

ADELAIDE DESALINATION PROJECT



WATER QUALITY CHARACTERISATION STUDY

May 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 20th May, 2011.

2 Results and Discussion

2.1 Salinity (Specific Conductivity and TDS)

TDS concentrations in the region surveyed, ranged between 36.4 g/L and 37.9 g/L (± 0.1 g/L).

On the seafloor, TDS concentrations were a consistent 37.9 g/L with the exception of narrow band along the foreshore, in which the concentration was less than 37.6 g/L (Figure 1). The minimum concentration observed on the seafloor was 37.2 g/L in the shallow water adjacent to Hallett Cove (north east of outfall).

There is evidence of a strong halocline forming offshore, with the difference in TDS concentrations between the surface and the seafloor as great as 1.5 g/L (Reference sites; Figure 11). The halocline is not as evident in the shallower depths (<15 m).

2.2 Water temperature

Water temperature in the region ranged between 16.2 °C and 17.2 °C (± 0.15 °C).

Seawater temperature was generally cooler inshore when compared to offshore (Figure 2), with a temperature change of up 1.0 °C across the region. The maximum water temperature observed on the seafloor (17.1 °C) occurred in the deep water (>25 m) off the coast of Hallett Cove / Port Stanvac.

Surface waters were generally warmer than the water temperature close to the seafloor, by 0.2 to 0.4 °C (Figure 6). There was evidence of stratification occurring in the water column between 0 to 10 metres, at some of the northern sites. The temperature difference between the layers was up to 0.4 °C. It is not clear whether the stratified layer persisted across changes in the tidal cycle.

2.3 Dissolved Oxygen

Dissolved oxygen (DO) concentration in the region ranged between 7.3 mg/L and 8.1 mg/L (± 0.1 mg/L), which equates to an oxygen saturation of 95.5 %-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 possible mixture of surface disturbance, macroalgal communities associated with local reefs, and lower water temperatures.

2.4 Chlorophyll

Chlorophyll concentrations in the region ranged between 0.2 $\mu\text{g/L}$ and 1.7 $\mu\text{g/L}$ (± 1 $\mu\text{g/L}$), based on the sensitivity of the YSI sonde.

There is a general trend of higher chlorophyll concentrations offshore when compared to the shallower depths (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 0.50 $\mu\text{g/L}$ and ranged between 0.38-0.79 $\mu\text{g/L}$ (Table 1). These results were similar to those acquired from the YSI sonde, at a depth of 15 metres.

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	0.38
North	500	0.50
North	100	0.48
South	100	0.46
South	500	0.41
South	5000	0.79

2.5 Turbidity

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

The sensor's accuracy is ± 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). An increase in turbidity, 500 m south at a depth of 5 m, was due to the sensor disturbing the sediment on the seafloor.

2.6 pH

pH in the water column was a constant 8.1 (± 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

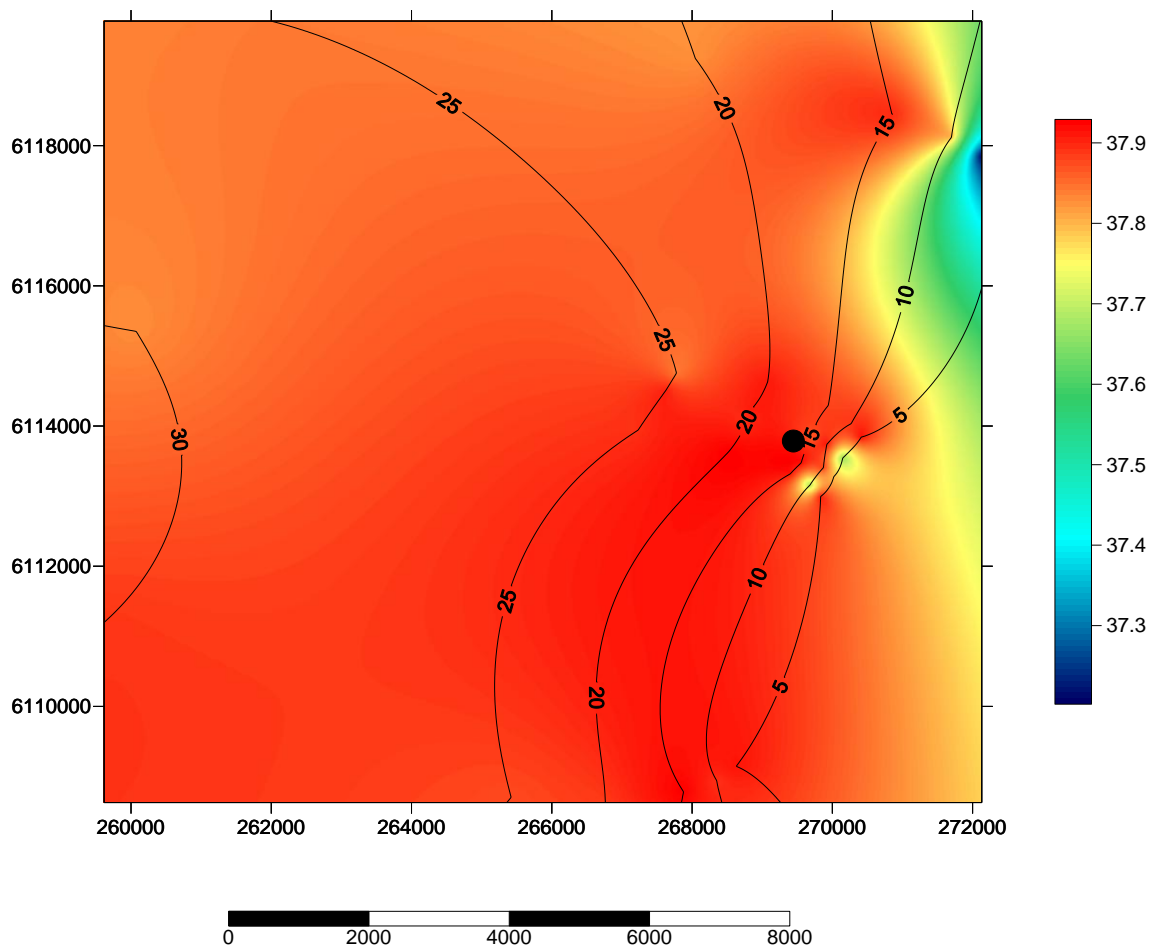


Figure 1 Spatial change in TDS (g/L) concentration, on the seafloor, in the Port Stanvac region. The coloured scale bar represents changes in TDS concentration between 37.2 g/L and 37.9 g/L. Contour lines denote a five metre change in depth. The bottom scale bar represents distance in metres across the region. X coordinates refer to eastings and Y coordinates refer to northings measured in metres. Black dot represents position of ADP outfall.

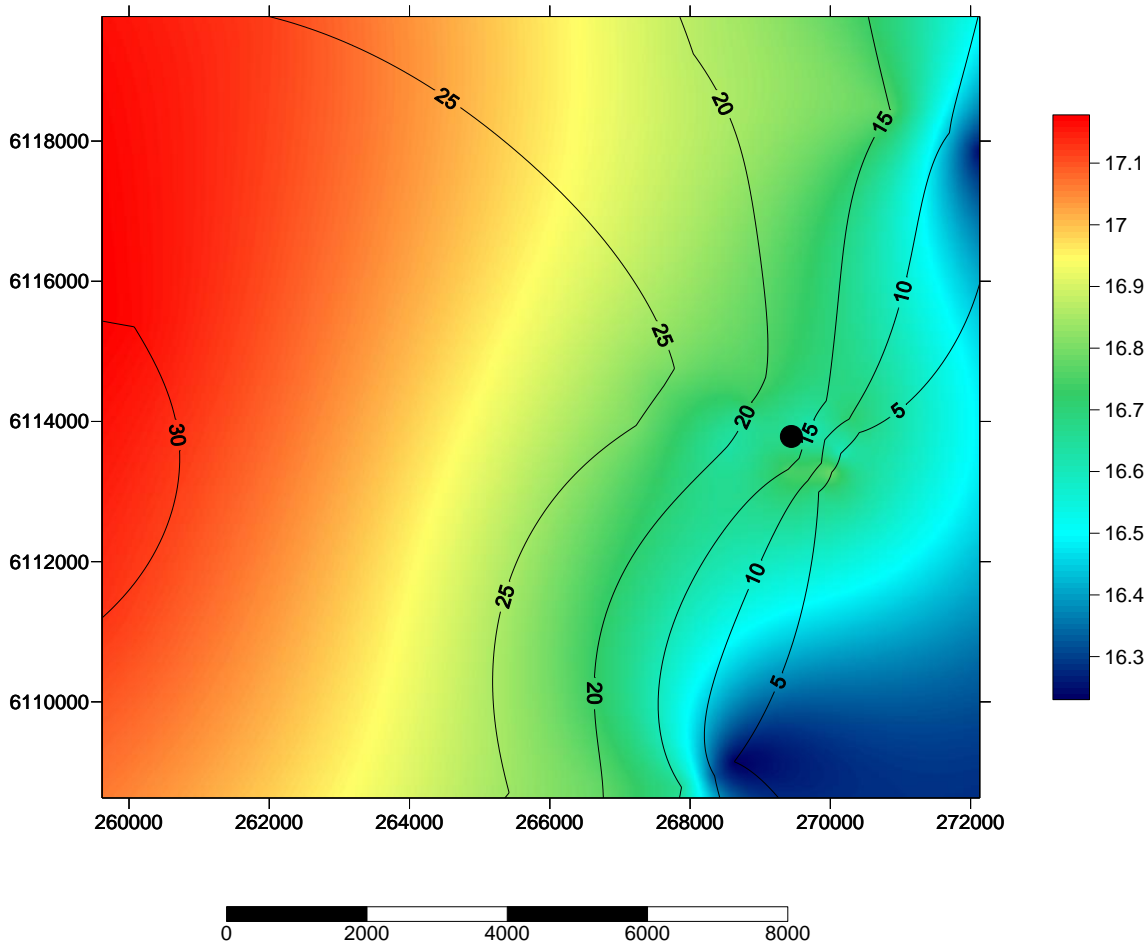


Figure 2 Spatial change in water temperature, on the seafloor, in the Port Stanvac region. The coloured scale bar represents temperature changes between 16.2 °C and 17.2 °C. Contour lines denote a five metre change in depth. The bottom scale bar represents distance in metres across the region. X coordinates refer to eastings and Y coordinates refer to northings measured in metres. Black dot represents position of ADP outfall.

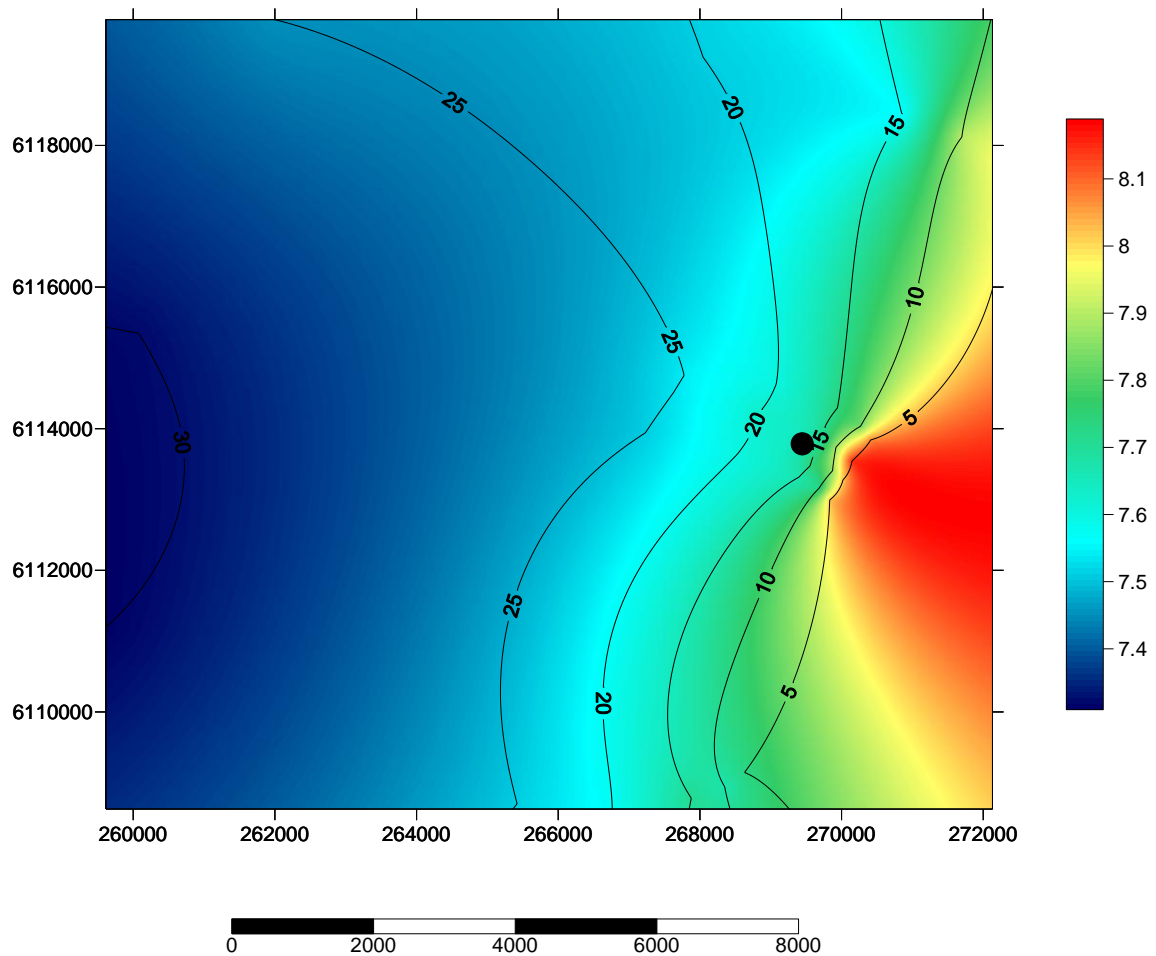


Figure 3 Spatial change in dissolved oxygen concentration, on the seafloor, in the Port Stanvac region. The coloured scale bar represents a change in the dissolved oxygen concentration between 7.3 mg/L and 8.1 mg/L. Contour lines denote a five metre change in depth. The bottom scale bar represents distance 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.

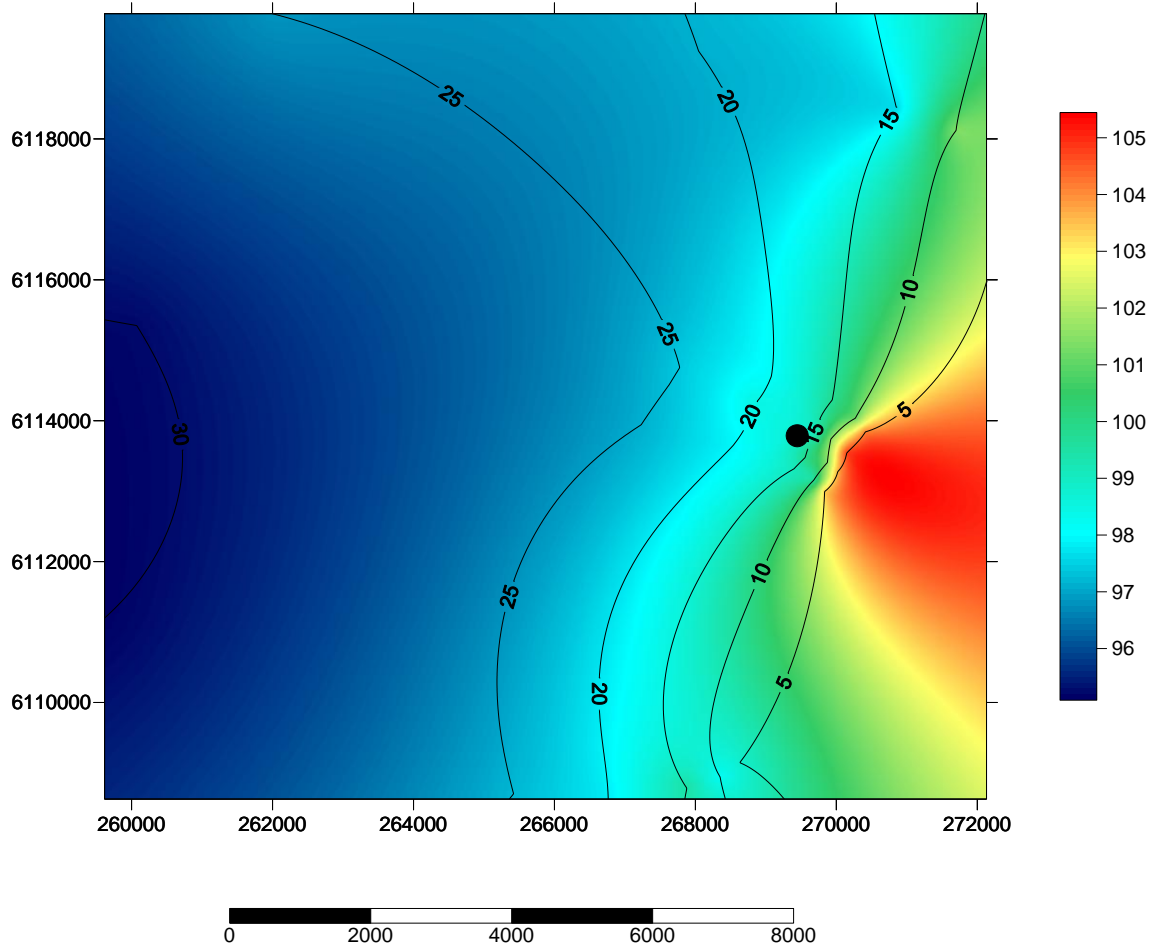


Figure 4 Spatial change in dissolved oxygen concentration (expressed as percentage saturation), on the seafloor, in the Port Stanvac region. The coloured scale bar represents a change in the dissolved oxygen concentration between 95.5% and 105 %. Contour lines denote a five metre change in depth. The 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.

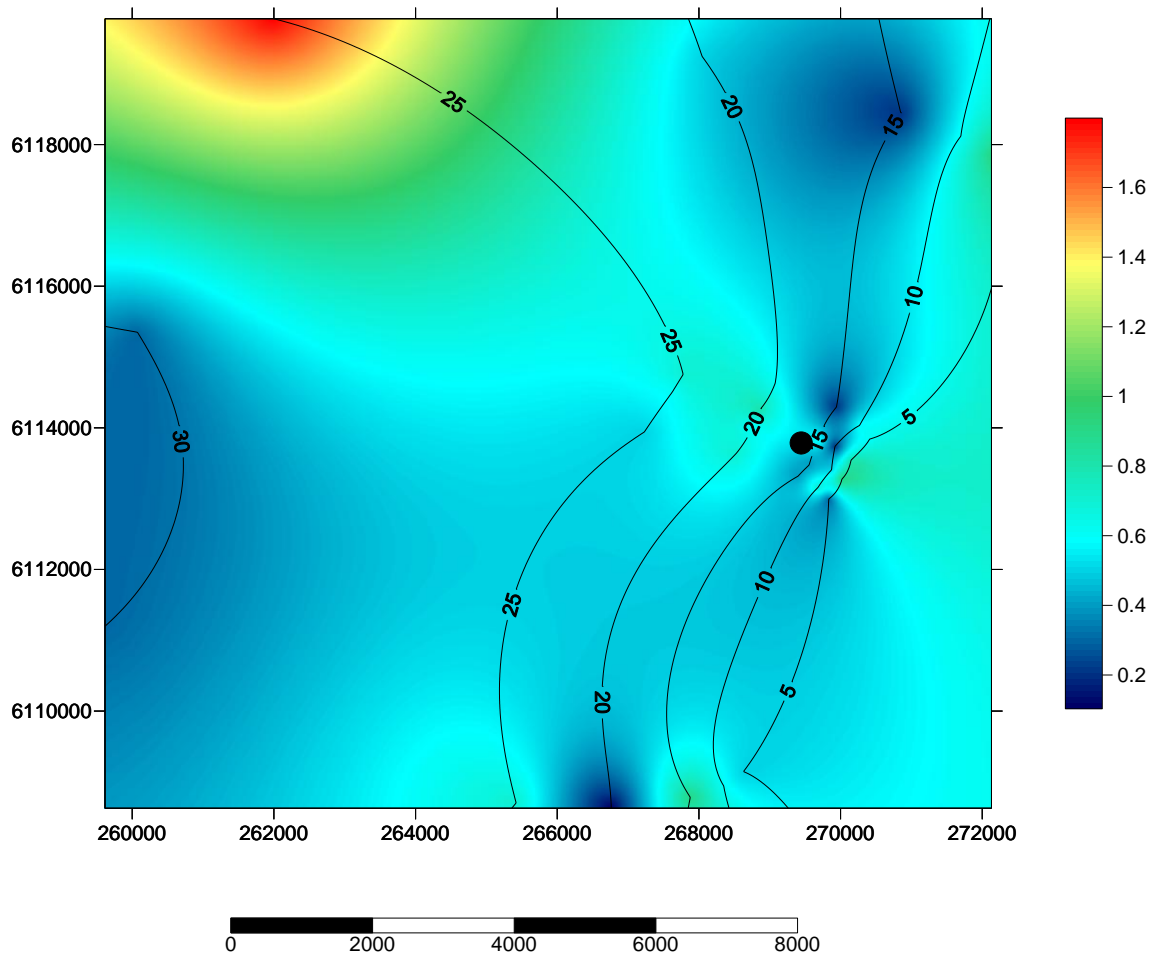


Figure 5 Spatial change in chlorophyll a concentration, one metre below the surface, in the Port Stanvac region. The coloured scale bar represents a change in chlorophyll concentration between 0.2 $\mu\text{g/L}$ and 1.7 $\mu\text{g/L}$. Contour lines denote a five metre change in depth. The bottom scale 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.

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 May 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).

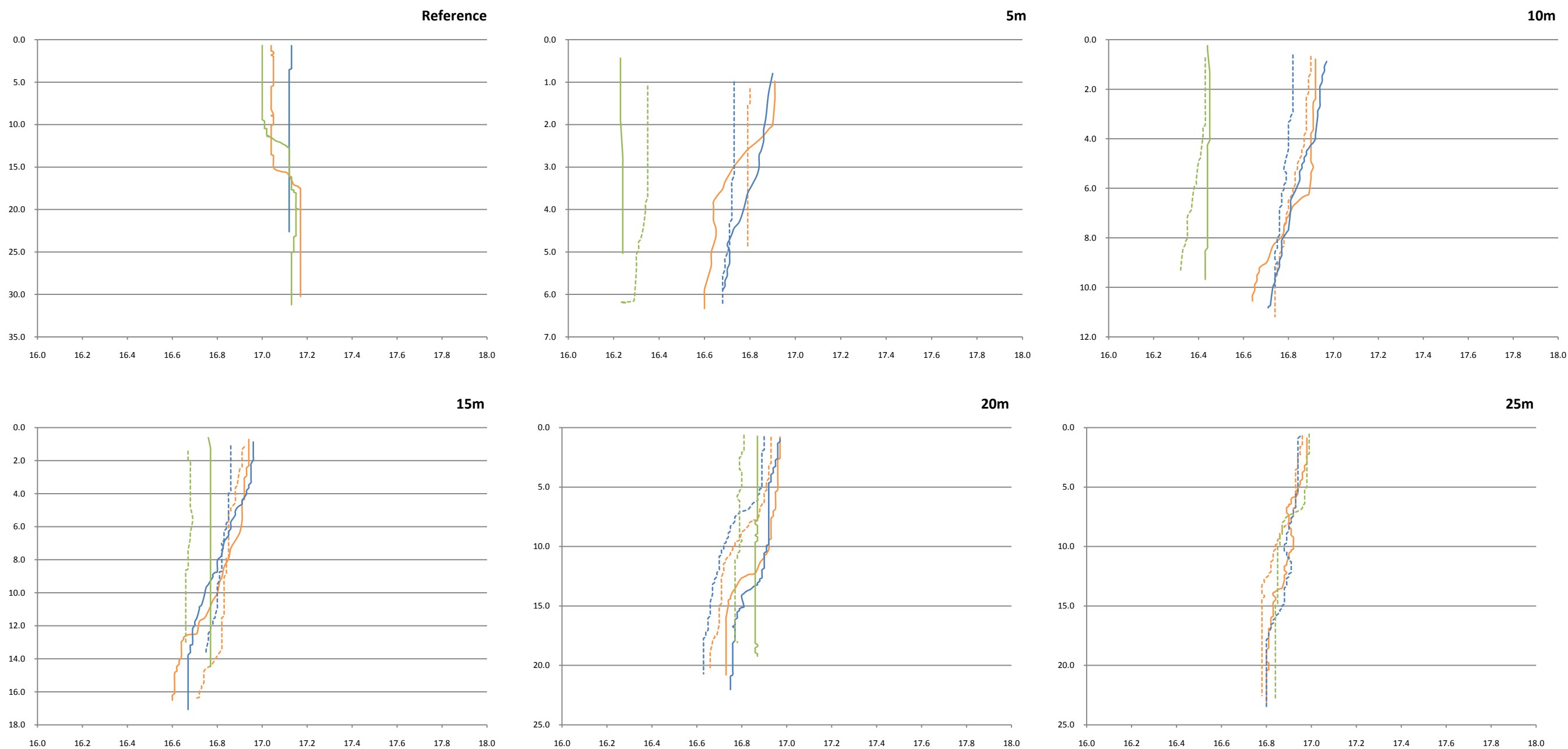


Figure 6 Change in water temperature (x axis; degrees Celsius) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15 m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line) of the ADP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

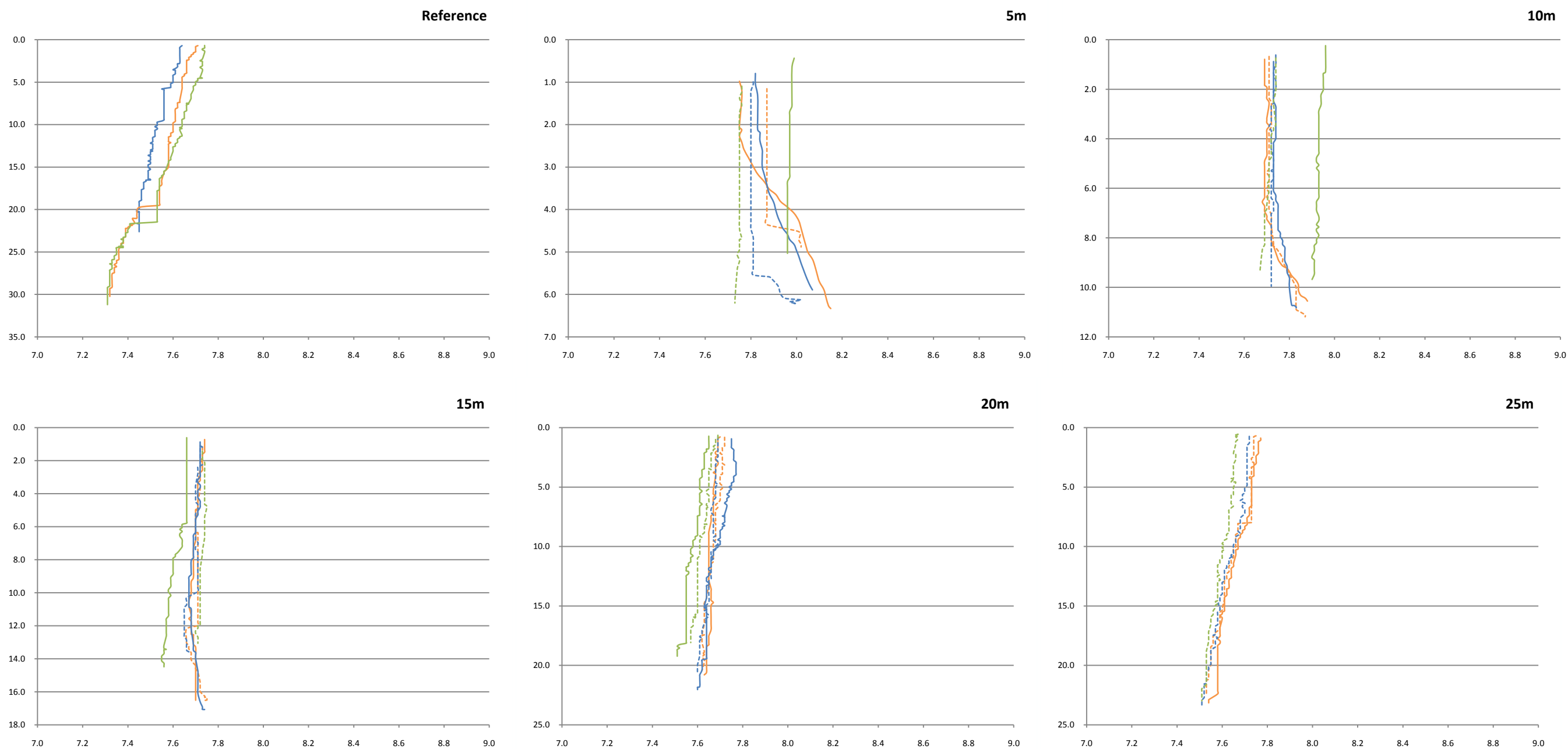


Figure 7 Change in dissolved oxygen (x axis; mg/L) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line) of the ADP diffuser. Orange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

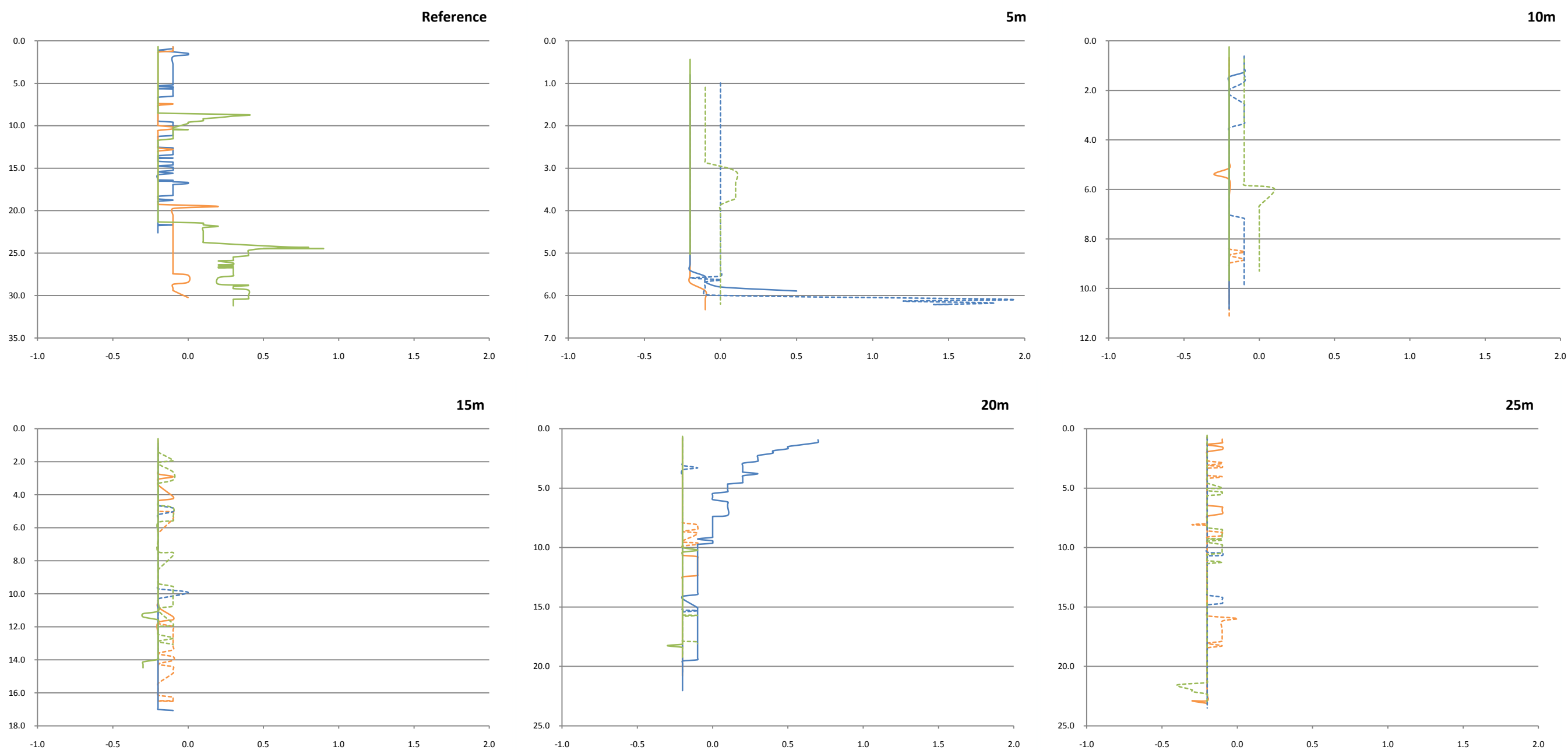


Figure 8 Change in turbidity (x axis; NTU) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line) of the ADP diffuser. Orange represents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

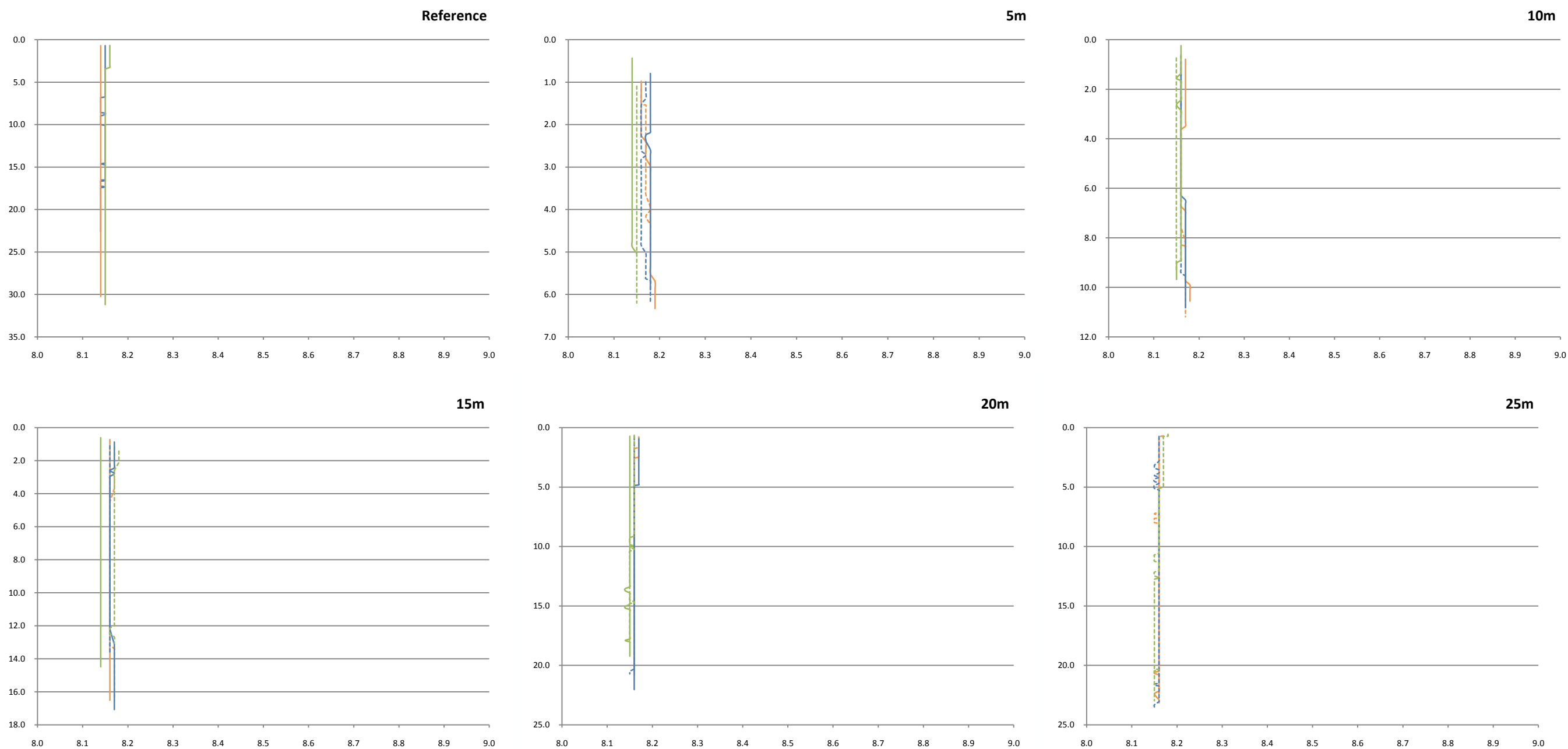


Figure 9 Change in pH (x axis; pH units) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line) of the ADP diffuser. Orange represents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

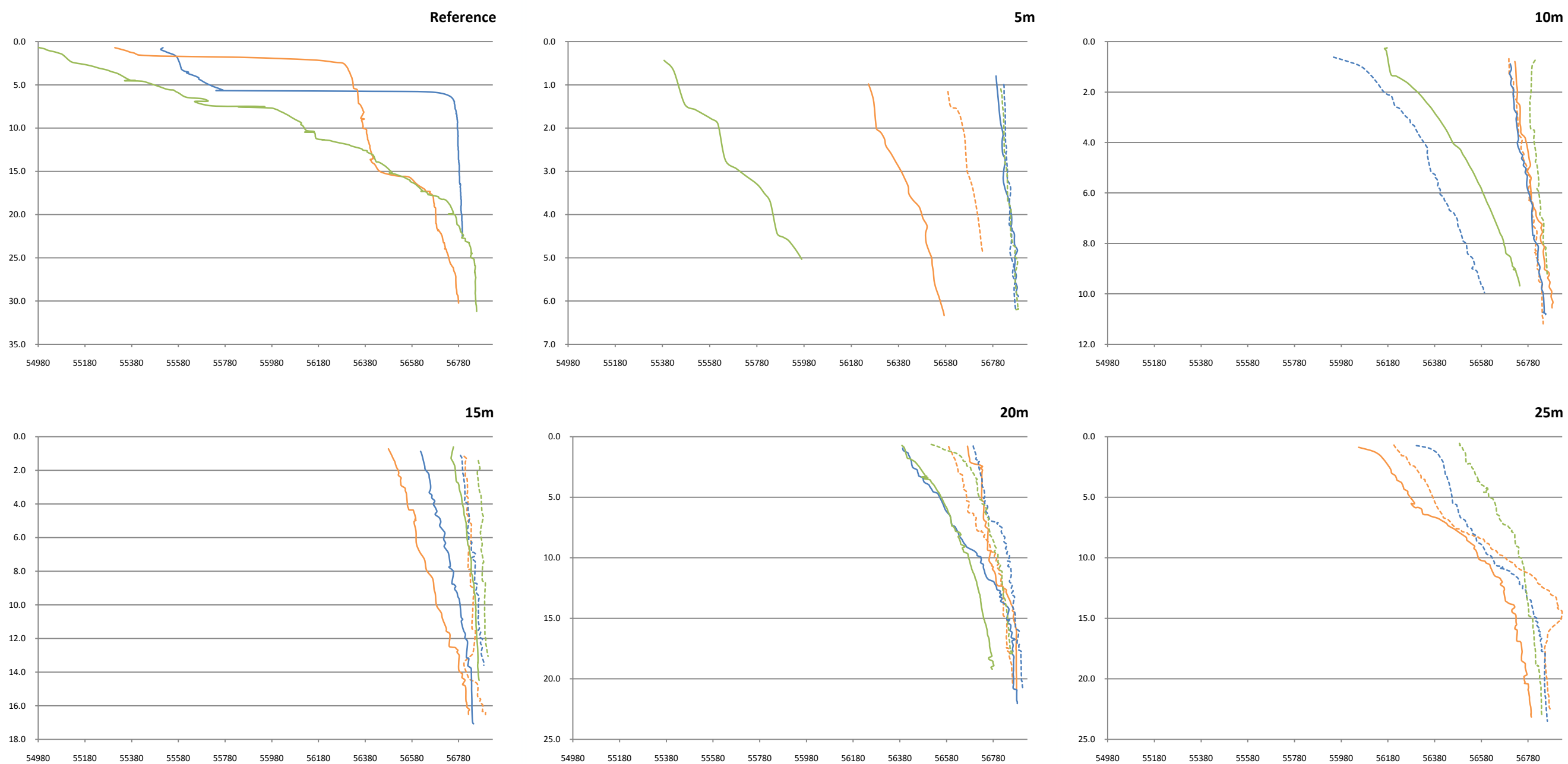


Figure 10 Change in specific conductivity (x axis; $\mu\text{S}/\text{cm}$) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line)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

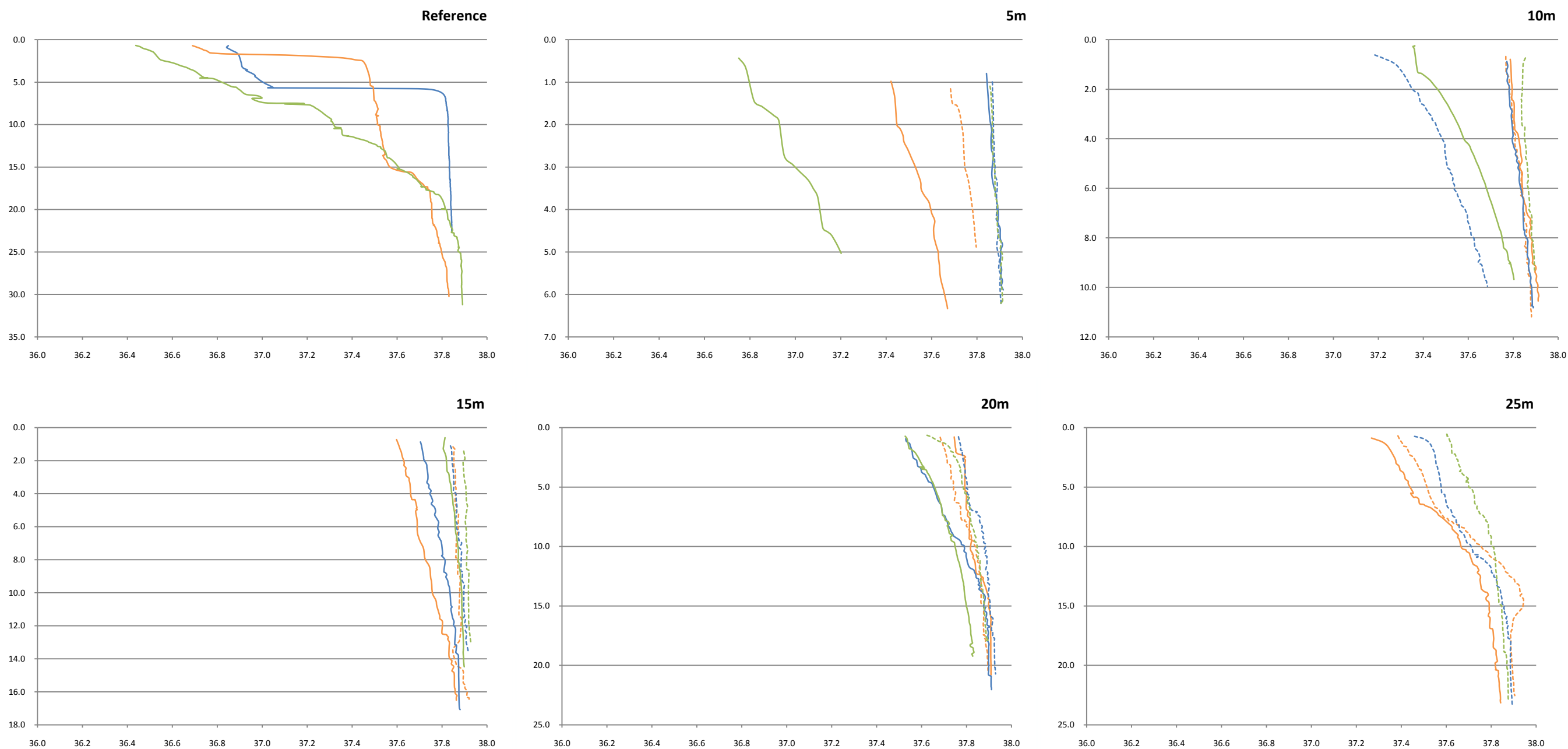


Figure 11 Change in total dissolved solids (x axis; g/L) at different depths (y axis; metres) throughout the water column. Water quality profiles were conducted at a depth of 5 m, 10 m, 15m, 20 m, 25 m and 10 km offshore (Reference sites); north (solid lines) and south (broken line) of the ADP diffuser.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