Contents

7 Coastal processes and hydrodynamics

7.1 Chapter content

The Project impact assessment for coastal processes and hydrodynamics assessment was provided in Chapter 7 of the Project EIS.

This chapter provides additional information to address the submissions received during the statutory public display period of the Project EIS. The key issues raised from the Project EIS submission process relevant to the coastal processes and hydrodynamics assessment are summarised Table 7.1.

Table 7.1 Summary of submission issues received in relation to the Project EIS coastal processes and hydrodynamics assessment chapter

Submitter ID number (refer Appendix A)	Summary of submission issue raised	Project EIS section (public notification version)	AEIS section containing information to address submission comments	Complete replacement section for Project EIS	Supplements the Project EIS information
12.10	Describe the applicability of the chosen ARI design level. Demonstrate how the design has taken into account current modelled climate change driven increases in the frequency and intensity of storms and cyclones and sea level rise.	Section 2.5.3 Section 7.2	Section 7.2 Section 11.3.2		✓
12.11	Describe in detail why a final bund height of +7m LAT and the design of the bund wall, having an allowance of +1.88m above existing HAT at Fisherman's Landing, was determined as adequate in relation to the potential impacts of climate change	Section 2.5.3 Section 7.2	Section 7.2 Section 11.3.2		✓
12.19	Relevant sea level rise level information should be updated to be consistent with the current IPCC report	Section 7.3.2	Section 7.2		✓
12.95	Remove the contradictions in the draft EIS with regards the frequency and intensity of cyclones	Section 7.3.2	Section 7.2		✓
12.20	Commitment to monitor sedimentation in the Facing Harbour before, during and after the Project	Section 7.4.5 and Appendix D (Section 4.5.1)	Section 7.3	✓	
		Appendix Q4	Appendix I	✓	

Submitter ID number (refer Appendix A)	Summary of submission issue raised	Project EIS section (public notification version)	AEIS section containing information to address submission comments	Complete replacement section for Project EIS	Supplements the Project EIS information
12.18	Commitment to update bathymetric data prior to dredging	Appendix Q4	Appendix I	✓	
12.21	Monitor and identify changes in landforms, intertidal areas and sub-littoral bathymetry for areas adjacent to, or expected to be impacted by, the proposed WBE reclamation area	Section 7.4.5 and Appendix D (Section 4.5.1)	Section 7.3	✓	
		Appendix Q4	Appendix I	✓	
12.26	Predict the spatial extent of sediment dispersion from all tailwater release points and demonstrate that the water quality objectives would be met within a reasonable distance from these. Modelling should consider a worst case scenario where all release points were releasing simultaneously at the maximum TSS and at maximum release rate. Predictions should be made across varying tidal cycles and current velocities. Demonstrate that the release locations chosen for the release points provide the greatest potential for mixing and dilution and would result in the lowest risk to the receiving environment.	Section 9.13.2.3	Section 7.4		✓
		Appendix G	Appendix D	✓	
12.43	Include a detailed discussion and assessment of the limitations of the modelling and the predicted zones of impact	Appendix G	Submission comment response provided in Appendix B		
12.115	Discuss how maintenance dredging would be influenced by climate change, particularly how the volume of dredged material to be removed during maintenance dredging would change as a result of climate change	Appendix G	Submission comment response provided in Appendix B		

Submitter ID number (refer Appendix A)	Summary of submission issue raised	Project EIS section (public notification version)	AEIS section containing information to address submission comments	Complete replacement section for Project EIS	Supplements the Project EIS information
12.04	Potential impacts and risk assessment rating in each draft EIS chapter should be amended to include effective mitigation measures to assist with their interpretation	Section 7.6.2	Section 7.5	✓	

7.2 Extreme water levels

This section replaces the Project EIS Section 7.3.2 (extreme water levels).

Water levels at the coast during cyclones may be substantially higher than normal tides due to storm surge effects. Storm surges are increases in water level caused by onshore wind stresses and reduced atmospheric pressure.

The storm tide level is the result of tide plus surge. The surge may peak at any stage of the tidal cycle. Hence abnormally high storm tide levels may result from extreme surge peaks coinciding with moderate to high tides, or moderate surges coinciding with high tides. The probability of an extreme surge peak coinciding with a spring high tide is low.

The DTMR's guideline *Storm Tide – Issues for Design of Road Infrastructure in Coastal Areas* (DTMR 2014c) provides predicted storm surge and storm tide levels for a number of probability levels for future climatic conditions in the Gladstone area. The Gladstone predicted storm tide (i.e. tide, plus storm surge) and future climate change conditions included in the DTMR guideline are summarised in Table 7.2.

Table 7.2 Storm tide level data for Gladstone

Scenario		Storm tide level (m LAT)		
		100 year ARI	500 year ARI	1,000 year ARI
Gladstone (2003)	Storm tide level	5.09	5.78	6.07
	Storm surge allowance[2]	0.26	0.95	1.24
Gladstone (with future climate change conditions)[1]	Storm tide level	5.60	6.45[3]	6.78
	Storm surge allowance[2]	0.77	1.62	1.95

Table notes:

1 Based on Climate Change Scenarios for a 50 year planning period (DTMR 2014c)
2 Assumes that the HAT at Gladstone is 4.83m LAT and AHD is 2.27m LAT (MSQ 2018)
3 6.45m LAT has been used as an input into the EIS preliminary design for the BUF and WBE reclamation area

The EIS preliminary design for the BUF and WBE reclamation area bund walls has allowed for a combined storm tide and sea level change up to 7m LAT. This is a 0.55m allowance above the predicted 500 year ARI storm tide, including a climate change estimate of 6.45m LAT. The proposed reclamation area bund wall height of 7m LAT is consistent with the height of the adjoining Western Basin reclamation area and Fisherman's Landing reclamation area.

The modelled sea level rise predictions from the most recent Intergovernmental Panel on Climate Change (IPCC) report presented in Project EIS Chapter 11 (climate and climate change assessment) are consistent with the values over that 50-year planning period.

7.3 Sediment dynamics

This section replaces the Project EIS Section 7.4.5 (sediment dynamics).

The influence of sediment plumes generated during dredging on water quality and ecological values are addressed in Project EIS Chapter 8 (water quality) and Project Chapter 9 (nature conservation), respectively. The AEIS Chapters 8 and 9 also provide supplementary information on these values.

Potential long term changes in the sediment dynamics within the Port Curtis estuary caused by the duplication of the channels were assessed by modelling the ambient sediment dynamics for a 12 month period with the Base Case geometry and comparing the results with a simulation of the same 12 month period with the Project Channel Case Geometry (refer Appendix D).

In the vicinity of the WBE reclamation area and BUF, the model results indicate the potential for some erosion to occur in the channel surrounding the new reclamation areas. This erosion would continue (provided the bed material is erodible) until the channel reaches a new equilibrium depth. Note that this means that the predicted rates of erosion in the channels would not be sustained long term, since the bed morphology would adjust to the new regime and net erosion and accretion will trend towards zero as a new equilibrium profile is obtained.

Analysis of the channel stability using an empirical stream equilibrium relationship (refer AEIS Section 8.2) indicates that the channel between the two parts of the proposed WBE reclamation area could deepen by up to 2m following construction, while the northern part of the channel between the proposed reclamation and the mainland could deepen by up to 1m. This assessment will be undertaken again during the detailed design phase of the WBE reclamation area, and the design will be optimised to minimise potential erosion. The detailed design of the top of the reclamation area bund wall will take into account the potential for erosion of the adjacent channel.

A monitoring program will be developed and implemented to manage any observed impacts in the channels and along the shoreline adjacent to the new reclamation area, including changes to:

- Land forms, including coastal and dune vegetation
- Existing navigable channels
- Intertidal areas, including feeding area for migratory birds
- Wetlands, including groundwater regimes
- Existing approved tidal works structures
- MNES and MSES values.

The model results also indicate an increase in siltation rates in the Golding Cutting section of the new channel, due to a reduction in velocity caused by the increased water depth. Analysis of the modelling results indicates that the overall net annualised siltation rate within the shipping channels of the Port is likely to increase by approximately 7% following the completion of the Project. This increase is associated with additional dredging required in the new duplicated section of channel. It will not require a significant change to the maintenance dredging regime, only a proportional increase in the average duration of the typical annual dredging campaign.

The model indicates that the Project will have a negligible effect on siltation rates elsewhere in the Port, including at small boat harbour at the southern end of Facing Island. Notwithstanding this, the Project will monitor sedimentation in the Facing Island harbour before, during and after the Project and implement mitigation measures to address any significant increase in sedimentation resulting from the Project. This Project commitment has been included in Appendix I.

The proponent has committed to a monitoring regime to manage any observed impacts in the channels and along the shoreline adjacent to the new WBE reclamation area, including MNES and MSES values. Approximate final seabed depths are provided in Table 4.2 of the Project hydrodynamic modelling report (refer AEIS Appendix D). However the detailed design process will take this analysis into account and the design will be revised (where required) to minimise the Project impacts to the seabed elevation, shoreline position and associated MNES and MSES values. The final WBE reclamation area design will be sufficiently optimised to avoid large-scale changes to seabed elevation and shoreline position.

7.4 Project tailwater discharges

This section supplements the Project EIS Section 9.13.2.3.

AEIS Appendix D replaces the Project EIS Appendix G (coastal processes and hydrodynamics technical report).

7.4.1 Licenced discharge releases

Discharge from the two existing Western Basin reclamation area discharge points will only occur if Project dredged material is placed and managed within this area. Licenced discharges from the two existing Western Basin reclamation area discharge points will not occur at the same time as at the proposed WBE reclamation area discharge point.

Therefore the predicted sediment dispersion provided in the AEIS Appendix D is an adequate assessment for the Project EIS and AEIS.

7.4.2 Tailwater plume dispersion

The discharge of tailwater is included in all of the relevant Project modelling results presented in the AEIS Appendix D. The Project modelling of dredging activities includes a range of parameters which were included into the numerical modelling process. The Project model parameters are provided in AEIS Appendix D, Section 5.2.1 (initial dredging works), Section 5.2.2 (stage 1 dredging), Section 5.2.3 (stage 2 dredging), Section 5.2.4 (stages 1 and 2 dredging), Section 5.2.5 (worst case dredging scenario), and Section 5.2.6 (cumulative case scenarios).

An additional simulation of the tailwater discharge has been carried out to illustrate the rapid mixing and dispersion of the plume in typical tidal conditions. The model snapshots shown in Figure 7.1 illustrates that even during neap tides, when tailwater plume concentration would be highest, the modelled depth-averaged tailwater-related total suspended solids (TSS) concentration is very low (less than 2mg/L).

Figure 7.1 **Typical tailwater plume depth-average TSS concentration (Top: neap flood tide, Bottom: neap ebb tide)**

AEIS Appendix D Section 4.3.2 provides the predicted velocity impacts from the construction of the WBE reclamation area. Figure 7.2 shows the proposed channel between the new reclamation areas has very good tidal flushing characteristics. The modelling undertaken as part of the Project EIS and AEIS has incorporated varying tidal cycles and current velocities.

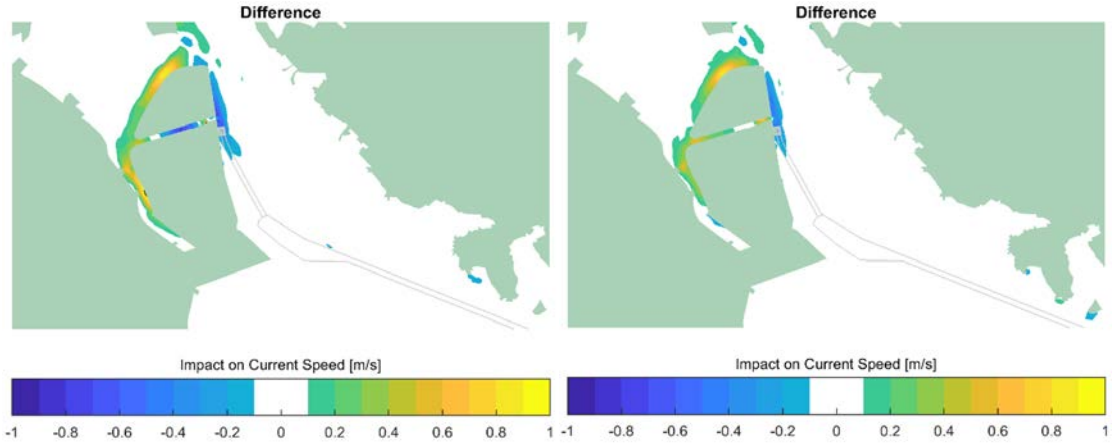

Figure 7.2 **Changes to the flood tide peak spring velocity (left) and ebb tide peak spring velocity (right) for the Project Channel and WBE reclamation area geometry case**

7.5 Summary of risk assessment

This section replaces the Project EIS Section 7.6.2 (summary of risk assessment). The risk assessment methodology is provided in Section 7.6.1 of the Project EIS.

The Dredging EMP (refer AEIS Appendix F) and the Project EMP (refer AEIS Appendix G) provide a range of mitigation measures to reduce the potential coastal processes and hydrodynamics impacts of the Project. As part of the risk assessment, the management plans and associated mitigation measures below have been applied to determine the post mitigation HRG shown in Table 7.3.

- Dredging EMP (refer AEIS Appendix F)
  - General environmental management measures (refer Section 8)
  - Water quality management plan (refer Section 9.10)
- Project EMP (refer AEIS Appendix G)
  - Water quality management plan (refer Section 8.10)

The potential coastal processes and hydrodynamic impacts risk assessment is summarised in Table 7.3.

It is important to note that the potential Project water quality and ecological impacts associated with the potential coastal processes and hydrodynamic impacts are provided in the Project EIS and AEIS Chapters 8 and 9, respectively.

Table 7.3 Potential coastal processes and hydrodynamics impacts and risk assessment ratings

Potential impact	Project phase					Preliminary HRG			Post mitigation HRG		
	Reclamation area and BUF establishment	Dredging	Navigational aids	Demobilisation	Maintenance	Likelihood	Consequence	HRG	Likelihood	Consequence	HRG
Changes to water levels											
Permanent changes to water levels	✓				✓	Rare	Negligible	Low	Rare	Negligible	Low
Changes to velocities											
Permanent changes to velocity magnitudes and/or patterns adjacent to the WBE reclamation area and BUF	✓				✓	Almost certain	Low (minor)	Medium	Almost certain	Low (minor)	Medium
Permanent changes to velocity magnitudes and/or patterns adjacent to the duplicated channel					✓	Almost certain	Negligible	Medium	Almost certain	Negligible	Medium
Changes to wave climate											
Permanent changes to wave climate adjacent to the WBE reclamation area and BUF	✓				✓	Almost certain	Low (minor)	Medium	Almost certain	Low (minor)	Medium
Permanent changes to wave climate adjacent to the duplicated channel					✓	Almost certain	Negligible	Medium	Almost certain	Negligible	Medium
Changes to extreme water levels											
Changes to extreme water levels	✓				✓	Rare	Negligible	Low	Rare	Negligible	Low
Changes to sediment dynamics											
Potential erosion of channels adjacent to the WBE reclamation area and BUF	✓				✓	Likely	Low (minor)	Medium	Likely	Low (minor)	Medium
Overall increase in siltation rates in the shipping channels and consequent increase in maintenance dredging requirements					✓	Likely	Low (minor)	Medium	Likely	Low (minor)	Medium

Potential impact	Project phase					Preliminary HRG			Post mitigation HRG		
	Reclamation area and BUF establishment	Dredging	Navigational aids	Demobilisation	Maintenance	Likelihood	Consequence	HRG	Likelihood	Consequence	HRG
Changes to coastal processes											
Changes to coastal processes along shorelines adjacent to the WBE reclamation area and BUF	✓				✓	Likely	Low (minor)	Medium	Likely	Low (minor)	Medium
Changes to coastal processes along other shorelines	✓				✓	Rare	Negligible	Low	Rare	Negligible	Low