MEMO

Date: 15 March 2024
To: Rebecca Dawson
From: David Wright
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Regarding: PER349327 – RIA Peer Review of Dredge Plume Modelling and Coastal Processes Reports

Background and Scope of Peer Review

RPS has been engaged by the Rottnest Island Authority (RIA) to prepare an environmental referral for RIA's proposed South Thomson Bay Barge Development. This development aims to convert the former Army Jetty (now Army Groyne) site in South Thomson Bay into a barge landing site, allowing bulk cargo transports to be landed here and thereby moved away from the Main Ferry Wharf site to the west.

To support development of this referral, RPS' Ocean Science & Technology (OST) team has been asked to peer review two reports provided to RIA by a third-party consultant, Baird Australia, assessing the impacts of dredge plumes and coastal processes as they each relate to the proposed barge development.

This peer review is a high-level evaluation with the primary aim of identifying key issues in approach, methodology and analysis that may pose the greatest risk to favourable assessment of the submitted referral. It is not intended as an exhaustive review of all technical aspects of each report.

Review of Dredge Plume Modelling Assessment Report

The following table contains comments following a review of Baird report *14029.101.R2.Rev0 – South Thomson Bay Barge Development: Dredge Plume Modelling Assessment* (dated 2 February 2024). We note that the filename contains a different identification number (14209), but we assume the one listed on the front cover and preface is correct.

The objective of this report is to assess the extent, severity and duration of sediment plumes from dredging activities associated with the proposed barge development.

Item no.	Report section	Comment
1	General	Many figures are small and contain text or other features that are difficult to read without zooming in, so readers would benefit from seeing these figures on separate pages and/or in landscape orientation.
2	Executive Summary	The following sentence is repeated from the Executive Summary of Baird's Coastal Processes Assessment (Baird report *13029.101.R1.Rev1*) and should be corrected to reflect the dredge plume modelling content: "*Assessment has been made here of the impact of the proposed barge development on the coastal processes acting within South Thomson Bay, including wave conditions, sediment transport pathways, wrack dynamics and the impact of wave penetration within the proposed harbour basin of the barge development.*"
3	Section 1.2	It is stated that "*… plume dispersion will be modelled in 5 to 10 vertical layers.*" Table 4.3 specifies that five layers of 20% thickness were used, so this sentence can be clarified.
4	Section 2.1	Considering the baseline metocean data sets listed in Table 2.1, please refer to item 4 in the '**Review of Coastal Processes Assessment**' comments table in this memo. It is noted there the 'Aquadopp Site 1' deployment is not continuous over the stated date range.

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5	Section 2.1	Figure 2.1 shows measured data locations but is too small and too low in resolution for the sites to be clearly discerned – particularly the inset showing the nearshore locations.
6	Section 3	Through this chapter it is clear that the dredge plume modelling considered only dredging of an approach to, and a footprint within, the proposed breakwater structure. These activities generally appear to have been considered adequately, given the information available to inform their representation in a model. Handling of dredge spoil is not assessed, perhaps because at the time of modelling it was assumed (as described in an in2Dredging technical note; in2D report *i2D-BAIRD-TN-001*) that this material would be transferred onshore and trucked to a disposal site near the island's airport. At the time of the RPS peer review, it is now known that construction of the Barge Development structure's laydown area is likely to involve creation of a bunded area that is progressively backfilled with dredged material. Because this method has the potential for return of finer dredged material to the ocean through dewatering and disturbance of temporary bunds, this potential should be assessed for significance in the context of modelling already completed. Similarly, the potential for sediment losses to the ocean during construction of the breakwater itself should be assessed for significance in the context of modelling already completed.
7	Section 4.1 (first one)	It is not clear how the hydrodynamic model's flexible mesh arrangement in the vicinity of Rottnest Island, shown in Figure 4.2, relates to the domain-decomposition grid scheme shown in Figure 4.3. The latter figure and the discussion in this section implies regular grids have been used in downscaling a regional model (as shown in Figure 4.1) to the site of interest for dredge plume modelling, so this should be clarified.
8	Section 4.1 (second one)	Past validation of water levels in the "*… north-west region*" is cited but this was probably intended to be "*… south-west region*".
9	Section 4.2.1	It is stated that "*… the validation metrics are good for both the current speed and direction, with good model skill…*", but the data presented in Figure 4.6 shows otherwise. Measured current speeds during peak events are reproduced well, but the model tends to overpredict speeds during calm conditions. Model predictions of direction also seem most accurate during peak events but generally the measured variations in direction are not reproduced at all, and the model skill measure of 0.19 reflects this. The low-energy environment is noted here, and representation of such environments in models can be difficult to achieve, but the model performance issues should be discussed clearly and evaluated in terms of the potential impacts to predictions of sediment plume transport and fate.
10	Section 4.2.1	Table 4.1 presents statistics for the "*ADCP*" location, but these are for the "*Aquadopp*" location as presented in Figure 4.6.
11	Section 4.2.2	There is some discussion here about problems with Aquadopp wave direction data quality affecting validation of the wave model. These problems are not explained but the text suggests they are known to both Baird and RIA. With these problems known, validation time series and statistics are therefore also presented for an AWAC site located 200 m to the north. Although model performance is better at this location, there remains a common overprediction of significant wave height, and a consistent eastward shift in predicted wave direction, versus measurements. The cause of these issues should be discussed clearly and evaluated in terms of the potential impacts to predictions of sediment plume transport and fate.
12	Section 4.3.2	Table 4.3 lists parameters used to configure the sediment plume model (Delft3D-MOR), but two key dredging source terms are not included or discussed elsewhere: the loss rate of dredged sediment to the water column (i.e. what proportion of the in situ dredge quantity is assumed by the model to be 'mobile'); and the vertical distribution of sediment initially suspended in the water column (prior to far-field dispersion and settlement). Both of these parameters serve to relate sediment sources to the type of dredge plant being used and to the manner in which it brings sediment from seabed to surface. Without knowledge of how these source terms have been defined, the accuracy of the predicted dredge plume cannot be fully judged.

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13	Section 5.3	It may have been more appropriate (albeit less conservative) to assume an average background SSC only from the Rottnest IMOS NRS site data, regardless of its location further offshore, when it is considered that nearshore waters in Cockburn Sound are known to be more turbid than those in the vicinity of Rottnest.
14	Section 5.4.1	The lack of site-specific data notwithstanding, this section requires further justification of the use of a methodology previously applied at Port Beach, contextualising the relative similarity (or otherwise) of the local benthic environments. In the referenced BMT report (BMT report *R-10807-5*), nominal SSC values of 2, 5, 10 and 20 mg/L were selected to define 'visible', 'low risk', 'moderate-risk' and 'high-risk' categories on the basis of site-specific sampling allowing a relationship between SSC and light attenuation coefficient (LAC) to be derived. It is not clear from the current text why these SSC values are immediately applicable here. Table 5.1 has been reproduced from Table 5.14 of the referenced BMT report (BMT report *R-10807-5*), and its listing of sedimentation thresholds is not relevant as these are not used as criteria for the ZoHI/ZoMI calculated in this report.
15	Section 5.5	The contours of Figure 5.13 may offer more visual clarity for the reader if they were semi-transparent or hatched. Also, the ZoI contour is not included in the legend.

Review of Coastal Processes Assessment Report

The following table contains comments following a review of Baird report *13029.101.R1.Rev1 – South Thomson Bay Barge Development: Coastal Processes Assessment* (dated 14 February 2024). We note that the filename contains a different identification number (14209), but we assume the one listed on the front cover and preface is correct.

The objective of this report is to assess the impact of the proposed barge development on the coastal processes acting within South Thomson Bay, including wave conditions, sediment transport pathways, wrack dynamics and the impact of wave penetration within the proposed harbour basin of the barge development.

Item no.	Report section	Comment
1	General	Many figures are small and contain text or other features that are difficult to read without zooming in, so readers would benefit from seeing these figures on separate pages and/or in landscape orientation.
2	Executive Summary	Use of the word "minimal" to describe a difference in wave climate of <0.4 m or <0.15 m is questionable. Although these values seem small, the location has a low-energy wave climate: based on data presented in the report ~85% of the waves are below 0.5 m in height. These values represent differences of 30-80% of that wave height.
3	Section 2.4	Figure 2.3 shows measured data locations but is too small and too low in resolution for the sites to be clearly discerned – particularly the inset showing the nearshore locations.
4	Section 2.4	Table 2.1 lists the measured data sets utilised in various parts of the study, but some deployment dates stated here can be confusing when the data is discussed later in the report. In particular, when the 'Signature1000_Site1' and 'Aquadopp_Site2' data sets are discussed later in Section 2.7.2 it is clear that these deployments are not continuous and do not span the entire period, as a reader might assume from the start/end dates in Table 2.1.

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5	Section 3.1	A four-year data set is not considered a long-term hindcast in the context of a structure with a 50-year design life. While the data set may contain a range of wave conditions at the site, processes that occur over longer timescales – variability in sea levels, wave heights and dominant wave directions from ENSO cycles – can also have relatively large influence. The four years selected for consideration need to be justified in the context of broader metocean conditions: why these years, by which measures are these years particularly representative of the site in question, etc.
6	Section 3.1.1	The statements about the calibration ("*… the model showed good agreement with the measured wave data for significant wave height, period and direction at locations in Thomson Bay…*") and about the validation ("*Based on the outcomes of the model validation, the model system is considered to reproduce the wave conditions in Thomson Bay well and suitable for application for developing the hindcast used in this study.*") are overly brief and not accurate. While the modelled significant wave height shows reasonable agreement with measurements, there are some clear problems in the wave period/direction calibration and validation plots and statistics presented in Appendix A. The poor statistical performance and clear shift in the wave direction at the nearshore sites need to be discussed further. It should be justified why, although there are problems with the calibration/validation, the model remains fit for purpose. Additionally, typically a validation period would be chosen to check the calibrated model is representative of a broad range of wave conditions/regimes at the site – particularly seasonal variability, which has been shown to be significant here. The validation period chosen was another winter period despite data being available during summer. If there is a reason for limiting all validation efforts to winter, it needs to be clearly stated.
7	Section 3.1.3	A 2 m grid scale in the phase-averaging SWAN model is very fine and lies outside the bounds of recommended resolution (50-1,000 m) outlined in the model's user manual. A phase-resolving model should be used if these scales are needed. Given the small area covered by the 2 m x 2 m grid, and the method applied to assess wave shadowing in Section 3.2, the problem perfectly lends itself to use of a phase-resolving model. The use of SWAN for this assessment needs to be justified.
8	Section 3.2	While the wave assessment at the RIA moorings (Section 3.2.1) notes that further investigation should be done using a phase-resolving model, this is also true for the assessment of wave conditions with and without the Barge Development structure. SWAN was used but it is not clear if or how its limited capabilities for wave reflection and, in particular, diffraction processes were applied here. Results should be noted as indicative only.
9	Section 4.2	A prediction of 5-10 m of cross-shore erosion for the 100-year ARI storm sequence has been made, but there is no discussion of how the presence of the proposed Barge Development impacts this prediction or how it needs to be considered in the concept design.
10	Section 4.3	The erosion hazard line that needs to be considered for the 50-year design life of the project structure is shown as being ~50 m behind the current shoreline position, but there is no discussion of how the presence of the proposed Barge Development impacts this prediction or how it needs to be considered in the concept design.
11	Section 4.7	The discussion here is confusing and very brief. The first two paragraphs are contradictory: the first says the structure is unlikely to have a significant impact, but the second says that the structure may cause more sediment to build up around it than presently. This needs to be clarified. The first line states "*Considering the above analyses, it is unlikely that the proposed barge development would have a significant impact on the sediment dynamics along South Thomson Bay.*" This is referring to previous sections but, without further discussion in those sections of the Barge Development structure's impact on the stated predictions of erosion and accretion, it is not clear that this statement is justified. While the longshore sediment transport assessment (Section 4.3) shows the present coastline is stable with relatively small volumes of net sediment transport in the vicinity of the Army Groyne, the cross-shore sediment transport (Section 4.2) and climate change

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		(Section 4.6) lack linking discussions to state what impact the project structure will have on predictions. It is not clear how the red dashed line on Figure 4.23 has been derived; no explanation or calculation is provided. If it is a conceptual line based on experience and judgement rather than calculation, then it should be referred to only as such and made clearer that it is not a derived forecast of potential impacts. Additionally, within previous sections there is no detail or calculation provided as to whether sediment is, or is not, transported past the tip of the existing Army Groyne. It should be shown whether or not the tip of the groyne – or of the proposed Barge Development – is outside the active transport zone and therefore beyond the point where sediment transport can occur.
12	Appendix A	The wave model validation plots presented here appear to have been reproduced from a previous report or presentation. This raises points of confusion, as the 2 m x 2 m grid shown on the maps is focused around the Main Ferry Terminal rather than the Army Groyne, and the labelling of the measurement sites is not consistent with those in the main body of the report.

Yours sincerely,

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