ASSESSMENT OF EXPECTED CHANGES TO MIXING ZONES OF FACILITIES ADJACENT TO THE DMSF PROJECT SITE

As part of the scope of this study, and to directly address a particular concern of the DEC, an assessment of the changes that the proposed port expansion may have on three key mixing zones adjacent to the DMSF project site was conducted (Figure 1). This involved an examination of the predicted changes to the current and wave conditions at the beach caused by the new coastline and adjusted bathymetry as a result of the dredging.

To do this, two scenarios were developed that represented the proposed construction layout and existing layout respectively. Currents (HYDROMAP) and waves (SWAN) were modelled for these two scenarios, forced with the same environmental conditions over the same hindcast modelling period. Full details of these models and their calibration are provided in APASA (2009). The modelling period used for comparison was from September 2008 to August 2009 and is expected to depict the potential change over a typical year (APASA, 2009).

A quantitative analysis of the correlation between the existing and after construction scenarios was conducted through the use of the Index of Agreement (IOA), presented in Willmott (1981). This index, commonly used to assess differences between two comparison series, is calculated as:

\[ \text{IOA} = 1 - \frac{\sum |X_{\text{model}} - X_{\text{obs}}|^2}{\sum (|X_{\text{model}} - \bar{X}| + |X_{\text{obs}} - \bar{X}|)^2} \]

In this equation, \( X \) represents the variable being compared and \( \bar{X} \) the time mean of that variable. A perfect agreement can be said to exist between the two series if the index gives a measure of one, and complete disagreement will produce an index measure of zero (Willmott, 1981).

The current and wave conditions predicted by the model were examined separately to gauge the relative change in each as a result of the altered bathymetry and coastline. The three mixing zones examined during the study were the WaterCorp Brine Line, the North West Shelf
Venture (NWSV) Stormwater Release and NWSV LNG Jetty Discharge, with their locations illustrated in Figure 1. Details of these sites are provided in Table 1.

Although the model output at these three sites was analysed over the entire modelling period, only the results for the winter month of July are shown, as this was the period where the greatest change between before and after conditions was predicted.

![Figure 1 Locations of the mixing zone sites (blue) analysed. DMSF project site indicated in red.](image)

**Table 1 Details of the mixing zone sites**

<table>
<thead>
<tr>
<th>Mixing Zone</th>
<th>Location</th>
<th>Depth (m MSL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WaterCorp Brine Line</td>
<td>116.749 E, 20.629 S</td>
<td>5.1</td>
</tr>
<tr>
<td>NWS Venture Stormwater Release</td>
<td>116.766 E, 20.598 S</td>
<td>1.0</td>
</tr>
<tr>
<td>NWS Venture LNG Jetty Discharge</td>
<td>116.766 E, 20.590 S</td>
<td>6.6</td>
</tr>
</tbody>
</table>
Currents

The introduction of a new dredge region and adjustment to the coastline was expected to have a minor impact on the current regime in the immediate area surrounding the DMSF. The depth-averaged currents were used in the analysis, as the shallow depths of the output locations meant that variations in current speed and direction over the depth were likely to be minimal. Comparison plots of the E-W and N-S current components are presented in Figure 2 and Figure 3 respectively.

As the comparison plots depict, all the sites show a high correlation between the existing and after-construction current dynamics. During the representative winter month the E-W and N-S current velocity IOA was 0.99 for all locations, indicating a near perfect correlation between the two scenarios. This clearly indicates that alterations to the current dynamics are expected to be negligible at all the mixing zones analysed.

Figure 2  E-W current velocity component comparison at the WaterCorp Brine Line (top), NWS Venture Stormwater Release (middle) and NWS Venture LNG Jetty Discharge (bottom) sites from the existing and after construction models over July.
To indicate the localised impact of the DMSF on the current velocity field, spatial plots of the depth averaged current velocity for the flood and ebb tides on the spring tide of the 23rd of July 2009 were produced. This was done for both the scenarios so that a direct comparison could be made between the two velocity field maps, with the results illustrated in Figure 4 and Figure 5.

The plots show that the alterations to the current velocity field are highly localised to the immediate region surrounding the DMSF project site. Regions over 1 km from the extents of the proposed dredge zone and reclamation area (please refer to drawing 42906759-037-B) show a negligible effect on the current speed and direction as a result of the construction. This supports the results indicated in Figure 2 and Figure 3, as each of the sites analysed are over 1 km from the extents of the DMSF project site.
Figure 4 Maximum current velocity field in the immediate surrounds (within 1-2 km) of the DMSF project site during the spring ebb tide event on the 23rd of July 2009 (image is at 8am) for the existing (top) and after construction (bottom) scenarios.
Figure 5 Maximum current velocity field in the immediate surrounds (within 1-2 km) of the DMSF project site during the spring flood tide event on the 23rd of July 2009 (image is at 3 pm) for the existing (top) and after construction (bottom) scenarios.
Waves

Adjustments to the wave climate at the three sites were analysed through investigating changes to the dominant wave characteristics, namely significant wave height (Hs), swell height (Hswell), peak wave period (Tp), mean wave direction (Dir) and the maximum bottom orbital velocity (Ubot). All of these wave parameters directly influence mixing characteristics and were therefore considered the most appropriate to gauge any change to the dispersion at these sites.

Plots of the comparisons made between the existing and after construction predictions from the model are presented in Figure 6 to Figure 8 for the representative winter month. For the representative winter month of July, the modified coastline and bathymetry were found to have only a minor predicted impact on the wave conditions experienced at the three locations selected. The IOA for Hs was consistently high with 0.97, 0.98 and 0.99 for the Brine Line, Stormwater Release and LNG Jetty sites respectively, indicating a near perfect correlation at all sites. Although the correlation for Tp was moderately low at 0.87, 0.86 and 0.89 for the three respective sites, the Hswell, Dir and Ubot correlations were all consistently high at above 0.93 for all locations.

Figure 6 Comparison of key wave parameters at the WaterCorp Brine Line from the existing (blue line) and after construction (green line) models over July.
Figure 7 Comparison of key wave parameters at the NWSV Stormwater Release from the existing (blue line) and after construction (green line) models over July 2009.
The results from this assessment of the changes to the current and wave conditions clearly indicates that the proposed development is predicted to have a negligible effect on the current and only a minor effect on wave conditions at the WaterCorp Brine Line, the NWSV Stormwater Release and NWSV LNG Jetty Discharge sites.

References