

Contents

| | | |
|----------|---|------------|
| 8 | Water quality | 8-1 |
| 8.1 | Chapter content | 8-1 |
| 8.2 | Potential impacts from the proposed Western Basin Expansion reclamation area on coastal processes and hydrodynamics | 8-4 |
| 8.3 | Water quality monitoring..... | 8-8 |
| 8.4 | Queensland Water Quality Guidelines | 8-13 |
| 8.5 | Stormwater management | 8-13 |
| 8.6 | Summary of risk assessment | 8-14 |

8 Water quality

8.1 Chapter content

The Project impact assessment for water quality was provided in Chapter 8 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 water quality assessment are summarised Table 8.1.

Table 8.1 Summary of submission issues received in relation to the Project EIS water quality assessment chapter

| Submitter ID number (refer Appendix B) | 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 tables in each draft EIS chapter should be amended to include effective mitigation measures to assist with their interpretation | Section 8.9 | Section 8.5 | | ✓ |
| 12.22 | Describe the likely future equilibrium depth of the channel to the north and west of the proposed WBE reclamation area as a result of increased flows and erosion in these areas | Section 8.6.4.2 (erosion and siltation subsection) | Section 8.2 | ✓ | |
| | | Appendix G (Section 4.5.1) | Appendix D (Section 4.5.1) | ✓ | |
| 12.23 | Provide an assessment of how increased sedimentation adjacent to the proposed WBE reclamation area would influence the requirement to undertake maintenance dredging of the northern section of the shipping channel | Section 8.6.4.2 (erosion and siltation subsection) | Section 8.2 | ✓ | |
| | | Appendix G (Section 4.5.1) | Appendix D (Section 4.5.1) | ✓ | |
| 12.24 | Describe whether increased sedimentation in the Gatcombe and Golding Cutting Channels would increase the requirement for maintenance dredging | Section 8.6.5.3 (siltation) | Section 7.3 | | ✓ |
| | | Appendix G (Section 4.5.2) | Appendix D (Section 4.5.2) | ✓ | |

| Submitter ID number (refer Appendix B) | 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 |
|--|--|---|--|--|---|
| 12.27 | Describe why the project cannot achieve the industry best practice limit of 50mg/L and why this project should be licensed to discharge at the higher 100mg/L. This information should include evidence that this increased discharge limit will not impact environmental values | Section 9.13 | Section 8.3.3 | | ✓ |
| 12.29 | Nominate appropriate water quality monitoring reference sites (i.e. for physicochemical parameters and toxicants) located outside the predicted zone of influence of dredging | Section 8.2.1.2 | Section 8.3.1 | | ✓ |
| | | Appendix Q3 | Appendix H | ✓ | |
| 12.30 | Provide a table describing the naming of each site and its relation to historical water quality monitoring data, as well as monitoring methods proposed to be used in the future monitoring program. | Section 8.2.1.2 | Section 8.3.2.1 | | ✓ |
| | | Appendix Q3 | Appendix H | ✓ | |
| | Demonstrate that historic baseline monitoring data are representative of water quality at these new sites and that the monitoring methods used are comparable. For example, explain the relationship between baseline data and the proposed new 'compliance sites' like MH10, MH60, and NW50 mentioned in Appendix Q3. | Section 8.2.1.2 | Section 8.3.2.1 | | ✓ |
| | Describe how baseline data, triggers proposed and approaches to assess compliance, would be sufficiently conservative to distinguish potential impacts from the proposed Project from natural variation | Section 8.2.1.2 | Section 8.3.2.3 | | ✓ |
| 12.31 | Describe why the inshore sites are excluded from the compliance water quality monitoring program, or re-instate baseline monitoring sites (e.g. QE3, P5 and CD3) for inshore waters in the future project monitoring program (refer Section 6.1, Table 4 and Table 11). | Appendix Q3 (Section 6.1.2) | Section 8.3.2.1 | | ✓ |
| | | Appendix Q3 | Appendix H | ✓ | |

| Submitter ID number (refer Appendix B) | 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 |
|--|---|---|--|--|---|
| 12.32 | Clarify how stormwater will be managed within the reclamation area. Describe any potential discharge from approved release points following significant rain events and the need to discharge stormwater from additional discharge points (for example from the northern part of the WBE reclamation area). | Section 8.7.2 | Section 8.4 | | ✓ |
| 12.38 | Include appropriate monitoring sites at a suitable spatial resolution. Consider the need for additional sites for monitoring water quality parameters between CD1 and CD5. | Appendix Q3 (Section 6.1.2) | Section 8.3.4 | | ✓ |
| | | Appendix Q3 | Appendix H | ✓ | |
| 12.45 | The draft EIS should include an additional monitoring site in close proximity to the tailwater release and apply appropriate triggers in the EMP as required | Appendix Q3 (Section 6.1.1) | Section 8.3.3.2 | | ✓ |
| | | Appendix Q3 | Appendix H | ✓ | |
| E9.07 | Discharge of the separation water from the dredged material placement area should be monitored continuously and not rely on monitoring at arbitrary locations in the harbour to pick up on problems | Appendix Q3 | Appendix H | ✓ | |
| E9.08 | Given the location within the Great Barrier Reef World Heritage Area, all oils, fuels, chemicals and hazardous materials stored in the Western Basin and WBE reclamation areas should be stored in impervious bunded areas to prevent spillages entering the local environment, and reliance should not be placed on spill kits alone | Appendices Q1 and Q2 | Appendix F and G | ✓ | |

| Submitter ID number (refer Appendix B) | 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 |
|--|---|---|--|--|---|
| E9.09 | The proposed further coastal processes and hydrodynamic modelling of the WBE reclamation area bund wall and construction sequences should be carried out before the EIS is approved, so that decision makers can take into account any likely impacts during the decision making process, and condition any approvals accordingly | Executive summary | Section 8.2 | | ✓ |

Table notes:

- 1 Submitter ID number commencing with 'E' are submissions received under the EPBC Act public notification process (refer AEIS Appendix B for details)
- 2 Other ID numbers are submissions received under the SDPWO Act public notification process (refer AEIS Appendix A for details)

8.2 Potential impacts from the proposed Western Basin Expansion reclamation area on coastal processes and hydrodynamics

This section replaces Project EIS Section 8.6.4.2 (impacts of reclamation area on coastal processes and hydrodynamics, erosion and siltation subsection).

The calibrated TUFLOW FV model was used to investigate the sediment dynamics of the Port for each of the assessment scenarios. The cohesive sediment transport module was used to simulate the ambient turbidity in the water column for the full 12 month assessment period. Sediment exchange with the seabed was modelled (deposition and resuspension) and included the influence of both wave and current generated bed shear stresses.

Figure 8.1 illustrates the modelled change to the annual siltation/erosion rate for the Base Case and the Project Channel Geometry Case (i.e. the expected change in the siltation/erosion rate due to construction of the reclamation area). The model indicates the potential for some erosion in the channels 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.

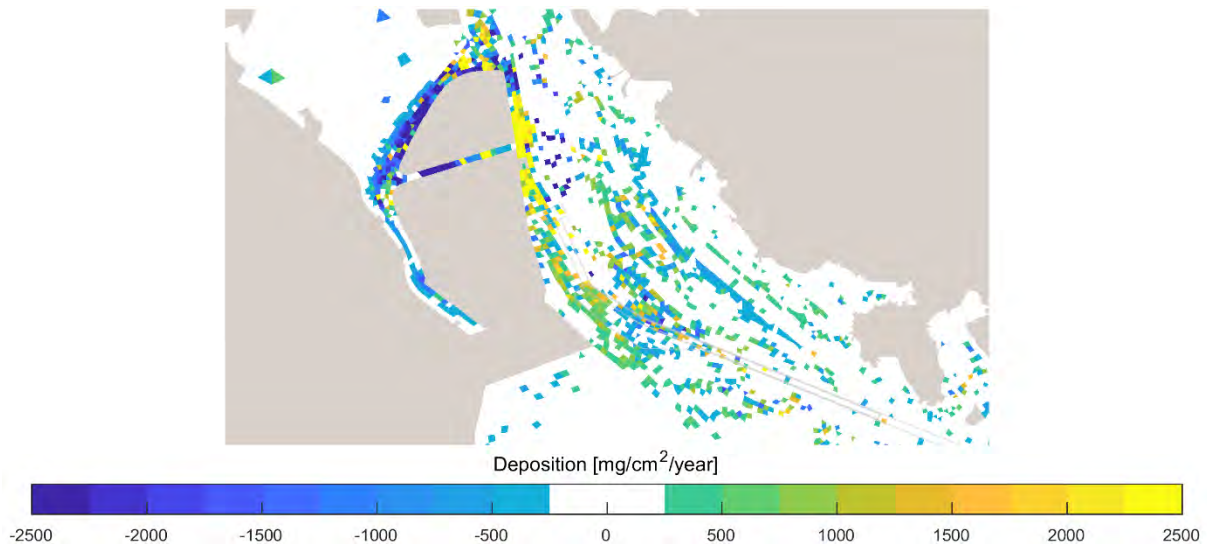


Figure 8.1 Impact to siltation rate near the Western Basin Expansion reclamation area due to the Project

Stable tidal channels, unless otherwise geologically restricted or subject to strong external influences such as input of sediments by other processes, have been shown to exhibit a well-defined relationship between the volume of tidal flow (tidal prism) and the cross-section area of the flow; a consequence of the fact that they tend to adjust their geometry until a certain equilibrium is achieved. A large number of river entrance channels have been studied throughout the world and a number of stability expressions have been developed. The best known of these is that of O'Brien (1969), which is commonly adopted as follows:

$$A = 0.91 \times 10^{-3} P^{0.85}$$

Where A is the river mouth cross-section area below mid-tide level and P is the tidal prism volume between mean high high water and mean low low water (approximately mean spring tide range).

Similar types of regime equilibrium expressions have been found to apply along the tidal reaches of estuaries, upstream of the mouth. Using numerical models of various tidal streams in Eastern Australia, BMT has developed a clear equilibrium relationship that applies to a wide range of channel sizes from minor creeks to large rivers. This relationship is given as:

$$A = 3.1 \times 10^{-3} P^{0.81}$$

The TUFLOW FV model results were used to determine the likely regime status of the completed channels adjacent to the new reclamation areas, with a view to assessing the stability of the channel cross-sections and their likely morphological development. The calibrated TUFLOW FV model was used to estimate the tidal prism for a mean spring tide range (i.e. 3.2m) at seven transects, shown in Figure 8.2. The cross-section area below mean sea level was calculated using the digital elevation model that was developed for the Port of Gladstone model.



Figure 8.2 Transects analysed for likely morphological evolution

The results of the channel stability analysis are presented in Figure 8.3. The channel to the north west of the proposed northern reclamation area is likely to become shallower (accrete) near transect 3, likely to be stable (neither erode nor accrete) near transect 2 and may show a tendency to deepen (erode) near transect 1. The channel to the west of the proposed southern area (the extension to the existing Western Basin reclamation) is likely to deepen (erode) near transect 4, as is the channel between the two WBE reclamation area sections (transects 5, 6 and 7).

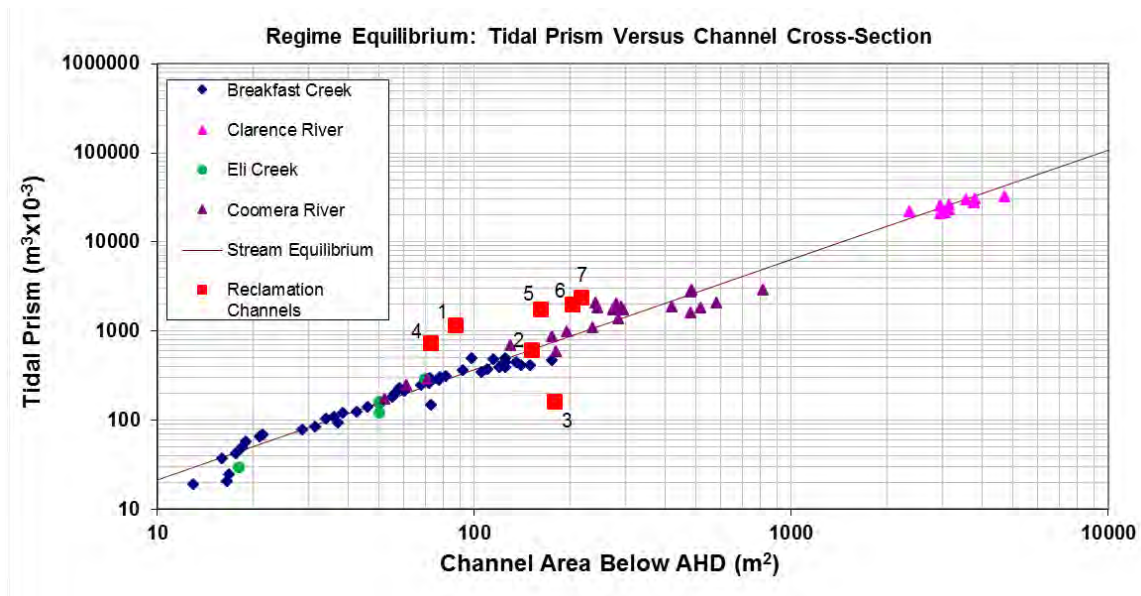


Figure 8.3 Regime equilibrium: Tidal channels adjacent to proposed WBE reclamation area

The likely equilibrium cross-sectional areas at each of the transects is provided in Table 8.2. It is not possible to use the empirical stream equilibrium relationship to determine whether the channel area will increase or decrease by widening or deepening, except where hard structures are expected to restrict the ability of the channel to widen. In Table 8.3, the potential mean equilibrium depth is provided based on the assumption that the width of the channel at each transect is held constant.

Table 8.2 Likely equilibrium cross-section areas at each transect

| Transect | Design area (m ²) | Tidal prism (x10 ³ m ³) | Equilibrium area (m ²) |
|----------|-------------------------------|--|------------------------------------|
| 1 | 87 | 1149 | 251 |
| 2 | 152 | 605 | 150 |
| 3 | 179 | 162 | 51 |
| 4 | 73 | 724 | 173 |
| 5 | 162 | 1732 | 350 |
| 6 | 204 | 1978 | 390 |
| 7 | 218 | 2391 | 455 |

Table 8.3 Potential equilibrium depth at each transect

| Transect | Design width (m) | Mean initial design depth (m) | Mean equilibrium depth (m) |
|----------|------------------|-------------------------------|----------------------------|
| 1 | 183 | 0.5 | 1.4 |
| 2 | 196 | 0.8 | 0.8 |
| 3 | 270 | 0.7 | 0.2 |
| 4 | 150 | 0.5 | 1.2 |
| 5 | 100 | 1.6 | 3.5 |
| 6 | 100 | 2.0 | 3.9 |
| 7 | 100 | 2.2 | 4.5 |

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 toe of the bund wall will take into account the potential for erosion of the adjacent channel.

A monitoring program will be 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.

Figure 8.1 also indicates that the siltation rate can be expected to increase to the east of the proposed WBE reclamation area, including part of the dredged channel in the vicinity of Fisherman's Landing (though not in swing basins and berth pockets adjacent to the liquified natural gas (LNG) facilities on Curtis Island). The model results indicate that an increase in maintenance dredging volume in the Fisherman's Landing area of approximately 11% could be expected (i.e. additional 3 days of maintenance dredging within the Port of Gladstone).

8.3 Water quality monitoring

8.3.1 Reference sites

This section supplements the Project EIS Section 8.2.1.2 (monitoring locations and rationale).

The Project EIS Appendix Q3 (Environmental Monitoring Procedure) has been replaced with AEIS Appendix H which includes the addition of one Project reference water quality site at Rodds Bay (i.e. RB1 shown on Figure 8.4). This proposed reference water quality site has been monitored previously for the WBDDP. The Project water quality reference site will be monitored for water quality parameters as per the other Project water quality monitoring sites as detailed in the Project Environmental Monitoring Procedure (refer AEIS Appendix H).

8.3.2 Water quality monitoring sites

8.3.2.1 Naming of water quality monitoring sites

This section supplements the Project EIS Section 8.2.1.2 (monitoring locations and rationale).

The Project EIS baseline water quality monitoring sites (referring specifically to physico-chemical monitoring sites) were spread across a wide area throughout Port Curtis and as a result, the factors influencing the background conditions at the surface and seabed varied between some sites. During the design of the Project EIS baseline monitoring strategy the water quality monitoring sites were split into the two groups identified below, based on historical water quality data and knowledge of background environmental influences within Port Curtis waters:

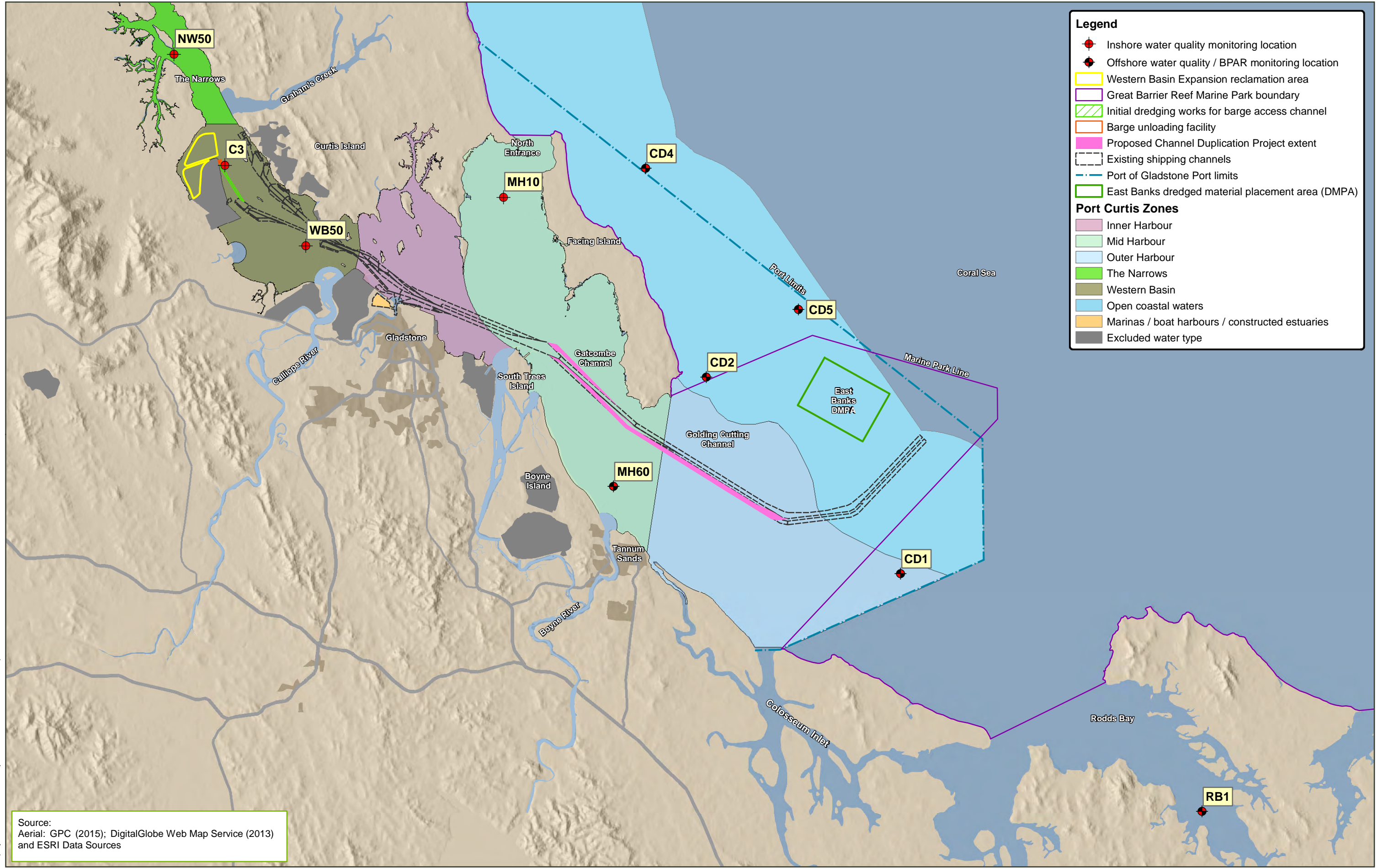
- 'Offshore' (i.e. CD1, CD2, CD3, CD4 and CD5)
- Inshore' (i.e. P5/MH10, P2B/WB50 and QE3) (refer Table 8.4).

The Project EIS water quality site naming convention adopted between 2013 and 2015 was based on combination of previous water quality monitoring sites (e.g. WBDDP) and new Project EIS water quality monitoring sites (i.e. CD1 to CD5). This water quality site naming was included in the Project EIS water quality chapter (refer Project EIS Chapter 8) and the Project Water Quality Technical Report (refer Project EIS Appendix H1), and is shown in Table 8.4 in the column labelled 'monitoring site name used in Project EIS baseline monitoring'.

All Project EIS water quality monitoring locations were selected to provide data to characterise the baseline water quality of Port Curtis during the monitoring period, with the potential for these sites to transition into compliance or reference monitoring sites during the Project reclamation and dredging activities.

The Project water quality monitoring naming convention has been amended for some of the Project EIS sites for the purpose of the Project Environmental Monitoring Procedure (refer AEIS Appendix H) to be consistent with the naming convention of the Port Curtis Integrated Monitoring Program (PCIMP) where the water quality monitoring locations are the same (or in close proximity) to the Project EIS water quality monitoring sites. Table 8.4 provides the Project Environmental Monitoring Procedure naming convention (refer column labelled 'monitoring site name used in the Project Environmental Monitoring Procedure') and includes the water quality sites that are located in the same location (or in close proximity) as the PCIMP water quality sampling sites.

The relationship between the Project EIS baseline water quality sampling data for CD3, P5/MH10, P2B/WB50 and QE3, and the compliance water quality sites MH60, MH10, WB50 and NW50 shown in the Project Environmental Monitoring Procedure, respectively, are the same sites spatially, with the only change being the naming convention of the sites.



Legend

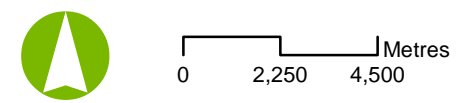
- Inshore water quality monitoring location
- ◆ Offshore water quality / BPAR monitoring location
- Western Basin Expansion reclamation area
- Great Barrier Reef Marine Park boundary
- Initial dredging works for barge access channel
- Barge unloading facility
- Proposed Channel Duplication Project extent
- Existing shipping channels
- Port of Gladstone Port limits
- East Banks dredged material placement area (DMPA)

Port Curtis Zones

- Inner Harbour
- Mid Harbour
- Outer Harbour
- The Narrows
- Western Basin
- Open coastal waters
- Marinas / boat harbours / constructed estuaries
- Excluded water type

Source:
 Aerial: GPC (2015); DigitalGlobe Web Map Service (2013)
 and ESRI Data Sources

Map by: NKM/RB P:\GIS\Projects\237374_GPC_Channel_Duplication_EIS\237374_EIS_378.mxd 18/07/2019 13:51



Date: 18/07/2019 Version: 1 Job No: 237374
 Coordinate system: GDA_1994_MGA_Zone_56

Gatcombe and Golding Cutting Channel Duplication Project

Figure 8.4: Baseline water quality monitoring locations

Table 8.4 Project EIS baseline and Environmental Monitoring Procedure water quality monitoring names and locations

| Grouping ¹ | Monitoring site name used in Project EIS baseline monitoring | Monitoring site name used in Project Environmental Monitoring Procedure (refer AEIS Appendix H) | Location (WGS84) | Site type ² | Zone ³ | Location description | Environmental Protection (Water) Policy management intent/ level of protection | Project EIS monitoring period |
|-----------------------|--|---|---------------------------|------------------------|--------------------------|---|--|-------------------------------|
| Offshore | CD1 | CD1 | S23 57.469 E151 30.115 | Concern | Open coastal waters | Adjacent to Seal Rocks | Moderately disturbed | June 2014 to July 2015 |
| | CD2 | CD2 | S23 52.017 E151 24.380 | Concern | Open coastal waters | Off East Point off Facing Island | Slightly moderately disturbed | June 2014 to July 2015 |
| | CD3 | MH60 (PCIMP site) | S23 54.989 E151 21.569 | Concern | Mid Harbour ⁴ | Located outside the mouth of the Boyne River | Moderately disturbed | June 2014 to July 2015 |
| | CD4 | CD4 | S23 46.269 E151 22.639 | Concern | Open coastal waters | Off the eastern side of Facing Island, adjacent to Pearl Ledge | Slightly moderately disturbed | June 2014 to July 2015 |
| | CD5 | CD5 | S23 50.187 E151 27.153 | Concern | Open coastal waters | Off the eastern side of Facing Island, 3km northwest of East Banks DMPA | Slightly moderately disturbed | June 2014 to July 2015 |
| Inshore | P5/MH10 | MH10 (PCIMP site) | S23.78382 E151.30647 | Reference | Mid Harbour ⁴ | Adjacent to Pelican Banks seagrass meadows | Moderately disturbed | June 2014 to July 2015 |
| | P2B/WB50 | WB50 (PCIMP site) | S23.70204 E151.13865 | Concern | Western Basin | Outside the mouth of the Calliope River | Moderately disturbed | June 2014 to July 2015 |
| | QE3 | NW50 (PCIMP site) | S23.70204 E151.13865 | Concern | The Narrows | Adjacent to Worthington Island in The Narrows | Slightly disturbed | January 2014 to July 2014 |
| | Not applicable | C3 | S23.76748 E151.16817 | Concern | Western Basin | Adjacent to Western Basin reclamation area | Moderately disturbed | Nil |
| Reference site | Not applicable | RB1 | S24.06795 E151.650883 | Reference | Rodds Bay | Rodds Bay (as part of Baffle Basin) | - | Nil |

Table notes:

- 1 Type refers to the general term used to group the Project EIS water quality monitoring sites
- 2 Concern refers to monitoring sites within zone of impact or zone of influence. Reference refers to sites for ambient background turbidity.
- 3 Water zones in accordance with EPP (Water) Schedule 1 – Plan WQ1312 (EHP 2014c)
- 4 While CD3 and P5/MH10 were both located in the Mid Harbour Zone they were grouped as 'inshore' and 'offshore', respectively. CD3 was located close to the edge of the Mid Harbour and Outer Harbour Zone boundaries and baseline water quality appeared to show more wind and wave influences. Conversely P5/MH10 was located in a more enclosed coastal location showing a more tidally influenced, well-mixed water column.

Modified from: VE (2015)

8.3.2.2 New water quality monitoring sites

This section supplements the Project EIS Section 8.2.1.2 (monitoring locations and rationale).

The Project EIS Appendix Q3 (Environmental Monitoring Procedure) has been replaced with AEIS Appendix H which includes the addition of one Project water quality reference site at Rodds Bay (refer Section 8.3.1) and the addition of a new water quality monitoring site (i.e. C3 shown on Figure 8.4), to measure turbidity in close proximity to the existing Western Basin reclamation area. The site will be used for identification of potential Project water quality impacts during the construction of the BUF and WBE reclamation area, and will also be used to measure the potential water quality impacts of the tailwater discharges from the Western Basin reclamation area during Project dredging activities. The site will be monitored for water quality parameters as per the other Project water quality monitoring sites as detailed in the Project Environmental Monitoring Procedure (refer AEIS Appendix H).

At this stage of the Project, the water quality site C3 does not have an appropriate level of current historic water quality data. Therefore the Project water quality triggers for water quality site C3 will be developed from six months of monitoring prior to Project construction commencing, or alternatively, regional water quality objectives (Schedule 1, EPP (Water)) will be applied.

8.3.2.3 Procedure for distinguishing Project impacts from natural variation

This section supplements the Project EIS Section 8.2.1.2 (monitoring locations and rationale).

Large levels of natural variation in water quality values occurring during Project activities are to be expected within the Port Curtis area due to the known hydrological processes observed within the Port. Natural variation will be required to be identified utilising a weight of evidence approach when exceedances of set triggers are registered. The use of a control (reference) site will indicate ambient turbidity values and will be accompanied by a series of steps (procedure) to identify any potential Project impact from background variation in water quality.

The procedure to be adopted will include the following steps/actions:

- Examination of the monitoring equipment to determine if any interference has occurred (e.g. extreme low tide; particles lodged on the probe such as debris) to validate the exceedance
- Analysis and comparison with background turbidity levels and predicted dredge plume modelling in order to place elevated turbidity levels in local and dredge influenced context, including where necessary some of the following activities:
 - Recent weather conditions and/or unusual events surrounding the area to be dredged, in Port Curtis and the Calliope River and Boyne River systems that may have impacted upon turbidity
 - Turbidity levels at the reference sites and other water quality monitoring sites (current and previous 48 hours)
 - Predicted background turbidity ranges for the monitoring site based on background water quality and tidal data (i.e. six hourly exponentially weighted moving average (EWMA), including the 99th percentile)
 - Spot monitoring of turbidity at upstream locations and investigation to determine any unusual events upstream of site that may have impacted on turbidity
 - Consideration of the turbidity in relation to the predictive modelling of the dredge plume at specific locations
- Check anthropogenic influences (outside the direct Project activities) occurring within Port Curtis
- The spatial distribution of exceedances in relation to unaffected sites and the position of the dredger and associated equipment, including the consideration of aerial surveys
- Determine the position of dredging equipment in relation to the exceedance location

- Determine the production rate and type of material currently being dredged, including any changes over the previous 48 hours.

8.3.3 Turbidity limit

This section supplements the Project EIS Section 9.13.2.3 and AEIS Appendix H (which replaces the Project EIS Appendix Q3 (Environmental Monitoring Procedure)).

The proposed Project 100 milligrams per litre (mg/L) TSS licenced discharge limit has been utilised in the following Project impact assessment areas:

- Project hydrodynamic modelling has predicted the potential changes to suspended sediment concentrations (i.e. turbidity percentiles and deposition rate statistics) and reductions in light received at ecological sensitive receptors (i.e. seagrass meadows, corals and other marine substrates). The zones of impact and influence associated with suspended sediment plumes have been derived (refer AEIS Appendix D) and included in the Project water quality and ecological impact assessment.
- The Project water quality impact assessment (refer Project EIS Section 8.6.6 and AEIS Appendix D) has demonstrated that the potential water quality impacts from the licenced discharges from the existing Western Basin reclamation area are temporary and minimal, and water quality impacts will be minimised during dewatering activities and licenced discharges by implementing the Dredging EMP and Environmental Monitoring Procedure (refer AEIS Appendices F and H).
- The predicted Project zone of impact from the Project initial dredging works is shown to be low impact within the barge access channel, while the licenced discharge from the existing Western Basin reclamation area is shown as the zone of influence for marine waters between the reclamation areas and Curtis Island (refer Figure 8.5). The zone of influence represents the predicted full extent of detectable plume, but no ecological impacts will occur.

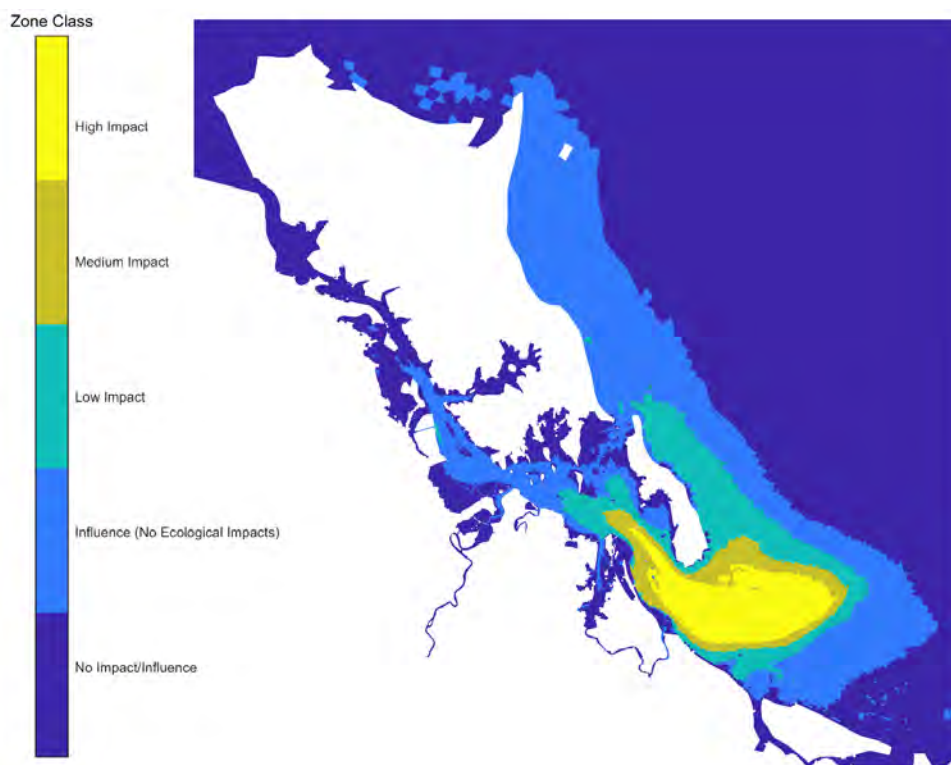


Figure 8.5 Zones of impact for the overall Project dredging activities

- Ecological impact assessment of the potential water quality impact on the following ecological values:
 - Intertidal flora and fauna values (e.g. seagrass meadows, macroalgae, soft sediment habitats, benthic macroinvertebrates)
 - Wetland values
 - Reef communities
 - Marine turtles, fish and other marine reptiles
 - Marine mammals
 - Migratory shorebirds
 - World Heritage values.

The predicted low level of changes to the suspended sediment concentrations (i.e. turbidity percentiles and deposition rate statistics) and minor short term reductions in light received at ecological sensitive receptors (i.e. seagrass meadows, corals and other marine substrates) has demonstrated that the potential ecological impacts from the Project licenced tailwater discharges are temporary and minimal, and potential ecological impacts will be minimised during the Project dewatering activities and licenced discharges by implementing the Dredging EMP and Environmental Monitoring Procedure (refer AEIS Appendices F and H).

The Project EIS and AEIS, and the implementation of the Dredging EMP and Environmental Monitoring Procedure (refer AEIS Appendices F and H) have demonstrated that the modelled licenced discharge of 100mg/L is appropriate for the maintenance of water quality and sensitive ecological receptors within the Port of Gladstone. The AEIS has amended the Environmental Monitoring Procedure to include an additional water quality monitoring site (C3) in the vicinity of the existing Western Basin reclamation area (refer Figure 8.4) which will further assist in minimising the potential impacts from the Project tailwater licenced discharges by implementing the adaptive management measures included in the Procedure.

Modelling of 100mg/L TSS load as a maximum discharge was included within the Project modelling scenarios based on the Project EIS conceptual design of the WBE reclamation area taking into account the nature of the Project dredged material (i.e. high silt and clay content). If a lower Project TSS licenced discharge limit is applied (i.e. below 100mg/L) it is likely that a larger reclamation area will be required to manage the Project dewatering process, however this will be confirmed during detailed design.

While the proponent notes the agency's preference for appropriate best practice for sedimentation basins (at 50mg/L), the proponent refers to the condition that this guideline explicitly refers to the relevance to prescribed ERAs where the activity is managing stormwater. While the proponent notes that rain water will be captured within the WBE reclamation area, no further stormwater from the surrounding catchment will flow into the WBE reclamation area. The primary purpose of the WBE reclamation area and the Project ERA activity that the TSS discharge limit relates is ERA 16 (dredging) and the tailwater decant of this activity.

The sediment plume modelling and tailwater discharge provided in the Project EIS was modelled at an ongoing maximum discharge limit of 100mg/L of clay particles (i.e. tailwater discharge will cease at TSS levels over 100mg/L) (refer AEIS Appendix D: Section 5.2). Based on historical dredging tailwater discharge information from the existing Western Basin reclamation area, discharge levels are variable under 100mg/L and water is not discharged above 100mg/L, therefore the Project modelling undertaken was conservative for the worst case scenario and actual TSS release levels are expected to be less than 100mg/L.

Based on the outcomes of the Project water quality and ecological impact assessment it is predicted that sensitive receptors are unlikely to be affected by sediment generated by the Project tailwater licenced discharges. Therefore from impacts dredging activities to aquatic ecosystems and other relevant environmental values within the Port of Gladstone are not expected.

8.3.4 Offshore water quality monitoring site suitability

This section supplements the AEIS Appendix H (which replaces the Project EIS Appendix Q3 (Environmental Monitoring Procedure)).

The location of Project baseline water quality monitoring sites was guided by the results of preliminary hydrodynamic modelling (Aurecon 2014). Sites were located within the predicted zone of impact and zone of influence, while others were located outside of the area of predicted impact. All sites were in the vicinity of known sensitive receptors (i.e. seagrass meadows and/or coral reefs).

Water quality sites CD1 and CD5 have the capacity to appropriately identify Project water quality changes in the outer harbour within the zone of influence, and additional sites are not required as the proposed sites, and the implementation of the Environmental Monitoring Procedure (refer AEIS Appendix H), will ensure that sensitive ecological receptors between and beyond CD 1 and CD5 (e.g. deep water seagrass meadows that might occur) are not impacted by Project water quality and light changes.

8.4 Queensland Water Quality Guidelines

The approach to baseline water quality collection and assessment, with reference to Queensland Water Quality Guidelines (QWQG) (specifically use of reference sites and sample size), was originally discussed in Project EIS Section 5.3.

Within the EPP (Water) and QWQG percentile values can be estimated, which can be used to further derive water quality objectives for an area. Under this approach, an expected 18 samples at each site over a minimum of 12 months may allow for the creation of an appropriate value (trending towards the blanket ANZECC 2000 guideline of 24 data values for an appropriate population estimate). Noting this, percentiles based on a smaller number of samples will typically derive percentile estimates within actual percentile estimates, giving more stringent estimates (EHP 2009).

Ten Project water quality monitoring sites, spanning from The Narrows to open coastal waters east and south of Facing Island, were selected in 2014 as part of the Gatcombe and Golding Cutting Channel Duplication Project EIS water quality baseline data collection strategy (over a period of 13 months) was developed in consultation with Commonwealth and State regulatory agencies (i.e. Department of the Environment, Great Barrier Reef Marine Park Authority, Department of the Environment and Heritage Protection and Department of Science, Information Technology, Innovation and the Arts). All monitoring locations were selected to provide data to characterise the current baseline water quality of Port Curtis, with the potential for these ten Project sites to transition into compliance and reference monitoring sites during dredging works. The water quality baseline collection strategy was considered to comply with the collection of reference data, in regard to site selection and data continuity, under the QWQG reference site guidelines.

8.5 Stormwater management

This section supplements the Project EIS Section 8.7.2.

As stated in the AEIS Section 2.3, GPC has undertaken further concept design considerations of the proposed WBE reclamation area internal dewatering cells as part of the AEIS preparation process, including the requirement that the internal cells and variable height weir boxes will be designed and maintained so that a freeboard of not less than 1.0m is maintained at all times during the dredging operation. This freeboard allowance is considered sufficient to accommodate extreme climatic events within Gladstone (e.g. cyclone, flooding), including any changes in rainfall volume caused by climate change.

A 1.0m freeboard within the WBE reclamation area is equivalent to an approximate 1 in 500 year rainfall event within Gladstone. It is important to note that the rainfall catchment for the proposed WBE reclamation area only includes the footprint of the reclamation area (i.e. no upstream catchment will flow into the new reclamation area). Also any significant rainfall event within Gladstone that approaches or exceeds a 1 in 500 year event is likely to halt Project dredging activities due to wider Port safety issues.

As a result of the proposed 1.0m freeboard, the stormwater gathered within the existing Western Basin and WBE reclamation areas will not require discharge, even during extreme weather events. As there is no catchment area other than the reclamation pond surface area, the actual rainfall is the amount captured. Therefore the reclamation areas have enough capacity to contain the equivalent of a 1 in 500 year rainfall event, and there is no requirement for additional discharge points, other than the licenced discharge points included in the Project Environmental Monitoring Procedure (refer AEIS Appendix H).

8.6 Summary of risk assessment

This section supplements the Project EIS Section 8.9 (risk assessment), where the risk assessment has also been provided. Project EIS Section 8.6 (potential impacts), Section 8.7 (mitigation measures), and Section 8.8 (monitoring, reporting and corrective actions) have also informed this supplementary section.

AEIS Appendix F (Dredging EMP) and AEIS Appendix G (Project EMP) provide a range of mitigation measures to reduce the potential water quality 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 8.4.

- Dredging EMP (refer AEIS Appendix F)
 - Water quality management plan (refer Section 9.10)
- Project EMP (refer AEIS Appendix G)
 - Water quality management plan (refer Section 8.10).

The implementation of mitigation measures provided in the abovementioned Project management plans will result in the water quality impacts and risks to human health and environmental values being generally assessed as low to medium (refer Table 8.5).

Table 8.5 Potential water quality impacts and risk assessment ratings

| Potential impact | Project activity | | | | | Preliminary HRG | | | Post mitigation HRG | | |
|---|--|----------|-------------------|----------------|-------------|-----------------|-------------|--------|---------------------|-------------|--------|
| | Reclamation area and BUF establishment | Dredging | Navigational aids | Demobilisation | Maintenance | Likelihood | Consequence | HRG | Likelihood | Consequence | HRG |
| Establishment of Western Basin Expansion reclamation area and BUF | | | | | | | | | | | |
| Increased turbidity and sedimentation in adjoining marine areas through construction of the bund walls and BUF | ✓ | | | | | Likely | Moderate | High | Unlikely | Moderate | Medium |
| Increased turbidity through changes in hydrodynamics | ✓ | | | | | Possible | Moderate | High | Possible | Low | Medium |
| Potential mobilisation of contaminants into the water column through construction of the bund wall and BUF | ✓ | | | | | Possible | Moderate | High | Unlikely | Moderate | Medium |
| Potential release of contaminants into the water column through construction operations (e.g. hydrocarbon spills) | ✓ | | | | | Unlikely | High | Medium | Rare | High | Medium |
| Changes to water quality from PASS lowering the pH | ✓ | | | | | Possible | Moderate | High | Unlikely | Moderate | Medium |
| Sedimentation within adjacent environments as a result of erosion within the reclamation area | ✓ | | | | | Possible | Low | Medium | Unlikely | Low | Low |
| Erosion and sedimentation in adjoining marine areas due to the establishment of the reclamation area and BUF | ✓ | | | | | Likely | Low | Medium | Likely | Low | Medium |
| Dredging activities and dewatering | | | | | | | | | | | |
| Increased turbidity and sedimentation; and potential mobilisation of contaminants through dredging operations and equipment | | ✓ | | | | Likely | High | High | Unlikely | High | Medium |
| Increased turbidity and potential mobilisation of contaminants through dewatering within the reclamation areas | | ✓ | | | | Likely | Moderate | High | Unlikely | Moderate | Medium |

| Potential impact | Project activity | | | | | Preliminary HRG | | | Post mitigation HRG | | |
|---|--|----------|-------------------|----------------|-------------|-----------------|-------------|--------|---------------------|-------------|--------|
| | Reclamation area and BUF establishment | Dredging | Navigational aids | Demobilisation | Maintenance | Likelihood | Consequence | HRG | Likelihood | Consequence | HRG |
| Changes to water quality from PASS lowering the pH | | ✓ | | | | Unlikely | Moderate | Medium | Unlikely | Low | Low |
| Sedimentation within adjacent environments as a result of erosion within the reclamation areas | | ✓ | | | | Possible | low | Medium | Unlikely | Low | Low |
| Introduction of contaminants and PASS from the dredged sediments into the reclamation areas | | ✓ | | | | Possible | Moderate | High | Unlikely | Moderate | Medium |
| Removal of existing navigational aids and installation of relocated and new navigational aids | | | | | | | | | | | |
| Localised, short term increases in turbidity | | | ✓ | | | Likely | Low | Medium | Unlikely | Low | Low |
| Potential release of contaminants into the water column | | | ✓ | | | Possible | Moderate | High | Unlikely | Moderate | Medium |
| Maintenance activities on the reclamation area | | | | | | | | | | | |
| Potential release of contaminants into the water column through maintenance activities (i.e. hydrocarbon spills) | | | | | ✓ | Possible | High | High | Unlikely | High | Medium |
| Contamination of surface water and/or groundwater due to spills from site compound storage of hydrocarbons and other potential contaminants | | | | | ✓ | Possible | High | High | Unlikely | High | Medium |
| Operation of the duplicated shipping channels | | | | | | | | | | | |
| Potential release of contaminants into the water column through shipping operations and vessel movements | | | | | ✓ | Possible | High | High | Unlikely | High | High |
| Permanent change in hydrodynamics due to duplicated channels | | | | | ✓ | Unlikely | Low | Low | Unlikely | Low | Low |
| Maintenance dredging | | | | | | | | | | | |
| Short term increases in turbidity | | ✓ | | | | | | High | | | High |