. Orange represents 100 m, blue 500 m and green 5 km either north or south of the diffuser.



**Figure 10** Change in specific conductivity (x axis;  $\mu\text{S}/\text{cm}$ ) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15 m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line) of the ADP diffuser. Orange represents 100 m, blue 500 m and green 5 km either north or south of the diffuser.



**Figure 11** Change in total dissolved solids (x axis; g/L) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15 m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line) of the ADP diffuser. Orange represents 100 m, blue 500 m and green 5 km either north or south of the diffuser.