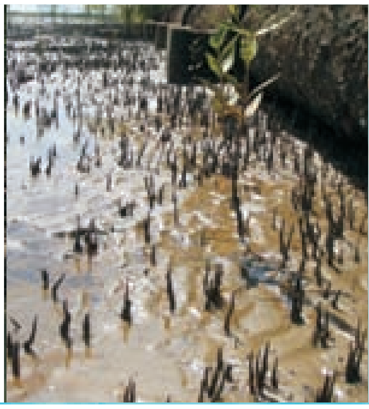
PORT of TOWNSVILLE


Townsville Marine Precinct Project

Environmental Impact Statement

GHD

August 2009

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Executive Summary

ES1 Introduction

The Port of Townsville (the Port) is a seaport located in Townsville, north Queensland. The Port is the third largest seaport in Queensland handling exports and imports including, but not limited to, mineral ores, fertiliser, sugar and motor vehicles. The Townsville region also supports a diverse marine fabrication industry and an expanding population base. The continued growth of residential development along Townsville's waterways has encroached upon existing industrial areas and restricted ability for expansion.

The proposed Townsville Marine Precinct Project (TMPP or the 'Precinct') seeks to provide a dedicated industrial marine precinct facility at the mouth of the Ross River in the Port of Townsville. The TMPP will address the existing and increasing demand for industrial marine facilities in the region by providing a sheltered, purpose-built precinct for the co-location of similar marine-dependant industries currently spread around Ross Creek and South Townsville.

The Precinct project has been discussed since the 1970's and in 2007 was identified as a key infrastructure component of the Townsville City-Port Strategic Plan (Department of Infrastructure, 2007). Ongoing expansion of this industry sector in Townsville provides a motivator for progression of the project to completion at this time. An additional catalyst for the development of the Precinct is the Department of Main Roads' Townsville Port Access Road (TPAR), which includes a low-level fixed bridge, 7 meters at Highest Astronomical Tide (HAT), across the Ross River. This bridge has a programmed date for closure of the last span of the bridge by 1 July 2011 and will impose height restricted access to existing upstream marine industrial facilities.

To facilitate construction of the dedicated marine precinct it is proposed to reclaim approximately 34 hectares of currently intertidal Strategic Port Land (SPL) located to the south-east of existing port operational facilities. Industrial facilities will then be constructed on this reclaimed land. A breakwater will be positioned offshore from the facility to protect it from incident wave activity (refer Figure ES1). In addition to land reclamation and breakwater construction, dredging activities will be required to realign the navigation channel and create an inner harbour and swing basin for the facility.

From the concept master plan and concept layout a Reference Design has been established for the TMPP. Desktop literature reviews, database searches and baseline field studies have been undertaken against this Reference Design to provide context to the assessment of impacts and identification of mitigation and management measures.

The Precinct Reference Design has been developed around a staged construction. The staged delivery allows for the progressive development of stages 2 and 3 of the Precinct as demand warrants, whilst allowing for the fast-tracked development of Stage 1 to cater for accommodation of required activities prior to the completion of the TPAR bridge construction. It is expected that Stage 2 will be completed by 30 June 2015 and stage 3 by December 2017.

The provision of a purpose-built facility with contemporary environmental controls will also provide an opportunity to remediate upstream lands that are vacated by industries relocating to the Precinct. These waterside sites would be proposed for redevelopment into mixed residential/commercial consistent with the Townsville City Plan.

LEGEND

- Marine Interface
- Channel Base
- Proposed Road and Rail Corridor
- Proposed Services Corridor
- Temporary Hardstand
- Marine Precinct
- Stage 3
- Open Hardstand
- Breakwater
- Innerwall
- Industrial Shed

1:10,000

0 50 100 150 200 250

Metres (at A4)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

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PORT of TOWNSVILLE

Port of Townsville
Marine Precinct EIS

Job Number	42-15399
Revision	A
Date	06 Feb 2009

Reference Design

Figure ES1

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Data source: Imagery (flown 2004) - NRW ©The State of Queensland (Department of Natural Resources and Water) November 2007. Proposed marine precinct - PoT ©The State of Queensland (Port of Townsville) 2008.

ES2 Benefits of Undertaking the Project

Industrial land with direct marine access is currently only available in Townsville at the Port of Townsville or at the currently occupied sites on Ross River and Ross Creek. To meet market demand there is a pressing need for the expansion of Townsville's marine services industry sector by catering for marine activities including shipbuilding, ship repair and commercial fishing. With the development of the TPAR restricting access and continued business opportunities for industries currently located on the Ross River, the Precinct is considered essential to support industrial marine services in the Townsville region.

The existing Ross River marine industry is estimated to contribute $113.0 million annually ($2009, including direct and flow-on activity) in output to the regions economy and $143.0 million annually to Queensland. During the construction phase it is estimated that the TMPP will result in the injection of approximately $95.0 million into the region and $109.1 million into the Queensland economy. The initial expenditure from the reclamation phase will primarily support construction and related professional service industries in the local and State economies, as well as the manufacturing sector through flow-on business activity.

The construction phase will also provide incomes in the form of wages and salaries that will encourage additional consumer expenditure and activity. Household income is estimated to increase by approximately $30.6 million in the region over the course of the construction phase with approximately $39.0 million additional income in Queensland. This expenditure is effectively all new expenditure in the economy that would not otherwise occur if the TMPP does not proceed.

The TMPP will eventually offer additional space for marine industry to expand and may offer an enhanced operating environment dependent on the final design and features. It is estimated that following the completion of the TMPP in 2018 there will be potential to grow the value added contribution of the existing Ross River marine sector by $9.0 million annually ($2009, including direct and flow-on activity) in the regional economy and $11.1 million annually in the Queensland economy. This would represent an increase of the existing Ross River marine industry's economic value-add in the region by 21% and employment by 24%.

Not undertaking the TMPP would see the State of Queensland and the regional economy forego these economic benefits. As a result of the TPAR restricting access to the Ross River, failure to develop an alternative industrial marine services facility could also result in loss of industry from Townsville and the region with resultant local impacts in the South Townsville community.

ES3 Reference Design Configuration

The Precinct facility Reference Design, adopted for EIS studies, includes an offshore breakwater, an inner harbour, vessel moorings and land area developed from reclamation on which sheds and other infrastructure are to be located, a dedicated trawler fleet base, pile moorings for recreational vessels and an offshore breakwater to protect the swing basin, pile moorings and quayline of the Precinct from waves (refer Figure ES1). The offshore breakwater allows future port expansion to the north and east of the existing Eastern Reclaim Area while providing protection from the predominant wave direction and minimising impacts on the mudflats to the east of Ross River.

The Reference Design caters for industries that are consistent with the requirements identified through demand analysis and consultation.

ES4 Construction Assessments

The required design configuration of the breakwater and quayline walls to enable reclamation works has been determined and preliminary design criteria have been established. The estimated volume of reclamation and protective rockworks for the Precinct development reference design is 922,000 m^3. This estimate takes into consideration the required dredge depths for the Precinct berths, swing basin and departure channel for safe operation and manoeuvring of the vessels that are expected to occupy the Precinct. It also considers an appropriate reference level for safe performance of the Precinct and breakwater over a 100 year life span in the face of potential climate change and sea level rise.

Reclamation for construction of the Precinct may utilise both mechanical (backhoe dredge) and hydraulic (cutter suction dredge) approaches to achieve the necessary reclamation works. Geotechnical investigations have determined that some of the material targeted for dredging is suitable for re-use for construction of the Precinct and some of the material is Potential Acid Sulfate Soils requiring either management for re-use or offshore disposal. Management opportunities to maximise re-use of this material have been considered and include treatment with lime and/or capping with clean fill. Further assessment of material prior to reclamation works may facilitate additional opportunities to re-use material for reclamation. Some material importation from terrestrial fill is expected to be required and this will be transported to site from quarries within the Townsville region by road.

The Precinct is expected to require piles, quaylines, jetties and vessel work berths. It is anticipated these will be constructed using a combination of land based and floating marine plant. Buildings required by the operators of the precinct facilities are expected to consist of maintenance sheds up to 6 storeys in height constructed predominantly from steel frame and metal cladding, and supported on raft or piled foundations.

Internal roads, pavements and hardstand areas are expected to be constructed from concrete or asphaltic pavement. Construction will involve levelling, importation and compaction of sub base material and placing and construction of the pavement wearing surface.

Construction of the Stage 1, Stage 2 and Stage 3 reclamation, protective rockworks and inner harbour navigation dredging will be conducted adjacent to but off the line of existing navigation channels and are not expected to cause interference to other operations. The construction methodologies have determined the most appropriate approach for minimising potential impact to the environment. This includes minimising need for ocean disposal of dredge spoil and addresses requirements for management of acid sulfate potential of onsite materials. Construction works will be undertaken in conformance with a Construction Management Plan prepared by the Developer and Contractor and specific to the construction procedures to be adopted for the works.

ES5 Operational Infrastructure Requirements

The operational usage of the Precinct is expected to include a combination of relocation and expansion of existing marine industries. Site services including power, water, sewerage, stormwater drainage and telecommunications will be provided to the proposed development. Detailed design of the Precinct will be required to refine the configuration to provide each industry lot within the Precinct appropriate access to site services and facilities.

There will be a need to manage the collection and containment of wastes derived from vessels berthed in the Precinct or moored in Ross River. This will include regulated wastes that will be generated by the Precinct users such as waste oils, chemical containers and sewage sludges. Regulated wastes require special disposal arrangements due to their hazardous or toxic nature. The likely wastes generated from the TMPP and recommendations for appropriate disposal are detailed in the EIS.

Existing access to the Project site is via Benwell Road, South Townville. It is expected that all road access to the Precinct for construction of Stage 1 will use this transport corridor. Following completion of the road link across the Ross River commercial and construction traffic access to the Precinct is expected to use the TPAR.

ES6 Environmental Values and Management of Impacts

ES6.1 Land Use, Landscape Character and Visual Amenity

The TMPP will be developed wholly within port limits and within the Ross River. The land based components of the project will be developed on reclaimed Strategic Port Land that has limited existing use other than for public recreation. The proposed works are consistent with the POTL Land Use Plan 1996. Redevelopment of vacated upstream industrial land will provide alternative opportunities for public access to the coast and other public facilities in addition to those being considered through the Precinct itself.

The project site is located within an area that has existing industrial development including both port and land based activities. The assessment of visual impacts to the landscape resulting from the TMPP construction is considered to be of moderate significance. While the ongoing industrial and port development diminishes the naturalness of the visual outlook in this sector of the visual landscape, this development also provides a unique landscape that combines the background of the mountains with the inter-tidal zone of Cleveland Bay and the Ross River.

ES6.2 Transport and Associated Infrastructure

The construction and operation of the Precinct and all other proposed developments in the vicinity of the Port of Townsville will result in an increase in traffic to and from this area of Townsville. The impact of traffic related directly to the construction and operation of the Precinct is not considered to be significant. Consideration does need to be given to upgrading a number of intersections in the area in future to enable continued acceptable access to the Precinct assuming an increased growth in background traffic in the area. This includes the Boundary Street / Saunders Street and Benwell Road / Archer Street intersections.

As Lot 773 is currently an intertidal marine sand/mud flat construction will not impact upon any existing infrastructure in this area. Infrastructure will need to be provided to the site across the Services Corridor. Detailed design of the Precinct will need to consider routing of this infrastructure within the footprint of the Precinct so as to not impact upon user access.

ES6.3 Climate and Climate Change

The Townsville region experiences a tropical climate with monsoonal rains and cyclones during summer months and dryer periods during winter months. The Precinct is not expected to contribute significantly to or impact upon predicted climate change for the region. Design of the Precinct facilities will need to take into consideration opportunities to minimise risks to proposed infrastructure from potential sea level changes or increased frequency of severe storms.

ES6.4 Surface and Groundwater Resources

Water quality in the area has been monitored during periods that included heavy rainfall to achieve understanding across a range of conditions. Generally water from adjacent land flows through the Precinct site to the ocean. Groundwater impacts from the Marine Precinct during construction reclamation works may include an increase in levels and the direction of flow until an equilibrium is reached. Alteration of natural surface water flow directions may also occur if land built barriers are constructed. Contamination of the watertable is also possible if wastes are not managed appropriately. Design approaches for the TMPP and the TPAR should take these matters into consideration and develop appropriate construction and impact management strategies to address the potential cumulative impacts upon these systems.

ES6.5 Coastal Environment

The coastal processes in the vicinity of the Precinct comprise both onshore/offshore and longshore components, which are influenced by the proposed breakwater structures. However, the natural processes are only capable of moving sediment at relatively slow rates due to the low wave climate and hence any changes will take time to develop and will be restricted to the local area. The projected impacts from the construction of the Precinct are restricted to an area around 500m south-east of the breakwater structures and the predicted effects on this area of coastline will not be compounded by parallel developments.

In addition, the existing Port development blocks any influence of coastal processes in the vicinity of the Precinct on the coastal areas north-west of the Port. The proposed Precinct will have no additional contributory effect causes of any existing coastal degradation to the west of the Port and hence will have no influence on the state of the beaches to the west in either the short or long term.

Hydrodynamic modelling shows little change in bed shear stresses for the proposed Precinct and navigation channels in the Ross River. With the development in place there is considered to be limited impacts on erosion or siltation in this region. Good flushing characteristics are maintained with only minor influences on existing circulation patterns.

The Ross River is highly regulated, with the Ross River Dam and several weirs in place. This provides a mitigated pattern of flood flows discharging from the Ross River past the Precinct into Cleveland Bay. Studies indicate that the combined influence of the TPAR and Precinct do not significantly affect the existing flood levels, with only minor impacts downstream of the Ross River Bridge (QDMR 2009). These predicted changes equate to only minor changes in erosional and depositional characteristics around the breakwater. These can be mitigated by design.

ES6.6 Water and Sediment Quality

Six months of monitoring across the project area and in reference areas, including during monsoonal rains, has provided an understanding of the sediment and water quality associated with the TMPP. The project area is recognised to be a naturally turbid system with suspended sediment loads being affected by wind and waves and influx of freshwater runoff during rainy periods. Nutrients in the area were also often observed elevated above guideline values. This suggests an input to the system from anthropogenic sources. Elevations were typically observed in monitoring locations up river of the Precinct site and a change in these observed levels may occur following relocation of industries to new facilities in the Precinct.

That values were observed above guidelines indicates that site specific parameters should be developed for any monitoring program implemented to provide the ability to manage potential construction water quality impacts. Ongoing monitoring of turbidity and nutrient levels during construction, and for a period post construction, provides opportunity to detect potential water quality declines related to dredging and other construction activities. Early detection may enable active management of these impacts prior to their affecting any sensitive ecosystem receptors, including seagrass meadows.

Other anthropogenic inputs to the system are considered minor. Some elevations of metals were detected during the monitoring program and dredging activities could result in remobilisation of any sediment bound contaminants compounding any increased turbidity impacts. Potential acid sulfate soils were also detected at over 70% of sites examined. This may affect the ability to re-use some of the material targeted for dredging for reclamation and construction activities. Management strategies to mitigate against potential impacts to water and sediment quality from disturbance of acid generating material include ocean disposal or treatment of potential acid generating material.

Given the naturally turbid state of the system and the approach of using a mechanical or cutter suction dredge, impacts on turbidity from dredging activities are expected to be minimal. Management of decant waters from any reclamation activities can be achieved to limit stresses on any sensitive ecosystem receptors including offshore seagrass meadows. Historical data indicates that offshore disposal has little direct or indirect impact upon adjacent sensitive habitats, which have persisted in Cleveland Bay during decades of dredge material disposal. Ocean disposal methods for the TMPP are not expected to affect seagrass or other benthic communities adjacent to the ocean disposal ground.

ES6.7 Terrestrial Ecology and Avifauna

The Precinct Project is expected to have very limited impacts on the terrestrial ecological values of the area in which it is located. The majority of the impacts comprise the removal of a small area (approximately 1.5 ha) of low integrity marine vegetation on the northern precinct site within the proposed TPAR Service Corridor. Species present in this location are well represented in adjacent environs on the east bank of the Ross River, which is to be preserved as part of a conservation area. This removal is, therefore, not expected to impact the regional ecosystem values of the Townsville area.

The eastern bank of the Ross River supports a diverse set of terrestrial assemblages including mangroves, sclerophyll woodland and minor areas of foredune vegetation. The areas investigated had a high level of weed incursion, with five species declared pests detected. This area is reserved for conservation purposes and no impacts to the site are expected from the TMPP.

The mud flat and sand bank seaward of the mangroves on the eastern bank of the Ross River provide a critically important wading and migratory bird roosting area of regional significance. This area is highly utlised by species protected under international conservation agreements and under the Nature Conservation Act and EPBC Act. Measures to mitigate against potential disturbance of this area to protect these birds from disturbance include disconnection of the proposed breakwater from land. This decreases the risk of the roosting site being accessed by terrestrial predatory pests (like cats) or experiencing increased disturbance from people. Adopting identified mitigation strategies should provide for no long term impacts upon these species.

A number of potential temporary impacts related to construction activities, such as dust and sedimentation impacts, are able to be mitigated using approaches including wetting and sealing of roads. These are not expected to impact upon the avifauna.

ES6.8 Aquatic Ecology including Megafauna

The Precinct project area supports a range of intertidal and subtidal soft sediment marine communities. Crabs, snails and worms were commonly found and no marine pests were detected. Seagrasses were found offshore of the Precinct and mangroves were also common fringing the waterways. Various commercially and recreationally targeted fish and crab species were found throughout the study area and none of these were restricted to the Lot 773 habitat. During seven months of monitoring turtles, dugongs, rays, sea snakes and dolphins were observed but none of these were shown to be exclusively using the Precinct footprint. By adopting proposed management measures, these species are not expected to be impacted by the construction or operation of the Precinct.

The TMPP will have a number of permanent impacts on the marine ecological values of the area in which it is located. The majority of the impacts involve the removal of the intertidal sand/mud flat on the western bank of the Ross River that forms the bulk of Lot 773 and the loss of seabed associated with the footprint of the breakwater. Temporary impacts are expected as a result of construction activities, including dredge plume impacts and noise impacts. Decline in species diversity, removal of species or reduced use of the area by mobile marine fauna may occur as a consequence of these potential impacts. Detailed assessment conducted under this study indicates losses associated with the TMPP are not expected to have flow on effects for the value of the marine ecosystems within the Townsville region.

The benthos that will be directly affected by construction of the Precinct is known to occur in other locations within the Townsville region including in other locations within the Port, Rowes Bay, Pallarenda and Magnetic Island. It is not considered to be a community or ecosystem of high value either in its own right or as a critical feeding ground for other, higher order, species. Removal of this type of seabed community for the TMPP is not expected to have a negative effect on the importance of the benthic marine habitats of the Townsville region. Nor it is anticipated to reduce biodiversity of the region significantly or affect the habitat utilisation patterns of marine megafauna within the area.

Development of the inner harbour of the Marine Precinct will provide future opportunity for some of the Lot 773 area to be recolonised with benthic taxa from adjacent environs like the mud flat. This may partially offset some of the habitat losses associated with direct removal. Creation of interstitial rocky shore habitat both intertidally and subtidally through provision of rock revetment walls of the Precinct and development of the breakwater may also partially offset some of the habitat losses associated with direct removal.

Megafauna other than rays, including turtles, dugong or dolphins, were not noted using Lot 773. Investigations indicated a lack of key food groups for these megafauna within the area, including, but not limited to, seagrasses. Seagrasses were found offshore of the mouth of Ross River, a finding consistent with that reported by Rasheed and Taylor (2008). There is potential for degraded water quality to impact these offshore meadows particularly if dredging activities for the TPAR, Berth 12 and Precinct coincide and produce a larger or more persistent plume than anticipated by any single activity. Mitigation and management strategies to address identified potential direct and indirect impacts include approaches for managing water quality impacts on seagrasses.

ES6.9 Air Quality and Greenhouse Gas Assessment

Modelling of air quality data of relevance to the TMPP indicates that construction related dust would not significantly impact on the amenity of sensitive receivers provided appropriate management procedures are implemented. These include, but are not limited to, watering of all exposed surfaces and sealing of access roads. Operational activities expected at the Precinct, including abrasive blasting and fuel storage, are not expected to have a significant impact on any nearby sensitive receivers. Developments on the site inconsistent with the Reference Design would need to go through individual assessment and planning approval on a case-by-case basis.

Greenhouse gas (GHG) sources from the existing site prior to development of the Precinct are primarily from dredging operations carried out by POTL for maintenance of the Ross River channel. Many of the facilities that will be located in the Precinct once completed are existing facilities currently located upstream of the Ross River. These facilities are, therefore, already contributing GHG emissions through their existing operations and, consequently, operational impacts on GHG emissions are expected to be minimal. Construction emissions may equate to approximately 0.01% of the annual emission profile for Queensland, however, mitigation opportunities to decrease this contribution include sourcing materials from nearby locations and maximising re-use potential.

ES6.10 Noise and Vibration Impacts

In situ monitoring and modelling of data have demonstrated that construction related noise and vibration from the TMPP will not significantly impact on the amenity of sensitive receivers provided appropriate management procedures are implemented. This includes adopting appropriate work hours for pile driving and management of potential for sleep disturbance of trawler occupants during staged construction. Potential for vibration impacts on marine fauna can be mitigated by using partial strikes as warning signals of pile driving activities.

ES6.11 Waste Management

The most significant wastes generated during the construction phase of the TMPP are likely to be excess spoil from earthworks and foundations, excess concrete and building material waste. Likely operational wastes include those directly associated with shipping and boating (e.g. wastes produced onboard) and those associated with the industrial operations of the marina (e.g. chemical wastes). Reuse of excess spoil, appropriate handling and discarding/recycling of solid and liquid wastes and other management options, including adoption of a waste minimisation strategy, is provided in the EIS.

ES6.12 Cultural Heritage

Indigenous and European heritage studies have been conducted for the footprint of the TMPP. Based on the available geomorphological, historical and environmental evidence the overall prehistoric archaeological potential of the development area is considered to be negligible. The project area does, however have significant Aboriginal cultural heritage values and is linked to adjacent European heritage sites of importance. Although direct impacts from the proposed development are unlikely there is potential for indirect impacts to identified places of cultural importance. The environmental harm to Indigenous cultural heritage values in the vicinity of the project is to be managed under the cultural heritage management plan developed specifically for the project in consultation with relevant parties.

ES6.13 Health and Safety

The main community values for public health and safety that may be affected by the construction, operations and decommissioning of the TMPP are air quality and noise levels. The implementation of workplace health and safety procedures and the management plans, which are identified in the EIS, will minimise the potential risks to acceptable levels.

ES6.14 Cumulative Impacts

The TMPP is not considered to make a significant contribution to cumulative impacts associated with wider strategic policy such as greenhouse gas emissions, regional resource consumption and waste disposal. The ability to upgrade some operational industrial facilities through relocation to the new Precinct in fact provides opportunity to achieve some reductions in existing cumulative impacts, such as to GHG emission or water quality impacts. A number of potential cumulative impacts have, however, been identified. The most significant area where cumulative impacts are likely from concurrent or successive project development within the port precinct in Townsville relate to the marine environment. The TPAR construction is expected to commence prior to the Precinct construction and there may be overlap in construction activities. These projects, and others that may undertake dredging and disposal activities and in water construction need to consider the potential cumulative impacts identified in this EIS and adopt appropriate mitigation strategies.

ES7 Social Values and Management of Impacts

The population and demographics of South Townsville is not expected to change significantly as a result of the construction or operation phases of the TMPP. The marine industries and businesses operating up river from the proposed TPAR that become untenable as a result of the restricted water access to the Ross River are expected to relocate to the TMPP. Consequently the TMPP is viewed positively by these industries and businesses. However, concern has been registered relating to the potential negative impacts to business resulting from development timing and relocation arrangements.

If the existing marine businesses do not relocate and are forced to close there is expected to be a flow on effect into South Townsville in relation to essential services such as schools and retail providers. A decrease in demand could lead to closure or relocation out of the suburb, to the detriment of the people currently using those services, especially the elderly.

Staged development of the Precinct provides opportunity to meet affected industry space needs prior to bridge closure impacting upon those businesses. The resultant construction workforce and employment opportunities in the TMPP will provide flow-on benefits to South Townsville, rather than negative impacts.

The other major concern beyond relocation timing for the Precinct and impacts to business relates to the development of the beach adjacent to Benwell Road and the perceived loss of public access to the coast and potential for environmental harm from the development. If redevelopment of vacated upstream land occurs, it is envisaged that it will be required to meet the planning objectives for the South Townsville Precinct as identified in the Townsville City Plan. Specific recreation and public access opportunities are planned in the redeveloped upstream lands (e.g. boardwalks, fishing or viewing platforms, food outlets) that should enhance, rather than detract from, the character of the suburb and these will provide alternative recreation opportunities to those that currently exist for Lot 773.

Construction of the Precinct will not affect the existing use of Ross River by recreational boat users. It may in fact have a small beneficial effect by extending the calm water environment further seaward once the TMPP is constructed. Configuration of the Precinct, including the breakwater footprint, has considered the potential for environmental impact and been optimised to mitigate against potential impacts.

ES8 Economic Impacts

It is estimated that the TMPP will result in the injection of approximately $95.0 million into the regional economy and $109.1 million into the Queensland economy during the construction phase of the project. The operational phase of the development is predicted to contribute marine industry worth $43.3 million in Gross Regional Product to the regional economy per year (in $2009) and directly or indirectly account for preservation of 504 jobs. Additionally, there is potential for further expansion following the completion of Stage 3 with the potential to grow to an additional contribution of $6.4 million to the regional economy per year and account for an additional 121 direct and indirect jobs. Whilst a significant portion of this business is expected to be redirected from elsewhere in Queensland, some may represent new business to the State, or business that may have otherwise been lost to other States or overseas.

The TMPP has the potential to provide better quality facilities for existing marine businesses if they relocate from the Ross River. Of the identified benefits of the new facility the potential to develop new services/access new markets has been assessed as potentially of high impact level.

It is unlikely that there would be a significant change in the level of Government expenditure due to the development during the construction phase. However, the loss of all the existing marine industry on Ross River would displace an estimated 504 direct and indirect FTE jobs.

The site on which the TMPP will be established has little alternative economic uses. The opportunity cost of proceeding with the project is represented by the ecosystems services of the area, valued as approximately $757,960 (in $2009), and any social values of the area that may be lost (refer ES7). Current cost estimates for relocating a number of upstream industries to equivalent facilities within the Precinct, summed across all of these industries, totalled approximately $AUD43 million.

There are three main opportunity costs identified in not proceeding with the TMPP given that the TPAR bridge will proceed. These are:

- An estimated $113.0 million per annum ($2009) in direct and indirect output from the existing Ross River marine industry. This would be the immediate opportunity cost of not proceeding with the TMPP and relocating the existing Ross River marine industry;
- An estimated up to $140.8 million per annum ($2009) in direct and indirect output from the TMPP once all three stages are completed (post 2018-19). This would be the long term annual opportunity cost of not proceeding with TMPP; and

- An estimated one-off $128.7 million ($2009) over 9 years (2009-2018) in direct and indirect output from the construction activities associated with the development of the TMPP and upstream residential redevelopment.

Key mitigatory strategies for the economic impacts resulting from the development of the TMPP relate to the management of impacts on the existing Ross River marine industry. POTL is in continued negotiations and planning for strategies to manage the impact on the Ross River marine industry.

ES9 Hazard and Risk Assessment

A detailed Hazard and Risk assessment has identified the nature and scale of hazards that may occur during the design and construction, operation and decommissioning of the Project. High risks identified for the TMPP include dredging impacts, strain on existing infrastructure, member/s of public entering the site intentionally to cause harm, increased traffic, disturbance of potential acid sulfate soils, vessel collision and tropical cyclone related hazards. Opportunities to manage these potential risks, and others identified, include development of a suitable Dredging Management Plan, liaison with local government regarding infrastructure upgrade requirements, development of an acid sulfate soil management plan and an Emergency Management Plan to deal with situations related to intruders, vessel collision and tropical cyclones.

Based on the assessments conducted it can be concluded that there are no hazards which have offsite impacts. The controls identified for the TMPP construction and operation will adequately safeguard against safety, asset and environmental consequences from hazards associated with the TMPP.

ES10 Matters of National Environmental Significance

ES10.1 Impacts on World Heritage Properties: Habitat Loss of the GBRWHA

The operational areas of the port are excluded from the Great Barrier Reef Marine Park, however, the World Heritage Area extends to mean low water mark along the coast. The TMPP will consequently occur wholly within the GBRWHA. Direct, indirect, permanent and temporary impacts on the benthic marine systems within the GBRWHA are expected from construction and operation of the TMPP. The majority of the impacts involve the removal of the intertidal sand/mud flat on the western bank of the Ross River that forms Lot 773 and the loss of seabed associated with the footprint of the breakwater. Temporary impacts expected as a result of construction activities include dredge plume impacts and noise impacts. Potential impacts and appropriate mitigation measures associated with construction and operation of the Precinct include provision of new benthic habitat as a result of construction of the Precinct and use of dredge and waste management approaches to reduce potential for indirect impacts. Under the identified mitigation measures the Precinct is not expected to have significant impact on the marine ecological values of the Townsville region.

ES10.2 Impacts on National Heritage Places

There are no places of national heritage significance within the project site or the immediate adjoining area. Nine places of state or regional heritage significance are adjacent to the project site but will not be negatively impacted by the TMPP.

ES10.3 Wetlands of International Importance

The Bowling Green Bay Ramsar wetland area is located approximately 10 km southeast of Townsville. Because of the considerable distance from the Ramsar wetland to the project area and the very localised nature of potential impacts from the TMPP it is not considered possible that the TMPP will impact this area.

ES10.4 Listed Threatened Species and Communities and Migratory Species

Avifauna

Five threatened terrestrial bird species listed as protected matters under the EPBC Act were identified as potentially occurring within the project area. However, none of these species were identified during the field survey. The TMPP is not expected to impact upon these listed threatened species.

Wading and migratory shorebirds are known to use the project area and the adjacent environs. The regionally important habitat for these species is considered to be adjacent to the footprint of the project area being the sand and mud banks to the east of Lot 773. This area is highly utlised by species protected under international conservation agreements and under the Nature Conservation Act and EPBC Act. Measures to mitigate against potential disturbance of the environs adjacent to Lot 773 to protect these species from disturbance include disconnection of the proposed breakwater from land. This decreases the risk of the roosting area being accessed by terrestrial predatory pest species or experiencing increased visitation, and hence disturbance, of the area by people. Adopting identified mitigation strategies should provide for no long term impacts upon these species.

Turtles and Reptiles

Terrestrial reptiles are not expected to be impacted by the TMPP. Studies have clearly shown that the habitat is unlikely to support Listed Threatened species and the identified Migratory species are highly mobile and are not likely to be effected by removal of the terrestrial habitat associated with this project.

The project area is not considered to be critical habitat for marine reptiles, however, it adjoins Cleveland Bay which is recognised as an important foraging habitat for green turtles. Potential direct and indirect impacts to marine turtles resulting from the TMPP include vessel strike, lighting concerns and decreased water quality. Mitigation measures against these potential impacts have been identified and are provided under this EIS. The TMPP is not expected to impact upon turtles in the Townsville region if these measures are adopted.

Mammals

Two threatened terrestrial mammal species, the spectacled flying fox and false water rat, are identified as potentially occurring within the study area. Neither species were observed during field surveys, however habitat suitable for each species is represented within the study area. Although the project site does contain habitat appropriate for these species it is unlikely to serve as an important resource and it is considered highly unlikely that this project will impact on this species.

Humpback whales (*Megaptera novaengliae)* generally occur in offshore areas and are observed off Magnetic Island. Given the inshore location of the TMPP and the shallow waters of the area (<10m) it is unlikely that the project will have any affect on this species. Similarly, killer whales are uncommon in the project area and unlikely to be impacted by the project.

Dugong, dolphin and turtle prevalence and habitat utilisation studies have been compared to previously collected data to provide an understanding of the spatial and temporal use of the Precinct area by migratory marine mammals. Based on the findings of that assessment the construction of the TMPP is not expected to impact marine megafauna species, either in terms of direct impacts to important habitat, or disruption of transit routes between patches. The operational phase of the Precinct may alter vessel traffic at the Ross River mouth, however, significant increases in traffic are not anticipated and an increased potential for vessel strike is not likely. Potential impacts and mitigation measures to marine mammals were assessed and are summarise above.

Sharks

The whale shark has been identified as potentially occurring within the region although no records of presence have been recorded. The project is not predicted to affect this species as they are widespread and migratory and the inshore location of the TMPP is not considered favourable habitat for this species.

ES11 Environmental Management Measures

An environmental management plan has been developed for the Project, which outlines specific actions and measures, designed to mitigate potential impacts identified through the environmental assessment process. The environmental management plan is implemented in addition to existing management policies and regulations. Several detailed monitoring studies are also proposed to be undertaken in order to assess potential impact and to provide an indication of the longer-term impacts associated with the Project and recovery of impacted areas. These studies will include (but are not limited to):

- Marine Water Quality Monitoring
  - Suspended sediment concentrations as part of a turbidity monitoring program;
  - At sensitive habitats for compliance to site specific water quality objectives;
  - Reclamation tailwater decant water quality;
  - Potential impacts of dredging on seagrass communities; and
  - The construction operations reporting incidents likely to cause environmental harm to the project location and surrounding areas.
- Marine Habitats and Megafauna
  - Monitor the health of adjacent seagrass communities as indicators of water quality impacts and to act as an indicator for potential impacts to marine megafauna;
  - Temporal and spatial persistence of meadows to existing baseline data should be assessed; and
  - Consideration be given to ongoing marine megafauna monitoring to assess any influence on habitat utilisation of threatened and listed species. If marine fauna are sighted during dredging activities the dredge should avoid moving into that area if capture or strike is likely.
- Noise
  - Log any received complaints regarding noise; and

- Upon receipt of a noise complaint where required undertake monitoring within 3 to 5 working days. If exceedances are detected, the source should be investigated and equipment and operational procedures reviewed to identify means of reducing noise to acceptable levels.

- Air Quality
  - Regularly undertake visual inspections of working areas and access tracks to monitor dust levels;
  - Note visible observations of dust moving off-site; especially during dry and/or windy weather;
  - Conduct daily audit of mitigation equipment and dryness of exposed surfaces;
  - Use dust deposition gauges in front of representative residences if construction activity is likely to be within 500 m for more than 30 days (considered unlikely); and.
  - Make available a free-call number for public complaints and information.

The principal impacts of concern associated with the proposed works are in relation to marine fauna and flora and water quality. Effective mechanisms are in place to manage potential impacts on marine fauna and the studies identified above will assist in the monitoring of predicted impacts on marine flora. However, the most effective mitigation measure identified to manage potential impacts is to minimise the period of works.

ES12 Conclusions

The TMPP involves the construction of an industrial marine precinct on intertidal land to the south-east of existing Port operations. This EIA study has investigated potential environmental impacts, including social, economic and cultural impacts that could result from the construction and operation of the Precinct. Consideration has been given to the need and alternatives of the project. Desktop literature reviews, database searches and baseline field studies have been undertaken to provide context to the assessment of impacts and identification of mitigation and management measures.

Within this study construction and operational impacts, including potential cumulative impacts, have been identified and mitigation and management strategies described for a range of environmental values including nature conservation, social, economic and cultural values.

No impacts considered to be significant were identified that could not be ameliorated. Some habitat losses are expected, however, these can be offset. Under the mitigation strategies identified for each of the environmental values assessed the TMPP is not expected to have any significant long term effects on the regional or local environmental values of the Townsville region or Ross River environ. Importantly the TMPP is not predicted to impact upon protected species including dolphins, dugongs, turtles and birds. Economic benefits to the region accrue if the project proceeds and the project mitigates potentially significant negative impact of other development in the region.

Glossary of Terms

PORT of TOWNSVILLE
Nexus North Queensland

Glossary of Terms

Townsville Marine Precinct Project
Environmental Impact Statement

GHD

Glossary of Terms

AASS	Actual Acid Sulfate Soils
ABS	Australian Bureau of Statistics
ACH Act	Aboriginal Cultural Heritage Act 2003
AHD	Australian Height Datum
ANC	Acid Neutralising Capacity
ASS	Acid Sulfate Soils
ASSMP	Acid Sulfate Soils Management Plan
BoM	Bureau of Meterology
BSS	Bed Shear Stress
CAMBA	China-Australia Migratory Bird Agreement
CBD	Central Business District
CEMP	Construction Environmental Management Plan (for the Precinct)
CFISH	Commercial Fisheries Information System
CHRIS	Coastal Habitat Resources Information System
CLR	Contaminated Land Register
Coastal Act	Coastal Protection and Management Act 1995
CG	Coordinator-General
dB	Decibel
DEEDI (formerly DPI&F)	Department of Employment, Economic Development and Innovation Queensland Primary Industries and Fisheries
DERM (formerly EPA)	Department of Natural Resources and Environment (formerly Environmental Protection Agency (Qld))
DERM (formerly NRW)	Department of Natural Resources and Environment (formerly Department of Natural Resources and Water)
DES (formerly QAS)	Department of Emergency Services (formerly Queensland Ambulance Service)
DES (formerly QFRS)	Department of Emergency Services (formerly Queensland Fire and Rescue Services)
DES (formerly SES)	Department of Emergency Services (formerly State Emergency Service)
DEWHA	Department of Environment, Water Heritage and the Arts (Federal)
DIP	Department of Infrastructure and Planning
DO	Dissolved Oxygen
DOIW	Directory of Important Wetlands
DTRDI	Department of Tourism, Regional Development and Industry

EIA	Environmental Impact Assessment
EIL	Environmental Investigation Levels
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Environmental Management System
EP Act	Environmental Protection Act 1994
EPBCA	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
ERA	Environmentally Relevant Activity
FHA	Fish Habitat Area
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GBRWHA	Great Barrier Reek World Heritage Area
GED	General Environmental Duty
GHG	Greenhouse Gas
GIS	Geographic Information System
ha	hectares
HAT	Highest Astronomical Tide
HSE	Health, safety and environment
IAS	Initial Advice Statement for this EIS
IDAS	Integrated Development Assessment System
IPA	Integrated Planning Act 1997
ISQG	Interim Sediment Quality Guidelines
JAMBA	Japan-Australia Migratory Bird Agreement
JSA	Job Safety Analysis
km	kilometres
km/h	kilometres per hour
Land Act	Land Act 1994
LAT	Lowest Astronomical Tide
LGA	Local Government Area
LOR	Limit of Reporting
LOS	Level of Service
LW	sound power levels
m	metres
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
MARPOL	International Convention for the Prevention of Pollution from Ships

MSDS	Material Safety Data Sheet
MSL	Mean Sea Level
NCA	Nature Conservation Act 1992
NES	National Environmental Significance
NTU	Nephelometric Turbidity Units
OEMP	Operational Environmental Management Plan (for the Precinct)
ORP	Oxidation Reduction Potential
PAH	Polycyclic Aromatic Hydrocarbons
PASS	Potential Acid Sulfate Soils
PCB	Polychlorinated Biphenyl
pH_{KCL}	pH of the soil before oxidation (laboratory)
pH_F	field pH (laboratory)
pH_{FOX}	field pH following oxidation with peroxide (laboratory)
PHA	Preliminary Hazard Analysis
PM10	Respirable particulate matter
PNCG	Planning for Noise Control Guideline 2004
PNL	Planning Noise Level
PoT	Port of Townsville
POTL	Port of Townsville Limited
PPE	Personal Protective Equipment
ppm	Parts per million (by volume)
Precinct	Townsville Marine Precinct Project
PQL	Practical Quantification Limit
QA	Quality Assurance
QAS	Queensland Ambulance Service
QASSIT	Queensland Acid Sulfate Soil Investigation Team
QFRS	Queensland Fire and Rescue Service
QGEOP	Queensland Government Environmental Offsets Policy
QWQG	Queensland Water Quality Guidelines
RE	Regional Ecosystem
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SCBA	Self Contained Breathing Apparatus
SDPWOA	State Development and Public Works Act 1971 (Qld)
SED	State Electoral Division
SES	State Emergency Services
SPL	Strategic Port Land

SS	Suspended Solids
State Coastal Plan	State Coastal Management Plan – Queensland's Coastal Policy
TAA	Tritratable actual acidity (mol H^+/tonne)
TBT	Tributyltin
TDS	Total Dissolved Solids
The Port	The Port of Townsville
ToR	Terms of Reference for this EIS
TMPP	Townsville Marine Precinct Project
TPAR	Department of Main Roads' Townsville Port Access Road
TPALUP	Townsville Port Authority Land Use Plan (1996)
TPH	Total Petroleum Hydrocarbon
TRBOC	Townsville Region Bird Observation and Conservation Australia
TSS	Total Suspended Solids
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VMA	Vegetation Management Act 1999
Waste EPP	Environmental Protection (Waste Management) Policy 2000

This information and a statement regarding copyright of maps that appear in this document are provided as Appendix A of this document.

A tracking table of how this documents structure aligns with the Terms of Reference for this EIS (ToR) is also provided in Appendix A.

PORT of TOWNSVILLE

North Queensland

Section 1
Introduction

Townsville Marine Precinct Project

Environmental Impact Statement

1. Introduction

1.1 Project proponent

The Port of Townsville Limited (POTL) is the proponent for the commercial marine precinct project (known as the Townsville Marine Precinct Project or the “Project”). POTL is a government owned corporation and a port authority under the *Transport Infrastructure Act 1994*. POTL is responsible for managing and developing the Port of Townsville.

POTL has commissioned GHD Pty Ltd to prepare the Environmental Impact Statement (EIS) for the Townsville Marine Precinct Project (TMPP).

1.2 Project description

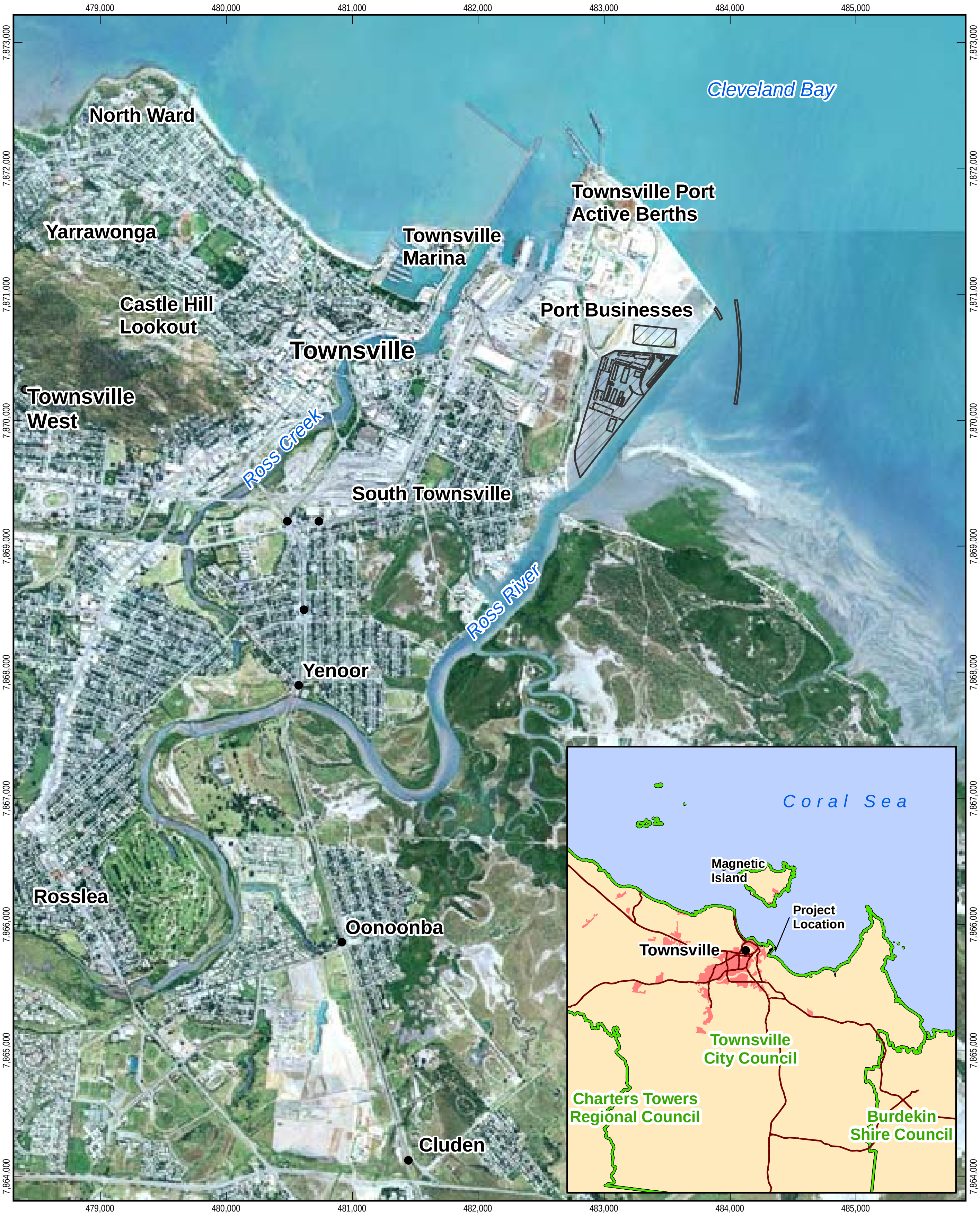
The Port of Townsville (the Port) is a seaport located in Townsville, north Queensland (Figure 1-1). The Port is the third largest seaport in Queensland handling exports and imports including, but not limited to, mineral ores, fertiliser, sugar and motor vehicles.

The Townsville Marine Precinct Project (TMPP or the ‘Precinct’) is proposed to be located on intertidal land to the south-east of existing Port operations. The Precinct seeks to provide a dedicated industrial marine precinct facility at the mouth of the Ross River in the Port of Townsville.

The TMPP will address the ongoing and increasing demand for industrial marine facilities in the region by providing a sheltered, purpose-built precinct for the co-location of similar marine-dependant industries and public facilities currently spread around Ross Creek and South Townsville.

Facilities to be provided within the industrial precinct are detailed in Section 2; in brief these may include:

- Marine industry allotments including maritime infrastructure and vessel fabrication;
- Berth facilities including for 50 trawlers, scientific and tourism vessels, provisioning activities, refuelling and for commercial and recreational users;
- Commercial and recreational chandlery;
- Defence force marine activities, including vessel maintenance
- Seafood industry cold storage and distribution facility;
- Small scale eateries to service industry within Precinct;
- Marine industry training facilities;
- Public and recreational use facilities including provision for 40 pile moorings and a recreational marina.



LEGEND

- Locality
- Major Road
- Proposed Marine Precinct and Breakwater Option
- Local Government Area
- Builtup Area

1:40,000 (at A4)

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number 42-15399
Revision A
Date 01 July 2009

Townsville Port

Figure 1-1

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

 Created by: T Hatfield

To provide the dedicated marine precinct facility it is proposed to reclaim approximately 34 hectares of currently intertidal Strategic Port Land (SPL) located to the south-east of existing port operational facilities. Industrial facilities will then be constructed on this reclaimed land. A breakwater will be positioned offshore from the facility to protect it from incident wave activity (Figure 1-2). In addition to needs for land reclamation and breakwater construction, dredging activities will be required to create an inner harbour and swing basin for the facility.

The project has been discussed since the 1970's and in 2007 was identified as a key infrastructure component of the Townsville City-Port Strategic Plan (Department of Infrastructure, 2007). The provision of a new facility to which existing marine industries from around Ross Creek and South Townsville could relocate may trigger redevelopment of the sites vacated by these industries, which are identified in the plan and on Figure 1-3.

The proponent has estimated that the capital expenditure required to deliver the project will range between $100 million to $150 million and that it will employ approximately 500-550 people (Peron 2008, Section 5).

The construction workforce is estimated at approximately 318 direct and 162 indirect employees, including the marketing and construction workforce for redevelopment of upstream vacated sites (refer Section 5). In the economic assessment undertaken for this EIS AEC*group* has calculated that the existing Ross River marine industry currently contributes $113 million annually into the Northern Statistical Division (SD) and $143 million annually into Queensland's economy including direct and flow-on activity (in 2009 dollars). They further estimate that after completion there is the potential to grow the sector by $9 million annually in the SD.

1.3 Project objectives and scope

1.3.1 Objectives and scope

Townsville region is experiencing continued growth. This has resulted in encroachment of residential development on Townsville's waterways and limited ability for existing industrial facilities occupying facilities in Ross River and Ross Creek to expand.

To facilitate continued delivery of industrial marine services in the Townsville region and provide opportunity for expansion potential of existing industries there is a current need to provide a dedicated marine industrial facility to co-locate and consolidate marine-dependent industries. An additional catalyst for the development of the Precinct is the Department of Main Roads' Townsville Port Access Road (TPAR), which includes a low-level fixed bridge, 7m at Highest Astronomical Tide (HAT), across the Ross River. This bridge has a programmed construction date of completion of December 2011 and will impose height restricted access to existing upstream marine industrial facilities mid 2011.

LEGEND

Proposed Marine Precinct
- Stage 1
- Stage 2
- Stage 3

- Shed
- Maintenance (Open Hardstand)
- Industrial Shed
- Barge Berth
- Fuel Berth
- Marine Infrastructure
- Ramp
- Shed - Stage 3
- Potential Temp. Hardstand Site
- Unloading Berth
- Trawler/Commercial Berth
- Work Berths
- Breakwater Option C (Preferred)
- Min and Max Option

1:10,000 (at A4)

0 50 100 150 200 250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number	42-15399
Revision	A
Date	01 July 2009

Marine Precinct and
Breakwater Reference Design

Figure 1-2

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia T +61 7 3316 4496 F +61 7 3316 333 E bnemail@ghd.com.au W www.ghd.com.au

Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management). Created by: TH

1	Australian Defence Force Ten Terminal Regiment	5	Curtain Brothers	9	Sunferries
2	Ross River Marina, commercial trawler fleet and NQ Marine Fresh Seafoods	6	Townsville Water Police	10	Curtain Bros.
		7	Harbourside Coldstores	11	Riverside Marine (Magnetic Is. Car Ferry)
3	Rosshaven Marine	8	Riverside Marine	12	Regional Harbour Master, Townsville MSB
4	Pacific Marine Group				

1:15,000 (at A4)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number 42-15399
Revision A
Date 01 July 2009

Existing Marine Industries Adjacent to the Precinct Development Site

Figure 1-3

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Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management). Created by: TH

Key objectives for the Marine Precinct are, therefore, to:

- Co-locate compatible activities in Townsville;
- Increase capacity to service the existing commercial marine activities in the region;
- Grow the local marine industry through the development of a dedicated industrial marine precinct;
- Cater for the industrial marine services that will be required with the anticipated growth in boating in the region;
- Achieve higher standards of marine industry operating practice;
- Provide opportunities to increase competition within the Marine Precinct;
- Deliver a solution that provides an alternative location opportunity for industries currently located elsewhere that may be effected by the TPAR project; and
- Create opportunities to redevelop any Port land vacated by industries that choose to locate within the Precinct facility.

The Environmental Impact Assessment (EIA) that has been undertaken is for the TMPP and has been prepared by GHD Pty Ltd for the POTL. A Terms of Reference (ToR) for this EIA has been developed based on the outcomes of the Initial Advice Statement (IAS), the requirements of relevant government agencies and submissions from stakeholders and the community.

POTL is undertaking a parallel process to that conducted for this EIA to engage a proponent to undertake development and operation of the Marine Precinct. A Reference Design, described in detail in Section 2, has been developed in consultation with developer groups through POTL to facilitate conduct of this EIA. To meet timing needs for development of industrial facilities to service industries effected by the impending TPAR bridge closure the reference design has been developed with staged construction. This is described below.

1.3.2 Staging

The detailed staged development concept for the Marine Precinct has been developed in accordance with the Demand Analysis undertaken as part of the Feasibility Study (Peron Group 2008). This staged delivery allows for the progressive development of the Precinct as demand warrants, whilst allowing for the fast tracked development of Stage 1 to cater for accommodation of required activities prior to the TPAR bridge construction completion in December 2011 (Peron Group 2008) prior to closure of the last span of the TPAR bridge mid 2011.

The development method of all stages of the Marine Precinct will include construction of bunds and rock revetment and the importation of fill from terrestrial sources or the reclamation of material from dredging activities. In brief, studies have assessed material to be dredged for construction processes is potentially unsuitable for reclamation works and contains potential acid sulfate soils.

Stage 1

Due to the construction schedule of the TPAR Bridge crossing and subsequent access restrictions for upstream activities, issues surrounding the continuation of vessel servicing and fishing fleet activities in Townsville need to be addressed. The Stage 1 concept has been developed to accommodate these activities, essential to the marine industry in the Townsville region, by incorporating the specific functional requirements of these activities in a fast tracked development scenario able to be constructed by the bridge completion date.

To achieve continuous operation of marine industry activities in the Townsville region during the period of TPAR bridge completion, Stage 1 development of the Precinct will support the following capabilities:

- 50 berths, capable of accommodating a fishing trawler up to 15m long;
- Loading, unloading and provisioning wharf for a minimum of 10 vessels;
- Provisioning, sullage and refuelling docks for both recreational and commercial users (minimum of two vessels);
- Maritime fabrication of at least 2 hectares that may be initially located on a temporary hardstand area (on land previously reclaimed by POTL) with access to barge loading facilities;
- Barge berthing facility plus a vehicle ramp;
- General purpose berthing wharf or jetty of 80m; and
- Commercial/larger vessel straddle carrier or travel lift of at least 180t capacity plus hardstand, offices and work sheds.

Stage 1 of the Marine Precinct is expected to be in place and operational by 30 June 2011.

Stage 2

Stage 2 of the concept plan encompasses the reclamation of approximately 12 hectares of land to cater for further marine industries surrounding a seven hectare inner harbour and the progressive development of vessel maintenance and industrial buildings and in-water work berths. In conjunction with development of the industrial Precinct infrastructure there is potential for development of an offshore breakwater to protect the external quayline of the Precinct facility from incident wave action.

This stage of works aligns with anticipated demand growth, utilisation trends and revenue projections (Peron Group 2008). Activities permitted within the facility include:

- Maritime infrastructure fabrication;
- Commercial and recreational vessel construction and maintenance (land-based);
- Work berths within a safe all weather harbour area;
- Commercial and recreational chandlery;
- Tourist vessel berthing;
- Scientific vessel berthing;
- Defence force marine activities, including naval vessel maintenance;
- Seafood industry cold storage and distribution;
- Small scale eateries to service industry within the Marine Precinct;

- Marine industry training facilities;
- Heavy vessel slip or lift;
- Floating dock;
- Recreational boat dry stack storage (covered or uncovered) with associated lift out facilities;
- Recreational marina to accommodate vessels up to maximum 25 metres length; and
- Boat sales.

It is envisaged that Stage 2 will be progressively developed with completion by 30 June 2015, by which time all work areas will be fully utilised with capital injection timed to coincide with market demand (Peron Group 2008).

Stage 3

The Strategic Port Land (SPL) identified for location of the Precinct (Lot 773 of EP2211) encompasses an area of land of approximately 32 hectares of tidal sand/mud flats. The areas to be developed in Stages 1 and 2 do not propose to fully reclaim the site in its entirety. An area of approximately 10 hectares forms Stage 3.

Any further development works for Stage 3 will depend upon market demand and utilisation rates of existing developed areas. It is proposed that the developer will reclaim and construct the necessary usable areas for Stage 3 of the development as the market demands (Peron Group 2008). This activity will be progressive following on from Stage 1 and 2 developments. Industries and uses of Stage 3 will be compatible with the Precinct and relevant planning requirements. It is expected that Stage 3 development will be completed by December 2017.

Redevelopment of Vacated Upstream Lands

The provision of a purpose-built facility with contemporary environmental controls will also allow for remediation of any upstream lands that are subsequently vacated. These waterside sites would be proposed for redevelopment into mixed residential / commercial consistent with the Townsville City Plan.

1.4 Project need, costs and benefits

1.4.1 Overview

This section describes the justification for the project including its strategic, economic, environmental and social implications and its technical feasibility and commercial viability. The status of the project is discussed in a regional, state and national context. The project's compatibility with relevant policy and regulatory frameworks is also described.

This section summarises:

- The economic costs and benefits of the project to businesses and the wider community, including employment and spin-off business development;
- Social costs and benefits, including community disruption, related land use changes, employment, skills development and any workforce accommodation issues; and
- Increased demand for natural resources.

1.4.2 Justification

The concept of a dedicated marine industrial precinct facility located in the mouth of Ross River has been discussed since the 1970's. The previously considered alternatives are described below in Section 1.5. Since the Precinct was first envisaged new environmental management and marine park legislation have been gazetted and trade and commercial activities in Townsville have grown considerably.

The Townsville City-Port Strategic Plan 2007 revisited need for a marine precinct facility dedicated to Townsville's heavy marine industries and small boating facilities. The Plan also indicated the facility should address pressing need for expansion of Townsville's marine services industry sector by catering for marine activities including shipbuilding, ship repair, commercial fishing, small boat ramps and marine search and rescue services. A necessary element was considered to be a breakwater on the eastern bank opposite the precinct to shelter a number of protected pile moorings for small to moderate sized vessels. With development of the TPAR the Precinct was considered essential for continued capability of providing industrial marine services in the Townsville region.

As noted under Section 1.3.2 the TPAR bridge closure is programmed for mid 2011. This provides impetus for development of a facility to cater for industries and vessels affected by that development. In response the POTL commissioned an assessment of financial, social and environmental impacts of the proposed development to inform the feasibility of the development (Peron Group 2008). This study provided a number of conclusions and recommendations that demonstrated positive benefits to the region, including:

- Potential for economic growth by providing new opportunities for business expansion;
- Potential for job creation through construction and operation of the facility;
- Potential for development of dedicated recreational facilities, including marinas and boat ramps;
- Amelioration of potential social and economic impacts resulting from restricted access to the Ross River by vessels due to the TPAR development;
- Amelioration of potential social impacts resulting from conflicting land uses as residential developments expand to occupy water ways adjacent to existing commercial industry facilities; and
- Reduction of potential for environmental harm by co-locating disaggregated industrial facilities into a modern facility with best practice environmental management infrastructure.

The Precinct was considered to be technically feasible, commercially viable, and in accordance with state and local planning objectives for the Townsville region (Peron Group 2008). On this basis POTL has proceeded with the current studies.

In its current proposed form, the Precinct facility proposes consolidation of slipways, vessel maintenance facilities and associated marine service industries that are currently scattered around South Townsville and Ross Creek (refer Figure 1-3).

There is a pressing need to either upgrade or relocate the older facilities, many of which are now situated in inner city and residential areas as the city has grown, and provide capacity for new marine-related activities. A new purpose-built facility will provide an opportunity to co-locate similar marine-dependent industries in the one place and will enable the provision of best practice environmental management infrastructure (GHD 2008).

Because these industries are no longer compatible with inner city residential lifestyles, the potential for conflict between land uses will only increase the longer they remain in the old locations. The region's economic growth extends from its diversified economy. Townsville is the most populated centre in north Queensland and the administrative centre for the region.

POTL may justify capital investment in the proposed development on the basis that the following benefits could be derived:

- Provision of a marine precinct sheltered from prevailing waves where commercial marine activities in Townsville can be consolidated;
- Provision of an area in Ross River for relocation of the existing trawler fleet which is required to occur prior to completion of the bridge linking the Port Access Road to Townsville Port;
- Restriction of westward longshore sediment transport into the navigation channel and subsequent reduction in the requirement to dredge in the longer term;
- Consideration of provision of mooring areas for vessels currently on buoy and pile moorings in Ross River; and
- Consideration of provision of recreational facilities, potentially including boat ramps and parking.

The provision of a purpose-built facility with contemporary environmental controls will also allow for remediation of any upstream lands that are subsequently vacated. Following vacation of this area by commercial operators (and their associated vessels) the on-water environment is expected to be quieter upstream of the bridge. These waterside sites would be proposed for redevelopment into mixed residential / commercial consistent with the Townsville City Plan.

1.4.3 Relationships to other projects

The Project does not directly relate to any other actions being undertaken by the POTL. However, the Project is associated with the Department of Main Roads project (TPAR) for a low-level fixed bridge of 7 m at Highest Astronomical Tide (HAT) across the Ross River, which has a programmed construction of its 'last span' by July 2011. The timeline of the TMPP has been brought forward by the construction of this bridge. The resultant access restrictions imposed on the existing commercial marine activities on Ross River has hastened the requirement for the development of a Precinct to cater for existing industry needs and to provide for the realisation of potential Port growth and further Townsville's status as the North Queensland economic gateway (Peron Group 2008).

A number of other coastal developments are being undertaken in the Townsville region concurrently. These include:

- Investigations related to the Townsville Port Expansion (POTL);
- Development of the Townsville Ocean Terminal (City Pacific Ltd); and
- Development and expansion of Berths 12 ,10 and 8 within the Townsville Port (POTL).

None of these projects is directly related to the Precinct project in regard to construction and development processes. However, there is potential for cumulative environmental impacts to the region resulting from concurrent developments. Any cumulative impacts of relevance to the Precinct have been addressed under the relevant sections of this report.

1.5 Alternatives to the project

1.5.1 Previously considered alternatives

Investigations into the potential for a Marine Precinct in this location have been documented since 1977 when a fishing boat haven development was proposed in the mouth of Ross River to provide:

- An anchorage enclosed by rock breakwaters on three sides (crest RL +4.5 m), with an entrance located to protect the anchorage from prevailing weather;
- Moorings for up to 50 boats of up to 30 m in length at mooring jetties; and
- Service wharf, fuelling pontoon and slipways, with substantial adjacent land area for service buildings.

In 1995 a concept design for a small boat harbour in the mouth of Ross River was developed for the Townsville Port Authority (now POTL; Paterson 1995) and in 1999 a study was undertaken of the minimum development options required to realise a commercial marina development on Ross River (SKM 1999).

Through the Townsville Port Authority's planning review for rationalising the utilisation of Port land and the adjacent waterways the need was continuously recognised for a dedicated marina facility located within the mouth of Ross River on the Strategic Port Land (SPL) currently proposed for development. In 2003 a revised and updated concept plan for a marine precinct was produced (Figure 1-4).

To reflect the needs of the region the 2003 Townsville Marine Port Precinct was proposed to include a slipway, commercial fleet and support maritime industries, concepts that persist to the current proposed development. The concept plan also illustrated the changed and/or new development proposals across a range of Port Lands, including that areas up Ross River currently utilised for commercial purposes be redeveloped into residential lands.

In 2006 the notion of a dedicated marina facility in the mouth of Ross River was revisited in a Prefeasibility Study (Maunsell 2006) that considered viability of the development with inclusion of slipways, barge ramps, ship-lifts, docking and associated mooring facilities, workshop facilities, water and fuel services. Protection of the facility from wind and passing boat wash was to be achieved through construction of a breakwater on the eastern bank of the Ross River that included:

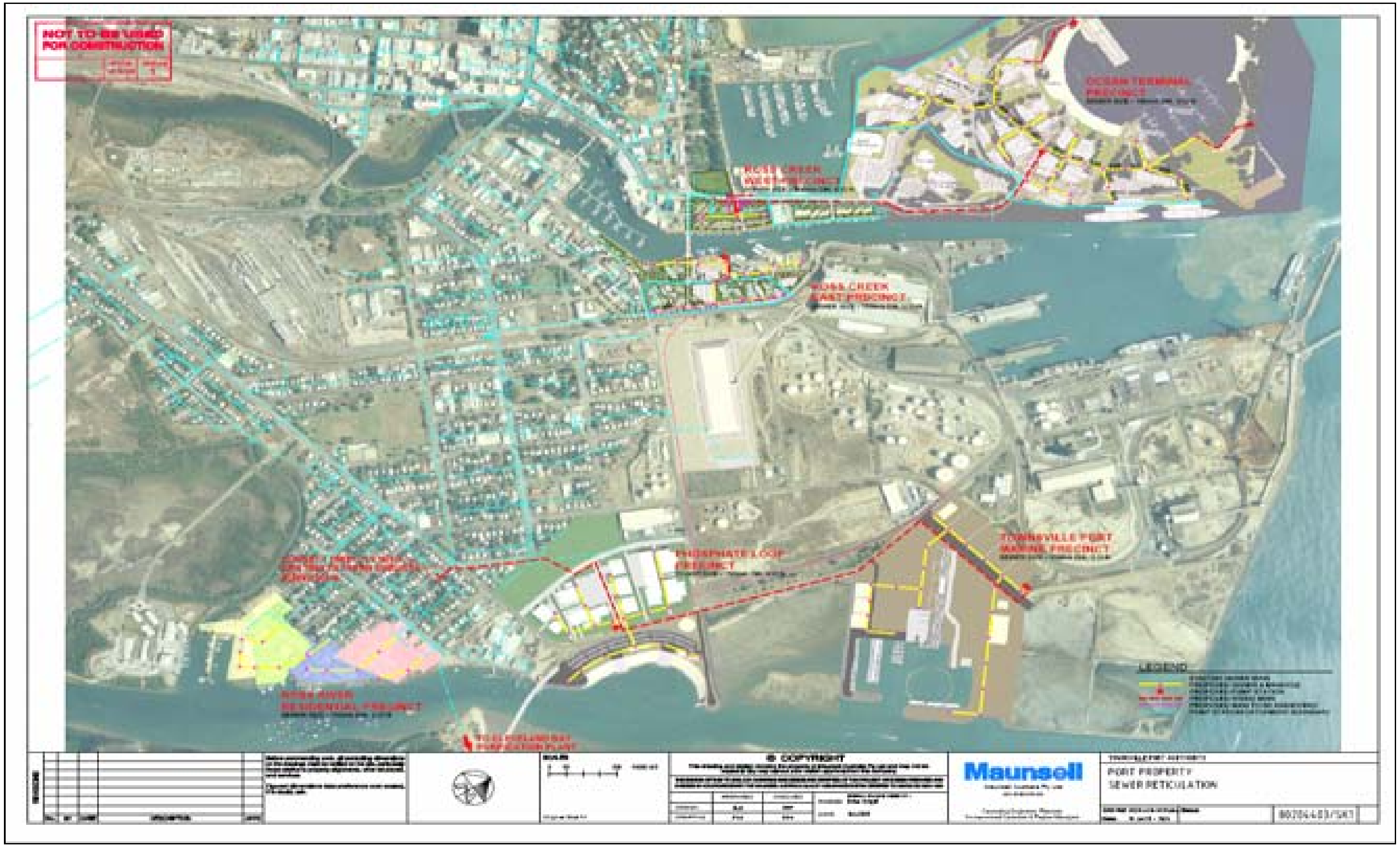
- A northern return to minimise long wave action and afford greater protection;
- A stub-wall at the midpoint to protect the relocated private moorings from long or refractive wave action;
- A stub-wall arrangement at the marina entrance to provide protection to the trawler fleet and other marina users; and

- Connection to the proposed bridge abutment.

The proposed Precinct configuration from this study formed the basis for the concept design provided in the IAS for the present study (refer Appendix B). This Precinct concept was recognised in the 2007 Townsville City-Port Strategic Plan as a facility that should be dedicated to Townsville's heavy marine industries and small boating facilities, and to cater for marine activities including shipbuilding, ship repair, commercial fishing, small boat ramps and marine search and rescue services. A necessary element was considered to be a breakwater on the eastern bank opposite the precinct to shelter a number of protected pile moorings for small to moderate sized vessels. With development of the TPAR the Precinct was considered essential for continued capability of providing industrial marine services in the Townsville region.

In its current form, the Precinct facility proposes consolidation of slipways, vessel maintenance facilities and associated marine service industries that are currently scattered around South Townsville and Ross Creek (refer Figure 1-3). As noted above a new purpose built facility will provide an opportunity to co-locate similar marine dependent industries and enable the provision of best practice environmental management infrastructure.

Figure 1-4 2003 Townsville Marine Port Precinct Concept Plan (reproduced from Maunsell 2003 with permission from POTL)



1.5.2 The ‘do nothing’ case

The ‘do nothing’ option increases the potential for social and environmental conflict between land uses. Many of these marine industries are no longer compatible with inner city residential lifestyles and the potential for conflict between land uses will only increase the longer they remain in the old locations. Requirements for more stringent environmental management will continue to increase, which may require some existing industries to upgrade their current facilities to continue to meet environmental controls.

Further, closure of the river access to large vessels resulting from the completion of the bridge will restrict operational capability of existing upstream industries given the expected bridge height restrictions of 6m operational height above HAT. In the extreme this could result in closure of some upriver businesses. This was identified during the assessment of social impacts of the TMPP, through the course of this EIS study (refer Section 4). It was noted that Ross River marine industries and businesses could likely be forced to either close or relocate to other areas within the region if they are not able to occupy the TMPP. Potential for relocation opportunities within Townsville were considered low. As such, under the ‘do nothing’ option negative impacts on the business and economy of the Townsville region could be expected as a result of direct impacts upon existing Ross River marine industries and businesses that will be effected by the TPAR. Indirectly, this closure could likely have flow-on impacts to local stores, public bars and hotels, maritime equipment suppliers and seafood outlets and potentially schools, given that any family relocation would effect school numbers and potentially staffing within those schools. The Townsville area would, therefore, have a notable negative economic impact resulting from both direct and indirect effects as a consequence of not proceeding with the development of the Precinct despite the completion of the TPAR. This finding is further supported by economic assessments completed during the course of this EIS (refer Section 5).

Alternatives to the location of a public boat ramp were considered in the report SKM 1988 Public boat Ramps North Queensland: Strategic Plan Volumes 1 and 2. Recommendations in the report include upgrades to existing boat ramps in the area and consideration of a new recreational boat ramp location on the leeward side of Kissing Point, a location likely to involve much greater environmental impact than the proposed project location, including potential impact on the Kissing Point Fort, which is listed on the National Heritage Register.

The Precinct is being developed to cater for the needs of commercial marine industries in Townsville and to provide some opportunity for expansion of those industries. Although initial concept plans for a commercial marine precinct in this location indicated the likely incorporation of public boat ramps and parking bays it has become apparent through EIS and other investigations that inclusion of those public facilities in the proposed TMPP could compromise the viability of the TMPP as a commercial marine precinct. The Strategic Port Land identified for location of the Precinct and anticipated need for industrial facilities does not provide adequate land for the recreational boat ramps and parking currently required to address the immediate shortfall in Townsville (estimated to be approximately 20 lanes) without compromising the needs of the commercial marine industries, for whom the Precinct is being developed. Reduction of commercial industrial infrastructure to allow for inclusion of recreational facilities would affect the economic growth ability of the facility and may result in conflicting land uses within the area by co-locating industrial and recreational activities.

In addition, potential development timing for the Precinct, with Stage 1 prioritised and Stage 3 potentially not completed until 2017, timelines for construction of any recreational facilities would not address immediate needs for additional boat ramps in the Townsville region.

The Port of Townsville is committed to participating, with Townsville City Council and Queensland Transport, in a broader examination of potential boat ramp sites in the Townsville region. An initial options analysis, which identified 12 potential sites including a site adjacent to the proposed TMPP, was completed in February 2009. Further investigation of 3-4 of those sites will be undertaken in coming months towards a solution for boat ramp location in the Townsville region. Environmental findings from this study are supporting that process.

Alternatives to the configuration and location of the breakwater were presented in the Feasibility Study and ToR. For this study GHD has undertaken a Breakwater Options assessment, which included an assessment of a 'no breakwater' option. A description of that assessment follows.

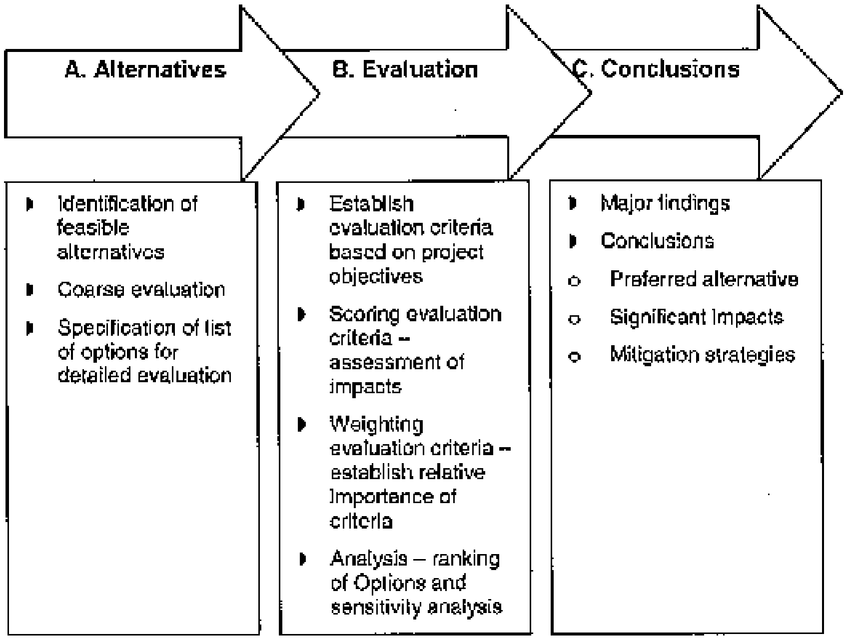
1.5.3 Breakwater Options

1.5.3.1 Overview

Investigation of breakwater options for the Precinct was achieved through a breakwater options assessment undertaken by GHD early in the EIS process. The assessment was comparative across breakwater configuration options, including a no breakwater case, using subjective criteria and rating of potential impacts. The primary aim of the assessment was to select a preferred breakwater configuration that represents the best solution after consideration of the project imperatives of operational, commercial, social and environmental impacts. Selection of a single case provided opportunity for that case to be subject to a rigorous assessment during the course of the EIS studies.

The methodology used in the evaluation was drawn from a multi-criteria assessment (MCA) framework. This framework was used to establish preferences between design options by reference to an explicit set of project objectives. The extent to which the project objectives are achieved by each design option was established by assessing the options against measurable criteria. An overview of the evaluation framework that was used to analyse the options is outlined in Figure 1-5.

Figure 1-5 Breakwater Options Evaluation Methodology



1.5.3.2 Breakwater Options Assessed

Six options were identified in workshops as potentially viable and relevant for assessment in order to select a preferred configuration option. These options included:

- Options identified in the Terms of Reference (ToR)
  - Max - ToR Max Option [Refer ToR Option 1: Longer more distant breakwater option]
  - Min - ToR Min Option [Refer ToR Option 2: Shorter, closer breakwater option]
- No breakwater option
  - No Breakwater - continuous quay line option
- Intermediate refinement of the ToR options
  - Option A – refinement of ToR Option 1 to reduce footprint
  - Option B – Refinement of ToR Option 2 to reduce footprint
  - Option C – hybrid of Options A and B

Each of the breakwater configurations was assessed and considered in conjunction with a continuous quay line reclamation for the purposes of options assessment. Schematics showing the layout of each of the options are provided as Figure 1-6 to Figure 1-11.

Figure 1-6 Max - TOR Max Option [Ref TOR Option 1: Longer more distant breakwater option]

** Reproduced from Admiralty Chart AUS256, Copyright Commonwealth of Australia, user license number 2475SB*

Option **Max** is characterised by extensive breakwater protection offshore, extending beyond the existing Eastern Reclaim Are

Option **Max** is characterised by extensive breakwater protection offshore, extending beyond the existing Eastern Reclaim Area and to the east of the Marine Precinct development. The option isolates a large expanse of water and the mud flats within the breakwater and provides an obstacle to littoral transport from the beaches to the East of the development.

Figure 1-7 Min - TOR Min Option [Ref TOR Option 2: Shorter, closer breakwater option]

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Option **Min** is characterised by breakwater protection extending alongside the Marine Precinct reclamation with a partial return just beyond the seaward extent of lot 773. The option isolates the Ross River navigation channel from the mud flats to the east and provides an obstacle to littoral transport from the beaches to the East of the development.

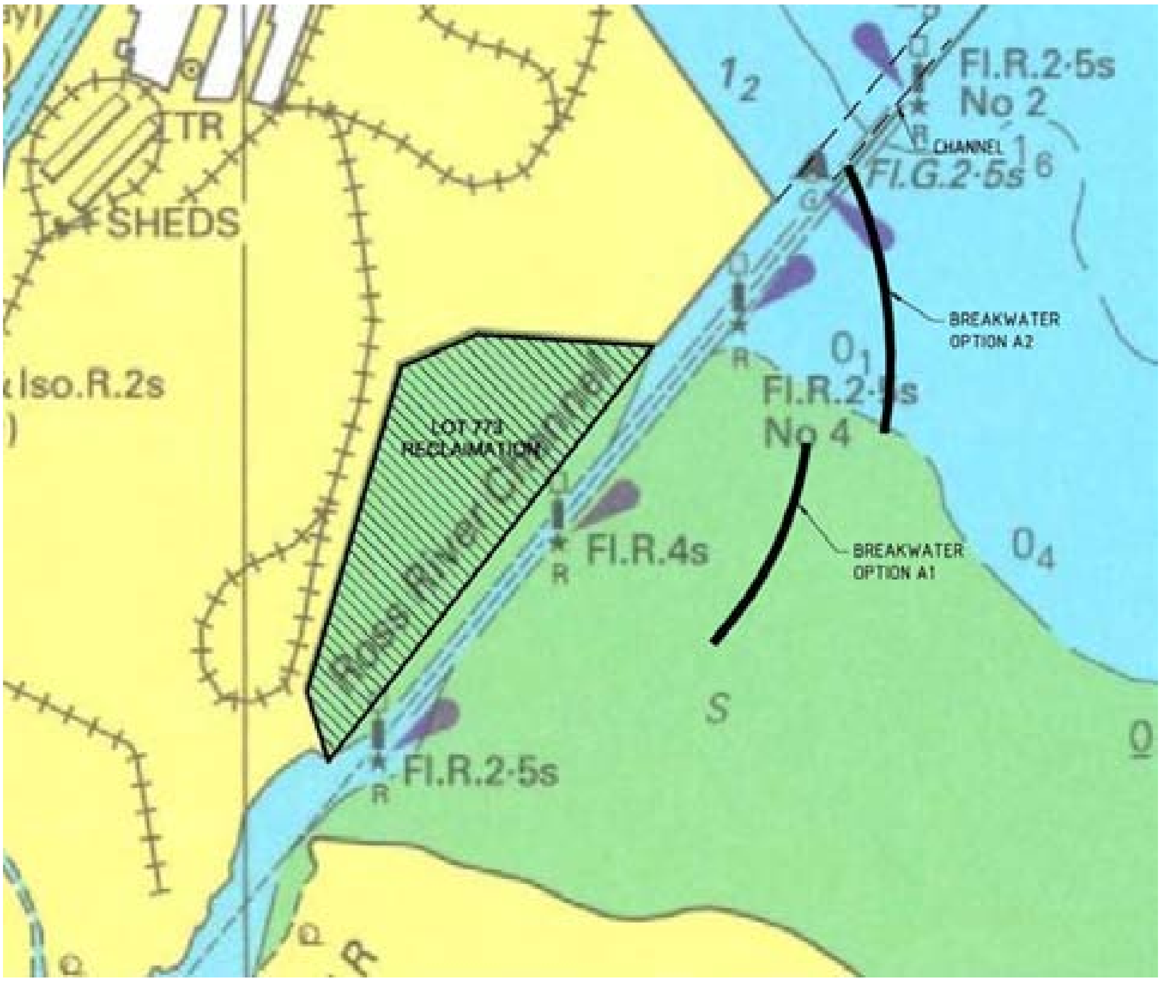
Figure 1-8 No Breakwater - continuous quayline option

** Reproduced from Admiralty Chart AUS256, Copyright Commonwealth of Australia, user license number 2475SB*

Option **No Breakwater – continuous quayline** is an option which provides a maximum area of reclaimed land within the Precinct area. This option requires the external quayline to be utilised as the “working” face for marine industries within the precinct. The precinct reclamation configuration provided by this configuration has been adopted as the base case for the reclamation configuration in all of the breakwater options assessed.

Figure 1-9 Option A – refinement of TOR Option 1 to reduce footprint

** Reproduced from Admiralty Chart AUS256, Copyright Commonwealth of Australia, user license number 2475SB*



Option A is characterised by extensive breakwater protection offshore, extending beyond the existing Eastern Reclaim Area and to the east of the Marine Precinct development. The option was selected as a refinement of TOR option Max and features a split breakwater resulting in a reduced extent of rockworks and reduced isolation / containment of flows, whilst theoretically maintaining equivalent protection from waves and littoral transport. Option A was assessed in 2 configurations, requiring a refinement during wave modelling to improve performance.

Figure 1-10 Option B – Refinement of TOR Option 2 to reduce footprint

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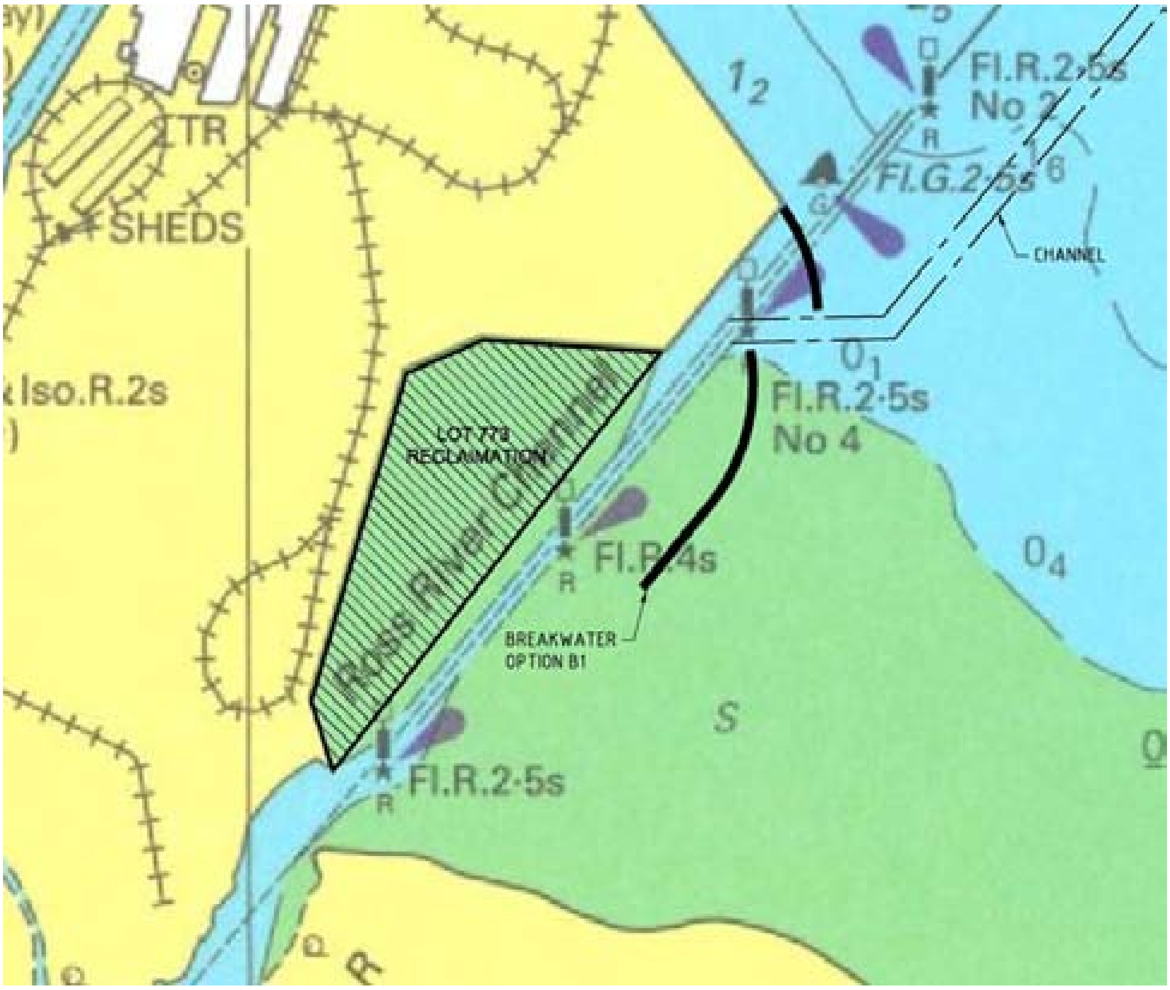


Option B is characterised by breakwater protection extending alongside the Marine Precinct reclamation lot 773 with an additional breakwater extension adjacent the end of the Eastern Reclaim Area. The option was selected as a refinement of TOR option Min and features a split breakwater providing additional protection from the predominant wave direction and reducing the impact on the mudflats to the east of Ross River.

Figure 1-11 Option C – hybrid of Options A and B

** Reproduced from Admiralty Chart AUS256, Copyright Commonwealth of Australia, user license number 2475SB*

Option C is a hybrid option developed subsequent to the initial ratings workshops and is characterised by a short breakwater extension adjacent the end of the Eastern Reclaim Area and an offshore section to seaward of the Eastern Reclaim Area. The option features a split breakwater, facilitating future port expansion to the north and east of the existing Eastern Reclaim Area, providing protection from the predominant wave direction and minimising impacts on the mudflats to the east of Ross River.

1.5.3.3 Assessed criteria

Criteria were developed in a workshop with POTL to consider the operational, commercial, social and environmental impacts relevant to the project. The criteria adopted for the assessment are shown in Table 1-1 and described in detail below.

Table 1-1 Criteria used for the Breakwater Options Assessment

Capex	Length of Breakwaters Capital Dredging
Operational Performance	Wave Agitation Shelter during Storms Flushing and Water Quality Navigation Safety Future Port Expansion Maintenance Dredging Provision of Swing Basin
Construction	Construction Method Duration of Construction
Social Impacts	Visual Amenity Cultural Heritage Fishing
Environmental Impacts	Mega Fauna Habitat Impact Marine Flora Issues Wading Bird Habitat Influence on Longshore Drift Dredging Plumes

1.5.3.4 Capex

A measure of the cost of breakwater options was assessed by comparing the length of protective rock structures required. To accommodate the differing effects of wave exposure (either direct attack or angled attack effecting crest height and rock size) and varying water depths a comparative assessment was also made on breakwater civil volumes.

The volume of capital dredging required to establish navigation channels, swing basins and remove potentially unsuitable material underneath breakwater structures was assessed as a measure of capital cost to implement the project. The assessment does not consider common volumes required to develop the marine precinct reclamation.

1.5.3.5 Operational Performance

Provision of shelter during storms and operating wave climate and has been assessed against the Australian Code AS/NZS3962. The classifications for operating wave climate nominated by this code are wave heights to be exceeded once a year;

Moderate = 0.375 m

Good = 0.3 m

Excellent = 0.225 m

An assessment of the operating wave climate has been carried out by modelling the wave penetration under a 1 yr return interval wave case.

The flushing characteristic of the area contained by the breakwater footprint was comparatively assessed against the existing performance (no breakwater/Precinct) through hydrodynamic modelling of the retention time of a conservative constituent.

Navigation safety was subjectively assessed by an experienced mariner, considering required ship manoeuvres, predominant current, wind and wave directions and the provisions for and ramifications of error.

POTL has indicated a future expansion planned to extend the existing Eastern Reclaim Area to the north. An assessment of the implications of this future expansion on the infrastructure and navigational ramifications of the Marine Precinct development was undertaken from the perspective of whether the proposed configuration may constrain or impact upon this future expansion.

A comparative assessment of siltation potential was undertaken by hydrodynamic modelling of bed shear stress impacts as a result of development of the various options. An increase in bed shear stress was taken to indicate an increase in scouring potential and a reduction in the potential to accrete silt. An assessment of each configuration was then made considering localised accretion zones, scour of the navigation channel as well as potential to block potential littoral sources from beaches to the east of the development.

The geometric constraints imposed by configuration of the breakwater options was assessed from the perspective of limitation to vessel manoeuvring and swinging.

1.5.3.6 Construction

An assessment of the dominant form of construction required to establish the breakwater options was incorporated in order to encompass the potential risk, cost and downtime contingencies inherent in offshore works.

An estimate of the duration of construction was determined for the construction of the various breakwaters. For comparison purposes, the analysis adopted transport of armour rock breakwater core material and under footprint replacement material as the principal time constraint. The comparison of construction times was based on the total estimated volume of rock and core material required to be transported to the site

1.5.3.7 Social Impacts

Visual amenity was assessed based on a subjective assessment of the degree of interference with the view toward Cleveland Point from the Benwell Road intersection. This location currently provides the public access point for activities undertaken on Lot 773 and would, therefore, be the perspective from which social impacts were detectable.

The potential to impact cultural heritage sites has been assessed on the basis of infrastructure footprint impact on the mudflats and beach system to the east of Ross River and the degree of increased public access that may be afforded to this area after the construction of the breakwater option.

The positive or negative potential impacts to public access for the purposes of commercial, recreational and indigenous fishing, crabbing and bait sourcing activities was subjectively determined based on the infrastructure footprint impact on the mudflats and beach system to the east of Ross River and the degree of increased public access that may be afforded to this area after the construction of the breakwater option.

1.5.3.8 Environmental impacts

Impact on mega fauna was assessed relative to impacts to the nearshore shallow mudflat area to the east of Ross River. Impacts from construction of the Precinct on Lot 773 are non-differentiating for breakwater configuration and are assessed under the EIS. Footprint impact, division of the habitat by structures and significant changes to the flow regime potentially impacting accretion or scour of the habitat were assessed.

Impact on marine flora was assessed based on impacts to the potential seagrass meadows and coastal mangrove communities located adjacent to and to the north and east of the eastern reclaim area. Footprint impact, division of the habitat by structures (fragmentation) and significant changes to the flow regime potentially impacting accretion or scour of the habitat were assessed.

Impact on wading bird habitat was assessed for the exposed mudflat area to the east of Ross River. Both footprint impact, access by the public and significant changes to the flow regime potentially impacting accretion or scour of the habitat were assessed.

The influence of longshore drift has been assessed by the blocking potential of the structure and the control requirements or opportunities provided by the structures forming part of the development.

An assessment of the control measures or opportunities provided by the structural constraints afforded by the development were assessed from the perspective of impact on the control and management of dredging plumes.

1.5.3.9 Non-differentiating criteria

The assessment workshop proposed and discarded a significant number of criteria as either irrelevant to the selection of the preferred option or as non-differentiating criteria (criteria for which a tangible difference could not be determined for various options).

Non-differentiating criteria considered but not progressed to rating and weighting for the development options included:

- Loss of marine invertebrates;
- Loss of marine vertebrate (non megafauna) biodiversity;
- Wind tranquillity;
- Pile moorings;
- Access to the foreshore area to the east of Ross River; and
- Beach usage activities (including ability to walk dogs).

These criteria were therefore not considered through this process; impacts are being assessed elsewhere in the EIS.

1.5.3.10 Criteria Weighting

Criteria Weighting was undertaken by assessing the relative importance of the scores across the criteria utilising a pair wise comparison where, for each pair of assessment criteria, a more/less important criteria was established leading to a weighting of relative importance for each criterion.

To complete the analysis a weighted average of scores for each of the options over each of the criteria was determined to establish an overall score for the option. The highest scoring options are regarded to be the most suitable and a preferred option has been selected on this basis.

The weighting process was undertaken by representatives of the POTL and GHD with the following focus groups:

- POTL Operations, Environmental, Project / Commercial; and
- GHD Engineering/Operational, Environmental.

A summary of the mean weighting and criteria weighting ranges is provided below in Table 1-2.

Table 1-2 Criteria Weighting

Criteria	Mean Weighting [%]	Range [%]		
Length of Breakwaters	4.4	2	-	8
Capital Dredging	4.3	2	-	7
Wave Agitation	9.0	6	-	11
Shelter during Storms	7.7	3	-	9
Flushing and Water Quality	8.3	7	-	9
Navigation Safety	10.9	10	-	11
Future Port Expansion	6.6	4	-	10
Maintenance Dredging	4.7	1	-	6
Provision of Swing Basin	5.3	2	-	9
Construction Method	3.6	1	-	6
Duration of Construction	4.1	2	-	8

Criteria	Mean Weighting [%]	Range [%]
Length of Breakwaters	4.4	2 - 8
Capital Dredging	4.3	2 - 7
Visual Amenity	2.0	1 - 4
Cultural Heritage	4.0	1 - 6
Fishing	0.7	0 - 2
Mega Fauna Habitat Impact	6.0	4 - 8
Marine Flora Issues	5.4	2 - 8
Wading Bird Habitat	5.7	3 - 9
Influence on Longshore Drift	3.9	1 - 6
Dredging Plumes	3.9	0 - 6

1.5.3.11 Preferred Option

Options comparison was undertaken by each of the representatives across the performance criteria to establish a preferred option as well as a mean weighting of the criteria across the groups.

The various performance levels were allocated a weighting of:

- Fatal flaw = -10;
- Significant impact requiring significant control measures = 0;
- Non-significant impact able to mitigated = 1; and
- No expected impact = 1.5.

The options were compared utilising a weighted average of scores for each of the options over each of the criteria. The process determined an overall score for the option. The highest scoring options are regarded to be the most suitable and a preferred option has been selected on this basis.

The options scores are tabulated below.

Option Max		Min	No Breakwater	Option A	Option B	Option C
Mean Score	71.4	-94.6	-63	83.6	88.4	118.1
Max Score	82.5	-39.5	-11	94	95	120.5
Min Score	62.5	-114	-87	70	77	113

The preferred breakwater option identified is Option C.

This option was selected as the preferred option unanimously across the various criteria weighting provided by each of the representatives of POTL and GHD.

A discussion of the advantages and disadvantages of the preferred option (Option C) are provided below under each of the assessment criteria.

Criteria		Advantages and Disadvantages of Option C
Capex	Length of Breakwaters	Option C provides the shortest breakwater of the configurations assessed although rock volumes are slightly greater than option B due to water depths for the offshore protection structure.
	Capital Dredging	Dredging requirements to establish the swing basin and navigation channels are relatively consistent across the options assessed and most of the options including option C fall within the range of 250,000 – 300,000 m^3.
Operational Performance	Wave Agitation Shelter during Storms	Options C and B provide superior protection against wave penetration on both an annual and storm basis.
	Flushing and Water Quality	Option C is a relatively open configuration allowing relatively unconstricted flow through the main navigation channel and around the offshore breakwater structure. Flushing is not considered to be adequately impacted by Option C.
	Navigation Safety	Navigation safety is initially considered to be reduced by the constriction between breakwater with some restricted visibility but subsequently significantly enhanced by the protection afforded by the breakwater and the obstacle free area within the breakwater protected zone.
	Future Port Expansion	Due to the channel offset Option C does not constrain the future seaward expansion of the Eastern Reclaim Area.
	Maintenance Dredging	Maintenance dredging requirements are not expected to be significantly impacted by the introduction of the offshore breakwater. Opportunities to block or trap littoral transport behind a groyne structure are not provided by this option, but this is offset against a net benefit of limiting the impact on the dune and mudflat area to the East of Ross River.
	Provision of Swing Basin	The option does not provide any geometric limitations to provision for swinging vessels in a sheltered environment (up to and greater than 75m vessels).
Construction	Construction Method	Construction is partially able to be effected from the Eastern Reclaim area with the offshore breakwater section in deeper water. The draft constraints on offshore work for Option C are considered to be the least constraining of the options considered.
	Duration of Construction	Due to relatively modest quantities of breakwater material required to be transported to site the works are considered to be able to be completed more rapidly than other options assessed.
Social Impacts	Visual Amenity	The offshore structure, remote from the Benwell Road intersection is considered to have the least visual impact of the breakwater options assessed (aside from no breakwater).
	Cultural Heritage	As the option avoids a footprint over the sandbar and mudflats, and does not provide public access to the area to the East of Ross River, this is considered to be the least likely option to have an adverse Cultural Heritage impact.
	Fishing	As the option does not impact the mudflats or sand spit to the East of Ross River, no measurable impact on fishing amenity is expected.

Environmental Impacts	Mega Fauna Habitat Impact	As the option avoids a footprint over the sandbar and mudflats to the East of Ross River, this is considered to be the least likely option to have an adverse Mega Fauna impact.
	Marine Flora Issues	The option may potentially impact ephemeral seagrass beds identified offshore of the Eastern Reclaim Area.
	Wading Bird Habitat	As the option avoids a footprint over the sandbar and mudflats, and does not provide public access to the area to the East of Ross River, this is considered to be the least likely option to have an adverse impact on Wading bird habitat.
	Influence on Longshore Drift	The option is not considered to significantly impede the limited littoral transport currently exhibited.
	Dredging Plumes	The open breakwater configuration is expected to result in similar plume responses to the existing situation.

A comparative discussion of advantages and disadvantages of all other breakwater configuration options assessed relative to the preferred option (Option C) is provided below;

Criteria		**Advantages and Disadvantages of Option Max compared to Preferred Option C**
Capex	Length of Breakwaters	Option Max is considerably longer (greater than 2x) than the preferred option and rock volumes are likely to be significantly greater.
	Capital Dredging	Dredging requirements to establish the swing basin and navigation channels are consistent with the preferred option.
Operational Performance	Wave Agitation Shelter during Storms	Option Max provides significantly reduced protection than the preferred option due to direct access to the dominant incident wave direction.
	Flushing and Water Quality	Option Max provides a slight flushing restriction compared to the preferred option which is not considered to be significant in terms of water quality impacts.
	Navigation Safety	Navigation safety is considered to be enhanced compared to existing configuration due to sheltering and better than the preferred option due to unrestricted visibility.
	Future Port Expansion	Option Max does not constrain the future seaward expansion of the Eastern Reclaim Area.
	Maintenance Dredging	Maintenance dredging requirements are expected to be less than the existing configuration due to the interruption of any littoral transport from beaches to the east.
	Provision of Swing Basin	The option does not provide any geometric limitations to provision for swinging vessels in a sheltered environment (up to 75m vessels).
Construction	Construction Method	Construction is able to be effected from the shore making Option Max potentially easier to construct than the preferred option.
	Duration of Construction	Due to larger length of breakwater and quantities of breakwater material required Option Max is likely to take longer than the preferred option to complete.

Social Impacts	Visual Amenity	The Option Max structure is considered to have significantly greater visual impact than the offshore, preferred option.
	Cultural Heritage	Option Max requires a footprint over the sandbar and mudflats, providing public access and construction disturbance to the area to the east of Ross River and is therefore considered to be more culturally impacting than the preferred option.
	Fishing	Option Max provides facility for public access and is considered to provide greater recreational (fishing) amenity than the preferred option.
Environmental Impacts	Mega Fauna Habitat Impact	Option Max requires a significant footprint over the sandbar and mudflats to the East of Ross River and potentially disrupts the flow regime. This option is therefore considered to have a more adverse impact than the preferred option.
	Marine Flora Issues	Option Max may fragment the flow regime over the nearshore mudflats with similar potential impacts on offshore seagrass beds and is considered worse than the preferred option.
	Wading Bird Habitat	The option provides a footprint and public access to the sandbar and mudflats to the East of Ross River providing a significantly greater impact on wading bird habitat than the preferred option.
	Influence on Longshore Drift	Option Max is considered to provide some enhanced littoral transport opportunities through containment of the littoral material from beaches to the east when compared to the preferred option.
	Dredging Plumes	The closed breakwater configuration is expected to facilitate containment of the extent of dredging plumes.

Criteria		**Advantages and Disadvantages of Option Min compared to Preferred Option C**
Capex	Length of Breakwaters	Option Min is considerably longer (greater than 1.5x) than the preferred option and rock volumes are likely to be significantly greater.
	Capital Dredging	Dredging requirements to establish the swing basin and navigation channels are consistent with the preferred option.
Operational Performance	Wave Agitation	Option Min provides significantly reduced protection than the preferred option due to direct access to the dominant incident wave direction.
	Shelter during Storms	
	Flushing and Water Quality	Option Min provides enhanced flushing compared to the preferred option which is not considered to be significant in terms of water quality impacts. Some adverse flood attenuation impacts upstream may be experienced from Option Min.
	Navigation Safety	Navigation safety is considered to be consistent with the existing configuration due to sheltering and better than the preferred option due to unrestricted visibility.
	Future Port Expansion	Option Min does not constrain the future seaward expansion of the Eastern Reclaim Area.
	Maintenance Dredging	Maintenance dredging requirements are expected to be less than the existing configuration due to the interruption of any littoral transport from beaches to the east.

	Provision of Swing Basin	Option Min provides geometric constraint to the swinging of vessels and is considered worse than the preferred option.
Construction	Construction Method	Construction is able to be effected from the shore making Option Min potentially easier to construct than the preferred option.
	Duration of Construction	Due to larger length of breakwater and quantities of breakwater material required Option Min is considered to take longer than the preferred option to complete.
Social Impacts	Visual Amenity	The Option Min structure is considered to have significantly greater visual impact than the offshore, preferred option.
	Cultural Heritage	Option Min requires a footprint over the sandbar and mudflats, providing public access and construction disturbance to the area to the east of Ross River and is therefore considered to be more culturally impacting than the preferred option.
	Fishing	Option Min provides facility for public access and is considered to provide greater recreational (fishing) amenity than the preferred option.
Environmental Impacts	Mega Fauna Habitat Impact	Option Min requires a significant footprint over the sandbar and mudflats to the East of Ross River and potentially disrupts the flow regime. Consequently this option is considered to have a more adverse impact than the preferred option.
	Marine Flora Issues	Option Min may fragment the flow regime over the nearshore mudflats but is not expected to impact offshore seagrass beds when compared to the preferred option.
	Wading Bird Habitat	The option provides both a footprint and public access to the sandbar and mudflats to the east of Ross River providing a significantly greater impact on wading bird habitat than the preferred option.
	Influence on Longshore Drift	Option Min is considered to provide some enhanced littoral transport opportunities through containment of the littoral material from beaches to the east when compared to the preferred option.
	Dredging Plumes	The closed breakwater configuration is expected to facilitate containment of the extent of dredging plumes.

Criteria		**Advantages and Disadvantages of Option No Breakwater compared to Preferred Option C**
Capex	Length of Breakwaters	Option No Breakwater is the least expensive option.
	Capital Dredging	Dredging requirements to establish the swing basin and navigation channels are consistent with the preferred option, no material replacement under breakwater footprints will be required and dredging volumes for No Breakwater option are less than the preferred option.
Operational Performance	Wave Agitation Shelter during Storms	The No Breakwater option does not provide protection to the external quayline of the precinct or the navigable area to the east. The tranquillity environment outside the precinct Inner Harbour does not conform to Australian Standards.
	Flushing and Water Quality	Option No Breakwater is not likely to cause any flushing impacts.

	Navigation Safety	Navigation safety for the No Breakwater option is considered to be consistent with the existing configuration with access to the precinct Inner Harbour entrance and external quayline operations less safe than a protected configuration.
	Future Port Expansion	Option No Breakwater does not constrain the future seaward expansion of the Eastern Reclaim Area.
	Maintenance Dredging	Maintenance dredging requirements are not expected to be impacted and are comparable to the preferred configuration.
	Provision of Swing Basin	Option No Breakwater provides geometrically unconstrained swinging for vessels and is comparable to the preferred option.
Construction	Construction Method	Construction of the precinct is contained to the onshore reclamation works and is significantly less than the preferred option.
	Duration of Construction	The No Breakwater option can be constructed more quickly than the preferred option.
Social Impacts	Visual Amenity	The No Breakwater option has no offshore visual impact.
	Cultural Heritage	The No Breakwater option does not impact the sandbar and mudflats and is therefore comparable to the preferred option.
	Fishing	The No Breakwater option does not provide increased fishing opportunities and is comparable to the preferred option.
Environmental Impacts	Mega Fauna Habitat Impact	The No Breakwater option avoids a footprint over the sandbar and mudflats to the East of Ross River and is therefore comparable to the preferred option.
	Marine Flora Issues	The No Breakwater option will not impact seagrass beds identified offshore and is better than the preferred option in this regard.
	Wading Bird Habitat	The No Breakwater option avoids a footprint over the sandbar and mudflats to the east of Ross River and is therefore comparable to the preferred option.
	Influence on Longshore Drift	The option is not considered to significantly impede the limited littoral transport currently exhibited.
	Dredging Plumes	The No Breakwater configuration is expected to result in similar plume responses to both the existing configuration and preferred option.

Criteria		**Advantages and Disadvantages of Option A compared to Preferred Option C**
Capex	Length of Breakwaters	Option A has a breakwater length slightly larger than the preferred option.
	Capital Dredging	Dredging requirements to establish the swing basin and navigation channels are consistent with the preferred option.

Operational Performance	Wave Agitation Shelter during Storms	Option A provides significantly reduced protection than the preferred option due to direct access to the dominant incident wave direction.
	Flushing and Water Quality	Flushing time for Option A is slightly enhanced when compared to the existing and preferred configurations but is not considered to be significant in terms of water quality impacts. Some flood attenuation impacts upstream may be experienced from Option A.
	Navigation Safety	Navigation safety is considered to be consistent with the existing configuration due to sheltering and better than the preferred option due to unrestricted visibility.
	Future Port Expansion	Option A does not constrain the future seaward expansion of the Eastern Reclaim Area.
	Maintenance Dredging	Maintenance dredging requirements are expected to be less than existing due to the interruption of any littoral transport from beaches to the east.
	Provision of Swing Basin	Option A allows unconstrained swinging of vessels and is comparable to the preferred option.
Construction	Construction Method	Construction impacts of the option are considered to be difficult due to draft restrictions assuming access requirements across the sensitive mudflats will be restricted.
	Duration of Construction	A slightly longer construction duration than the preferred option is anticipated due to draft constraints imposed by working in shallow water.
Social Impacts	Visual Amenity	The Option A structure is considered to have slightly greater visual impact than the preferred option.
	Cultural Heritage	Option A requires a footprint over the sandbar but does not facilitate public access and is considered to be more culturally impacting than the preferred option.
	Fishing	Option A does not provide for public access and is consistent with the preferred option.
Environmental Impacts	Mega Fauna Habitat Impact	Option A requires a slight footprint over the sandbar and potentially disrupts the flow regime and is therefore considered to have a more adverse impact than the preferred option.
	Marine Flora Issues	The option may potentially impact ephemeral seagrass beds identified offshore of the Eastern Reclaim Area.
	Wading Bird Habitat	The option provides a footprint but no public access to the sandbar to the east of Ross River. Accretion of the sandbank due to littoral blockage may enhance wading bird habitat.
	Influence on Longshore Drift	Option A is considered to provide some enhanced littoral transport opportunities through containment of the littoral material from beaches to the east when compared to the preferred option.
	Dredging Plumes	The closed breakwater configuration is expected to facilitate containment of the extent of dredging plumes.

Criteria		Advantages and Disadvantages of Option B compared to Preferred Option C
Capex	Length of Breakwaters	Option B has a breakwater length slightly larger than the preferred option.
	Capital Dredging	Dredging requirements to establish the swing basin and navigation channels are slightly larger than the preferred option due to more extensive re-alignment of the navigation channel.
Operational Performance	Wave Agitation	Option B provides comparable protection to the preferred option.
	Shelter during Storms	
	Flushing and Water Quality	Flushing time for Option B is slightly reduced when compared to the existing and preferred configurations but is not considered to be significant in terms of water quality impacts. Some flood attenuation impacts upstream may be experienced from Option B.
	Navigation Safety	Navigation safety is considered to be consistent with the preferred configuration, offering some restricted visibility.
	Future Port Expansion	Option B does not constrain the future seaward expansion of the Eastern Reclaim Area.
	Maintenance Dredging	Maintenance dredging requirements are expected to be less than existing due to the interruption of any littoral transport from beaches to the east.
	Provision of Swing Basin	Option B allows unconstrained swinging of vessels and is comparable to the preferred option.
Construction	Construction Method	Construction impacts of the option are considered to be difficult due to draft restrictions assuming access requirements across the sensitive mudflats will be restricted.
	Duration of Construction	Construction durations consistent with the preferred option are expected.
Social Impacts	Visual Amenity	The Option B structure is considered to have slightly greater visual impact than the preferred option.
	Cultural Heritage	Option B requires a footprint over the sandbar and is considered to be more culturally impacting than the preferred option.
	Fishing	Option B does not provide for public access and is consistent with the preferred option.
Environmental Impacts	Mega Fauna Habitat Impact	Option B requires a slight footprint over the sandbar and potentially disrupts the flow regime. This option is therefore considered to have a more adverse impact than the preferred option.
	Marine Flora Issues	The option is less likely than the preferred option to impact ephemeral seagrass beds identified offshore of the Eastern Reclaim Area.
	Wading Bird Habitat	The option provides a footprint but no public access to the sandbar to the east of Ross River. Accretion of the sandbank due to littoral blockage may enhance wading bird habitat.

	Influence on Longshore Drift	Option B is considered to provide some enhanced littoral transport opportunities through containment of the littoral material from beaches to the east when compared to the preferred option.
	Dredging Plumes	The closed breakwater configuration is expected to facilitate containment of the extent of dredging plumes.

1.5.3.12 Summary

The Multi Criteria Analysis completed for the assessment of the breakwater options evaluated the performance of six Breakwater options, including a no breakwater option, against a number of criteria including cost, operational performance, construction, social and environmental impacts.

Using the weighting system determined through workshops the strongest performing option was Option C. Option C is a second stage refinement of options following on from the initial screening and weightings workshop and has been designed to optimise operational performance whilst minimising footprint impacts on the area to the east of Ross River.

Option C breakwater configuration has been adopted for the EIS studies.

1.6 The environmental impact assessment process

1.6.1 EIA process and methodology of the EIS

On 22 August 2008, the Coordinator-General (CG) declared the Project to be a 'significant project' for which an EIS was required pursuant to section 26(1)(a) of the *State Development and Public Works Act 1971* (Qld) (SDPWOA).

On 3 November 2008, the Australian Government Minister for the Department of the Environment, Water, Heritage and the Arts (DEWHA) determined that the Project is a ‘controlled action’, which requires assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBCA). The controlling provisions are:

- Listed threatened species and communities (sections 18 & 18A);
- Listed migratory species (sections 20 & 20A);
- Wetlands of international importance (section 16 & 17B);
- World Heritage properties (section 12 & 15A);
- National Heritage places (section 15B &15C).

The statutory impact assessment process under the SDPWOA is also the subject of a bilateral agreement between the Queensland and the Commonwealth Governments in relation to environmental assessment under the EPBCA. Pursuant to the bilateral agreement this EIS addresses the requirements of both State and Commonwealth legislation.

The Department of Infrastructure and Planning will manage the EIS assessment process on behalf of the Coordinator-General. A draft Terms of Reference (ToR) has been prepared as the first stage of the EIS process. The Coordinator-General invited comments on the draft ToR for the EIS process. Submissions on the draft ToR closed on 5 pm Monday 22 December 2008.

Submissions on the draft ToR were considered and, where appropriate were incorporated into the final ToR. A copy of the final ToR for the Project included as Appendix C[1].

The EIS has been developed in the following phases:

- **Data Collection and Review:** This included collation of all available relevant data for the Project area from previous studies specific to the development and general studies within the region. New data was also collected were existing references were insufficient.
- **Specialist Studies:** Several specialist studies were undertaken to provide input into the EIS. These included:
  - Sediment sampling and analysis;
  - Hydrodynamic and water quality modelling;
  - Sampling of water quality;
  - Flora and Fauna assessments, including terrestrial and aquatic systems;
  - Noise and Air Assessments;
  - Cultural Heritage Assessment
  - Social Impact Assessment; and
  - Economic Impact Assessment.
- **Description of the Environment Values:** Based on the data collection and specialist studies conducted for the Project, a detailed description of the existing environment values was prepared. The purpose of this phase is to provide a baseline from which to determine potential impacts associated with the Project.
- **Description of Potential Environmental Impacts:** The identification and quantification of potential impacts that may result from development of the Project is based on an analysis of known impacts associated with the proposed works, from previous knowledge and experience, and the characteristics of the areas to be impacted. From this analysis, potential impacts can be identified and quantified (where possible) and possible mitigation strategies developed where necessary to minimise the potential impacts.
- **Development of the Environmental Management Plan:** The Environmental Management Plan details the implementation strategies for the development of the Project to achieve the mitigation strategies identified to minimise potential impacts.

1.6.2 Objectives of the EIS

The objective of the EIS is to ensure that all potential environmental, social and economic impacts of the project are identified and assessed and, where possible, how any adverse impacts would be avoided or mitigated. Direct, indirect and cumulative impacts must be fully examined and addressed. The project should be based on sound environmental protection and management criteria.

The EIS should be a self-contained and comprehensive document that provides sufficient information for an informed decision on the potential impacts of the project and the

[1] The ToR were developed with knowledge of the EPBC Referral for the project, which forms Appendix D.

management measures employed to mitigate adverse impacts. The EIS document should provide information for the following persons and groups, as the project “stakeholders”:

- Interested persons and bodies as a basis for understanding the project, prudent and feasible alternatives, affected environmental values, potential impacts that may occur and measures to be taken to mitigate potential adverse impacts;
- Groups or persons with rights or interests in the land as an outline of the potential effects of the project on that land including access arrangements;
- Government agencies as a framework for decision-makers to assess the environmental aspects of the project with respect to legislative and policy provisions and based on that information to make an informed decision on whether the project should proceed or not and if so, on what conditions, if any;
- The Commonwealth Minister for the Environment, Heritage and the Arts as information to determine the extent of potential impacts of the project on matters of national environmental significance, in particular the controlling provisions under the EPBCA: sections 12 and 15A (world heritage properties), sections 18 and 18A (listed threatened species and communities) and sections 20 and 20A (listed migratory species);
- The proponent as a mechanism by which the potential environmental impacts of the project are identified and understood and information is provided to support the development of management measures including an environmental management plan (EMP), to mitigate the adverse effects of residual environmental impacts of the development.

1.6.3 Submissions

The EIS will be publicly notified to enable the public to review and make submissions in relation to the findings of the EIS. Each submission will be reviewed by POTL and taken into account in finalising the EIS. Submissions on the EIS may be made to the Coordinator-General during the submission period set by the Coordinator-General.

For an environmental impact statement, a properly made submission means a submission that:

(a) Is made to the Coordinator-General in writing;

(b) Is received on or before the last day of the submission period;

(c) Is signed by each person who made the submission;

(d) States the name and address of each person who made the submission; and

(e) States the grounds of the submission and the facts and circumstances relied on in support of the grounds.

Properly made submissions must be considered by the Coordinator-General alongside the environmental impact statement and other material relevant to the project. Written submissions on the EIS should be provided to:

The Coordinator-General
C/- EIS Project Manager: Townsville Marine Precinct project
Significant Projects Coordination
Department of Infrastructure and Planning
PO Box 15009
City East QLD 4002 Australia
Fax : +61 7 3225 8282
Email : townsvillemarine@dip.qld.gov.au

Submissions received during the submission period, which will be advertised with the release of the EIS for public comment, will be collated by the Department of Infrastructure and Planning and where additional information is required to address the submissions, response requirements will be issued to the proponent, which will be addressed in a supplementary report, as outlined under Section 1.8.3.3 The supplementary report together with the EIS will constitute the final report considered by the Coordinator-General.

1.7 Public consultation process

1.7.1 Overview

Community engagement has informed the development of the EIS. From the outset, community input was sought to inform the EIS studies and to identify community issues and opportunities. Environment and Behaviour Consultants (EBC) were specifically engaged by POTL to work with GHD in this regard.

EBC delivered the community consultation and social impact assessment components of the EIS. EBC has acted as an independent consultant during the consultation process and was bound by POTL protocols and policies. All consultation materials produced throughout the project have been approved and endorsed by POTL. Full details of the community consultation process are included in Appendix E.

Community awareness of the Precinct was already high given its interrelationship with the TPAR project. EBC had involvement in the community consultation process for the TPAR and drew upon their extensive stakeholder database for the Precinct consultation process.

Key stakeholder groups were contacted and the broader community informed through the use of newsletters, letter box drops, targeted interviews and information days. The approach to engagement has facilitated relationship building with stakeholders, which has been maintained throughout the program.

The aim of the community engagement process was to:

- Ensure the community was aware of the EIS process;
- Inform the community about the key components of the EIS and how the EIS would be formulated;
- Provide a range of opportunities for community feedback and input into the EIS; and
- Deliver community feedback to the EIS technical study team to inform the final EIS report.

1.7.2 Stakeholders

At the outset of the project 'community' in the context of the TMPP included property owners, businesses and residents with geographic proximity to the project and those with an interest in the project generally including residents of Townsville, community interest groups, traditional owners, regional industry and businesses, state government agencies and departments, commonwealth authorities and local government.

The suburbs of South Townsville, Railway Estate, Oonoonba and Cluden are located in proximity to the lower reaches of the Ross River. Residents of South Townsville generally have an interest in the activities at the mouth of the Ross River from an employment, recreation and amenity perspective. Residents of the broader Townsville area have an interest in the commercial and employment opportunities relating to marine industries operating from Ross River.

There are a number of marine based industries which operate on the north bank of the Ross River upstream of the future TPAR bridge which may be affected by any restrictions to vessels accessing the river upstream from the bridge. The TMPP provides an opportunity for these businesses to relocate.

These businesses include:

- Townsville Ross River Marina and commercial trawler fleet (marina facilities for the commercial trawler fleet, including a seafood outlet NQ Marine Fresh Seafoods);
- Rosshaven Marine (slipway and hard-stand facility for commercial and recreational vessels, including a chandlery);
- Pacific Marine Group (commercial marine construction and maintenance);
- Riverside Marine (Palm Island barges and Australian Institute of Marine Science (AIMS) research vessels);
- Harbourside Coldstores; and
- Curtain Brothers.

The Australian Defence Force Ten Terminal Regiment also operates from Ross River, as does the Townsville Region Water Police.

There are a number of community groups who have shown an interest in the TMPP from an environmental or community amenity perspective. These include:

- North Queensland Conservation Council;
- Coastal Dry Tropics Landcare Inc.;
- SUNFISH (recreational fishing);

- Commercial Fishers Association;
- Townsville Bird Observers' Club;
- Townsville Local Marine Advisory Group (to the Great Barrier Reef Marine Park Authority);
- Seagrass Watch;
- Wildlife Preservation Society of Queensland (NQ Branch);
- Townsville Wildlife Carers;
- Birds Australia NQ; and
- Sea Turtle Foundation.

River users with a direct interest in the project included:

- Owners and operators of vessels currently occupying pile moorings, including commercial and pleasure-craft;
- Owners and operators of vessels undergoing maintenance and repairs at Rosshaven Marina;
- Owners and operators of vessels located at Fisherman's Wharf;
- Owners and operators of recreational vessels using public boat ramp facilities in both Ross River and Ross Creek (inc. speed boats, jet skis, trailer-sailers);
- Owners and operators of kayaks and other water sports equipment;
- Recreational users of the Benwell Road beach; and
- Townsville Wooden Boat Club.
- In addition to the interest groups identified above, there were also a number of additional key stakeholders with an interest in the project. These included:
- Burdekin Dry Tropics NRM;
- Aboriginal traditional owners; and
- Members of the Port of Townsville's Community Partnerships Forum.

Key project partners for the project are primarily state government agencies and authorities, and local government. These included:

- Townsville Enterprise Limited (TEL);
- Townsville City Council (TCC);
- Queensland Department of Main Roads (QMDR);
- Queensland Rail (QR);
- Queensland Transport (QT);
- Queensland Department of Infrastructure and Planning (DIP); and
- Department of Employment, Economic Development and Innovation (DERM) (formerly Queensland Department of Tourism, Regional Development, and Industry (QTRDI)).

There were also a number of other government agencies and authorities, both state and federal, who have an interest in the project either directly through statutory approval responsibilities or from an interest in the integrity of adjacent land or marine environments. These included:

- Department of Natural Resources and Environment (DERM) (formerly Department of Natural Resources and Water (NRW);
- Department of Employment, Economic Development and Innovation Queensland Department of Primary Industries and Fisheries (DEEDI formerly DPI&F);
- Queensland Department of Employment and Industrial Relations (DEIR);
- Maritime Safety Queensland (MSQ);
- Queensland Department of Communities (Communities);
- Queensland Department of Local Government, Sport and Recreation (DLGSR) (formerly Queensland Department of Local Government, Planning, Sport and Recreation (DLGPSR));
- Queensland Health (Health);
- Great Barrier Reef Marine Park Authority (GBRMPA);
- Department of Defence (Defence); and
- Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA).

1.7.3 Methodology

The consultation process will be delivered through two stages which include (i) consultation during the development and preparation of the EIS (November 2008 to March 2009); and (ii) consultation undertaken on the release of the EIS for public comment[3].

The objectives of the community consultation are to:

- Implement a consultation process that was fair, equitable and transparent;
- Build relationships with the community and stakeholders based on trust, openness and respect;
- Provide opportunities for all members of the community to provide meaningful input at appropriate intervals in the EIS;
- Ensure the community (the broader Townsville community and stakeholders, as well as the communities and stakeholders directly affected by the project) are well informed about the TMPP and the EIS. Including the relationship between the TMPP and the broader context of port development and contribution to the regional economy;
- Assist and encourage relevant members of the EIS team to gain an understanding of community issues and concerns with regards to potential social and environmental impacts;
- Facilitate the use of local community knowledge and expertise in the EIS and project design;
- Provide appropriate and timely feedback to participants and the community generally on the outcomes of the consultation process, including how community issues are being used and addressed.

[3] This consultation is yet to occur. Key team members from GHD's and EBC's research teams will partake in this activity. GHD team members are noted under Appendix F.

A number of community involvement techniques were identified and used in the project. These included:

- Dedicated telephone number, website and email address providing information regarding the project, the consultation process and avenues for obtaining further information;
- Project fact sheets which were distributed via mail and email contacts and displayed at public places and on notice boards;
- Project advertorials including newspaper advertisements to advise of details regarding the project and consultation avenues;
- Call cards, which were distributed through door knock consultations and included summary information regarding the project and avenues through which further information could be sought;
- Questionnaires, six of which were issued, targeted at stakeholder groups to seek dedicated feedback on particular issues of concern; and
- Project covering letters to accompany all correspondence.

These techniques were selected as they enabled the consultation objectives to be achieved and facilitated the involvement of the different stakeholder and special interest groups (identified above) in the project. The area doorknocked for targeted one-on-one interviews included the entirety of Boundary Street, Seventh Street and surrounding streets from Victoria Park back towards the Precinct. To capture areas not doorknocked a letter was sent to residents in Cluden, Oonoonba, Railway Estate and South Townsville inviting them to participate in the consultation process.

A separate Indigenous Cultural Heritage Report has been prepared for the EIS by Northern Archaeology Consultancies and Segue Pty Limited. The report presents the results of an indigenous cultural heritage investigation for the TMPP and port expansion development areas at Ross River and Ross Creek. Section 3.15 of this EIS discusses cultural heritage aspects of the Precinct.

Additionally traditional owners requested that they have the opportunity to provide feedback as part of the wider community consultation process for the TMPP. Subsequently EBC prepared a short questionnaire and provided it to the Endorsed Aboriginal Parties. This consultation was undertaken in addition to that included in the development of the Cultural Heritage Management Plan for the Precinct.

Nine responses to the questionnaire were received. This was a 50% response rate by members of the Endorsed Aboriginal Parties. Several traditional owners indicated they did not live locally and therefore should not complete the questionnaire.

At the time of consultation, artist impressions and detailed layouts of the project (as they appear throughout this EIS report) were not available, and an early conceptual diagram was used to assist community and stakeholders visualise the likely layout and footprint of the project (see Appendix E). It is therefore likely that on review of more detailed visual representations of the project, there may be some changes to the type and extent of issues and concerns identified by community and stakeholders to date.

Community and stakeholders will have an opportunity to review artist impressions and more detailed layouts of the project when the EIS report is released for public comment and during the public displays that will be held as part of that process.

Appendix E provides a summary of the materials produced and used throughout the consultation process. It also provides a summary of the consultation methods used for each stakeholder group. Details of all consultations are available on request.

1.7.4 Attitudes towards the TMPP

In general there was some division in the community about the benefits the TMPP would provide to them as residents and the South Townsville area in general.

While 46% of residents were in favour of the TPAR, as they believed there would be some reduction in heavy vehicle traffic on Boundary Street, they were uncertain about the impacts of the TMPP. This was partly due to the belief that the TMPP would affect the recreational opportunities provided by the beach in South Townsville and the belief that South Townsville was already over industrialised.

Another 26% remained uncertain, with much of the uncertainty based around the conceptual design of the TMPP. Without knowing what activities and businesses would be located in the precinct, with little knowledge about the appearance of the precinct and public access to the precinct, it was difficult for most residents to make an informed decision.

There was some acknowledgement of the potential the Precinct could bring in relation to new employment opportunities and increased competition for industry. However resident beliefs about impacts on their lifestyle due to the potential loss of the beach and beliefs about increased pollution and road traffic, often outweighed the positive impacts associated with employment and industry development.

46% of surveyed residents believed the TMPP was “a good idea”. Comments from the 28% of South Townsville residents who did not believe the TMPP was a good idea included:

- Dredging will be terrible. The community use the beach, where is the community good.
- Will increase traffic and can't access the beach.
- Should put in an opening bridge so the beach can be used for tourism. Marine businesses fine tucked away in river.
- Depends what goes in and where. Lots of people I know come to walk their dogs. I would like to see beach stay.
- If it was nice and not commercial I wouldn't mind.
- Rather it not be there, put it around the corner facing north.
- Area is becoming too industrial with associated pollution and noise.
- Not good environmentally or socially. This area is hemmed in by development. For example Palmer St, the port and the V8's.
- Opening bridge would be better. Too much expense for tax payers. Perhaps not right place. Should go on the reclaim near the casino.

- Kills yabbie banks.

Some 26% of residents surveyed were uncertain about the TMPP. Uncertainties were generally based in a lack of knowledge about the facilities the Precinct may provide and the positive and negative benefits on traffic corridors and commerce for the area.

The majority of respondents believed upstream businesses should be provided opportunity to relocate to alternative facilities to avoid impact to industry from the TPAR. Community recreational facilities, eateries and low density residential blocks were preferred development options for upstream lands that would be vacated by relocating industries.

Beach users provided mixed responses with approximately 50% of respondents indicating they “would be upset if they could no longer access the beach”. 25% of respondents were uncertain.

There was general acknowledgement that the Precinct facility was to be an industrial commercial area and some suggestions were provided in regards to recreational facilities that may be compatible with the environment, including provision of boardwalks and cafes. Only 25% of residents believed boat ramps should be included in the TMPP. However, 85% of boat ramp users believed boat ramps should be provided in the TMPP to meet current shortfalls of ramp numbers in the Townsville region. The provision of boat ramps is addressed under Section 1.5.1.

Local industries noted concern regarding economic flow on effects for the region if the Precinct was not constructed.

Pile mooring respondents indicated concern about safe shelter locations in the event of severe storms or cyclones with the removal of ability to access upstream in Ross River. A suitably designed breakwater, artificial bank or mangrove area was preferred so as to provide shelter. Other suggestions were to include enough space between buoys to manoeuvre boats in rough or windy conditions and the use of flood netting to prevent debris running into moored boats.

Consultation was undertaken with upstream businesses, with the objective of providing information on the project; receiving feedback about the requirements of businesses in a new precinct and identifying any issues of concern.

Many upstream businesses were concerned about the timing for the development of the TMPP and the need to have sufficient time to relocate their businesses. They were also concerned that businesses had currently not been given an indication they would be relocated into the TMPP and that they may have to compete with other businesses for space within the TMPP. In addition some businesses complained about the accuracy of the information circulated to the public about the TMPP, including issues relating to timing and relocation of businesses.

A full description of all responses and consultations is provided under Appendix E.

1.8 Project approvals

1.8.1 Relevant legislation and policy requirements

This section provides an explanation of the legislation and policies controlling the approvals process for the project. The approval process resulting from the gazettal of this project as a ‘significant project’ pursuant to the SDPWOA is described and an outline of the linkage to other relevant state and Commonwealth legislation is provided.

The public notification and appeal rights processes are outlined. Local government planning controls, local laws and policies applying to the development are described, and a list is provided of the approvals required for the project and the expected program for approval of applications.

1.8.2 Commonwealth legislation

1.8.2.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBCA)

The *Environment Protection and Biodiversity Conservation Act 1999* is the legislation applicable to developments that may have an impact at the Commonwealth level on matters protected under the Act. The object of the EPBCA is to protect the environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).

In accordance with the requirements of the EPBCA an approval from the Department of the Environment, Water, Heritage and the Arts (DEWHA) was sought prior to undertaking of any development, as it was determined that the development was likely to have a significant impact (as defined in the Act) on a matter/s of National Environmental Significance (NES). The EPBCA provides automatic protection for World Heritage Properties by ensuring that an Environmental Impact Assessment (EIA) process is followed for proposed actions that will, or are likely to, have a significant impact on World Heritage values of a declared World Heritage property.

The development approval sought takes into account the following Matters of National Environmental Significance, which are expected to be impacted:

- Sections 12 and 15A (World Heritage properties);
- Sections 15B and 15C (National heritage places);
- Sections 16 and 17B (Wetlands of international importance);
- Sections 18 and 18A (Listed threatened species and communities); and
- Sections 20 and 20A (Listed migratory species), of the EPBCA.

Following referral to the DEWHA, the Project was determined to be a “controlled action” requiring a form of environmental assessment (including an EIA) and approval at the Commonwealth level.

On 22 August 2008, the CG declared the Project to be a “significant project” for which an EIS was required according to section 26(1)(a) of the *State Development and Public Works Act 1971* (Qld) (SDPWOA).

The statutory impact assessment process under the SDPWOA is also the subject of a bilateral agreement between the Queensland and the Australian Governments in relation to environmental assessment under the EPBCA. In accordance with the bilateral agreement, this EIS addresses the requirements of both State and Commonwealth legislation.

The Queensland Department of Infrastructure and Planning will manage the EIS assessment process on behalf of the CG.

Matters of National Environmental Significance

The Queensland EIS process is accredited under a bilateral agreement with the Commonwealth therefore, it is necessary to address potential impacts on the matters of national environmental significance that have been identified in the "controlling provisions" for the project. In this case the matters are as follows:

- Sections 12 and 15A (World heritage properties);
- Sections 15B and 15C (National heritage places);
- Sections 16 and 17B (Wetlands of international importance);
- Sections 18 and 18A (Listed threatened species and communities); and
- Sections 20 and 20A (Listed migratory species).

These matters of national environmental significance (NES) are in a stand-alone report included as Section 7. This stand-alone report includes:

- A description of the affected environment relevant to the matters protected including:
  - the current status of the matters protected under the EPBCA, described in sufficient detail, to inform the analysis of the impact from the proposed works on these matters; and
  - for listed threatened and migratory species, a description of the environment including:
    - the current species distribution;
    - relevant information about the ecology of the species (habitat, feeding and breeding behaviour etc);
    - information about any populations of the species or habitat for the species in the area affected by the proposed works; and
    - current pressures on the species, especially those in the area to be affected by the proposed works relevant controls or planning regimes already in place.
- An assessment of relevant impacts and mitigation measures, including:
  - impacts and potential impacts on the matters protected;
  - an analysis of possible mitigation measures for each impact;
  - the relative impacts of alternatives;
  - compensatory measures to offset unavoidable residual impacts; and
  - sufficient justification for all conclusions reached on specific impacts.

The following potential impacts will be addressed in this EIS. The impacts are provided as a guide for specific matters of national environmental significance.

- Impact on listed threatened species (potential impacts vary depending on whether the species is extinct in the wild, endangered or vulnerable):
  - lead to long term decrease in the size of a population;
  - reduce the area of occupancy of the species;
  - fragment an existing population into two or more populations;

– adversely affect habitat critical to the survival of the species;
– disrupt the breeding cycle of a population;
– modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
– result in invasive species that are harmful to the species becoming established;
– interfere with the recovery of the species; or
– consistency with recovery plans.

- Impact on a listed migratory species:
  – substantially modify (including by fragmentation or altering fire regimes, nutrient cycles or hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
  – result in an invasive species that is harmful to the migratory species becoming established;
  – area of important habitat for the migratory species; or
  – seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Great Barrier Reef Marine Park Act 1975

Activities which have direct or indirect impacts on the Great Barrier Reef Marine Park (GBRMP) are required under the *Great Barrier Reef Marine Park Act 1975* (GBRMP Act) to obtain a Marine Parks Permit prior to undertaking development. The Great Barrier Reef Marine Park Authority (GBRMPA) considers the *Great Barrier Reef Marine Park Regulations 1983, Sea Dumping Act 1981*, *National Ocean Disposal Guidelines for Dredged Material 2002* and any GBRMPA policies when assessing an application made under the GBRMP Act.

The Townsville Port is excluded from the GBRMP, however should any development within the boundaries of the GBRMP, the GBRMP Act will apply. Despite the Townsville Port exclusion from GBRMP, the GBRMPA has been consulted and informed of progress throughout the planning and investigative stages of the project.

Environment Protection (Sea Dumping Act) 1981

The *Environment Protection (Sea Dumping) Act 1981* (Seas Dumping Act) was enacted to fulfil Australia's international responsibilities under the London Convention of 1972 and has been amended to implement the 1996 Protocol to the London Convention (ratified by Australia in 2001). Under the protocol, Australia is obliged to prohibit ocean disposal of waste materials considered too harmful to the marine environment and regulate the permitted dumping of wastes at sea to ensure that environmental impact is minimised.

The Sea Dumping Act is administered by DEWHA and applies in respect of all Australian waters (other than waters within the limits of a State or Territory), from the low water mark out to the limits of the Exclusive Economic Zone. The Sea Dumping Act regulates the deliberate loading and dumping of waste materials and other matter at sea. It applies to all vessels, aircraft or platforms in Australian waters and to all Australian vessels or aircraft in any part of the sea.

The *National Ocean Disposal Guidelines for Dredged Material* establishes a procedure to determine if material is suitable for unconfined disposal at sea. Only uncontaminated dredged material is deemed suitable for confined disposal at sea.

A sea dumping permit will be required under the *Sea Dumping Act 1981* to enable disposal of dredge spoil from the works associated with the construction of the Project.

Native Title Act 1993

The *Native Title Act 1993* (NT Act) recognises the rights and interests over land and water of Australian Indigenous people in accordance with traditional laws and customs.

The objectives of the NT Act are:

- To provide for the recognition and protection of native title;
- To establish ways in which future dealings affecting native title may proceed, and to set standards for these dealings;
- To establish a mechanism for determining claims to native title; and
- To provide for, or permit, the validation of past acts and intermediate acts, invalidated because of the existence of native title.

A “Native Title Tribunal” has been established in accordance with the provisions of the NT Act. The tribunal prescribes processes for the determination of native title rights and interests over land and water.

During the establishment of the perpetual lease for Lot 773, Native Title was determined to have been suppressed in accordance with the non-extinguishment principle. Provided the existing tenure arrangements (perpetual lease) are maintained, the Project may be carried out and maintained in accordance with the purpose of the lease.

Should the POTL wish to freehold Lot 773, the process will involve surrender of the current perpetual lease and, subsequently, the re-emergence of Native Title rights and interests over the area. Any freeholding application will need to address native title rights and interests under a future act provision of the NT Act, and may involve entering into a Land Use Agreement with relevant indigenous parties.

1.8.3 State legislation

1.8.3.1 State Development and Public Works Organisation Act 1971

The Project has been declared a “Significant Project” under section (26)(1)a of the *State Development and Public Works Organisation Act 1971* (SDPWOA). The CG will facilitate and coordinate the assessment process including an evaluation of the EIS and the preparation of a report. Under the SDPWOA the CG is empowered to make certain recommendations, as well as, to state conditions of approval that must be imposed under certain approval processes.

1.8.3.2 Bilateral agreement

The EPBCA Bilateral Agreement between Queensland and the Australian Government came into effect on 13 August 2004. It is commonly referred to as the Bilateral Agreement however, the full title is *An Agreement between the Australian Government and the State of Queensland* *under Section 45 of the Australian Government Environment Protection and Biodiversity Conservation Act 1999 Relating to Environmental Assessment*.

The purpose of the agreement is to avoid assessment process duplications for proposals that:

- are deemed “controlled actions”;
- require assessment under Part 8 of the EPBCA; and
- are undergoing an EIA process under State legislation.

The Bilateral Agreement applies only to three classes of actions, specifically those assessed by an EIS under:

- Chapter 3 of the *Environmental Protection Act 1994*;
- Part 4 of the SDPWOA; or
- Chapter 5, Part 5.8 of the *Integrated Planning Act 1997*.

This Project will require an EIS process under Part 4 of the SDPWOA.

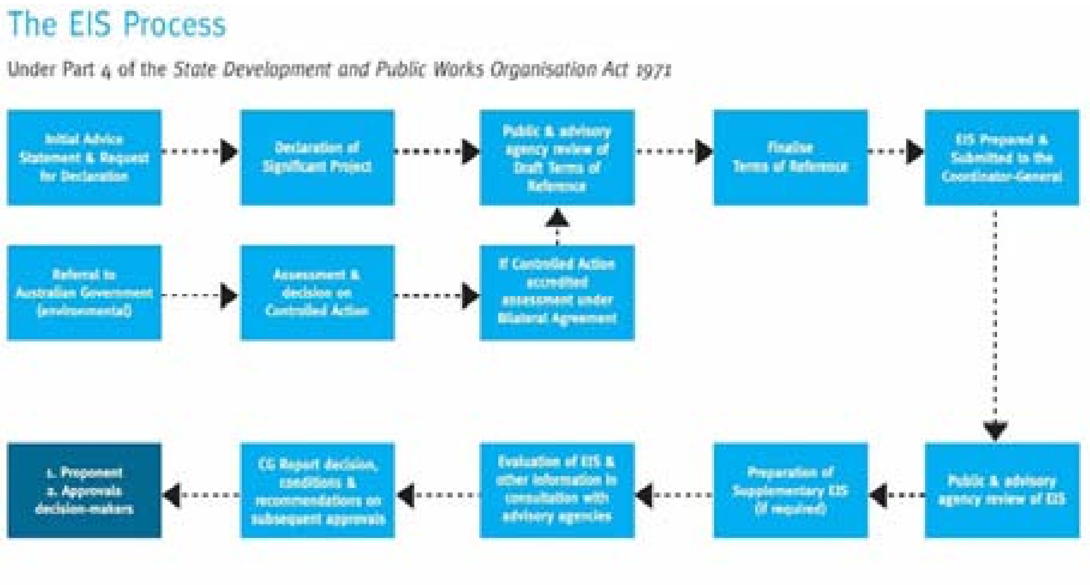
1.8.3.3 EIS under SDPWOA

The process for undertaking an EIS under the SDPWOA is illustrated in Figure 1-12 and outlined below:

1. The environmental impact assessment process for a significant project is commenced by the CG advising the developer that an EIS is required for the project.
2. The CG then prepares and publicly notifies a draft terms of reference for the EIS. During the notification period, comments are invited from the public.
3. To assist in the preparation of the EIS, the CG may also refer the details of the project, the initial advice statement from the developer and the terms of reference to any entity.
4. The EIS prepared by the developer must address the terms of reference to the satisfaction of the CG.
5. If the CG is satisfied with the EIS, the developer must publicly notify the EIS for a period (the submission period) set by the CG, during which a submission may be made by the public.
6. The CG must accept a properly made submission during the submission period.
7. The CG must, after the close of the submission period, consider the EIS, all properly made submissions and any other material the CG considers relevant.
8. The CG must then prepare a report evaluating the EIS and forward a copy of that report to the developer and the Assessment Manager. The report may include conditions which should be imposed on the project.

The EIS for the Project will be submitted to the CG for evaluation and for administering the EIS process. Detailed information in regards to where CG involvement occurs in the IDAS process is detailed under the following sub heading titled *Integrated Planning Act 1997*.

Figure 1-12 The EIS Process



1.8.3.4 Integrated planning act 1997

The Integrated Planning Act 1997 (IPA) forms the legislative framework for the preparation of planning instruments, development assessment (through the Integrated Development Assessment System (IDAS)) and planning dispute resolution in Queensland. The purpose of the IPA is to seek to achieve ecological sustainability by coordinating planning at all levels of government and by managing the development process and the impacts of development.

IDAS allows for the assessment of development proposals by multiple agencies to be integrated into one overall application process. It is a four stage assessment process including:

- Application Stage;
- Information and Referral Stage;
- Notification Stage; and
- Decision Stage.

Not all stages apply to all applications. Schedules 8 and 9 of IPA prescribe certain development types to be assessable, self-assessable or exempt. A development application is triggered under IPA if the proposed development is identified as assessable in Schedule 8 or 9 or the relevant local government's planning scheme (assuming that the development is subject to assessment against the planning scheme).

The IDAS process requires that applications are referred to individual "Referral Agencies" if referral to those agencies is triggered by the characteristics of the proposed development and/or the subject site. A Referral Agency has jurisdiction, relevant to the matter triggering referral, to assess applications, provide advice (if an Advice Agency) and impose requirements or direct refusal (if a Concurrence Agency).

Section 5.8.14 of the IPA sets out how the IDAS process applies for development that is the subject of an EIS as follows:

(a) Where the development application is for a development that is the subject of the EIS, the following apply:

- the EIS and EIS assessment report are part of the supporting material; and
- sections 3.3.6 (Information Request Stage) to 3.3.9 (Referral Agencies advise the Assessment Manager that they have received the applicant's response to the Information Request) and the Notification Stage do not apply; and
- for development requiring impact assessment, a properly made submission about the draft EIS is taken to be a properly made submission about the application; and
- if there is a referral agency, the referral agency's assessment period does not start unless the Chief Executive gives the referral agency the material under section 5.8.13; and
- if there is no referral agency, the decision stage does not start unless the Chief Executive gives the Assessment Manager the material under section 5.8.13; and
- if the application is changed in a way that the development is substantially different, the EIS process starts again for the development.

Material Change of Use

The *State Development and Public Works Organisation Act 1971* (SDPWOA) contains provisions which outline the relationship with the IPA if a proposal triggers an application for Material Change of Use under the IPA and associated legislation (refer to Part 4, Division 4 of the SDPWOA).

The EIS process prescribed by the SDWPO Act replaces the Information and Referral Stage and the Notification Stage of the IDAS process for Material Change of Use applications. At the completion of the EIS process, the CGs Evaluation Report will be taken as being a Concurrence Agency response under IPA and will be provided to the Assessment Manager to consider and incorporate into the Decision Notice.

The above applies only to assessable development.

A material change of use on SPL that is <u>inconsistent</u> with the Port Authority's land use plan is assessable development under Schedule 8 of IPA.

The *POTL Land Use Plan 1996* designates the land proposed for the marine precinct and the breakwater as "*port-dependent Industry*". The purpose of this designation is to provide for:

> *"uses which <u>are not</u> part of the core port operations as described above but which are intimately associated with and dependent upon being conducted in proximity to the land/sea interface and core port operations. They include stockpiles, granaries, silos and container storage. Facilities included in this category are those which;*
>
> - *handle bulk material either sourced by sea transport or dispatched by sea transport*
> - *generate such significant sea trade as to positively enhance the usage of the port".*

The Project is consistent with this land use designation as the marine precinct will not provide core port operations but will enhance the usage of the port by relocating existing marine industries, storage for sea transport and opportunities for new marine related industries that will.

The land included in the *Townsville Port Authority Land Use Plan 1996*, may require an application to be made under IPA for a Material Change of Use to allow for the specific proposed uses, however this will need to be confirmed with POTL.

Operational Works

In accordance with section 1.3.5 of the IPA, the following constitutes Operational Works (amongst others):

- tidal works; or
- work in a coastal management district; or
- constructing or raising waterway barrier works; or
- performing work in a declared fish habitat area; or
- removing, destroying or damaging a marine plant.

In terms of Schedule 8A of the IPA, the Chief Executive administering the *Coastal Protection and Management Act 1995* is the Assessment Manager for tidal work or work within a coastal management district for operational work that is:

a) tidal work not in a Port Authority's strategic port land tidal area or in local government's tidal area; or

b) work carried out completely or partly within a coastal management district; and

c) does not involve other assessable development.

In the event of the work being defined as prescribed tidal works, section 3.1.7(3) states the following:

(3) If a local government is the Assessment Manager for development not completely within the local government's planning scheme area—

(a) subsection (1) applies despite the Local Government Act 1993, section 25; and

(b) to the extent the application is for development for prescribed tidal work, the local government has the jurisdiction to assess the application in addition to any other jurisdiction it may have for assessing the application.

The Environmental Protection Agency's Guideline for "Making an Application for Prescribed Tidal Work" identifies that the Assessment Manager for these applications is the relevant local government. In the case under consideration, the proposed works are in the Townsville Port Authority's Area, and immediately adjacent areas, identified as "Strategic Port Land".

In terms of schedule 4A of the *Coastal Protection and Management Regulation 2003,* Prescribed Tidal Work is tidal works that is completely or partly within a local government tidal area. Schedule 10 of the IPA defines a "tidal area" as follows:

***tidal area**, for a local government—*

1 Tidal area, for a local government, means—

(a) to the extent both banks of a tidal river or estuarine delta are in the local government's area, the part of the river or delta below high-water mark that is—

(i) from the mouth of the river or delta as far up the river or delta as the spring tides ordinarily flow and reflow; and

(ii) adjacent to the local government's area; and

(b) to the extent 1 bank of a tidal river or estuarine delta is in the local government's area, the part of the river or delta between high-water mark and the middle of the river or delta that is—

(i) from the mouth of the river or delta as far up the river or delta as the spring tides ordinarily flow and reflow; and

(ii) adjacent to the local government's area; and

(c) if the boundary of the local government's area is the high-water mark or is seaward of the high-water mark—the area that is seaward and within 50m of the high-water mark.

2 Tidal area, for a local government, does not include a tidal area for strategic port land.

***tidal area**, for strategic port land, means—*

(a) to the extent both banks of a tidal river or estuarine delta are part of the strategic port land, the part of the river or delta below high-water mark that is—

(i) from the mouth of the river or delta as far up the river or delta as the spring tides ordinarily flow and reflow; and

(ii) adjacent to the strategic port land; and

(b) to the extent 1 bank of a tidal river or estuarine delta is part of the strategic port land, the part of the river or delta between high-water mark and the middle of the river or delta that is—

(i) from the mouth of the river or delta as far up the river or delta as the spring tides ordinarily flow and reflow; and

(ii) adjacent to the strategic port land; and

(c) if the boundary of the strategic port land is the high-water mark or is seaward of the high-water mark—the area that is seaward and within 50m of the high-water mark.

In accordance with 2(b)(ii) above, the tidal area for strategic port land extends to the middle of the river or delta adjacent to the strategic port land.

In accordance with IPA Schedule 8, Table 2, the Assessment Manager for the application will be POTL because:

- (ref. 2a) The site for the Marine Precinct is completely in a single port authority's strategic port land *(Lot 773 on EP2211*); and
- (ref. 2c) The breakwater *(preferred Option C)* constitutes tidal work partly in a single port authority's strategic port tidal area and in no Local Government tidal area or another port authority's strategic port land tidal area.

Under the *Coastal Protection Act 1995* the proposed works are defined as tidal works. Approval is required for the dredging and disposal of solid waste material in tidal water. The application will require referral to the Department of Natural Resources and Environment (DERM) (formerly Environmental Protection Authority (EPA)) who will assess the proposed development against the *Coastal Protection and Management Act 1995* (Coastal Act) and the provisions of the State Coastal Management Plan – Queensland's Coastal Policy (2001) and relevant regional coastal management plans.

The application for tidal work must be lodged with POTL as Assessment Manager for the TMPP. The application will trigger referral to the following Referral Agencies:

- Department of Natural Resources and Environment (DERM) as Concurrence Agency.
- Department of Employment, Economic Development and Innovation Queensland Primary Industries and Fisheries Queensland Primary Industries and Fisheries (DEEDI, formerly DPI&F) as Concurrence Agency.
- Department of Infrastructure and Planning (DIP) as Advice Agency.

Other Development

Other development made assessable through Schedule 8 also applies on SPL. This includes, for example, a material change of use for an Environmentally Relevant Activity (ERA) or operational works for clearing native vegetation on freehold land (unless the clearing is an exception under Part 1, Schedule 8). Reconfiguration of a lot on SPL is exempt development.

Land Act 1994

The Department of Natural Resources and Environment (DERM) administers the *Land Act 1994* (Land Act). The object of the Land Act is to ensure that land to which the Act applies is managed for the benefit of the people of Queensland. The Land Act applies to all land, including land below high-water mark.

In terms of section 9(1) of the Land Act, all land below high-water mark, including the beds and banks of tidal navigable rivers —

(a) is the property of the State, unless the land is inundated land or a registered interest in the land is held by someone else; and

(b) may be dealt with as unallocated State land.

Section 126 of the Land Act states:

126 Strategic port land

(1) If land above high-water mark is needed as strategic port land for a port authority, the port authority may be given, without competition, either a lease or deed of grant.

(2) However, if land below high-water mark is needed as strategic port land for a port authority, the port authority may be given, without competition, only a lease.

Section 127 of the Land Act addresses land tenure for reclaimed land as follows:

127 Reclaimed land

(1) If a person has reclaimed land under the authority of an Act—

(a) *the Governor in Council may issue to the person, without competition, a deed of grant over all or part of the land; or*

(b) *the Minister may issue to the person, without competition, a lease over all or part of the land.*

(2) *When granting the reclaimed land, the Governor in Council or Minister may amalgamate the land granted with an adjoining tenure held by the person.*

(3) *If the reclaimed land is already held under lease, the lease must be surrendered before a new lease or deed of grant is issued.*

(4) *If a deed of grant or lease is issued over only part of the reclaimed land, the rest of the land must be dedicated as a reserve or a road.*

(5) *If the reclaimed land is dedicated as a reserve and the person who reclaimed the land wishes to be the trustee of the reserve, the Minister must appoint the person as the trustee.*

(6) *If a deed of grant is issued, the purchase price is—*

(a) *the purchase price stated in the permission to reclaim the land or in the lease; or*

(b) *if no purchase price is stated—the amount of the unimproved value of the land, on the day the permission to reclaim the land was given, decided by the Minister.*

(7) *The person may appeal against the Minister's decision on the amount of the unimproved value.*

At least part of the subject site is currently below the high-water mark and thus owned by the State.

In its current state, the land below the high-water mark to be developed may be given to POTL under lease only.

Prior to the application being made for Resource Allocation, application must be made to lease the unallocated State land.

Once the land is reclaimed, POTL can apply for ownership of the land. However, section 127(3) of the Land Act requires that the lease must be surrendered before a deed of grant can be issued if the reclaimed land is held under lease.

Environmental Protection Act 1994

The Environmental Protection Agency administers the *Environmental Protection Act 1994* (EP Act). The objective of the Act is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (*ecologically sustainable development*).

The EP Act, together with the IPA, provides a licensing and approval regime for a range of Environmentally Relative Activities (ERAs). A regulation may prescribe an activity, other than a mining activity, as an environmentally relevant activity if the Governor in Council is satisfied that:

- a contaminant will or may be released into the environment when the activity is carried out; and
- the release of the contaminant will or may cause environmental harm (refer to Sections 18 and 19).

The EP Act requires that any person carrying out an ERA must hold, or be acting under a registration certificate for the activity. It is an offence to carry out an ERA unless the person is a registered operator for the activity, or is acting under a registration certificate for the activity. All operators are also required to have a development permit approval for the activity, unless a code of environmental compliance applies to the activity. Development permit approvals are granted under the IPA.

Levels of Environmentally Relevant Activities

There are two levels of ERAs:

- ERAs with an aggregate environmental score (AES) are considered to present a higher risk to the environment. There is an annual fee based on the AES for these ERAs.
- ERAs without an AES are considered to present a lower risk to the environment. There is a set annual fee for these ERAs.

ERAs (excluding mining and petroleum activities) are required to have obtained development approval or a code of environmental compliance (where one has been approved for a particular ERA or certain aspects of a particular ERA) and a registration certificate. This will be achieved through the process outlined in the EP Act and the *Environmental Protection Regulation 2008*.

Environmental Protection (Noise) Policy 2008

The object of the Environmental Projection (Noise) Policy 2008 (Noise EPP) is to fulfil the objective of the *Environmental Protection Act 1994*.

The development of the Precinct is likely to generate noise throughout the construction and operational phases of the development and dredging activities. As a result, the development of the Precinct will need to adhere to the requirements outlined under the Noise EPP and the *AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites*.

Specifically, the following sections are key reference points that are addressed by the Project:

- Section 11 – Acoustic quality objectives;
- Part 3 – Evaluation procedure and the approval of a Draft EMP;
- Part 4 – Measures for noise nuisance control;
- Part 6 – Procedures for noise assessments; and
- Schedules 1 and 3 – Planning levels for particular noise generating works.

Environmental Protection (Air) Policy 2008

As with the Noise EPP, the object of the Environmental Protection (Air) Policy 2008 (Air EPP) is to fulfil the object of the *Environmental Protection Act 1994*. The policy seeks to achieve this through the identification of environmental values to be protected or enhanced, specify air quality indicators and provide a framework for decision-making.

Specific obligations currently prescribed under the Air EPP that will be applicable to future development within the Precinct include:

- Section 8 – Air quality indicators;
- Section 9 – Air quality goals;
- Part 3 – Environmental management decisions;
- Part 4 – Management of certain sources of contamination; and
- Schedule 1 – Air quality indicators and goals.

Environmental Protection (Water) Policy 1997

The Environmental Protection (Water) Policy 1997 (Water EPP) aims to fulfil the object of the *Environmental Protection Act 1994* by identifying environmental values for Queensland waters, providing water quality guidelines and objectives, efficiently and equitably using water recourses, promoting best practice environmental management, and promoting community responsibility and involvement.

Unless prior approval is obtain, as outlined in Sections 31(3) or 32(2), the Water EPP prohibits the release of the following items into a roadside gutter, stormwater drain or a water; or in a place where it could reasonably be expected to move or be washed into a roadside gutter, stormwater drain or a water, and result in a build-up of sand, soil, silt or mud in the gutter, drain or water:

1. rubbish;
2. scrap metal, motor vehicle parts, motor vehicle bodies or tyres;
3. building waste;
4. sawdust;
5. solid or liquid waste from an on-site domestic waste water treatment system;
6. cement or concrete;
7. a degreasing agent, paint, varnish or paint thinner;
8. any manufactured product, or any by-product or waste from a manufacturing process, that has a pH less than 6 or greater than 9;
9. an insecticide, herbicide, fungicide or other biocide;
10. oil;
11. stormwater run off; and
12. sand, soil, silt or mud.

Environmental Protection (Waste Management) Policy 2000

The Environmental Protection (Waste Management) Policy 2000 (Waste EPP) provides a strategic framework for managing waste in Queensland. The objectives of the Waste EPP are achieved through establishing a preferred waste management hierarchy and principles for achieving good waste management, to be applied by both industry and government. The waste management hierarchy provides a framework for prioritising waste management practices to achieve the best environmental outcome. The hierarchy, from the most preferred to the least preferred method, is: waste avoidance; waste reuse; waste recycling; energy recovery from waste; and waste disposal.

The principles for achieving waste management objectives include:

- The polluter pays principle - all costs associated with waste management should be borne by the waste generator, including the costs of minimising the amount of waste generated, containing, treating and disposing of waste, and rectifying environmental harm;
- The user pays principle - all costs associated with the use of a resource should be included in the price of goods and services (including government services) developed from the resource; and
- The product stewardship principle - the producer or importer of a product should take all reasonable steps to minimise environmental harm from the production, use and disposal of the product.

The required contents of a Waste Management Program are outlined in Sections 18-21 of the Waste EPP. It is likely that a Waste Management Program will be required as a condition of an ERA licence.

The dredging operation associated with the development is classified as an Environmentally Relevant Activity (ERA) under the *Environmental Protection Regulation 2008* of the EP Act. The proposed dredging associated with the development is classified as ERA 16.

In accordance with changes to the *Environmental Protection Regulation 2008* legislation (in force as of 1 January 2009), port authorities are no longer exempt from requiring approval to undertake dredging. POTL will be required to make an application for ERA 16.

The Project may also trigger assessment of other ERAs as set out under Schedule 1 of the *Environmental Protection Regulation 2008*. These may include for example ERA 16 Extractive and screening activities. The operational phase of the development may require the assessment of ERAs such as ERA 49 Boat maintenance or repair, ERA 17 Abrasive blasting etc. Obtaining approval for these ERAs will become the responsibility of the developer of individual sub lessees.

Aboriginal Cultural Heritage Act 2003

The DERM administers the *Aboriginal Cultural Heritage Act 2003* (The ACH Act). The ACH Act binds all persons, including the State, to provide effective recognition, protection and conservation of Aboriginal cultural heritage.

Aboriginal cultural heritage is defined under Section 8 of the ACH Act as anything that is:

- A significant Aboriginal area in Queensland; or
- A significant Aboriginal object; or
- Evidence of archaeological or historic significance, of Aboriginal occupation of an area in Queensland.

Section 14 of the ACH Act denotes that as far as practicable, Aboriginal cultural heritage should be owned and protected by Aboriginal people with traditional or familiar links to the cultural heritage if it is comprised of any of the following:

- Aboriginal human remains;
- Secret or sacred objects; or
- Aboriginal cultural heritage lawfully taken away from an area.

In accordance with Sections 87, 88 and 89 of the Act requires the development of a Cultural Heritage Management Plan if:

- An EIS is required;
- An environment authority is required under a different Act; or
- Under the IPA, a development application is made for the project or the Chief Executive is a concurrence agency.

The requirements of a Cultural Heritage Management Plan (CHMP) and the assessment process are outlined in Part 7 of the Act.

As the Project requires an EIS, a CHMP has been developed in accordance with Section 87 of the ACH Act. The CHMP prepared for the Project was approved by NRW on 23 December 2008.

Coastal Protection and Management Act 1995

Overview

The *Coastal Protection and Management Act 1995* (Coastal Act) repealed the *Harbours Act 1955,* the *Canals Act 1958* and the *Beach Protection Act 1968*. The Coastal Act includes provisions to continue permissions and approvals given under the superseded coastal legislation. Assessable development within tidal areas is likely to trigger assessment of the development under the Coastal Act in circumstances such as the disposal of dredge material within tidal areas or construction within tidal areas.

The DERM administers the Coastal Act. The main objects of the Act are to—

(a) provide for the protection, conservation, rehabilitation and management of the coast, including its resources and biological diversity; and

(b) have regard to the goal, core objectives and guiding principles of the National Strategy for Ecologically Sustainable Development in the use of the coastal zone; and

(c) provide, in conjunction with other legislation, a coordinated and integrated management and administrative framework for the ecologically sustainable development of the coastal zone; and

(d) encourage the enhancement of knowledge of coastal resources and the effect of human activities on the coastal zone.

Coastal Management Plans

Coastal Management Plans, Coastal Management Districts and other legislative instruments are used to achieve “co-ordinated and integrated management and administrative framework”.

Coastal management plans:

- Identify principles and policies for coastal management;

- Identify key coastal sites and coastal resources in the coastal zone; and
- Plan for the long term protection or management of key coastal sites and resources.

Coastal Management Plans are developed in a consultative process including opportunities for public notification and seeking submissions from the public. The preparation of these plans are also undertaken specifically, with regard to the traditions and customs of Aboriginal and Torres Strait Islander people affected by the plans.

The State Coastal Management Plan – Queensland's Coastal Policy (State Coastal Plan) 2002 was prepared by the Minister in accordance with Section 30 of the Coastal Act. The State Coastal Management Plan is discussed further in Section 1.8.4.1. The State Coastal Plan deals with matters of international, national and state significance. Under Section 35 of the Coastal Act, the Minister is also required to:

- Prepare regional Coastal Management Plans to provide direction for the implementation of the State Coastal Plan; and
- Identify Coastal Management Districts in each region.

Coastal Management Districts are areas requiring special development controls and management practices.

Regional Coastal Management Plans must describe how the coastal zone is to be managed and identify the Coastal Management Districts. Regional Coastal Management Plans implement the State Coastal Management Plan's policy framework at the regional level and identify key coastal sites requiring special management within the region. The Queensland coastline has been divided into eleven regions. With the Precincts project area being within the Dry Tropical Coast region. The Dry Tropical Coast region extends from the northern boundary of Townsville City Council to the southern boundary of the former Bowen Shire. The region incorporates the local government areas of Townsville City Council, Palm Island Shire Council, Burdekin Regional Council and part of Whitsunday Regional Council.

The subject site is located within the area to be covered by the yet to be completed Dry Tropical Coast Regional Plan. Therefore, the proposed works are only currently subject to the provisions of the State Coastal Plan, which also has effect as a State Planning Policy under the IPA.

Removal of Quarry Material

The removal of quarry material from State coastal land below high water mark in a Coastal Management District is regulated by a resource allocation (Chapter 2, Part 5, Division 1) and a Dredge Management Plan (Chapter 2, Part 5, Division 2). The removal of quarry material below high water mark incorporates all types of dredging activity, including extractive industry dredging, capital dredging associated with some form of tidal works and maintenance dredging. Applications for these works are assessed by DERM against criteria listed in section 75 of the Coastal Act, the State Coastal Plan and the relevant regional Coastal Management Plan. An allocation notice or an approved Dredge Management Plan authorises the holder, during the period the notice or plan is in force, to access quarry material (refer to Section 100 of the Coastal Act).

In addition, operational work involving the disposal of dredge spoil or other solid waste material in tidal water, carried out completely or partly within a Coastal Management District, is deemed assessable development under the IPA (Schedule 8). The DERM is the Assessment Manager for these applications and an assessment is made against the provisions of the Coastal Act, the State Coastal Management Plan and the relevant Regional Coastal Management Plan.

Tidal Works

The proposed development is not defined as Prescribed Tidal Work in schedule 4A of the Coastal Act. This is because Prescribed Tidal Works exclude:

- Tidal works that will be used for port authority operations or a public marine facility constructed by or for Queensland Transport or a port authority; and
- Tidal works for creating or changing the configuration or characteristics of a navigational channel.

The subject site (Lot 773 on EP 2211) is identified as "Strategic Port Land" in the current *Townsville Port Authority Land Use Plan (1996)* (TPALUP). The area proposed for location of the breakwater is located to the east POTL reclamation area described as Lot 791 on EP2348 in the mouth of the Ross River. This land is described Strategic Port Land under the TPALUP.

Townsville City Council's *City Plan 2005* indicates that "Strategic Port Land" is "not subject to Planning Scheme". Therefore, "Strategic Port Land" is not subject to a local government planning scheme. As the identified location for the Precinct is identified as "Strategic Port Land", the proposed works will be assessed against the relevant provisions of the TPALUP by the POTL as Assessment Manager. The breakwater adjoins SPL and is within 50m of SPUL and, accordingly, POTL will also act as the Assessment Manager for works related to the breakwater. An application to undertake tidal work will be assessed by the POTL in accordance with the relevant procedural requirements of the Integrated Development Assessment System (IDAS).

Dredging

The proposed works will trigger either a quarry material allocation notice or a Dredge Management Plan under Chapter 2, Part 5 of the Coastal Act. A dredging ERA approval or approval of an Operator's License will be required.

Land reclamation

The application to dispose of material in tidal water will form part of the application for tidal works. If the DERM is not the Assessment Manager for the application, the application will be referred to the DERM as a concurrence agency. The DERM will assess the proposed disposal of dredge spoil against the provisions of the Coastal Plan.

Transport Infrastructure Act 1994

Queensland Transport administers the *Transport Infrastructure Act 1994* (TI Act). The overall objective of the TI Act is to provide a regime that allows for and encourages effective integrated planning and efficient management of a system of transport infrastructure.

In order to provide this regime, land needs to be managed by a land use instrument that will make development assessable or at least provide codes for self-assessable development.

Therefore, the TI Act requires POTL, to have an approved Land Use Plan over the Port Land in place that outlines proposed operational works or tidal works, reclamation, change of use for buildings and excavation permits. The TPALUP is such documentation. A new Land Use Plan is currently under preparation and is expected to be completed by the end of 2009. It is considered that the proposed works are consistent with the TPALUP and the Draft Review of the Port Land Use Plan.

Fisheries Act 1994

The DEEDI (formerly DPI&F) administers the *Fisheries Act 1994* (FA). The FA provides for the management, use, development and protection of fisheries resources and fish habitats, and the management of aquaculture activities. The FA includes provisions for the following:

- Taking, causing damage to or disturbance to marine plants, including mangroves;
- Works in a declared fish habitat;
- Waterway barrier works; and
- Tidal water, fresh and marine aquaculture operations.

In accordance with Schedule 8 of the IPA, operational works for the purposes of the above activities under the *Fisheries Act 1994* is assessable development. As a result, development approvals for the above activities are required under the IPA.

The proposed works are likely to result in the disturbance of marine plants and therefore requires assessment against the FA. Therefore, when the application for tidal works is lodged, the proposal will be referred to the DEEDI as a referral agency.

Water Act 2000

The DERM administers the *Water Act 2000* (Water Act). The Water Act provides a regime for the licensing, regulation and management of water resources in Queensland. The Water Act requires requisite licences (and/or development approvals under the Schedule 8 of IPA) be obtained for the purposes of all or some of the following:

- Artesian bores;
- Water pipelines;
- Pumping stations;
- Ground level storage sites; and
- Treatment plants.

All work that may interfere with or impact on watercourses, particularly within the bed and banks, must comply with the requirements of the Water Act and, as necessary or desirable, will also be discussed with DERM.

Under section 266 of the Water Act, any activities involving excavation or the destruction of vegetation in a watercourse require a permit. In deciding such an application, the DERM considers the type and location of the vegetation, the effect of the activity on the watercourse and the reason for the proposal, among other things.

A watercourse is defined as:

> *“1 Watercourse means a river, creek or stream in which water flows permanently or intermittently—*

(a) in a natural channel, whether artificially improved or not; or

(b) in an artificial channel that has changed the course of the watercourse; but, in any case, only—

(c) unless a regulation under paragraph (d), (e) or (f) declares otherwise—at every place upstream of the point (point A) to which the high spring tide ordinarily flows and reflows, whether due to a natural cause or to an artificial barrier; or

(d) if a regulation has declared an upstream limit for the watercourse—the part of the river, creek or stream between the upstream limit and point A; or

(e) if a regulation has declared a downstream limit for the watercourse—the part of the river, creek or stream upstream of the limit; or

(f) if a regulation has declared an upstream and a downstream limit for the watercourse—the part of the river, creek or stream between the upstream and the downstream limits."

The Precinct reclamation will occur on tidal lands adjacent to the mouth of the Ross River. Dredging activities will occur in the channel adjacent to the Precinct reclamation area and for construction of the Precinct and breakwater in the mouth of the Ross River. DERM will need to be consulted for a decision on whether this constitutes that works for the project are in a watercourse.

No marine vegetation is expected to be influenced during any construction activities and it is unlikely that this project will meet any major obstacles under the Water Act. Measures should be implemented during construction works to address issues such as sedimentation and erosion.

Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VMA), in conjunction with the IPA, regulates the clearing of native vegetation excluding grasses and mangroves. The VMA is administered by DERM. Under the IPA, operational works are defined as, in part, clearing vegetation, including vegetation to which the VMA applies. Schedule 2 Table 2 of the *Integrated Planning Regulation 1998* (IP Reg) requires that operational work that is the clearing of native vegetation be assessed against the provisions of the *Vegetation Management Act 1999*.

As the Project involves the reclamation of land there is unlikely to be any clearing of vegetation. However, some vegetation clearing may be required as part of the construction of any road or access way. DERM would assess any clearing required for the proposed works against the relevant Regional Ongoing Clearing Code. Only the clearing of remnant vegetation (native vegetation that occurs in a mapped Regional Ecosystem (RE), or that meets the structural and species requirements to be mapped as a RE) will be assessed under this process (non-remnant vegetation can be cleared under this VMA without a permit).

The *Fisheries Act 1994* is concerned with the protection and management of the State's marine and freshwater fish resources, inclusive of their habitats. Clearing marine plants, including plants in tidal areas will be assessed by DPI&F as part of the application for tidal works.

Nature Conservation Act 1994

The DERM administers the *Nature Conservation Act 1992* (NCA).

Under section 73 (a) of the NCA, the DERM is required to conserve wildlife and its values to:

- Ensure the survival and natural development of the wildlife in the wild; and,
- Conserve the biological diversity of the wildlife to the greatest possible extent; and,
- Identify reduce or remove, the effects of threatening processes relating to the wildlife; and,
- Identify the wildlife's critical habitat and conserve it to the greatest possible extent.

Any activity that may have the potential to impact on wildlife or its values in an area may be seen as a threatening process, and will be referred to the DERM as part of the development approval process. In particular, the effect of the project on Endangered, Vulnerable, or Rare wildlife, or the habitat on which that wildlife depends will be of interest to the DERM in regard to their obligations under section 73 of the NCA.

Wild Rivers Act 2005

The *Wild Rivers Act 2005* (WR Act) provides a higher level of environmental protection for rivers that have all or almost all of their natural values intact. The Minister is responsible for declaring "Wild Rivers" for protection under the WR Act.

The proposed works will not impact on any rivers declared as "Wild Rivers" under the WR Act.

1.8.4 Planning processes and standards

1.8.4.1 State planning policies

State Coastal Management Plan

The State Coastal Management Plan - Queensland's Coastal Policy 2002 (the State Coastal Plan) is a statutory instrument under section 29 of the *Coastal Protection and Management Act 1995* (Coastal Act) and has the effect of a State Planning Policy under the IPA. The plan operates in conjunction with other policies and instruments of the Coastal Act and the IPA.

The proposal must have regard to the State Coastal Plan, more particularly the principles and policies of the ten (10) management outcomes. These management outcomes include:

- Coastal Use and Development;
- Physical Coastal Processes;
- Public Access to the Coast;
- Water Quality;
- Indigenous Traditional Owner and Cultural Resources;
- Cultural Heritage;
- Coastal Landscapes;
- Conserving Nature;
- Coordinated Management; and
- Research and Information.

The State Coastal Plan has been discussed further in Section 1.8.3.

The ten management outcomes of the State Coastal Plan and their relevance to the Project are discussed further below.

Coastal Use and Development

- 2.1.1 Areas of state significance (social and economic)

The policy applies to the areas neighbouring or adjoining areas of state significance (social and economic). Strategic Port land is considered an area of state significance.

This policy requires that "*the integrity and functioning of 'areas of state significance (social and economic)' are maintained and protected from incompatible land uses and activities that may adversely affect the continued use of these areas*".

This policy does not apply to the development as the land is the type of land use that this policy is designed to protect as is demonstrated by the designation of Strategic Port Land and is being developed as a port related industry.

- 2.1.2 Settlement pattern and design

This policy applies to the *coast*, existing *urban areas* on the *coast*, or new *urban areas* containing *coastal resources* and their values.

This policy requires that "*the coast is conserved in its natural or non-urban state outside of existing urban areas and urban growth is managed to protect coastal resources and their values by minimising adverse impacts*".

The proposed development is to be developed on strategic port land and on land designated as future strategic port plan in an area already heavily developed for port related industry. It is also being developed on land that has been reclaimed under existing approvals and therefore the natural state of the coastal area has been altered. Further, the footprint of the breakwater has been configured to minimise adverse environmental impacts (refer Breakwater Options Section 1.5.3). It is therefore considered that the development is consistent with this policy.

- 2.1.3 Coastal-dependent land uses

The policy applies to the land on and neighbouring the *foreshore* and land containing *coastal resources* and their values.

This policy requires that when:

> "*planning for appropriate land uses in areas adjoining the foreshore, adequate provision needs to be made for coastal-dependent land uses. Where there is competition for available land, preference should be given to necessary coastal-dependent land uses ahead of other urban land uses.*
>
> *Planning for the location and design of new coastal-dependent land uses outside of existing coastal townships should be undertaken so as to avoid or minimise adverse impacts on coastal resources and their values".*

The proposed development is to be developed on strategic port land for a port related use. It is therefore considered that the development is consistent with this policy as the Precinct is a coastal dependent land use.

- 2.1.4 Canals and dry land marinas

A dry land marina is defined as "*a marina created by the excavation of land above high water mark.*"

The development of a canal or dry land marina is not proposed as part of this Project. It is therefore considered that this policy does not apply to this development.

- 2.1.5 Maritime infrastructure

This policy requires "*that maritime infrastructure (such as ports) have an important role in the state's economy and is appropriate where there is a demonstrated public need, no net loss of public access to the coast (in accordance with policy 2.3.1) and adverse impacts on coastal resources and their values are avoided where practicable, or minimised*"

It is considered that the location of the Project on Strategic Port Land is a compatible land use for the subject site and is consistent with this policy as it consolidates port related industry in one area.

The public access aspects of this policy are detailed further in Policy 2.3.1 Public Access.

- 2.1.6 Extractive industry

This policy requires that "*the economic value of particular coastal resources to the development industry and other industries is recognised. Any extraction activities are to be appropriately located and sustainably managed so as not to compromise relevant coastal management outcomes and principles*".

Dredging, including capital works for construction, is considered an extractive activity. Other than dredging, the TMPP will not involve any extractive activities or industries other than dredging. For the TMPP to proceed dredging is required of areas including the Ross River channel and Lot 773. Dredging and construction assessments completed for this EIS have determined the minimum required dredging activities to enable the project to proceed. These activities and strategies for minimising impact to coastal resources are described under Section 2.4.6.

The biodiversity values of the areas to be effected by dredging have been determined under Section 3 of this EIS and under Section 5 (economics) an ecosystem services assessment has determined the economic value of the coastal resources that will be effected by construction of the TMPP. Dredging activities proposed to enable the TMPP to proceed, further addressed under Section 2.1.8 below, will not negatively affect the regional coastal values of the Townsville region and are considered to be consistent with this policy.

- 2.1.7 Mining and petroleum activities

This policy requires that "*when assessing mining and petroleum activities (including exploration activities) in the coastal zone under the Environmental Protection Act 1994, the relevant decision-maker is to consider the State Coastal Plan and any relevant regional coastal plan*."

This policy will not apply as the TMPP does not involve a Mining and petroleum activity.

- 2.1.8 Dredging

This policy requires that the "*dredging from land below highest astronomical tide (e.g. within coastal waters) provides navigational and economic benefits to Queensland, and is to be* *appropriately located and sustainably managed to avoid or minimise adverse impacts on coastal resources and their values*".

Assessment of dredging activities required for the TMPP has been addressed in detail under Section 2.4.6. In summary dredging activities determined as required for the operational efficacy of the TMPP involve:

- Deepening of the existing levels to accommodate required shipping channels, berth pockets and a swing basin;
- Provision of a navigable area to accommodate pile moorings; and
- Removal of any soft sediments below rock revetment and breakwater footprints.

The shallow nature of the environment and material to be dredged is likely to require use of a mechanical Backhoe Dredge for the majority of dredging works. A proportion of dredge material has been identified as geotechnically suitable for reclaim and a Cutter Suction Dredge may be the appropriate plant for this activity.

Navigational benefits will be realised for access to the facility as a result of construction dredging works. Impacts on the state and local economy resulting from the TMPP have been assessed and are provided under Section 5 of this document. In brief, economic benefits are expected from the TMPP as it will provide an alternative location from which industries being negatively affected by the bridge construction could operate in conjunction with providing an opportunity for expansion of maritime construction industries in the Townsville region.

To meet policy requirements required dredging activities will be minimised to reduce any potential for environmental harm as a result of this activity. The proposed dredging will be undertaken using an approved Dredge Management Plan to ensure adverse impacts on coastal resources and their values are avoided or minimised and are sustainably managed.

- 2.1.9 Reclamation

This policy requires that:

> *"land below the highest astronomical tide is maintained in its natural state. It may only be reclaimed where:*
>
> *(a) it is necessary for erosion control or beach nourishment purposes;*
>
> *(b) it is necessary for protecting the natural environment and its processes;*
>
> *(c) it is for coastal-dependent land uses or other 'areas of state significance (social and economic)' and there is a demonstrated net benefit for the state or a region;*
>
> *(d) it is necessary for the operation of a port or harbour;*
>
> *(e) it is necessary for the development of a public or private facility and there is public support and a demonstrated public benefit from the proposal;*
>
> *(f) it is necessary to reinstate land that has been eroded; or*
>
> *(g) it is for reclamation within a canal or marina.*
>
> *For (c), (d) and (e) above, it needs to be demonstrated that there are no alternative sites available that do not require reclamation.*

For (f) above, reclamation should be undertaken in a coordinated manner with neighbouring properties also subject to erosion.

Reclamation of tidal waters creates adverse impacts on coastal resources and their values and therefore requires clear justification and the avoidance or minimisation of such adverse impacts.

The Project will require the reclamation of lands on Lot 773 on EP2211 (Benwell Road beach - approximately 34 hectares (ha)). This reclamation is consistent with point (c) of this policy as it is required for the development of coastal dependent land uses and provides a net social and economic benefit for the region, as noted under Sections 4 and 5 of this EIS (social and economic respectively). Lot 773 is designated as Strategic Port Land and has long been identified as the only available site within the Townsville region (refer Section 1.4) for placement of an industrial marina facility to provide services to existing and potential businesses.

Construction assessments conducted under this EIS (refer Section 2.4) have identified procedures to minimise adverse impacts on coastal resources and their values. Reclamation is required to facilitate construction of the Precinct. The social impact assessment conducted as part of this EIS has articulated that upstream marine industries and businesses may be forced to close or relocate beyond the Townsville region if the TMPP is not provided as an alternative location to existing facilities. This stems from impacts to business operational capability resulting from closure of the Ross River by development of the TPAR and that no alternative suitable site for the TMPP is available within the Townsville region. The economic assessments conducted as part of this EIS have articulated that failure to provide the TMPP as a relocation site for existing industries will have a net negative effect on the economy of the Townsville region through direct (loss of marine industry) and indirect (flow-on) effects.

Development of the project will address the ongoing and increasing demand for marine facilities in the region by providing a sheltered, purpose-built precinct for the collocation of similar marine dependant industries and public facilities currently spread around Ross Creek and South Townsville.

- 2.1.10 Tourism and recreational activities

This policy requires that:

"*the diversity and quality of recreational and tourism opportunities are maintained while ensuring that the coastal resources and their values, upon which these experiences rely, are protected.*

When planning for tourism and recreation, facilities and services such as waste treatment and access need to be designed to be capable of meeting projected peak demand. New tourist or recreational developments must be compatible with the coastal landscape values of the area and be of a scale that does not result in a significant impact on coastal resources and their values. Consideration also needs to be given to allow for a diversity and balance of tourism and recreational opportunities".

Maritime fabrication industries will be located within the TMPP and may service or supply marine tourism vessels or recreational craft. The facility will not be a destination port for tourism or recreational vessels and will provide waste management services of relevance only to vessel maintenance requirements. The TMPP will, therefore, be consistent with the intent of this policy.

- 2.1.11 Rural land uses

This policy requires that "*rural land uses are sustainably managed to maintain their important economic role in Queensland, as well as to protect coastal resources and their values, particularly coastal waters and wetlands*".

This policy will not apply as the Project does not involve rural land uses.

- 2.1.12 Managing water resources

This policy requires that "*in assessing an application for an authorisation to take water from a watercourse or to construct infrastructure that will interfere with the flow of water in the watercourse (for example, dams, weirs and tidal barrages), regard must be had to the effects of the proposal on coastal ecosystems and coastal processes*".

Hydrological, sediment transport and wave and coastal process investigations have been undertaken as part of this EIS and are documented under Section 3.8. Studies have demonstrated that the project will not negatively impact on the flow of water in the Ross River, flushing capability of the mouth of the Ross River or sedimentation patterns within the local area.

- 2.1.13 Fishing

This policy requires that "*the ecological health and economic and social value of the fisheries resource is protected through careful management of fishing activities, particularly in terms of the protection of endangered or vulnerable species, nursery grounds and feeding areas*".

Section 3.10 of this EIS provides detailed assessment of the marine biodiversity of the area to be impacted by the TMPP. Areas considered of high importance for support of fisheries resources (in particular seagrass meadows and mangroves) will not be affected by the TMPP. The small fringe of mangroves at the rear of Lot 773 is likely to be reclaimed as part of the road, rail and services corridor for the TPAR, not the TMPP.

Studies have demonstrated that loss of benthic habitats associated with reclamation of Lot 773 will not negatively affect regional biodiversity and of any species considered to be food sources for other fishery species. Some benthic habitats will be created through construction of the offshore breakwater and external rock revetments, and may act as fish refuges. Some social fishing opportunities will be lost through reclamation of Lot 773 (refer Section 4), however, consideration will be given to provision of alternative recreational opportunities through inclusion of public access areas on the Precinct (eg fishing from external revetments) and through inclusion of public access facilities on upstream lands made available through industry relocation to the Precinct. The TMPP is therefore considered to be consistent with the values identified in this policy.

- 2.1.14 Aquaculture

This policy requires that "*aquaculture on the coast will be located and undertaken in a manner that results in no significant adverse impacts on the coastal resources and their values*".

This policy will not apply as the Project does not involve the development of aquaculture activities in the region.

Physical Coastal Processes

- 2.2.1 Adaptation to climate change

This policy requires that:

> *"Knowledge and understanding of greenhouse issues and climate change impacts should be improved amongst the public and private sectors with the aim of setting the foundation for cost effective adaptation measures. The four target areas are: avoidance of development on vulnerable areas; improved knowledge and understanding of climate change; assessments of impacts and vulnerability; and incorporating adaptation strategies into coastal planning and management".*

A climate change impact assessment and adaptation study have been conducted as part of this EIS. Those are detailed under Section 3. Information from those studies has influenced the reference design to reduce the breakwater footprint and avoid construction and impacts upon sensitive wading and migratory bird habitats. Through the climate adaptation studies information on potential sea level changes has provided support for design considerations of an appropriate reference level and construction approach to minimise possibility of the Precinct being inundated within its operational design life. Understanding of potential climatic risks and threats to the development has been developed enabling incorporation of that knowledge into design and management strategies to minimise impacts and this study is, therefore, in accordance with this policy.

- 2.2.2 Erosion prone areas

This policy requires that "*to the extent practicable, erosion prone areas are to remain undeveloped apart from acceptable temporary or relocatable structures for safety and recreational purposes*".

Lot 773 on which the Precinct will be developed is Strategic Port Land. The subject site is located within the area to be covered by the yet to be completed Dry Tropical Coast Regional Plan. Therefore, the proposed works are only currently subject to the provisions of the State Coastal Plan, which also has effect as a State Planning Policy under the IPA. The Port of Townsville (including the area covered by Lot 773) and the upstream industrial sites do not have any specified erosion prone area distances provided on the Erosion Prone Area Plan (SC3391). Therefore, the erosion prone area for both the above areas is determined by Clause 2(i) of the plan that specifies that the erosion pone area is

> "a line measured 40 metres landward of the plan position of the mean high water springs (MHWS) tide level except where approved revetments exist, in which case the line is measured 10 metres landward of the upper seaward edge of the revetment, irrespective of the presence of outcropping bedrock".

Given that the current Port landward boundary is identified by approved revetments, and that formal approval would be sought for the external revetment for a reclaimed Lot 773, the landward boundary of the erosion prone area for the Port is assumed to be 10 m landward of the upper seaward edge of the revetment. Along the banks of the Ross River upstream of the mouth where there is an approved revetment, the landward boundary of the erosion prone area would extend to 10 m landward of the upper seaward edge of the revetment. Because much of the upstream land is currently occupied by existing marine industry the erosion prone area would be 10 m from the edge of the revetment or 40 m if there is no approved revetment.

Construction and operation assessments conducted as part of this EIS have included a 10 m buffer in their assessments to provide impact assessment against a reference design that minimises development of erosion prone environs. The reference design, and assessments undertaken for this EIS, are therefore in accordance with this policy. Detailed design of the Precinct will be referred to DERM to assess concurrence with policy 2.2.2.

Lands located upstream from Lot 773 within Ross River may be redeveloped following relocation of the occupying industries to the Precinct. Redevelopment of these lands will also need to account for erosion potential. In relation to setback distances for any infrastructure in the redevelopment of the existing marine industry areas, the following scenarios are possible:

- If the land is to be reconfigured, DERM may require the surrender to the State of all or part of the land in the erosion prone area as a condition of their concurrence response. This process resets the property boundaries, which would then form the basis of any other setback requirements under planning legislation that may be required; alternatively
- If the land is subject to a material change of use application, the DERM will be triggered as a concurrence agency provided the associated redeveloped building development > 1000 square metres, and may apply setbacks to ensure that any development is not in the erosion prone area with justification based on the various policies in the State Coastal Management Plan.

Upstream lands are currently industrial sites and are likely to have some approved revetments, jetties and seawalls. Following surrender and remediation they will likely be proposed for redevelopment into mixed residential / commercial consistent with the Townsville City Plan. As this will trigger a material change of use application any development application will be referred to DERM for consideration of any setbacks or land surrender that may be required.

- 2.2.3 Shoreline erosion management

This policy specifies that:

> "*Regional coastal management plans will identify any priority areas for erosion management.*
>
> *These areas will be taken into account when considering:*
>
> *(a) applications for renewal or conversion of leases for leasehold land on the coast;*
>
> *(b) issuing any approvals for coastal protection works; and*
>
> *(c) assessing applications for funding proposals for coastal management programs*".

Lot 773 and the upstream lands linked to the Precinct development are located in the dry tropics of Queensland in Townsville. A regional coastal management plan has yet to be developed for this coastal area and in the absence of that approved management plan the policy default for shoreline erosion management is the defined Erosion Prone Area policy of the State Coastal Management Plan. As such, in the case of the Precinct, shoreline erosion management is to be given due consideration under the policy noted above in Section 2.2.2.

◗ 2.2.4 Coastal hazards

This policy requires that:

> "*When determining new areas for urban land uses on the coast, an evaluation is to be carried out to identify the level of potential risk to life and property from coastal hazards. This evaluation should be based on mapping of storm tide hazard areas in addition to considering the impact of physical coastal processes, including any impacts from potential sea level rise.*
>
> *Development in areas on the coast identified as having a risk of being affected by coastal hazards needs to be carefully considered and wherever possible, be retained undeveloped. Where areas vulnerable to storm tide inundation have been developed, further development in these areas needs to address: u its vulnerability to sea level rise and storm tide inundation; and the proposed access to and protection of evacuation routes.*
>
> *In such areas, local government should have in place counter-disaster plans to address these coastal hazards.*

A detailed coastal processes assessment has been conducted as part of this EIS and is provided as Section 3.8 of this document. Assessment has determined that development and operation of the Precinct will not unduly effect coastal processes including flushing, sediment transport and wave dynamics in the coastal areas associated with the Precinct footprint. Hydrodynamic and wave modelling studies supported selection of the breakwater design configuration to minimise potential for impacts on the coastal habitats from ambient and under storm conditions. Further opportunities to minimise operational impacts have been identified and articulated within the project specific Environmental Management Plan. These include strategies for hazardous material storage that mitigate against spills and environmental harm, opportunities to mitigate against wave inundation under severe storms (cyclones) and sea level rise scenarios and evacuation strategies to maintain safety in emergency situations. The studies and their findings clarify that the development and operation of the Precinct is, therefore, in accordance with this policy.

◗ 2.2.5 Beach protection structures

This policy requires that:

> *"Construction of structures for the purpose of beach protection (including artificial reefs, banks, wrecks, breakwaters and groynes) in coastal waters will only be approved where:*
>
> *(a) there is a demonstrated need in the public interest; and*
>
> *(b) comprehensive investigation has been carried out and it can be demonstrated that:*
>
> *(i) there would not be any significant adverse impacts on the longshore transport of sediments; and*
>
> *(ii) there would be no increase in coastal hazards for the neighbouring foreshore".*

To be functional the Precinct will require opportunity to berth vessels for in water servicing and maintenance and to slip vessels for out of water maintenance. Berth areas for mooring and provision are also necessary. To meet this need the outer quayline of the Precinct and the swing basin and channel approach to the Precinct must provide safe operational conditions under a range of wind, wave and tidal conditions. A detailed assessment was undertaken as part of the studies for this EIS to develop an appropriate design configuration for the Precinct breakwater. This included consideration of environmental, hydrodynamic and wave impacts under a range of breakwater configurations as well as consideration of the effects on the Precinct quayline of not constructing a breakwater. The wave tranquillity of the Precinct quayline was not within safe operational requirements without inclusion of a breakwater and the breakwater is considered necessary for safe vessel operation for the Precinct quayline.

The breakwater configuration assessment selected a design that provided little to no impact upon the longshore transport of sediments in comparison to existing conditions and upon the existing hydrodynamic regime of the Ross River mouth. Studies have demonstrated that, adopting the mitigation strategies identified within this EIS, construction and operation of the Reference Design Precinct will not have any adverse impacts upon the neighbouring foreshore as long as the detailed design process gives due consideration to reference levels under different climate scenarios. Environmental benefits from the selected breakwater configuration may include:

– Restriction westward of longshore sediment transport into the Ross River navigation channel and a reduced requirement to dredge the Ross River channel in the longer term;
– Provision of an effective barrier between the common use areas and the sensitive environmental areas to the east; and
– Provision of an opportunity for sand to accrete on the eastern side of the breakwater to provide an alternative migratory bird roosting and nesting area.

The Precinct Reference Design, including the breakwater, and the studies against it are therefore considered to be in accordance with this beach protection policy.

Public Access to the Coast

◗ 2.3.1 Future need for access

This policy requires that:

> *"There is no net loss of public access to the foreshore or of public useability of coastal waters. This is to be maintained, protected and enhanced where the provision and operation of infrastructure of state economic significance and protection of coastal (natural and cultural) resources is not compromised".*

The Project area includes Lot 773 and areas on the eastern side of Ross River. Lot 773 is reclaimed land currently comprising a sandy beach margin with mudflats exposed at low tide. This area is held under perpetual lease by POTL and is identified as Strategic Port Land. The public has been allowed to access the beach and mudflats for recreation purposes until such time as the land is required for Port related purposes such as construction of an industrial marine precinct. Current uses include fishing, yabbying, walking and dog exercise. These are detailed further under the social impact assessment section of this study (refer Section 4).

The TMPP will form an industrial marine facility within which maritime fabrication, boat maintenance and commercial barge operations will occur. This will include the use of forklifts, trucks, operational cranes for heavy lifting, welding, abrasive blasting and other machinery. The facility will, as appropriate, be bound by workplace health and safety regulations including required use of Personal Protective Equipment such as hard hats, eye protection, work boots and ear protection for the safety of employees. Public access to the full operational facility may be unsafe and, therefore, inappropriate.

To maintain public access to the coast, consideration is being given to inclusion of areas within the Precinct that may be open to the public. This may include opportunity for direct purchase from seafood suppliers or provision of access points along the external face of the rock revetment. The detailed design of the Precinct will need to address these considerations against the safe operation of the Precinct facility and the safety of the public.

Upstream industrial lands may be vacated by industries relocating to the Precinct. The desired planning outcome of the redevelopment of any upstream lands will be to provide enhanced public access to the coast that offsets losses experienced through development of the Precinct. These upstream lands are currently inaccessible to the public because they are working commercial sites. When they are redeveloped in accordance with any approval from Council it is anticipated that increased opportunities for public access and recreation will be provided e.g. riverside boardwalk, seafood sales outlet, possible fishing locations and potentially a fenced dog exercise area in the existing environmental park.

At this point it cannot be guaranteed that redevelopment of upstream lands will be able to replace all existing public access opportunities. However POTL will endeavour to provide alternative recreation opportunities as identified above.

An Aboriginal Cultural History storyboard will be located at the environmental park that recognises the significance of the area to Indigenous Traditional Owners. Information on the importance of the mangroves and mud flats within the area may also be included to educate public users of the importance of these environs to recreational and commercial fisheries.

- 2.3.2 Design of access

This policy requires that:

> "*The design of access to the coast or along the foreshore and any associated facilities is to meet the following criteria:*
>
> *(a) maintain the long-term stability of dunes or other types of landforms;*
>
> *(b) avoid alteration to tidal regimes and coastal processes;*
>
> *(c) minimise impacts on coastal resources, particularly disturbance to coastal wetlands, other coastal habitats, protected species, and significant habitats including wildlife nesting and breeding areas (such as for turtles and shorebirds);*
>
> *(d) minimise damage to island substrate from anchor damage;*
>
> *(e) avoid routes that pass through or have an adverse impact on sites of cultural significance, except where such access is in keeping with the values of the site; and*
>
> *(f) provide appropriate signposting of access ways*".

A Reference Design for the Precinct, which includes an offshore breakwater, has undergone detailed assessment as part of this EIS study for its potential to impact existing hydrodynamic regimes, coastal processes, flushing, sediment transport, impacts to natural systems and the biodiversity they support (including avifauna and megafauna) and transport regimes. Transport access corridors have, in particular, been assessed against proposed development of the TPAR and strategies to mitigate against identified impacts, such as disturbance to nearby residential areas during construction of the Precinct, have been identified. Assessment has determined that development and operation of the Precinct will not unduly affect coastal processes, transport corridors or natural systems. Adoption of the proposed breakwater configuration, in particular, reduces potential to impact upon wading and migratory birds by avoiding critical habitat. Use of the TPAR access route following its completion will greatly reduce any transport impacts upon nearby sensitive receivers and, as such, staged construction of the Precinct to minimise development prior to completion of the TPAR is appropriate. The studies, their findings and proposed mitigation strategies clarify that the development and operation of the Precinct is, therefore, in accordance with this policy.

- 2.3.3 Coastal road network

This policy requires that "*the coastal road network is planned to minimise impacts on coastal resources and their values*".

The proposed Townsville Marine Precinct will continue to be accessed via Benwell Road, a locally controlled road currently under jurisdiction of POTL. The two-lane bitumen sealed road provides the main access to the Port. A new access intersection from Benwell Road will be constructed as part of the Benwell Road/Port Access Road interface.

The Project does not require the development of new roads other than local roadways within the Precinct itself to enable vehicular access to all Precinct facilities.

- 2.3.4 Vehicle use on beaches

This policy requires that "*plans that address vehicle use on beaches, including regional coastal plans, will determine long-term levels of use that provide for public access and safety while ensuring that the coastal resources and their values are protected*".

The Project does not involve vehicle use on beaches and therefore this policy does not apply.

Water Quality

The coastal management outcome for water quality under the State Coastal Plan requires that "*water quality in the coastal zone to be maintained at a standard that protects and maintains coastal ecosystems and their ability to support human use*".

There are six policies for water quality under the plan, these include:

- 2.4.1 Water quality management;
- 2.4.2 Wastewater discharges to coastal waters;
- 2.4.3 Waste-disposal facilities;
- 2.4.4 Stormwater management;
- 2.4.5 Groundwater quality; and
- 2.4.6 Acid sulfate soils.

Detailed investigations of water and sediment quality undertaken to support this EIS have demonstrated that the water quality within the vicinity of the Precinct has elevated levels of nutrients. Potential acid sulfate soils have been determined to be present in approximately 70% of the area of the development footprint, including areas proposed for dredging. Potential re-use of dredged material for reclamation will, therefore, require consideration of acid sulfate treatment and management options.

Groundwater levels within fill material placed in Lot 773 are likely to be influenced by tidal fluctuations and by rainfall events. Existing shallow groundwater is saline and of relatively poor condition with elevated concentrations of dissolved metals and ammonia. Given that groundwater quality does exceed the water quality guidelines for surrounding surface waters, any groundwater extracted as part of excavation dewatering operations will require treatment to meet acceptable levels prior to discharge. Migration of groundwater is likely to be predominantly from the west, however, there is potential for saline waters to affect the integrity of foundations and infrastructure within Lot 773. This should be considered during the detailed design phase.

Construction and operation activities have the potential to impact upon the local water and sediment quality and strategies to mitigate against these impacts appropriate to the TMPP have been developed. These include waste water and stormwater management recommendations, recommendations for water quality management during dredging and reclamation works and management strategies for potential acid sulfate soils. These are discussed in detailed under the EMP developed for the project to appropriately manage and mitigate any impacts upon water quality in accordance with the Water EPP. If suggested management strategies are adopted it is expected that the project will meet the six water quality policies under the State Coastal Plan.

Indigenous Traditional Owner and Cultural Resources

The coastal management outcome for Indigenous Traditional Owner and Cultural Resources under the State Coastal Plan requires that **"***the living culture of Indigenous Traditional Owners and their connection with cultural resources within the coastal zone is valued and continues for future generations of Indigenous Traditional Owners*".

There are two policies for Indigenous Traditional Owner and Cultural Resources under the plan, these include:

- 2.5.1 Areas of state significance (Indigenous Traditional Owner cultural resources); and
- 2.5.2 Involvement of Indigenous Traditional Owners in managing their cultural resources.

Lot 773 is not an area of state significance for Traditional Owner cultural resources and this policy, therefore, does not apply in that regard. The Precinct site and upstream lands targeted for redevelopment lie along the Ross River, which is considered to have cultural importance to local Traditional Owners (refer Section 3.15). Accordingly, a project specific Cultural Heritage Management Plan has been developed for the construction and operation stage of the Project in accordance with Section 87 of the ACH Act. The CHMP prepared for the Project was approved by DERM on 23 December 2008.

Cultural Heritage

The coastal management outcome for Cultural Heritage under the State Coastal Plan requires "*that places, buildings and objects with important cultural heritage values located on the coast are appreciated, conserved, managed and passed on to future generations"*.

There are two policies for Cultural Heritage under the plan, these include:

- 2.6.1 Areas of state significance (cultural heritage)

◗ 2.6.2 Cultural heritage

A project specific Cultural Heritage Management Plan has been developed for the construction and operation stages of the Project. The CHMP prepared for the Project was approved by DERM on 23 December 2008. The cultural heritage importance of lands associated with development and operation of the TMPP have been assessed under Section 3.15 of this study. Although a number of sites of importance occur within the South Townsville area none are directly linked to the TMPP. The project is not expected to impact upon any of the identified areas of significance and, therefore, this policy is not triggered.

Coastal Landscapes

◗ 2.7.1 Areas of state significance (scenic coastal landscapes)

This policy discusses incorporating areas of state significance into regional coastal plans and planning schemes.

> *"In preparing regional coastal plans, 'areas of state significance (scenic coastal landscapes)' are to be identified and their diversity, quality and extent of scenic landscape values are to be recognised and protected.*
>
> *The preparation of regional planning strategies and local government planning schemes for areas that include 'areas of state significance (scenic coastal landscapes)' as identified by regional coastal plans, are to include measures that protect areas with coastal landscape values from incompatible land uses.*
>
> *Where 'areas of state significance (scenic coastal landscapes)' have not been identified by a regional coastal plan, regional planning strategies and planning schemes are encouraged to protect scenic landscape values from incompatible land uses".*

In the absence of a regional plan the default policy document for coastal landscape is the State Coastal Management Plan. Under Schedule 2 of that Plan Townsville is noted as an area of 'high scenic management priority'. The area proposed for the Townsville Marine Precinct and breakwater (Lot 773 and Lot 791) are identified as Strategic Port Land in the current (1996) Port Land Use Plan. Townsville City Council City Plan 2005 designates Strategic Port Land as 'not subject to Planning Scheme'. However, to address how the Precinct may impact upon the scenic values of the Townsville region a landscape character and visual impact assessment was conducted as part of this EIS (refer Section 3.3 and Appendix N).

The project site is located within an area that has existing industrial development including both port and land based activities. While individual impacts may have a minimal impact on the visual landscape, the cumulative impact is a continuing industrialised landscape within this area. This is particularly the case with the additional land reclamation. The project will alter the surrounding landscape and the visual experience of the receptors. However, these changes must be seen within the context of the existing local environment. The new works are co-located within the existing port and industrial development therefore it is not considered to be a new element in the visual outlook. The assessment of impacts is considered to be of moderate significance. A strategy for minimising these impacts that could be considered during the detailed design phase of the TMPP would be to reduce the size of worksheds below the proposed reference height as far as practically possible to minimise the visual impact of these facilities.

- 2.7.2 Other coastal landscape values

This policy requires that:

> *"When assessing landscape values, the importance of coastal landscapes to the state and regional community is to be addressed. In particular, the relevant Indigenous Traditional Owner communities are to be involved in the assessment of landscape values (refer to policy 2.5.2).*
>
> *In addition to policy 2.7.1, which focuses on scenic values of coastal landscapes of state significance, regional coastal plans will assess the following:*
>
> *(a) for areas identified as 'areas of state significance (scenic coastal landscapes)' — other coastal landscape values such as cultural and spiritual values that are of state or regional importance;*
>
> *(b) for areas not identified as 'areas of state significance (scenic coastal landscapes)' — the importance of coastal landscape character and associated values; and*
>
> *(c) the coastal landscapes' sensitivity to development and change.*
>
> *Investigations into landscape values will be undertaken as part of the preparation of regional coastal plans to identify the values identified in this policy. Other relevant and current landscape studies for the region will be identified and used in these investigations.*
>
> *Regional planning strategies and local government planning schemes for coastal areas should protect areas with state and regionally important coastal landscape values, identified by regional coastal plans, from incompatible land uses.*
>
> *Where state and regionally significant coastal landscape values have not been identified by a regional coastal plan, regional planning strategies and planning schemes are encouraged to protect coastal landscape values that are consistent with this policy".*

A regional plan does not exist for Townsville. Consistent with this policy relevant aspects of this EIS study have discussed with Traditional Owners. Efforts have been made to reduce impacts to coastal landscape values, including reducing the breakwater footprint, in forming the reference concept design. Landscape values of the Project Area have been assessed as part of a visual impact assessment, forming part of this EIS. Detailed assessment of the landscape character is provided under Section 3.3 and within Appendix N. Construction of new land within Ross River to add to the existing port facilities and construction of the breakwater will increase the extent of this type of landscape within the local area. As the works will be co-located within the existing industrial area of Townsville this development is considered in accordance with the existing landscape character of the local area.

Conserving Nature

- 2.8.1 Areas of state significance (natural resources)

This policy requires that "*land identified to be developed in the future for urban, maritime and rural land uses in regional plans, planning schemes and port land use plans is to be located outside of 'areas of state significance (natural resources*)".

The area proposed for the Townsville Marine Precinct and breakwater (Lot 773 and Lot 791) are identified as Strategic Port Land in the current (1996) Port Land Use Plan. Townsville City

Council City Plan 2005 designates Strategic Port Land as 'not subject to Planning Scheme'. It is therefore concluded that the Project does not interfere with an area of State Significance. The areas targeted for development have, however, been assessed under this EIS as to their value as a coastal resource in a regional and local context. Ecological studies (refer Section 3.10) note that there are no Regional Ecosystems of concern within the study area and that any terrestrial vegetation associated with the study area is fragmented and degraded with a high incursion of weed species. No terrestrial animals of conservation concern were detected in the study footprint.

A number of wading and migratory birds of international conservation importance were noted in the mouth of the Ross River adjacent to the project footprint. This site was acknowledged as an area of regional significance for these species and this area has been deliberately excluded from the project footprint to reduce potential impacts upon these species. Similarly, the benthic habitats in Cleveland Bay near the project footprint are also acknowledged to be of importance for marine species vulnerable to anthropogenic impacts and of high conservation value, including turtles, dugong and dolphins. Impact mitigation measures have been identified for any perceived risks to these species and are detailed under Section 3.10 of this document. If identified mitigation measures are adopted it is considered this project will not negatively impact the regional value of coastal resources.

- 2.8.2 Coastal wetlands

This policy requires that "*further loss or degradation of coastal wetlands is to be avoided and impacts on coastal wetlands prevented, minimised or mitigated (in order of preference)".*

The policy addresses matters that are relevant to the conservation and management of Queensland's coastal wetlands, including land within 100m of a coastal wetland.

The Precinct footprint on Lot 773 is adjacent to mangrove communities that support significant wading and migratory birds among other fauna. To avoid potential to impact upon this area the biodiversity it supports the breakwater footprint has been set offshore disconnected to land.

The Bowling Green Bay Ramsar wetland area is located approximately 10 km southeast of Townsville and is listed on the Department of Environment, Water, Heritage and the Arts, '*Directory of Important Wetlands*'. Under this directory the Project area falls adjacent to the Ross River Reservoir (QLD008) and Bowling Green Bay (QLD002) (www.environment.gov).

Wetlands south and east of the Ross River are designated as being within an Area of State Significance (natural resources) by virtue of their listing within the Queensland chapter of the '*Directory of Important Wetlands*' in Australia. The Precinct footprint falls within Strategic Port Land, which also holds social and economic significance for the State. If a use or activity has the potential to adversely affect this area, it must demonstrate an overriding net benefit for the State as a whole. Because of the considerable distance from the Ramsar wetland to the project area the Project is not expected to have an effect on the Ramsar area and it will provide social and economic benefits to the region and state.

- 2.8.3 Biodiversity

This policy requires that "*biodiversity on the coast is to be safeguarded through conserving and appropriately managing the diverse range of habitats including coral reefs, seagrass, soft* *bottom (benthic) communities, dune systems, saltflats, coastal wetlands and riparian vegetation*".

The biodiversity and natural values of the Precinct footprint and adjunct habitats have been assessed under this EIS. Ecological studies (refer Section 3.10) note that there are no Regional Ecosystems of concern within the study area and that any terrestrial vegetation associated with the study area is fragmented and degraded with a high incursion of weed species. No terrestrial animals of conservation concern were detected in the study footprint.

A number of wading and migratory birds of international conservation importance were noted in the mouth of the Ross River adjacent to the project footprint. This site was acknowledged as an area of regional significance for these species and this area has been deliberately excluded from the project footprint to reduce potential impacts upon these species. Similarly, the benthic habitats in Cleveland Bay near the project footprint support seagrasses and are acknowledged to be of importance for marine species vulnerable to anthropogenic impacts and of high conservation value, including turtles, dugong and dolphins.

Within the direct footprint of the Precinct and breakwater soft sediment benthic taxa occur. Potential impacts to assessed biodiversity from construction and operation of the Precinct have been determined and mitigation measures have been identified for any perceived risks to these species. Potential offsets for impacts, including removal of benthic taxa, that cannot be mitigated against have also been suggested. If suggested measures are adopted it is considered this project will not negatively impact the regional biodiversity values.

- 2.8.4 Rehabilitation of coastal resources

This policy requires that "*rehabilitation of degraded coastal areas and resources is encouraged. For existing activities in the coastal zone, a proactive voluntary approach to rehabilitation working in partnership with landholders, community groups (such as catchment management), local government (including Aboriginal Councils and Island Councils) and local Indigenous Traditional Owner groups is supported. The priority for rehabilitation is the restoration of degraded coastal ecosystems to their natural ecological, physical and aesthetic condition'*.

POTL has recently undertaken rehabilitation of a disused (Sun Sun) aquaculture facility on the banks of the Ross River upstream from the Precinct location. In accordance with this policy POTL will also undertake rehabilitation of upstream lands vacated by relocating industries to a standard appropriate for redevelopment. Discussions with indigenous groups in relation to this EIS have provided avenues for including signage on rehabilitated lands that are publicly accessed to provide information in regards to Aboriginal cultural heritage of the sites. Any such activities will be undertaken through continued consultation and involvement with the endorsed Aboriginal parties. All rehabilitation works will be in accordance with the Environmental Management Plan that accompanies this EIS.

- 2.8.5 Pest species management

This policy requires that:

> *"The focus of pest management activities is on minimising the risk of introducing new pest species and reducing or at least controlling the impact of pest species infestations. Management of pest species will have regard to:*

- *preventing the introduction, establishment and spread of pest species in the coastal zone; and*
- *managing the impacts of existing and new pest species".*

Terrestrial vegetation adjacent to the Precinct footprint has been identified as fragmented and degraded with a high incursion of weed species (refer Section 3.10 of this document). Mitigation strategies suggested under this EIS to minimise the risk of spreading weed species during construction include the use of wash down facilities. Rehabilitation of degraded lands not associated with the Precinct through removal of weed species is also noted to assist in controlling reinfestation. No marine pest species were detected during the aquatic studies and the Precinct is not identified to be a first port of call for international vessels requiring quarantine clearance. Strategies to avoid introduction of marine pests during the construction and operation of the Precinct are suggested under Section 3.10, including adherence to international ballast management requirements. If strategies identified in this EIS are adopted it is suggested the project will be in accordance with this policy.

Coordinated Management

The coastal management outcome for Coordinated Management is "*coordinated management is coordinated and integrated across all levels of government and within the community*".

There are five policies for Coordinated Management under the plan, these include:

- 2.9.1 Regional coastal management plans;
- 2.9.2 Coordinated management of jurisdictions;
- 2.9.3 State land on the coast;
- 2.9.4 Private use of State land on the coast; and
- 2.9.5 Control districts.

These policies deal with the coordination and implementation of the State Coastal Plan into regional and local planning documents. A Whole of Government (WoG) working group established by POTL has been engaged during all phases of this project from prior to commencement to reporting of findings and provides an avenue through which management is coordinated and integrated across levels of government. In addition to meetings with the WoG group a number of additional consultation events have occurred during the life span of this project to enable interactive discussions with relevant regulatory agencies on the activities being conducted under the TMPP EIS process. A summary of these is provided as Table 1-3.

Table 1-3 Summary of Government consultation activities during the TMPP EIS process

Date	Briefing to	Location	Purpose
14/11/07	DIP/CoG Dept	Brisbane	To brief DIP officers on the upcoming projects (Marine Precinct and Port Expansion) and to flag POTL's intention to seek Major Project status for each project.
21/11/07	Whole of Government (State)	Townsville (DTRDI Boardroom)	To brief State Agencies on upcoming projects (Marine Precinct and Port Expansion)
3/3/08	GBRMPA	Townsville (GBRMPA)	To brief GBRMPA on upcoming projects (Marine Precinct and Port Expansion)
12/3/08	DEWHA	Canberra (DEWHA office)	To brief DEWHA on upcoming projects (Marine Precinct and Port Expansion)
27/8/08	Whole of Government (State)	Townsville (POTL)	To brief State Govt agencies on the EIS process for the Marine Precinct and introduce the EIS team (GHD, EBC).
9/10/09	DEWHA	Canberra (DEWHA)	To brief DEWHA on the findings of the EIS to date and the process for selecting a commercial developer for the Marine Precinct.
15/10/08	DIP/CoG Dept	Brisbane (DIP)	To provide an update on the findings of the EIS.
1/12/08	Whole of Government (State and C'Wealth)	Townsville (DIP)	Presentation to WoG participants on the Marine Precinct project to coincide with release of draft Terms of Reference for public comment.
4/12/08	GBRMPA	Townsville (POTL)	To brief GBRMPA on the findings of the EIS investigations to date, an accelerated Berth 12 project and to conduct initial discussions about the possibility of locating a new capital dredge spoil disposal area in the Marine Park.
10/12/08	Whole of Government (State)	Brisbane (DIP)	Presentation to WoG participants on the Marine Precinct project to coincide with release of draft Terms of Reference for public comment.
5/3/09	Whole of Government (State)	Townsville (POTL)	To provide an update on the findings of EIS investigations to date and on the process for

Date	Briefing to	Location	Purpose
			selecting a commercial developer for the Marine Precinct.
11/3/09	Whole of Government (State)	Brisbane (DIP)	To provide an update on the findings of EIS investigations to date, on the process for selecting a commercial developer for the Marine Precinct and on the local issue of recreational boat ramps.
12/3/09	DEWHA	Canberra (DEWHA office)	To brief DEWHA on the findings of the EIS investigations to date and the full suite of major projects underway at POTL. Also to conduct initial discussions about the possibility of locating a new capital dredge spoil disposal area in the Marine Park.

Research and Information

The coastal management outcome for Research and Information is "*research programs, and data and information collection and management focus on, support and enhance effective coastal management*".

There are three policies for Research and Information under the plan, these include:

- 2.10.1 Information management;
- 2.10.2 Inter-agency coordination; and
- 2.10.3 Monitoring.

These policies principally deal with the coordination of data management by government departments. POTL is a GOC and has entered, as appropriate, into arrangements with relevant other agencies to share information for the benefit of projects associated with the TMPP including the TPAR, Townsville Ocean Terminal Project and Townsville City Council sand resource study. POTL is also supporting a collective investigation into the possible expansion of boat ramp facilities within the Townsville region. The approach adopted by POTL is aimed at enhancing coastal management outcomes for all relevant projects and is, therefore, in accordance with this policy.

SPP 1/92 – Development and Conservation of Good Quality Agricultural Land

The purpose of State Planning Policy 1/92 for the Development and Conservation of Good Quality Agricultural Land (GQAL) is to provide local government with guidelines to consider GQAL issues in planning assessments. In order to assist in determining the suitability of land for future development, four agricultural land classes have been developed.

The project will be developed on reclaimed land designated as Strategic and Future Strategic Port Land. The subject site does not contain GQAL and State Planning Policy 1/92 is not relevant to the proposal.

SPP 2/02 – Planning and Managing Development involving Acid Sulfate Soils

State Planning Policy 2/02 – Planning and Managing Development involving Acid Sulfate Soils is concerned with the development of low-lying coastal areas below 5 metres AHD potentially containing Acid Sulfate Soils (ASS).

These soils may be found close to natural ground level but could also be found at depth in the soil profile. ASS generally overlie potential ASS horizons, but both may also occur within the same layer and may not be mutually exclusive.

The SPP applies to development that would result in:

- The excavation of, or otherwise removing, 100 cubic metres or more of soil or sediment from areas below 5 metres AHD; or
- Filling of land involving 500 cubic metres or more of material with an average depth of 0.5 metres or greater.

DERM assess potential ASS issues as a Referral Agency during the development assessment process.

SPP 2/02 requires the identification, assessment and management of soils in Local Government Areas listed in Annex 1 of the SPP2/02 where:

The natural surface elevation of the site is below 20 mAHD;

- More than 100 m^3 of soil is proposed to be excavated below 5 mAHD (Dear *et al.* 2004); and/or
- Placing 500 m^3 or more of fill material with an average depth of 0.5 m or greater.

The proposed development site is State Government-owned on lease to POTL, is not encompassed within local government planning schemes and does not therefore fall under SP2/02. However, the potential exists for the disturbance of PASS and/or AASS material as part of the development and therefore identification, assessment and management of such soils is still required.

Based on the results of the ASS investigation undertaken as part of this EIS, the following recommendations were made with regard to the development of the site:

- Given the identification of PASS in samples obtained across the Marine Precinct site, an ASS Management Plan (ASSMP) will be required in accordance with Queensland Acid Sulfate Soils Management Committee Guidelines (2002) specific to site development, in addition to the ASSMP prepared as part of the EIS, and may require the incorporation of additional sampling for ASS; and
- To minimise the potential for environmental harm, all of the material disturbed as part of the development should be assumed to be PASS and managed accordingly, unless more detailed assessment, either pre- or post- dredging and placement, can confirm the material is non-ASS. This includes the need for potential offshore disposal of all material to limit the potential for oxidation and acid generation.

SPP 1/02 - Development in the Vicinity of Certain Airports and Aviation Facilities

State Planning Policy 1/02 - Development in the Vicinity of Certain Airports and Aviation Facilities sets out broad principles for protecting airports and aviation facilities as they are essential components of the State's transport infrastructure and national defence system.

The subject site is not in close proximity to any airports (i.e. located on land affected by the Obstacle Limitation Surface). Therefore, SPP1/02 is not applicable.

SPP 1/03 – Mitigating the Adverse Impacts of Flood, Bushfire and Landslide

State Planning Policy 1/03 – Mitigating the Adverse Impacts of Flood, Bushfire and Landslide seeks to minimise the potential adverse impacts of natural hazards by providing guidelines for considering potential natural hazards when making decisions about development. SPP 1/03 identifies three outcomes that developments affected by natural hazard overlays must comply.

SPP 1/03 applies to assessable development not addressed by a planning scheme and subject to assessment under the IPA Reg. The assessment manager must have regard to the SPP 1/03 when assessing development proposals in "Natural Hazard Management Areas" (flood prone land, steep land and bushfire areas).

The subject site is not likely to include natural hazard management areas. The subject site may be at risk of storm surge as it adjoins the coastline

The Hydrological Data Report prepared by GHD in March 2009 for the TMPP found that the Precinct site appears to be very well sheltered in the developed case from the effect of the extreme waves. However, the channel experiences larger currents and Bed Shear Stresses when developed suggesting greater scouring potential around the toe of the breakwater, which should be mitigated through appropriate design consideration.

As detailed Health and Safety Report prepared for the Project by GHD in February 2009 details the controls will be put in place such as Emergency Response Plans, Job Safety Assessments to specifically consider imminent weather conditions to ensure safety of people, the environment and property.

SPP 1/07 – Housing and Residential Development

State Planning Policy 1/07 – Housing and Residential Development took effect on the 29 January 2007 and seeks to identify housing needs for certain Local Governments in Queensland.

This SPP applies to local governments that meet the following criteria:

- A population of 10,000 or more within at least one urbanised area; and
- A minimum average dwelling approval rate of 100 dwellings per annum over the latest five year period.

The Policy has effect when a local government decides to prepare a new scheme or amend an existing scheme or is required to amend their planning scheme as a result of a regional planning process. The Policy has no effect when development applications are assessed or when designating land for community infrastructure.

This project does not seek to amend a Local Government Planning Scheme. The Precinct site is not suitable for Housing and Residential Development and, therefore, SPP 1/07 is not applicable to the proposed works for development of the TMPP. Upstream lands vacated by industries that may choose to relocate to the Precinct will be rehabilitated by POTL. These waterside sites would be proposed for redevelopment into mixed residential / commercial consistent with the Townsville City Plan. This policy may be relevant should the Townsville City Council seek to amend the planning scheme in relation to this land.

SPP 2/07 – Protection of Extractive Resources

State Planning Policy 2/07 – Protection of Extractive Resources came into force on the 3 September 2007. The purpose of this policy is to identify and protect extractive resource areas of state or regional significance from incompatible land uses that could potentially constrain or sterilise resources.

SPP 2/07 defines extractive resources as sand, gravel, quarry rock, clay and soil. The policy identifies a number of "Key Resource Areas" (KRAs) and "Transport Routes" throughout the State.

No identified "Key Resource Areas" or "Transport Routes" are in close proximity to the subject site and, therefore, SPP 2/07 is not relevant to the proposed works.

1.8.4.2 Local government planning controls, local laws and policies

Local Planning Scheme - Townsville City Plan 2005

Townsville City Council's *City Plan 2005* has identified that for the purposes of its planning scheme, "Strategic Port Land" is "not subject to the Planning Scheme". Both the location of the Marine Precinct and Breakwater are shown on the planning scheme maps as not being subject to the planning scheme (refer to Figure 1-1). The proposed TMPP development is therefore not subject to assessment against a Local Government Planning Scheme.

Upstream lands that will be vacated by relocating industries are currently industrial sites. Following surrender and remediation they will likely be proposed for redevelopment into mixed residential / commercial. Any proposed redevelopment will be consistent with the Townsville City Plan.

Northern Economic Triangle Infrastructure Plan (2007 – 2012)

The Northern Economic Triangle Infrastructure Plan (NETIP), prepared by the Department of Infrastructure and Planning, was released on 3 August 2007. Along with Bowen and Mount Isa, Townsville is recognised as an integral component of the economic triangle for mining, mineral processing and industrial development.

The objectives, strategies and actions of the NETIP are based on realising the vision for an economic triangle through provision of skills development, infrastructure, and leadership capable of underpinning major private sector investment. The NETIP provides a commitment to "facilitate broad economic and social development of Townsville by adoption and implementation of the Townsville Economic Gateway Strategy".

It is considered that the proposed works are consistent with intent, objectives and strategies of the Northern Economic Triangle Infrastructure Plan.

Townsville Economic Gateway Strategy (2006)

Townsville Economic Gateway Strategy (2006) forms the strategic vision of the City of Townsville. The vision seeks to balance economic, environmental and social goals and maintain the diversified economy present in Townsville. Townsville has a population of approximately 170,000 and is a key trade centre in North Queensland. It provides a lifestyle combining the best of the tropics with an amenity level generally associated with large southern capital cities.

The Port of Townsville has been integral to the development of this economy, with general commerce, trade and industrial development fuelling prosperity and creating an inseparable link between the city and its port.

The Townsville Economic Gateway Strategy (2006):

- Reinforces the Port of Townsville's central place in the region's economy; and
- Presents a vision for revitalising the city through the progressive relocation and expansion of industrial activity out of the inner city to the Port and other areas, to accommodate demand and facilitate future prosperity of the region.

Given that the proposed works seek to relocate commercial and industrial marine facilities from the city to the Port to provide for future trade, commercial and residential growth in Townsville, it is considered that the proposed works are consistent with the intent and strategies of the Townsville Economic Gateway Strategy.

Townsville City – Port Strategic Plan (2007)

In March 2006, the CG was requested to undertake a strategic planning exercise on the interface between Townsville's port and CBD. This led to the formulation of the Townsville City – Port Strategic Plan (2007) by the Department of Infrastructure and Planning in consultation with POTL, Townsville City Council, Department of Tourism, Regional Development and Industry, Queensland Transport, Queensland Treasury and the Department of Main Roads. The plan was finalised in June 2007.

The plan provides a vision for an effective and sustainable interface between Townsville's Port area and the CBD. The plan identifies eleven (11) proposed development projects throughout the CBD - Port interface area, including the Project, as desirable for Townsville.

The plan builds on previous work carried out by POTL and Townsville City Council, and identifies two (2) critical planning areas:

- The Secure Port Area where port operations are carried out; and
- The Port Interface Area between the CBD and the port, which requires careful planning to ensure that any development in this area does not adversely impact on the port.

The plan primarily focuses on the Port Interface Area and examines the interconnections between various projects within it. In addition, individual precinct development plans have been prepared for key projects within the Port Interface Area. The plan is being used by POTL and the Townsville City Council to assist with their forward strategic planning.

The following statement is made on page 1 of the Townsville Port Strategic Plan:

> *The City-Port Strategic Plan depicts, in general terms, capital works for port expansion currently being considered by the Townsville Port Authority to cope*

> *with anticipated growth in trade over the forthcoming 25 years. These works are shown in detail in the Port of Townsville Master Plan and include of an extensive reclamation area seaward of the existing port together with protective breakwaters and dredged deep water berthing areas. It has no statutory standing nor does it have explicit government endorsement. It is conceptual only, as are the individual projects listed and their graphic representations. The plan is intended to highlight what is achievable in Townsville's city-port interface area, to outline conflicts that exist and others that could arise, to suggest one option for the scheduling of projects to overcome these conflicts and to present these concepts in as concise a manner as possible.*

Rather than being a statutory document, the plan articulates a vision and forecasted needs for the next 25 years.

The proposed works are identified as one of the first developments, with other precincts building on it in later years. Within the Strategic Plan this project is referred to as "Precinct 1 – Marine Industries and Boating Facilities: a precinct which would accommodate marine activities including shipbuilding, ship repair, commercial fishing, recreational boat ramps and marine search and rescue services, and is located on the western bank of the Ross River immediately downstream of the future Eastern Port Access Corridor".

The proposed works are central to achieving intent of the Townsville City – Port Strategic Plan (2007).

Townsville Port Authority Land Use Plan 1996

The *Townsville Port Authority Land Use Plan 1996* (TPALUP) came into force in 1996 and has statutory powers. The proposed location of the Marine Precinct and breakwater are identified as Strategic Port Land in the TPALUP. Section 285 of the *Transport Infrastructure Act 1994* provides the mechanism whereby the reclaimed land can be incorporated into the *Townsville Port Authority Land Use Plan 1996*.

A new Land Use Plan is currently under preparation (Statement of Proposals document advertised for public comment in 2007) and is expected to be gazetted by the end of 2009. It is considered that the proposed works are consistent with this draft Land Use Plan.

It is considered that the proposed works are consistent with the TPALUP and the Draft Review of the Port Land Use Plan.

1.8.5 Approval summary

To date no approvals have been obtained for the project. Table 1-4 lists the approvals required and the applicable act regulating the approval. Table 1-5 indicates expected timeframes for the various approvals and Table 1-6 provides a summary of the estimated timeframes for the approvals where timeframes for applications can run concurrently.

Table 1-4 Approvals required for the Townsville Marine Precinct Project

Legislation	Administering Authority	Trigger Project	Response
Land Act 1994	Departmental of Natural Resources and Environment	Tenure	Prior to application being made for Resource Allocation, application must be made to lease the unallocated State land. Presently Lot 773 already has tenure, however an application is necessary for the area under the breakwater. Once the land is reclaimed, POTL can apply for ownership of the land. However, in terms of section 127(3), if the reclaimed land is held under lease, that lease must be surrendered before a deed of grant can be issued.
Native Title Act 1993	Departmental of Natural Resources and Environment	Native Title Notification	During the establishment of the perpetual lease for Lot 773 Native Title was determined to have been suppressed pursuant to the non-extinguishment principle. Should POTL wish to freehold Lot 773, the process will involve surrender of the current perpetual lease with the subsequent re-emergence of Native Title rights and interests in the area. In this case, the Assessment Manager would be responsible for undertaking Native Title Notification. Notification is undertaken at the time when an application for a development permit (for instance an application for prescribed tidal works) is lodged. The process runs concurrently with the IDAS process.
Coastal Protection and Management Act 1995	Departmental of Natural Resources and Environment	Resource Allocation	A Resource Allocation must be obtained prior to the application for Tidal Works is lodged. Application is lodged with the Environmental Protection Agency. [Refer to the DERM Guideline "*Allocation of quarry material*"]

Legislation	Administering Authority	Trigger Project	Response
Integrated Planning Act 1997	Department of Infrastructure and Planning	Tidal Works	The Assessment Manager for an application for Tidal Works is the relevant local authority. In this case the Assessment Manager would be POTL for the TMPP. The application will cover the work for dredging as well as the disposal of material in tidal water. The application will require referral to the following agencies: ◗ Department of Natural Resources and Environment (DERM) as concurrence agency. ◗ Department of Employment, Economic Development and Innovation Queensland Primary Industries and Fisheries DEEDI as concurrence agency. ◗ Department of Infrastructure and Planning (DIP) as advice agency.
Environmental Protection Regulation 2008	Departmental of Natural Resources and Environment	Proposed dredging associated with the development is classified as ERA 16	In accordance with changes to the ERA legislation (in force as of 1 January 2009), port authorities are no longer exempt from requiring approval to undertake dredging. POTL will be required to make an application for ERA 16.

Legislation	Administering Authority	Trigger Project	Response
Vegetation Management Act 1999	Departmental of Natural Resources and Environment	Operational works, clearing vegetation, including vegetation to which the VMA applies.	As the Project involves the reclamation of land there is unlikely to be any clearing of vegetation. However, some vegetation clearing may be required as part of the construction of any road or access way. DERM would assess any clearing required for the proposed works against the relevant Regional Ongoing Clearing Code. Only the clearing of remnant vegetation (native vegetation that occurs in a mapped Regional Ecosystem (RE), or that meets the structural and species requirements to be mapped as a RE) will be assessed under this process (non-remnant vegetation can be cleared under this VMA without a permit).
Fisheries Act 1994	Department of Employment, Economic Development and Innovation Queensland Department of Primary Industries and Fisheries	Operational Works ◗ Taking, causing damage to or disturbance to marine plants, including mangroves; ◗ Works in a declared fish habitat; ◗ Waterway barrier works; and ◗ Tidal water, fresh and marine aquaculture operations.	The proposed works are likely to result in the disturbance of marine plants and therefore requires assessment against the FA. Therefore, when the application for tidal works is lodged, the proposal will be referred to the DPI&F as a referral agency.

Table 1-5 Estimated timeframes to obtain approvals required for the Townsville Marine Precinct Project

Type of Approval	Expected Timeframe	Comment
Tenure		Prior to application being made for Resource Allocation, application must be made to lease the unallocated State land. Once the land is reclaimed, POTL can apply for ownership of the land. However, in terms of section 127(3) of the Land Act 1994, if the reclaimed land is held under lease, that lease must be surrendered before a deed of grant can be issued.
Resource Entitlement	10 to 20 Business Days	Can run concurrently with application for Resource Allocation. Resource Allocation has to be obtained prior to the application for Tidal Works is lodged.
Resource Allocation	20 to 60 Business Days [Timeframe is estimated as there are no statutory timeframe applicable]	Can run concurrently with application for Resource Entitlement. Must be obtained prior to the application for Tidal Works is lodged. Application is lodged with the Environmental Protection Agency. Obtaining approval may take around 28 dates if all relevant information is provided. [Refer to the DERM Guideline "*Allocation of quarry material*"]
Tidal Works	14 - 23 Weeks	Application can only be lodged after Resource Entitlement and Resource Allocation had been approved. It should be noted that the Information Stage and the Decision Stage of the IDAS process can be extended without the applicant's consent and further extensions can occur with the applicant's consent. More complicated applications can take anything from 26 to 52 weeks. Native Title Notification runs concurrently with the IDAS process. A realistic timeframe for the approval of the tidal works would be 26 weeks.

Table 1-6 Summary of estimated timeframes to obtain approvals required for the Marine Precinct Project

Type of Approval	Expected Timeframe	Comment
Tenure		Prior to application being made for Resource Allocation, application must be made to lease the unallocated State land. Once the land is reclaimed, POTL can apply for ownership of the land. However, in terms of section 127(3) of the Land Act 1994, if the reclaimed land is held under lease, that lease must be surrendered before a deed of grant can be issued.
◗ Resource Entitlement; ◗ Resource Allocation; and ◗ Operator Registration Certificate	20 to 60 Business Days (4 – 12 weeks)	
◗ Tidal Works; and ◗ Environmentally Relative Activity (ERA) 16	14 - 23 Weeks	
TOTAL	18 – 35 weeks	It is suggested that the longer timeframe of 35 weeks be considered the more accurate estimate.

1.9 Accredited process for controlled actions under Commonwealth legislation

This project has been determined to be a controlled action under the Australian Government EPBCA. In this regard, the Australian Government has accredited the state's EIS process for the purposes of the Australian Government assessment under Part 8 of the EPBCA.

When a State EIS process has been accredited, it is necessary to address potential impacts on the matters of national environmental significance that have been identified in the 'controlling provisions' for the project. In this case the matters are as follows:

- Sections 12 and 15A (World heritage properties);
- Sections 15B and 15C (National heritage places);
- Sections 16 and 17B (Wetlands of international importance);
- Sections 18 and 18A (Listed threatened species and communities); and
- Sections 20 and 20A (Listed migratory species).

A stand-alone report addressing the matters of national environmental significance is provided as Section 7. This document exclusively and fully addresses the issues relevant to the controlling provisions.

A description of the affected environment relevant to the matters protected, including assessment of relevant impacts and mitigation measures and potential offsets, is provided under Section 3 of this document. The policy against which offsets have been assessed is described following.

1.10 Queensland Government Environmental Offsets Policy

The Queensland Government Environmental Offsets Policy (QGEOP) was developed by the DERM. The policy provides a framework for the appropriate use of environmental offsets across terrestrial and aquatic ecosystems, based on the principles of *Ecologically Sustainable Development* (ESD) and the premise that offsets should only be considered after all environmental impacts have been avoided and minimised.

An environmental offset is a positive action for the natural environment taken to counterbalance unavoidable, negative environmental impacts that result from an activity or a development. It differs from mitigation in that it addresses remaining impacts, after attempts to reduce (or mitigate) the impact have been undertaken. An offset may be located within or outside the geographic site of the impact.

The scope of the QGEOP is limited to Queensland Government-led assessment of impacts to environmental values and it applies where current legislation triggers State Government assessment of impacts on environmental values. The QGEOP applies to decisions on *development approvals* under a range of approval processes, that is, for all developments under the EP Act, IPA, the SDPWOA and Main Roads administrative processes.

As the TMPP has been declared a Significant Project under the SDPWOA, the need for offsets should be considered during the EIS assessment stage. The project design considered in the

EIS has been considered to avoid and minimise environmental impacts. However, there are remaining impacts that are covered by a specific-issue offsets policy(s) and, accordingly, it is anticipated that the CG's report will provide recommendation for the provision of offsets consistent with the specific-issue offsets policy(s).

Queensland currently has three specific-issue offsets policies that provide detailed direction for offsets that address specific environmental issues and are administered by the relevant government agencies. The specific-issue offsets policies, and their regulating agencies are:

- Vegetation Management — Policy for Vegetation Management Offsets, September 2007, DERM.
- Fish Habitat Management Operational Policy FHMOPOO5 — Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss, 2005, DEEDI.
- Koala Habitat — Offsets for Net Benefit to Koalas and Koala Habitat, 2006, DERM.

As the proposed works are likely to result in the disturbance of marine plants (refer Section 3.10) the relevant offset policy for the TMPP is the Fish Habitat Policy. Koalas are not a feature of the landscape of the project area and vegetation is not expected to be impacted for development of the Precinct (as discussed in Section 3.10) and, accordingly, the other specific-issue policies are not applicable to this project.

1.10.1 Fish Habitat Management Operational Policy

The Fish Habitat Management Operational Policy (FHMOP) assists and guides permit assessment to achieve mitigation of impacts and compensation for marine fish habitat losses that are likely to result from authorities granted under the Fisheries Assessment. A range of actions for mitigation or compensation are recognised by the FHMOP that can include:

- Best practice methodologies;
- Habitat productivity enhancement;
- Restoration/rehabilitation or replacement of fish habitat;
- Fisheries resource research, education support and community initiatives;
- The payment of bonds (held towards ensuring that impacts are minimal;
- Fish habitat acquisition/exchange (relinquishment of private tenure); or
- Fisheries stock enhancement;
- Signage or educational materials for marine fish habitat information management; or to enhance fishing access for the community; and
- Land-exchange where landholders may choose to relinquish critical fish habitats to the State, and in some cases, for these habitats to be included within declared Fish Habitat Areas.

Compensation options may be part of a 'Statewide Compensation Program' that may consider projects including:

- Undertaking/funding restoration projects across the State, where outcomes have a Statewide application;
- Initiating community awareness projects; or

- Contributing credits before debits are used (mitigation banking concept).

Mitigation or compensation agreements will be recognised as a condition of the authority granted, and monitoring will be required to evaluate and document the success of the measures adopted.

Section 3.10 of this document provides information on the existing conditions, potential impacts that may result from the TMPP and strategies for mitigation of those impacts. Where impacts may not be mitigated discussion of an appropriate offset against those impacts is provided in accordance with this policy.

Section 2
Description of the project

Townsville Marine Precinct Project

Environmental Impact Statement

2. Description of the project

2.1 Introduction

This section describes the project through its lifetime of construction, operation and decommissioning. Included is an overview of the project to describe:

- Reasons for the preferred operating scenario;
- A description of the key components of the project; and
- The expected cost, overall duration and timing of the project.

2.2 Overview of project – reference design

The Port of Townsville is situated between the mouths of the Ross River and Ross Creek in Cleveland Bay. Cleveland Bay is defined by Cape Pallarenda, Cape Cleveland and includes Magnetic Island. The proposed Townsville Marine Precinct Project will be situated at the mouth of Ross River (refer to Figure 2-1).

With increasing trade, commercial and residential growth in Townsville, strategic planning activities for the city have focussed on providing opportunities to relocate existing old commercial marine facilities spread around Ross Creek, Ross River and South Townsville into a new, purpose-built facility on Ross River, which will incorporate current best practice environmental management.

A Precinct concept in the mouth of the Ross River has been mooted since the mid 1970s. As discussed under Section 1.5.1 the first concept drawings were prepared in 1977. In 1991 the first environmental studies commenced to examine the potential impacts of developing a marine precinct in the eastern port area. More recent strategic planning activities in Townsville (Port Development Plan, Townsville City-Port Strategic Plan, Port of Townsville Limited Draft Land Use Plan) focus on the port interface area and provide a coordinated vision for the provision of key infrastructure.

The proposed project will require the reclamation of lands on Lot 773 on EP2211 (Benwell Road Beach). Lot 773 is approximately 34 hectares (ha), however, some of this land once reclaimed will be occupied by the TPAR and Services Corridor (approximately 2 ha). The proposal also incorporates the possible construction of a breakwater on the eastern side of the mouth of Ross River to protect the Precinct from sediment infill and the action of waves (refer to Figure 2-2).

POTL may justify capital investment in the proposed development on the basis that the following benefits could be derived:

- Provision of a marine precinct sheltered from prevailing waves where commercial marine activities in Townsville can be consolidated;
- Provision of an area in Ross River for relocation of the existing trawler fleet which is required to occur prior to completion of the bridge linking the TPAR to Townsville Port;
- Restriction of westward longshore sediment transport into the navigation channel and subsequent reduction in the requirement to dredge in the longer term;

- Consideration of provision of mooring areas for vessels currently on buoy and pile moorings in Ross River; and
- Consideration of provision of recreational boat ramp facilities and parking.

The concept master plan for the proposed Townsville Marine Precinct Project incorporates onshore and offshore elements, which are listed below. A concept layout is depicted in Figure 2-2.

Access to the precinct: Two dedicated access points will be provided from Benwell Road; one associated with the Boundary Street/Benwell Road intersection and one to the north of Archer Street. The final design of the access is still under negotiation with the Queensland Department of Main Roads in relation to the Port Access Road/Services Corridor interface.

Marine industry allotments: A commercial slipway, barge ramp, ship-lift, docking facility and associated marine facilities are proposed for the Precinct. A rack and stack vessel storage system is being considered.

Trawler berths: Approximately 50 trawler berths and two trawler maintenance berths are proposed for the Precinct.

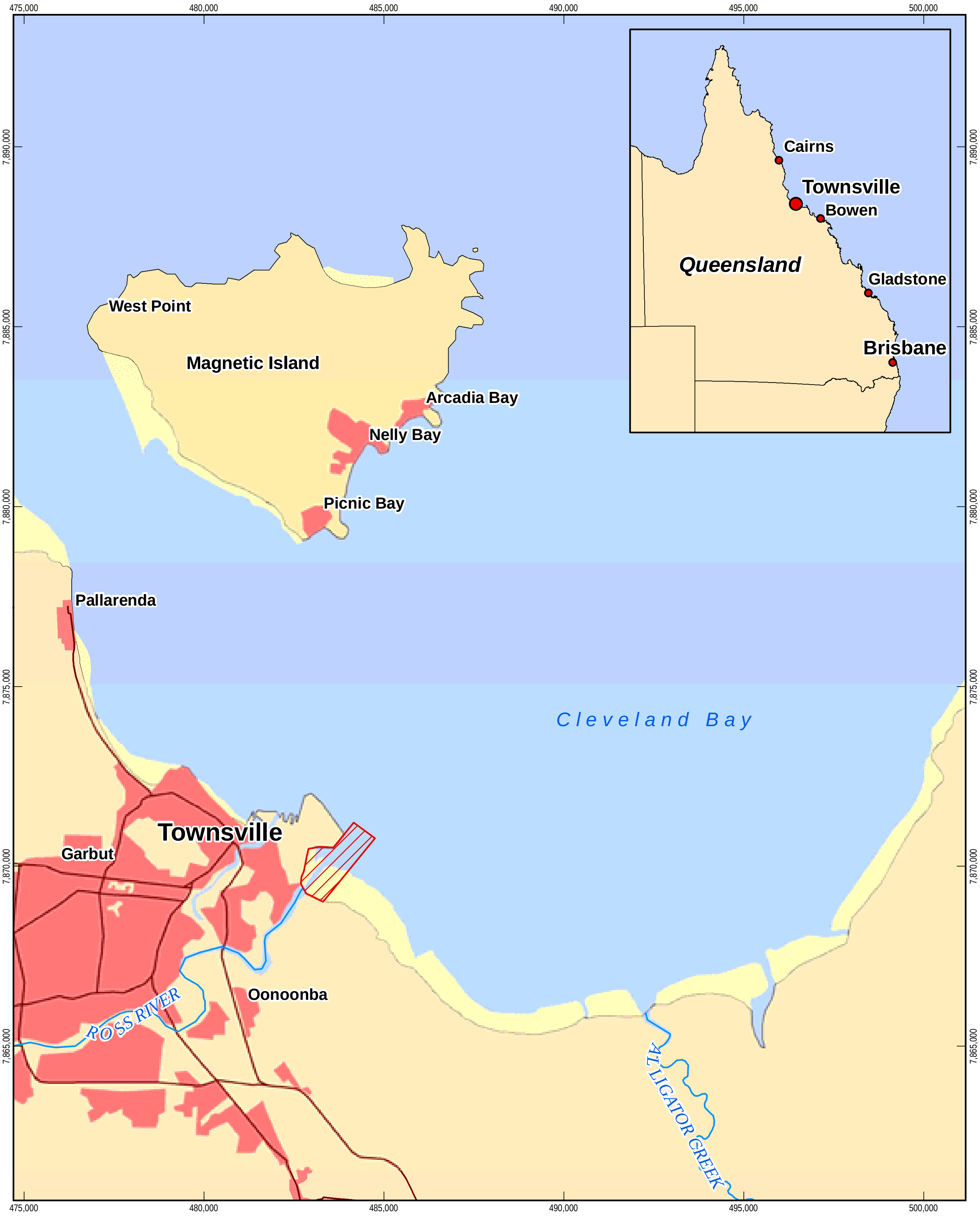
Private pile moorings: The inside of the proposed breakwater could accommodate 40 pile moorings. There may be the opportunity for provision of additional pile moorings at a later date should demand arise.

Boat ramps and car/trailer parking bays: Consideration is being given to the regional demand and location of boat ramps and car/trailer parking bays as part of a separate process involving Townsville City Council, Queensland Transport, POTL and DIP. Comment in regard to the inclusion of boat ramps in the Precinct was provided under Section 1.5.1. Opportunity for the co-location of the volunteer coastguard in any new proposed recreational boat ramp facility to service recreational vessel users will be considered under the boat ramp site selection process.

Services: The full range of site services including power, water, sewerage, stormwater drainage and telecommunications will be provided to the proposed development. Due to evolving legislative changes to wastewater requirements in the Great Barrier Reef World Heritage Area, a sullage pump out facility may be required.

Breakwater: A breakwater may be required to:

- Provide shelter for the commercial marine area and pile moorings from prevailing waves;
- Provide a sheltered swinging area for commercial vessels;
- Provide a sheltered departure point to Cleveland Bay for smaller recreational boats;
- Restrict westward longshore sediment transport into the navigation channel and reduce the requirement to dredge the Ross River channel in the longer term;
- Provide an effective barrier between the common use areas and the sensitive environmental areas to the east; and
- Allow sand to accrete on the eastern side of the wall to provide an alternative migratory bird roosting and nesting area.



LEGEND

Project Area of Interest | Watercourse | Major Road | Builtup Area | Foreshore Flat

1:140,000 (at A4)

0 1 2 3 4 5

Kilometers

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number | 42-15399
Revision | A
Date | 01 July 2009

Project Location

Figure 2-1

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data source: Project AOI - GHD; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management); 250K Topo Data - ©Commonwealth of Australia (Geoscience Australia) 2007. Created by: TH

1:10,000 (at A4)

0 50 100 150 200 250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number 42-15399
Revision A
Date 01 July 2009

Concept Layout

Figure 2-2

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management). Created by: TH

From the concept master plan and concept layout a Reference Design has been established against which studies reported here have been undertaken. This includes a Precinct facility with an inner harbour, vessel moorings and land area developed from reclamation on which sheds and other infrastructure are to be located, a dedicated trawler fleet base, pile moorings for recreational vessels and an offshore breakwater to protect the swing basin, pile moorings and quay line of the Precinct from waves. The preferred option for the breakwater is discussed further in Section 1.5.3.

To enable considered studies to be undertaken for this EIS the Reference Design includes requirements for a number of industries and facilities that may be included in the Precinct. These are identified as:

- Marine industry allotments including:
  - maritime infrastructure fabrication;
  - commercial and recreational vessel construction and maintenance (land based);
  - commercial slipway, barge ramp, ship-lift, docking facility and associated marine facilities;
- Berth facilities including:
  - 50 trawler berths;
  - Two trawler maintenance berths;
  - Loading, unloading and provisioning wharf area for a minimum of 10 vessels;
  - Provisioning, sullage and refuelling docks accessible to both commercial and recreational users;
  - Barge berthing facility plus a vehicle ramp, including vessels up to 35m long;
  - Tourism/scientific vessel berthing facilities; and
  - General purpose berthing wharf or jetty length of minimum 80m;
- Commercial and recreational chandlery;
- Defence force marine activities, including vessel maintenance
- Seafood industry cold storage and distribution facility;
- Small scale eateries to service industry within Precinct;
- Marine industry training facilities;
- Potential relocation of the Volunteer Coastguard office and mooring;
- Public and recreational use facilities including:
  - Provision for 40 pile moorings;
  - Boat ramps and associated vehicle/trailer parking;
  - Recreational boat dry stack storage and associated lift out facilities;
  - Recreational marina to accommodate vessels up to maximum 25 metres in length; and
  - Boat sales.

Dredging: POTL undertakes an approved program of maintenance dredging to maintain the navigability of channels, within the port area, including Ross River. The Ross River channel dredging program is sufficient to provide access for the commercial, defence and recreational vessels that currently use Ross River. It is not anticipated that development of the project will increase the requirement for maintenance dredging.

Capital dredging will be required for the initial development of the project to obtain the necessary depth for vessel movements. Capital dredging would also be required to provide a swing basin and mooring area for any pile moorings adjacent to the proposed breakwater. Dredging will vary across the required areas (i.e. there may be a channel, swing basin and pile mooring area dredged initially). The requirement for further capital dredging could be driven by demand for additional pile moorings. The depth and volume of dredge material is described in detail in Section 2.4.

A large volume of the material identified for dredging (>70%) is considered to be unsuitable for reclaim fill and it is expected that this material will be disposed of at sea. This is discussed further in Section 2.4. For the small quantity that may be suitable for use as reclaim fill the preferred method of dredging to reclaim would be to use a cutter suction dredge discharging through pipes directly into the reclamation area. Any material that is determined unsuitable as engineering fill may be extracted with an excavator rather than cutter suction dredge.

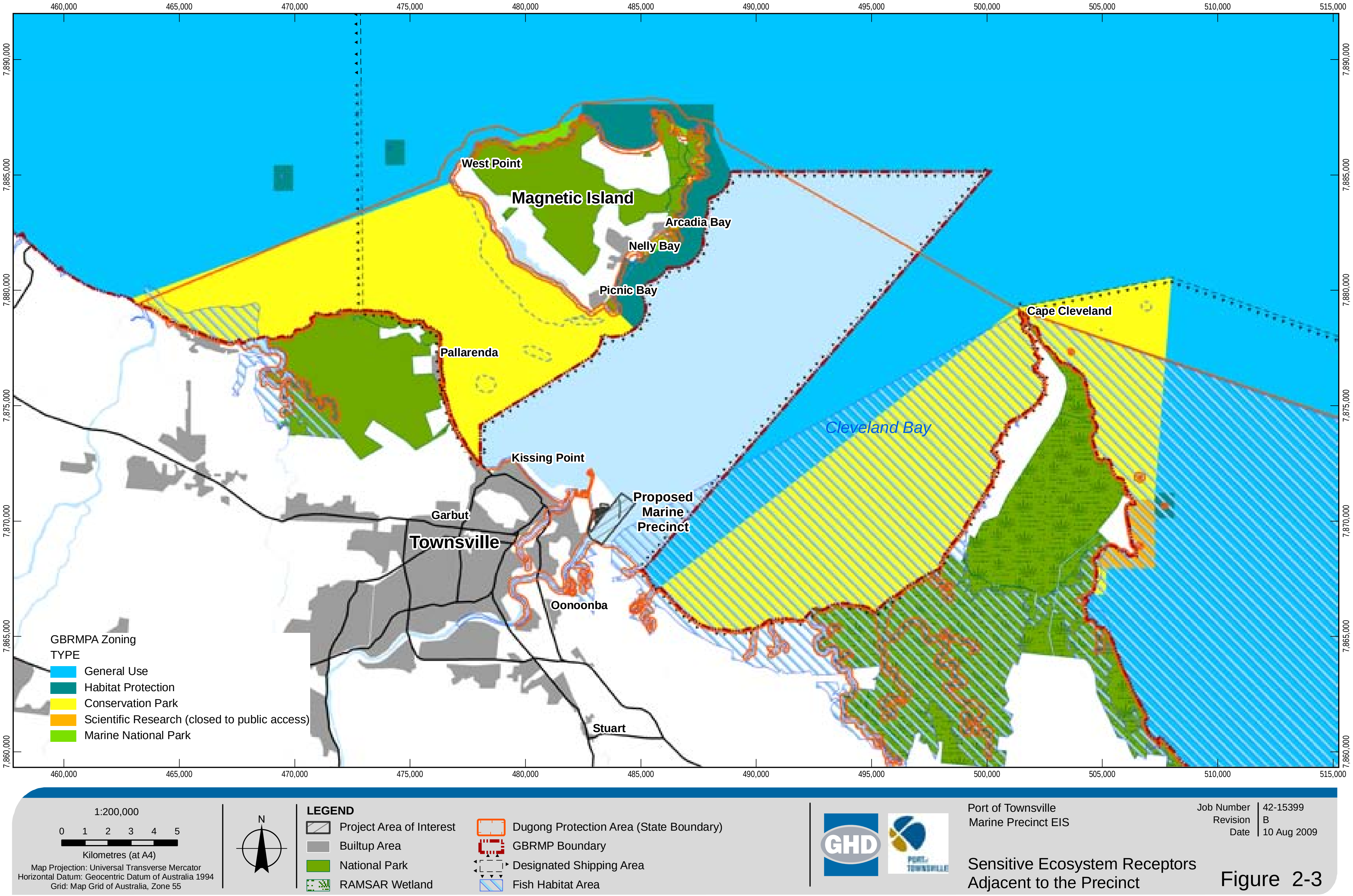
Vessel movements: It is not anticipated that the development of a marine precinct in the mouth of Ross River will substantially increase vessel numbers in the area. The majority of industries being considered for co-location in the Precinct (and their associated vessels) already exist either upstream of the proposed site in Ross River or in Ross Creek. The Ross River channel is already a restricted speed zone.

2.3 Location

2.3.1 Overview

The Port of Townsville is located within the dry tropics of the north Queensland coast (Figure 1-1). Townsville's Port represents a gateway facility not only for the adjoining Great Barrier Reef World Heritage Area (GBRWHA), Magnetic Island and the surrounding coastal environments, but also inland northern Australia. The Port of Townsville is situated at the mouth of the Ross River in Cleveland Bay, an area that is defined by Cape Pallarenda, Cape Cleveland and includes Magnetic Island. A locality map is provided in Figure 2-1.

Similar to many other port facilities throughout the world, the Townsville Port has evolved as a dynamic industrial area. The Port lies entirely within the GBRWHA in Cleveland Bay, which is characterised as a sensitive marine and estuarine ecosystem including a Dugong Protection Area 'A' (DPA). It is adjacent to the Great Barrier Reef Marine Park, a Fish Habitat Area (FHA) pending gazettal by the Department of Primary Industries and Fisheries (DPI&F) and other sensitive habitats such as seagrass beds, mangrove forests and fringing coral reefs, although many of these are some distance from the operating Port. The sensitive ecosystem receptors of Cleveland Bay adjacent to the Precinct are depicted on Figure 2-3.



Port of Townsville
Marine Precinct EIS

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Revision B
Date 10 Aug 2009

Sensitive Ecosystem Receptors Adjacent to the Precinct

Figure 2-3

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia T +61 7 3316 4496 F +61 7 3316 333 E bnemail@ghd.com.au W www.ghd.com.au

The Port of Townsville is almost wholly located on reclaimed land. The present port operations precinct is situated adjacent to the central business district (CBD), which contains a significant concentration of commercial, administrative, service and cultural facilities. The Ross Creek industrial precinct also forms part of the CBD. The area extending from the Ross River precinct to Cape Cleveland is considered to be of high ecological and conservation value although the Ross River itself is a significantly modified environment.

Residential development in the Townsville region has focussed around the banks of the Ross River, expanding the city's footprint towards the dam, which was constructed in 1973. Since construction of the dam and three weirs on the river (in the 1900's) for flood mitigation virtually all bed load transport of sediments to the coast has ceased. Sediments that accumulate behind the weirs have historically been dredged and used in construction, including for reclamation work on Port land. Pringle (1989) notes that between 1968 and 1980 over three million cubic metres of sand was removed from the Ross River estuary and pumped ashore for reclamation of activities. Currently the Ross River does not contribute any bed load sediment to Cleveland Bay. However, coastal sediment movements (discussed in detail in Section 3.8) do result in the need for ongoing maintenance dredging of the channel in the mouth of the Ross River to maintain navigability for the fishing fleet, which was moved from Ross Creek to Ross River in 1983.

A key challenge for development of the Marine Precinct is to balance protection of the natural resources of this region with growing demands of regional industry.

The proposed Project area is to the south-east of the existing port operations and runs parallel with Benwell Road, South Townsville. The area is identified as Lot 773 on EP2211. The proposed Precinct will require the reclamation of Lot 773 on EP2211 and provision of a breakwater at the eastern channel entrance to Ross River (Figure 2-1).

Lot 773 total area is approximately 34 hectares (ha). The total area of development for the Precinct on this Lot will be approximately 32 ha, extending south from the Benwell Road Beach. Additionally, an area of approximately 2 ha of seabed will be developed for construction of the breakwater. The location of individual components of the project including the breakwater, marine berths and buildings is illustrated on Figure 2-2.

2.3.2 Land tenure

All the proposed works lie within the declared Port Limits of the POTL. The proposed Project area of Lot 773 on EP 2211 is under a Perpetual Lease to POTL. This came into effect following vesting of EP 2211 in 1987 from the Governor of Queensland to the Townsville Port Authority. A Lease in Perpetuity was granted by the Department of Natural Resources and Water commencing on 30/11/2000 for port and transport related purposes.

An area near the mouth of Ross River adjacent to Lot 773 will also be required for a breakwater and pile moorings (Figure 2-1). POTL is in discussions with the Department of Natural Resources and Water in regards to tenure for the seabed associated with the footprint of this facility. It is not expected that POTL will require tenure of the seabed of this breakwater location, however, a firm direction on that requirement will fall out of ongoing discussions.

2.4 Construction

2.4.1 Overview

This section describes the construction phases of the project and includes the type and methods of construction to be employed, the construction equipment to be used and the items of plant to be transported onto the construction site.

The approaches to the construction of the Precinct reclamation and the proposed breakwater Option C are discussed including proposed dredge plant and equipment that would be employed, the estimated number of persons to be employed during the project construction phase and a description of the timing of the construction of the project. Construction methods associated with the implementation of other marine precinct infrastructure and topside construction has been deferred pending the identification of a suitable developer and finalisation of a configuration.

A detailed description of possible phasing of the project is provided under Section 1.3.2 and is summarised here with reference to related works within the region including the TPAR.

2.4.2 Timing and phasing of the project

Delivery of the Precinct is to provide opportunity to industries affected by construction of the TPAR, which closes the Ross River to vessels >6m in height mid 2011, to continue operation within Townsville unimpeded. Staging of the project and details of industries that can be supported by each stage of the development are provided in detail in Section 1.

Timing for delivery is as follows:

- Stage 1 of Marine Precinct in place and operational by 30 June 2011;
- Stage 2 to be operational by 30 June 2015; and
- Stage 3 to nominally be operational by December 2017.

This staged delivery allows for the progressive development of the Precinct as demand warrants, whilst allowing for the fast tracked development of Stage 1 to cater for accommodation of required activities prior to the TPAR bridge closure of Ross River, expected to be July 2011.

2.4.3 Disturbance to existing users

Construction of the Stage 1, Stage 2 and Stage 3 reclamation, protective rockworks and inner harbour navigation dredging will be conducted adjacent to but off the line of existing navigation channels and are not expected to cause interference to other operations.

The majority of the works associated with bed preparation and construction of the offshore breakwater will be conducted remotely from the main navigational access except for the northerly section of the offshore breakwater and the re-alignment of the Ross River channel. The latter two operations will be conducted within and in close proximity to the existing navigation channel. However, the works will be conducted using relatively small dredging plant, and only minor constraint to the operation of existing commercial, defence or recreational users is envisaged. In the event that marine construction operations do lead to partial blockage of the channel the plant will be able to be periodically pulled aside to allow access to other traffic. Provision can be made within the construction contracts to manage potential navigation constraint including the placement and management of spoil pipelines.

Dredging operations can be shut down and the dredge moved to the side of the channel relatively quickly (approx 10 minutes) to facilitate emergency access to the channel.

2.4.4 Construction workforce

The average workforce onsite during dredging and filling construction works is envisaged to be between 30 – 50 people. Depending on the staging of the works a peak workforce in excess of 100 people may be expected for the concurrent construction of the stage 2 reclamation works and the construction of the offshore breakwater.

- Dredging operations (Stage 1, Stage 2, and Offshore Breakwater preparation) 25 – 35 ppl
- Rockworks (Stage 1 Breakwater, Stage 2 and 3 rockworks) 20 – 70 ppl
- Reclaim and filling (Stage 2 and 3 reclamation) 30 – 70 ppl
- Offshore Breakwater foundation preparation 80 – 110 ppl
- Offshore Breakwater Construction 60 – 80 ppl

Depending on the staging of the works these workforces may be concurrently deployed. Additional information with regard to workforce requirements and economic impacts of the project is provided under Section 5.

The Precinct is located in close proximity to the CBD of Townsville and is readily accessible for locally based construction workforce. There is no anticipated need for worker accommodation on site. The additional labour force needs are expected to be mostly met from existing residents of the region. However, if a portion of the workforce is temporarily required from elsewhere that portion will not be of material concern to Townsville's existing accommodation capacity (see Appendix BB).

2.4.5 Pre-construction activities

2.4.5.1 Overview

This section should set out a description of the pre-construction activities, including:

- Any land acquisitions required, be it in full or as easements, leases;
- Vegetation clearing;
- Site establishment requirements for construction facilities;
- Temporary works; and
- Upgrade, relocation, realignment or deviation of roads and other infrastructure.

2.4.5.2 Land acquisitions

There are no land acquisitions required as the entire Project will occur on POTL land or on seabed designated for the breakwater. Leasing arrangements will be required for the proposed facilities to be included within the Precinct. These leasing arrangements will be managed by the developer and the POTL. Tenure for the project has been discussed in Section 2.3.2.

2.4.5.3 Vegetation clearing

The majority of vegetation adjacent to the Precinct has been identified as being located under the Port Access Road services corridor. A very small section of mangroves at the northern end of Lot 773 (approximately 0.5 ha) falls within the TMPP area. Impacts to the vegetation in the Services Corridor will occur at the same time as reclamation work for the TMPP. This section of vegetation has, therefore, been assessed under the terrestrial ecology component of this study (refer Section 3.10.4).

2.4.5.4 Upgrade, relocation, realignment or deviation of roads and other infrastructure.

POTL will need to consider the facilitation of appropriate access to the site during construction whilst maintaining security of the Port facilities. This will primarily include traffic corridors, including possible temporary access during construction. The construction workforce is not anticipated to require access the Port security zone.

Upgrade, relocation, realignment of roads and other infrastructure will be required for the project. These works will consist of:

- Reclamation of the Eastern Access Road Service Corridor;
- Provision of access to a temporary hardstand area within the eastern reclaim area at the Port of Townsville if required;
- Provision of project access corridors at the Boundary Street and Benwell road Intersection and entrance corridor off Benwell Road, North of Archer street;
- Provision of temporary access, routed outside the Port security zone, to the temporary hardstand area to facilitate Stage 1 construction and operation; and
- Provision of power, water, sewer and communications headworks at the marine precinct boundary.

2.4.5.5 Temporary works and site establishment

The Construction Contractors will require an area to accommodate their operations during the works. Some of the principal activities that would occur within the construction works area may include:

- Office, staff amenities and administrative functions;
- Vehicle parking for construction vehicles and contractors staff;
- Workshops and maintenance area;
- Stockpiling and handling of rock and fill for revetment and reclamation purposes; and
- Temporary Barge loading facility.

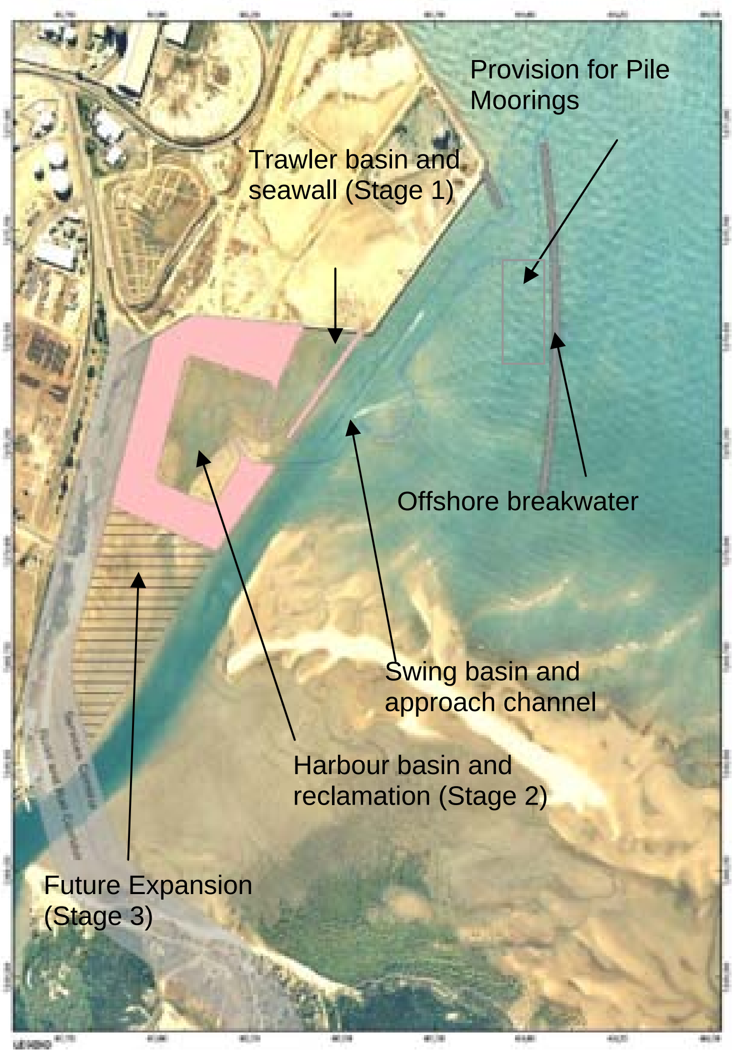
It is expected that the Contractor would construct an area within either Lot 773 or the temporary hardstand area as appropriate to accommodate these operations and that an additional area outside the project footprint will not be required.

2.4.6 Tidal works – dredging and reclamation

2.4.6.1 Location and area of dredging and reclamation

POTL currently undertakes an approved program of maintenance dredging to maintain the navigability of channels within the port and Ross River areas. The development of the Precinct and associated infrastructure will require capital dredging and reclamation works and maintenance dredging works. A plan of work areas is provided as Figure 2-4.

Figure 2-4 Plan showing works areas



In terms of dredging and reclamation, the Precinct development involves:

- Deepening of the existing levels to shipping channels, berth pockets and a swing basin;
- Provision of a navigable area to accommodate pile moorings;
- Removal of any soft sediments below rock revetment and breakwater footprints;
- Placement of fill below breakwater footprints to replace dredged soft sediments;
- Placement of rock materials to form rock revetments and breakwaters; and

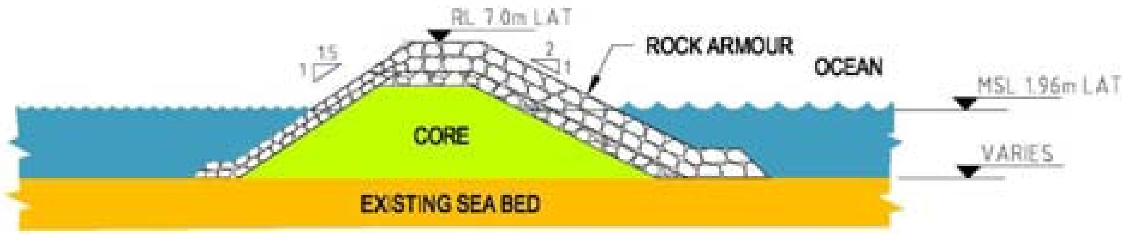
- Filling behind rock revetments to form reclaimed land.

Dredge levels for shipping channels and harbour basins have been determined separately based on ship sizes and maintenance dredge requirements. The following scope of dredging and/or filling works is required at each works area in order to accommodate the ground conditions encountered.

Table 2-1 Anticipated scope of dredging and filling works

Location	Summary of dredging and filling work
Trawler basin (Stage 1)	Dredge soft clay and silt from below north side of revetment footprint. Construct revetment (using imported land based source of rock armour and rock core). Dredge trawler basin area to -3.5mLAT.
Offshore breakwaters	Dredge soft clay and silt from below the breakwater footprint. Refill dredged trench to seabed level using imported sand fill (from marine or land based source). Construct revetment (using land based source of rock armour and rock core).
Swing basin and approach channel	Dredge approach channel and basin area to -3.0mLAT.
Harbour basin (Stage 2)	Construct revetment (using land based source of rock armour and rock core). Dredge harbour basin area to -4.5mLAT. Filling to form precinct reclamation area using imported non-cohesive fill.
Future Reclamation (Stage 3)	Construct revetment (using land based source of rock armour and rock core). Filling to form precinct reclamation area using imported non-cohesive fill.
Pile Moorings	Dredge navigable area to -3.0mLAT.

Typical sections of the finished reclamation, dredged levels and protective rock works relevant to the construction assessment are included below.

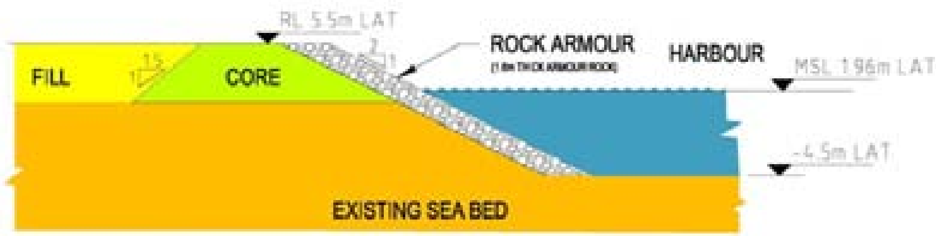


OFFSHORE BREAKWATER

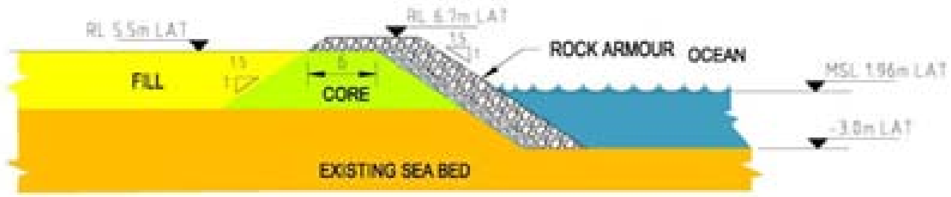
The offshore breakwater section is typical of the breakwater construction including the stub section attached to the Eastern Reclaim Area.

CHANNEL CROSS SECTION

The channel cross section is typical of the design navigation depths for the realigned channel which locally widens to accommodate the dog leg through the offshore breakwater opening. The swing basin and pile mooring are dredged to similar depths with similar design batters.

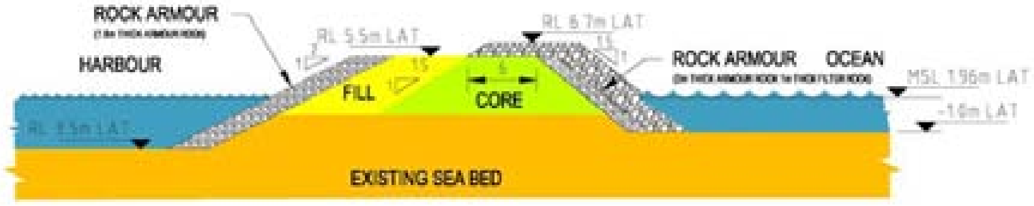


The inner revetment section is typical of the rockworks on protected faces such as the Stage 2 Inner harbour Basin (Peron, 2008).



OUTER REVETMENT

The outer revetment section is typical of the rockworks on exposed external faces of the Marine Precinct (along Stage 2 and Stage 3) and includes a protective crest wall (Peron, 2008).



TRAWLER BREAKWATER

The Trawler Breakwater is typical of the Stage 1 breakwater Section and includes a protective crest wall (Peron, 2008).

2.4.6.2 Volume of Dredging and reclamation

The volume of dredging required for the marine precinct development reference design is estimated to be 951,000 m^3. The volumes of dredging works are summarised in Table 2-2 below.

Table 2-2 Summary of Dredge Volumes

Dredg	**e (in-situ)**	**Reuse Dispos**	**e to spoil**	**Comments**
Trawler Basin (Stage 1)	95,000* m^3	0 m^3	95,000 m^3	Approx. 15,000 m^3 of soft silty clay below northern part of the revetment. Elsewhere, sand over silty clay. Estimated approx. 30% will be reusable sand. However, sand is potential acid sulfate soil and there is limited opportunity to reuse within the project (Stage 1 is constructed in advance of filling in other areas).
Offshore breakwaters	262,000 m^3	0 m^3	262,000 m^3	Soft silty clay below breakwaters.
Swing Basin and Channel	185,000*m^3	0 m^3	185,000 m^3	Mixed sand, silt and mud. Separation of materials not likely to be feasible.
Harbour Basin (Stage 2)	340,000* m^3	85,000 m^3	255,000 m^3	Sand (1-2m thick) overlying silty clay. Estimated approx. 25% will be sand and reusable within the Project provided it is placed below water.

Dredg	e (in- situ)	Reuse Dispos	e to spoil	Comments
Future Reclamation (Stage 3)	0 m^3	0 m^3	0 m^3	No dredging required for this stage of works
Pile Moorings	70,000* m^3	0 m^3	70,000 m^3	Soft silty clay
Totals 952,00	**0 m^3 85,000**	**m^3 867,00**	**0 m^3**	

** includes overdredging provision*

This estimation was based on the following parameters:

- Navigation Channel = 50m wide, dredged to -3.0 mLAT (-4.86 mAHD);
- Swing basin = 150m diameter, dredged to -3.0 mLAT (-4.86 mAHD);
- Depth of unsuitable material beneath the breakwaters requiring removal and spoiling to sea varies from 1m to 7m depth below seabed;
- Stage 2 precinct inner harbour basin - depth of -4.5mLAT (-6.36 mAHD);
- Stage 1 trawler basin - depth -3.5mLAT (-5.36 mAHD); and
- It is assumed that all the soil types found in the areas to be excavated are potential acid sulfate soils and have to be treated accordingly.

The volumes of reclamation works are summarised in Table 2-3 below.

Table 2-3 Summary of Fill Volumes

Non	- Cohesive fill	Rockfill (core + armour)	Comments
Trawler Basin (Stage 1)	0 m^3	39,000 m^3	Stage 1 Breakwater-
Offshore breakwaters	262,000 m^3	147,000 m^3	Backfilling dredged trench refilled using 262,000m^3 of imported non cohesive fill. Offshore Breakwater construction.
Harbour Basin (Stage 2)	394,000 m^3	118,000 m^3	85,000 m^3 sand fill available for reuse from Stage 2 dredge operations reducing total amount of imported sand required from 394,000 m^3 to 309,000 m^3
Future Reclamation (Stage 3)	351,000 m^3	44,000 m^3	
Totals 1,007,00	**0 m^3 348,00**	**0 m^3**	Import requirements 922,000 m^3 sand fill and 348,000 m^3 rock fill.

Volumes are in situ volumes – a bulking factor has been included for transportation and handling assessment.

2.4.6.3 Grading and composition of likely dredged materials

A number of intrusive investigations for the marine precinct have been carried out since 2007. These include:

- Preliminary Geotechnical and Acid Sulfate Soils Investigation, by Golder Associates (report dated July 2008) comprising 23 cone penetration tests (CPT's) and boreholes; and
- Acid Sulfate Soils Investigation, by GHD (report dated January 2009) comprising 72 vibrocores (23 vibrocores in Lot 773, and 49 vibrocores in the Harbour Area). Appendix H.

The various investigations indicate that the near surface marine ground conditions comprise relatively recent marine deposits overlying an older firm to stiff silty clay. The near surface marine deposits are mostly loose sandy deposits in the proposed precinct area (Lot 773), although soft marine clay was encountered in a number of places, notably in the outer section of the development, under the breakwater footprint and the northernmost area of Lot 773.

Particle size distribution (PSD) plots of samples above -6mLAT (i.e. just below the planned dredge limit) are included in Appendix G. These suggest the upper (1-2m) sand layer is likely to have a percentage of fines (< 0.075 mm) in the order of 20%, whilst the underlying clay layer is likely to have a relatively high 70% of fines.

In addition, the results of acid sulfate soil testing suggest that all of the material disturbed as part of the development should be assumed to be potential acid sulfate soils (PASS) and, subject to detailed assessment, managed accordingly.

Geological cross-sections and indicative gradings through the various areas of proposed work are shown in Appendix G.

The ground conditions are briefly summarised below.

Table 2-4 Composition of likely dredged materials

Stage 1 Trawler Basin	Subsurface conditions at the proposed trawler basin area comprise up to 2m of loose sand (with zones of silty clay) over firm to stiff clay. A zone of soft silty clay is present at the north-east end, adjacent to the existing revetment.
Offshore Breakwaters	Investigation at the breakwater has shown subsurface conditions below the breakwaters comprise very soft clay overlying firm clay. The thickness of soft clay varies between 1m and 7m.
Swing Basin and Approach Channel	The inferred subsurface conditions below the swing basin comprise between 1m and 2m of loose sand (with zones of silty clay) over firm to stiff silty clay.
Stage 2 Harbour Basin, Revetment and Reclamation	The inferred subsurface conditions at the proposed Stage 2 area comprise up to 2m of loose sand (with zones of silty clay) over firm to stiff clay.
Stage 3 Future Reclamation	The inferred subsurface conditions at the proposed Stage 3 area are similar to those determined for Stage 2.
Pile Moorings	Material similar to that determined for Offshore Breakwaters is expected. Consisting of soft clay over firm clay. The thickness of soft clay is expected to extend to full dredging depths.

2.4.6.4 Proposed disposal methods

There is potential for some dredged material to be re-used within the project. This potential will be affected by the composition of the material and its suitability for re-use as engineering fill, staging of the works and the availability of reclaim areas for onshore disposal concurrent with dredging activities coupled with successful management of potential acid sulfate soils.

Due to the presence of Potential Acid Sulfate Soils and geotechnical suitability of the material, it is anticipated that a significant volume of material will need to be disposed of to spoil and is likely to include ocean disposal pending approval of an Ocean Disposal Permit.

The breakdown of material for re-use within the project and disposal to spoil is indicated in Table 2-2.

2.4.6.5 Maintenance dredging

Maintenance dredging requirements are informed by:

- Historical dredging requirements;
- Assessment of impact of the development on coastal and littoral processes; and
- Assessment of impact of the development on the sedimentation potential (hydrodynamic, wind, wave regime).

The assessment undertaken for the EIS has the following key outcomes;

- Dredge records for maintenance of the Ross River channel go back to 1971. Over the record period, an average of approximately 37,000 m^3/annum has been removed from the existing Ross River navigation channels. In recent years (since 1990) the dredging has reduced in frequency and magnitude (campaign occurring every 2-3 years) with an average of 25,000 m^3/annum maintenance material removed.
- Coastal assessment (Section 3.8) has concluded that;
  - The littoral transport rate in Cleveland Bay is low with the majority of material transported in the littoral zone currently being trapped by the Ross River Channel;
  - Coarse sediment contributions from Ross River are essentially source limited due to infrastructure (dams and weirs) blocking the riparian sediment transport.; and
  - The offshore breakwater has the potential to cause the littoral material transported along the shoreline to accumulate in the lee of the breakwater on the existing sandbank to the east of the river mouth. This effect will occur in the short to medium term.
- Hydrodynamic modelling (refer Section 3.8.4) has established that;
  - The opening of the breakwater (to the north and east) is likely to be self scouring;
  - Under the existing conditions bed shear stress resulting from tidal exchange in the Ross River is below likely sediment remobilisation thresholds and the siltation response is predominantly depositional;
  - Under the developed configuration the bed shear stress resulting from tidal exchange in the Ross River is in a similar range to the existing conditions except around the toe of the breakwater where increased potential for scouring is expected on spring tides. No significant reductions in bed shear stress have been identified that would lead to large increased sedimentation potential;

– Under the developed configuration the currents within the inner harbour are significantly lower than those occurring across the existing Lot 773 and there is a potential to trap suspended material within the inner harbour; and

– Under significant flood discharge events from Ross River both the existing and developed channels demonstrate bed shear stresses greater than re-suspension thresholds and are expected to flush or scour.

The existing siltation regime is driven by the rate of supply of material to the site and the development will not impact this mechanism. Consequently, it is concluded that the magnitude of maintenance dredging of the Ross River Channel is unlikely to increase as a result of introduction of the offshore breakwater or the reclamation of the precinct area. Notwithstanding, the distribution of maintenance material may be affected by the wave shadowing effect of the breakwater structure and lead to potential accretion of the existing sandbank to the east of the Ross River in the short to medium term.

The maintenance dredging requirements for the Ross River channel will be 25,000 – 40,000 m^3/annum, typically with maintenance dredging conducted biannually or every 3 years. In past campaigns this material has been re-used in port reclamation.

There is potential to accumulate fine silt within the marine precinct inner harbour and trawler basin due to reduction in bed shear stress in this area and trapping of suspended sediment. Due to the relatively high background turbidity measured a provisional estimate of 200 - 300 mm / year is projected for this accumulation based on trapping of fine sediments within the inner harbour (allow as much as 15,000 – 20,000 m^3/annum). Dredging will likely be completed in conjunction with the maintenance of the Ross River Channels (every 2 – 3 years) and spoil will consist of finer silts which are unlikely to be suitable for reclamation.

A provisional allowance for maintenance dredging over a 20 year life is estimated to be in the range of 800,000 m^3 to 1.2 Million m^3.

Similarly, provisions for emergency dredging in the event of a large storm event are anticipated to be similar to those currently experienced for the Ross River channels. A severe storm event with elevated water levels and higher waves has the potential to mobilise a very large volume of sediment and reshape the sandbars and seabed. It is anticipated that the offshore breakwater will potentially stabilise the existing sandbank and mudflats immediately to the east of the Ross River.

2.4.6.6 Dredging methods

The majority of the dredging work for the TMPP is expected to be conducted by a mechanical Backhoe Dredge with a small proportion of the material suitable for reclaim expected to be conducted by Cutter Suction Dredge.

A backhoe dredge (BHD) is in principal a mechanical excavator on a pontoon equipped with hydraulically operated spuds. It is one of the most commonly used mechanical dredging techniques for smaller projects and is particularly effective when there is limited water depth and manoeuvrability and the spoil disposal location is greater than 1-2 km from the dredging site.

The spoil is relocated by the excavator into a hopper barge and then transported to the disposal site. Split hopper barges are commonly used to transport spoil and range in capacity from 100 m^3 to 1,000 m^3 and operate by splitting the hull to dispose of the dispose of their material by bottom dumping. For the marine precinct project, it is estimated that two 500 m^3 capacity barges would be required. Assuming 5 hours to fill the barge and a 5 hour return trip to the offshore disposal site (15 – 20 km), two barges and 100 m^3 per hour filling rate would allow continual 24 hours operations.

Figure 2-5 Typical backhoe dredge with split hopper barge being loaded

A proportion of the dredge material has been identified as geotechnically suitable for reclaim (Refer Table 2-2 proximate (within 1 – 2 km) to a reclaim / land based disposal site and consistent with the construction staging for the development. A Cutter Suction Dredge (CSD) will be the appropriate plant to dredge and reclaim this material.

A Cutter Suction Dredge (CSD) is a stationary hydraulic dredge which makes use of a “cutter head” to loosen the material to be dredged and pumps the dredged material to the disposal area via a sunken or floating pipeline. A key feature of a CSD is a rotating cutter. The loosened material enters the suction mouth, passes through the suction pipe and pumps and then into the delivery line.

A more detailed summary of the application of the various dredging plant is incorporated in Appendix G.

Figure 2-6 Typical cutter suction dredgers

Small sized cutter suction dredge

Medium sized cutter suction dredge

2.4.6.7 Reclamation and Rockworks Methods

Breakwaters and revetments are required to protect the precinct from the potential adverse effects of waves, particularly during storm events. The walls typically consist of a rock armour layer over a core of quarry material. The width of the bund crest is usually dictated by sufficient space to allow the passage of trucks to build the bund while maintaining working room for plant to lay the armour layers.

A total of 348,000 m^3 imported rock fill (Table 2-3) is required for the project. It is understood that sufficient quantity/ quality of rock armour (typically 2 -5 tonne size offshore) and rock core material (typically quarry run size) can be sourced from local quarries located within 60km from the marine precinct site.

This material must be delivered from the quarry to the site by road in a fleet of road-registered haulage trucks. The trucks will haul the material from the quarry to the bund site and continue out to the bund and end tip material into place allowing progressive bund construction nearest-shore to furthest from shore.

For the offshore breakwater construction, the trucks will dump the rock fill directly into barges, which will transport the rock to the breakwater location, where it will be placed by barge mounted grab crane.

Alternately, the road-registered fleet could dump fill at a stockpile and the material can be rehandled and placed by dedicated on site plant. Photographs of the indicative method are shown in Figure 2-7.

Figure 2-7 Breakwater Construction

Excavator and grab barge placing rock offshore

Loader rehandling armour to offroad dump truck

A similar process is required for filling of the reclaim with terrestrial fill. A total of 1,007,000 m^3 imported non cohesive fill (Table 2-3) is required for the project (up to 922,000 m^3 imported from terrestrial source). This material would be delivered to site using a fleet of haulage trucks and spread on site using conventional swamp dozers and earthmoving plant.

Some ground improvement or consolidation / compaction works will be required before construction on reclaimed land, this may include; dynamic compaction, vertical drains or surcharging. The actual method adopted will depend on the ground conditions, required speed of construction and the contractor's plant.

2.4.6.8 Summary of construction plant

The actual equipment adopted will depend on the final configuration of the development, plant availability and the Contractors preferred working method. An indicative list of equipment is provided below based on the identified construction method above.

Table 2-5 Construction Equipment on Site – Dredging and Reclamation Works

Phase of Works	Equipment	Number	Activity
End Dumped Revetment / Breakwater construction			
Trawler Basin revetment 18 weeks *(prior to opening TPAR)*	Trucks	24/ day	Delivery of Revetment core material and armour
	Excavator:	1	Handling / placing rock fill
	Loader:	1	Rehandling / Stockpiling fill
	Offroad Dump Truck	1	Rehandling / Transporting fill
	Dozer:	1	Trimming / Level finished surface
Stage 2 revetment 10 weeks Stage 3 revetment 4 weeks *(post opening TPAR)*	Trucks	140/ day	Delivery of Revetment core material and armour
	Excavator:	3	Handling / placing rock fill
	Loader	2	Rehandling / Stockpiling fill
	Offroad Dump Truck	3	Rehandling / Transporting fill
	Dozer:	3	Trimming / Level finished surface
Offshore Breakwater Construction			
Offshore Breakwater Construction 14 weeks	Trucks	140/ day	Delivery of Breakwater core material and armour
	Excavator	1	Handling / placing rock fill
	Dozer:	1	Trimming / Level finished surface
	Loader	1	Rehandling Fill / Loading barges
	Bobcat	2	Rehandling Fill onboard barges
	Transport Barge	2	Transporting core and armour
	Grab Barge	1	Placing Breakwater armour
	Survey Boat	1	Hydrographic Surveys
	Work Boat	1	General support

Phase of Works	Equipment	Number	Activity
Backhoe Dredging			
Trawler Basin 7 weeks Stage 2 Inner Harbour 19 weeks Channel + swing basin re-alignment 14 weeks Under Offshore breakwater foundation 22 weeks Pile Moorings 6 weeks	Backhoe Dredge	1	Dredging
	Split Bottom barge	2	Transporting and dumping dredge spoil
	Tug	1	Supporting dredger and split bottom barges
	Workboat	1	Supporting dredger and tug
	Survey Boat	1	Hydrographic survey
	Support Boat	1	General support / provisioning / fuel / transport
Cutter Suction Dredging			
Dredging of Stage 2 Inner Harbour 7 weeks	Small Cutter Suction Dredge	1	Dredging to reclaim
	Floating spoil pipeline	1	Spoil transport
	Adjustable weir box	1	Tailwater management
	Dozer / loader	1	Spoil pipe handling
	Support Boat	1	General support / provisioning / fuel / transport
Reclamation using imported fill			
Stage 2 33 weeks Stage 3 30 weeks *(post opening TPAR)*	Trucks	140/ day	Delivery of sand fill material
	Excavator	3	Placing and handling fill
	Dozer:	3	Trimming, Placing and compacting fill
	Loader	2	Placing and rehandling fill
	Offroad Dump truck	3	Rehandling and transporting fill
Backfilling dredge trench			
Reinstatement of foundation under offshore breakwater	Trucks	140/ day	Delivery of sand / quarry run fill material
	Loader	1	Loading barges

Phase of Works	Equipment	Number	Activity
24 weeks	Survey Boat	1	Hydrographic survey
	Drag bar / bed leveller	1	Finishing / levelling
	Split bottom Barge or transport barge	2	Transporting and dumping fill
	Spreader barge	1	Placing / dumping fill

2.4.7 Structures

The structures proposed for the Precinct include;

- Offshore Breakwater
- Protective rockworks and reclamation
- Marine infrastructure
- Buildings and other facilities

Details of the proposed infrastructure, operations and configuration for the Reference design are provided under Section 1.2 and elsewhere within Section 2. Information on the metes and bounds for each stage of the TMPP are provided on Figure 2-9. The coordinates provided on this figure are against the Reference Design. Detailed survey of the site prior to construction activities will be required and metes and bounds for the TMPP will be refined at that stage of the project to be accurate against detailed design footprint.

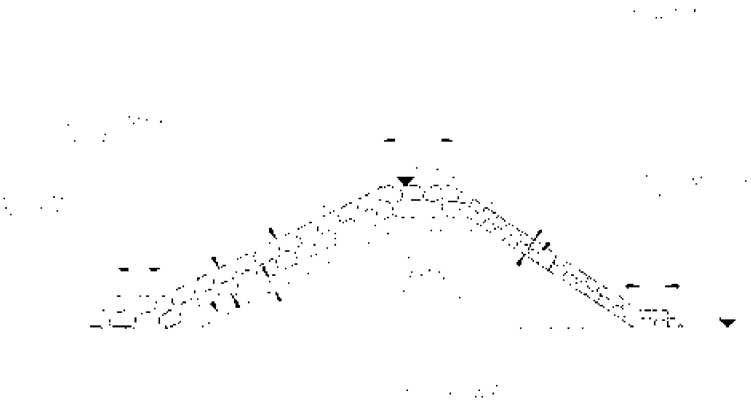
2.4.7.1 Offshore Breakwater

It is anticipated that the Breakwater structures will be constructed using imported fill material sourced from quarries within the greater Townsville Area. Additional details are provided under the previous section (Section 2.4.6) including volumes of imported fill and construction methods.

The typical cross-section for the external breakwater is shown in Figure 2-8 below.

The seaward side is sloped at 1v:2h, with two layers of 2 to 5 tonne armour rock (typical) and a filter layer of 0.2 to 0.4 tonne rock (typical). The lee side of the breakwater has a slope of 1v:1.5h and uses two layers of 0.3 to 1 tonne armour rock. The breakwater has a crest level of +7.0 mLAT (5.14 mAHD).

Figure 2-8 Offshore Breakwater – Typical Section



Preliminary design for the Offshore Breakwater has been undertaken using the following criteria:

Water level = 4.85 mLAT (1 in 100 yr storm tide including surge) (GHD. 2007 – Townsville Thuringowa Storm Surge Study)

Incident wave = H_{sig} = 3.4m – 2.6m depending on location (greater waves at outer end)
T_p = 9 seconds (I in 100yr wave event)

Resulting Damage = intermediate for offshore end (5-10% armour damage), acceptable for middle and inshore section (<5% damage).

The offshore section of the breakwater will be subject to some damage requiring maintenance under 100 year design conditions (including sea level rise provision). Detailed design will require the rationalisation of the armour size distribution along the breakwater and revetments.

2.4.7.2 Protective rockworks and reclamation

It is anticipated that the reclamation area will be constructed using some material from dredge spoil sourced from within the footprint of the inner harbour excavation but predominantly from imported fill. Imported fill will be sourced from quarries within the greater Townsville Area. Additional details are provided under the previous section (Section 2.4.6) including volumes of imported fill and construction methods.

The typical cross-section provided from the commercial development process for the revetment armouring are shown in Section 2.4.6 above.

The nominated reclamation level is 5.5 mLAT (3.64 mAHD) with internal harbour sloped at 1v:2h, with 600mm thick rock layer for protection for vessel wake waves. The external rockworks include a crest wall to 6.7 mLAT (4.84 mAHD) with a single layer of 2 to 4 tonne armour rock.

An assessment of the nominated design has been undertaken using the following criteria;

Water level = 4.85 mLAT (1 in 100 yr storm tide including surge) (GHD. 2007 – Townsville Thuringowa Storm Surge Study)

For the reference design including an offshore breakwater the harbour is protected from larger waves and wave modelling indicates an attenuated wave height of;

Incident wave = Hsig = 0.3m, Tp = 9 seconds (I in 100yr wave event)

Resulting Damage = very low (no damage).

With the provision of an offshore breakwater no damage is expected. Detailed design will require the rationalisation of the armour size distribution along the revetments.

2.4.7.3 Marine infrastructure

An indicative layout for the Marine Infrastructure relevant to the reference design is provided under the project description (Section 2).

A number of vessel lifting facilities are expected and are likely to consist of driven steel piles supporting a concrete superstructure to accommodate travelling shiplifts.

The works will involve marine pile installation and overwater concrete work requiring a floating barge to support piling work followed by construction of suspended formwork and concreting. Structures would be of a standard form and require delivery of materials to site up to 10 trucks per day.

Vessel work berths are expected to be constructed to accommodate trawlers and work berths within the inner harbour of the stage 2 reclamation. These facilities are expected to consist of floating pontoons tethered by driven steel piles.

The works will involve marine pile installation followed by installation of pre-fabricated pontoon and walkway infrastructure and require a floating barge and work boats to support piling works and installation of floating infrastructure. Structures would be of a standard form and require delivery of materials to site up to 10 trucks per day.

Pile moorings are proposed for the lee of the breakwater and these structures are likely to consist of driven piles. Pile moorings would require marine pile installation similar to the construction of the vessel works berths.

2.4.7.4 Buildings and other facilities

A number of buildings will be required by the operators of the precinct facilities, these are expected to consist of maintenance sheds up to 6-7 storeys in height constructed predominantly from steel frame and metal cladding, and supported on raft or piled foundations.

An indicative layout for the topside works relevant to the reference design is provided under the project description (Section 2).

The works will involve minor excavation, foundation concrete works including bored piers and erection by mobile crane. Structures would be of a standard form and require delivery of materials to site up to 10 trucks per day.

Internal roads, pavements and hardstand areas are expected to be constructed from concrete or asphaltic pavement.

Construction will involve levelling, importation and compaction of sub base material and placing and construction of the pavement wearing surface. Importation of materials may require delivery traffic of up to 10 trucks per day.

2.4.7.5 Pollution control during construction

Construction works will be undertaken in conformance with a Construction Management Plan prepared by the Developer and Contractor and specific to the construction procedures to be adopted for the works. This plan will address pollution control issues under plans for:

- Erosion and sediment control;
- Emergency and incident response;
- Waste management, and
- Air Quality and Noise impacts.

Further details relevant to the development of this plan are provided under Section 3.16 and Section 6.

2.4.7.6 Summary of construction plant

The actual equipment adopted will depend on the final configuration of the development, plant availability and the Contractors preferred working method. An indicative list of equipment is provided below in Table 2-6 based on the identified construction method above.

Table 2-6 Construction Equipment on Site – Structures

Offshore Breakwater and Protective rockworks - Refer Table 2-5			
Marine Infrastructure			
Trawler Basin 20 weeks Stage 2 Inner Harbour 30 weeks Pile Moorings 12 weeks	Trucks	10/day	Delivery of construction materials
	Barge	2	Pile transport and Installation. Floating crane platform
	Pile Hammer / leader:	1	Installation of Piles
	Crane	1	Pile handling, installation, prefab unit handling
	Work Boat	1	General support
	Concrete Truck / Pump	5/day	Transporting / Pouring concrete
	Work Boat	1	General support
Buildings and Other Infrastructure			
Stage 1 Hardstand development 30 weeks Stage 2 Development progressively	Trucks	10/day	Delivery of construction materials
	Excavator	1-2	Excavation to install services and building foundations
	Piling Rig	1-2	Installing bored piles

constructed Stage 3 Development progressively constructed	Concrete Truck / Pump	5/ day	Transporting / Pouring concrete
	Crane	1	Building erection
	Grader	1	Levelling / trimming surface
	Water Truck	1	Dust Control
	Asphalt Paving machine	1	Laying Asphalt
	Rollers	2-3	Compacting subgrade / finishing surface

2.4.7.7 Modifications for sea level rise and climate change

Water levels for analysis have been derived from the Townsville-Thuringowa Storm Tide Study, undertaken in 2007. The levels presented are a statistical combination of tide, storm tide and sea level rise where applicable for Ross River, Townsville. The report is consistent with the changes proposed by DERM to the State Coastal Management Plan in that it allows for a static sea level rise of 500 mm over 50 years and 900 mm over 100 years.

Table 2-7 Design Water Levels

Scenario	Water Level (m AHD)	Water Level (m LAT)	Components
Present day	+2.94	+4.85	100yr ARI storm tide including surge
2050	+3.1	+4.95	100yr ARI storm tide including surge and 50yr allowance for sea level rise
2100	+3.5	+5.35	100yr ARI storm tide including surge and 100yr allowance for SLR

In addition, increased water levels allow a slightly greater wave height to propagate to the site, with assessment showing the design incident wave height increasing from H_{sig} = 3.4m (present day) to H_{sig} = 3.6m (year 2100).

For the combination of increased water levels and incident waves the offshore breakwater damage factors increase as follows:

Table 2-8 Typical Breakwater – Impacts of Sea Level Rise and Climate Change

Water Level	Present Day	2050	2100
Central Section			
% Damage	0 – 5	0 – 5	0 – 5
Implications	Acceptable	Onset of damage	Onset of damage

Offshore Breakwater overtopping is within acceptable limits for all cases and the breakwater effectively protects the precinct from wave penetration.

Damage levels will increase as a result of increased water levels and propagation of large waves to the site however the damage on the typical breakwater section is considered to be within allowable limits (<5% damage). As previously indicated the detailed design will require the rationalisation of the armour size distribution along the breakwater and revetments and this process should be undertaken considering the impacts of climate change and sea level rise.

For the reference design (incorporating an offshore breakwater) the wave height penetrating to the precinct is not increased and damage to the revetment armour is not impacted.

However, for the nominated Precinct revetments and reclamation levels (Peron, 2008), the 2050 storm tide levels reduce the reclamation freeboard to 50 mm and the 2100 storm tide levels are expected to inundate the precinct reclamation by 350 mm.

Detailed design of the reclamation levels should be undertaken utilising a risk based approach and rationalising the potential damage to infrastructure against the probability of inundation. Whilst flooding of the hardstand and pavement areas is not considered to be a major problem, consideration should be made to locating infrastructure sensitive to flooding (eg hazardous material storage, mechanical and electrical plant, services and structures with finishes / fittings subject to damage in the event of inundation) clear of the projected storm tide levels. In addition, selection of the final reclamation level must consider constraints related to operation of the shiplifts and vessel transfer with the levels and flood immunity for the various operations, along with the containment of waste. Options may include raising the reclamation level to accommodate future potential sea level rise as well as refining the crest wall height and armour in the event the development does not incorporate a protective breakwater.

Other impacts of climate change and sea level rise are dealt with in Section 3.6.

2.4.8 Commissioning

The commissioning process will occur for each stage of the Precinct. For each stage a detailed commissioning or start-up plan will be prepared to provide that all safety, environmental and operating procedures are being complied with.

Two types of commissioning will occur for the Precinct:

- Building/structure commissioning – refers to the physical facility completion for occupation by the contractor. The activities include the successful running of all plant and equipment; and
- Operational commissioning – refers to activities undertaken leading up to handover of the building to the users. Typical activities include familiarisation of staff with safety, environmental and security and communications systems (DHS 2008).

The commissioning process will most likely be undertaken by the assigned construction contractor. The POTL will be responsible for ensuring that commissioning is effectively completed as detailed in a commissioning or start up plan (DHS 2008).

The main objectives of the commissioning or start up plan will be to:

- Ensure the new facilities and equipment are ready for occupancy and use, with approvals and verification in accordance with the Building Code;

- Ensure that the new equipment meets all Government legislative requirements and prescribed energy levels under the relevant greenhouse policy/guidelines;
- Train staff in the operation of new equipment and safety procedures;
- Identify any minor defects which require rectification by the Contractor; and
- Receive all warranties and procedure manuals (DHS 2008). .

2.5 Operations

2.5.1 Overview

This section describes the location and nature of the processes to be used during operation of the Precinct. Operational issues addressed include:

- A description of plant and equipment to be employed;
- The capacity of plant and equipment;
- Maintenance dredging requirements;
- A description of arrangements for long-term maintenance of the marine facilities including details of the responsible parties;
- Details of the predicted usage of the marine facilities;
- Detailed requirements of vessel operations including tugs, pilotage, channel closures, quarantine and security arrangements etc; and
- The numbers of people to be employed in the project operations.

Concept and layout plans are provided highlighting proposed buildings, structures, plant and equipment associated with the processing operation. The nature, sources, location and quantities of all materials to be handled, including the storage and stockpiling of raw materials, is described.

2.5.2 Proposed operations

The proposed operations and facilities to be included at the Precinct provide commercial marine capabilities consistent with those currently in operation within the Townsville region. Stage 3 of the Precinct facility (Stages described under Section 1.3.2) provides expansion potential of industries to match increases in trade, commercial and residential growth in Townsville.

As noted above, a number of industries currently housed in facilities up Ross River may be affected by construction of the TPAR. The Precinct facility provides an alternative location for those industry types. Whether existing businesses choose to relocate into the Precinct is a matter for individual negotiations with the developer of the Precinct facility and POTL. For the purposes of undertaking a robust EIA process a number of operational industry activities were identified as part of the Reference Design for this project. The Reference Design is described in Section 1.2 and above. Table 2-9 summarises the types of industries and activities to be undertaken on the site as per the Reference Design. Figure 2-2 provides a visual estimate of the layout of the operational industries within the Precinct according to the Reference Design.

Table 2-9 Industries Supported by the Precinct

Type of business	Activities to potentially be undertaken on site
Commercial marine construction and maintenance	◗ Large workshop; ◗ Yard storage; ◗ Fully serviced office facility; ◗ Full access wharf facility nearby; and ◗ Diving and marine plant.
Commercial Marina	◗ Management operation and maintenance of a Marina for use by owners and operators of a licensed fishing vessel and for purposes related to activities associated with the commercial fishing industry; ◗ Packaging and wholesaling agency service for seafood trading, sale of fuel and chandlery and casual mooring services; ◗ Commercial marina; ◗ Seafood sales; ◗ Products/Services including gasoline; mooring services refrigerated storage facilities; seafood distribution; ships chandlery; and ◗ Industry operations for trade in chemicals, food / beverage, marine technical and engineering supply, transport services / storage and marine industrial wholesale supply.
Boat building operation	◗ Boat hauling and lifting, small craft repair, rigging and servicing facility, small boat storage and marine retail sales; ◗ Boat repair facilities- small pleasure craft to military and commercial vessels up to 500T; ◗ Boilermaking/engineering; ◗ Shipwright work; ◗ Abrasive blasting; ◗ All types of painting above and below the waterline; ◗ Versatile Marine Shiplifters capable of 70T and 180T; ◗ 500T Slipway; ◗ Floating pontoons capable of supporting vessels up to 25m in length; and ◗ Diesel refuelling.
Commercial Trawler Base	◗ 50 trawler berths; ◗ Two transfer / maintenance berths; ◗ Waste management facilities; and ◗ Diesel refuelling.

Type of business	Activities to potentially be undertaken on site
Commercial Barge Operation	◗ Barge terminal including facility for receiving, processing, storing and distribution of seafood as well as providing consultancy and management services to external companies.
Passenger Barge Operation	◗ Freight terminal, including vessel mooring.
Chandlery	◗ Provision of supplies such as wire, rope and lifting equipment to the fishing industry.

Other proposed facilities

Along with the industries mentioned above the following facilities will be included in the Precinct:

- Marine industrial allotments for industries similar to those mentioned above;
- The full range of site services (power, water, sewerage, stormwater drainage and telecommunications); and
- A sullage pump out facility may be required.

There is potential for other, relevant, service groups, including the Queensland Police Service Water Police facility, to be located within the Precinct. Consideration of the occupants to be housed within the Precinct will be undertaken by the developer to ensure an appropriate mix of facilities within the industrial area.

2.5.3 General operating procedures

General operating procedures to be employed for the Project are expected to be similar to those procedures in place for the existing industries in the Townsville region, including those that may choose to relocate to the Precinct. The developer and/or subsequent managing contractor will manage the general operating procedure for the new facilities.

Operating times will reflect the existing businesses hours and some aspects of the Precinct will require 24 hour, 7 day a week operation.

2.5.4 Environmental management procedures

A site-specific EMP has been prepared for the Project. The aim of the EMP is to:

- Facilitate the development and operation of the Precinct in accordance with applicable environmental laws, policies and procedures;
- Integrate environmental considerations into the development and operation of POTL planning;
- Provide a framework for continual improvement to environmental performance and strive for best practice; and
- Provide a platform for integration with the POTL Environmental Management System (EMS).

All users of the Precinct will accommodate the EMP.

2.5.5 Rehabilitation

As this Project is not likely to be decommissioned in the foreseeable future (not less than 75 years), detailed rehabilitation information can not be provided at this time. It would be expected that a decommissioning plan would be required to be developed at a later stage.

It is noted however, that rehabilitation of small components of the project during construction may be required. This may include any proposed vegetation removal and dredging impacts. Details regarding rehabilitation that may be required for the project are detailed further in the Section 8.

2.6 Associated infrastructure requirements

2.6.1 Overview

The following section identifies the infrastructure requirements for the Project. The proposed Precinct infrastructure, including location of roads, pathways, buildings, power lines and other cables, wireless technology is illustrated in Figure 2-9.

The full range of site services including power, water, sewerage, stormwater drainage and telecommunications will be provided to the proposed development. Detailed information regarding infrastructure requirements on site is provided in Section 3.4.

2.6.2 Workforce and accommodation

A detailed assessment of the economic impacts of this project on the Northern Statistical Division (SD) has been undertaken and is presented in Section 5. The Northern SD includes Hinchinbrook Palm Island, Townsville, Burdekin and Charters Towers and is the smallest region for which many statistics are prepared by State Departments and the Australian Bureau of Statistics. Section 2.4 describes the construction requirements for the project. Both of these sections provide further information with regards to the employment needs and opportunities of the TMPP during construction and operational phases.

The total (direct and indirect) additional labour force needs created by the construction activity and eventual potential expansion of activity at the Precinct are summarised in Table 2-10.

The Northern SD currently (September Quarter 2008) has an estimated labour force of 118,759 workers (smoothed data series) and according to the 2006 Census was home to 8,492 persons employed in the construction industry (of a total estimated Northern SD workforce by the 2006 Census of 94,375 persons). The additional employment created by the construction and operating phases of the project should easily be met by the region’s existing labour force, particularly given the current easing in the jobs market due to the economic downturn.

Label	Easting	Northing
A	483579.39	7870512.18
B	483315.93	7870193.11
C	483158.01	7869996.28
D	482811.23	7869543.80
E	482767.53	7869718.98
F	482869.45	7870104.19
G	482986.15	7870502.05
H	483091.81	7870552.32
I	483392.19	7870528.56
J	483290.72	7870277.75
K	483879.36	7870884.71
L	483931.87	7870801.56
M	484050.04	7870954.73
N	484041.28	7870127.60

LEGEND

- State Controlled Road
- Road
- Breakwater
- Stage 1
- Stage 2
- Stage 3
- Industrial Shed
- Potential Temp. Hardstand Site
- Maintenance (Open Hardstand)
- Marine Infrastructure

1:10,000 (at A4)

0 50 100 150 200 250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number 42-15399
Revision C
Date 08 Aug 2009

Reference Design Infrastructure Plan

Figure 2-9

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Table 2-10 Estimated total employment impacts from the construction and operating phases of the Precinct

Year	Additional Employment Generated
2008-09	0
2009-10	64
2010-11	78
2011-12	115
2012-13	58
2013-14	59
2014-15	117
2015-16	100
2016-17	75
2017-18	18
2018-19 and each year beyond (Estimated 'maximum' employment – likely to be achieved in entirety a number of years after 2018-19	258

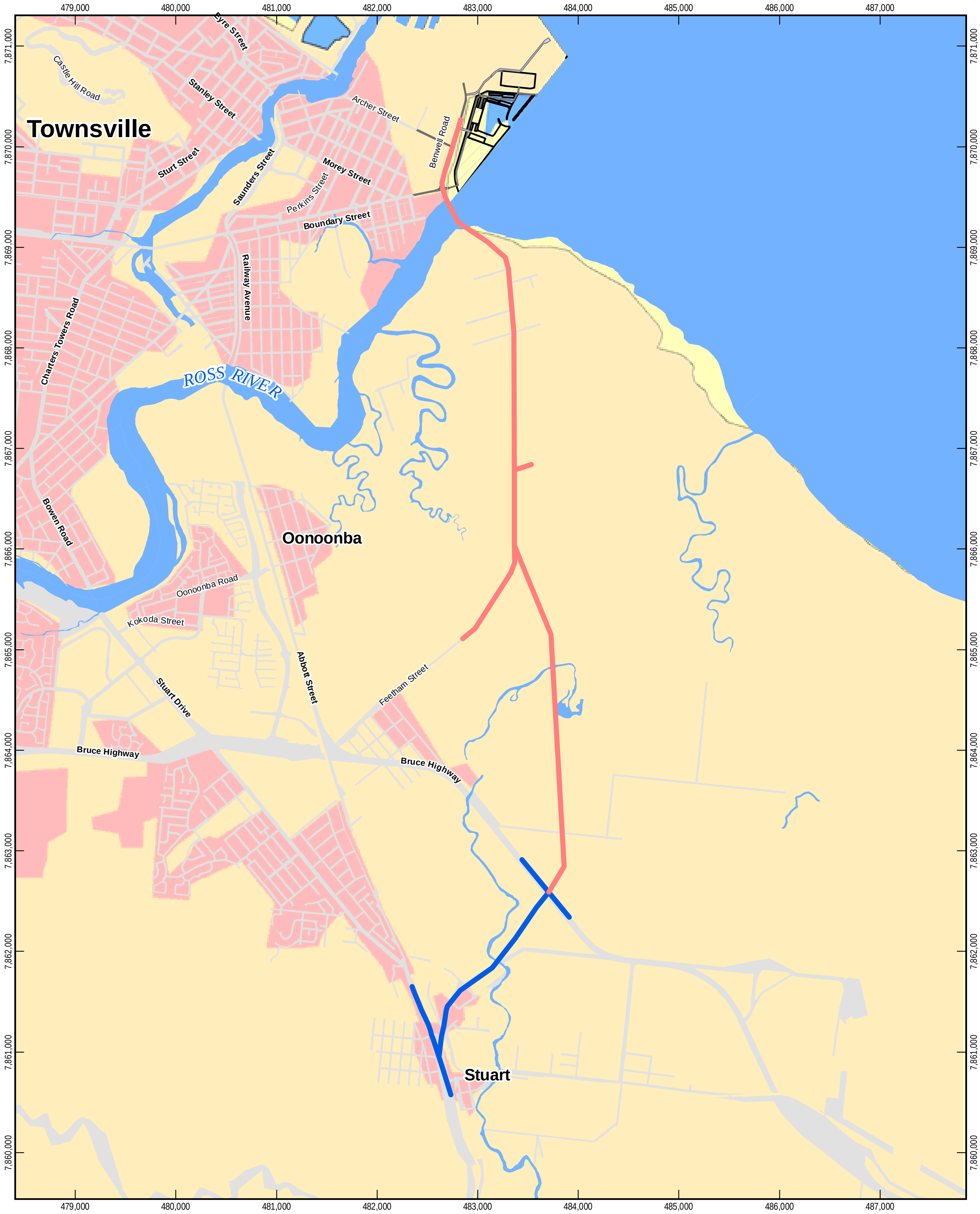
(Source: AEC*group*, Appendix BB)

The skills requirements for the construction phase of the project should be easily met from within the region's existing construction workforce. The skills needs for any expansion of Marine Industries at the Precinct are more specialised and less common in the region and will likely take a period of time to acquire / develop post 2018-19.

The existing and proposed new marine industry precinct are located near to the CBD of Townsville and is easily commutable for the majority of the region's labour force. There is no anticipated need for worker accommodation on site. The additional labour forced needs are expected to be mostly met from existing residents of the region however, if a portion of the workforce is temporarily required from elsewhere the temporary portion of the workforce will not be of material concern to Townsville's existing accommodation capacity.

2.6.3 Transport

Existing access to the Project site is via Benwell Road, South Townville. In 1996/97, a study into a new port access road/rail link from the eastern bank of Ross River was commissioned. This link, now known as the TPAR will require new road and rail links to be built over the mouth of Ross River (Figure 2-10).



LEGEND

- Stuart Bypass
- Eastern Access Corridor
- Builtup Area
- Road
- Water
- Foreshore Flat

1:50,000 (at A4)

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

Port of Townsville
Marine Precinct EIS

Job Number 42-15399
Revision A
Date 28 May 2009

Proposed Port Access Routes

Figure 2-10

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2 / 100 Goondoon Street Gladstone QLD 4680 Australia T 61 7 4972 6377 F 61 7 4972 6236 E gltmail@ghd.com.au W www.ghd.com.au

Data source: NRW (DCDB: road, water - February 2009); NAVTEQ (waterbodies - November 2008); GA (250k topo data: Builtup Area - 2006); GHD (Proposed Port Access - May 2009). Created by: NDB

Both Boundary Street and Benwell Road form part of the ‘Principal Road Freight Network’ as defined in Townsville City Council’s City Plan 2005. A future access route to the site will be via the Stuart Bypass and proposed Port Access Road. The proposed Port Access Road Corridor will provide a direct transport connection along part of Benwell Road and across Ross River to the State Development Area. No transport infrastructure currently exists on the Project site. Construction of the Stuart Bypass and Port Access Road commenced in August 2008. Further information regarding transport impacts and management measures are detailed further in Section 3.4.

2.6.4 Energy

Electrical energy supply infrastructure for the Precinct does not currently exist on the Project site. It is proposed to provide this infrastructure as part of the development. Ergon Energy is the local Distribution Network Service Provider (DNSP) for the area. There is an existing Ergon Energy 66kV/11kV zone substation located on Hubert Street, this substation has recently been upgraded from a 66kV switching only station to include 2 step down transformers to improve supply to the local area. 11kV underground cabling is located in the vicinity of the Project site feeding residential and commercial loads in the area. There is also a recently constructed Powerlink bulk supply substation located on Archer Street. It is likely that Precinct load will be supplied from these substations and negotiation of the supply of services to the Precinct will be required with the DNSP.

The likely electrical demand for the site is estimated as 840kVA based on 16800m² of light industrial facilities at approximately 50VA/m². Based on the present site layout it is anticipated that this would be serviced by a minimum of two separate distribution substations. This will however required further information during detailed design based on actual occupancy and intended use.

Release of some loading on the local electricity grid may occur as a result of industries re-locating from upstream sites into the Precinct facility.

The detailed design phase should also consider abilities to use renewable energy sources within the Precinct.

2.6.5 Water supply and storage

Water supply infrastructure for the Precinct does not currently exist on the Project site. It is proposed to provide this infrastructure as part of the development. Council records indicate a 300mm diameter AC water main in the Benwell Rd corridor. It is possible this main has sufficient capacity to service the development (expected to be in the order of an additional 12.8 L/s peak hour demand), however further information will be required to determine this, and liaison will be required with the service owner/operator.

2.6.6 Stormwater drainage

Stormwater infrastructure for the Precinct does not currently exist on the Project site. It is proposed to provide this infrastructure as part of the development.

Council records indicate several stormwater flow paths through the proposed site, including a 1350 mm diameter RCP along Archer St, and a 1500 mm diameter RCP along Boundary St.

These flow paths will need to be preserved within the proposed layout. In addition to this, stormwater quality improvement will be required within the proposed layout, and possibly quantity reduction to prevent upstream and downstream impacts from flooding. This will have to be considered during the detailed design phase of the Precinct.

Due to evolving legislative changes to wastewater requirements in the Great Barrier Reef World Heritage Area, a sullage pump out facility may also be required. Requirements at the time of construction will need to be met.

2.6.7 Sewerage

Sewerage infrastructure for the Precinct does not currently exist on the Project site. It is proposed to provide this infrastructure as part of the development. Council records indicate a 150 mm diameter sewer main on the southern side of Boundary St. It is unlikely this main could service the development (expected to be in the order of an additional 4800 EPs). There are no other Council sewerage mains in the vicinity of the site, and as a result it appears a pump station and rising main will be required to convey the sewerage to the nearest Council gravity main, or alternatively an on site treatment plant will be required.

2.6.8 Telecommunications

Telecommunications infrastructure for the Precinct does not currently exist on the Project site. It is proposed to provide this infrastructure as part of the development. During detailed design consideration will need to be given to each occupants requirements and appropriate routing of supply of infrastructure from existing telecommunications infrastructure (such as optical cables, microwave towers, etc.). Consultation with the owners of that infrastructure will be required.

2.6.9 Waste management

Solid, inert waste from Precinct activities are expected, based on the Reference Design, to include waste metal, timber, packaging materials (including plastic pallet wrap), office waste and other general solid waste. The majority of solid inert waste from POTL is land-filled at TCC’s municipal facility, although scrap metal associated with pile renewal is segregated for recycling. Waste transporters are contracted to remove this material.

There will be a need to manage the collection and containment of wastes derived from vessels berthed in the Precinct or moored in Ross River. Regulated wastes generated by port users include waste oils, old batteries, oily rags, tyres, chemical containers, obsolete light fittings and sewage sludges. Regulated wastes require special disposal arrangements due to their hazardous or toxic nature. The likely wastes generated from the Project and recommendations made for appropriate disposal are detailed further in Section 3.14.

Section 3
Environmental values and management of impacts

Townsville Marine Precinct Project

Environmental Impact Statement

3. Environmental values and management of impacts

3.1 Introduction

This section addresses all elements of the environment, such as land, water, air, noise, nature conservation, cultural heritage, waste, health and safety. In presenting this information this section:

- Describes the existing environmental values of the area that may be affected by the proposal. Environmental values are described by reference to background information and studies;
- Describes the potential adverse and beneficial impacts of the proposal on the identified environmental values. Any likely environmental harm on the environmental values are described;
- Describes any cumulative impacts on environmental values caused by the proposal, either in isolation or by combination with other known existing or planned sources of contamination; and
- Examines viable alternative strategies for managing or mitigating identified potential impacts.

Special attention is given to those mitigation strategies designed to protect the values of any sensitive areas and any identified ecosystems of high conservation value within the area of possible proposal impact.

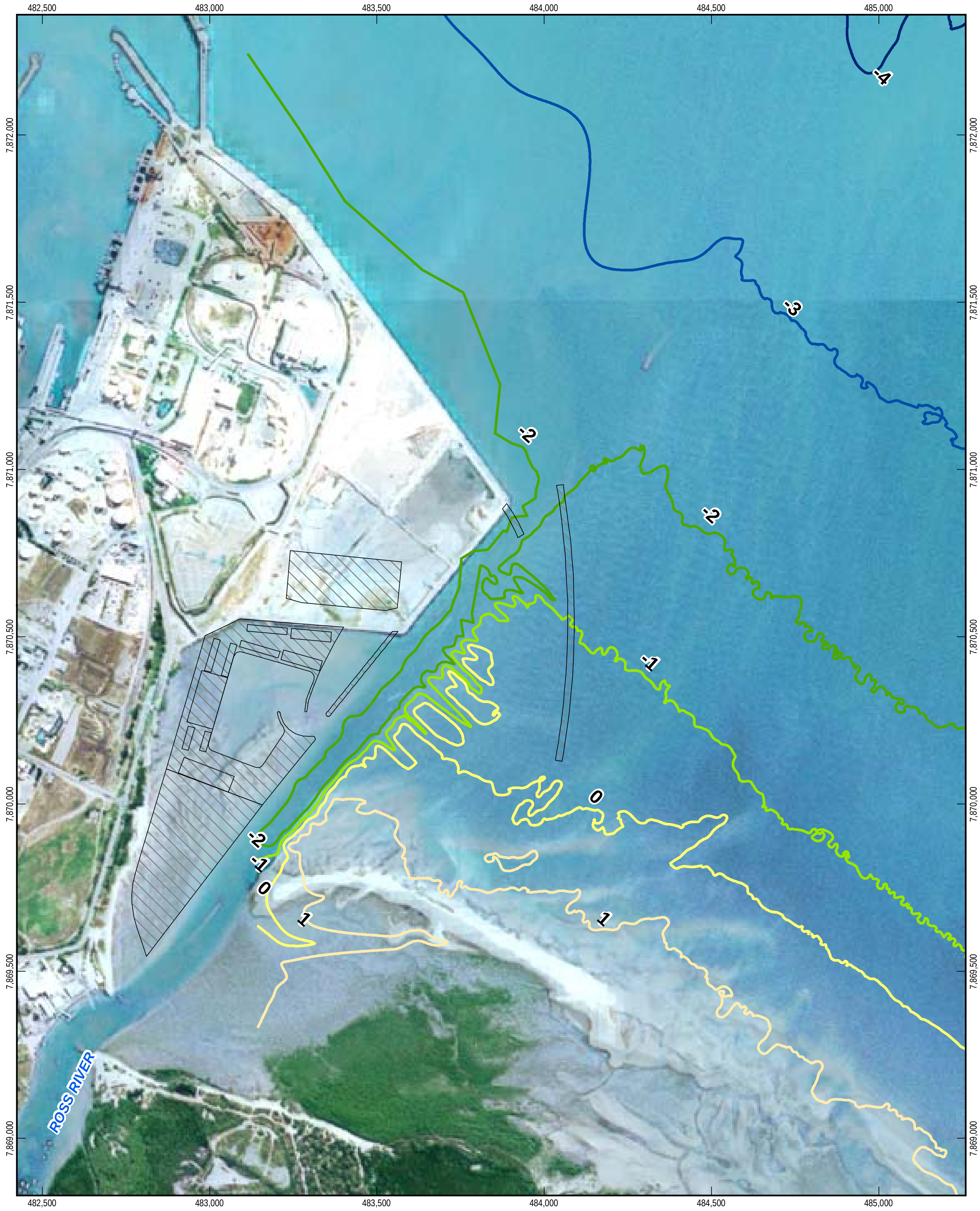
Any requirements and recommendations of the relevant State planning policies, environmental protection policies, national environmental protection measures and integrated catchment management plans are addressed. Cumulative impacts on the environmental values are described and discussed. Control, monitoring and auditing programs are described where appropriate and mitigation and management strategies are described to provide environmental protection. The source of the information given under each element is provided and any uncertainties in the information are discussed.

3.2 Land

3.2.1 Description of environmental values

3.2.1.1 Topography and geomorphology

Collated topography and bathymetry, prepared by GHD, is shown in Figure 3-1. The map shows the elevation of ground surface at Lot 773 is typically between 0 and 3.5 m LAT and shows that area of reclaimed POTL land (Eastern Reclamation Area) immediately north of Lot 773 is built on flat, low lying coastal sediments and has been reclaimed to typically 4.5 to 5.5 m LAT. Note that elevation in m LAT minus 1.856 m gives elevation in m AHD. The majority of Lot 773 is intertidal. To the south lies the mouth of Ross River, sand dunes and tidal mud flats with mangroves close to shore.



LEGEND

Proposed Marine Precinct and Breakwater

Bathymetry Elevation (metres LAT)

- 1
- 0
- -1
- -2
- -3
- -4

1:15,000 (at A4)

0 100 200 300 400 500

Meters

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

PORT of TOWNSVILLE

Port of Townsville
Marine Precinct EIS

Job Number	42-15399
Revision	A
Date	01 July 2009

Precinct Collated Bathymetry

Figure 3-1

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 Created by: TH

3.2.1.2 Geology and soils

The 1:100,000 scale digital geological map for Townsville (Tile 8259, DME) indicates the near-surface lithology in the vicinity of the project area are Quaternary-age sediments including mud, silt and sand deposits (described as coastal tidal flats, supratidal flats and mangrove flats) and sand (beach) deposits immediately to the west and south of Lot 773 (see Figure 3-2). Alluvial and flood plain deposits (silt, sand, clay and gravel) have been mapped a few hundred metres west of area Lot 773. The underlying bedrock is indicated to be Permian-age granite on the geological map.

It is understood that some of the material placed in the Eastern Reclamation Area, north of Lot 773, was sourced from nearby off-shore areas. The geological log for monitoring bore TPA9, reports a layer of sand underlain by silty sand to 6 m below ground level immediately west of Lot 773.

Geological bore logs for TPA-14 to TPA-18 (Golder Associates 2008) suggest bedrock is at least 16.5 m below the seabed in the vicinity of Lot 773. The bore logs, which start from between around 4.4 and 6.5 m depth suggest that the shallow sediments typically consist of layers of sandy clay (1 to 8 m thick) and clay, with some clayey sand (1 to 6 m thick). The bore log for TPA-17 starts at the sea bed and shows silty sand underlain by sandy silt up to around 3 m depth.

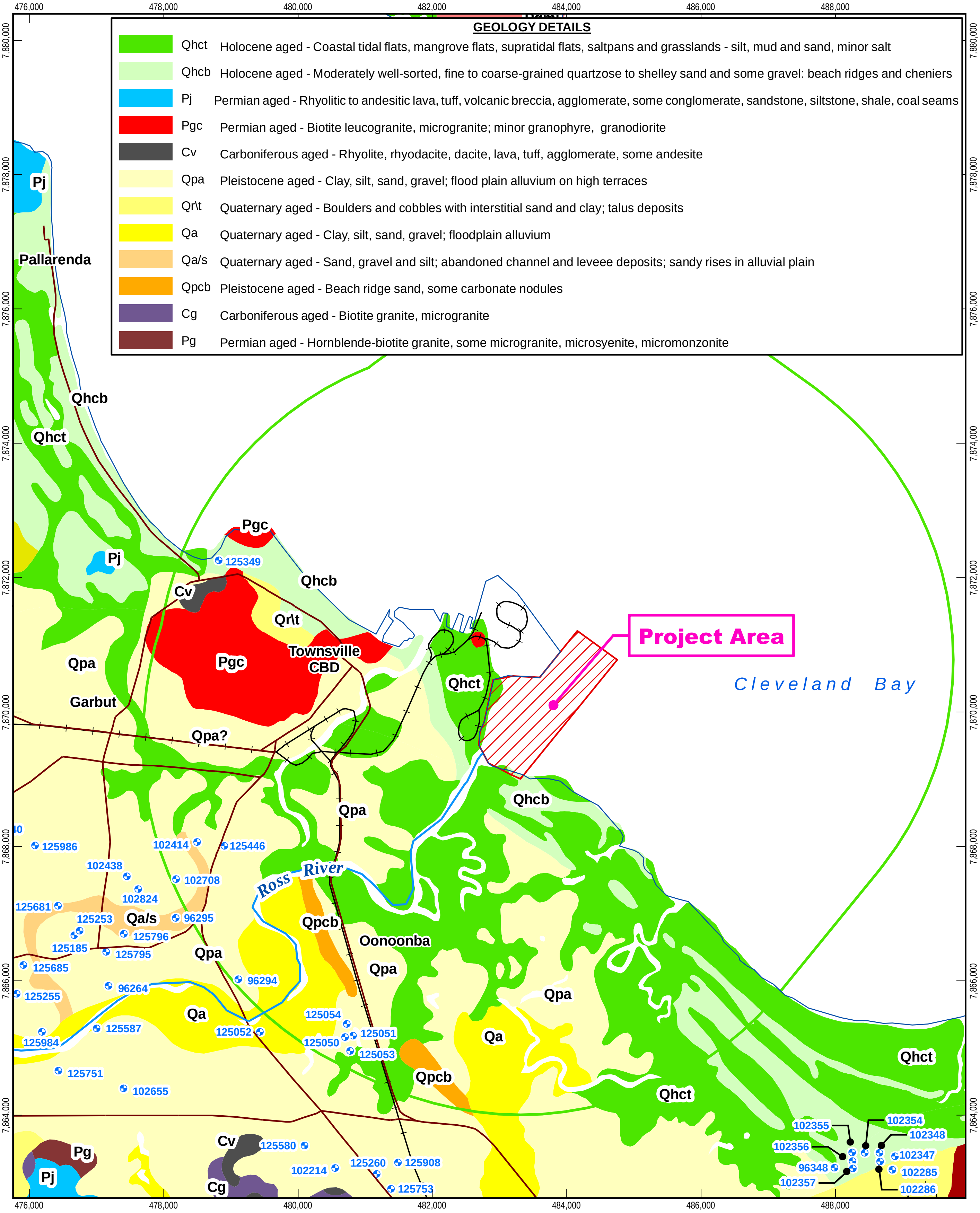
3.2.1.3 Acid sulfate soils

An Acid Sulfate Soils Investigation Report and an Acid Sulfate Soils Management Plan were prepared by GHD in 2009 and are included as Appendix H.

Reporting areas for the field observations defined as Lot 773, Outer Harbour Area 1 and Outer Harbour Area 2 are shown in Figure 3-3.

PASS has been identified across the Precinct in all of the main material types encountered at various depths below the sea bed in 77% of samples analysed, based on values of S_{POS}. However, no AASS (i.e. no existing acidity) has been identified. The origin of the oxidisable sulfur detected at the site is from both inorganic sulfur compounds (such as pyrite) and from organic matter and/or sulfate minerals (such as gypsum) predominantly identified in materials containing significant proportions of clay (including silty clay/clayey silt, sandy silty clay and silty clay).

The ability of sediment to buffer acidity is measured by its acid neutralising capacity (ANC) and for the samples analysed, 80% had more neutralising capacity than acid (organic and/or inorganic) generated, indicated by a reported net acidity of <0.02%S for these samples. Environmental factors (such as grain size, water through flow and precipitates) however, influence the ability of the sediment to fully neutralise the acidity generated. A reported net acidity of <0.02%S does not necessarily mean that all acid generated would be neutralised in reality because not all of the reported capacity may be available as the neutralising agent. For example, shell material can become coated in reaction products (such as gypsum and iron oxide precipitates) that can reduce the effectiveness of buffering and/or the acid generated with the matrix can be removed from the system faster than the neutralising reactions can complete



LEGEND

- Registered Groundwater Bore
- Major Road
- Railway
- Watercourse
- 5km Buffer

1:75,000 (at A4)

0 0.5 1 1.5 2

kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
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Revision A
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Mapped Geology and
Registered Groundwater Bores

Figure 3-2

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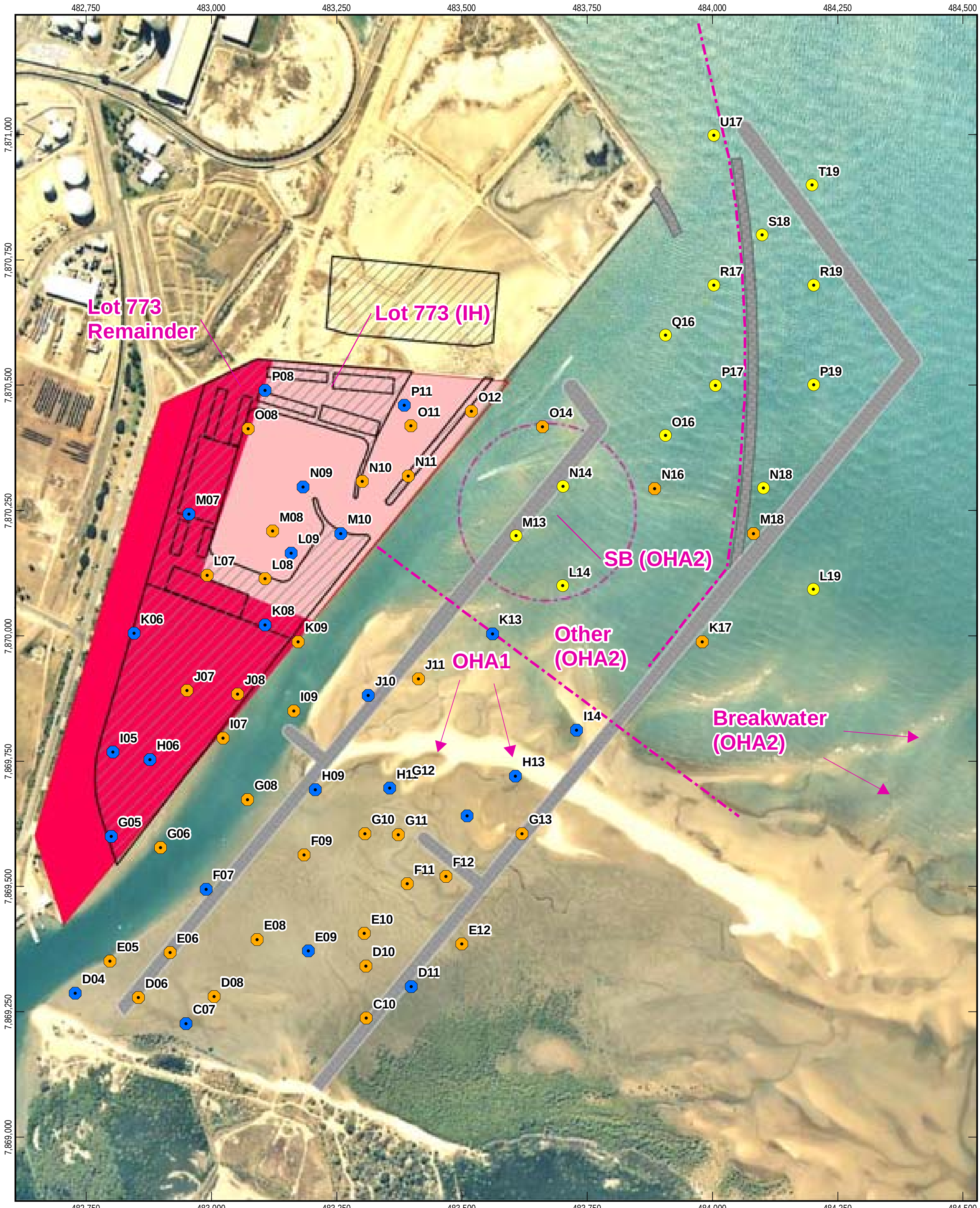
Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Groundwater Bore - ©The State of Queensland (Department of Environment and Resource Management); 250K Topo Data - ©Commonwealth of Australia (Geoscience Australia) 2007. Created by: JVC



LEGEND

- Vibra-Core Sample Locations - Phase 1
- Vibra-Core Sample Locations - Phase 2
- Vibra-Core Sample Locations - Phase 3
- Precinct Layout
- Breakwater Min Max Option
- Breakwater Option C (Preferred)
- Lot 773 Inner Harbour and Trawler Basin
- Lot 773 Remainder
- Reporting Areas:
  OHA1-Outer Harbour Area 1
  OHA2-Outer Harbour Area 2

1:10,000 (at A4)

0 50 100 150 200 250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Vibra-core Sample Locations
and Reporting Areas

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Date	01 July 2009

Figure 3-3

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data source: Vibra Core Locations - ©GHD; Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management). Created by: TH

The amount of "spare neutralising capacity" (ANC / S_{POS}) gives an indication of the likelihood that acidity generated will be neutralised. For the samples analysed, 41% had an ANC less than two times the value of S_{POS} (maximum oxidisable sulfur), and present moderate to high risks from acid generation while 59% of the samples analysed present a low risk. However, given that results suggest all of the main material types encountered present a range of risk no one material type, or types can be classed as presenting a low, moderate or high risk from acid generation.

Mixing of materials during the dredging process may help to distribute the materials with more ANC and thus could potentially reduce the risk of acid generation overall, however the dredging process can separate fines (which typically have a higher potential for ASS) from the coarser components (which can have a lower potential for ASS) thus potentially counteracting the benefit of mixing.

Analysis of the swing basin sample results suggest that the potential for environmental harm as a result of oxidation of PASS material is less likely than in other areas of the site. The level of ANC is twice that of S_{POS} which indicates a low risk potential. Note that this interpretation is based on analysis of only 14 samples from the swing basin, which does not meet ASSMAC sampling guidelines.

Based on the ratio of the calculated average ANC to average S_{POS}, for samples obtained from each reporting area, the Inner Harbour and Trawler Basin (Lot 773), Breakwater (Outer Harbour Area 2), 'other' including channel (Outer Harbour Area 2) and Swing Basin reporting areas, present a low risk from acid generation assuming full mixing of each sample (see Table 3-1). Note that although the samples, on average, present a low risk from acid generation for these reporting areas, full neutralisation of any acid generated is not guaranteed to occur. In addition, 'hot spots' of material with in-sufficient capacity to neutralise acidity have been identified in these areas, except for the proposed swing basin and therefore the likelihood of the presence of other 'hot spots' (as yet unidentified) should also be considered.

Table 3-1 Ratio of ANC to SPOS by reporting area

Reporting Area Name	Ratio[1] of ANC to S_{POS}	Presented Risk
Lot 773 - Inner Harbour and Trawler Basin	2.84	Low
Lot 773 - Remainder of Lot 773	0.61	High
Outer Harbour Area 1	0.85	High
Breakwater (Outer Harbour Area 2)	2.56	Low
Other, including channel (Outer Harbour Area 2)	3.28	Low
Swing Basin (Outer Harbour Area 2)	5.77	Low

[1] Based on the average ANC and average S_{POS} calculated for samples from each 'reporting area'

3.2.1.4 Land contamination

A description of any possible land contamination from the Precinct is detailed further in Section 3.9 Water and Sediment Quality, and discusses the following land contamination issues:

- Mapping of any areas listed on the Environmental Management Register or Contaminated Land Register under the *Environmental Protection Act 1994*;
- Identification of any potentially contaminated sites not on the registers which may need remediation; and
- A description of the nature and extent of contamination at each site.

3.2.1.5 Land use

Land tenure

All the proposed works lie within the declared Port Limits of the POTL. The proposed project area of Lot 773 on EP 2211 is under a Perpetual Lease to POTL. This came into effect following vesting of EP 221 in 1987 from the Governor of Queensland to the Townsville Port Authority. A Lease in Perpetuity was granted by the Department of Natural Resources and Water commencing on 30/11/2000 for port and transport related purposes.

An area across the mouth of Ross River adjacent to Lot 773 will also be required for a breakwater and pile moorings. POTL is in discussions with the Department of Natural Resources and Water in relation to tenure for the seabed associated with the footprint of this facility.

Public use of Lot 773

A Public Use and Traffic Surveys report was undertaken by GHD for the TMPP (Lot 773 and Benwell Road) in June 2008. This report identified the majority (48%) of all activities undertaken in the area was boating. Most of these were recreational boats with a minor proportion made up of commercial vessels. The subsequent most popular activities were walking dogs (20% of all activities), walking or jogging (13% of all activities), fishing (8% of all activities), activities undertaken in cars (e.g. talking, eating meals, enjoying the view) (5% of all activities) and other activities (e.g. taking pictures, kayaking, kids playing) (4% of all activities). Additional information in regards to public use of Lot 773 is available under Section 4 of this document.

3.2.1.6 Precinct land holdings

The following Table 3-2 provides a description of the existing and proposed uses for each lot (shown on Figure 3-4) and the works proposed for the Project.

Lot 773 forms the basis for the TMPP footprint. The northern adjacent land, Lot 791, is reclaimed Strategic Port Land, often referred to as the Townsville Port Eastern Reclaim Area. The relevance of this land to the TMPP is that the breakwater will adjoin this area and it may temporarily provide a hardstand area associated with Stage 1 of the Precinct during construction of Stage 2 of the Precinct if required (refer Section 1 for a description of the TMPP stages). Lot 791 will only be used by Precinct occupants, if required, until Stage 1 is completed and will be returned to POTL in its existing state by June 2011. Beyond Stage 1 completion no continued use of Lot 791 is expected.

Lot 791, being reclaimed land, has no previous land uses. Lot 773 will become reclaimed land. It is currently intertidal and during low tide is used by the public for recreational activities. No other uses of Lot 773 currently occur.

Table 3-2 Precinct land holdings

Property Description	Tenure	Existing Use	Proposed Use	Land Use Designation POTL Land Use Plan
Lot 773 on EP 2211	Perpetual Lease	◗ Strategic Port Land ◗ Sea Bed (reclamation area). ◗ Public access to foreshore area currently allowed by POTL	◗ Precinct	Port Dependent Industry
Lot 791 on EP2348	Perpetual Lease	◗ Strategic Port Land ◗ Port-dependent industry, reclamation, land development	◗ The breakwater will adjoin this land ◗ Temporary hardstand area while Stage 1 developed	Port Dependent Industry

3.2.1.7 POTL land use planning

Both Lots 773 and 791 are designated as 'Port Dependent Industry' within the POTL Land Use Plan 1996.

'Port Dependent Industry' designation is for uses:

> *"which are not part of the core port operations of the port but which are intimately associated with and dependent upon being conducted in proximity to the land/sea interface and core port operations. They include stockpiles, granaries, silos and container storage. Facilities included in this category are those which;*
>
> - *handle bulk material either sourced by sea transport or dispatched by sea transport*
> - *generate such significant sea trade as to positively enhance the usage of the port".*

As discussed in Section 1.7.4.2, the Project is considered to be consistent with this land use designation.

LEGEND

- Townsville State Development Area
- Proposed Marine Precinct and Breakwater
- Cadastre
- Road
- Water
- Breakwater
- Education, Heritage And Business Park
- Central Business District
- Centre Frame
- Core Industry
- Business And Industry
- Traditional Residential
- Neighbourhood Residential
- Mixed Residential
- City View Slopes Residential
- Medium Density Residential
- Community And Government
- Not Subject to Planning Scheme
- Green Space

1:25,000 (at A4)

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Land uses

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Figure 3-4

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Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; DCDB - ©The State of Queensland (Department of Environment and Resource Management); 250K Topo Data - ©Commonwealth of Australia (Geoscience Australia) 2007. Created by: TH

3.2.1.8 Port of Townsville

Land uses

The majority of the Port Lands are used for industrial-based operations. Existing uses include; wharves, cargo consolidation, marine-related industries, buffers, storage of dry bulk materials and bulk liquids, container handling, product stockpiles, transit and transport area, and screening facilities.

The POTL envisages that the existing uses on Port land will expand to meet the growing demands of future trade forecasts for the Port of Townsville. They have identified the importance of clustering related industrial type land uses within the Port, to ensure that an adequate area is provided for future growth and minimise the occurrence of incompatible land use.

The areas immediately adjoining the wharf are used as short-term lay-down areas for the loading and unloading of ships.

The Port area is in close proximity to the South Townsville residential community. Currently land uses are separated by physical barriers including, but not limited to, open space (Port Environmental Park), transport corridors (roads) and benign development (such as warehousing).

Transport

The Port of Townsville is a commercial, industrial multi-cargo Port. Activities undertaken within the Port have the potential to generate noise, odours, dust or light emissions, or may impact traffic movements and visual amenity of the surrounding land uses.

Rail access to the Port is via the rail corridor located along Perkins Street. Townsville City Council City Plan 2005 identifies that this transport route is part of the Rail Freight Network and is designated as ‘Other Freight’ on Map 3.3(b). It is envisaged that this route will continue as a rail transport corridor to and from the Port, however, development of the TPAR corridor is expected to eventually provide an alternative rail transport corridor to and from the Port.

Road access to the Port of Townsville is primarily via Boundary Street and Benwell Road. Boundary Street is bounded by a mix of residential and non-residential uses, including industrial, commercial and shop-type uses. Both Boundary Street and Benwell Road form part of the ‘Principal Road Freight Network’ as defined in Townsville City Council’s City Plan 2005. A connection to the Port also exists via McIlwraith Street and Perkins Street to Ross Street which forms part of the ‘Secondary Road Freight Network’ and further on to Lennon Drive which is part of the ‘Principal Road Freight Network’ as defined in Townsville City Council’s City Plan 2005.

A future access route to the site will be via the Stuart Bypass and proposed Eastern Access Corridor. The proposed Eastern Access Corridor will provide a direct transport connection along part of Benwell Road and across Ross River to the State Development Area. This route will also include a future rail corridor for movement of rail carriages primarily from the south and west of Townsville and potential for product services corridor such as conveyor and pipeline.

Facilities

Port facilities include all land, transport infrastructure, wharves, shipping navigation infrastructure and product storage and handling facilities required to operate the Port.

The Port of Townsville is easily accessible by road, rail and sea. It has a dedicated rail network within the port area, which is provided by Queensland Rail, POTL and port tenants. Road networks to the port are a combination of state and local roads. Roads within the port boundaries are developed, owned, managed and maintained by POTL. Navigational access to the port is via access channels, swing basin and berth pockets. Development and maintenance of these is a core function of POTL.

The access channels to the Port of Townsville have a total length of 6.4 nautical miles. The Platypus Channel is 92 metres wide and has a depth of approximately 11.7 metres below the Lowest Astronomical Tide (LAT). Depths along the wharves vary from 12.3 metres to 9.8 metres according to the requirements of the individual trade using the berth.

The Port of Townsville has nine operational wharves. Wharves are equipped with bulk handling facilities including pipelines for fuel, oil, gas, chemicals, cement and molasses, shiploaders for sugar, mineral and metal concentrates and fertiliser, cranes for containers, refined metals, nickel ore, fertilisers and breakbulk cargo and RORO ramps for rolling stock.

3.2.1.9 Surrounding land use

The existing land uses surrounding the PoT and the Precinct are shown in Figure 3-4. This shows that the areas surrounding the Project area are heavily developed urban area.

The Project is directly located between the PoT and the Ross River. Land to the south west of the Project site (not within the PoT) is residential. The areas to the west of the project area (not within the PoT) include the commercial and industry centre of Townville.

The land across the Ross River includes environmental reserve and the proposed Townsville State Development Area.

3.2.1.10 Environmentally sensitive areas

The Project is located within Cleveland Bay which is protected by the Great Barrier Reef. Areas of specific ecological significance within the Project area include:

- The Great Barrier Reef Marine Park;
- The Great Barrier Reef World Heritage Area (GBRWHA);
- Dugong Protected Areas;
- Fish Habitat Areas;
- RAMSAR – Bowling Green Bay; and
- Magnetic Island.

Environmentally Sensitive areas are discussed further in Section 3.10 Nature Conservation of this EIS.

3.2.1.11 Native Title

During the establishment of the perpetual lease for Lot 773, Native Title was determined to have been suppressed in accordance with the non-extinguishment principle. Provided the existing tenure arrangements (perpetual lease) are maintained, the Project may be carried out and maintained in accordance with the purpose of the lease.

Figure 3-5 illustrates the areas covered by applications for Native Title claims or Native Title determinations.

3.2.2 Potential impacts and mitigation measures

3.2.2.1 Overview

The Precinct and Breakwater will be developed wholly within port limits and within the Ross River. The land based components of the Project will be developed on reclaimed land with limited existing use except for some public recreation.

The proposed works are consistent with the POTL Land Use Plan 1996. The Plan identifies the reclaimed land as Strategic Port Land and necessary for the provision of the Precinct and Breakwater development.

3.2.2.2 Potential impacts

Direct land use

The proposed works are not expected to have any direct impacts in relation to land use and land use planning as the project is located on reclaimed land wholly within port limits for a port related industry and is consistent with the POTL Land Use Plan 1996.

Public access

There will be impacts on the public use of Lot 773; however the public has only been allowed to access the beach and mudflats of this strategic port land area for recreation purposes until such time as the land is required for Port related purposes.

Current uses include fishing, yabbying, walking and dog exercise. These are detailed further under the social impact assessment section of this study (refer Section 4).

The TMPP will form an industrial marine facility within which maritime fabrication, boat maintenance and commercial barge operations will occur. This will include the use of forklifts, trucks, operational cranes for heavy lifting, welding, abrasive blasting and other machinery. The facility will, as appropriate, be bound by workplace health and safety regulations including required use of Personal Protective Equipment such as hard hats, eye protection, work boots and ear protection for the safety of employees. Public access to the full operational facility may be unsafe and, therefore, inappropriate.

To maintain public access to the coast, consideration is being given to inclusion of areas within the Precinct that may be open to the public. This may include opportunity for direct purchase from seafood suppliers or provision of access points along the external face of the rock revetment. The detailed design of the Precinct will need to address these considerations against the safe operation of the Precinct facility and the safety of the public.

Upstream industrial lands may be vacated by industries relocating to the Precinct. The desired planning outcome of the redevelopment of any upstream lands will be to provide enhanced public access to the coast that offsets losses experienced through development of the Precinct. These upstream lands are currently inaccessible to the public because they are working commercial sites. When they are redeveloped in accordance with any approval from Council it is anticipated that increased opportunities for public access and recreation will be provided e.g. riverside boardwalk, seafood sales outlet, possible fishing locations and potentially a fenced dog exercise area in the existing environmental park.

Ecologically sensitive areas

Seagrass meadows, roost sites for wading and migratory birds, mangroves and mud flats are in the immediate vicinity of the Precinct and considered to be sensitive ecological receptors. The direct impacts on any areas of high conservation value identified during studies, such as these, is discussed further in Section 3.10 Nature Conservation. The mitigation management measures identified to cope with any identified impacts are also addressed below and Section 8.

Surrounding land uses

As discussed above the Project is directly located between the PoT and the Ross River. The Ross River provides a natural buffer to the environmental reserve and State Development Area on the eastern side of the Ross River.

Potential visual impacts from the project are described in Section 3.3.

The Noise and Vibration Assessment undertaken for the project is included as Appendix K. This report found that noise impacts on surrounding land uses will not significantly impact on the amenity of sensitive receivers provided appropriate management procedures as outlined in the report are implemented.

An Air Quality Assessment was undertaken for the Precinct and is included as Appendix L. This report found that the construction related dust from the TMPP would not significantly impact on the amenity of sensitive receivers provided appropriate management procedures as outlined in this report are implemented. An Environmental Management Plan will need to be implemented for the construction phase to control dust in the nearby residential area to the south. This is addressed in detail under Section 8 of this document.

The report also concluded that air emission from proposed operational activities, consisting of abrasive blasting, fuel storage and fishing trawlers, will not have a significant impact on any nearby sensitive receivers and air quality objectives will be achieved.

The PoT is surrounded by a heavily developed urban area, and is located wholly within port limits and is consistent with the POTL Land Use Plan 1996. Therefore the Project is not likely to impact significantly on the surrounding land uses.

LEGEND

- Register of Native Title Claims
- Registered and Notified Indigenous Landuse Agreements
- Proposed Marine Precinct
- Proposed Breakwater

1:75,000 (at A4)

0 0.5 1 1.5 2

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

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Native Title

Figure 3-5

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Impacts on Infrastructure, Roads and Rail

A Traffic Impact Assessment has been undertaken by GHD and is included as Appendix M. This report investigated the potential impacts of the proposed development on roads. The report found that the all of the aforementioned existing intersections are currently providing acceptable service conditions under existing peak hour traffic loading. The report concluded that development can take place with little significant impact on the external road network.

Existing access to the Project site is via Benwell Road, South Townville. No transport infrastructure currently exists on the Project site. Construction of the Stuart Bypass and Port Access Road commenced in August 2008. This includes a road/rail link to be built over the mouth of Ross River

Further information regarding transport impacts and management measures are detailed further in Section 3.4 Transport and associated infrastructure.

Sediment erosion

The sources of sediment that could affect this area of Cleveland Bay are Cleveland Bay itself, the Ross River, and the foreshore areas south-east of the site. Mechanisms for moving sediment are wave action, tidal currents, flood flow currents, wind driven currents, and longshore sediment transport. The effect of coastal processes on sedimentation is described and discussed in detail under Section 3.8.

Hydrodynamic modelling (refer to Section 0) was undertaken to describe the circulation patterns in the vicinity of the proposed marina and breakwater development directly across the mouth of the Ross River. The main aim of this exercise was to assess the relative impact of the proposed development in terms of flushing potential and changes in bed shear stresses leading to the potential for sediment accretion of erosion. Refer to Section 0 for a full discussion of the findings of this study. The following key results of relevance to erosion potential were identified as follows:

- Absolute values of bed shear stress appear to remain relatively low (i.e. less than the 1 N/m2 threshold for erosion) under the majority of conditions, with increases in bed shear typically less than 0.5 N/m^2. Hence, under the majority of conditions, changes to stresses appear unlikely to require mitigation; and
- Under flood conditions, bed shear stresses could potentially increase by 5 – 8 N/m2 in the entrance and at the tail of the eastern breakwater. This imposes a risk of scour, which will need to be addressed during design.

Acid sulfate soils

Potential impacts have been identified in relation to the proposed development based on current information presented in this study and will be addressed in the ASS Management Plan (ASSMP). In addition to the list below there will also be potential impacts related to the options for the management of ASS material, discussed in the ASS Management Plan.

Excavation of Dredge Spoil (All 'Reporting' Areas)

- Potential for the generation of acid from dredge spoil if saturation of the material is not maintained throughout the dredging process; and

- Separation of sulfidic fines from granular material during the dredging and fill placement process could result in concentration of PASS materials, for example this could occur when spoil is pumped into a holding vessel and/or when dredge spoil is placed as fill.

Lot 773

Potential for:

- Acidification of groundwater within fill material in Lot 773 if dredge spoil is placed above the permanent water table and hence exposed to the atmosphere. Percolation of water through oxidised ASS material above the permanent water table could result in the generation of acid within the unsaturated fill which, when it reaches the water table, could lower the pH of the groundwater (i.e. make it more acidic). It is likely that a proportion of the acid generated will be neutralised within the soil matrix however full neutralisation cannot be guaranteed;
- Mobilisation of metals such as aluminium and iron from the fill material as a result of increased acidity and hence potential for an increase in metals concentrations in groundwater within reclaimed Lot 773;
- Migration of acidic groundwater to Cleveland Bay from Lot 773 containing elevated concentrations of metals;
- Precipitation of metals including iron, arsenic and manganese out of solution when acidic groundwater containing elevated concentrations of iron in solution mixes with sea water, given that sands are proposed to be used as reclaim fill for Lot 773 and that the oxidisable sulfur reported appears to be inorganic (i.e. likely to be pyritic) for this material. The groundwater will become less acidic on mixing with seawater and can result in precipitation of iron, thus the potential to create extensive red/orange iron staining in the water, on infrastructure and vessels;
- Iron staining at ground surface if dredge spoil is placed at ground surface, where it will dry out, oxidise, generate acid and mobilise iron from within the sediments and result in precipitation of iron;
- Fish kills and algal blooms as a result of increased levels of nutrients produced from reactions within acid sulfate soils and discharge of the nutrient rich water to the sea. The impacts of elevated nutrients are likely to be most significant in the inner harbour and trawler basin where flushing with ‘fresh’ seawater may be limited and hence potential for limited dilution of any nutrients discharged to sea;
- Discolouration and noxious odours emitted from open water bodies which are not regularly flushed (e.g. inner harbour);
- Generation of acid within in-situ sediments (identified as PASS) if they are exposed to the atmosphere (and oxidised) such as through dewatering or through excavation during future development on Lot 773;
- Lateral flow of groundwater away from Lot 773 into the surrounding material when in-situ sediments, which include material identified as PASS, are compacted during reclamation (such as placement of fill and bund construction) and hence the potential to temporarily increase groundwater levels in materials adjacent to Lot 773. No AASS were identified within Lot 773 and the majority of the site lies within the intertidal zone. Therefore in-situ material will generally be saturated for much of the time. Water displaced from the in-situ

- Degradation/corrosion of concrete and steel structures founded in dredge material or founded in material where groundwater has become acidic as a result of oxidation of overlying materials; and
- Cracking, shrinking and subsidence of PASS material that are allowed to dry out.

Recommendations

Based on the results of this ASS investigation, the following recommendations were made with regard to the development of the site:

- Given the identification of PASS in samples obtained across the Precinct site, an ASS Management Plan (ASSMP) will be required in accordance with QASSMAC Guidelines (2002) specific to site development, in addition to the ASSMP prepared as part of the EIS, and may require the incorporation of additional sampling for ASS; and
- Given the above points and to minimise the potential for environmental harm, all of the material disturbed as part of the development should be assumed to be PASS and managed accordingly, unless more detailed assessment, either pre- or post- dredging and placement, can confirm the material is non-ASS.

Land contamination

Under the EP Act contamination is recognised to be the release of a contaminant into the environment. Contaminants may be in various states (liquid, gas, solid) or may include via noise, radiation or organism introduction (among other mechanisms). The potential contamination impacts from construction and operation of the Precinct are the:

- Resuspension of particles into the water column causing generation and migration of turbid plumes resulting from capital and maintenance dredging;
- Mobilisation of sediment bound contaminants into the water column (including nutrients and acid sulfate soils) during capital and maintenance dredging; and
- Release of contaminants from various marine industries into Ross River.

The proposed mitigation measures to deal with these impacts are detailed further in the Section 3.9 Water and Sediment Quality and in Sections 3.14 and 6 (Waste management and Hazards and Risks).

3.2.2.3 Mitigation Measures

Direct Land Use

As the Precinct is to be developed on reclaimed land wholly within port limits, no mitigation measures are considered necessary in relation to land use and land use planning as the Precinct is consistent with the approved land use in the TPALUP and perpetual lease for the site.

Public Access

The TMPP will provide some public access to the coast where it is safe and won't interfere with the operation of the Precinct.

The desired planning outcome of the redevelopment of any upstream lands will be to provide enhanced public access to the coast. For example these lands are currently inaccessible to the public because they are working commercial sites. However when they are redeveloped in accordance with any approval from Council it is anticipated that increased opportunities for public access will be provided e.g. boardwalk, seafood sales outlet, and possible fishing locations.

At this point it cannot be guaranteed that upstream redevelopment will be able to meet inclusion of all potentially desirable public facilities. For instance, replacement of an off-lease dog walking facility upstream should be considered but cannot be guaranteed for any redeveloped lands. However, POTL will endeavour to provide alternative recreation opportunities as identified above.

An Aboriginal Cultural History story board will be located at the environmental park that recognises the significance of the area to Indigenous Traditional Owners.

Management of Construction

The proposed management measures for construction are covered within the Environmental Management Plan, and are included as Section 8 of this EIS. The EMP details the management measures of the immediate environs of the project including approaches as to how potential noise and dust impacts on sensitive environmental areas and residential areas will be minimised.

Operation

The proposed management measures for operation of the Project are covered within the Environmental Management Plan, and are included as Section 8 of this EIS. The EMP details the management measures of the immediate environs of the project and information on how to avoid impacts to the surrounding sensitive environmental and residential areas.

Sediment erosion

The coastal erosion aspects of the Project and mitigation measures for potential impacts identified are discussed further in Section 3.8. A project specific Environmental Management Plan has been developed for the construction and operation phases of the project to appropriately manage and mitigate any impacts caused by sediment erosion.

Acid sulfate soils

An Acid Sulfate Soil Management Plan (ASSMP) has been provided as Appendix H and is designed to cover acid sulfate soil (ASS) management during the construction phase of the Precinct, any future expansions, activities within the reclamation areas and recommended on-going monitoring.

3.3 Landscape character and visual amenity

3.3.1 Overview

A Landscape and Visual Character Assessment for the Precinct Reference Design has been undertaken by GHD and is included as Appendix N.

This section describes the landscape and visual character of the area surrounding the TMPP, assesses the potential impacts that the project may have on these values and recommends mitigation measures where appropriate.

The assessment of the potential landscape impacts of a project is carried out as an impact on an environmental resource (i.e. the landscape) whereas visual impacts are assessed as one of the interrelated impacts of a project on the viewing population.

Landscape features and elements are determined and/or influenced by physical, biological and cultural factors and may include soils, vegetation, and land uses. As such, landscape effects occur from changes in the physical landscape, which may give rise to changes in its visual character and how this is experienced. This may in turn affect the perceived value of the landscape.

This visual impact assessment (VIA) describes the existing landscape and visual character within the visual catchment of the project, identifies and assesses the existing visual context and viewpoints, undertakes an assessment of the significance of the impacts on the visual landscape and identifies the extent to which mitigation of impacts is required.

This visual impact assessment addresses the potential landscape and visual impacts associated with the TMPP including:

- Review of existing information including planning and statutory requirements;
- A description of the project and its visual components;
- Identifying the limitations and assumptions of this method;
- An evaluation of the existing landscape and visual environment;
- Discussion of visual receptor sensitivity within the study area through the use of viewpoints;
- Assessment of the significance of impacts on landscape character and visual amenity at the viewpoints as a direct result of the project;
- Identification of residual and cumulative impacts;
- Proposed mitigation strategies; and
- A summary of the findings of the assessment.

The methodology for this study, including impacts and proposed mitigation measures, has been derived from the *Guidelines for Landscape and Visual Impact Assessment, Second Edition*, published by The Landscape Institute and Institute of Environmental Management and Assessment (2002) and the Forest Practice Board of Tasmania's *A Manual for Forest Landscape Management*. The methodology is detailed further in the Landscape and Visual Character Assessment included as Appendix N.

3.3.2 Description of environmental values

Landform

The Townsville area is characterised by a low-lying coastal landform bounded by Cleveland Bay and the Paluma and Hervey mountain ranges (Queensland Government, 2007). Castle Hill (refer Figure 3-6) and Mt Stuart (refer Figure 3-7) are key landform elements within the wider landscape rising above the urban areas of the city.

Magnetic Island located off the coast of Townsville, has steep landform with numerous bays and inlets, and provides a visual backdrop to the east of the city.

Figure 3-6 Castle Hill landscape Feature

Figure 3-7 Mt Stuart Landscape Feature

Mt Stuart, located on the south-west edge of Townsville, is another dominant landscape feature and provides a visual backdrop to the city

Land Use and Statutory Requirements

Townsville is a major regional Queensland centre providing a range of services and facilities to the city and surrounding communities. The project site is located within the Port of Townsville precinct, which incorporates large scale industrial development, port facilities, and areas undergoing reclamation. The site is also located within close proximity to the South Townsville residential area and the commercial and residential development in the city centre area. The area on the eastern bank of Ross River is largely an undeveloped inter-tidal coastal area.

Townsville – Thuringowa Strategy Plan

The 2007 Townsville – Thuringowa Strategy Plan is the framework for managing growth and development in the region and while it is not a statutory document it provides a guiding framework for population growth. This plan states that “the region’s dominant features including its mountainous and hilly areas, coastline, rivers and creeks combine to present a strong physical image. The landscape and seascape values should be protected for the long-term benefit and enjoyment of the region and its visitors”.

The Townsville Port area is identified as Major Industry while the area on the eastern bank of Ross River is identified as Critical Conservation Area outside Reserves, and Special Uses.

State Coastal Management Plan

No regional coast plan has been developed for this area therefore for this site the provisions of the State Coastal Management Plan have been assessed in relation to landscape value. Under that management plan Townsville is recognised as being an area of High Scenic Management Priority. The plan incorporates three principles relating to coastal landscapes:

- The values of coastal landscapes are conserved and recognised for their importance to the quality of life of both residents and visitors, as well as to the economic development and growth of Queensland;
- The dominance of the natural character of the coast (excluding developed urban areas) is retained, including elements of landscape and vegetation; and
- The cultural and spiritual values of coastal landscapes are recognised and conserved through the involvement of the relevant Indigenous Traditional Owner communities.

Townsville Port Authority Statement of Proposal 2006

Townsville Port Authority Statement of Proposal 2006 identifies the following features within Port limits that are considered to have high scenic value:

- Port of Townsville port facilities including active berths;
- Ross River (sandy beaches, boat ramps and recreational fishing areas);
- Ross Creek;
- Tracts of vegetation along the coast;
- The Strand;
- Magnetic Island coastline;
- Townsville Maritime Museum;

- Port Environmental Park; and
- Cape Cleveland Coastline.

Port facilities and operations at the Port of Townsville are visible from many points in Townsville, including Castle Hill, Townsville City and built structures.

Vegetation

Three State bioregions meet in the Townsville region, the Brigalow Belt North, the Einasleigh Uplands, and the Wet Tropics. This is representative of the diversity in the natural characteristics, such as landform and vegetation, of the region.

The Townsville – Thuringowa Strategy Plan identifies that the main vegetation type in the region is Eucalypt dominated savannah woodland and grasslands. However, the region also includes significant examples of other vegetation communities such as beach ridge vine thickets, riparian forests along creeks and rivers, mangrove forests in estuarine areas, and samphire communities associated with saltpans (Queensland Government, 2007).

On the eastern side of Ross River, mangroves dominate while the area between the mangroves and the areas above the tidal influence contains saline mudflat including salt couch (*Sporobolus virginicus*). The most abundant vegetation community in the vicinity of the site is located above the tidal reach and includes sclerophyll woodland dominated by Moreton Bay ash (*Corymbia tessellaris*) or grey paperbark (*Melaleuca dealbata*) (primarily in the swales).

Of the project site on the western side of the river there is approximately 1.5 hectares of vegetation characterised by a low shrub layer dominated by grey mangrove (*Avicennia marina*) and club mangrove (*Aegialitis annulata*) and a ground layer of predominately typical saline system plants. Further detail in regard to the vegetation in this area is provided in Section 3.10 of this report.

Visual catchment

The topography in the vicinity of the site limits the viewpoints from which the site will be visible, thereby limiting the visual exposure of the project. The identification of the visual catchment of the project provides an assessment tool used to define the area from which the project may be visible. Site assessment further defines the location from which the project site is visible within the identified visual catchment and the viewpoints from which detailed assessment will be undertaken.

The visual catchment for the proposed port works extends over the ridges and high points of the city and incorporates both residential and commercial development, recreation areas and lookouts. The topography of the region means that areas distant from the site, such as Mt Stuart, are part of the visual catchment. While these areas are within the visual catchment, due to the distance from the project area they are not considered to be viewpoints.

The visual catchment for the project includes:

- South West to Mount Stuart;
- Castle Hill to the north;
- Residential areas to the north and west; and
- Cleveland Bay and Ross River.

The extent of the visual catchment of the project is shown on Figure 3-8.

Viewpoints and sensitive receptors

The visual catchment provides the basis upon which viewpoints and sensitive visual receptors can be identified and further assessment undertaken. The viewpoints are areas where full or screened views of the site are possible and there is human activity being undertaken. This activity may include residential, business, recreation. In addition, viewpoints also include areas where the only views are transient such as vehicles using a road or views from trains.

The identification of viewpoints for this assessment excluded views from Mount Stuart and the surrounding area due to the separation distance from the site and therefore the background nature of the view. The viewpoints that have been identified and assessed in this report are:

- Castle Hill;
- Townsville City Residential East;
- Townsville City Residential and Commercial West;
- Boundary Street, Archer Street and Benwell Road; and
- Ross River and Cleveland Bay.

The viewpoints are described, including visually, below.

	Label
1	Castle Hill
2	Townsville City Residential East
3	Townsville City Residential and Commercial West
4a	Benwell Road
4b	Archer Street
5	Ross River and Cleveland Bay

LEGEND

View Points and View Direction

View Catchment

Proposed Marine Precinct

Breakwater Option

1:30,000 (at A4)

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Visual Catchment
and Viewpoints

Job Number 42-15399
Revision A
Date 01 July 2009

Figure 3-8

G:\42\15399\GIS\Projects\EIS\42-15399_805_rev_a.mxd

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Viewpoint 1 –Castle Hill

Castle Hill is a dominant landscape feature of Townsville rising above the city centre and surrounding suburbs. This location is frequently visited by both residents and visitors and provides extensive views of Townsville, Cleveland Bay, and Magnetic Island. A description of this viewpoint is contained in Table 3-3.

Table 3-3 Viewpoint 1 – Castle Hill

Typical local landscape character	 View of the city centre and south east proposed reclamation site from Castle Hill
Landform	Castle Hill is a granite monolith that is located close to the Townsville CBD and the eastern suburbs of the city. The hill rises steeply from the largely flat landform of the city.
Vegetation	The vegetation of Castle Hill is dominated by indigenous species in particular mixed Eucalyptus species. There are small areas of notophyll vine thickets, and grassed slopes with kangaroo grass and giant spear grass. Specialised flora also occur on the cliffs and rocky outcrops (EPA, 2009)
Land Use	Residential and commercial development is located on the lower slopes of the hill with the upper parts used primarily as a lookout with associated facilities, including car parking, lookouts, interpretative material, and walking tracks.
Visual Context	Visually dominant landscape feature providing extensive views of Townville urban area, Cleveland Bay and Magnetic Island. Views from this location are experienced by: ◗ Visitors; ◗ Recreation users accessing the walking tracks and road for recreation activities; and ◗ Road uses.

Viewpoint 2 – Townsville City Residential East

This residential area located in the north-east suburbs of the city provides elevated house site and the opportunities for views of the surrounding urban development and over Cleveland Bay to Magnetic Island. This is predominately an area of single detached houses. This viewpoint is described in Table 3-4.

Table 3-4 Viewpoint 2 – Townsville City Residential East

Typical local landscape character	 View towards the site from an elevated residential area in the eastern part of the Townsville
Landform	These residential areas rise to an elevation of approximately 55 m AHD providing views of the surrounding built and natural environment.
Vegetation	Urban landscape and residential planting.
Land Use	Primarily residential development comprised of detached housing.
Visual Context	This location provides one of the few elevated residential locations in Townsville, therefore providing residents with views of the surrounding urban environment and of Cleveland Bay and Magnetic Island. The mature vegetation and buildings in this location provides screening of some views and limits outlooks from some locations within this area. Views from this location are experienced by: ◗ Residential properties with both screened and unscreened views. These residents have long viewing periods; and ◗ Road uses travelling through the area.

Viewpoint 3 – Townsville City Residential and Commercial West

The development that has occurred on the southern slopes of Castle Hill, including both residential development and commercial development associated with the city centre has views that encompass the southern and eastern suburbs of Townsville. The characteristics of this viewpoint are detailed in Table 3-5.

Table 3-5 Viewpoint 3 – Townsville City Residential and Commercial West

Typical local landscape character	 Residential and commercial development located on the south-east slopes of Castle Hill. Views from this viewpoint are generally to the south-east.
Landform	Sloping land that forms the lower slopes of Castle Hill.
Vegetation	Urban landscape and residential planting.
Land Use	Residential and commercial land uses.
Visual Context	The commercial and residential development located within this viewpoint. Due to the landform the views from this location are focused to the south-east. The mature vegetation and buildings in this location provides screening of some views and limits outlooks from some locations within this area. Views from this location are experienced by: ◗ Residential properties with both screened and unscreened views; ◗ Activity focused workers in commercial buildings; and ◗ Road users visiting or passing through the area.

Viewpoint 4 – Boundary Street, Archer Street and Benwell Road

This South Townsville location is immediately adjacent to the reclamation area. The roads in this location provide access to industrial development with the main Townsville Port access on Benwell Road. This area is described in Table 3-6.

Table 3-6 Viewpoint 4 – Boundary Street, Archer Street and Benwell Road

Typical local landscape character	 Existing Ross River foreshore and Benwell Road
	 View of Ross River and reclamation site from Archer Street (intersection with Benwell Road
Landform	The landform at this viewpoint is largely flat with some small rises in elevation.
Vegetation	Urban and industrial landscaping, and intertidal vegetation including mangroves.

Land Use	The area is comprised of industrial development and vacant industrial land. The industrial development includes activities in large buildings and storage tanks.
Visual Context	The landform of this viewpoint is flat with the visual outlook dominated by the existing industrial development and the waterfront fringing vegetation. Views from this location are experienced by: ◗ Activity focused workers on industrial sites; and ◗ Local road users accessing the port and other industrial developments and visiting the foreshore.

Viewpoint 5 – Ross River and Cleveland Bay

Ross River and Cleveland Bay near the mouth of the river provide water access and water based recreation use for commercial craft, recreation boats and other water based activities. Water craft travelling through this area have extensive views of the site and the surrounding built and natural environment. The characteristics of this viewpoint are described in Table 3-7.

Table 3-7 Viewpoint 5 – Ross River and Cleveland Bay

Typical local landscape character	 View of reclamation site from Cleveland Bay at the entrance to Ross River. Castle Hill is the dominant landscape feature from this location.
Landform	The land immediately surrounding the entrance to the Ross River and this part of Cleveland Bay is generally low-lying with Castle Hill being the only significant landscape feature when viewing to the north and north-west.
Vegetation	The vegetation of this view point is characterised by mangroves and saline mudflats.
Land Use	The land uses in the vicinity of this viewpoint are characterised by large industrial development and low-lying undeveloped foreshore areas.
Visual Context	The site is located at the entrance to the Ross River with this viewpoint providing the closet views of the bunds and reclamation works. The existing port reclamation area is visible from this location with the existing fringing mangroves providing a narrow vegetated strip along the western bank of the river. The view from this location to the north and north-west is dominated by Castle Hill while Mt Stuart provides the background view to the south-west. Views from this viewpoint are experienced by: ◗ Water based recreation users including people fishing and using recreational water craft; and ◗ Commercial water based users largely activity focused.

3.3.3 Potential impacts and mitigation measures

3.3.3.1 Introduction

The potential visual impacts have been considered in the context of the sensitivity of the surrounding visual environment and the potential for viewing of the areas that have had changes to their visual outlook due to site works.

3.3.3.2 Construction stage

The construction stage of the project will be undertaken as pre-construction activities and 3 stages. Construction activities are described in detail in Section 2.4.

The visual impacts that will occur during the construction stage include:

- Construction of the breakwater resulting in a new linear element in the visual landscape;
- Creation of the new land area through the reclamation process. This will incorporate heavy machinery with the possibility of dust during the construction state. The full extent of these activities will be clearly visible from some viewpoints;
- Construction and security lighting. The extent of lighting during construction will result in some increased sky glow in this part of the city; and
- Building construction and other associated site development works. The extent of visibility of these activities depends on the viewing location.

These impacts are addressed in more detail for each of the viewpoints in the Section 3.3.3.4.

3.3.3.3 Operation stage

The proposed operational activities to be undertaken on the site are described in detail in Section 2.5.

Operating times will reflect existing businesses hours, and some proposed uses will require 24 hour, seven day a week operation, as required (e.g. police and emergency vessels).

A future access route to the site will be via the Stuart Bypass and proposed TPAR. The proposed TPAR will provide a direct transport connection along part of Benwell Road and across Ross River to the State Development Area.

At the completion of construction operations the site will be used for industrial and port related development. Additional activities that will occur as a result of the operation of the port facilities include:

- Security and night lighting;
- Increased vehicle movements, including both cars and heavy vehicles;
- On-going building construction and site development works;
- Increased possibility of reflection from the large industrial buildings; and
- Outside storage areas and loading and unloading areas.

These impacts are addressed in more detail for each of the viewpoints in Section 3.3.3.4.

3.3.3.4 Visual impact and viewpoints

The visual impact on the viewpoints have been assessed for the construction and operational phases of the project. These impacts are addressed below in Table 3-8 to Table 3-12.

Table 3-8 Visual impact to viewpoint 1 – Castle Hill

Project Elements	**Construction** All construction operations will be visible from the Castle Hill lookout that provide views to the south-east **Operation** ◗ All buildings and other structures on the site; ◗ Vessels and port related activities; and ◗ Most outdoor industrial and storage related activities.
Visualisation	 Existing view of the project area from Castle Hill  Visualisation of the view from Castle Hill incorporating the proposed land reclamation area and constructed buildings. The major components of the project will be clearly visible from this location.
Landscape Impact Construction and Operation	The reclamation area will be a prominent landscape feature when viewed from Castle Hill. The proximity of this viewpoint to the site (approximately 3.5 km) along with the addition of the new linear elements in the reclamation area and breakwater will have an impact on the landscape amenity. The project will result in the following changes to the landscape character from this viewpoint:

	◗ Introduction of an additional linear element into the landscape particularly when viewed in association with the existing port facility; ◗ Creation of a new constructed landscape feature in the breakwater. This element will be situated in a position where the background is largely natural adding to the landscape impact; ◗ Creation of additional features that will alter the appearance of the entrance to the Ross River. This will reduce the naturalness of the current landscape in this location and create an area having an engineered appearance; and ◗ Introduction of additional industrial elements into the landscape decreasing the degree of naturalness when viewing to the south-east from this location. The landscape character visible from this view point will also be impacted on the proposed construction of the road and rail crossing of Ross Creek adjacent to the reclamation area. While the bridge is not part of this project, this new constructed feature of the visual landscape will visually be closely linked with the port development and will add to the perceived loss of naturalness of the landscape from this viewpoint. The bridge has been added to the above visualisation to enable a full understanding of the cumulative impact of the works proposed to occur in this area. It is assessed that the project will have a **moderate adverse landscape impact** from this viewpoint.
Visual Impact Construction and Operation	The view from this location will be experienced by visitors to Castle Hill. This view point has a high level of visual impact due to the extensive views offered from this location. As it is a landscape feature and a popular attraction for both visitors and residents the visual impact will be experienced by a large number of people. Viewing times vary depending on the nature of the activity, but would largely be of short duration. The project will result in some changes to the visual outlook during both construction and operation. Visual impacts during construction include: ◗ Gradual loss of naturalness of the landscape in this area with the creation of the breakwater and associated dredging and reclamation activities; ◗ Construction lighting; and ◗ Increase in the activity occurring in this location with the operation of large machinery and the construction work site operations. Visual impacts during operation include: ◗ Introduction of new linear elements in the reclamation area and the breakwater that provide a new edge to the Ross River and extend into the mangrove and inter-tidal area on the western side of the river; ◗ Visual extension of the South Townsville industrial development with the appearance of this development extending into Cleveland Bay; ◗ Security and other operational lighting; and ◗ Creation of a new development edge to the city in this location. The change in view will be experienced by: ◗ Visitors to Castle Hill at lookout points that have views to the south-east will have unscreened views of both the construction operations

the parts of Castle Hill with views to the south-east will also experience unscreened views as well as some vegetation screened views of all the construction and operation activities on the site; and

- Road users travelling to and from the top of Castle Hill will have views to the construction site. These views are of short duration due to the transient nature of the viewing opportunity.

It is assessed that the project will have a **medium adverse visual impact** from this viewpoint.

Significance of Visual Impact	**Moderate Significance**

Table 3-9 Viewpoint 2 – Townsville City Residential East

Project Elements	**Construction** ◗ Breakwater and parts of the reclamation area; ◗ Site equipment, particularly elevated structures such as cranes; and ◗ Construction lighting. ◗ **Operation** ◗ Buildings and other structures on the site with the extent of the visibility of the building depending on viewing location and surrounding vegetation. The height of the proposed buildings is such that a large proportion will be screened by foreground buildings; ◗ Vessels and elevated port related activities; and ◗ Operational lighting.
Visualisation	 An example of the existing views from this viewpoint.

	 The residential properties in this location will have screened views of the project area as shown from this visualisation. The location of the project works are included within the red area with the extent of available view dependent on the specific viewing location, surrounding vegetation and buildings.
Landscape Impact Construction and Operation	The residences in this location are elevated above the level of the site with this ranging from about 20-55m AHD providing views from some properties. The proposed construction works will not be a prominent landscape feature from the residences in this location as: ◗ Screening by vegetation and other buildings limit the view from many of the residential locations; ◗ The site works and completed reclamation area does not incorporate any elevated structures which would be a feature of the landscape when viewed from this location; ◗ The distance from this viewpoint to the site of approximately 2 km places it in the middleground view. Between this viewpoint and the site there is both commercial and industrial development, incorporating both buildings and tanks, which are evident in the landscape from this location; and ◗ Background views, including the distant landscape features are visible from this location and draw the visual interest away from the middleground. It is assessed that the project will have a **small adverse landscape impact** from this viewpoint.
Visual Impact Construction and Operation	The view from this location is experienced by some residents and visitors to the area. Residents with screened or unscreened views are sensitive receptors that have long viewing periods and therefore a higher sensitivity to the visual environment. The project will result in some changes to the visual outlook during both construction and operation. Visual impacts during construction include: ◗ Increased visible activity through machinery (particularly tall equipment); ◗ Breakwater construction and the increase in vessels at the entrance to the Ross River; and ◗ Additional lighting. Visual impacts during operation include:

	◗ Additional buildings in the landscape that provide a visual extension to the industrial nature of this view although the extent of visibility of the buildings is dependent on viewing location and the foreground buildings and structures; ◗ Reduction in the view of Cleveland Bay due to extension of the land area through reclamation and the buildings and other activities on the site; and ◗ Increased lighting. The change in view will be experienced by: ◗ The residents located at elevation with either partially screened or unscreened views will have views of completed buildings located and other structures located on the site. The views of reclamation and site will works will be limited due to level at which these works will be undertaken. ◗ Road users travelling in a southerly direction will have some views of both construction operations and completed site development. The extent of these views and the impact depend on location and extent of visual screening offered by building and vegetation. For this viewpoint is therefore assessed as having **low visual sensitivity.**
Significance of Visual Impact	**Not Significant**

Table 3-10 Viewpoint 3 – Townsville City Residential and Commercial West

Project Elements	**Construction** ◗ Breakwater and parts of the reclamation area; ◗ Site equipment, particularly elevated structures such as cranes; and ◗ Construction lighting. **Operation** ◗ Buildings and other structures on the site with the extent of the view of increasing with height of the building from which it is viewed; ◗ Vessels and elevated port related activities; and ◗ Operational lighting.
Landscape Impact Construction and Operation	The residences and commercial buildings in this location are elevated above the level of the site up to approximately 60m AHD providing views to the south-east from some of the properties. The distance from this viewpoint to the site is approximately 2 km, which places it in the middleground view. Between this viewpoint and the site there is both commercial and industrial development, incorporating both buildings and tanks, which are evident in the landscape from this location. Background views, including the distant landscape features are visible from this location and draw the visual interest away from the middleground. The landscape impact of the proposed construction and operation works will vary from site to site with this being largely dependant on the elevation, existing vegetation and vegetation which influence the current visual landscape.

	The proposed development will generally not be a prominent feature in the visual landscape, however the project will cause some change in the landscape character through: ◗ Introduction of an additional linear element into the landscape particularly when viewed in association with the existing port facility; ◗ Create a new constructed landscape feature in the breakwater. This element will be situated in a position where the background is largely natural adding to the landscape impact; ◗ Creation of additional features that will alter the appearance of the entrance to the Ross River. This will reduce the naturalness of the current landscape in this location and create an area having an engineered appearance; and ◗ Introduction of additional industrial elements into the landscape decreasing the degree of naturalness when viewing to the south-east from elevated positions in this viewpoint. It is assessed that the project will have a **moderate landscape impact** from this viewpoint.
Visual Impact Construction and Operation	The view from this location is experienced by some residents and visitors to the area, and workers in commercial buildings. Residents with screened or unscreened views are sensitive receptors that have long viewing periods and therefore a higher sensitivity to the visual environment. Activity focused workers will also have views over the site. The project will result in some changes to the visual outlook during both construction and operation. Visual impacts during construction include: ◗ Increased visible activity through machinery (particularly tall equipment) and site construction buildings; ◗ Breakwater construction and the increase in vessels at the entrance to the Ross River; and ◗ Additional lighting. Visual impacts during operation include: ◗ Additional buildings in the landscape that provide a visual extension to the industrial nature of this view; ◗ Reduction in the view of Cleveland Bay due to extension of the land area through reclamation and the buildings and other activities on the site; ◗ The buildings constructed on the site will be visible although the extent of visibility will depend on viewing height and the nature of the foreground structures. The buildings are unlikely to impact on the appearance of the mountains in the background view although it is expected that there will be increased focus on the middleground view with the increased development; and ◗ Increased lighting. The change in view will be experienced by: ◗ The residents located at elevation with either partially screened or unscreened views will have views of completed buildings located and other structures located on the site. The views of reclamation and site works will be limited due to the level at which these works will be undertaken; ◗ Activity focused workers in commercial buildings; and ◗ Road users travelling through the area will have some views of both

	construction operations and completed site development. The extent of these views depend on location and extent of visual screening offered by building and vegetation and are only experienced for very short duration due to the transient nature of the viewing opportunity. For this viewpoint is therefore assessed as having **medium visual sensitivity.**
Significance of Visual Impact	**Moderate Significance**

Table 3-11 Viewpoint 4 – Boundary Street, Archer Street and Benwell Road

Project Elements	**Construction** » Most of the construction operations. **Operation** » All buildings and other structures on the site; » Vessels and port related activities; and » Most outdoor industrial and storage related activities.
Visualisation	 Existing Ross River foreshore and Benwell Road  Visualisation of the site from near the intersection of Benwell Road – The land reclamation and buildings will be clearly visible from this

	location. There will also be loss of the existing vegetation adjacent to the water.
Landscape Impact Construction and Operation	During both construction and operation the project will have a permanent impact on the visual landscape from this viewpoint. This impact needs to be assessed in the context of the existing landscape of the viewpoint. The existing and approved industrial and port related development, which these roads are part of, is changing the nature of the landscape and visual environment. It is assessed that the project will have a **large adverse landscape impact** from this viewpoint.
Visual Impact Construction and Operation	The project will result in permanent changes to the visual outlook during both construction and operation. Visual impacts during construction include: ◗ Gradual loss of naturalness of the landscape in this area with the creation of the breakwater and associated dredging and reclamation activities; ◗ Construction lighting; and ◗ Increase in the activity occurring in this location with the operation of large machinery and the construction work site operations. Visual impacts during operation include: ◗ Introduction of new linear elements, in the reclamation area and the breakwater that provide a new edge to the Ross River and extend into the mangrove and inter-tidal area on the western side of the river; ◗ The construction of new buildings on the reclaimed site will permanently alter the outlook from this viewpoint and block some of the views that are currently available of the water and background mountains; ◗ Security and other operational lighting; and ◗ Creation of a new development edge to the city in this location. The landscape character visible from this view point will also be impacted on the proposed construction of the road and rail crossing of Ross Creek adjacent to the reclamation area. While the bridge is not part of this project, this new constructed feature of the visual landscape will visually be closely linked with the port development and will add to the perceived loss of naturalness of the landscape from this viewpoint. The bridge has been considered for the above visualisation to enable a full understanding of the cumulative impact of the works proposed to occur in this area. For this project this viewpoint is therefore assessed as having **medium visual sensitivity**.
Significance of Visual Impact	**High Significance**

Table 3-12 Viewpoint 5 – Ross River and Cleveland Bay

Project Elements	Construction ◗ All construction activities occurring seaward of the existing western

	foreshore of the Ross River; and ◗ Storage and land based construction related activities, in particular, activities that higher than the foreshore vegetation. Operation ◗ Breakwater; ◗ Dredging ; and ◗ Land reclamation area and industrial and port activities and buildings located on the site.
Visualisation	 Existing view of the site from Cleveland Bay.
	 Visualisation of the view of the site from Cleveland Bay – building bulk and scale is representative of that proposed for the site.
Landscape Impact Construction and Operation	During both construction and operation the project will have a permanent impact on the visual landscape from this viewpoint. This impact needs to be assessed in the context of the existing landscape of the viewpoint. The existing and approved industrial and port related development, which these roads are part of, is changing the nature of the landscape and visual environment. Castle Hill is a significant landscape feature from this viewpoint and will continue be the dominant visual element in the landscape. It is assessed that the project will have a **moderate adverse landscape impact** from this viewpoint.
Visual Impact Construction and Operation	The visual environment from this viewpoint will be impacted on both during construction and operation stages. The change in the view will be experienced by water based recreation users including people fishing and using recreational water craft and commercial water based users and will be a permanent visual change. The middleground views to Castle Hill will still be available, but the foreground view from water level will be modified with the introduction of the breakwater, the new landform and industrial and port related development. Views to the east and south will not be substantially different during construction or at the completion of the works when vessels are located outside the breakwater.

	As this project represents an extension of the existing port facility there are existing impacts on the visual amenity of this location due to land reclamation activities and the construction of industrial development. When viewed from water level there will be a visual intensification of these uses and an increase in the night lighting. The project will result in some changes to the visual outlook during both construction and operation. Visual impacts during construction include: ◗ Gradual loss of naturalness of the landscape in this area with the creation of the breakwater and associated dredging and reclamation activities; ◗ Construction lighting; and ◗ Increase in the activity occurring in this location with the operation of large machinery and the construction work site operations. Visual impacts during operation include: ◗ Introduction of new linear elements, in the reclamation area and the breakwater that provide a new edge to the Ross River and extend into the mangrove and inter-tidal area on the western side of the river; ◗ Security and other operational lighting; and ◗ Creation of a new development edge to the city in this location. The landscape character visible from this view point will also be impacted on the proposed construction of the road and rail crossing of Ross Creek adjacent to the reclamation area. While the bridge is not part of this project, this new constructed feature of the visual landscape will visually be closely linked with the port development and will add to the perceived loss of naturalness of the view from this location. The bridge has been considered for the above visualisation to enable a full understanding of the cumulative impact of the works proposed to occur in this area. For the project this viewpoint is therefore assessed as having **medium visual sensitivity**.
Significance of Visual Impact	**Moderate Significance**

3.3.3.5 Cumulative and residual impacts

Cumulative impacts

The project site is located within an area that has existing industrial development including both port and land based activities. While individual developments may have a minimal impact on the visual landscape the cumulative impact is a continuing industrialisation of the visual environment of this area. This is particularly the case with the land reclamation, which will create additional land beyond that currently available or which has been intended for industrial development.

In addition to the changes proposed as part of this development the visual landscape in the vicinity of the site will also be impacted on by the proposed construction of the road and rail crossing of Ross Creek. This new constructed feature of the visual landscape will visually be closely linked with the port development and will add to the perceived loss of naturalness of this area.

While the ongoing industrial and port development diminishes the naturalness of the visual outlook in this sector of the visual landscape, this development also provides a unique landscape that combines the background of the mountains with the inter-tidal zone of Cleveland Bay and the Ross River.

Residual impacts – construction

It is not anticipated that there will be any residual landscape or visual impacts arising from the construction phase of the project.

Residual impacts – operation

Some impacts resulting from the project are unavoidable and cannot be mitigated for during operation. The project will alter the surrounding landscape and the visual experience of the visual receptors. However, these changes must be seen within the context of the existing local environment.

Foremost amongst residual visual impacts is the creation of a new land area within Ross River adding to the existing port facilities, and the creation of the breakwater facilities. In addition the construction of industrial and port related development will increase the extent of this type of use in the visual landscape. As industrial and port development is located immediately adjacent to the site it is not considered to be a new element in the visual outlook.

The change in view will be permanent form all viewpoints with increased prominence when viewed from viewpoints 1, 4 and 5 as these either provide extensive uninterrupted outlooks over the site, or are located within close proximity and therefore not visually or physically separated from the impacts.

Site wide, in terms of the assessment criteria this equates to a moderate adverse residual landscape impact, with medium visual sensitivity due to proximity of the receptors to the site. Therefore, the assessment of significance of residual impacts is considered to be of moderate significance.

3.3.4 Mitigation measures

The intent of this section of the VIA is to identify mitigation measures that will reduce and/or manage adverse visual impacts of construction and operation on landscape and visual amenity.

3.3.4.1 Construction phase

To achieve construction without causing undue visual disruption to existing receptors the following mitigation measures are recommended:

- Avoid loss or damage to landscape features. Where possible, protect trees prior to construction and/or trim vegetation to avoid total removal. This includes vegetation that makes a significant and positive contribution to landscape character and/or has significant value in terms of biodiversity;
- Temporary hoardings, barriers, traffic management and signage to be removed when no longer required;

- Materials and machinery to be stored tidily during the works;
- Lighting of work sites is restricted to approved working hours and those that are necessary for security (additional lighting impacts in relation to flora and fauna are addressed under Section 3.10);
- Roads providing access to the site and work areas to be maintained free of dust and mud as far as reasonably practicable, and dust management techniques to be used (additional air quality impacts are addressed under Section 0; and
- Use of appropriate soil erosion prevention techniques (addressed in additional detail under Sections 2.4 and 3.14.

3.3.4.2 Operation phase

Mitigation of landscape and visual impacts as a result of the project seeks to achieve a balance between the site design and use requirements and achieving an optimal visual outcome. The mitigation strategy for the project is to minimise the detrimental effects on the landscape and visual character. Operation phase mitigation measures are:

- Building and structure design should respond to the surrounding environment with consideration to viewpoints through consideration of:
  - Building form and style;
  - Finish, including use of less reflective materials, appropriate colours, textures, and roofing; and
  - Building bulk and location.
- Establishment of landscaping works as soon as possible after the completion of construction operations, or if appropriate, during the construction stage;
- Mitigation of pollution from lighting through:
  - Appropriate lighting design to ensure the site is not over-lit;
  - Use of specifically design lighting that minimises the spread of light and glare towards visual receptors (also refer Section 3.10 for discussion on lighting impacts to fauna);
  - Specify appropriate luminaries to reduce light spill, sky glow and glare;
  - Consider the potential for solar power for lighting in accordance with the Solar Cities program; and
- Sensitive placement and specification of lighting to minimise any potential increase in light pollution within the natural environment.

3.3.5 Summary

Landscape and visual impacts of the project both during construction and when the site is available for industrial and port related development are assessed as being of moderate adverse significance. Due to the nature of the project there will be a permanent impact on the visual landscape and amenity of the area, particularly when viewed from the identified view points.

The construction effects of the project on landscape and visual amenity will be moderate due to the nature of the proposed works, the proximity of the site to residential areas and Castle Hill, which provides extensive views over this location. The assessment of a moderate impact on the landscape and visual amenity, and not higher, considers the natural of the surrounding industrial development in this location, the duration of viewing opportunities, and the nature of the proposed works.

The management of the construction process through the site EMP and the requirements of the environmental approval will help ensure that any adverse impacts resulting from the construction of the project on landscape and visual amenity are minimised or mitigated.

3.4 Transport and associated infrastructure

3.4.1 Overview

Given Lot 773 is currently an intertidal marine sand/mud flat there are no existing services and infrastructure in this area. Construction of the Precinct is expected to require supply of energy, water, sewerage, telecommunications and waste management and stormwater management infrastructure. These infrastructure needs are discussed under Section 2.6.

A Services Corridor exists between the Precinct boundary and Benwell Road. POTL will be undertaking reclamation of this area. There may be benefit in performing concurrent reclamation works to the development of the Precinct and this should be given consideration.

The developer will be required to provide all infrastructure services to site users within the Precinct from the boundary of the Precinct. POTL will provide services to the western boundary of the Precinct site, adjacent to the at-grade access road north of Archer Street (Figure 2-2). Services to be provided to the boundary of the Precinct by POTL and within the Precinct by the developer include:

- Underground electricity (developer to advise POTL of expected maximum power requirements over the life of the Precinct);
- Water;
- Sewerage; and
- Telecommunications (ducting only).

Further information regarding these required services is provided under Section 2.6.

A Traffic Impact Assessment (TIA), including infrastructure of relevance, was undertaken by GHD and is included as Appendix M. This assessment provides details of potential traffic and transport infrastructure impact and mitigation measures that may result from the development of the Precinct.

3.4.2 Description of environmental values

3.4.2.1 Existing and planned transport infrastructure

Operational completion of the first stage of the development will coincide with completion of the TPAR in December 2011. The relationship between location of the TPAR and the proposed development is shown in Figure 3-9.

It is expected that following completion of the TPAR construction traffic will be mobilised to the Precinct via the TPAR. This will facilitate completion of Stages 2 and 3 of the Precinct. Until that access is operational traffic routes through South Townsville have been considered.

The primary routes for haulage of construction materials and for operations until the TPAR is completed are highlighted in Figure 3-10.

The growth rate for roads within the vicinity of the port has been assumed at 7% p.a. Roads around the port relevant to the potential traffic related impacts of this development include:

- Benwell Road;
- Archer Street; and
- Eastern Access Road.

A summary of the existing traffic counts for the areas of relevance to the Precinct were sourced from the Department of Main Roads and have been used to assess how existing infrastructure is expected to perform during and post construction of the Precinct. Details of these traffic counts and background data are provided in Appendix M.

3.4.2.2 Proposed transport infrastructure development

The proposed development is an industrial reclaim consisting of approximately 18.8 hectares of trip generating land. The development will be constructed in three separate stages with the opening of the first stage to correspond to the completion of the Eastern Access Road scheduled for late 2011.

Analysis of transport infrastructure performance has been undertaken for the completion of all three stages with an anticipated opening year of all three stages by 2017 as well as the 10 year horizon analysis of 2027. Further analysis has been undertaken for 2011 to understand the impact construction traffic will have on intersections within Townsville prior to opening of the TPAR.

The site currently has frontage to Benwell Road. By late 2011, the site frontage will be primarily to the TPAR and interaction with Boundary Road. The Reference Design for the Precinct (and documents that support it) proposes access to the external road network via two new intersections to the site frontage located:

- A three-way intersection with Eastern Access Road to the north of Archer Street; and,
- A four way intersection with Boundary Street/Eastern Access Road.

LEGEND

- State Controlled Road
- Road
- Potential Temp. Hardstand Site
- Marine Precinct
- Stage 3
- Open Hardstand
- Breakwater
- Innerwall
- Industrial Shed

1:10,000 (at A4)

0 50 100 150 200 250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Eastern Access
Road Corridor

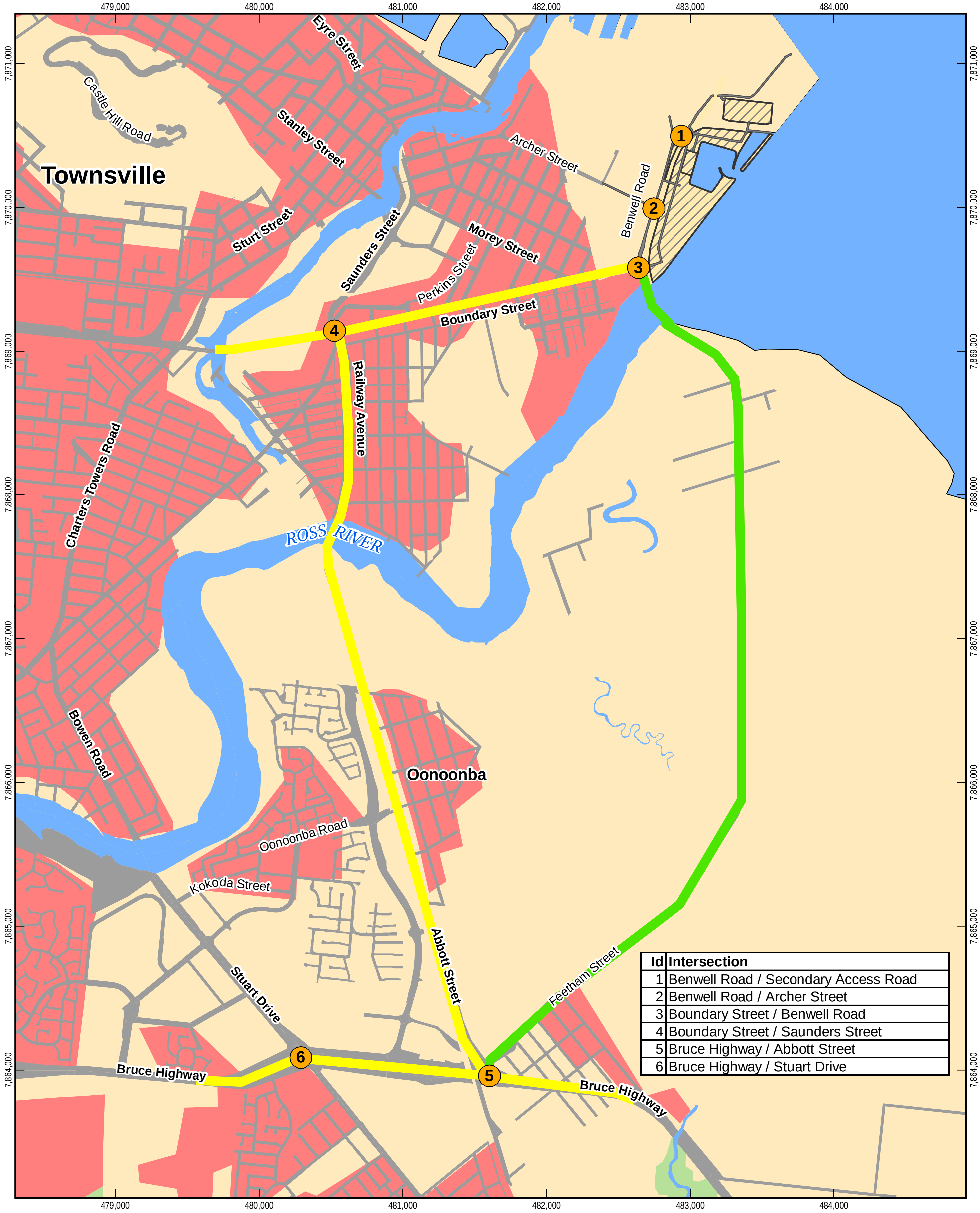
Job Number	42-15399
Revision	A
Date	01 July 2009

Figure 3-9

G:\42\15399\GIS\Projects\EIS\42-15399_023_rev_a.mxd

Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data source: Marine Precinct, Aerial Imagery, Road Layout - ©The State of QLD (Port of Townsville LTD) 2009. Created by: TH



LEGEND

Intersection

Primary Haulage Route

Existing Transport Route

Proposed Eastern Access Road

Proposed Marine Precinct

Builtup Area

1:35,000 (at A4)

0 250 500 750 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

PORT of TOWNSVILLE

Port of Townsville
Marine Precinct EIS

Job Number 42-15399
Revision A
Date 01 July 2009

Intersection Location and
Indicative Road Network Assignment

Figure 3-10

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data source: Haulage Route - GHD 2009; Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; 250K Topo Data - ©Commonwealth of Australia (Geoscience Australia) 2007. Created by: TH

3.4.3 Potential impacts and mitigation measures

3.4.3.1 Construction traffic generation

Table 3-13 shows the additional traffic due to Precinct construction works expected on the external road network. It has been assumed that all construction workers will arrive in the adjacent road network corresponding AM peak and will depart in the PM peak whilst heavy vehicles from the quarry will operate at 8 vehicles per hour in both directions between 6:30am and 6:30pm. The daily peak in construction workforce during the entire period of construction is expected to be 100 workers on-site at any point in time.

Table 3-13 Additional traffic due to construction

Construction Workers	Vehicle Occupancy	Heavy Vehicles	Total Vehicles AM		Total Vehicles PM	
			In	Out	In	Out
100	1.5	8	75	8	8	75

3.4.3.2 Construction traffic splits and distribution

Analysis of expected traffic volumes during construction demonstrates the haulage route for construction traffic associated with Stage 1 is likely to impact the following intersections prior to the completion of the Eastern Access Road:

- Bruce Highway/Stuart Drive;
- Bruce Highway/Abbott Street; and
- Boundary Street/Saunders Street.

3.4.3.3 Operational traffic generation

Table 3-14 is a summary of the range of peak hour and daily trip generation rates for industrial land uses. The generation rates are sourced from the *Design for Subdivisional Streetworks by Queensland Streets*.

Table 3-14 Range of Trip Generation Rates for Industrial Land Uses

	Peak Rate (per 100m^2)	Daily Rate (per 100m^2)	Source
Factories	1.0	5	RTA
Large Factories	N/A	4-5	QT
Warehouses	0.5	4	RTA
Warehouses	1.1	N/A	BCC
Light Industry	0.9	9	QT

The Light Industry land use was the most appropriate land use type and has been used to estimate the number of trips generated by the site as shown in Table 3-15. The rates are based on Gross Floor Area (GFA) and *Design for Subdivisional Streetworks* stipulates that for light industry, typically 45% of the site area is GFA.

Table 3-15 Light industrial trip generation rates

Area (GFA) m^2	Trip Generation Rate (per 100m^2)		Trips Generated (Two-way)	
			Peak Hour	Daily
84,600	0.9 trips per peak	9 trips per day	762	7,620

3.4.3.4 Operational Traffic Splits and Distribution

The following directional splits, shown in Table 3-16, for the AM and PM peak hour periods for the development traffic have been adopted from the "*Institute of Transportation Engineers – Trip Generation 7th Edition*".

Table 3-16 Development traffic directional splits

Direction	OUT	IN
AM Peak Hour Light Industrial	17% (130 Trips)	83% (632 Trips)
PM Peak Hour Light Industrial	79% (602 Trips)	21% (160 Trips)

Note: Number of trips have been rounded up.

The assumed trip distributions as a percentage for the development and surrounding roads have been analysed in conjunction with expected development traffic movements, based on existing traffic patterns, to determine expected traffic volumes for 2017 and 2027 with and without development scenarios. Table 3-17 highlights the percentage contribution of construction and operational traffic on the existing road network based on traffic volumes.

Table 3-17 Contribution of Development Traffic to Intersections

Scenario			Bruce Hwy / Stuart Dr	Bruce Hwy / Abbott St	Boundary St / Saunders St	Boundary St / Benwell Rd	Benwell Rd / Archer St
2011 With Construction	AM	Background	4001	2292	3907	N/A	N/A
		Additional	50	56	143	N/A	N/A
		% Addition	1%	2%	4%	N/A	N/A
	PM	Background	3908	2387	3784	N/A	N/A
		Additional	50	56	143	N/A	N/A
		% Addition	1%	2%	4%	N/A	N/A
2017 With Development	AM	Background	N/A	N/A	5195	572	736
		Additional	N/A	N/A	143	742	121

Scenario			Bruce Hwy / Stuart Dr	Bruce Hwy / Abbott St	Boundary St / Saunders St	Boundary St / Benwell Rd	Benwell Rd / Archer St
		% Addition	N/A	N/A	3%	130%	16%
	PM	Background	N/A	N/A	5013	572	742
		Additional	N/A	N/A	143	742	121
		% Addition	N/A	N/A	3%	130%	16%
2027 With Development	AM	Background	N/A	N/A	8358	1125	1447
		Additional	N/A	N/A	143	742	136
		% Addition	N/A	N/A	2%	66%	9%
	PM	Background	N/A	N/A	8021	1125	1459
		Additional	N/A	N/A	143	742	136
		% Addition	N/A	N/A	2%	66%	9%

Table 3-17 highlights that the contribution of development traffic is less than 5% for the following intersections:

- Bruce Highway/Stuart Drive;
- Bruce Highway/Abbott Street; and,
- Boundary Street/Saunders Street.

Although under DMR's Guide for Assessment of Road Impacts of Development (GARID), the traffic generated by the development does not trigger the need for assessment of the impacts at these intersections. For the purpose of completeness in this assessment, these intersections have been assessed.

3.4.3.5 Northern Access Rail Crossing

The rail crossing on the northern access to the Precinct was analysed to determine likely queue lengths produced by vehicles accessing the site. Queue lengths are expected to be less than 40m (refer Appendix M) and, accordingly, provision for queuing of approximately 40m should be made on both approaches to the rail crossing so as to minimise the likelihood of queue spillback to adjacent roads. This will minimise any potential flow on impacts.

3.4.3.6 Intersection Analysis

The analysis of the intersections expected to be impacted directly by the construction and operational traffic has been undertaken using SIDRA Intersection 3.2 for existing traffic, construction traffic and future traffic with and without development conditions following the planning guidelines stipulated in Section 13.4.4 of the DMR *Road Planning and Design Manual*. 2011 is the anticipated year that construction traffic will have the greatest impact on the road network, which is prior to the completion of the TPAR. After 2011, construction traffic for Stages

2 and 3 is assumed to use the TPAR for trips to and from the Precinct and will have a lesser impact on the adjacent road network. 2017 is the anticipated year of opening and 2027 has been used to assess the 10-year traffic horizon.

The layouts used for this analysis and detailed findings from the analysis, including descriptions of the background traffic and performance of the intersections with Precinct traffic, are provided within Appendix M. Summarised findings for the operational performance of the intersections are provided here.

It should be noted that traffic generated by the development contributed less than 5% of the total intersection volumes for a number of these intersections, which, therefore, does not trigger the need for assessment. However, all relevant intersections have been considered for completeness.

Bruce Highway / Stuart Drive

The intersection is a four-leg signalised intersection with pedestrian crossings provided on all legs. Studies indicate that while the intersection is operating near capacity without construction traffic, the addition of construction traffic has a negligible impact on the intersection. Notably queue lengths are within acceptable limits and don't encroach on neighbouring intersections.

The impact of the development generated traffic is not considered to be significant on the intersection by DMR guidelines.

Bruce Highway / Abbott Street

The intersection is a three-leg priority controlled junction with approaches from the East and West having priority. Studies indicate that the existing intersection layout and control will continue to operate satisfactorily in 2011 with the addition of construction related traffic. Queue lengths are within acceptable limits and do not encroach on neighbouring intersections; and the impact of the development generated traffic is not considered to be significant on the intersection by DMR guidelines.

Boundary Street / Saunders Street

The intersection is a four-leg signalised intersection with the major traffic movement being north-south. Studies indicate that the intersection isn't operating satisfactorily currently. However, when compared to the analysis without construction traffic it is suggested that the additional traffic doesn't significantly increase the adverse effects.

The results of the 2011 with construction traffic scenario indicate that queue lengths are within acceptable limits and don't encroach on neighbouring intersections. Consideration will need to be given to upgrading the intersection to continue to achieve acceptable traffic flow under the 2017 with development traffic scenario. However, this is not a Precinct specific result but related to growth in background traffic volumes. The additional traffic due to the development does not have a significant impact on the intersections performance.

Without upgrade the intersection will continue to operate sub-optimally towards 2027 with development traffic loads. Considerable delays for approaches are expected to be realised. However, this also relates to increased background traffic volumes and is not a Precinct specific result. The impact of the development generated traffic is not considered to be significant on the intersection by DMR guidelines.

Boundary Street / Benwell Road

The layout used for the analysis of the new intersection between Boundary Street / Benwell Road for the with development traffic scenario is based on the proposed intersection layout as shown in the Conceptual Design Report produced by Maunsell for the Port of Townsville.

The layout for the without development scenario is based on the Eastern Access Road as a two lane two direction road. Turning lane lengths are as required by the 2027 analysis.

Results for both the 2017 and 2027 analysis of scenarios with development traffic indicate that the intersection will continue to perform within expected parameters and queue lengths will be within acceptable limits. Traffic movements of relevance to the Precinct are not predicted to encroach on neighbouring intersections.

Benwell Road / Archer Street

The capacity of this intersection has been assessed as both a priority and signal controlled intersection and as a roundabout to consider flexible options and performance of traffic infrastructure.

As a Priority intersection this intersection is expected to perform with development traffic up until 2017, but will require upgrade to continue to perform out to 2027. Without upgrade from a Priority intersection queue lengths on the western approach are expected to interfere with accesses on Archer Street.

If Signalised this intersection is predicted to perform satisfactorily under both the 2017 and 2027 developed traffic volume scenarios. If Signalised queue lengths are not expected to encroach on neighbouring intersections and average delays will be within acceptable limits

Similarly, as a Roundabout this intersection is predicted to perform adequately under both the 2017 and 2027 development scenario traffic volumes.

The results of the options testing for upgrade of this intersection beyond 2017 shows that a Roundabout or Signalised intersection will provide adequate capacity to accommodate forecast traffic volumes at this location but that a Priority intersection will not.

Benwell Road / Secondary Access (Proposed Access)

This intersection will be a new intersection that will provide a secondary access location to the development. This intersection will cross rail and road associated with the TPAR and has been assessed as a Signalised intersection, a Priority access and a Roundabout. All scenarios demonstrate acceptable operational limits for the intersection with queue lengths that do not encroach on neighbouring intersections at both the 2017 and 2027 development horizons.

3.4.4 Summary

This section has investigated the potential construction and operational traffic related impacts of the proposed development by conducting intersection analyses at the following locations:

- Bruce Highway / Stuart Drive (Existing);
- Bruce Highway / Abbott Street (Existing);
- Boundary Street / Saunders Street (Existing);

- Boundary Street / Benwell Road (Proposed);
- Benwell Road / Archer Street (Existing); and
- Benwell Road / Secondary Access (Proposed).

The analysis has shown that the Boundary Street / Saunders Street intersection is expected to perform sub-optimally by 2011 due to continued growth in background traffic in the area. As a result of the significant growth in traffic realised to 2027, a feasible upgrade alternative was unable to be achieved and so further investigation is recommended on the capacity of the future road network.

An enhanced at-grade Boundary Street / Saunders Street intersection to accommodate the forecast traffic volumes is unlikely to be achieved without major rail relocations on the western side and property acquisitions on the eastern side.

From the traffic impact study, the following conclusions are made:

- The impact of the traffic generated by the development is not considered by DMR guidelines to be significant at the following existing intersections because the development traffic contributes less than 5% of the background traffic:
  - Bruce Highway / Stuart Drive (Existing);
  - Bruce Highway / Abbott Street (Existing);
  - Boundary Street / Saunders Street (Existing);
- Construction related traffic generated by the site will have a negligible impact on the adjacent road network at the 2011 horizon;
- An upgrade of the Benwell Road / Archer Street intersection is required some time between 2017 and 2027 as a result primarily of increased background traffic (right turn from Archer Street to Benwell Road). A signalised and roundabout control have been tested and both show that they can accommodate the forecast traffic volumes to 2027 in their simplest form;
- The analysis of the Benwell Road / Secondary Access intersection shows that the intersection will provide satisfactory operating conditions for all approaches with either a priority control, a roundabout or signals;
- An upgrade of the Benwell Road / Boundary Street intersection will be required with the addition of a fourth leg which will be the primary access to the site. An enhanced signalised intersection form will be required at this location; and
- Based on a 90/10 split between the two access locations, an average 37.2 metre queue is expected for traffic entering the site and an average 35.4 metre queue is expected for vehicles exiting resulting from the closure of the proposed level crossing on the northern (secondary) access to the site.

The assessment has demonstrated that there are no foreseeable traffic related impacts that are related directly to the Precinct and, hence, no impacts that should prohibit the proposed development from proceeding.

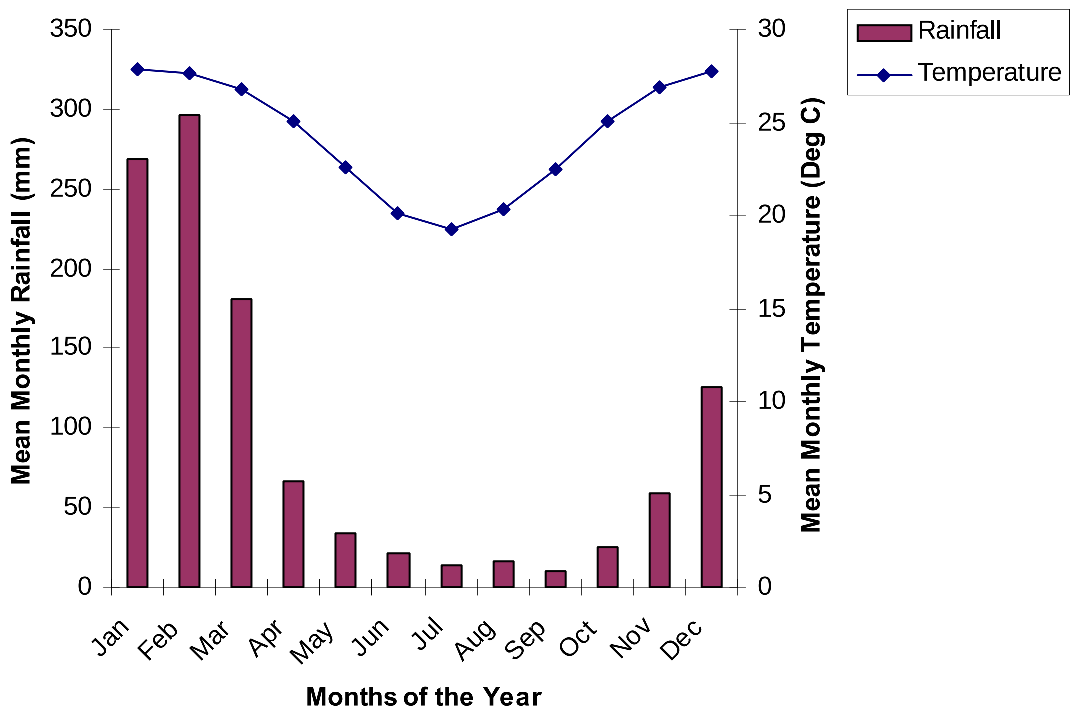
3.5 Climate and climate change

3.5.1 Rainfall and temperature

Average annual rain at Townsville is over 1m; with a recorded mean of 1115.3 mm for the past 68 years at the Townsville Airport BoM AWS. As indicated in Figure 3-11, April through to November is noticeably drier than other times of the year. On average, close to 66 days per year have recorded more than 1 mm of rain. This averages one in 5.5 days, although the 'dry season' months have fewer days with about three per month compared with 10 to 11 days per month for other months. This has implications for dust management, addressed in Section 0 as rainfall suppresses dust generation.

Temperature follows a tropical climatic pattern with summer months experiencing average temperatures approaching 30°C and winter months experiencing average temperatures around 20°C. Exceedances of average temperatures do occur during summer periods with maximum temperatures during daytime occasionally reaching 35°C.

Figure 3-11 Mean Monthly Rainfall and Temperature for Townsville (BoM 2009)



3.5.2 Wind

The Townsville Port meteorological monitoring station records indicate the wind speed classes for the Townsville Port shown in Figure 3-12, the most common occurrences fall between 1.5 and 3.0 m/s. The highest observed hourly-averaged wind speed was 6.7m/s and an overall average wind speed of 2.6m/s. This is lower than would normally be expected on a coast exposed to the south-east trade winds (albeit with Cape Cleveland in that direction) but may be influenced by the surrounding port infrastructure to the east and south, and the Jupiters Townsville Hotel and Casino to the west of the weather station.

The wind rose plot for the meteorological data (Figure 3-13) shows the predominant wind directions being from the NE, E, SE, and S. The stronger winds (>3m/s) are from the NE, E and SE directions, with most light winds (<3.0m/s) with a southerly component.

Figure 3-12 Wind speed frequencies at Townsville Port TEOM Weather Station

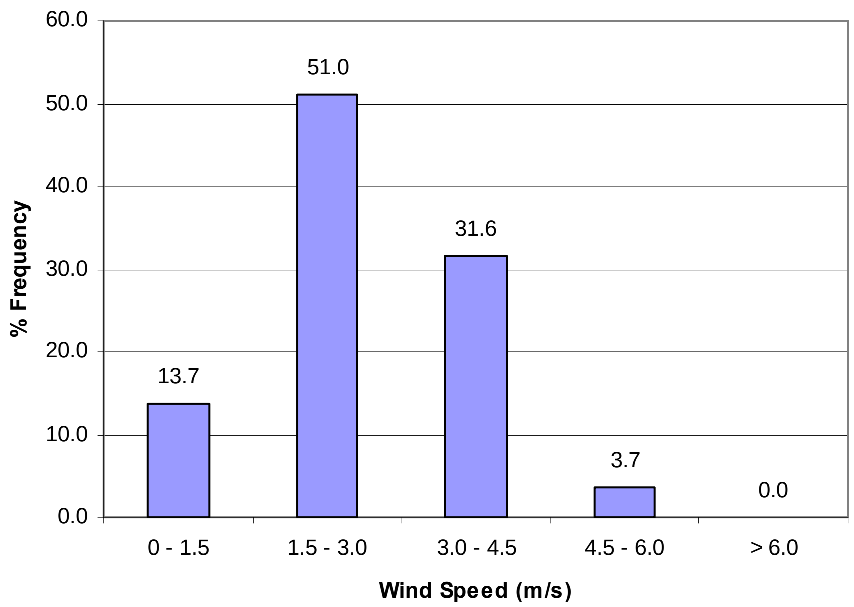
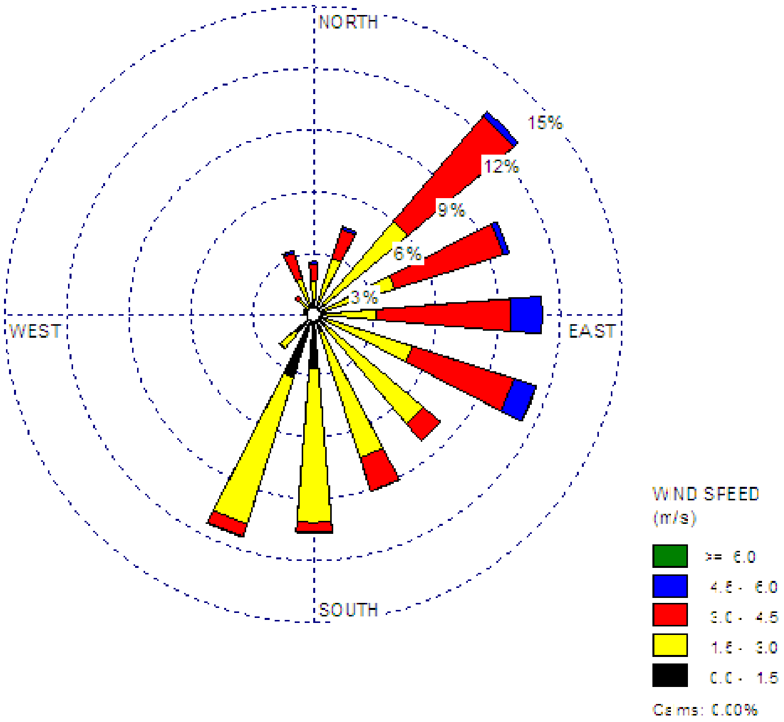


Figure 3-13 Speed and direction wind rose for Townsville Port TEOM Weather Station



3.5.3 Climate Change Projections – Temperature

Average annual temperatures for the Townsville region are expected to increase, with warming being greatest in the autumn and summer. The number of hot days is extremely likely to increase with major increases in the number of days over 30°C, and with increases of up to 24% more days over 35°C by 2070 under a high emission scenario.

Table 3-18 Projected Changes in Average Annual Temperature (relative to 1980-1999) for the Townsville Region

Projections (°C)	Current	2070 (High emission scenario)
CSIRO 2008	21 - 24	+2.7 (-0.9 to +1.1)

(Figures in brackets respond to the °C of uncertainty from the average annual temperature projected).

Table 3-19 **Projected changes in annual average numbers of hot days for the townsville region (CSIRO 2008)**

Annual average number of days over:	1971-2000 Baseline	2070 (High emission scenario)
30°C	43%	63 - 83%
35°C	1%	5 - 24%
40°C.	0	0.3 - 0.6%

3.5.4 Climate change projections – rainfall (intensity, timing and distribution)

Projections for rainfall (Table 3-20) are more uncertain then the projections for temperature changes. Changes in annual average rainfall are likely to decrease in the Townsville region by 2030 and 2070, although the ranges of uncertainty for all projections include decreases and increases in annual averages. Slightly fewer rain days are likely, but again the range of uncertainty includes increases in rain days. The intensity of heavy daily rainfall is also likely to decrease slightly, although projections are highly uncertain. OzClim, the CSIRO's online climate change scenario generator, projects the greatest decrease in seasonal rainfall in the winter months (Table 3-21).

Table 3-20 **Projected changes in rainfall statistics for the Townsville Region (CSIRO 2008)**

Change in:	Current	2070 (High emission scenario)
Average Annual Rainfall %	1117mm	-8% (-32 to +18%)
Number of Rain Days	73	-3 (-17 to +7)
Rainfall Intensity		+1% (-30 to +20%)

Table 3-21 **OzClim projections for seasonal change in rainfall (%) from baseline 1990 for the Townsville Region**

Rainfall	2070 (%) (High emission scenario)
Summer	-5 to 0
Autumn	-20 to -10
Winter	-30 to -20
Spring	-20 to -10

3.5.5 Climate change projections – sea level rise

Some planning and policy documents are now recommending 0.8m as the sea level rise to be planned for projects that are expected to have a lifespan beyond 2070. This level is a combination of the upper estimate of the high emissions scenario from the IPCC Fourth Assessment Report (2007) of 0.59m, combined with the suggested additional 0.2m to take into account potential accelerations in ice flow from glaciers.

Current examples where these recommendations have been implemented are:

- The DERM Guidelines for Preparing a Climate Change Impact Statement (CCIS) which recommends assessing potential impacts and adapting for the effects of a 0.79m rise in sea level for projects expected to exist beyond 2070 that require a cabinet submission; and
- The Victorian Coastal Strategy 2008 which recommends policy to plan for sea level rise of not less than 0.8m by 2100, and to allow for the combined effects of tides, storm surges, coastal processes and local conditions, such as topography and geology when assessing risks and impacts associated with climate change.

For the purposes of this EIS a potential rise of 0.8m above existing sea levels for the Townsville region has been considered, as a conservative estimate, in the climate impact assessment. Design considerations for the Precinct post this assessment have adopted an appropriate Reference Level for the Precinct to ameliorate anticipated impacts (refer Section 2).

3.5.6 Climate change projections – extreme events

3.5.6.1 Storm surge

It is very likely that Townsville will experience increases in storm tide height due to mean sea level rise and increases in tropical cyclone intensity. Higher mean sea levels (Table 3-22) will enable inundation and waves resulting from storm surges to penetrate further inland, increasing flooding, erosion and damage to infrastructure.

Table 3-22 Semidiurnal tidal planes for the Port of Townsville

Tidal Plane	Abbreviation	m AHD	Projected 2100 m AHD (+0.79m)
Highest Astronomical Tide	HAT	+2.15	+2.94
Mean High Water Springs	MHWS	+1.21	+2.00
Mean High Water Neap	MHWN	+0.36	+1.15
Mean Sea Level	MSL	+0.10	+0.89
Mean Low Water Neap	MLWN	-0.27	+0.52
Mean Low Water Springs	MLWS	-1.13	-0.34
Lowest Astronomical Tide	LAT	-1.86	-1.07

The *Townsville-Thuringowa Storm Tide Study* report, produced for the Townsville and Thuringowa City Councils (2007), estimated the increase in total storm tide levels (storm surge plus tide including wave set-up) for selected return periods under an enhanced greenhouse scenario for the years 2050 and 2100. These estimates are summarised in Table 3-23 for the Ross River.

Table 3-23 Estimated Increase in Total Storm Tide Level (m AHD) under Enhanced Greenhouse Scenarios (Townsville/Thuringowa City Council 2007)

Location – Ross River	50y	100y	500y	1000y
Current	2.9	3.0	3.2	3.7
2050	+0.1	+0.1	+0.6	+0.8
2100	+0.4	+0.5	+1.4	+1.7

3.5.6.2 Tropical cyclones

For the Townsville region the CSIRO (2008) projects that little change is likely in the annual average number of cyclone days, although severe cyclones may occur more often.

3.5.6.3 Fire

For eastern Australia, increases in fire risk are likely, along with an increase in the number of extreme high fire days and the fire season is likely to become longer, starting earlier then at present.

3.5.7 Summary of projected climate changes for the Townsville Region

A summary of projected climate changes for the Townsville region is provided in Table 3-24. Adaptation measures are discussed in the following section.

Table 3-24 Overview of projected climate changes for the Townsville Region

Climate Variable	Current Average	Source	Climate Change Projection	Scenario / Info	Source
Sea Level	HAT: +2.15 m, relative to AHD	Hardy *et al.* 2004, p.20	Sea Level: +0.59 (+0.2) Total +0.79	2090 - 2099 relative to 1980 - 1999 High emissions (A1FI) emissions scenario High range model result (plus 0.2m to account for additional contribution from ice sheets)	IPCC 2007
Wind and	100 year	Townsville	100 year	Climate change	Townsville

Wave Climate	return period for storm surge plus tide: +3.00 m, relative to AHD	and Thuringowa City Councils 2007, p.63	return period for storm surge plus tide: +0.5 m (+3.5 m relative to AHD)	scenarios include: Increase in cyclone MPI of 20%, Increase in frequency of tropical cyclones of 10% Mean Sea Level rise of 0.9m (based on the upper level IPCC (2001) prediction of MSL rise for 2100)	and Thuringowa City Councils 2007, p.96
Rainfall/Runoff (Highest Daily Rainfall 548.8 mm 11 Jan 98)	Annual average rainfall: 1117 mm	BoM	-8%	2070 A1FI emission scenario with high climate sensitivity (IPCC 2001 global warming values)	CSIRO 2008
	Average summer monthly rainfall 230.3 mm		-5%		
	Average winter monthly rainfall 17.0 mm		-4%		
Air Temp	Annual mean max temp: 28.9°C	BoM	Average temp increase: +2.7°C	2070 A1FI emission scenario with high climate sensitivity (IPCC 2001 global warming values)	CSIRO 2008
	Annual mean min temp: 19.8°C				
	Highest temp recorded: 44.3°C				
	Lowest temp recorded: 1.1°C				
	Annual average number of hot days (over 35°C): 3.5	BoM	Increase in number of days over 35°C : +38 days (+18 to +86)		

3.5.8 Climate change adaptation

3.5.8.1 Background

In 2007 the Intergovernmental Panel on Climate Change (IPCC) released its fourth assessment report on climate change, which stated that warming of the climate system is now unequivocal. Changes in the global climate system, as a result of this warming, are likely to result in:

- Fewer cold days and nights and an increased frequency of heat waves over most land areas;
- An increase in the proportion of total rainfall from heavy falls;
- An increase in area effected by drought; and
- Increased intensity of tropical cyclones and incidences of extreme high sea level.

Increases in global average air and ocean temperatures and rising global average sea level are already evident from observations during the late twentieth century. For example, over the period from 1961 to 2003, global average sea level rose at a rate of 1.8 (1.3 to 2.3) mm per year and during the period from 1993 to 2003, the rate was faster at approximately 3.1 (2.3 to 3.8) mm per year (IPCC 2007).

The QLD Government developed a methodology for *Climate Change Impact Statements* (CCIS) in July 2008 to consider climate change in decision making and to provide an assessment of the climate change impacts associated with projects. The guideline for a CCIS outlines a qualitative methodology for undertaking:

- A greenhouse gas (GHG) emissions assessment which measures the potential contribution of the project to the State's emissions profile; and
- A climate change adaptation assessment, which analyses the physical risks to the project from climate change and identifies measures to reduce these risks.

The impacts of climate change are likely to affect many infrastructure projects with a projected lifespan greater than 30 years. Therefore an assessment of this project's vulnerabilities to climate change was undertaken. This report encompasses a *Climate Change Adaptation Assessment* (CCAA), which includes an analysis of the risks to the proposal from climate change impacts and a description of adaptation measures to minimise these risks.

The main potential impacts identified and where sufficient information was available the consequence, likelihood and risk level of each impact was evaluated. The assessment and findings are described in detail in Appendix O) and summarised following. These findings have, since completion, been used to support design studies and construction assessments described in Section 2 of this report. Accordingly, the identified impacts are ameliorated.

This risk assessment has assessed the impacts of climate change on this project over a 100 year timeframe. This timeframe was chosen as it represents the projected design life of the project. The following risk evaluation framework (Table 3-25) was used to assign risk levels to identified impacts. These have been sourced from Port of Townsville risk assessment framework, with the addition of likelihood ratings adapted to a time scale for a design life of 100 years.

Table 3-25 Likelihood Ratings for CCAA (adapted Port of Townsville)

Rating	*Port of Townsville*
Almost Certain	*Expected to occur in most circumstances (more than once a year)*
Likely	*Will probably occur in most circumstances (once in 1-10 years)*
Possible	*Might occur at some time (once in 10-50 years)*
Unlikely	*Could occur at some time (once in 50-100 years)*
Rare	*May only occur in exceptional circumstances (less than once in 100 years)*

Overall, 11 main potential impacts to the TMPP as a result of projected changes in climate were identified. These are listed in Table 3-26.

Table 3-26 Potential Project Impacts from Climate Change Identified

ID	Project Impact
MSL1	Ground water rise impacts on foundations and services leading to asset deterioration
W1	Wind impacts on buildings and structures - potential operational restrictions on lifting operations (Not applicable to project as the design and construction of structures is not included within the project scope – therefore risk level not assessed)
ST1	Increased ship queuing due to interruptions of on-shore services eg. ship lift/rack & stack
ST2	Restrictions on accessing the harbour facilities (no impact considered likely once inside the breakwater, therefore no risk level assessed)
ST3	Breakwaters - overtopping Potential degradation of breakwater structure
ST4	Breakwaters - Reduced harbour tranquillity leading to interruption to service and potential injuries to people and property moored at breakwater
ST5	Reclamation and pavement areas- Potential degradation of assets installed in reclaimed areas
ST6	Reclamation and pavement areas- Environment Overtopping and run-off - water quality impacts
ST7	Reclamation and pavement areas- Safety Potential for health issues associated with inundation of reclamation and pavement area
RR1	Environmental impact due to water pollutant loadings in stormwater

ID Project	Impact
T1	Increases in ambient temperatures will result in greater thermal movement of concrete pavements, increasing the risk of cracking and subsequent degradation. Bitumen binder in pavements will be more at risk of soften at higher temperatures leading to excessive deformation and rutting of the road surfaces

3.5.8.2 CCA Risks Analysed

Of the impacts identified, two (W1 and ST2) were noted as key considerations, but, as noted in Table 3-26 the level of risk was not assessed due to the conclusion that the impact was outside the scope of this study. Of the remaining nine impacts identified, two were assessed as having a 'low' risk level, two as having a 'medium' risk level, four as having a 'substantial' risk level and one as having a 'high' risk level. Risk rankings are summarised in Table 3-27.

Table 3-27 Summary of CCAA Risk Ratings

		Consequence				
		Insignificant	Minor	Serious	Disastrous	Catastrophic
Likelihood	Almost Certain					
	Likely			**T1**	**ST6**	
	Possible	**ST1**		**MSL1**	**ST3, ST4, ST5**	
	Unlikely		**RR1**		**ST7**	
	Rare					

Based on the risk level treatments identified in Port of Townsville's risk framework, potential impacts that are assigned a risk level of substantial, high or extreme are required to document action plans to reduce the risk level. Potential impacts that are identified as low or medium levels of risk are considered acceptable without review and with review respectively.

3.5.8.3 Risks Evaluated and Reviewed

For impacts that were assigned a risk level of 'high' or 'substantial', current and potential controls and adaptation measures that could reduce the potential risk level over the life of the project were identified. All of the impacts assigned these higher levels of risk were related to the effect of increased sea level on the height and recurrence interval of storm tide events in the project area. The main areas for potential impacts from this variable will be the breakwater structures and the reclamation and pavement areas.

Breakwater

Impacts ST3 and ST4 were both related to the event of a high storm tide leading to overtopping of the breakwater structure. The risk of this event was assessed, taking into account the projected increase in sea level due to climate change (refer Appendix O). Specific impacts including degradation of the structure, reduced harbour tranquillity, disruption of services and potential injuries to people and property moored at the breakwater were assessed as having a 'substantial' level of risk.

Current Controls in Place

At the time of the workshop, it was understood that the breakwater structure was being designed for a current day 1 in 100 year event. The Queensland Coastal Plan consisting of the new State Planning Policy for Coastal Protection and the new Coastal Management Policy is currently being drafted but is yet to be finalised and, according to release timing, details contained within that policy may need to be taken into consideration for the design of this project. To adopt a conservative approach for the project for assessment purposes a potential sea level rise of 0.8m for a design life of 100 years was adopted for this project and it is expected this will be accordance with any new policies which are yet to be finalised.

Information from this component of the EIS has supported construction studies for the breakwater and, accordingly, the Reference Design has adopted conservative estimates to account for potential climatic impacts (refer Section 2). The approach of conducting the study and identifying potential impacts under current scenarios provided opportunity to identify areas to which additional consideration needed to be given. These areas, and the suggested approaches for addressing, are documented following and have informed the construction approach for the EIS to ameliorate expected impacts.

Potential Control Actions

Implementation of the new coastal management policy.

Reclamation and Pavement Areas

Impacts ST5, ST6 and T1 were related to the reclamation and pavement areas.

Impact ST5 related to the potential for more frequent inundation of the reclamation area during storm tide events leading to degradation of assets stored in these areas. This impact was assessed as having a 'substantial' risk for asset loss.

Impact ST6 was related to the potential for inundation of the reclamation and pavement areas during storm tide events leading to spills from dangerous chemicals stored in facilities within the reclamation area, which would then impact on water quality. The risk of this impact was assessed as being 'high'.

Impact T1 regarded the impacts of increases in ambient temperatures on the concrete and bitumen used for the pavement area and roads. Greater thermal movement of concrete pavements will increase the risk of cracking and subsequent degradation of the concrete. Bitumen binder in pavements will also be more at risk to soften at higher temperatures leading to excessive deformation and rutting of the road surfaces.

Current controls

At the time of the workshop a design height of 5m LAT for the height of the reclamation and pavement areas was considered for this impact assessment. Recognising that, based on this assessment, this level is likely to be insufficient construction and design considerations for the Precinct have adopted a design level of 5.5m LAT. The new Reference Level is considered adequate to ameliorate the risks noted.

Australian Standards for material specifications do not currently take potential changes in temperature over the design life of the project into account

Potential control actions:

ST5 and ST6: The Climate studies indicated that the 5m design height for the reclamation and pavement areas should be reviewed to reduce the risk associated with storm tide events inundating these areas. This has been achieved, as noted in Section 2, with a revised Reference Level of 5.5m LAT carried through the EIS. This new level is considered appropriate for amelioration of potential impacts.

T1. Concrete: Adequate allowance for predicted thermal movements during the design stage. This could be the inclusion of more joints in the pavement to relieve stresses and reduce the risk of damage. Detailed design of the Precinct will be required to consider this.

T1. Bitumen: Evaluate different bitumen formulation to suit projected climate conditions. This may include higher penetration grade bitumen, alternate mix designs or the use of polymer modified bitumen. Detailed design of the Precinct will be required to consider this.

3.5.8.4 Climate change adaptation assessment

Table 3-28 provides a summary if the climate adaptation measures recommended to mitigate risks identified in Section 3.5.8.3.

Table 3-28 Summary of adaptation assessment against 5m LAT Reference Level

Risk Level	Risk	Adaptation Option	Management
High	ST6 - Reclamation and pavement areas- Environment Overtopping and run-off - water quality impacts	Consideration for design of 0.8m SLR as a conservative height to account for potential sea level change, Consideration for the projected increase in total storm surge and tide figures for the 100 year return period of 0.5m.	Reference Design Level of Precinct adopted to be 5.5m LAT to achieve amelioration of potential impacts
Substantial	ST5 - Reclamation and pavement areas- Potential degradation of assets installed in reclaimed areas		Reference Design Level of Precinct adopted to be 5.5m LAT to achieve amelioration of potential impacts.
Substantial	ST3 - Breakwaters - overtopping Potential degradation of breakwater structure	Current design standard to be revised to the 1 in 100 year event for the year 2100, rather than to current conditions.	Reference Design Level of Precinct adopted to be 5.5m LAT to achieve amelioration of potential impacts.

Risk Level	Risk	Adaptation Option	Management
Substantial	ST4 - Breakwaters - Reduced harbour tranquillity leading to interruption to service and potential injuries to people and property moored at breakwater		Hazard and Risk assessment addressed potential impacts and provided mitigation strategies to address.

The risk level of impact ST6 was re-assessed during a workshop taking into account the identified adaptation options. The revised risk level was assessed as medium as the likelihood rank decreased to unlikely.

This risk assessment highlighted that some existing standards need to be updated to reflect projected climate changes. The design for the Precinct and the construction studies for this EIS have, accordingly, adopted a Reference Level of 5.5m LAT to accommodate potential climatic impacts.

This assessment has been used to inform relevant areas of this study. Construction levels, as detailed under Section 2.4, have used this information as appropriate in consideration of design levels against 100 year climate change scenarios. Hazard and risk assessments and the Environmental Management Plan for the TMPP have also incorporated this information when undertaking assessment of potential impacts like inundation of pavement areas and mitigation measures against these impacts are identified in Sections 6 and 8 of this document. Under the adopted mitigation strategies it is not anticipated that climatic impacts will negatively effect the TMPP.

3.6 Surface waterways

A description of the existing environment for surface waterways that may be effected by the Precinct, including Ross River, is provided under Section 3.8 – Coastal Environment and Section 3.9 – Water and Sediment Quality. These two sections address in detail the existing environment for surface waterways, which may be affected by the Precinct in the context of environmental values as defined by the EP Act and environmental protection policies.

A description is given in Section 3.8 and Section 3.9 of the waterways associated with the Precinct, their quality and quantity in the area affected by the project and an outline of the significance of these waters to the river catchments system in which they occur. This includes a characterisation of the water quality of the area from a baseline monitoring program.

The Queensland Water Quality Guidelines (2006, QWQG), the Australian and New Zealand Environment and Conservation Council (ANZECC) National Water Quality Management Strategy, the Australian Water Quality Guidelines for Fresh and Marine Waters (November 1992) and the Environmental Protection (Water) Policy 1997 are used as a reference for evaluating the effects of various levels of contamination.

Options for mitigation and the effectiveness of mitigation measures are discussed with particular reference to sediment, acidity, salinity and other emissions of a hazardous or toxic nature to human health, flora or fauna.

Details regarding flooding events are provided, potential impacts and mitigation measures on waterways resulting from the Precinct construction and operation are discussed Section 3.9 provides details of a water quality monitoring program appropriate to predicted impact management.

3.7 Groundwater resources

3.7.1 Overview

This section describes the existing environment for groundwater resources which may be affected by the Precinct in the context of environmental values as defined by the Environmental Protection Act 1994 and environmental protection policies. A review of the quality, quantity and significance of groundwater in the project area has been completed.

3.7.2 Description of environmental values

A Baseline Groundwater Monitoring program was completed as part of the environmental studies for this EIS (refer Appendix P) for a full report on that study component). The monitoring locations, TPA1, TPA3, GW1 and GW2, are shown in Figure 3-14. The assessment occurred during the summer months, capturing flood and heavy rainfall events in the Townsville region.

3.7.2.1 Geology

The bore logs from the baseline assessment (refer to Appendix P) suggest that shallow deposits immediately west of Lot 773 are characterised by layers of sand, silty sand and sandy silty clay of variable thickness and lateral extent, underlain by silty clay. The sandy deposits were encountered to between 3.8 and 5.8 m depth below ground surface and contained some shell material.

The deposits encountered appear to be of a similar composition to those investigated within Lot 773 (i.e. predominantly sandy deposits underlain by silty clay at depth) and similar to material encountered in TPA9.

3.7.2.2 Groundwater Levels

Groundwater levels in GW1, GW2 and TPA3 ranged between around 0.9 and 2.5 m AHD during the period of monitoring and peaked in early February within one day of a significant rainfall event (241.6 mm on February 3, 2009). Groundwater levels at TPA1 were recorded up to 2.6 m AHD, around 1.5 m higher than GW1, GW2 and TPA3 and suggest the presence of a recharge mound in the vicinity of TPA1. This may be associated with recent placement of materials up gradient of TPA1 in the Eastern Reclamation Area however historic data are not available to confirm this. The difference in water level could also be explained if TPA1 monitors a different water bearing horizon to GW1, GW2 and TPA3, however bore construction details are not available for TPA1 or TPA3.

Shallow groundwater levels immediately west and north of Lot 773 are influenced by tidal fluctuations (for example GW1, 8 January to 11 January), which appear to be dependent on tidal range and location, and influenced by significant rainfall events (for example 13 January). Of the monitored bores, the response of groundwater levels to tidal fluctuations is greatest in TPA3 with up to 0.6 m on February 7, 8 and 9, which is 15 - 20% of the tidal range (2.9 to

3.9 m). For the same period, groundwater level fluctuations in GW1 were only up to 0.25 m, or 5 to 7% of the tidal range. Changes in groundwater levels due to tidal fluctuations can be much less than changes in groundwater levels as a result of rainfall recharge.

Interpretation of groundwater levels for 18 December 2008 suggests groundwater flow is predominantly from west to east, towards Lot 773 and Cleveland Bay, with a very shallow hydraulic gradient (around 6.7 $x10^{-4}$). Groundwater flow direction within the Eastern Reclamation Area is not well defined due to the limited number of viable monitoring bores identified in this area (TPA1 and TPA3). The predominant flow direction within this area is likely to be east to south east and north east towards the ocean, however along the southern boundary of the reclamation area groundwater is likely to drain towards Lot 773. Groundwater flow is also likely to be controlled locally by internal bund walls within the Eastern Reclamation Area.

3.7.2.3 Permeability Testing Results

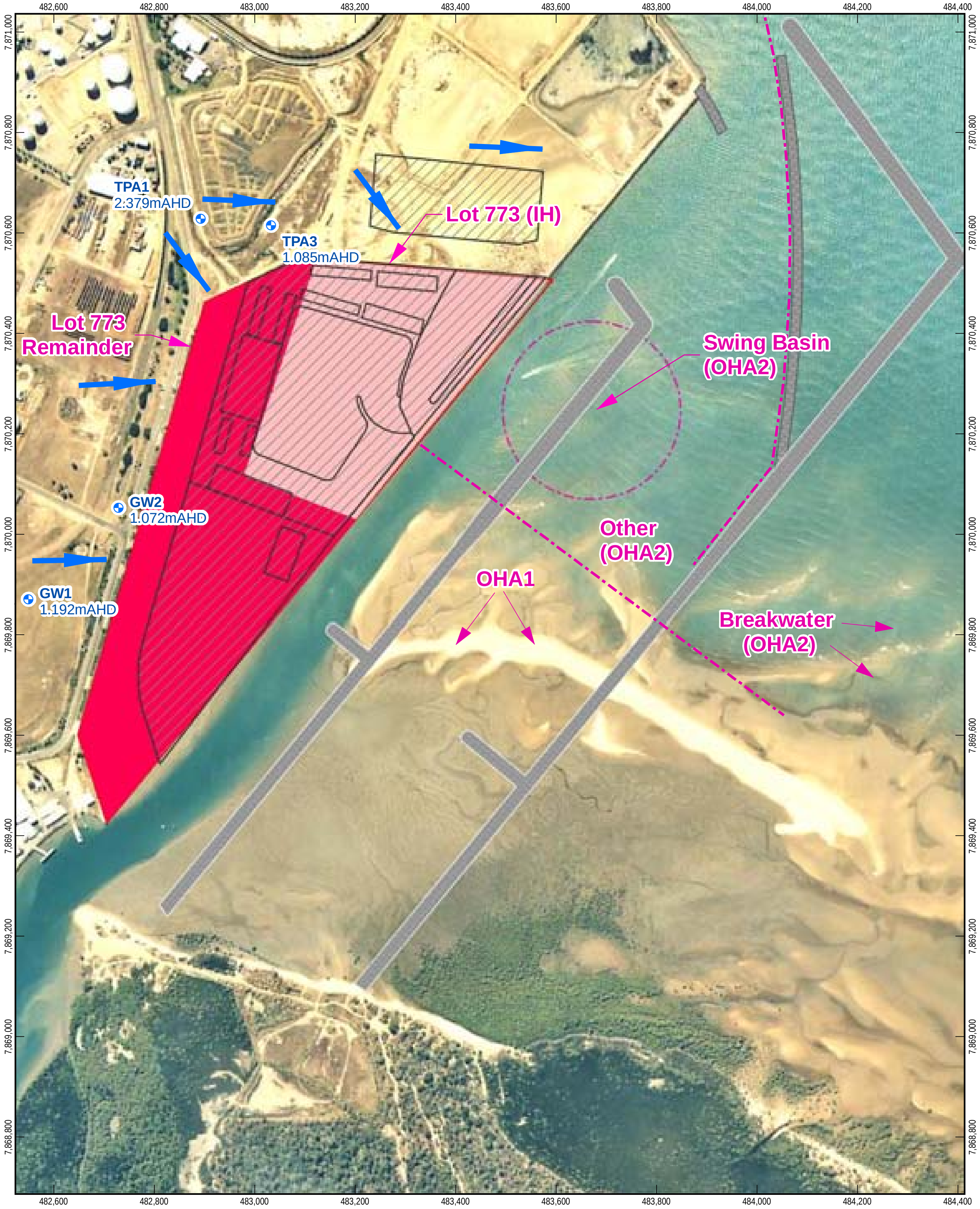
Analysis of the slug test data was carried out using the Bouwer-Rice and Hvorslev analytical solutions, supported by AQTESOLV software (developed by HydroSOLV Incorporated). Hydraulic conductivity values calculated for the screened interval of the monitoring bores are summarised in Table 3-29.

Calculated hydraulic conductivity values range between 13 and 25 m/day. This falls within the range for fine sand (0.02 to 17 m/d) and medium sand (0.08 to 43 m/d) reported in Domenico and Schwartz (1990).

Table 3-29 Permeability Test Results

Bore ID	K[2] (Bouwer-Rice Analytical Solution)	K (Hvolslev Analytical Solution)
GW1 test 1	18 m/d	24 m/d
GW1 test 2	25 m/d	25 m/d
GW2 test 1	13 m/d	13 m/d
GW2 test 2	13 m/d	13 m/d

[2] K – hydraulic conductivity



LEGEND

- Groundwater Bores (with GW elevation)
- Estimated Groundwater Flow Direction
- Proposed Marine Precinct
- Min and Max Options
- Breakwater Option C (Preferred)
- Lot 773 Inner Harbour (IH) and Trawler Basin
- Lot 773 Remainder
- Reporting Areas:
  - OHA1-Outer Harbour Area 1
  - OHA2-Outer Harbour Area 2

1:10,000 (at A4)

0 50 100 150 200 250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number 42-15399
Revision A
Date 01 July 2009

Baseline Groundwater Monitoring Locations

Figure 3-14

G:\42\15399\GIS\Projects\EIS\42-15399_410_rev_a.mxd

Level 4 201 Charlotte Street Brisbane QLD 4000 Australia T +61 7 3316 4496 F +61 7 3316 333 E bnemail@ghd.com.au W www.ghd.com.au

Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management); GW Monitoring Dec 2008 - GHD. Created by: TH

3.7.2.4 Groundwater Quality

Field Observations

During development of GW1 and GW2, GW1 was observed to give off a strong ‘mangrove mud’ odour and GW2 a slight ‘rotten egg’ odour which suggests the presence of hydrogen sulfide in groundwater, one of the by-products of the oxidation of pyrite. Given the environment and ASS mapping for the area this tends to confirm the presence of acid sulfate soils in the vicinity of GW1 and GW2. No similar odours were noted whilst sampling TPA1 or TPA3.

- The recorded field pH is typically neutral to slightly acidic and ranges from 6.03 to 7.71 (GW2), which is below the Queensland Water Quality Guidelines (QWQG 2006) for enclosed coastal water of 8 to 8.4 pH units, in all bores;
- Field electrical conductivity (EC) ranged from 3,850 (GW1) to 58,600 (TPA1) and is comparable to the laboratory analysis of EC. Groundwater at GW1 recorded the lowest values of electrical conductivity (EC), which is in line with its location furthest from the coastline; and
- Dissolved oxygen levels were below the QWQG guideline value for enclosed coastal water of 90-100% saturation at all locations monitored, ranging from 8.3 (GW1) to 65.7% (GW2) saturation.

Laboratory Analysis Results

The following analytes were not detected above laboratory reporting limits:

- Volatile Organic Compounds (VOCs);
- Semi Volatile Organic Compounds (SVOCs);
- BTEX (benzene, toluene, ethyl-benzene, xylene);
- PAHs and phenols; and
- Pesticides.

Major Ions

The cation/anion balance for the major ions was within +/-5% and confirms the accuracy of the major ion analysis. The major ion chemistry characterises the groundwater as sodium-chloride type at GW2, TPA1 and TPA3 and sodium-chloride-bicarbonate type at GW1. This suggests GW1 receives significantly more freshwater than the other three monitoring locations, which is consistent with the EC and TDS values recorded for this location.

Nutrients

- Nutrients (ammonia, nitrite, nitrate and phosphorus) were detected (i.e. above the laboratory limit of reporting) in all monitoring bores, except for nitrite which was not detected in TPA1 or TPA3;
- Concentrations of ammonia range from 0.28 to 5.61 mg/L (both reported for GW2) and exceed the QWQG of 0.008 mg/L at all locations. Concentrations also exceed the ANZECC/ARMCANZ (2000) guideline value for marine ecosystems (95%) of 0.91 mg/L

ammonia in all monitored bores on all occasions except for GW1 and GW2 in the January sampling round (0.68 and 0.28 mg/L respectively);

- Total oxidised nitrogen ranges from 0.02 to 30.9 mg/L and results show that nitrate is the predominant component. Concentrations of total oxidised nitrogen are above the QWQG of 0.003 mg/L; and
- Total phosphorus concentrations range from 0.46 (GW2) to 2.97 Mg/L (TPA1) and exceeded the QWQG for enclosed coastal water of 0.02 mg/L in all bores.

Dissolved Metals

- Dissolved metals concentrations, with the exception of manganese, are typically more elevated in TPA1 than in GW1, GW2 and TPA3;
- Concentrations of dissolved copper (all bores on one or more occasions) and zinc (TPA1 and TPA3 (on one occasion) exceed or equal the ANZECC/ARMCANZ (2000) marine ecosystem guidelines (95%) of 0.0013 mg/L for copper and 0.015 mg/L for zinc;
- Dissolved cadmium concentrations exceed the ANZECC/ARMCANZ (2000) marine ecosystem guideline (99%) of 0.0007 mg/L in TPA1 only, with a measured concentration of 0.0014 mg/L;
- Dissolved aluminium was detected just above the laboratory limit of reporting (0.01 mg/L) in GW1 (up to 0.02 mg/L) and significantly above in TPA1 (0.3 mg/L);
- Dissolved iron concentrations were detected above the laboratory limit of reporting (0.05 mg/L) in GW1, GW2 and TPA3 and ranged from 0.16 to 1.33 mg/L (GW1), however dissolved iron was not recorded above the limit of reporting in TPA1;
- Manganese concentrations range from 0.024 (GW2) to 2.63 mg/L (TPA3); and
- Concentrations of arsenic were detected above the laboratory reporting limit of 0.001 mg/L and range between 0.002 mg/L (GW2) and 0.025 mg/L (TPA3).

Total Petroleum Hydrocarbons

Concentrations of total Petroleum Hydrocarbon (TPH) were detected at all monitoring locations except for TPA1 and ranged from 0.135 to 0.320 mg/L. However, concentrations were typically only just above the laboratory limit of reporting for individual TPH carbon chain fractions (i.e. C10 to C14) and were consistent with the results for BTEX, i.e. no detectable concentrations of the light fraction of TPH (C6 to C9).

TPH was detected in TPA3 as well as GW1 and GW2, which suggests that the presence of TPH is unlikely to be from drilling and bore installation.

3.7.2.5 Preliminary Conceptual Understanding

The following conceptual understanding is based on historic information and data collected as part of this baseline study:

- Infiltration of rainfall to the shallow watertable, through an unsaturated zone approximately 1.0 to 2.5 m thick in existing material, consisting predominantly sandy materials west and north (Eastern Reclamation Area) of Lot 773;

- Potential for dissolution of minerals out of the sediments as rainwater infiltrates the unsaturated zone and as groundwater levels fluctuate as a result of tidal fluctuations. If the material within the unsaturated zone includes ASS material then there is also the potential for the generation of acid as water infiltrates the unsaturated zone and the mobilising of ASS reaction products (heavy metals, acid nutrients) into the shallow groundwater;
- Mixing and dilution of infiltrated water with shallow groundwater at the water table;
- Groundwater flow down hydraulic gradient along more permeable pathways, i.e. layers with sandy material, through pore spaces towards Lot 773 from the west and from the Eastern Reclamation Area to the north;
- Material placed within Lot 773 will develop a shallow water table connected to the existing water table in adjacent materials. The degree of connectivity will depend on construction materials used. Groundwater flow through material placed in Lot 773 is likely to be towards the east or south east towards Cleveland Bay. The rate of groundwater flow from the Eastern Reclamation Area into Lot 773 is likely to be reduced once a water table in Lot 773 is fully established;
- Groundwater within the reclaimed parts of Lot 773 will receive a proportion of freshwater from infiltration of rainfall (where the ground surface is permeable) but the greater proportion of groundwater will migrate onto the site from the existing land adjacent to Lot 773 and from the sea, hence the groundwater might typically range from brackish to saline beneath the site;
- Reduction of tidal influence on the existing materials of the Eastern Reclamation Area that border Lot 773; and
- Shallow groundwater levels in existing material adjacent to Lot 773 (to the west and north) may temporarily increase during placement of material within Lot 773 but are likely to return to within normal ranges once groundwater stabilises and a water table develops within the fill placed in Lot 773. Duration and approach to reclamation works will likely influence this. If significant surcharge of reclaimed material is required additional investigations should examine the potential effects on adjacent ground water quality and flows.

3.7.3 Potential Impacts

The following potential impacts of the development of Lot 773 on groundwater have been identified based on the information presented in this report.

Stage 1 of the Development

- Construction of the Trawler Basin is unlikely to have a significant impact on groundwater levels or on the quality of water bearing horizons within the adjacent existing land (the Eastern Reclamation Area) given that the point of contact of the moorings with the existing land will be relatively small;
- The quality of the water bearing horizon within any reclaimed land as part of the Stage 1 development is not likely to impacted from up gradient sources of groundwater given the limited contact with the adjacent land; and

- Depending on the composition of the fill material(s) used to construct Stage 1 there may be potential for degradation in the quality of groundwater within the fill material as a result of dissolution of minerals, including metals, and leaching of salts from the fill into groundwater. This could occur if the pH of groundwater within the fill material were to become acidic from infiltration of water through oxidised sulfidic materials.

Stages 2 and 3 of the Development

- Potential for a temporary increase in shallow groundwater levels within the existing material adjacent to Lot 773, during placement of fill material within Lot 773. Under extreme circumstances (heavy rainfall combined with a King tide and rapid placement of fill in Lot 773) groundwater levels could potentially rise to ground surface. Given the predominantly sandy nature of the shallow water bearing strata and that the aquifer is unconfined, however, groundwater level increases from loading, although possible, are likely to be insignificant in comparison to increases as a result of rainfall and tidal fluctuations. If significant surcharge is required of reclaimed material detailed investigations of potential impacts should address this potential;
- Potential for degradation in the quality of groundwater within the fill material of Lot 773 as a result of dissolution of minerals, including metals, and leaching of salts from the fill into groundwater however, will depend on the composition of the fill material(s) used to reclaim Lot 773. This could occur if the pH of groundwater established within the fill material were to become acidic from infiltration of water through oxidised sulfidic materials;
- Potential for degradation in the quality of the groundwater that will establish within fill placed in Lot 773 as a result of the migration of existing groundwater onto Lot 773 from up gradient sources containing components including dissolved metals, TPH and nutrients;
- Potential for degradation of the quality of surface water in Cleveland Bay as a result of the discharge of groundwater from within Lot 773 to the ocean;
- Potential for brackish/saline groundwater beneath the site to negatively impact the integrity of foundations and infrastructure within Lot 773, such as through corrosion, if they come into contact with groundwater or the capillary fringe; and
- If acid leachate is generated from ASS materials in the unsaturated zone and/or if foundation materials come into contact with acidic groundwater, for example as a result of acid leachate entering groundwater, then there is potential for a negative impact on foundations and infrastructure above (i.e. in the unsaturated zone) and/or below the water table.

3.7.4 Mitigation Measures

The following is applicable to any groundwater monitoring carried out for the site:

- A suitably qualified and experienced professional will carry out the monitoring in accordance with the AS/NZS 5667.11:1998 Australian/New Zealand Standard for water quality – sampling Part 11; Guidance on sampling of groundwaters;
- Standing water levels are to be recorded prior to purging of all monitoring bores;
- A NATA registered Laboratory is to be used for all analysis; and

- Laboratory Quality Control and Quality Assurance plans and protocols are to be supplied for all samples submitted for QA purposes and field replicate samples and blanks will be collected at a rate of 1 in 10 samples or part thereof.

The following baseline groundwater monitoring is recommended to be carried out for the site:

- Continuation of groundwater level monitoring on a monthly basis for GW1, GW2, TPA1 and TPA3 to obtain a minimum 12 months of data;
- Continuation of groundwater quality monitoring on a quarterly basis of GW1, GW2, TPA1 and TPA3 to obtain a minimum 12 months of data (see Table 3-30); and
- Review of the action criteria proposed for monitoring during construction and after development once 12 months of baseline data have been obtained to determine whether the recommended action criteria and sampling frequencies for the construction and operational phases of development are still appropriate. Update the EMP if necessary.

Monitoring During Development/Construction

Implementation of Stage 1 of the development (Trawler Basin) is not considered to significantly impact existing groundwater levels or groundwater quality and therefore routine monitoring should be conducted during the construction period.

Stages 2 and 3

- Groundwater quality monitoring on a monthly basis (see Table 3-30) in all monitoring bores during construction of Lot 773; and
- Comparison of groundwater level and water quality data against action criteria after every monitoring round and follow up with action if required.

Routine and Post Development/Construction Monitoring

- Establishment of a groundwater monitoring bore network within Lot 773 to monitor the potential impacts on groundwater quality within Lot 773 and potential risk to the receiving environment (Cleveland Bay);
- Quarterly recording of static groundwater levels (see Table 3-30) in all monitoring bores outside of Lot 773;
- Quarterly sampling for selected analytes (see Table 3-30) in all monitoring bores outside of Lot 773; and
- Comparison of groundwater level and water quality data against action criteria after each monitoring round.

Post development monitoring for should be carried out for a minimum of 12 months following completion of construction and the results reviewed by an experienced hydrogeologist to assess future monitoring requirements.

Table 3-30 Baseline groundwater quality sampling frequency and parameters

Parameter	Units	Sampling/ Monitoring Frequency (Baseline)	Sampling/ Monitoring Frequency (Construction/ Development[3])	Sampling/ Monitoring Frequency (Routine & Post Construction[4])
Field Parameters				
Static water level	m AHD	Monthly	Monthly	Quarterly
pH	pH units	Quarterly	Monthly	Quarterly
Temperature	°C	Quarterly	Monthly	Quarterly
Electrical Conductivity (EC)	µS/cm at 25°C	Quarterly	Monthly	Quarterly
Dissolved Oxygen	% saturation	Quarterly	Monthly	Quarterly
Redox potential	mV	Quarterly	Monthly	Quarterly
Laboratory Analysis				
Electrical Conductivity (EC)	µS/cm	Quarterly	Quarterly	Quarterly
Major Ions (Ca, Mg, Na, K, Cl, CO_3, HCO_3, SO_4)	mg/L	Quarterly	Quarterly	Quarterly
Nitrate and Nitrite as N	µg/L	Quarterly	Quarterly	Quarterly
Ammonia as N	µg/L	Quarterly	Quarterly	Quarterly
Nitrogen oxides (NO_3 + NO_2) as N	µg/L	Quarterly	Quarterly	Quarterly
Total Phosphorus	µg/L	Quarterly	Quarterly	Quarterly
Dissolved metals (low level) – Al, As, Cr, Cd, Cu, Fe, Hg, Mn, Ni, Pd, Zn	µg/L	Quarterly	Quarterly	Quarterly
TPH (C6 to C36)	µg/L	Quarterly	Quarterly	Quarterly

Auditing

Auditing shall take place in accordance with the respective Environmental Management Plan (construction or operation) for the site.

[3] Stages 2 and 3

[4] Includes Stage 1

Proposed action criteria (outside of which action should be taken) are identified in Tables 7-1 and 7-2 in Appendix P. Recommended corrective actions are identified in Table 3-31 and reporting actions are identified in Figure 3-32 below.

Table 3-31 Corrective Actions for Potential Impacts Identified

Impact	Response/Action	Corrective Action
During Construction Stages		
Increase in shallow groundwater levels within existing materials adjacent to Lot 773	Review data (levels, rainfall and tides) for increasing trends and compare levels to ground surface to establish cause of increase	Cessation of placement of fill if cause of increase is not considered to be rainfall or tidally related. Continue placement of fill only once levels return to background
Post Construction Stages		
Degradation in the quality of groundwater within the fill material placed within Lot 773 as result of in-situ processes	Increase frequency of sampling of selected water quality parameters within Lot 773 to monthly (including pH, EC and dissolved metals). Conduct a review of site data to determine the cause of degradation and asses the environmental risks to the site	Prepare and implement a remediation program to address the identified risks
Degradation in the quality of the groundwater within fill placed in Lot 773 as a result of on-site migration	Increase frequency of sampling of selected water quality parameters (on-site and off-site) to monthly (including pH, EC and dissolved metals). Identify the reasons(s) for degradation and asses the environmental risks to the site	Implement a strategy to minimise the migration of poor quality groundwater onto the site
Degradation of the quality of surface water in Cleveland Bay as a result of the development from spills/leaks on Lot 773	Documentation of the incident	Application of the correct management options adopted dependent on the level or environmental risk

Table 3-32 Reporting Summary

Report	Content	Timing
Monthly report	The report shall detail the monitoring carried out, any non-compliance events over the monitoring period and general groundwater quality. The report will also detail the action taken to rectify the non-compliance where action is required.	Each construction stage.
Non-compliance report	A brief report will be prepared documenting the non-compliance and any corrective actions.	Where a non-compliance events occurs.
End of construction report	A report summarising groundwater characteristics and trends during each construction Stage.	End of each construction stage.
Annual report	The report will summarise the results of the preceding period including groundwater quality and trends, groundwater levels, current monitoring network and any recommendations for the following 12-month period. This may include recommendation of no further monitoring.	End of the financial year/each 12-month period following completion of construction.
Site specific trigger levels report	The report will review the interim trigger levels and set site-specific trigger levels based on 18 sampling periods over at least a 12-month period.	At the completion of 18 sampling periods

3.8 Coastal environment

3.8.1 Existing wave environment

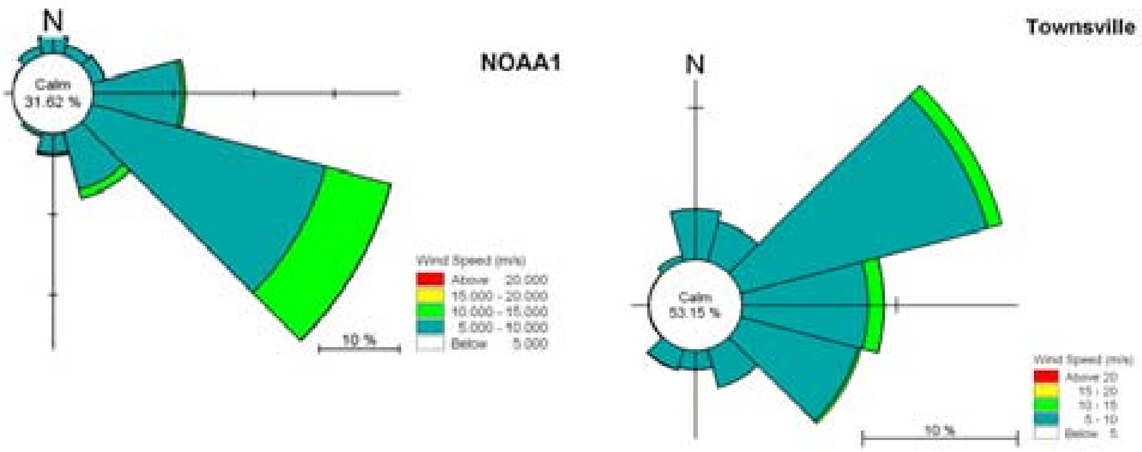
The proposed marina precinct is located at the mouth of the Ross River, on the eastern side of the existing Port of Townsville (refer Figure 2-1). Magnetic Island, situated directly north of the site provides protection from northerly waves. The dominant wind direction is from the trade winds from the south-east to east, however due to Cape Cleveland, waves generated offshore by the easterly wind diffract around Cape Cleveland and become north-east as they propagate into Cleveland Bay.

Offshore waves from other directions can reach the site at reduced heights through refraction around Cape Cleveland and Magnetic Island. The result is that waves reaching the Precinct area and proposed breakwater footprint have a predominately north-east direction.

The Townsville coastline is naturally protected from offshore wave conditions, such as long period ocean swell waves, by the Great Barrier Reef, which sits approximately 70 km from the shoreline. The wave climate in the area is therefore mostly governed by local winds, acting on the area between the reef and the coastline and within Cleveland Bay. As there is a large distance, or fetch, between the reef and the coastline, relatively large waves can still be generated during storms or cyclones.

Analysis of the available wind data for the region from Bureau of Meteorology (BoM) and National Oceanic and Atmospheric Administration (NOAA), extracted from the global WaveWatch III hindcast model, shows a predominant wind direction of north-east close to shore, with a more south-easterly component offshore, at the location of NOAA1, just inside the reef. The respective wave roses are illustrated in Figure 3-15 below.

Figure 3-15 Wave roses offshore and nearshore for Townsville Region



A spectral wave model has been employed to determine the likely 1 in 1 year and 1 in 100 year waves generated near the existing Port of Townsville. This is a wind driven wave model and is based on analysis of the available wave data. A detailed report of all wave modelling for this EIS is available in Appendix Q. The result of this modelling indicates that nearshore wave heights for 1 in 1 year and 1 in 100 year return period conditions are expected to be around 1.0m and 2.8m respectively. The wave heights offshore of Cleveland Bay in these conditions are respectively about 1.6 and 6.1m.

An analysis of different breakwater options was undertaken to determine the optimum breakwater configuration to provide protection to the proposed Precinct as well as allow for future expansion of the port. That assessment is described in detail in Section 1.4.2. Option C was selected from that process as the preferred breakwater configuration for consideration under the EIS studies.

Detailed wave modelling against Option C breakwater has been completed for investigation of performance of this structure under varying incident wave scenarios. A full description of those findings is provided as Appendix Q and effects of the breakwater on wave conditions is discussed below in Section 3.8.3.

3.8.2 Existing coastal processes and sedimentation

The coastal processes that operate in the vicinity of the proposed Precinct at the mouth of the Ross River have been investigated by examining sediment inputs and the processes that effect such including longshore sediment transport and historical sediment movement regime for the area. This has been done in conjunction with an assessment of the influence of waves on sediment movements. From this a description of the existing littoral transport regimes has been developed. The effect of the proposed development on those processes has been assessed and the likely operation issues for the marina precinct in terms of sediment movement have been identified.

The Precinct covers an area to be reclaimed and the proposed breakwater is positioned offshore from the mouth of the Ross River in Cleveland Bay, extending a short distance to the south-east. The sources of sediment that could affect this area of Cleveland Bay are Cleveland Bay itself, the Ross River, and the foreshore areas south-east of the site. Mechanisms for moving sediment are wave action, tidal currents, flood flow currents, wind driven currents, and longshore sediment transport. A detailed study of the coastal influences on sediment movements is provided in Appendix Q and is summarised following.

3.8.2.1 Wave climate

Existing wave climate of Cleveland Bay and the Precinct area is described above under 3.8.1. South-easterly waves under the influence of strong south-easterly trade winds will refract into the bay with a small proportion of the wave energy reaching the proposed site. Less frequent waves from the north-east and north will propagate through the gap between Cape Cleveland and Magnetic Island directly affecting the site.

3.8.2.2 Tidal currents

Tides in Cleveland Bay are mainly semi-diurnal with a spring tide range of around 2.4 metres and a maximum range of 4.0 metres. Ebb and flood tides generate substantial tidal currents especially during the higher range of spring tides (Pringle 1996). However, these are concentrated in the deeper areas of the Bay and have little influence on sediment movement along the shoreline south-east of the Ross River, apart from in the immediate vicinity of the river mouth where tidal currents are aligned with the river channel.

Tidal currents in the Ross River are moderate (refer Section 3.8.4.2) given the depth of the dredged entrance channel and the reduced tidal prism in the river, brought about by the construction of Aplin's weir, approximately 10 kilometres from the river mouth, in 1927.

3.8.2.3 Ross River

The Ross River was originally a primary source of sediments for Cleveland Bay. With the construction of the dam in 1973 and three weirs in the 1900's virtually all bed load transport of sediments to the coast has ceased. Currently 750km^2 of catchment land is located above the dam compared to approximately 45 km^2 located below. The weirs downstream of the dam in addition to altering the river hydraulics also retain sediments depending on their height above the river bed and are occasionally dredged. Sediment input from the catchment to Cleveland Bay is, therefore, unlikely to be reinstated while dredging of the accumulated sediments from behind the weirs continues. For the purposes of evaluating the effect of river flows on the sediment budget at the Precinct site, it can be concluded that the Ross River does not contribute any bed load sediment.

Fine sediment in the form of silts and muds will still be transported down the river as suspended load and a proportion of this could settle out in the Precinct with the majority being carried out into Cleveland Bay. The settlement pattern will depend on the flood flow velocities and the flood volume.

3.8.2.4 Wind driven currents

According to Pringle (1996) sediment on the coast and bed of Cleveland Bay is primarily siliceous and is supplied mainly from terrigenous sources by rivers and creeks, with some of the sediment originating from major floods in the Burdekin River. Wind records show that the prevailing winds are from the south-east which induces surface water currents capable of carrying suspended sediment alongshore. One of the outcomes of this phenomenon is a major current flowing southward along the west, leeward coast of Cape Cleveland, reinforced by the tidal flood current. This current induces sub-tidal bed load movement of sediment by ripple migration, which supplies sediment to the south Cleveland Bay intertidal flats. Further movement of sediment to the west towards the mouth of the Ross River is surmised to be through wave-induced longshore drift.

However, there is no net longshore movement from the bottom of the bay towards the Ross River, so the southern part of the bay is a sediment sink for sediments moving into the bay down the Cape Cleveland coastline.

3.8.2.5 Historical sediment transport regime

Coastal aerial photography has been assessed to determine the historical movement of the coastline and any notable features. The photography obtained was captured on the following dates:

- 14 June 1974;
- 28 November 1978;
- 14 July 1981;
- 14 July 1985;
- 10 September 1991;
- 7 August 1993;
- 17 November 1997; and
- 25 May 2003.

All photography was at a nominal scale of 1:12,000 and was captured within 2 hours of low water. The extent of the coverage was from the Ross River to Sandfly Creek (approximately 3.5 kilometres to the south-east). The photography was rectified and a number of features were mapped for each date. The features mapped are:

- Coastline – defined by the seaward limit of coastal vegetation;
- Beach – defined by the extent of exposed sand along the coastline;
- Exposed Sandbar – defined by areas of exposed sand above water level away from the coastline;
- Submerged Sandbar – defined by areas of sand below water level; and
- Mangroves – defined by the aerial extent of mangroves.

Observations

Coastal migration

There are a number of areas where the coastline has migrated landward by up to 100 metres. However, for all but the area closest to the mouth of the Ross River, the apparent landward movement has been replaced by a growth of the mangrove fringe.

Adjacent to the mouth of the river, there has been a general landward recession of the beach between 150m to 700m from the river mouth, with a maximum recession of 60 metres around 300m from the river mouth. In this area there are two distinct discontinuities in the coastline that appear to be “hard points” against which sand has accumulated. This indicates that there is some longshore transport along this section of beach.

The 100 metre section of coastline immediately adjacent to the river mouth prograded seaward between 1974 and 1978 and since then has shown little movement. It is concluded that the longshore transport movement along this section of beach must drop into the river channel to be distributed along the channel by tidal flows.

Beach migration

In general terms the beach width appears to have narrowed, possibly as a result of increasing vegetation cover. In one particular area at 900 metres from the river mouth, the beach has disappeared having been overtaken by an extensive area of mangroves.

Exposed sand bank

Photographic analysis (refer Appendix R) shows that the presence of the large exposed sand banks near the offshore end of the dredged channel is a relatively recent phenomenon. The first major sand bank appears in 1993, dissipated into a submerged sand bank in 1997, and returns much larger in 2003 and about 40 metres further landward. Since 2003 this sand bank has developed further, providing increased sheltering of the areas landward of it from wave action, thus encouraging the extensive growth of mangroves between the shoreline and the landward edge of the sand bank.

The shape of the sand bank in 2003 and its relative location to the 1993 sand bank indicates a net longshore movement along the seaward face of the sand bank.

Submerged sand bank

In the area adjacent to the offshore end of the dredged channel, the submerged sand banks have moved gradually closer to the channel and closer to the shore with the movement between 1991 and 1993 being predominantly onshore.

Further to the south-east at approximately 1000 metres from the river channel, the onshore movement is demonstrated clearly by a particular sand bank near the offshore limits. The particular sand bank first appeared in 1985 and by 1993 had moved 100 metres shoreward.

Generally the movement of the sand banks is onshore with some longshore movement close to the dredged channel of the Ross River. Away from the river, the lack of any significant longshore movement is demonstrated by the stable location of the channels of Stuart and Sandfly Creeks where they cross the tidal flats.

Mangroves

The main feature to note is the growth of the mangrove fringe between 1974 and 2003. In 1974 the mangroves occupied and area of coastline on either side of Stuart Creek. By 2003 the extent of mangroves had increased threefold with mangroves from about 500 metres from the river mouth to Sandfly Creek. By 2008, the mangrove areas southeast of the Ross River entrance have extended out to the landward edge of the offshore sand bank.

Assessment

Based on the assessment, detailed in Appendix R, the coastal processes in this area comprise:

- Onshore movement of sediment towards the coast under the action of waves and wind driven currents;
- The formation of submerged sand bars at the offshore limits of the tidal flats;
- Progradation of the sand bars across the intertidal flats;
- Establishment of mangroves along the coastal fringe as fine sediment gets pushed up to the shoreline, and
- Possible establishment of new beach line seaward of mangroves.

Adjacent to the dredged river channel movement of sand at the seaward edge of the exposed sand banks and also at the shore face is longshore. In addition the movement of the submerged sand banks in this area is both onshore and towards the dredged channel of Ross River. The dredged channel, therefore, is a sink for this sand movement and it is expected that the channel filling is concentrated adjacent to the outer sand banks and near the mouth of the river.

3.8.2.6 Longshore sediment transport

Wave modelling (described above and in Appendix Q) and data collated to support the breakwater options assessment have been used to support the assessment of the potential longshore sediment transport during normal conditions along the shoreline on the eastern side of the TMPP.

To determine an average nearshore wave climate, a long-term model simulation is required. Given the length of time required to run a wave model with an input data set of multiple years, a representative year was extracted from the NOAA wind time series based on wind speed exceedance distributions. Wind speed exceedance curves were plotted for each year and compared with the exceedance curve for the complete time series (Figure 3-16). 2005 was selected as the representative year, based on the high correlation with the complete 11 year time series.

The digital elevation model (DEM) for this long term simulation was constructed using bathymetric data extracted from C-Map (refer to Figure 3-17). The 2005 predicted Townsville tidal time series was also extracted from C-Map and used as the water level input for the model. As detailed above, the 2005 NOAA wind speed time series was applied over the model area.

Cape Cleveland, to the east of the site, is found to significantly shelter the Precinct area from all directions except north-east (Figure 3-18). Locations closer to the headland have a much higher occurrence of calm conditions (greater than 50% < 0.1m). Wave heights of less than 0.1m are considered to be calm conditions and are expected not to result in significant sediment transport. These conditions were excluded from longshore sediment transport calculations. Locations 1, 2, 3 and 5 depicted on Figure 3-18 were selected for the investigation of sediment transport.

Figure 3-16 NOAA Wind Exceedance Plot (Offshore Townsville

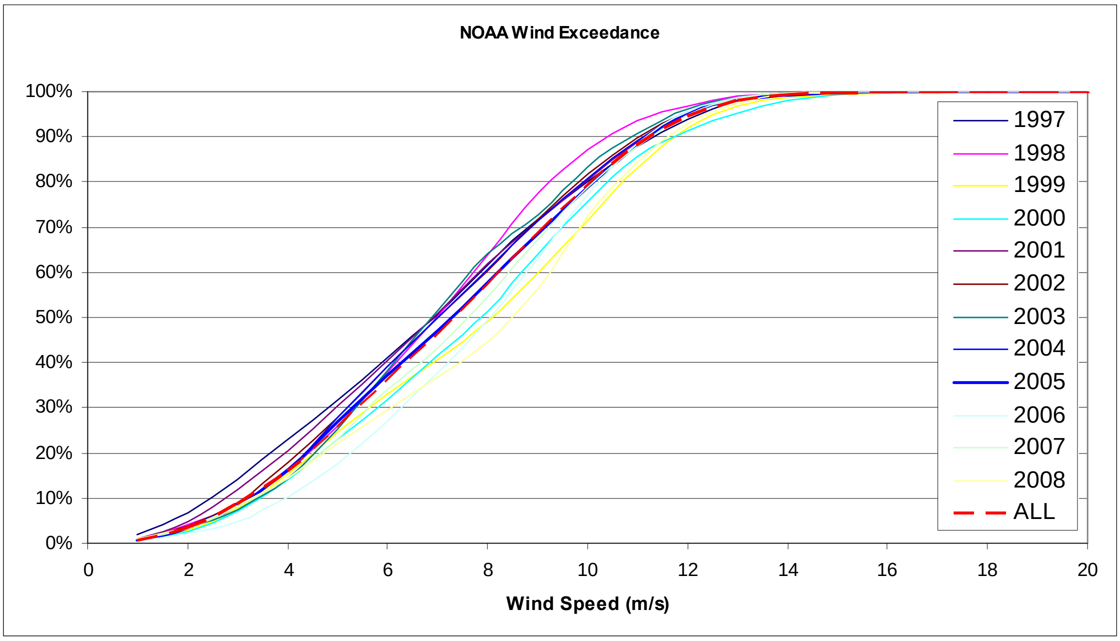


Figure 3-17 DEM of Townsville and the Surrounding Area

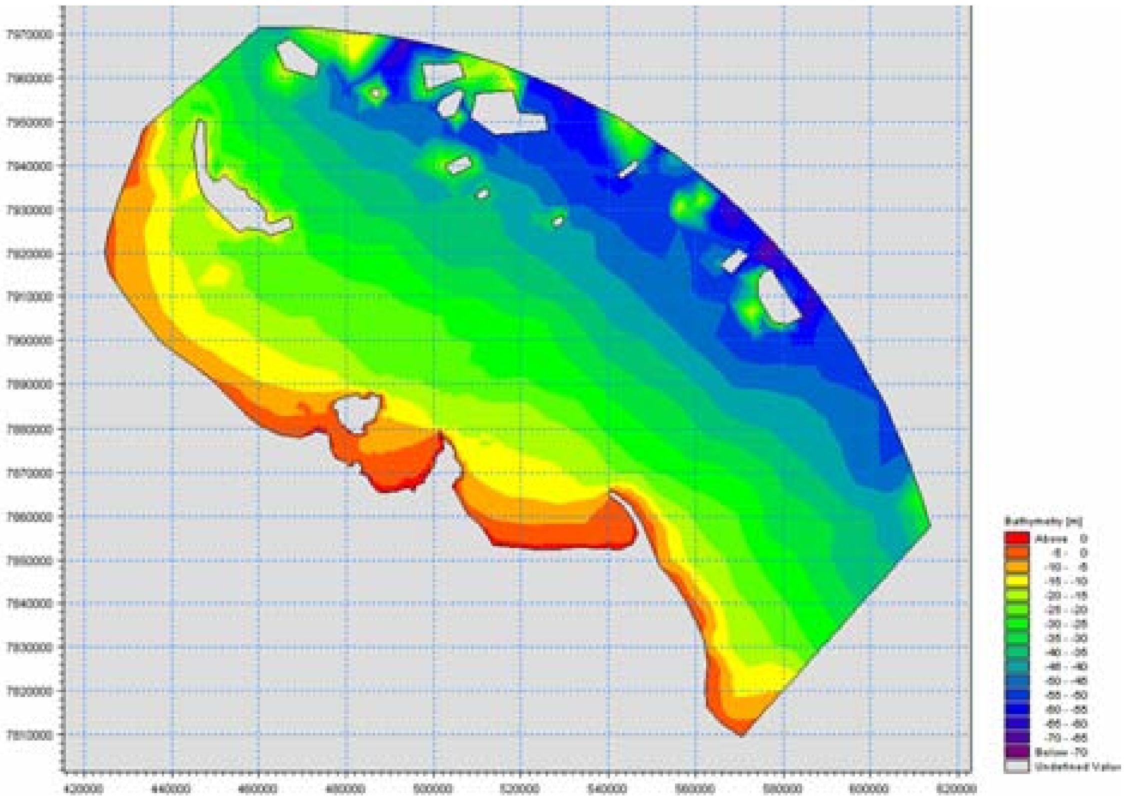
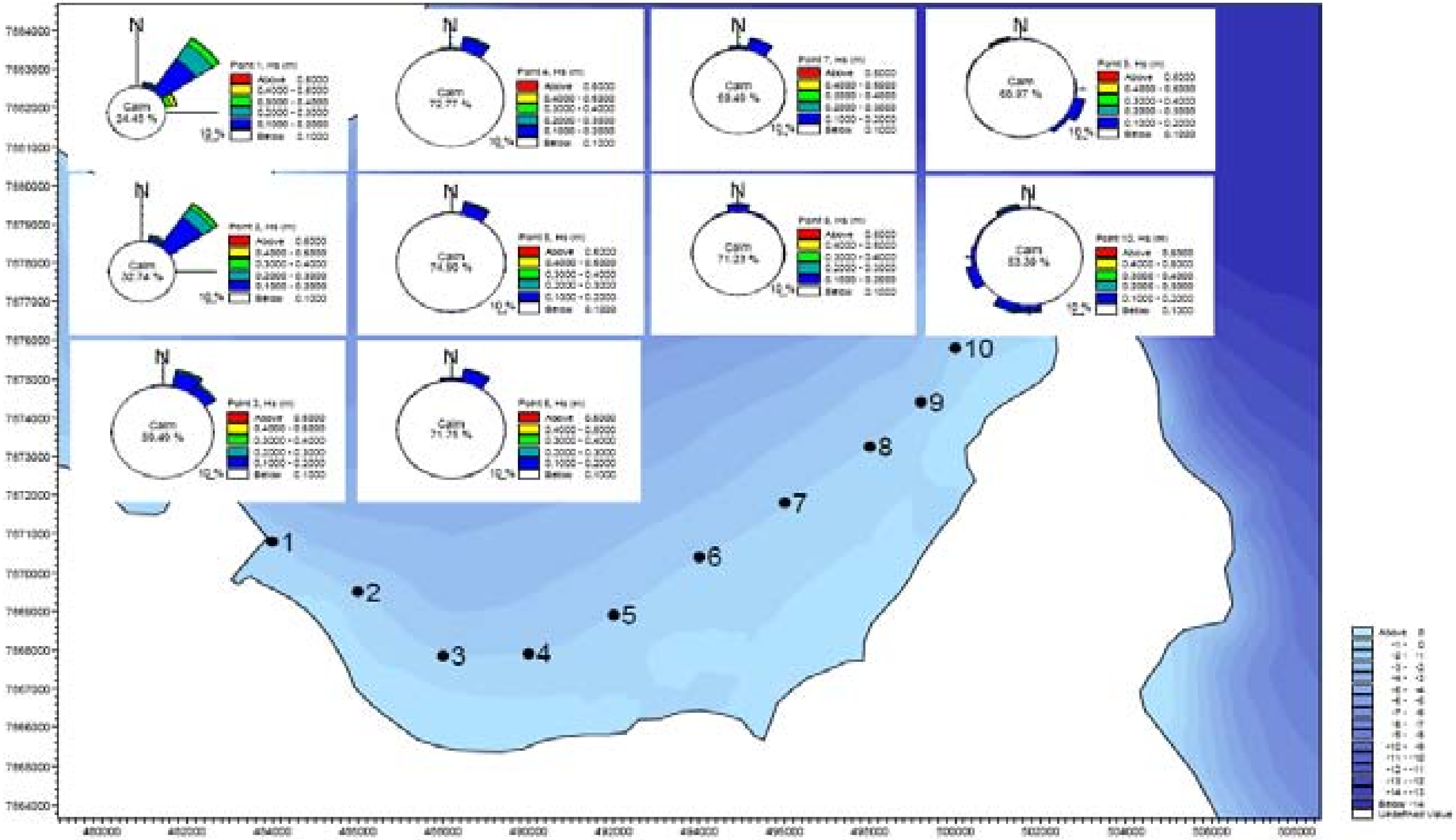


Figure 3-18 Wave Roses and Nearshore Reporting Locations



3.8.2.7 Potential Longshore Transport

Longshore sediment transport volumes of approximately 4000 m3/year were calculated at the more sheltered locations, however there is a potential for up to 25,000 m3/year closer to the Precinct (location 1, Figure 3-18), given the higher degree of exposure to the dominant wave direction. Refer to Figure 3-19 for the positive and negative sediment transport rates at the four locations.

Some of this transported material has contributed to the sand bank that has formed south east of the entrance channel, with the remainder falling into the entrance channel and being distributed along the channel by tidal currents and flood flows from the Ross River. Therefore under existing conditions there is potential for this longshore transport to result in silting of the channel and this is borne out by the maintenance dredging of the channel that is currently carried by the Port.

In addition, the negative transport rate at point 2 may transport a portion of any sediment plume from the Ross River under extreme runoff conditions, to the nearshore sandbar evident in aerial photography. Additionally, the positive rate at point 3, combined with the negative rate at point 2, may create a sediment transport null point, which will contribute to the stability of the sandbar at this location.

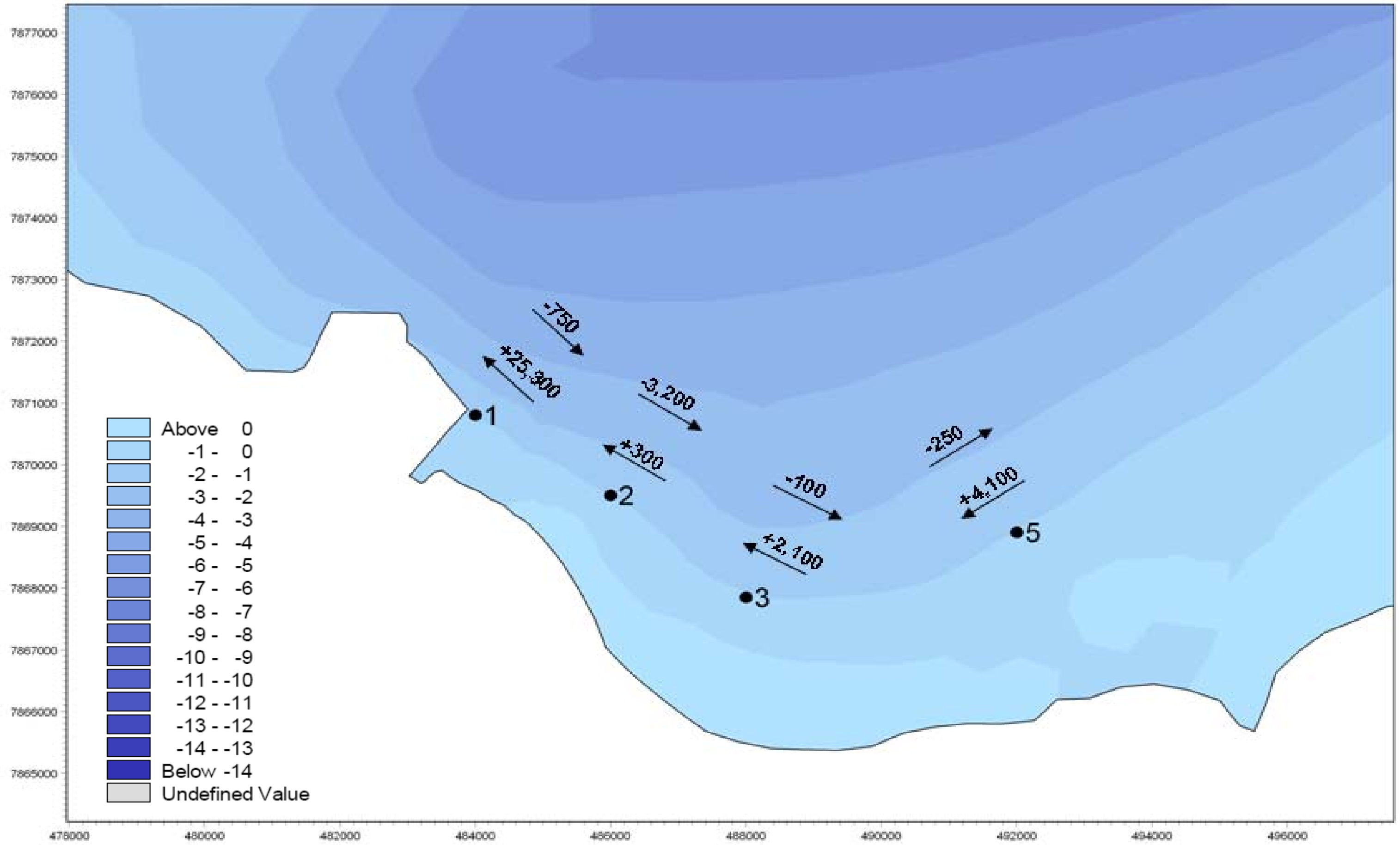
The above values apply to a grain size (D50) of 0.4mm; however final transport volumes are very sensitive to sediment size. The chosen grain size range results in a sediment transport range of 2,000 to 35,000 m^3/year over the area between the marina precinct and Cape Cleveland.

Of interest, in the context of the coastal processes described above, are the dredging records for the river channel, summarised in Appendix R. The average extraction rate from the river is 37,600m3/yr between 1971 and 2006. The maximum siltation rate from longshore transport at the river mouth and adjacent to the outer sand bar is 24,550 m3/yr (refer Figure 3-19). Given that there are other sources of siltation, this indicates that the longshore transport calculations are of the right order.

3.8.2.8 Conclusions

It is expected that longshore sediment transport rate in the vicinity of the south eastern extremity of the Option C breakwater is towards the Precinct (north westerly) and of the order of 15,000 m3/year taking into account the rate of change of transport potential towards point 1. A potential sediment transport null point is located between points 2 and 3 (refer Figure 3-18), resulting in the build up of the nearshore sand bank evident in aerial photography. The larger transport potential near the dredged entrance channel of the Ross River has resulted in the formation of the prominent sand bank abutting the dredged channel, and has contributed to silting of the channel.

Figure 3-19 Calculated sediment transport rates (m^3/yr) for median grain size of 0.4mm.



3.8.3 Effects of breakwaters on coastal processes

3.8.3.1 Wave environment

Figure 3-20 and Figure 3-21 below show the significant wave contours for the Precinct and port area with no breakwater and with Option C breakwater configuration.

Model results for the existing, no breakwater scenario, reveal that the average wave heights at the location in yearly conditions can be as high as 1.0m. This suggests that, for the no breakwater scenario, smaller vessels (<25m) will have difficulty in navigation and berthing will be also challenging, even for larger size recreational vessels, without protection from ambient wave conditions. The extreme events will also expose vessels to large waves of 1.5m or greater.

Option C provides a high level of protection to the Precinct and in the lee of the breakwater, as required for boat mooring, while allowing for future expansion of the port.

This improvement is further illustrated by analysis of the wave parameters, extracted adjacent to the reclaim area for the proposed marina precinct and reported in Table 3-33 for the two analysed return periods.

Table 3-33 Wave parameters comparison

Option	Return Period (yr)	Hs	Tp	MWD
No Breakwater	100	1.2 – 1.4	9.0	45
	1	0.6 – 0.8	6.0	40
Option C	100	0.4 – 0.6	9.0	40 – 50
	1	0.0 – 0.2	6.0	35 – 40

It should be noted that due to the model limitations with respect to diffraction and reflection, the wave conditions inside the breakwaters reported above should be considered indicative only and were used for comparison purposes. A more specific model with the ability to take into account diffraction and reflection interactions with structures was employed to further evaluate the impact of the breakwater on the Precinct and to ensure that the Precinct would comply with AS3962, the Australian Standard for the Design of Marinas. Based on the standard, a limiting wave height of 0.3m in 1 in 1 year would be considered acceptable and 0.25 m excellent.

The model results evaluating tranquillity behind the main breakwater and inside the proposed harbour basin are presented below in Figure 3-22, for 1 in 1 year and 1 in 100 year return period cases.

Figure 3-20 No breakwater significant wave height contours. 1 in 1 year return period (left) and 1 in 100 year return period (right)

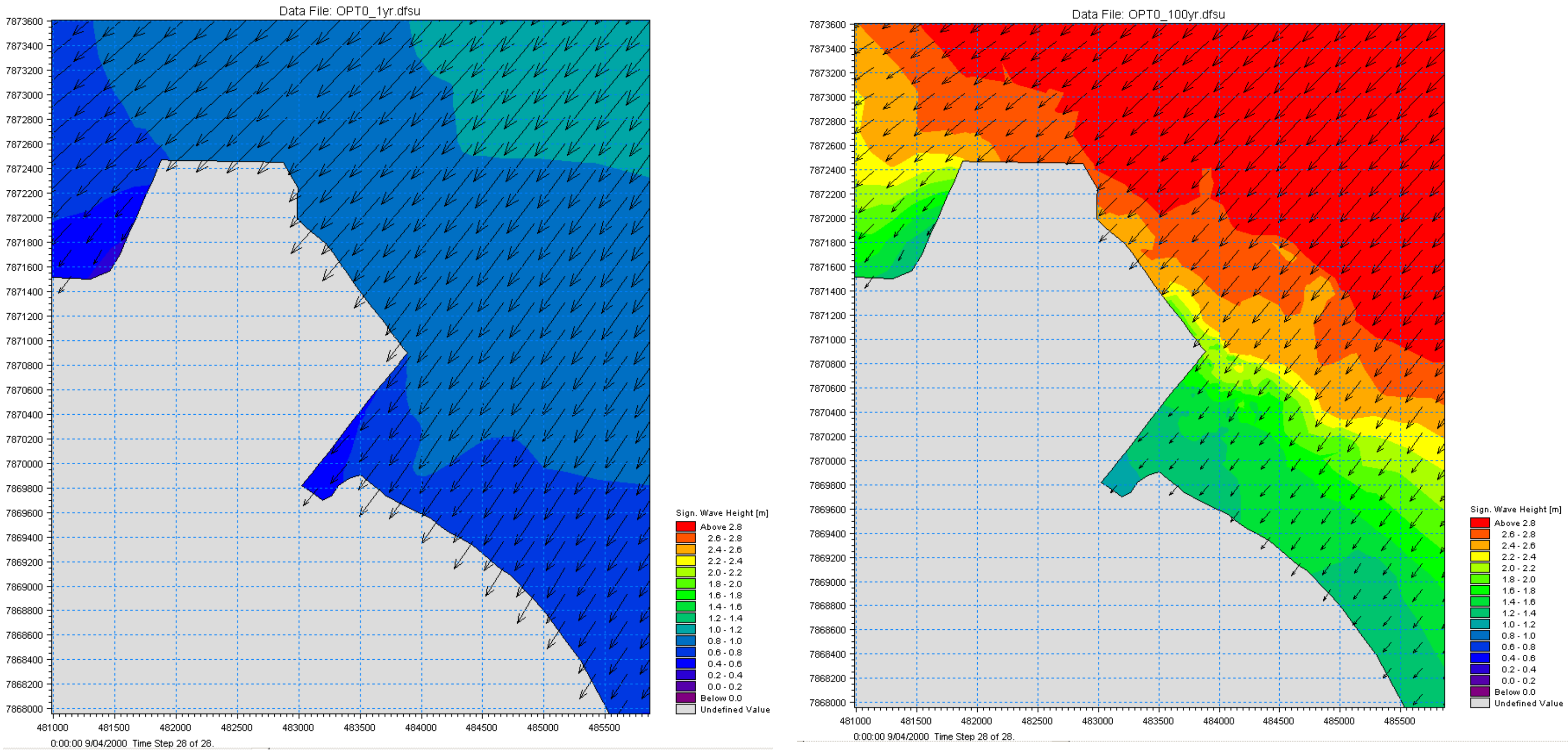


Figure 3-21 Option C breakwater configuration significant wave height contours. 1 in 1 year return period (left) and 1 in 100 year return period (right).

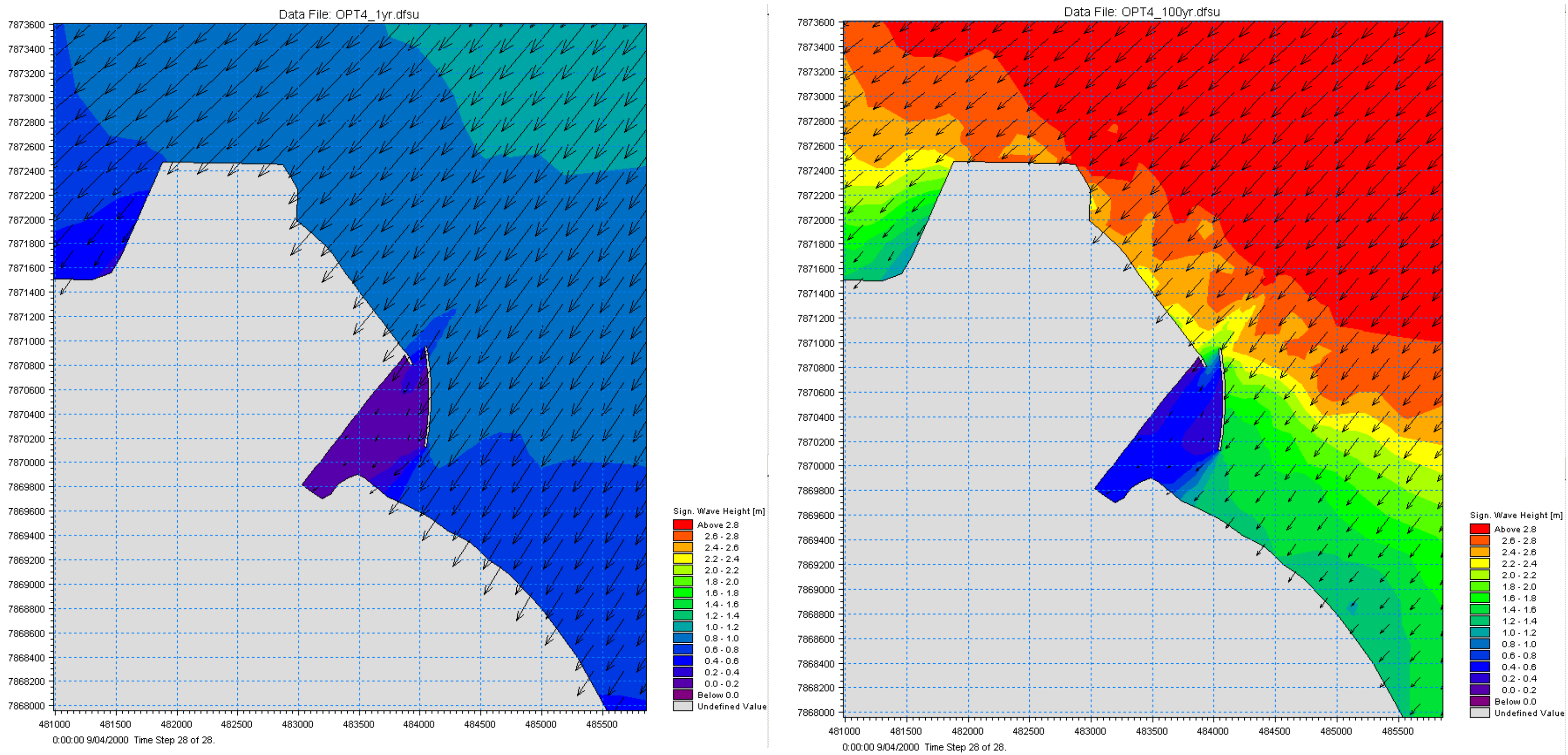
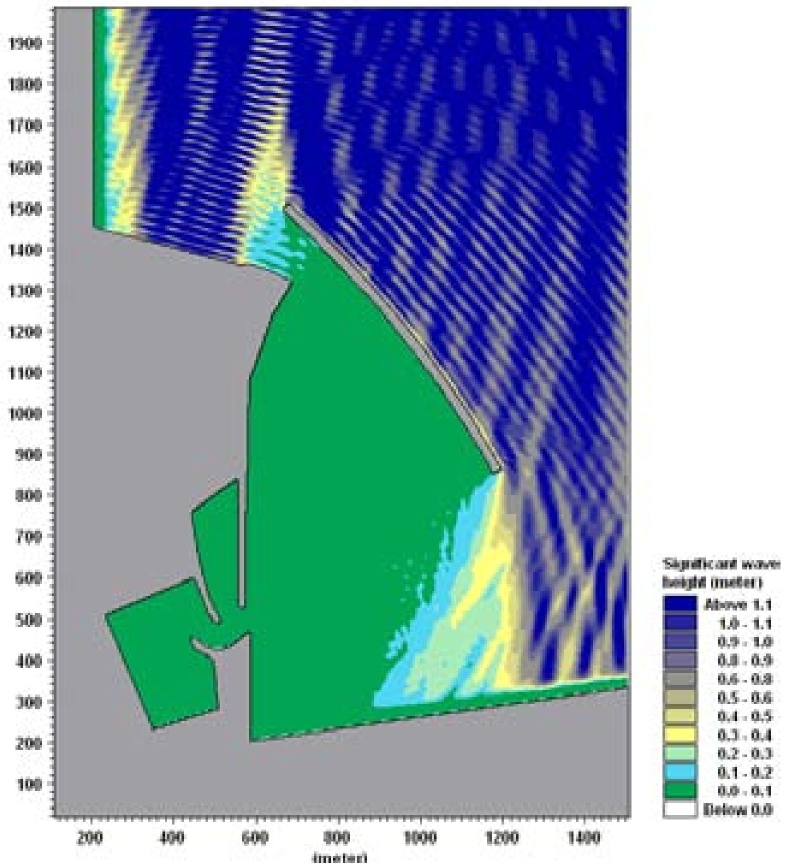
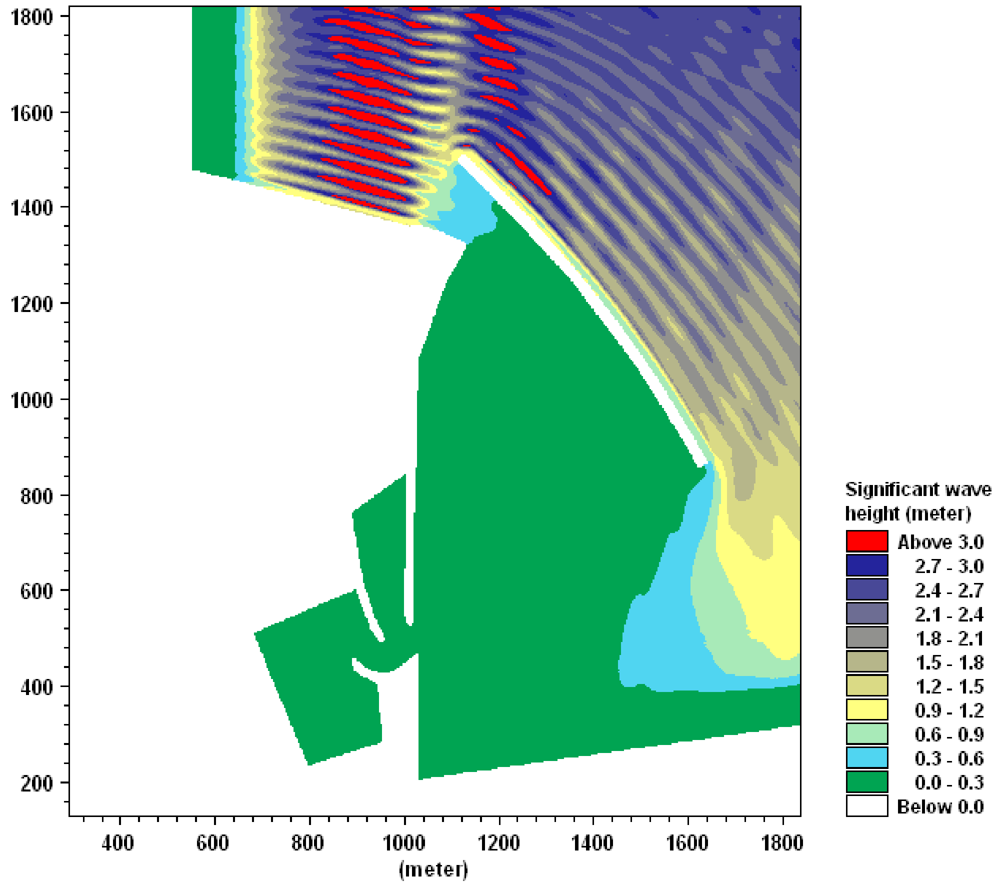


Figure 3-22 Option C significant wave height contour plots - refined model. 40°, Uni-directional, Monochromatic. 1 in 1 year (left) and 1 in 100 year (right).





The detailed modelling results reveal that in 1 in 1 year conditions, the significant wave height behind the breakwater and in the harbour is less than 0.2m in all cases. However, it can be seen that during 1 in 1 year events, reflection from the port structures at the entrance of the main breakwater increases the wave heights to as high as 1.5m. This may cause some navigation issues for smaller vessels coming through the channel into the harbour under storm conditions.

Evaluation of wave heights inside the harbour for 1 in 100 years has also revealed that the breakwater structure provides acceptable level of protection during storms. Wave heights inside the breakwater are generally very small, less than 0.3m. However, reflection from the breakwater has a similar effect to 1 in 1 year and can create large waves at the entrance, up to 3m in extreme events, potentially causing navigation difficulties.

The modelling results in general confirm that the layout of the breakwater is adequate to provide high level of protection against waves in all conditions to AS 3962 standards.

3.8.3.2 Longshore sediment transport - effects to the west

The Port development blocks any influence of coastal processes in the vicinity of the Precinct on the coastal areas north-west of the Port. The establishment of a Precinct will not influence this fact. The Port development (including the Port areas beyond the original coastline, breakwaters, other reclaimed areas, and the dredged entrance channel) effectively isolates the processes that occur south-east of the Port from the areas to the north-west.

There is no doubt that the Port and ancillary development have had a profound effect on the Strand beach immediately to the west. In a report to the Townsville City Council Mabin (1996) stated that since 1874 the Port has blocked the supply of sand to the beach from the Ross River mouth and the breakwaters that extend nearly 2km out into Cleveland Bay have shielded the beach from much of its normal wave energy.

However, there is another factor that needs to be considered in relation to the state of the coastline and that is the changes to the sand supply in this region. The Sinclair Knight Merz report (SKM 1996) highlighted that the loss of the sand supply to the coast is a more fundamental reason for the degradation of the coastline. The two principal causes of lost sand supply to the beaches to the west of the Ross River are changes to the river hydraulics (through the construction of weirs and dams affecting both the supply of sediments to the river and the flushing of these from the river) and sand mining of existing river resources.

Notwithstanding the reasons for the degradation of the coastline west of the Port area, the proposed Precinct will have no additional contributory effect on either of the causes of the degradation outlined above and hence will have no influence on the state of the beaches to the west in either the short or long term.

3.8.3.3 Longshore sediment transport - effects to the east

The Ross River and its current dredged channel form the boundary of longshore sediment movement from the beach and tidal flats to the south-east of the marina precinct. The sediment movement in this area is a mixture of onshore and alongshore at the outer margins of the tidal flat and predominantly along the beach towards the Ross River close to the river entrance. Further to the south-east away from the river, sediment movement is predominantly onshore.

Breakwaters proposed to be parallel to the existing dredged channel will affect sediment movement into the channel near the outer sand banks. Where the breakwater crosses the active littoral zone, it can be expected that there will be a slow build-up against the breakwater extending away to the south-east. The rate of build-up will be commensurate with the prevailing longshore transport rate. Similarly, a breakwater connected to the shore south-east of the river mouth will stop the small north-westerly flow of sand along the shore face in this area and lead to a slow build-up against the breakwater on the south-eastern side.

The breakwater proposed as Option C is located offshore from the currently prominent sand banks adjacent to the Ross River entrance channel and will directly affect sand transport that occurs in the shallow waters seaward of these banks. It will have an indirect effect on the longshore transport by “shadowing” the area closest to the Ross River channel effectively reducing the longshore transport to zero adjacent to the channel.

The principal beneficial effect of the breakwater in terms of coastal process is that they will provide some control over the longshore movement of sediment into the Precinct inner harbour and the existing dredged channel and reduce the maintenance dredging requirements in the short to medium term. In the long term, at the point where the longshore transport has effectively “filled” behind the breakwaters and the sediment paths have re-established around the breakwater structures and into the Precinct, increased maintenance dredging may be required.

An additional effect of breakwaters on the adjacent coastline is that generated by wave reflection and is dependent on the slope and nature of the seaward slope of the breakwater and the orientation of the breakwater to the coastline. For Option C, reflected waves could propagate parallel to the coastline to the south east and influence the longshore transport volume and direction in this area.

The coastal processes in the vicinity of the Precinct comprise both onshore/offshore and longshore components and are influenced by the proposed Option C breakwater structures in a number of ways. However, the processes are capable of moving sediment at only relatively slow rates due to the low wave climate and hence any changes will take time to develop and will be restricted to the local area. It is concluded that it is unlikely that there will be any significant affects on coastal processes from the Option C breakwater structures forming the Precinct on the coastal areas beyond around 500m south-east of the breakwater structures.

3.8.3.4 Longshore sediment transport changes resulting from Option C

The main breakwater in Option C extends from near the corner of the POTL eastern reclamation south east in a curve finishing offshore from the large prominent sand bank located at the seaward edge of the tidal flats. The likely changes to longshore sediment transport that may occur in the vicinity of the breakwater have been examined and are discussed below.

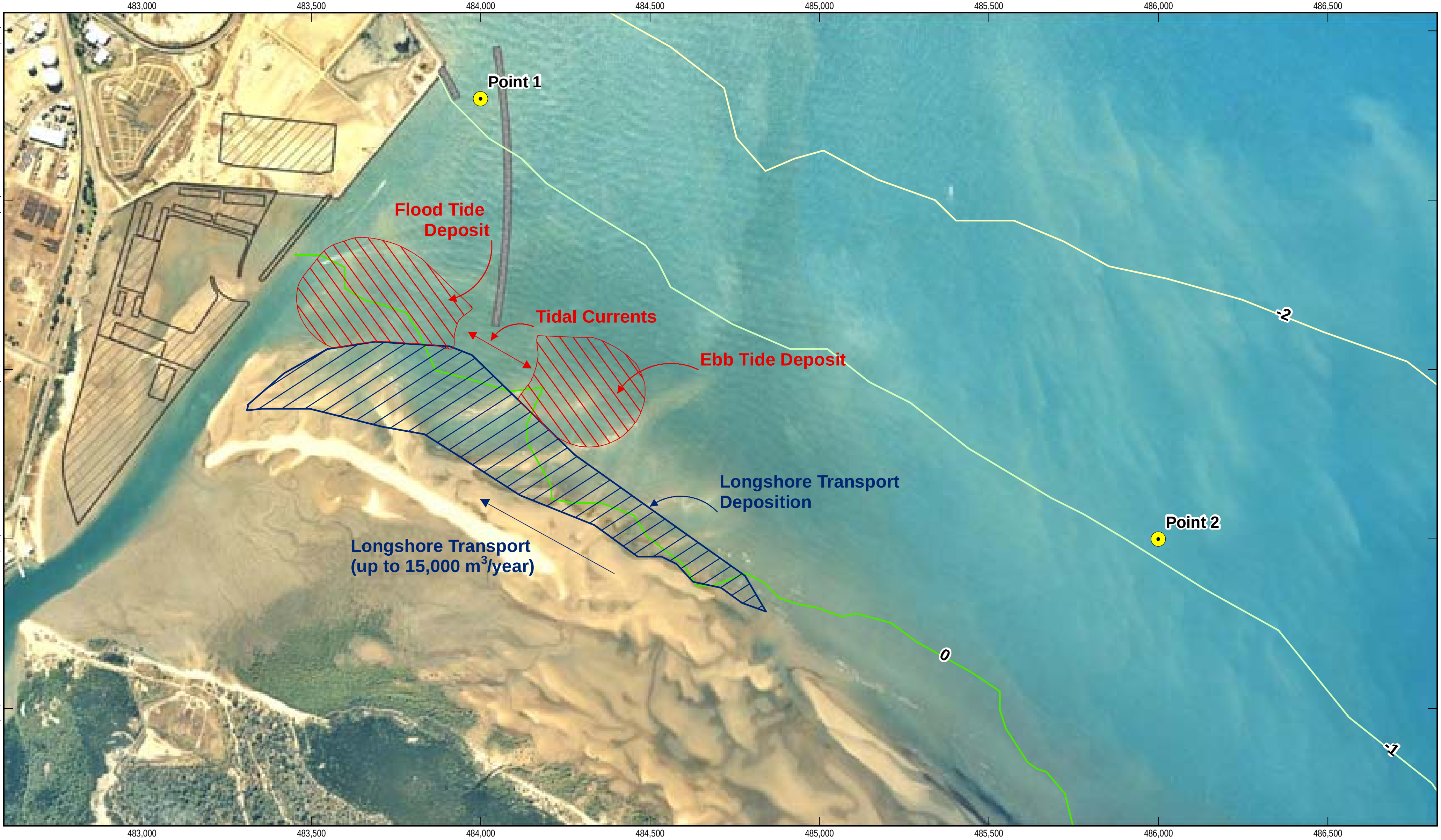
It is unlikely that sedimentation will cause major changes at the main entrance to the marina, due to the depth of the dredged channel reducing the ability of the currents to mobilise the bed sediments and the very limited sediment transport around the outside of the breakwater.

However, at the south eastern end of the breakwater, the water depths are much less and any currents generated by flood flows or tidal flows will have a much greater influence on sediment movement. In addition, it is here that the longshore sediment transport potential is the greatest.

Due to the “shadowing” effect of the breakwater, the longshore sediment transport will tend to accumulate in the lee of the breakwater and extend out to the south east over time. The growth of this sedimentation towards the end of the breakwater will be limited by the flood and tidal flows between the end of the breakwater and the sand bank. Flood flows and ebb tide flows will push sediment from shallow areas inside the marina and from the accumulated longshore transport deposition area, out of the marina onto the outer margins of the tidal flats to the south east. Flood tidal flows will cause sediment to move into the marina depositing sediment in the dredged areas adjacent to the end of the breakwater and areas where the current velocities are low. The above scenarios are summarised in Figure 3-23.

The conclusions in relation to dredged areas that may be affected by sedimentation are as follows:

- Sediment from longshore transport along the seaward edge of the outer sand banks will accumulate in the lee of the south eastern end of the Option C breakwater with most of the sediment accumulating along the outer sand bank to the south east. This sediment is not expected to settle far enough into the marina precinct to affect the dredged access channel or the mooring area immediately behind the breakwater.
- Flood flows from the Ross River and ebb tide flows will generally push sediment out of the marina precinct through the marina entrance and at the south eastern end of the breakwater and therefore not affect the dredged areas. However, large floods may move sediment out of the river into the Precinct and may also cause a general redistribution of sediments in the area, some of which may be deposited into the dredged areas.
- Flood tidal flows between the south eastern end of the breakwater and the outer sand banks may move sediment from the edge of the longshore accumulation and the ebb tide delta to the south east into the Precinct and this sediment is likely to accumulate in the dredged channel and the mooring area behind the breakwater. The rate of accumulation is governed by the strength of the currents and the availability of sediment. Lower sediment availability due to the trapping of the longshore transport, compared with existing conditions indicates that the rate of sedimentation will to be low.



1:15,000 (at A4)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

Sediment Transport Calculation Points
Breakwater Option C (Preferred)
Proposed Marine Precinct

Sediment Contours (1m)
0
-1
-2

Port of Townsville
Marine Precinct EIS

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Revision A
Date 01 July 2009

Predicted Sediment Distribution Patterns from Longshore Transport and Tidal Currents

Figure 3-23

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Data source: Sediment Deposition - GHD 2009; Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management). Created by: TH

3.8.4 Hydrodynamics and sedimentation

3.8.4.1 Background

Hydrodynamic and sediment transport models were originally developed by GHD for the then Townsville Port Authority from 2001 to 2003. These models, which had previously been calibrated to tide levels and sediment transport trends for the outer harbour, were also applied to the marine precinct area. For the current study, a number of improvements have been made, with the introduction of an additional level of high resolution nesting allowing detailed visualisation of results in the area of interest. Additional model calibration to measured currents has also been undertaken, as described further below.

Given the origin of the model, much of the data that has been utilised relates to the earlier work. Data sources included reports relating to previous capital works (TPA Capital Dredging Works 1993), research publications (Pringle (1989), Kettle *et al*. (2001)), data collection (wave data recording program Townsville Region 1975-1997) and operational numerical models (GHD 2001). This has been augmented by additional datasets with respect to localised bathymetry, tidal boundary conditions, and measurements of turbidity.

3.8.4.2 Tidal characteristics

Tidal constituent data has been obtained from Queensland Transport for the Port of Townsville. Tidal planes are given in the Tide Tables (QDOT 2009) as follows:

Table 3-34 Semidiurnal tidal planes for the Port of Townsville

Tidal Plane	Abbreviation	m AHD
Highest Astronomical Tide	HAT	+2.15
Mean High Water Springs	MHWS	+1.21
Mean High Water Neap	MHWN	+0.36
Mean Sea Level	MSL	+0.10
Mean Low Water Neap	MLWN	-0.27
Mean Low Water Springs	MLWS	-1.13
Lowest Astronomical Tide	LAT	-1.86

Tidal ebb and flood generates important tidal currents especially during the higher range of spring tides (Pringle A. 1989). Flood tide currents entering Cleveland Bay from the east, swing round Cape Cleveland and move across the Bay south-westwards with speeds of up to 0.5 m/s. Flood tide currents entering Cleveland Bay from the north, swing closer to Magnetic Island, reaching speeds of 0.2 to 0.3 m/s. A third flood stream, entering the Bay through the West Channel between Magnetic Island and Cape Pallarenda, reaches a speed of 0.7 m/s.

According to Mason *et al.* (1991), during neap tides (range 0.5-0.8 m) currents are of irregular direction and are generally less than 0.05 m/s velocity; during spring tides (2.3-3.6 m) currents vary between 0.15-0.30 m/s with minor asymmetry (flood slightly stronger). During extreme spring tides, currents may exceed 0.70 m/s. The measured tidal asymmetry indicated that net sediment transport should be into the Bay. The above general transport patterns were originally replicated in the GHD (2003) report.

3.8.4.3 Sediment data

Information pertaining to the distribution of sediments and turbidity within the study area is available from a variety of sources. This information is a key input to the sediment modelling when considering the potential impacts of the dredging process.

- Larcombe and Ridd (TPA EMP, 1993) report that sea-bed sediments with bimodal grain size distribution are common in Cleveland Bay. Given that 7% to 40% of material is finer than coarse silt, there is ample opportunity for the resuspension of sediment within Cleveland Bay.
- Peak near-bed suspended sediment concentrations (SSC) of 300 mg/l have previously been measured in water depths of 3 to 15 m,
- Mean near-bed suspended sediment concentrations of the order of 100 mg/l have been measured;
- Typical threshold shear stresses for sediment re-suspension are estimated at 1 N/m2.

More recent water quality measurements from work conducted for the current EIS (refer Section 3.9) have shown that:

- The turbidity level is fairly uniform across the water column;
- The calibration work concluded that a 1:3.5 relationship exists between the total suspended solids concentration (TSS) and turbidity NTU, i.e. TSS (mg/l) = 3.5 Turbidity (NTU).
- A median background concentration of 80 mg/L has been adopted based on measurements in the study area.

3.8.4.4 Sediment transport

A detailed explanation relating to the key driving forces affecting sedimentation patterns in this area was provided in earlier reports (GHD 2001). Further consideration has now been given with respect to littoral transport processes in the marine precinct. This report (Coastal Processes Study, GHD 2009) is presented as a separate appendix (Appendix R) to the EIS. An overview of key findings is reproduced below.

In this area the coastline configuration comprises major sand banks offshore near low water mark, shallow mud flats between the sand banks and the shore face, and a narrow sandy beach at the shore face. There are therefore two potential longshore transport pathways, one along the seaward edge of the sand banks and a second along the beach near the mouth of the river. The transport along the offshore sand bank will be the dominant mechanism as the sand bank is exposed to the limited wave climate that can mobilise the sediments. Transport along the beach is much less significant as the sand bank protects the beach from all waves except those that propagate across the sand bank at the highest of high tides.

3.8.4.5 Bathymetry

The bathymetry of the study area, a key input to the modelling process, has been based on a range of sources, including survey data provided by the Port of Townsville, DHI's CMAP database, the Australian Admiralty Charts, Australian geological Survey Organisation data and ETOPO2 datasets as listed below:

- Australian Hydrographic Chart 257 (Townsville Harbour and Ross River Entrance), Scale 1:7,500
- Australian Hydrographic Chart 256 (Cleveland Bay and Approaches), Scale 1:50,000
- Australian Geological Survey Organisation (AGSO) bathymetric 30 arc second grid
- ETOPO2 - The "Smith/Sandwell" data base, a set of 2-minute gridded ocean bathymetry derived from 1978 satellite radar altimetry of the sea surface that was interpreted as gravity anomalies and extrapolated to depth equivalents.

Recent aerial observations from commercial aircraft have shown that the sand bar to the west of Ross River mouth (refer Appendix I and R) has grown further. It is evident that there is no water transport across the sand bar under prevailing oceanic conditions. In the absence of detailed bathymetry in this very shallow mudflat, bathymetric data in the model has been manually adjusted to represent the sand bar. It will be shown later that impacts relating to the proposed development do not extend to this region.

3.8.4.6 Measured currents

Two acoustic doppler current profilers (ADCPs) were deployed at locations close to the site, in order to collect measurements of tidal currents and wave heights. The data from these ADCP units has subsequently been utilised in the calibration of both the wave and hydrodynamic models. The location of the ADCP deployments is shown in Figure 3-24. Data was collected for more than 1 month at each location, providing an enhanced data set for the purposes of calibrating the model for tidal currents. Previous calibrations had been primarily reliant on tidal water levels, with limited available current measurements.

LEGEND

ADCP Locations | Project Area of Interest | Proposed Marine Precinct | Proposed Breakwater

1:150,000(at A4)

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

ADCP Deployment Locations

Job Number 42-15399
Revision A
Date 01 July 2009

Figure 3-24

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Data source: Marine Precinct ©The State of QLD (Port of Townsville LTD) 2009; ADCP locations - GHD; 250K Topo Data - ©Commonwealth of Australia (Geoscience Australia) 2009;. Created by: TH

3.8.4.7 Numerical model establishment

Utilising the Delft software, existing models were enhanced in order to allow the simulation of water levels, tidal currents, bed shear stresses, waves, flushing characteristics and sediment transport.

- Numerical models of waves and currents cover areas from the mouth of the Ross River and encompass all of Cleveland Bay,
- The flushing characteristics of the mouth of the Ross River and the proposed marina precinct are defined in terms of the elapsed time to reach the e-folding time of flushing The latter analysis has been undertaken using a conservative, non-decaying substance (tracer) with the entire modelling area initialised with a constant concentration of the substance of 1 kg/m3.
- The e-folding time of flushing is a classical estimate of the flushing potential of a water body and is encountered when the concentration in the water column at a specific location is reduced to 1/e (approximately 37%) of the initial concentration.
- Wave-current interaction has been simulated by iteratively coupling the depth integrated hydrodynamic model (Delft3D FLOW) to the 2D phase-averaged spectral wave model SWAN.

Listed below are the main modelling assumptions relating to this study, as initially established for the Commercial Marina study (GHD 2003).

- Local winds are spatially uniform and varying in time. They are represented by a dataset collected at Cape Cleveland;
- A uniform value of Manning's number (0.023), a hydraulic parameter that describes bed roughness, is adequate to force the model to replicate the tidal flows in Cleveland Bay and the mouth of the Ross River.
- Sediment transport, as for the underlying hydrodynamics, has been modelled as two-dimensional (vertically-integrated);
- Following the outcome of a study by Larcombe *et al*. (2000), it is assumed that Cleveland Bay turbidity is not limited by sediment availability for re-suspension from the sea-bed;
- Swell from the east and south-east is the key driver for re-suspension of bed material. Lou and Ridd (1996) analysed two high turbidity events, recorded in the Bay in 1993, where suspended sediment concentrations (SSC) reached over 100 mg/l. The analysis revealed that these events were the result of strong swell events.
- For most of the modelled scenarios (i.e. other than the flood event scenarios), freshwater inflow from the Ross River has been ignored. This is consistent with the report of Kettle *et al*. (2001), which states that the regulation of Ross River has reduced fluvial discharge into the Bay, in turn increasing the influence of tidal processes. Peak annual flows of 500 to 1000 m3/s were common before the Ross River Dam was constructed with zero flows recorded only once every 25 years. By contrast, zero flows occurred for 48% of all years after the dam was constructed. Freshwater inflow, and hence sediment load from the Ross River, has been assumed nil for three of the four modelled scenarios (refer Table 6 of Appendix I). In

the case of the fourth scenario (adopted Precinct layout under the effect of a flood tide event), a flood event with maximum flood discharge of 1090 m3/s and a sediment load of 500 mg/l has been modelled. The selected discharge is nominally representative of a 100 year average recurrence interval (ARI) event.

3.8.4.8 Model grids

The local scale hydrodynamic model of the Marine Precinct (referred henceforth as model “D”) shown in Figure 3-25 has been established on a curvilinear orthogonal grid. The grid has highest resolution (10m x 10m) in the Marine Precinct, extending from the proposed breakwater to the upper extent of the Ross River. The “D” model was nested into a “C” model (Figure 3-26) which has cells 40 by 60 m near the mouth of the river while cells at the seaward extent lie in the range of 300 m by 600 m (at the seaward entrance of Platypus Channel) and up to 600 m by 700 m (at the tidal flats in Southern Cleveland Bay).

In turn, the “C” hydrodynamic model was nested within two large-scale regional models (referred henceforth as models “A” and “B”), which provided tidal elevation, salinity and temperature forcing for model “C” at the seaward open boundaries. Models “A” and “B”, which are part of the modelling system developed in 2001 for the investigation and mitigation of siltation in Platypus Channel (GHD 2001).

Existing hydrodynamic conditions are modelled first to provide a basis for comparison with hydrodynamic results following the establishment of the proposed marina and breakwater. The “A” model was first run using tidal constituents for August 2008 with three subsequent levels of nesting leading to the above mentioned “D” model.

Figure 3-25 “D” model grid showing increasing resolution towards the Precinct

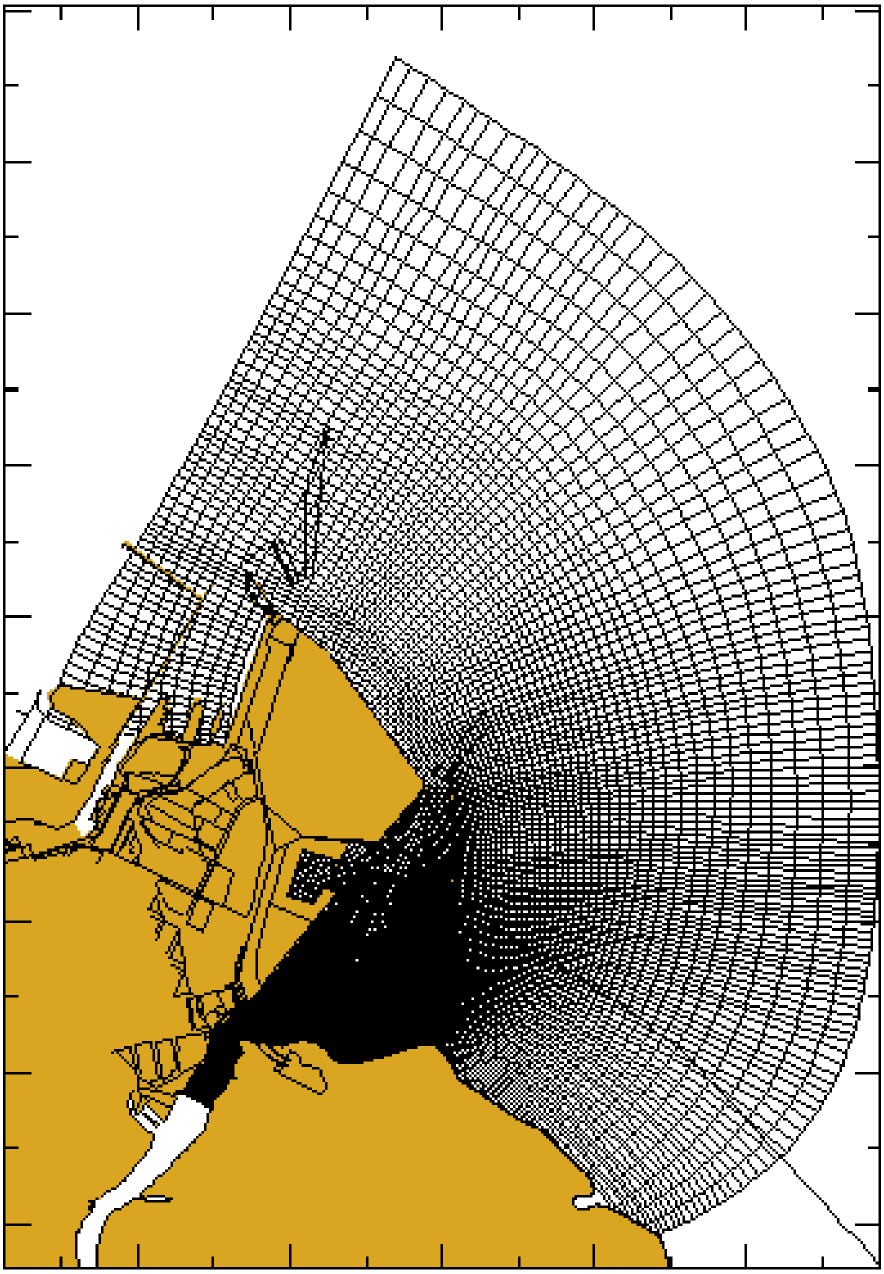
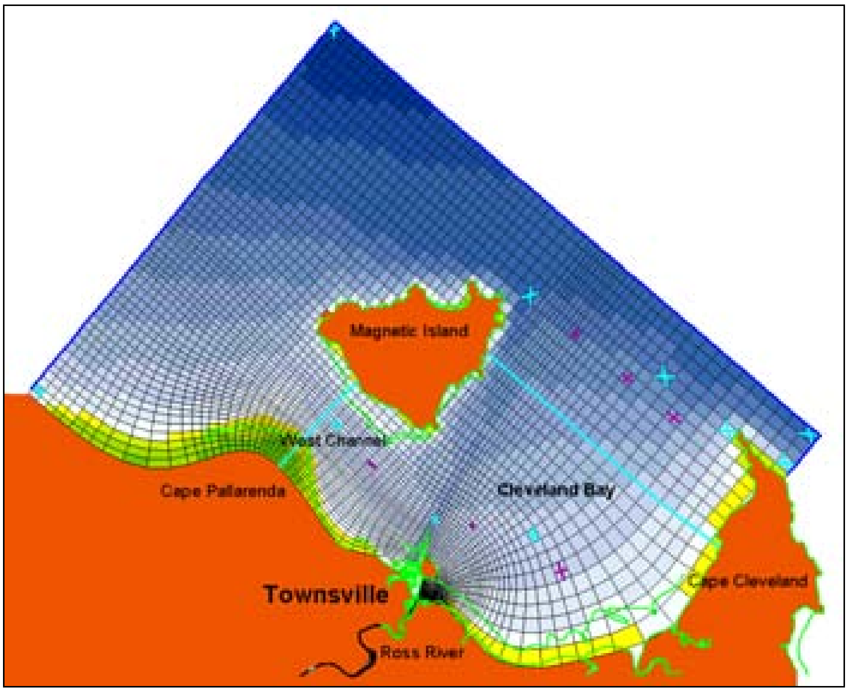


Figure 3-26 Grid for Model "C"



Wave modelling in Cleveland Bay and at the entrance of the Ross River has been undertaken using the two-dimensional, phase-averaged spectral wave model SWAN integrated into the Delft3D suite of models. In the present study, the domain of the SWAN model was slightly larger than the "C" class model.

3.8.4.9 Sediment transport model

Sediment transport modelling has been carried out using the online sediment transport module of Delft3D. The sediment transport model is capable of simulating cohesive and non-cohesive transport under wave and tide action, deposition, hindered settling and flocculation of suspended sediment and re-suspension of seabed material subject to consolidation. The sediment transport model simulates short-term transport of suspended (cohesive) sediment generated in the process of dredging, and has been operated for a period of two months.

3.8.4.10 Modelling scenarios

A range of modelling scenarios were investigated in order to provide an assessment of the combined impacts of tides, waves and winds and a 100 year average return interval flood event in the vicinity of the proposed marina and channel dredging works. These scenarios, described in Table 3-35 have been built around a variety of forcing conditions (tide, tide with prevailing waves, tide with storm waves, and tide with flood), which have generally been run for both the existing and developed (with breakwaters and marina constructed) conditions. A dredge plume scenario has also been investigated.

Table 3-35 Scenarios and modelled processes.

#	Modelled scenarios	Tide	Tide & Wave Interaction	Sediment Transport	Ross River Inflow
1	Existing conditions	✓	✓	X	X
2	Developed conditions - proposed marina dredged to –4.5 m LAT while approach channel dredged to –3.0 m LAT and breakwater Option C.	✓	✓	X	X
3	Construction dredge scenario (existing conditions / no breakwater in place)	X	✓	✓	X
4	100 year ARI flood event characterised by a maximum discharge of 1090 m^3/s	X	X	✓	✓

3.8.4.11 Hydrodynamic model calibration

Whilst calibration of the Port of Townsville model and Marine Precinct models were initially completed in 2001 and 2003, a second level of calibration of the model to tidal currents has been undertaken for the current study. This takes into consideration the newly acquired acoustic doppler current profiler (ADCP) measurements of tidal currents within Cleveland Bay. The “C” grid model was used for this calibration with measurement of currents and waves completed between 15 August 2008 and 22 September 2008 within Cleveland. Data from the offshore ADCP has been used in the calibration.

Plots of current magnitude (Figure 3-27) and water level (Figure 3-28) over a one month period show very good correlation between measured and modelled values. In addition to the fit by eye, the use of statistical methods allows a quantitative assessment of the standard of calibration. In this case, the method of measuring correlation between two data sets is to calculate the root mean square (RMS) error. The RMS error for the offshore current magnitude time series was 6%, which indicates a very good level of correlation. Figure 3-29 shows measured and modelled currents for a shorter time frame (3 days) and indicates that while the phase and relative magnitudes in currents match quite well (an RMS error of only 3%), the modelled currents are slightly underestimated. One reason for this discrepancy is that the calibration model does not include the effect of waves.

Figure 3-27 Measured (ADCP) versus modelled current magnitude time series for offshore site.

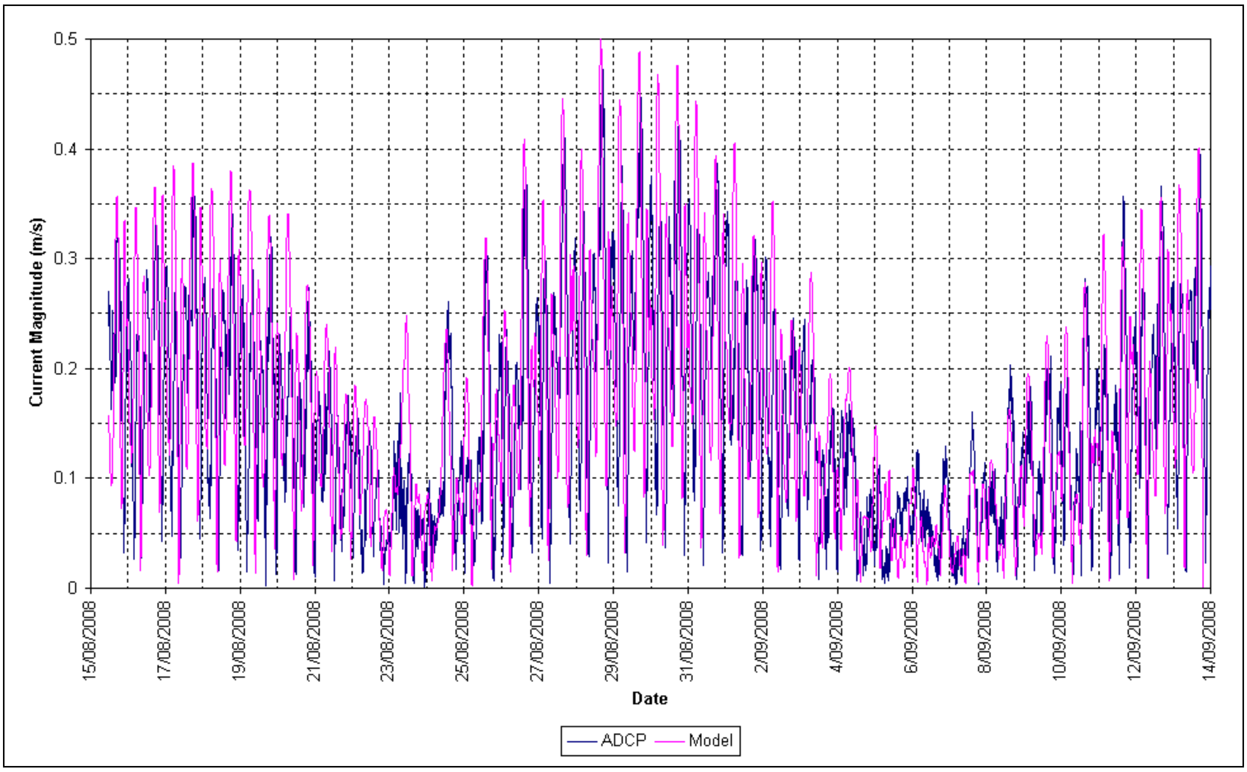


Figure 3-28 Measured (ADCP) vs modelled water level time series for offshore site

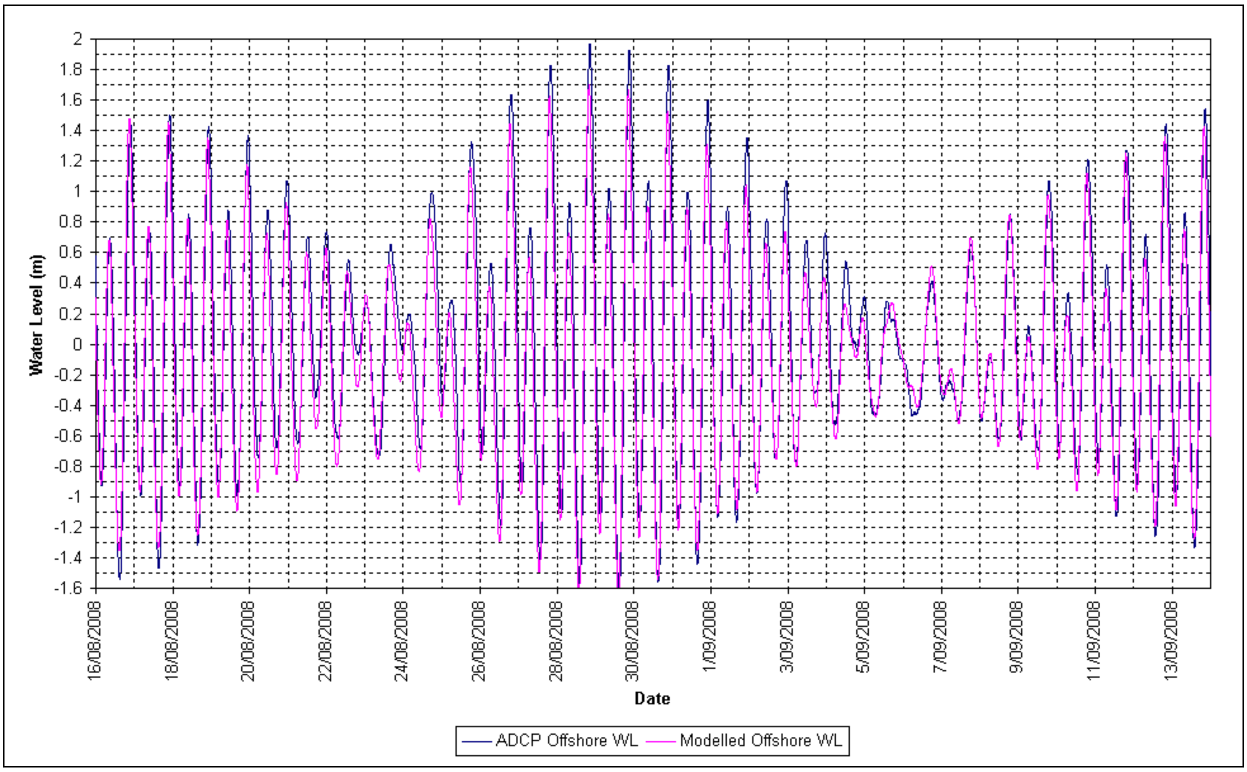
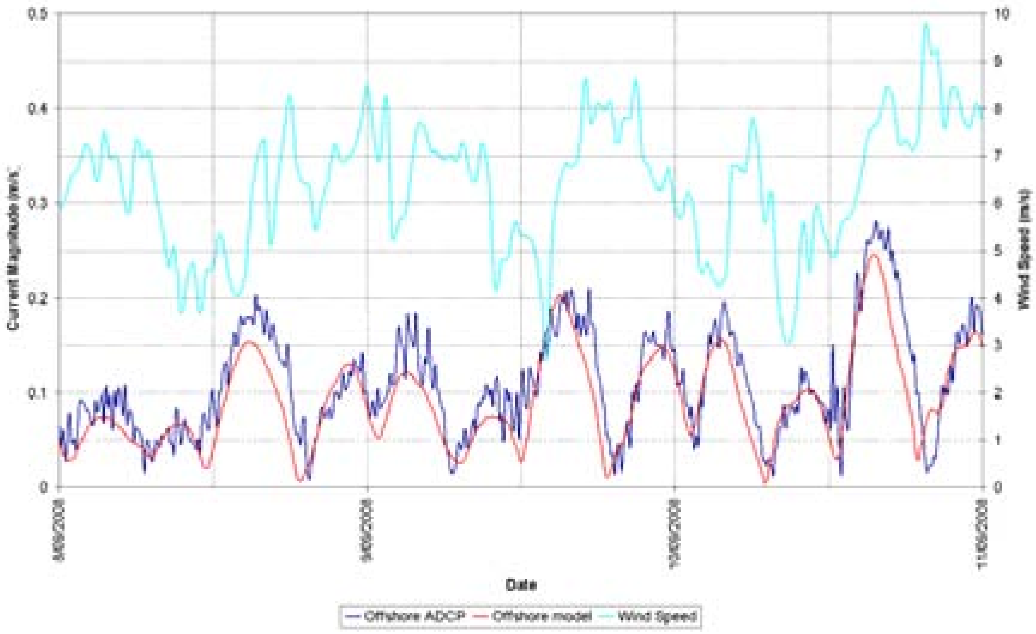


Figure 3-29 Presentation of ADCP measured and modelled current magnitudes (offshore site) for a shorter time frame, showing the standard of correlation between measured and modelled values.



3.8.4.12 Modelling Results – tidal circulation

Modelling results are presented in several formats, in accordance with the key items of interest. These consist of hydrodynamics (water levels and currents), bed shear stresses and flushing potentials, each of which is influenced by the hydrodynamic forces of tides and waves during various meteorological conditions.

Net current circulation patterns are influenced mostly by a combination of tidal and wave action. Consequently, greater emphasis has been placed on “tide and day to day wave” model results over “tide only” results, though both provide very similar results.

Large scale circulation results in Cleveland Bay have been extracted from the “C” class model, which offers the highest resolution model covering the whole area. With reference to drogue studies, previous reports (including GHD 2003) reported a distinct tidal circulation/oscillation pattern in Cleveland Bay which presents itself with an anticlockwise rotation on a local (drogue) scale. This is distinct from the large scale clockwise rotation, as indicated by residual current plots. Current magnitudes vary between 0 – 0.5 m/s with the largest currents produced during peak flood and ebb flows, particularly along Magnetic Island (maps of current vectors provided in Appendix I, with current patterns in the marine precinct presented in the same report.

Figure 3-30 illustrates the predicted residual currents (currents averaged for the semidiurnal M2 tidal constituent over the entire model simulation time) for existing conditions (i.e. no breakwater or marina), though the proposed marine precinct and breakwater layout are indicated as a background layer. A well defined eddy adjacent to the existing port reclamation is the most prominent feature. This eddy effectively covers the area that would be protected by the proposed breakwater. There are also two smaller clockwise eddies within the Marine Precinct /

Ross River mouth area, which may have arisen owing to the existence of the main channel between the Ross River mouth and Cleveland Bay. The channel is flanked by shallow regions, resulting in the residual patterns observed.

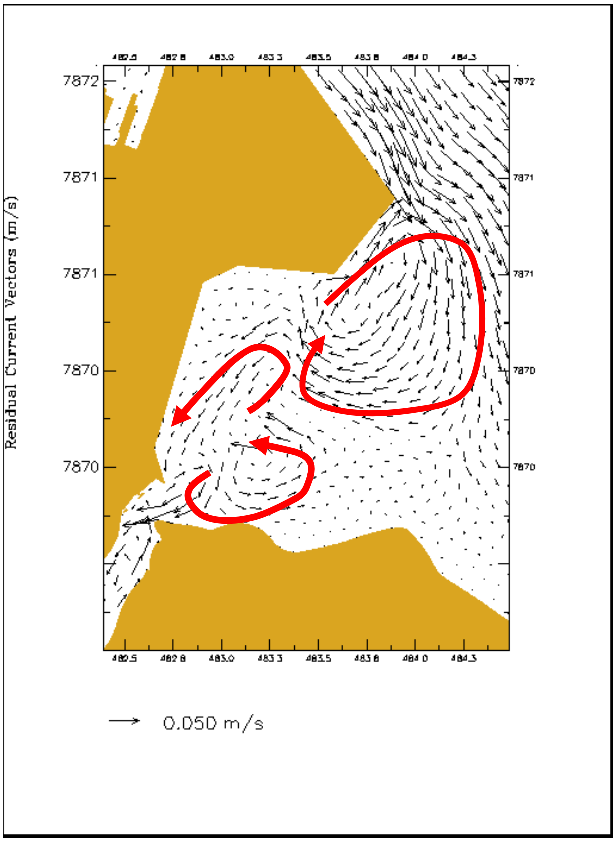


Figure 3-30 Residual currents resulting from tide only forcing for existing conditions.

3.8.4.13 Existing conditions – bed shear stresses

In order to better present the variation of bed shear stress that occurs during different tidal cycles, a series of time histories (i.e. bed shear stress v time) are presented for the "tide and prevailing waves" scenario. As previously indicated, the significant wave height applied at the model boundary for this scenario is 0.7 m. Given the relatively low wave height, it will be seen that the results for the tide plus waves scenario are similar to those for the tide only case.

Result plots have been generated in two primary formats: x-y plots of shear stress vs time at selected locations, and spatial plots of shear stress over the entire area of interest at specific times. Time history format results have been generated for nine sites, the locations of which are illustrated in

Figure 3-31. These sites were selected in order to cover a range of different exposures, and include the channel, inside and outside of the breakwater and the shallower area towards the inter-tidal flats. The full set of results is provided in Appendix I.

Figure 3-31 Location of numerical monitoring stations

Results have also been prepared in spatial format, as illustrated in

Figure 3-32. The plot illustrates bed shear stresses generated during the spring tide of 28th August 2008, during the peak flood stage of the tide. It is evident from

Figure 3-32 that maximum shear stress values of 1.50 to 1.7 N/m^2 are seen at the Ross River entrance while values of up to 2.2 N/m^2 are indicated in the sand shoal to the east of the river entrance. However, this localised peak, which is also seen for the developed condition case, is regarded as a function of shallow bathymetry as represented in the models, and is unlikely to be this high in reality. Elsewhere within the Precinct, BSS values are typically less than 1.0 N/m^2.

Figure 3-32 Spatial Plot of Bed Shear Stresses during Spring Tide

3.8.4.14 Flushing characteristics

The consideration of flushing time (potential) is undertaken in order to consider whether a water body is at risk of poor water quality. The technique involves the simulation of a passive tracer, with flushing time calculated using the e-folding technique. The e-folding time is the time required for the tracer to reach a concentration of $(1/e)\times C_o$, where C_o is the initial concentration of the tracer. When considering flushing time assessments, it is important to understand that the bigger the body of water, the longer the flushing time will be. Hence, the definition of whether flushing characteristics are good or bad must be determined in conjunction with the consideration of the size of the water body, and an appreciation of water quality measurements.

For the existing (undeveloped) conditions, flushing times were modelled as 1 day throughout the area of interest. A comparison of flushing times between existing and developed conditions is provided in the following section.

3.8.4.15 Ross River flood events

The Ross River is highly regulated, with the Ross River Dam and several weirs constructed. This provides a mitigated pattern of flood flows, with the river discharging into Cleveland Bay in the general vicinity of the proposed marine precinct. It is noted that for flood events occurring at low tide, the flood will tend to be contained largely within the existing channel, with shallow sandbanks to the north-east of the river mouth acting as a constraint.

3.8.5 Potential impacts and mitigation measures

3.8.5.1 Hydrodynamic circulation

In the developed case, the predominant flow exchange occurs through the breakwater entrance with the remaining exchange happening at the tail (southern end) of the eastern breakwater. Tidal current magnitudes are of the order of 0 to 0.35 m/s at the site of the breakwater entrance for the existing case with 0 to 0.60 m/s currents predicted for the developed case. At the tail of the eastern breakwater, existing currents vary between 0 and 0.35 m/s compared to the developed case which shows current magnitudes in the range of 0 to 0.55 m/s. Flows into the Ross River mouth and adjacent channel appear slightly weaker than for existing conditions.

A two day current magnitude time series is presented in Figure 3-33 for the two breakwater related locations discussed above. The figure shows that whilst predicted (modelled) shear stresses increase at both ends of the breakwater, these increases are not large for normal (i.e. tide only, or tide plus prevailing waves) conditions.

Figure 3-34 shows residual currents (currents averaged for the semidiurnal M2 tidal constituent over the entire model simulation time) for developed conditions. When breakwaters and Precinct structures are introduced to create the developed case, the eddy previously seen in the existing case (refer Figure 3-34) is enhanced due to “funnelling” effects while the smaller eddies in the Precinct are reduced.

Time series of water levels at three different locations within the study area reveal that for prevailing conditions, there is no change to water levels when comparing the existing and developed case results. These results (presented as Figure 19 in Appendix I) relate to three sites; namely (a) the mouth of the Ross River, (b) the entrance to the marina, and (c) the channel entrance to the breakwater.

Figure 3-33 Current magnitude (tide only case) at three locations (proposed marina entrance, tail of eastern breakwater and in navigation channel at breakwater entrance)

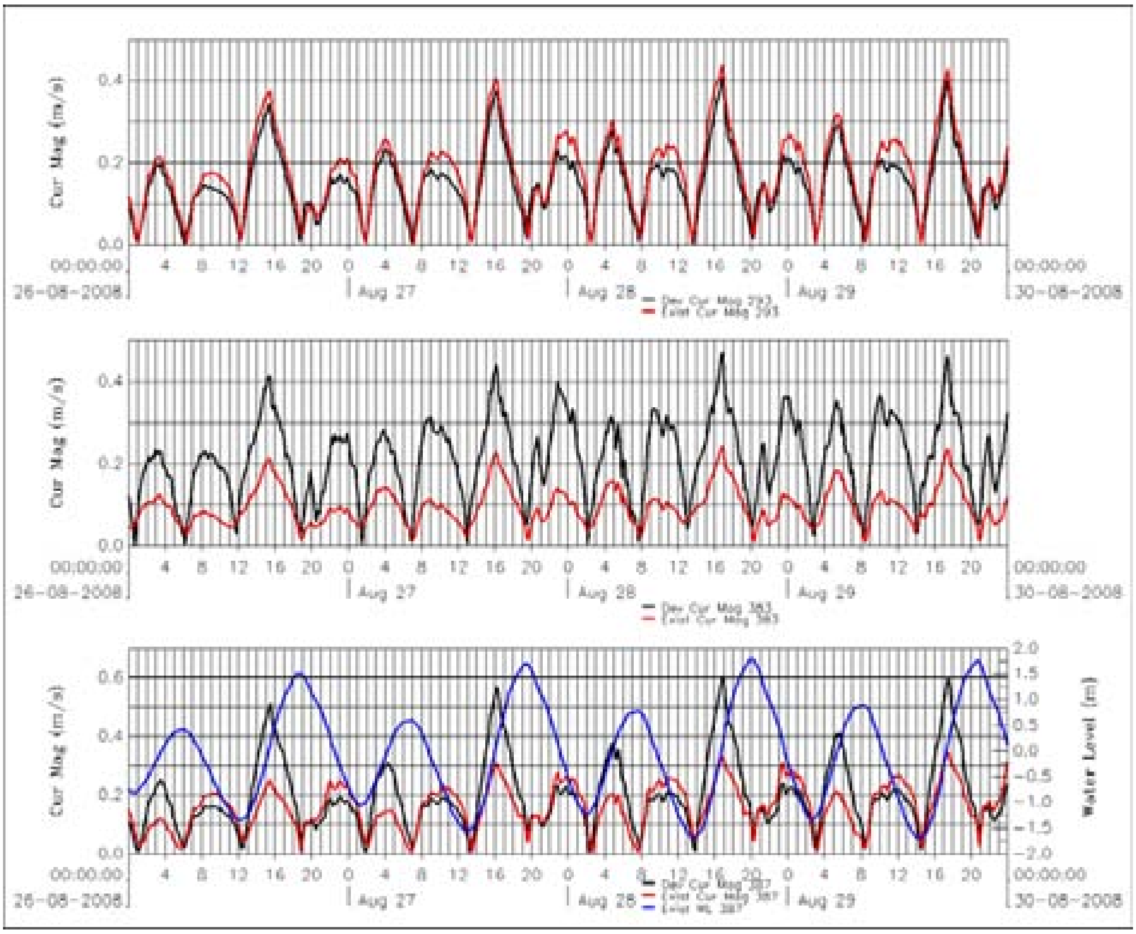
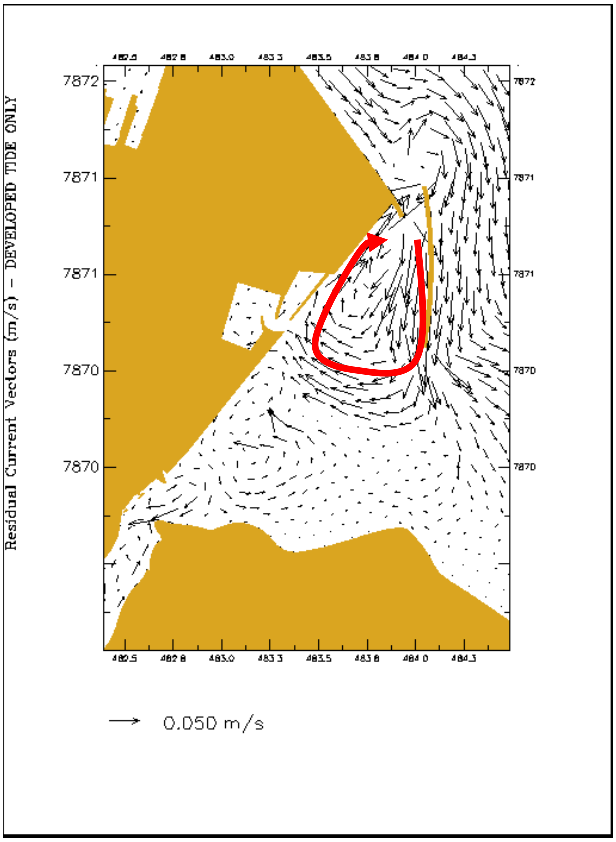


Figure 3-34 Residual currents as a result of tidal forcing on the developed bathymetry and structures



3.8.5.2 Bed shear stresses

Bed shear stress plots can be used to assess the potential for sediment erosion or deposition, with differential plots (i.e. the difference between existing and developed condition bed shear stresses) used to assess potential impact. Differentials in this context are values of a parameter in developed conditions minus the values of the same parameter in existing conditions and in applications concerning bed shear stresses (BSS), areas of potentially increased BSS are presented as positive values while potentially reduced BSS are indicated by negative values.

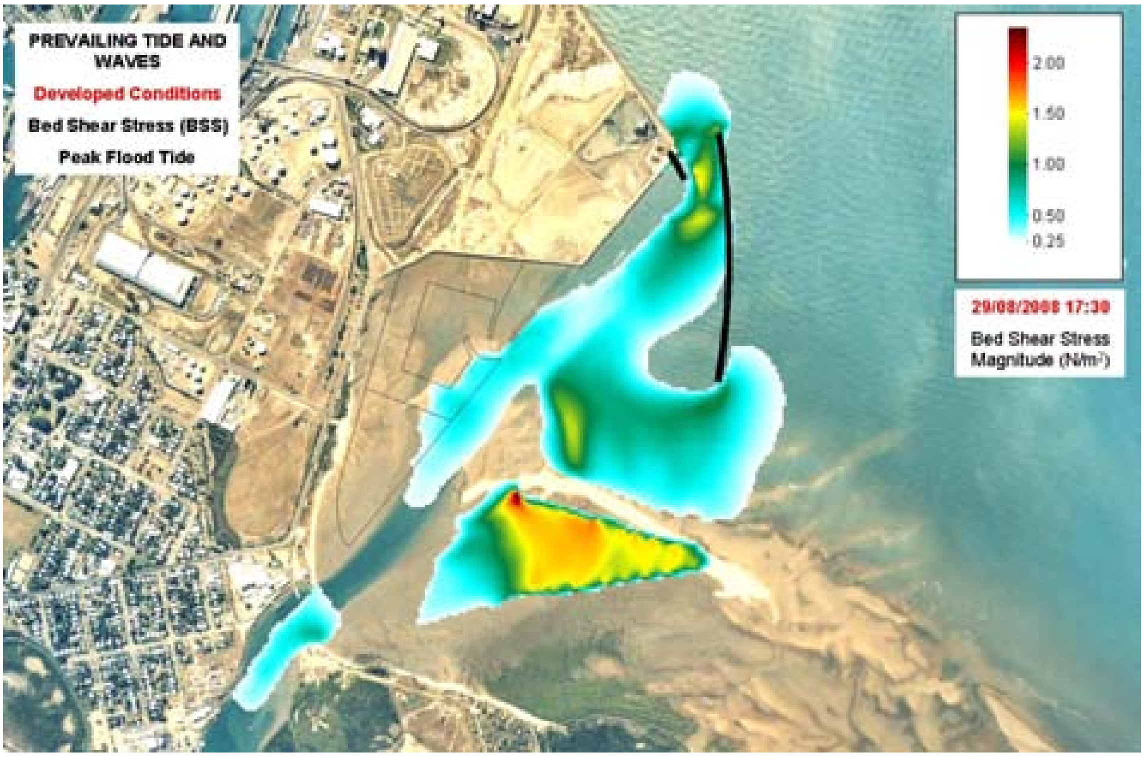
Whether erosion or deposition occurs is dependent on the threshold value of shear stress that applies. Based on GHD's previous work (GHD 2001, GHD 2003) in this area, a threshold for erosion of 1 N/m^2 was identified. Hence, values exceeding 1 N/m^2 may see either erosion or the resuspension of previously deposited material.

Values falling below the above thresholds can indicate a potential for deposition. Where a maximum value changes, but remains on the same side of the threshold (i.e. above or below the threshold) then the impact is related more to the time for which a threshold is exceeded.

Predicted bed shear stresses for peak flood flow during a spring tide on the 29th August 2008 is presented following. The results relate to the tide plus prevailing waves scenario.

In Figure 3-35, it can be seen that the breakwater causes two key changes. Shear stresses increase at the tail of the eastern breakwater to values of about 1 N/m^2 and also in the breakwater entrance with values as high as 1.7 N/m^2. The implications are limited to minor changes in erosional and depositional characteristics for a short period of time. Bed shear stress over the shallow flats are similar to the existing case.

Figure 3-35 Bed shear stresses during flood phase of spring tide (prevailing scenario) for developed conditions.



Additional results are provided in

Figure 3-36 and Figure 3-37.

Figure 3-36 provides a map of shear stress differentials (i.e. developed stresses less existing stresses for a given instant in time). These results, which are very similar to those for the tide only scenario, support the findings stated above. That is, changes in shear stresses are relatively small, being typically less than 1.25 N/m^2. The main changes occur at the ends of the proposed breakwaters, which will have minor implications for breakwater design. From an environmental impact perspective, there will only be minor changes in erosional and depositional characteristics for these conditions.

Figure 3-36 Differential of bed shear stresses during flood phase of spring tide (prevailing scenario) for developed conditions.

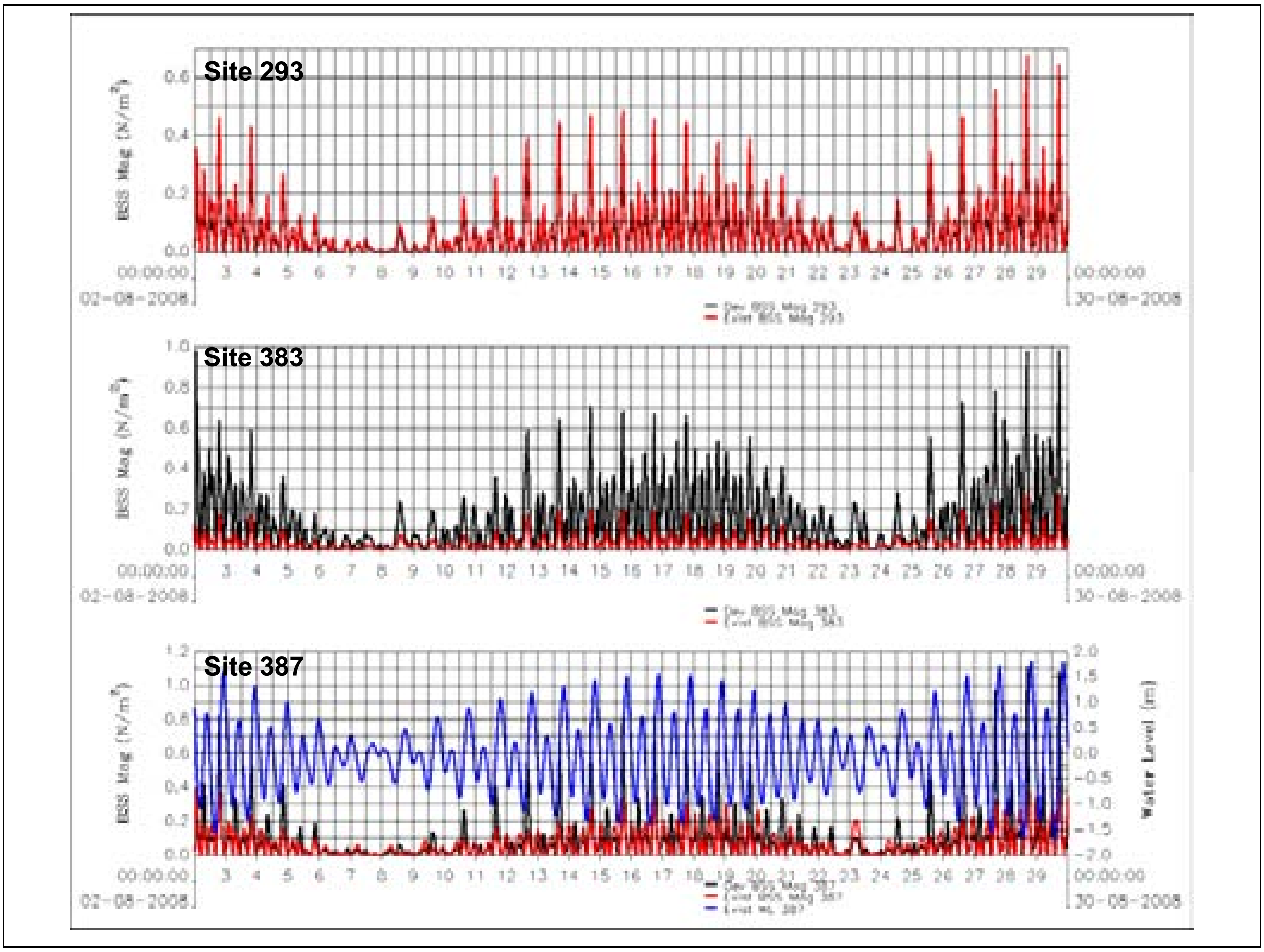
The spatial plots presented above provide information for single instants in time only. Time history plots therefore also of value, providing an enhanced understanding of the variable nature of shear stresses. Figure 3-37 provides time history results for three locations, station 293 (entrance of the proposed marina), station 383 (immediately south of the main breakwater), and station 387, located at the entrance of the two breakwaters (refer

Figure 3-31 for locations).

The generation of higher shear stress values at station 383 and 387 is evident, pushing peak values to 1.1 N/m^2 during spring tides. However, during neap tide periods (6th to 10th and 22nd to 26th August), shear stress values remain very low.

Bed shear stress values at station 417 are reduced for developed conditions with values reduced to half (from 0.70 N/m^2). Results for other locations are presented in Section 6.3 of Appendix I.

Figure 3-37 Time histories of bed shear stress at numerical monitoring stations 293, 383 and 387 for existing (red) and developed (black) conditions under the combined effects of tide and prevailing wave conditions



3.8.5.3 Bed Shear stresses associated with 1yr ARI Storm Event

The impact on bed shear stresses for the tide and 1yr ARI storm case follows a similar pattern to that determined for the "tide plus prevailing waves" case. As indicated in Figure 3-38, one year ARI storm waves result in bed shear stresses in excess of 2 N/m^2 at the mouth of Ross River for existing conditions. Shear stresses of about 0.7 N/m^2 are also observed eastern end of the sand shoal, a region where stresses were insignificant for prevailing conditions. With reference to Appendix I, it is also noted that:

- With the addition of the proposed breakwaters, current magnitudes are enhanced, with values of 0.45 m/s occurring at the tail of the eastern breakwater, compared to existing condition values of 0.25 m/s; and
- Current magnitudes at the tail of the eastern breakwater are increased from 0.3 to 0.6 m/s.

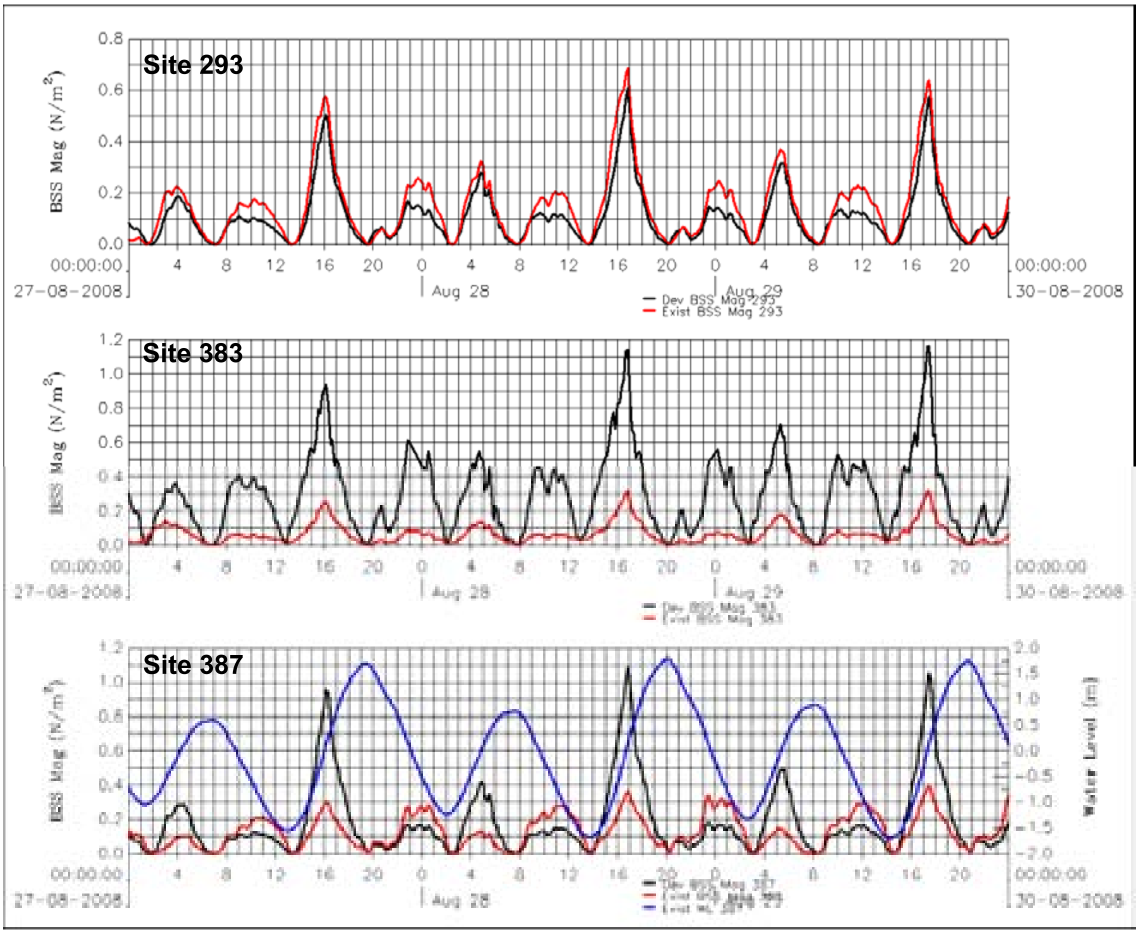
Figure 3-38 Existing bed shear stresses for storm wave (1 year ARI) conditions.

Figure 3-39 Differentials of BSS for storm wave (1 year ARI) conditions.

Figure 3-39 provides a differential plot for the storm wave scenario. The simulation was run for a spring tide period at the end of August 2008. Note that values in this figure are slightly lower than those for tide plus prevailing wave conditions as the map represents a time 30 minutes after flood tide has peaked (since results for this model run were written in two hour intervals). In reality, BSS values would be slightly higher than that observed for tide and prevailing wave conditions, as reflected in time histories. The breakwater also provides protection, and hence both the marina and navigation channels show little change in BSS with limited potential for any significant risk for erosion or siltation in this region during the simulated storm wave condition.

Results are also presented in time history format. Figure 3-40 provides a comparison of bed shear stresses for existing and developed conditions at three stations, one of which (station 383) is located at the southern end of the proposed breakwater. Monitoring station locations were previously provided in Figure 3-31.

Figure 3-40 Time histories of bed shear stress at numerical monitoring stations 314, 383 and 417 under the combined effects of tide and 1 year ARI storm event: Developed conditions (black solid line) versus existing conditions (red solid line)



Bed stresses for station 387 (located between the two breakwaters) have increased in comparison to the prevailing wave conditions (now exceeding 1.0 N/m^2 for the developed case compared to 0.9 N/m^2 previously), whist the difference between existing and developed is only of the order of 0.7 N/m^2 at peak flood tide.

Shear stresses for station 383 (southern end of breakwater) indicate a significant (percentage wise) increase associated with the developed scenario (1.2 N/m^2 compared to 0.3 N/m^2 for existing case). Station 383 shows the largest post-development increase in bed shear stress compared to the other two numerical stations as it is relatively more exposed to wave climate than station 293 or 387.

Values of bed shear stress at station 293 remain relatively unchanged between existing and developed cases.

3.8.5.4 Flushing characteristics

Table 3-36 provides a summary of the e-folding or flushing time at six locations (as indicated in Figure 12 of the Appendix I) for both existing and developed conditions. Results are provided for both the “tide only” and “tide plus prevailing wave” scenarios. Results indicate that once the marina and breakwater are constructed, it could take up to 50% longer for pollutants to leave the Precinct. However, while all the locations studied showed an increase in flushing times, the differences are not significantly high, given that the marina would tend to flush approximately 63% of the contaminant(s) in approximately 1.6 days under normal tidal and wave driven circulation. There is minimal difference for flushing times when comparing the tide only case with the tide plus waves case.

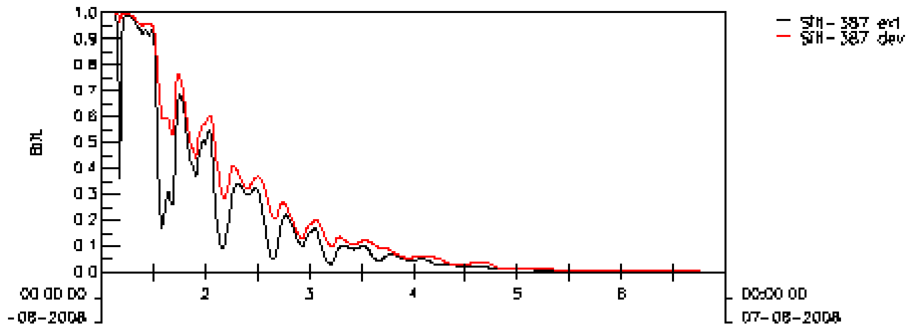
Table 3-36 Flushing Potential for a Passive Tracer Using E-Folding Technique

Location	Flushing Potential (days)			
	Tide and Wave Conditions		Tide Only Conditions	
	Existing	Developed	Existing	Developed
1 – inside marina	1.09	1.53	1.09	1.60
2 – inside marina	0.99	1.44	1.06	1.55
3 – channel adjacent to marina entrance	0.85	1.28	0.85	1.28
4 – channel between breakwaters	1.03	1.38	1.03	1.37
5 – river mouth at site of proposed access road	0.92	0.93	0.92	0.93
6 – N of proposed breakwater outside Marina Precinct.	1.03	1.22	1.03	1.22

The means of determining the flushing time is illustrated in Figure 3-41. The plot indicates the decay of dye over time, commencing with a concentration of 1 kg/m^3. As flushing with “clean” water occurs (i.e. water with no dye), the concentration at the point of interest decreases. The above plot provides results for Station 387, the location of which is described earlier. Reference can also be made to

Figure 3-31.

Figure 3-41 Passive tracer concentration time series at Ross River mouth/entrance (top panel), breakwater entrance/channel (middle panel) and proposed marina site (bottom panel)



3.8.5.5 Ross River Flooding

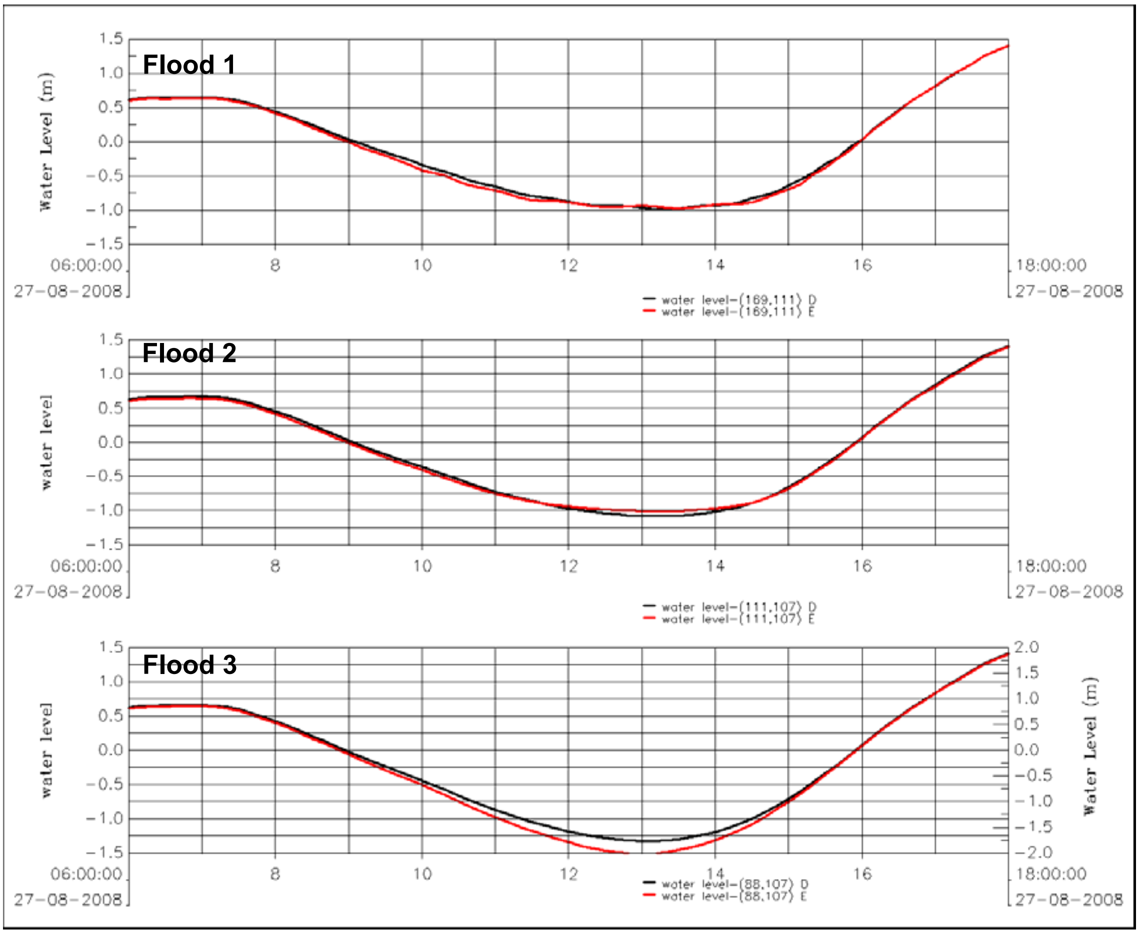
With the Ross River discharging directly into the Precinct area, it is necessary to consider whether there are any potential implications for flooding, and in particular, to assess the potential for impacts on upstream flood levels. Modelling studies to investigate the cumulative impacts of the TPAR and Precinct are being conducted under TPAR studies. Information available at the time of reporting for this EIS has been assessed and potential influence of the Precinct on flooding is considered following. Additional comments are also provided in the Cumulative Impacts section of this document (refer Section 3.17).

A flood event with a peak discharge of 1090 m^3/s, has been selected for the assessment. This is nominally equivalent to a major (e.g. 1 in 100 yr ARI) event. Results are presented in terms of changes to water levels, both within the Ross River and throughout the marine precinct area, and also with respect to changes in predicted bed shear stresses (representing erosion and sedimentation characteristics).

Results relating to current magnitude and direction are also presented in Appendix I, with a comparison of currents for the existing and developed cases over a period spanning peak river flood. For the existing case, flow patterns tend to follow the channel leading from the Ross River into the Cleveland Bay. For the developed case, there is a strong branching (separating) flow between the breakwaters and also along the tail of the eastern breakwater. The flow between the two breakwaters produces large currents between 2 to 3 m/s.

Figure 3-42 provides an indication of predicted water levels as a result of the proposed development at three locations.

Figure 3-42 Water level (m) at Ross River mouth/entrance (top panel), proposed marina site (middle panel) and breakwater entrance/channel (bottom panel).

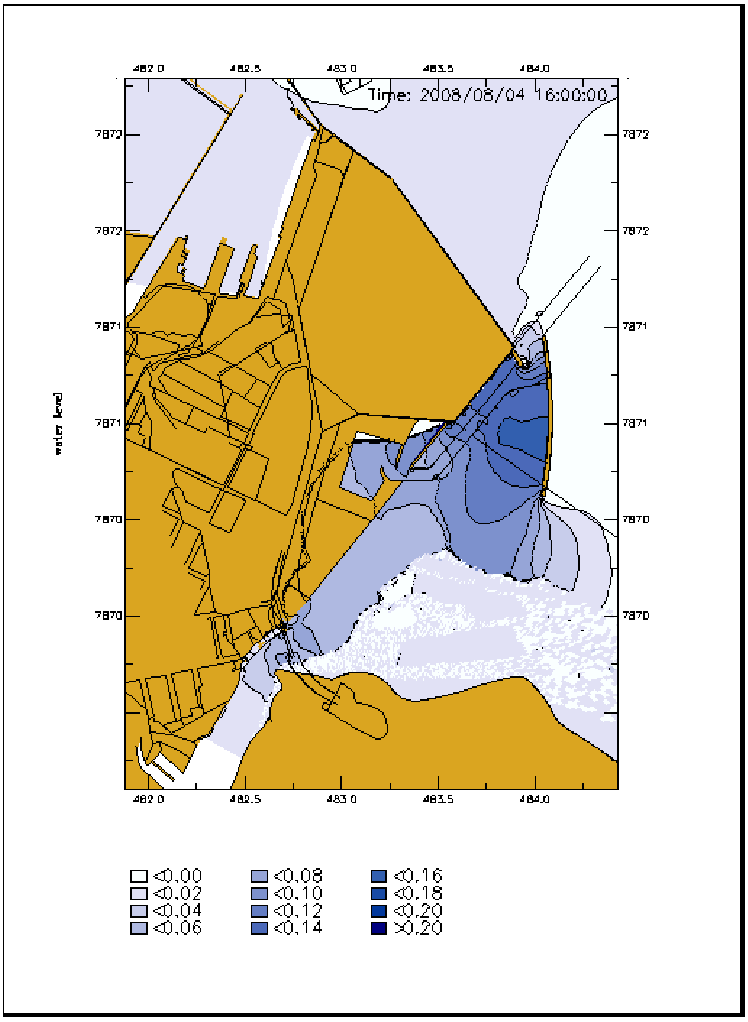


The top panel in the figure indicates that the water level is not affected in the Ross River entrance, with Station Flood 1 (flood numerical monitoring stations shown in

Figure 3-31) located mid channel under the proposed access road. Similarly, only small increases (0.10 m) are seen at the proposed Marina site (refer middle panel of Figure 3-42). Larger differences are observed in the region between the marina and the breakwater, with water level elevation differences of up to 0.25 m indicated adjacent to the breakwater entrance, though it is important to note that these occur at low tide, and hence do not affect the peak flood level.

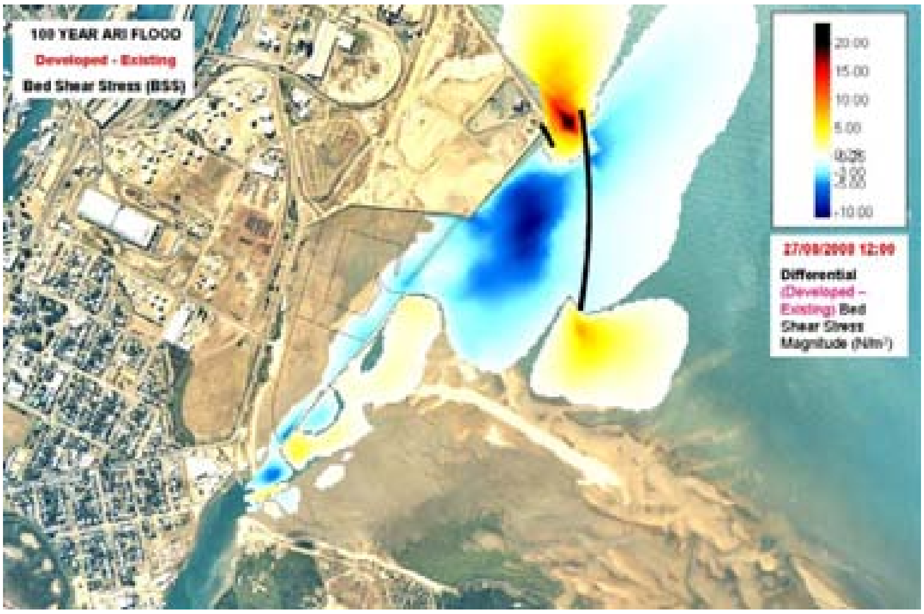
Maximum differences of up to 0.25 m are observed behind the breakwater as indicated in Figure 3-43. This map provides results for the time when differentials are a maximum, though again it is noted this would occur at low tide, and not at the time of maximum water level.

Figure 3-43 Map of differential water level for 100 year flood event in Ross River.



The potential impact on shear stresses (Figure 3-44) is that the channel between the two breakwaters is likely to scour during a flood event for both existing and developed conditions. The impact of the development is observed to be confined largely to three locations: large increases at the entrance of the breakwaters and at the tail of the eastern breakwater (values in excess of 15 N/m^2 for the first location and 5 N/m^2 for the latter) and decreases behind the breakwater (5 – 10 N/m^2). These locations will need careful consideration during design.

Figure 3-44 BSS differential for peak flood flow through the entrance of the Ross River.



Sedimentation and Erosion Potential for River Flooding

Sediment deposition and erosion potential has been assessed for 100 year ARI flood conditions. With a sediment load of 500 mg/L and erosion threshold of 1 N/m^2 and deposition of 0.25 N/m^2, sediment deposition of the order of 0.5 m occurs on either side of the navigation channel while erosion is seen in the channel itself. A similar pattern is seen for developed conditions at the mouth of the river. In this case, sediment appears to be completely eroded within the breakwater entrance while sediment deposition of 0.35 m is observed at the entrance of the marina (Figure 3-45). A sediment thickness differential plot (Figure 3-46) shows that there is potential for slight scouring at the tail end of the eastern breakwater and in the channel between the breakwaters. Indication of sediment deposition at the mouth of the marina is evident, suggesting maintenance issue needs to be addressed in detail design. The sand shoal and mangrove flats appear to be effectively unaffected in terms of sediment deposition or erosion.

Figure 3-45 Existing (left) and developed (right) sediment thickness following flood event in Ross River.

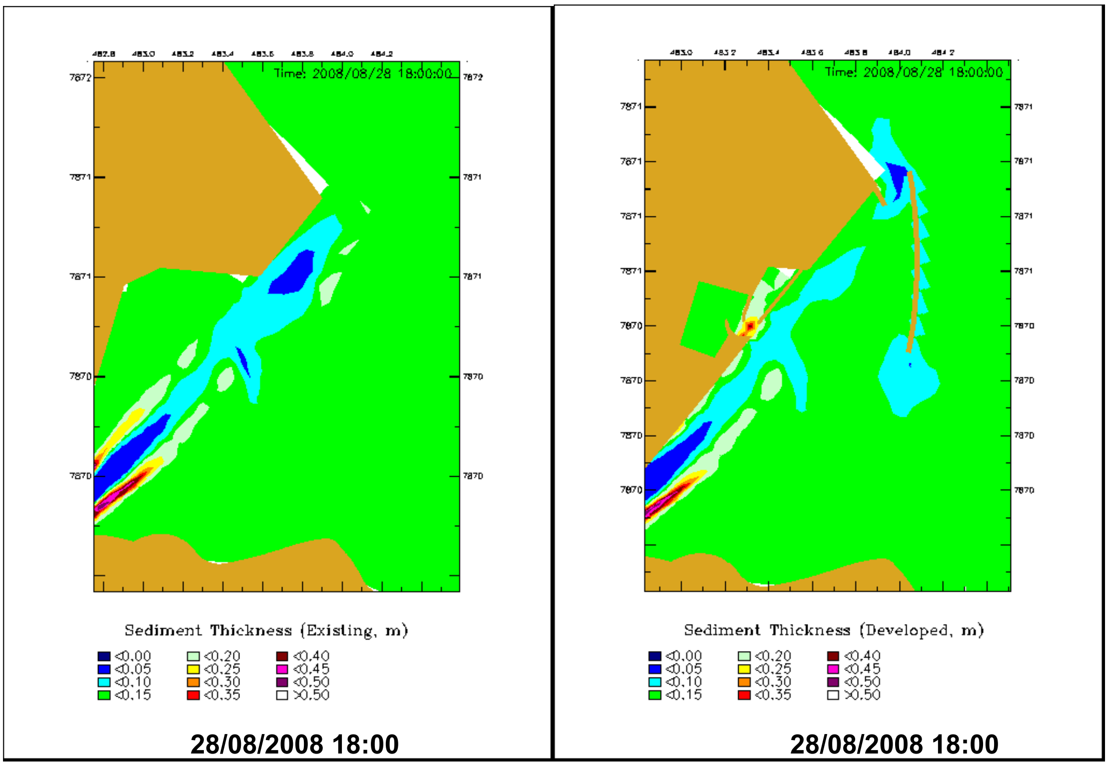
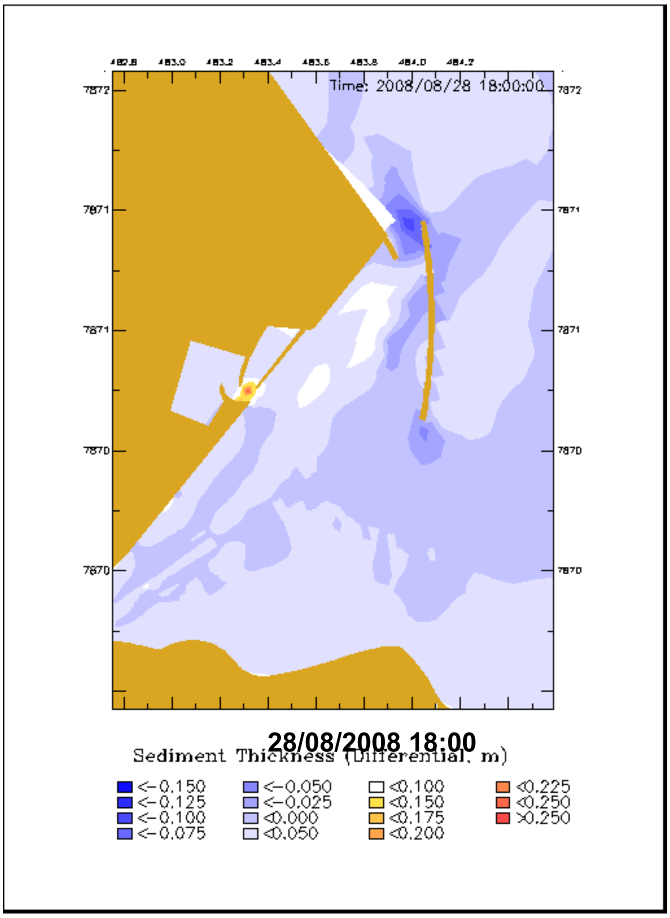
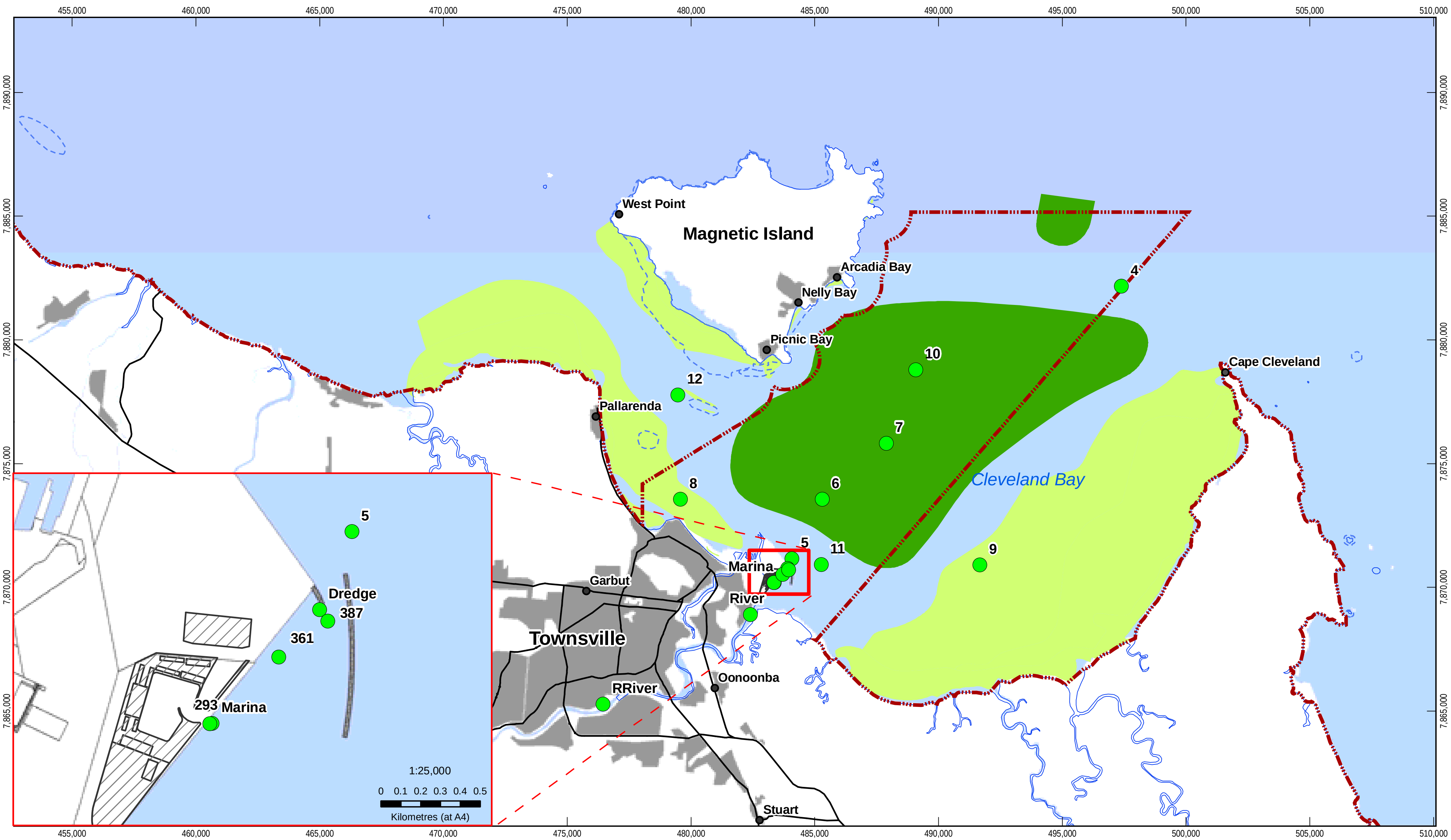


Figure 3-46 Comparison of sediment deposition from flood events for existing and developed conditions.



3.8.5.6 Dredge plumes

Sediment transport modelling has been undertaken, coupled with tides and prevailing wave conditions for a period of two months. Monitoring/observation stations have been set up in the model to cover the entire area of interest, particularly areas where coastal and deep water seagrasses grow (refer Figure 3-47). Details pertaining to the establishment of the sediment model are provided in Appendix I. It is important to note that all results represent a plume with no background concentrations, as this allows the shape and concentration of the plume to be easily identified. When considering potential impacts, the nominated background (median) concentration of 80 mg/L should be added.



1:200,000

0 1 2 3 4 5

Kilometres (at A4)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

LEGEND

- Key Numerical Monitoring Stations
- Major Road
- Marine Precinct Stages 20081201
- GBRMP Boundary
- Coastal Seagrass Meadows 2007
- Deepwater Seagrass Meadows 2007

Port of Townsville
Marine Precinct EIS

Job Number	42-15399
Revision	B
Date	01 July 2009

Environmentally Sensitive
Areas for Seagrass.

Figure 3-47

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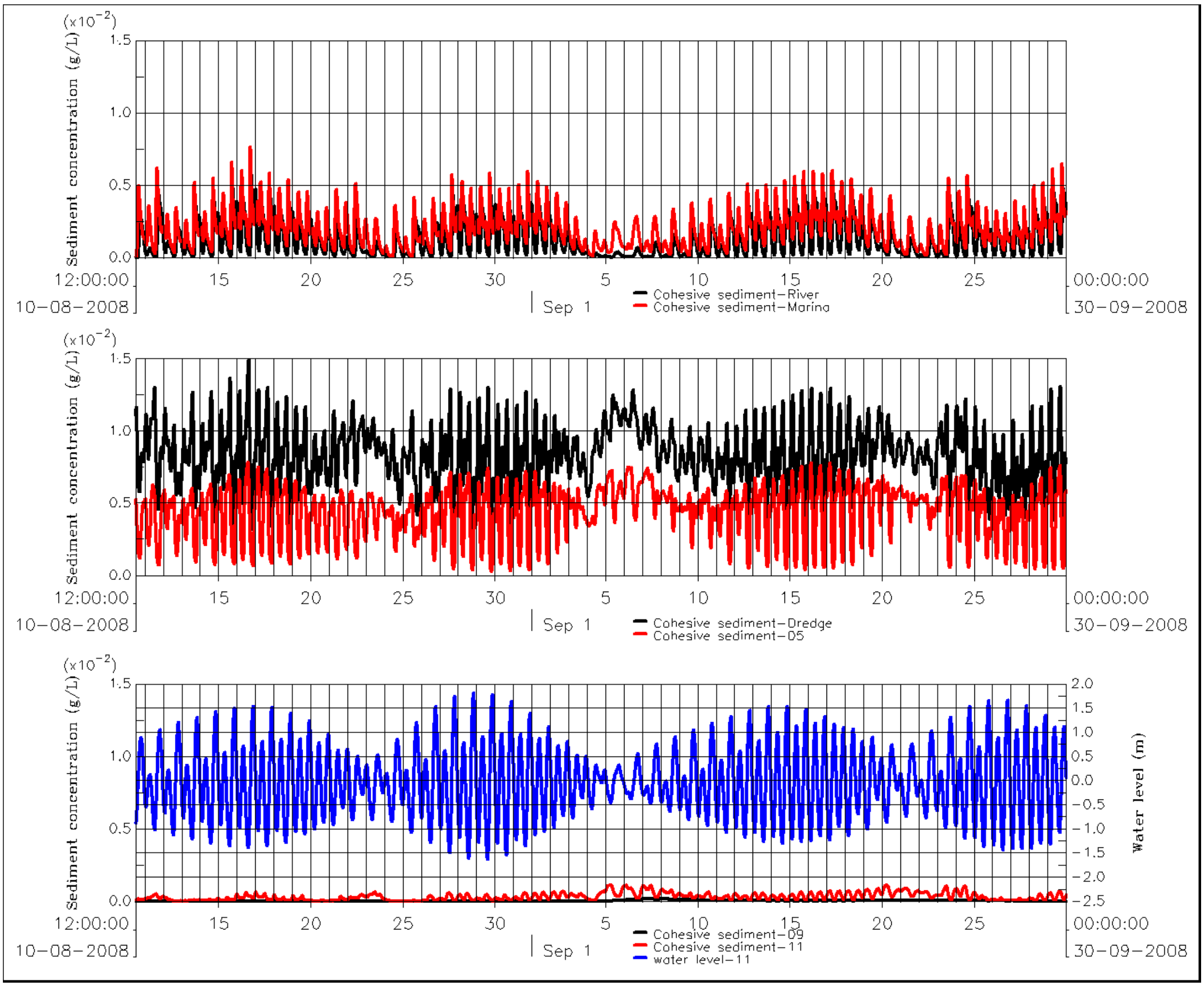
201 Charlotte Street Brisbane QLD 4000 Australia 61 7 3316 3000 61 7 3316 3333 bnemail@ghd.com.au www.ghd.com.au

Time series at several locations (defined in Figure 3-47) are plotted in Figure 3-48, with the spatial variation of the dredge plume during a spring tide presented in Appendix I. The time histories provide an understanding of peak suspended sediment concentrations, and of the variable nature of plumes, whilst the spatial plots demonstrate the full extent of the plume, for the modelled conditions.

Time history plots are presented with units of g/L x 10^{-2}. Hence, a value of 0.5 on the left axis is equivalent to 5 mg/L, 1 equates to 10 mg/L and so on. Where units are presented as g/L x 10^{-3}, the conversion is linear (i.e. a value of 10x10^{-3} g/L on the left axis equates to 10 mg/L.

As with all sediment modelling, values should be regarded as indicative rather than absolute. Actual values can change subject to type of equipment used, variable conditions, and in particular, significant wind and wave events. The plotted extent is similarly indicative.

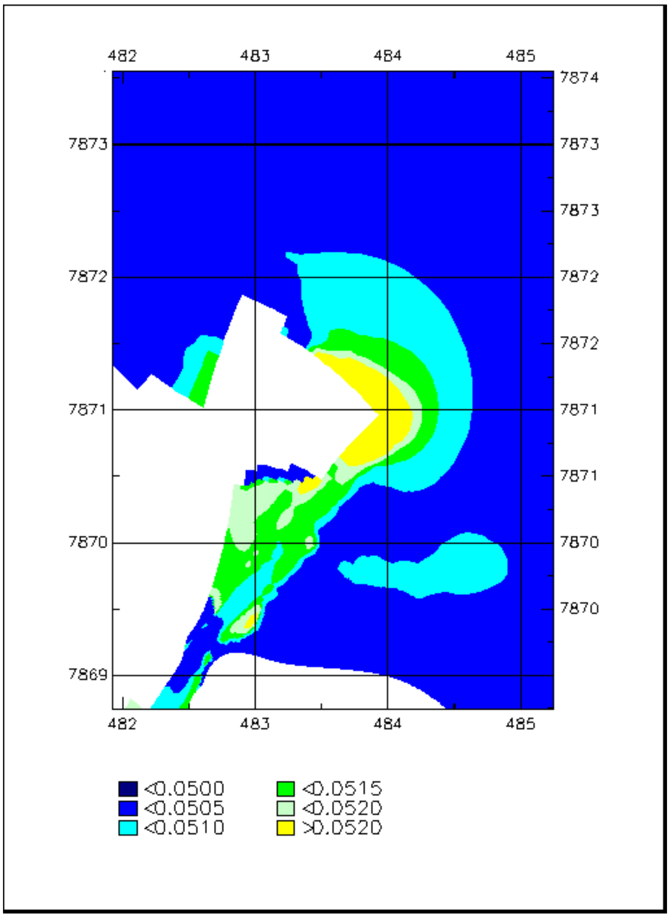
Figure 3-48 Suspended sediment concentration time series at key monitoring stations



With reference to the above figure, it is evident that suspended sediment concentrations associated with the plume are predicted to be relatively low, with a peak of 15 to 20 mg/L indicated in the middle panel.

With a median background concentration of 80 mg/L indicated in Section 3.9, this value is low. Even if doubled, there would be little impact evident in the form of increased turbidity.

Figure 3-49 Predicted sediment deposition for 2 months of dredging



An indication of the areas potentially subjected to sediment deposition is provided in Figure 3-49. The results relate to the 2 month period of dredging, and hence would need to be factored in accordance with the actual time of dredging. For example, if dredging is considered likely for a 6 month period, then the predicted sediment depths would need to be multiplied by a factor of 3.

The starting depth in the model is 0.05m (5cm), in that a layer of material 5cm in depth is assumed to exist prior to dredging. Hence, the main point of interest is to identify the depth of dredged material exceeding 0.05m.

By way of example, the green colour in Figure 3-49 denotes <0.0515m. That is, the estimated depth of deposited material for the 2 month period is 0.0015m, or less than 1.5mm. Yellow is therefore >2mm (and potentially up to 3mm). On this basis, and recognising that the period of simulation is 2 months, the total sediment depth could be 4 to 6 mm in the yellow area if dredging were to occur for a 4 month period, or 6 to 9mm for dredging over a 6 month period. This estimate is conservative, in that it does not allow for the resuspension and transport of deposited material during storm events that might occur within the 6 month period.

An additional observation relates to the boundary conditions of the model, and their affect on results. The dredge plume run is driven by a combination of tide plus 0.71m waves coming from just north of east. Hence, deposition patterns are more likely to be pushed to the west. Under different wave conditions, it is therefore possible that some of the material might stay (deposit) more to the east of where indicated by Figure 3-49.

The results of sediment transport modelling illustrate that the relatively low sediment loading from the proposed dredging works is unlikely to generate a plume of either significant concentration or extent. Modelling undertaken (driven by tide with 0.7m waves) indicates the spatial scale of the sediment plume is confined to a local scale of a few hundred meters, with maximum concentrations of the order of 20 mg/l close to the sediment source. The plume is not predicted to extend over any environmentally sensitive areas, other than at low concentrations, which lie well within the natural variation in turbidity.

The spatial plot does suggest a net transport to the northwest, though this is due in part to the wave conditions that drive the model. This is confirmed by consideration of time series data at sites 8 and 12, both of which show an increase in sediment concentration over the model duration. It would therefore be reasonable to expect that a differing wave conditions might result in a plume extending further to the east (i.e. into Cleveland Bay), but the concentrations would remain low in comparison to naturally occurring levels.

With median background turbidity measured at 80 mg/l, there does not appear to be any significant potential impacts associated with the dredge plume. Furthermore, it is noted that the 95th percentile value is over 100 NTU (or over 350 mg/L), and hence the addition of the background value of 80 mg/L to the predicted concentrations arising from the plume is not likely to lead to the 95th percentile value being reached. This conclusion is unlikely to change unless a completely different dredging operation to that proposed occurs.

3.8.6 Mitigation of impacts

Coupled hydrodynamic, wave and sediment transport modelling was undertaken in order to describe the existing hydrodynamic characteristics of Cleveland Bay, and in order to assess potential impacts associated with the construction of the proposed marine precinct and associated breakwaters. The modelling exercise provides an understanding of general circulation patterns in Cleveland Bay (as driven by tide and waves) as well as informing details of circulation, sedimentation and flushing patterns in the vicinity of the proposed marina and breakwater development within the Precinct.

Predicted impacts are low, leading to a limited need for formal mitigation measures.

The following conclusions can be derived from this study.

- There is no significant impact on water levels as a result of the proposed development under the driving forces of tide and wave (both prevailing and 1 year storm wave) conditions. However an increase in water level of up to 0.25 m is observed behind the proposed eastern breakwater during 100 year floods in the Ross River, albeit that this increase occurs at low tide;
- Tidal current magnitudes are expected to be reduced significantly at the proposed Marina site while an increase in current between the breakwaters is predicted. This will lead to an

increased potential for sedimentation within the marina, which will need to be catered for in estimating ongoing maintenance requirements.

- Absolute values of shear stress appear to remain relatively low (i.e. less than the 1 N/m2 threshold for erosion) under the majority of conditions, with increases in bed shear typically less than 0.5 N/m2. However, during spring tide flood flows, bed shear values exceed 1.25 N/m2 with differentials as high as 1.0 N/m2.
- Under major river flood conditions, bed shear stresses could potentially increase by 5 – 20 N/m2 in the entrance and at the tail of the eastern breakwater. This imposes a risk of scour, which will need to be addressed during design.
- The flushing time for contaminants increases by approximately 12 hours (i.e. an increase of 35%) over the existing conditions for most sites within the Marine Precinct, including the proposed marina. This potential increase in flushing time is not like to have a high impact as most passive contaminants are flushed within 1.6 days, which is a relatively short time. No mitigation measures are recommended, other than ongoing monitoring of water quality.
- Dredge plume modelling was undertaken for a period of one month to assess the potential impacts of dredging in the navigation channel closest to the breakwater entrance. The sediment plume has maximum concentration of approximately 20 mg/l in the vicinity of the dredge source and extends a few hundred meters radially outwards. Management of the dredge program will require monitoring, as undertaken for similar programs. Given the low magnitude of predicted turbidity, the modelling suggests that measures such as silt curtains are unlikely, though use of one near the mouth of the Ross River should be considered.
- Depths of sediment deposition are estimated to be of the order of 2 to 3mm per 2 month period. Actual values will depend on ambient wind and wave conditions, the dredge used, and the amount of material in suspension during natural turbidity events, which have been measured at an order of magnitude higher than those predicted for the dredging activity. If dredging were to continue for a period of 6 months, then 6 to 9mm of material is predicted to settle.

3.9 Water and sediment quality

3.9.1 Description of environmental values

3.9.1.1 Overview

The TMPP is located in the tidally influenced river mouth of the Ross River. The mouth of the Ross River has been highly modified over the past 100 years, particularly with the development of urban areas and Port of Townsville facilities on the northern bank. Potential influences on water and sediment quality from the urban areas and Port operations include stormwater run off, accidental spills of hydrocarbons and other products and dust and spillage of bulk commodities that are imported and exported through the Port. Other impacts on water and sediment quality within the Project Area include inputs of heavy metals, hydrocarbons, pesticides and herbicides from catchment activities such as urbanisation, agriculture, Ross River Dam and the presence of light industry. The Ross River discharges into Cleveland Bay, which forms part of the Great Barrier Reef World Heritage Area. The Ross River is located within the Port of Townsville Limits, which do not form part of the Great Barrier Reef Marine Park.

A review of existing data and the collection of baseline water and sediment quality data was undertaken to provide a means of assessing the current state of the environment and to allow for the assessment of potential impacts from the development of the Precinct. The construction and operation of the Precinct will include activities such as dredging, dredged material disposal, construction of bunds and the introduction of various commercial marine industries, all of which have the potential to impact on water quality in both the short and long term. Management and mitigation measures have been identified to reduce these impacts on water and sediment quality and to assist in maintenance of the environmental values of the area.

3.9.1.2 Previous water quality studies

There is a substantial amount of literature and information available on the existing water quality environment, both in the study area and throughout Cleveland Bay a review of this information is provided in Appendix J. The following data on water quality was summarised from the available reports:

- Data recorded between March 1971 and October 1973 at the Mouth of Ross River had a temperature range from 17.8 to 30.7 ºC and a dissolved oxygen (DO) percent (%) saturation that ranged from 38.4 to 110.0% (Archibald and Kenny, 1980). These low DO levels were generally attributed to the Ross River receiving heavy organic pollutant loading from the meatworks, urban drainage and raw sewerage, at that time (Geoffrey Mill Pty Ltd, 1974);
- The typical maximum and minimum surface water temperature reported for the Port of Townsville area ranges from 19.3 to 32.4ºC over a yearly cycle (Hilliard *et al*., 1997); and
- Summer and winter surface salinities, under ambient conditions, range between 25 – 34 ppt and 33 – 35 ppt, respectively in the Port of Townsville (Neil *et al*., 2007).

Water quality data is collected is a part of the POTL Long-term Sediment Monitoring Program. This program encompasses a number of different locations over the Port of Townsville; the sites of interest to this report are the sites in Ross River adjacent to the Precinct area (RR3, RR5, RR7, and RR9). An indication of which POTL long term monitoring sites correspond to which EIS water quality monitoring sites is provided in Table 3-37 and these sites are shown in Figure 3-50.

Table 3-37 Comparison of POTL and GHD Water Quality Monitoring Sites in Ross River

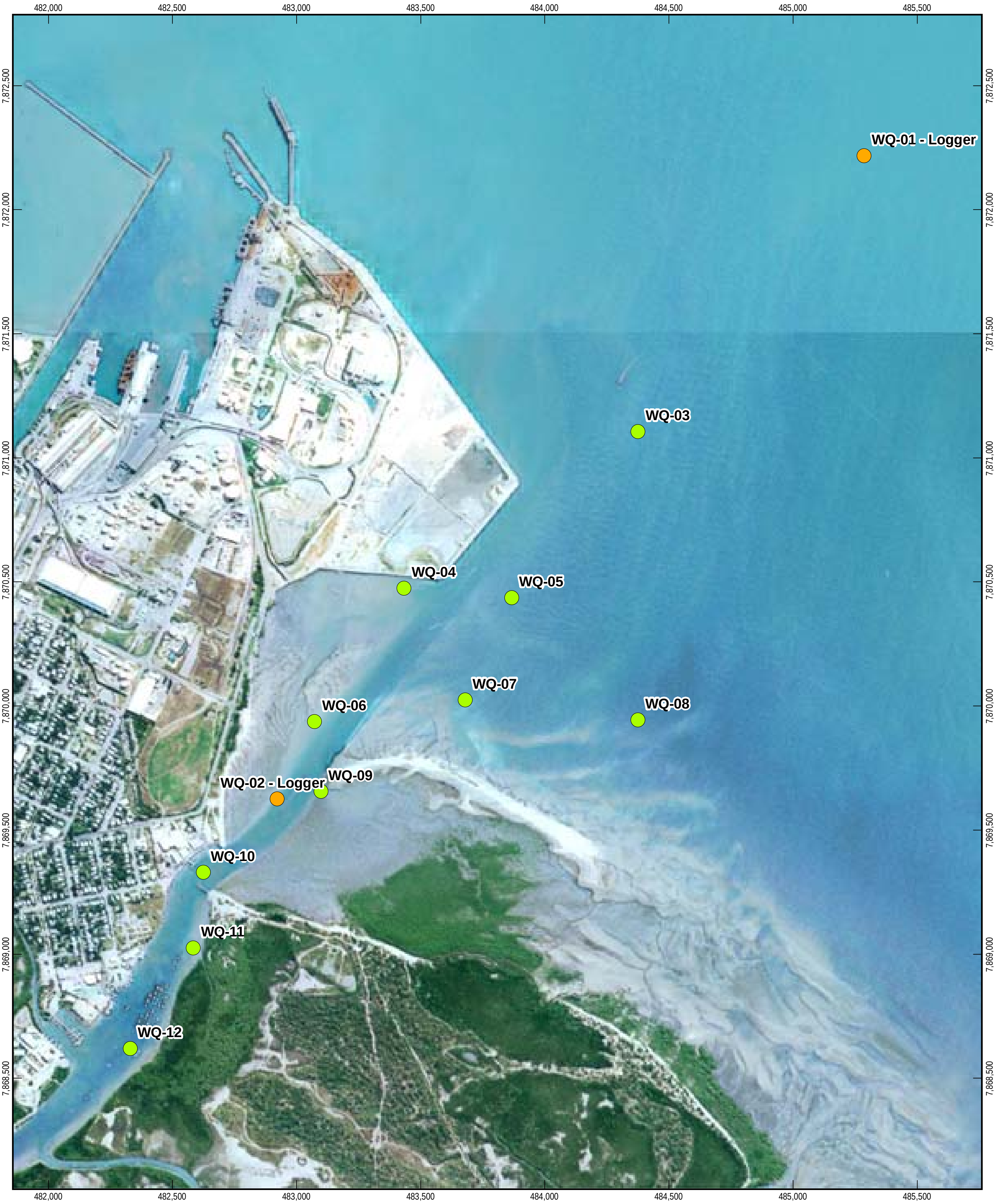
POTL Long Term Monitoring Sites	POTL Monitoring at this Site	GHD EIS Monitoring sites
RR9	Water quality and sediment quality	Near WQ3
RR7	Water quality and sediment quality	Near WQ7
RR5	Water quality and sediment quality	Just upstream of WQ10
RR3	Water quality and sediment quality	Upstream of WQ12

Water samples have been collected by POTL at these locations bi-annually since 2004. Samples were analysed for:

- Suspended solids;
- Total oil and grease;
- Petroleum Hydrocarbon;
- Silver, Barium, Cadmium, Cobalt, Chromium, Copper, Manganese, Molybdenum, Nickel, Lead, Antimony, Zinc, Arsenic;
- Total Nitrogen; and
- Total Phosphorus.

A review of the POTL data set indicates that the concentrations of suspended solids, total nitrogen and total phosphorus exceeded the QWQG (2006), while all the other results were compliant to the ANZECC (2000) 95% guidelines for toxicants and Secondary Recreation guidelines. Exceedances can be summarised as follows:

- The concentrations of suspended solids exceeded the QWQG (2006) of 15 mg/L in 26 out of 32 samples, with concentrations ranging from 7 to 55 mg/L;
- The concentrations of Total Nitrogen exceeded the QWQG (2006) of 0.2 mg/L in 14 out of 32 samples, with concentrations ranging from 0.13 to 0.32 mg/L; and
- The concentrations of Total Phosphorus exceeded the QWQG (2006) of 0.02 mg/L 15 out of 32 samples, with concentrations ranging from 0.01 to 0.044 mg/L.



LEGEND

- Long-term Logger Sites
- Sample Sites

1:20,000 (at A4)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Location of Sedentary Water Loggers and Water and Sediment Quality Monitoring Sites

Job Number	42-15399
Revision	A
Date	01 July 2009

Figure 3-50

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Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Monitoring Locations - GHD; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management). Created by: TH

3.9.2 Description of environmental values – baseline water quality studies

3.9.2.1 Overview

To describe existing water quality conditions of areas associated with the Precinct a baseline water quality monitoring program was implemented in Ross River as part of the Precinct Project EIS. The program involved six months of data collection from two sources:

- Sedentary water quality loggers; and
- Monthly vessel based monitoring involving in situ water quality measurements and collection of samples for laboratory analysis of water quality parameters.

The methodology for the baseline water quality monitoring program is described in detail in Appendix J (WQ report) and summarised following.

3.9.2.2 Methodology - Sedentary Water Quality Loggers

Fixed, *in situ* water quality loggers were deployed on the seabed at two locations within the Project Area (Figure 3-50). The deployed loggers were the JCU Mk9 sediment deposition and turbidity sensor, which is a 68HC11 based data logger that can simultaneously measure the deposition of sediment on a flat plate, the turbidity of the water from which the settling is occurring, Photosynthetic Active Radiation (PAR) and water pressure. One logger (WQ2) was deployed at the Ross River mouth (within the project footprint) and a second logger (WQ1) was deployed at the seagrass bed located just offshore from the Ross River mouth. Following review of the first month of monitoring the logger at WQ2 was retained for the remaining period of the monitoring program and monitoring at the Ross River mouth was discontinued. The location of each of the loggers is described in Table 3-38.

Table 3-38 Location of Sedentary Water Quality Loggers

Sites	Location	Approximate Depth (m)	Easting (GDA 94)	Northing (GDA 94)
GHD EIS monitoring site WQ1	In Cleveland Bay, outside of the Ross River mouth, at a known seagrass bed	6	0485287	7872218
GHD EIS monitoring site WQ2	Ross River channel marker, near mouth	3	0482921	7869626

Instruments were calibrated in the field prior to deployment. Loggers were deployed on 2 September 2008 and then serviced on a monthly basis. Each parameter (turbidity, PAR, water pressure and sediment deposition) was measured and recorded by the logger every 10 minutes. Logging units were attached to solid metal stands (30 – 40 kg), submerged and marked with a weighted rope to aid in relocating the loggers during the monthly download and maintenance events (Figure 3-51). The submerged logger setup was utilised to minimise the likelihood of vessel fouling and/or tampering as the loggers were deployed in locations with heavy commercial and recreational vessel activity.

During the 6-month sampling period attempts were made to retrieve the data logger monthly for data download and maintenance. This monthly period of deployment and maintenance has been shown through previous studies to provide the maximum level of confidence in data, with the logger being thoroughly cleaned of bio-fouling during each maintenance event before being redeployed. Weather conditions hampered monthly retrieval on a number of occasions. Table 3-39 summarises the field activities for the download and maintenance throughout the monitoring program.

During the program the long term logger data captured all types of conditions, including a large flood event, high seas without a flood event and calm periods. Obtaining a range of conditions for the area was the intent of the program and it is believed that the data collected adequately represents the conditions at the Precinct site (Prof. P. Ridd, pers. comm.). The sedentary water quality logger results are summarised in the following sections.

Table 3-39 Sedentary Logger Data Collection

Date	Logger 1 – Seagrass meadow	Logger 2 – Ross River mouth
2/09/2008 – 3/10/2008	Data retrieved	Data retrieved
3/10/2008 – 9/11/2008	Data retrieved	
9/11/2008 – 16/12/2008	Data retrieved	
20/12/2008 – 16/01/2008	Data retrieved	
16/01/2009 – 9/02/2009	Data retrieved	

Figure 3-51 Sedentary Water Quality Logger Prior to Deployment

3.9.2.3 Methodology – Vessel-based Water Quality Monitoring

Vessel-based monitoring was conducted to coincide with the maintenance and data download regime for the sedentary loggers. Two forms of data were collected during vessel-based monitoring; *in situ* physio-chemical parameters and water samples for laboratory analysis (Figure 3-52). Samples were collected from 12 monitoring sites located throughout the tidal section of Ross River. The sites are summarised in Table 3-40 and shown in Figure 3-50. Sampling dates are provided inTable 3-41.

Table 3-40 Water and Sediment Quality Monitoring Site Locations

Survey Site	Survey Location	Easting (GDA 94)	Northing (GDA 94)
WQ1 (nephelometer site)	Deepwater Seagrass Meadow	0485287	7872218
WQ2 (nephelometer site)		0482921	7869626
WQ3		0484376	7871106
WQ4		0483434	7870476
WQ5		0483867	7870436
WQ6		0483076	7869945
WQ7		0483679	7870025
WQ8		0484378	7869947
WQ9		0483099	7869665
WQ10		0482625	7869331
WQ11	Eastern Side of the Moored boats in Ross River	0482584	7869025
WQ12	Western Side of the Moored boats in Ross River	0482330	7868620

Table 3-41 Vessel-based Water Quality Monitoring Dates

Sampling Event	Date	Sampling Conducted
1	2nd September 2008	Water and Sediment
2	2nd October 2008	Water
3	4th November 2008	Water
4	1st December 2008	Water
5	22nd January 2009*	Water
6	9th February 2009	Water

* Delayed due to weather constraints: discussed further below

Water quality sampling was undertaken in accordance with the following guidelines and standards:

- Queensland EPA Water Quality Sampling Manual (1999);
- ANZECC and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) October 2000 Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1, The Guidelines (Chapters 1-7);
- ANZECC/ARMCANZ October 2000 Australian Guidelines for Water Quality Monitoring and Reporting (2000), Chapters 1-7 (ANZECC 2000a);
- Australian Standard Number 5667.1.1998 – Water Quality – Sampling – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples;
- Australian Standard Number 5667.6:1998 – Water Quality – Sampling – Guidance on sampling of rivers and streams;
- Australian Standard Number 5667.9:1998 – Water Quality – Sampling – Guidance on sampling of marine waters; and
- Environmental Protection (Water) Policy 1997.

The *in situ* physio-chemical water quality parameters were collected using a hand-held electronic multi-parameter water quality meter with logging capability for turbidity, dissolved oxygen, pH, salinity, redox and temperature (Figure 3-52). The data was stored on the logger and downloaded at the end of each field day. The *in situ* physio-chemical water quality values for each of the twelve locations had 10 replicates recorded at three depths (surface, middle and bottom).

Water samples were collected in laboratory supplied containers at each of the twelve monitoring locations and two sites were randomly sampled to provide quality assurance samples (Figure 3-53). Water samples were collected from approximately 0.2m below the surface of the water column at all sites for analysis of the following parameters:

- Total Suspended Solids (TSS);
- Chlorophyll a;
- Dissolved and total heavy metals (Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Manganese, Nickel, Lead, Vanadium, Zinc, Mercury);
- Oil in water; and
- Nutrients (Total Nitrogen, nitrate, nitrite, ammonia, Total Kjeldahl Nitrogen (TKN), Total Phosphorus and Reactive Phosphorus).

Additionally, the first sampling event also included analysis of pesticides, herbicides, polyaromatic hydrocarbons (PAHs), organotins, organochlorine pesticides (OCP), organophosphorus pesticides (OPP), Total Petroleum Hydrocarbons (TPHs) and BTEX. As these potential contaminants were not present at concentrations exceeding the adopted water quality guidelines, they were excluded from ongoing monthly sampling.

Water samples were stored on ice and couriered overnight to the NATA accredited ALS Laboratory Group for analysis under Chain of Custody documentation (Appendix J).

Figure 3-52 In-situ Water Quality Monitoring

Figure 3-53 Collection of Water Samples for Laboratory Analysis

3.9.2.4 Results of Baseline Water Quality Monitoring

This section summarises the results of the baseline water quality monitoring program, including comparison to adopted water quality guidelines.

Rainfall

The tidally influenced section of the Ross River receives freshwater inflows from the catchment during some rainfall events. There was a substantial amount of rainfall received in January and February of 2009, which influenced the results of the water quality monitoring program (Table

3-42).

Table 3-42 Comparison of the Average Rainfall Statistic to Total Rainfall During the Monitoring Program

Townsville Rainfall (mm)		
Month	**Rainfall average statistic**	**Monthly rainfall during the water quality monitoring period**
September	10	0.8
October	24.8	4.2
November	58.9	113.4
December	125.7	178.8
January	268.5	664
February	296.6	989

3.9.2.5 Summary of Water Quality in the Project Area

Based on information collected during the monitoring program and using previous data from the Project Area this section provides a summary of water quality in the vicinity of the TMPP and surrounds and seeks to describe the likely anthropogenic and environmental influences on water quality and temporal and spatial variation in water quality. Full details of the data collected are provided in Appendix J.

Turbidity

The monthly boat based monitoring at multiple sites and the successful collection of continuous data at the deepwater seagrass monitoring site (WQ1) are considered adequate to inform the discussion and management of water quality impacts (Prof. P. Ridd, pers. comm.).

Results for turbidity (monthly and continuous data) and suspended solids indicate that the Ross River estuary and the area immediately offshore from the river mouth is a naturally turbid system and that turbidity is fairly uniform across the water column. The spatial trend shows that turbidity is generally higher in the Ross River sites than the offshore sites and the seasonal trend shows slowly decreasing turbidity leading up to December with a rapid increase post December during the heavy rain period.

The continuous logger data indicated that turbidity was regularly elevated above the QWQG (2006) and ANZECC (2000) guidelines, which is consistent with the POTL long term monitoring data. The continuous logger data showed a correlation between increased wave action and increased suspended solids concentrations and turbidity within the water column (Figure 3-54). This is supported by the study by Sinclair Knight (SK 1991), which suggests that wind and wave induced resuspension are primarily responsible for elevated suspended solids, and therefore turbidity, in the Cleveland Bay area. This has also been confirmed by a number of other studies on sediment transport and hydrodynamics in Cleveland Bay and the Port surrounds as referenced in and determined by GHD (2004a) in their hydrodynamic modelling study of the Port of Townsville Outer Harbour. During monthly vessel based monitoring, it was also observed that increased turbidity at shallow monitoring sites resulted from wind and wave induced resuspension of fine sediments from the seafloor.

There does not appear to be a strong correlation between tidal state (neap/spring), as shown by water depth recorded by the continuous loggers, and turbidity or suspended sediment concentration (Figure 3-55). This indicates that tidal currents may not be a driving factor for turbidity in the vicinity of the Project Area. However, it is possible that on a low spring tide, when water depth is substantially reduced, tidal currents out of the Ross River mouth will also result in resuspension of bottom sediments.

The vessel based monitoring program also recorded elevated turbidity throughout the water column at all sites during the February 2009 monitoring event, which is thought to be a result of inputs of sediment laden runoff from the Ross River catchment. The elevated turbidity and suspended sediment concentrations recorded at WQ1 during January/February 2009 were similar to the elevations seen in mid-late October 2008, when there was no significant rainfall (Table 3-42). However, much higher sediment deposition was recorded at WQ1 during January/February 2009 compared to October 2008, indicating that the freshwater inflow from the Ross River catchment resulted in the mobilisation of sediments from the estuary into the marine environment.

Therefore, two environmental variables appear to influence sediment concentrations in the water column in the Project Area; wave induced resuspension of bottom sediments and the inflow of sediments from the Ross River estuary during rainfall events. Both of these are natural events, although clearing for agriculture and housing estates in the catchment will have increased the input of sediment in runoff into the estuary from rainfall since development of the catchment began.

As expected, elevated turbidity was linked to reduced light availability (measured as PAR) at the deepwater seagrass community (WQ1). This indicates that the seagrass and other subtidal and intertidal benthic communities in the vicinity of the Project Area regularly experience elevated turbidity and consequent low light levels. There were occasions where turbidity at the deepwater seagrass community was elevated above 50 NTU for sustained periods (hours and days), resulting in very low or no PAR levels. During periods of lower wave action, deposition of sediments increased at the continuous logger site WQ1.

A comparison of the continuous logger site data for September 2008 at the estuarine site WQ2 and offshore site WQ1 indicated that mean turbidity was higher at WQ1 (33.7 NTU at WQ1 compared to 9 NTU at WQ2). The maximum values for September were however similar at both sites (178.6 NTU at WQ1 and 152.2 NTU at WQ2). Vessel based monitoring in September was undertaken on a low tide during windy conditions. The elevated turbidity recorded at all monitoring sites during this event was a result of wind and wave induced resuspension.

Figure 3-54 Turbidity (NTU) at WQ1 and Wind Speed (m/s) from September 2008 – February 2009

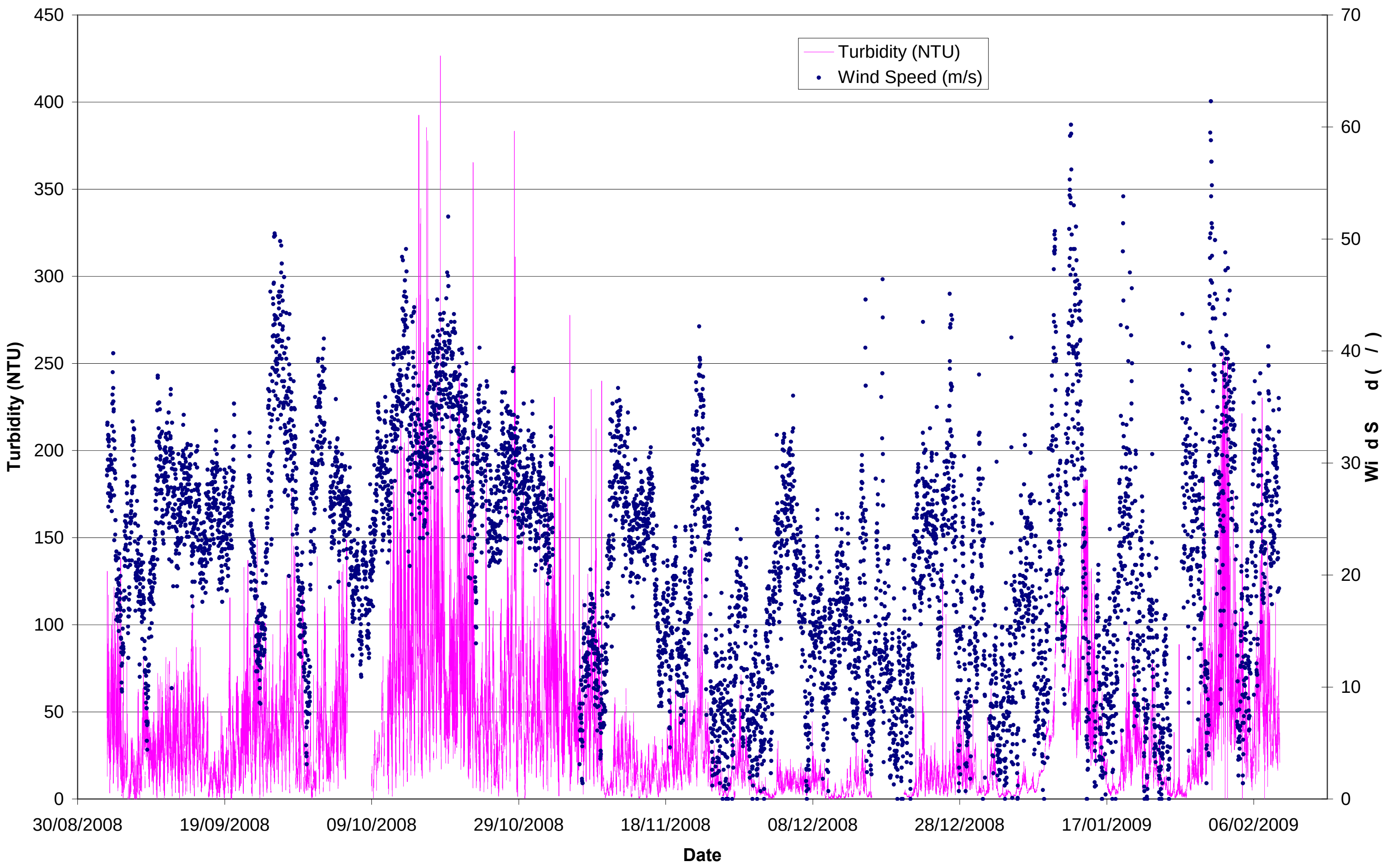
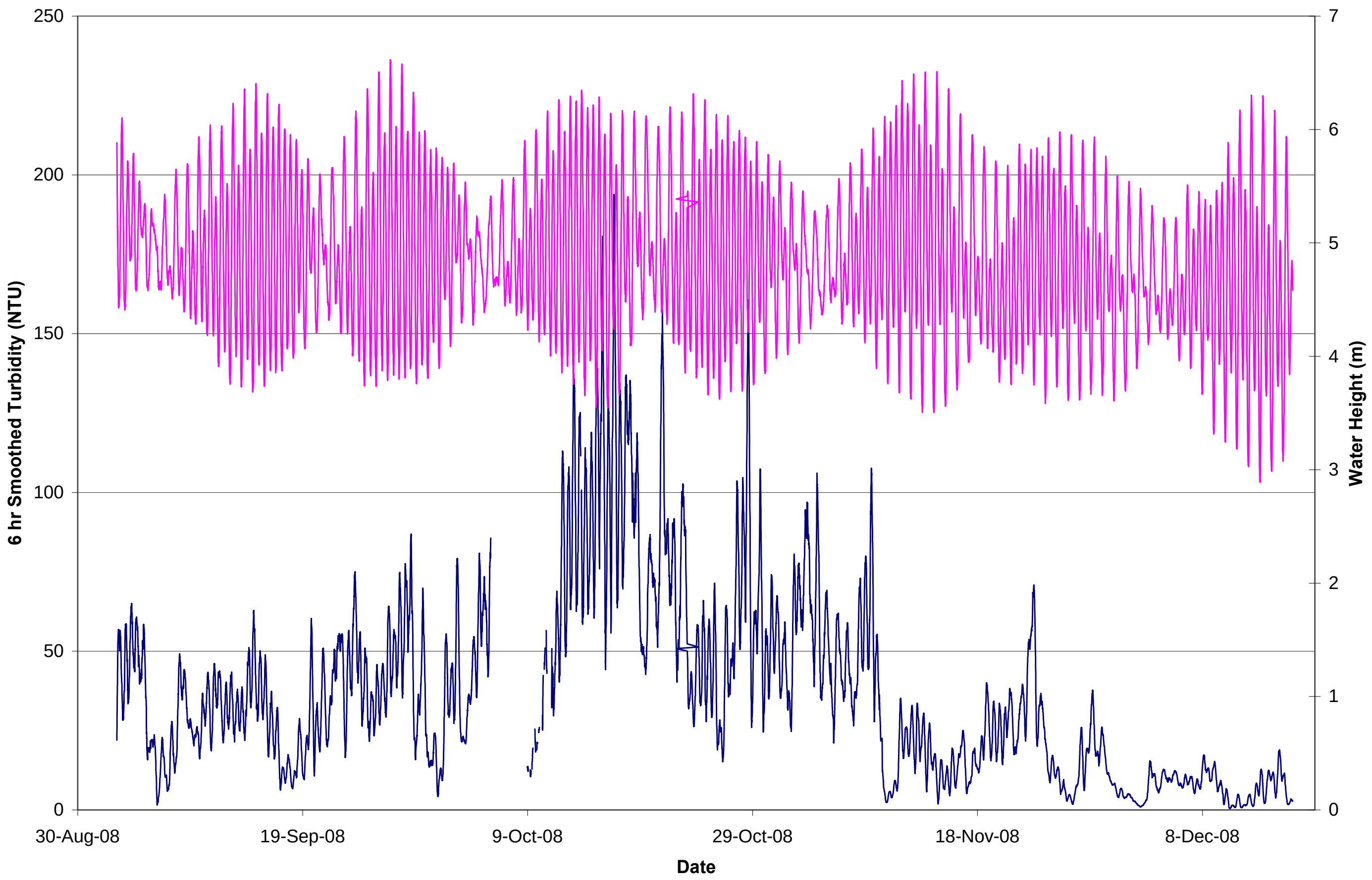


Figure 3-55 Turbidity (NTU) and Water Height (m) at WQ1 from September – December 2008



Nutrients and Inorganics

Generally the water quality at all twelve monitoring sites examined during this study exceeded the QWQG (2006) over the six sampling events for:

- Total Suspended Solids (with the exception of November WQ5, WQ9 and WQ12; December WQ1-8, WQ11-12; and January WQ1, which were all below the guideline level of 15 mg/L);
- Ammonia (guideline level of 8 g/L);
- Total Nitrogen (with the exception of November WQ 4, WQ5; and February WQ1-4, WQ6-12, which were all below the guideline level of 200 g/L); and
- Total Phosphorus (with the exception of January WQ2, WQ3, WQ4, WQ6 and WQ7; and February WQ1-4, WQ6, WQ7 and WQ8 which were all below the guideline of 20 g/L).

Twenty-two of the 60 samples collected during the monitoring program exceeded the QWQG (2006) for Total Oxidised Nitrogen of 3 μg/L and 10 of the 60 samples exceeded the QWQG for Reactive Phosphorous of 6 μg/L. Concentrations of ammonia did not exceed the ANZECC 95% trigger value of 0.91 mg/L, with the highest value being 0.17 mg/L, however, all sites were generally over the ANZECC general recreational guideline value for ammonia of 0.01 mg/L.

This demonstrates that both the long term POTL monitoring data and the EIS vessel based monitoring data showed elevations of nutrients above the QWQG (2006) guidelines in many of the samples collected. This indicates an anthropogenic input of nutrients, such as sewage effluent and fertilisers from urban and agricultural sources.

Results from the vessel based water quality monitoring program showed substantially higher nutrient concentrations at sites WQ10, WQ11 and WQ12, which are located in the vicinity of the existing boat moorings in Ross River (Figure 3-50). This suggests the presence of these moorings is influencing the water quality in that section of Ross River.

Chlorophyll a

The QWQG guideline for Chlorophyll *a* is 2.0 µg/L or mg/m^3. The highest Chlorophyll *a* value recorded during the monitoring program was 29 mg/m^3 at WQ6 in February 2009. This high value is believed to be from the detritus and weed observed in the area during the period of high flow from the Ross River.

With the exception of four sites that recorded values equal to the QWQG (WQ2 – December, WQ5 – January, WQ9 – November, and WQ10 – December), the chlorophyll *a* concentrations for the remainder of the program were below the QWQG.

Anthropogenic Contaminants

There appear to be only very minor inputs of pesticides into the lower estuary of the Ross River, with one compound present above laboratory limits of reporting in the first monitoring event. Pesticides are likely to be sourced from the upstream rural and urban catchment. Inputs of other anthropogenic contaminants from urban areas and the Port operations also appear to be low, with the exception of some localised, minor elevations in oil and grease surrounding the existing boat moorings in the upper estuary.

The POTL long term water quality monitoring program has not recorded concentrations of metals exceeding the ANZECC (2000) 95% trigger values for toxicants, however, the six month vessel based monitoring program recorded the concentration of a number of metals in exceedance of the ANZECC (2000) 95% trigger values. These included concentrations of chromium, copper, cobalt, lead and manganese. Exceedances occurred at various times through the program and were not restricted to any particular site or sampling event.

Locations upstream in Ross River have a long history of marine infrastructure construction and maintenance, including vessel maintenance. Further, a land fill area for domestic waste was previously located adjacent to Ross River upstream from the existing Precinct site. The recorded exceedances in metal contaminants are likely related to upstream industrial uses of the Ross River. Contamination from existing port activities on Ross Creek is not likely as the current and prevailing wind directions are to the north-east.

The different recordings between the POTL long term monitoring program and this program may be a result of different laboratory analysis techniques, with the EIS monitoring program achieving lower limits of reporting and being more sensitive. It did not appear that the concentrations of metals recorded in the vessel based monitoring program were correlated to the turbidity levels recorded at the time of monitoring, nor did the elevated readings persist on all sampling occasions. This indicates these findings are a transient occurrence for the area and not necessarily related to sediment disturbances. Rehabilitation of upstream lands from where contamination may be occurring would assist in reducing potential for water quality degradation in the Precinct area.

Environmental Variables

The influence of environmental variables on turbidity in the Project Area was discussed in an earlier section. The six month monitoring program also captured a significant rainfall period in January and February of 2009 when Townsville received greater than the annual average rainfall in a period of two months (Table 3-42). The vessel based monitoring identified a halocline following the significant rainfall in January/February 2009, with many of the surface samples collected for laboratory analysis being classed as freshwater samples based on their low salinity.

Other water quality parameters also varied with environmental conditions. For example, the concentrations of dissolved oxygen and nutrients (total nitrogen and total phosphorus) decreased with the inflow of freshwater from the catchment in January/February 2009. The exception was WQ10 – 12, where the concentration of total nitrogen and total phosphorus did not vary greatly from the first few months of sampling. Interestingly, the concentrations of oxidised nitrogen (a more bioavailable form of nutrient) exceeded the QWQG (2006) in January/February 2009 at most sites, indicating the influence of the freshwater inflows on nutrient forms and availability in the marine environment. The potential impact of this on cyanobacterial blooms is discussed below in Section 3.9.7.2.

3.9.3 Potential Impacts and Mitigation Measures

3.9.3.1 Impact Assessment

The potential impacts of construction and operation of the Precinct on water quality are:

- The generation and migration of turbid plumes from capital and maintenance dredging;
- The mobilisation of contaminants into the water column (including nutrients and acid sulfate soils) during capital and maintenance dredging; and
- The discharge of contaminants from various marine industries into Ross River.

3.9.3.2 Construction

The Precinct will be constructed in stages, as described under Section 1.2.2, with the second stage potentially including the construction of an offshore breakwater on the southern side of the Ross River mouth and a short section on the northern corner of the river mouth. The key construction processes that have the potential to impact on water quality within the receiving environment include:

- Dredging to remove unsuitable foundation material and create access channel, swing basin and harbour basin;
- Placement of rock to construct revetments and offshore breakwater; and
- Placement of material behind revetments to create a land reserve.

A separate, detailed construction methodology report has been prepared for this project and the outcomes of this report are summarised in Section 2.4. Other sections of the EIS also summarise the results of the geotechnical and acid sulfate soil investigations (refer Section 3.2), which provided a characterisation of the materials to be dredged to construct the Precinct. The general outcome of these investigations were that there is a large amount of material that is not suitable for use in construction of the Marine Precinct, both from a geotechnical and acid generating potential, without substantial treatment and management. It is therefore likely that this material will be dredged and disposed offshore. The environmental investigations and approvals for the offshore disposal component of this work are being addressed by POTL under a separate investigation and approvals process, therefore, this EIS focuses on the impacts of dredging, marine construction and dredged material disposal within the Marine Precinct revetment and does not consider the offshore disposal site in detail. For completeness, a summary of the potential impacts of disposal of dredged material at the offshore disposal site has been prepared from a desktop review of previous studies and monitoring programs.

The potential impacts and mitigation measures for each of the construction processes is outlined in Table 3-43, and a summary of potential impacts from offshore disposal are provided following.

Potential Impacts of Offshore Disposal

A number of studies have been conducted dating back to 1978 examining potential impacts of ocean disposal at the PoT ocean disposal ground. These cover a comprehensive scope including impacts on benthic communities and modelling of onsite/offsite effects of disposal. This includes work conducted by Maunsell in 2008 underpinning preliminary studies for the Port Expansion project. Given the comprehensive work conducted previously, including very recently, it was not deemed necessary to repeat any studies. To develop understanding of the potential impacts of offshore disposal for the TMPP these previous studies and their findings have been reviewed. Technical review comments relating to the behaviour of sea bed material deposited at the offshore spoil ground is provided in Appendix J. A summary of this information in combination with an understanding of proposed dredging/construction activities for the TMPP (as provided under Section 2 of this report) and potential for impacts on the ecology of the area is provided here.

It has been demonstrated that dredged material placed at the offshore disposal site settles rapidly and has little offsite influence (Mud Dynamics Group 1989, TPA 1995 Part 1, Cruz 2000). Information reviewed (refer Appendix J) indicates that during placement operations near-bed suspended sediment concentrations elevate but that any impacts remain close to the dump site. Dredge plumes have little impact upon the background water quality, which is naturally turbid, and also rapidly dissipate (within hours) following cessation of dredging under most conditions.

For the fraction of material that is remobilised, sediment redistribution from the offshore spoil ground occurs naturally and is directed towards southern Cleveland Bay mainly under relatively large swell conditions (Benson *et al.* 1994 and Maunsell 2009). According to Benson *et al.* (1994) impacts from the remobilisation of dumped material from the dump site may take place either as long term dispersion under low to medium level hydrodynamic conditions, or as events under major storms or cyclones. Some resuspended material may be flushed from the bay but some may be deposited in sub-tidal flats containing seagrass and in mangrove swamps.

TPA (1995, part 1) and Maunsell (2009) confirm this finding noting that while, in general, the disposal site is considered stable, redistribution of dumped sediments is likely to occur during periods of high wave energy. Redistributed material under typical hydrodynamic influences comprises primarily the fine silt fractions. Heavier sand fractions mix down through the sediment profile (TPA 1995, Dump Site Characterisation). Exceptions to this may occur during severe storm disturbances such as cyclones.

WBM (2009, Draft) concludes that no impacts from the disposal operations have been found at the ocean disposal ground. This reaffirms an ecological study finding from Cruz (2000) that determined that the benthic fauna of the ocean disposal ground is adapted to regular disposal activity and that offsite impacts decay rapidly in space and time with little influence on the benthic ecology of the area.

Based on the reconciliation of the above findings and considering the volume of material expected to be dredged for construction and operation of the Precinct (refer Section 2) it is predicted that:

- Most of the material dredge for the TMPP will remain at the disposal site during the disposal operations subject to the following conditions:
  - placement of material in depths in excess of 12 m;
  - placement operation undertaken under environmental conditions consistent with the operation constraints of the likely dredging plant;
- The soft clay and sand fractions of the material are expected to remain on site; and

- Subject to these conditions, the plumes generated during the proposed placement operations will have little offsite impact and decay rapidly following cessation of disposal activities.

It is noted that based on studies to support the water and sediment quality investigations of this EIS that a proportion of the material that is proposed to be disposed offshore contains silt and mud fractions. This finer material may disperse from the disposal site over a relatively long period of time depending on the frequency of occurrence of high energy wave conditions, however, offsite ecological impacts are not considered to occur given the demonstrated resilience of the existing system to repeated disposal activities.

Further comment regarding the ecological significance of any potential offsite impacts from ocean disposal is addressed under Section 3.9.3.4 below.

Table 3-43 Summary of Potential Impacts of Precinct Construction on Water Quality

Construction Aspect	Construction Process	Potential Impacts	Mitigation Measures
Dredging to: 1. remove unsuitable foundation material from beneath offshore breakwater 2. create a swing basin, access channel and harbour basin Backfilling of trench dredged beneath offshore breakwater	Material removed from seafloor by a backhoe dredge into a split hopper barge (offshore disposal) Dredged trench for offshore breakwater replaced by sand from land or marine source If marine source of sand utilised, cutter suction dredge used to pump and fill the trench; if a land based source of sand used, spreader barge used to fill the trench	Increased turbidity in the vicinity of the backhoe dredge and from hopper barge overflow Migration of turbid water into Cleveland Bay on an ebb tide and upstream Ross River on a flood tide Mobilisation of contaminants into the water column Disturbance of acid generating material	Use of silt curtains around construction site where practical to prevent migration of turbid plumes over sensitive habitats. This is likely to be most relevant for the dredging of the harbour basin in Stage 2 Monitoring of water quality during dredging and comparison of results to site specific water quality objectives for turbidity Sediment sampling undertaken for the EIS determined that surface and some below surface sediments are considered suitable for unconfined ocean disposal and are compliant to the EILs for contaminated land, therefore the risk of contaminants being mobilised into the water column is considered low Disposal of potential acid sulfate soil material offshore, which limits the potential for oxidation and acid generation A separate, detailed sampling is being undertaken by POTL for the assessment of all the sediment that is to be disposed offshore
Placement of rock to construct revetments and breakwater	Rock sourced from land based quarry Rock tipped from trucks off existing shoreline or end of revetment wall Rock barged to offshore breakwater and placed by	Turbidity generated by resuspension of fine sediments when rock is tipped from trucks Introduction of contaminants into waterway from rock Mobilisation of contaminants	Removal of soft material from foundation prior to construction of revetment/breakwater will reduce the potential for placement of rock to stir up bottom sediments A clean source of rock will be utilised to provide the material for the revetment and breakwater walls Analysis of the rock material will be undertaken to determine that it is clean (i.e. meets Queensland Draft

Construction Aspect	Construction Process	Potential Impacts	Mitigation Measures
	barge mounted grab dredge	into the water column Spills or leaks of hydrocarbons from construction equipment into Ross River	Guidelines for the Assessment and Management of Contaminated Land Environmental Investigation Levels, 1998) Use of silt curtains around construction site where practical to prevent migration of turbid plumes over sensitive habitats Monitor water quality at sensitive habitats for compliance to site specific water quality objectives. Undertake dredge management responses to any observed deviations from water quality objectives, including potential for cessation of dredging works Regular maintenance of construction equipment Spill kits to be carried on all land and marine based equipment Emergency procedures to be in place All personnel to be trained in the use of spill equipment and emergency response procedures
Placement of material behind revetments to create a land reserve 1. land based source 2. marine based source	Hydraulic (cutter suction) or mechanical (backhoe) dredging to relocate suitable dredged material into bunded reclamation. Material to be dredged is PASS and should be handled accordingly. Decant waters containing residual silts and clays discharged into receiving	Some increased turbidity at dredging plant as a result of agitation of seabed material during dredging activity. Increased turbidity as a result of the decant of tailwaters if a marine based source of fill is used to fill revetment. No significant turbidity impacts predicted given high background levels of TSS.	Sediment sampling undertaken for the EIS determined that surface and some below surface sediments are considered suitable for unconfined ocean disposal and are compliant to the EILs for contaminated land, therefore the risk of contaminants being mobilised into the water column is considered low Monitor water quality at sensitive habitats for compliance to site specific water quality objectives. Undertake construction management responses to any observed deviations from water quality objectives. If turbidity levels exceed allowable thresholds for

Construction Aspect	Construction Process	Potential Impacts	Mitigation Measures
	environment. or Dry fill tipped from trucks off existing shoreline or bund wall into area behind the bund wall to create the reclamation. Swamp dozers used to spread fill as required.	Mobilisation of contaminants into the water column Spills or leaks of hydrocarbons from construction equipment into Ross River.	receiving environment due to dredging effects consider use of silt curtains to contain impacts or adoption of different dredge activity profiles (duration/frequency). Provide adequate spoil settlement times to allow settlement of TSS to acceptable discharge standards. Consider potential to discharge into inner harbour of Precinct and use silt curtains across this water body to further mitigate any detected impacts. Regular maintenance of construction equipment Spill kits to be carried on all land and marine based equipment. Emergency procedures to be in place. All personnel to be trained in the use of spill equipment and emergency response procedures.

3.9.3.3 Operation

There are two main activities that will potentially result in impacts from the operation of the Precinct:

- Construction and operation of businesses related to the marine industry; and
- Maintenance dredging to maintain the declared depths of the harbour basin, access channel and swing basin.

The assessment of potential impacts from operation of the Precinct facility has been undertaken on the Precinct Reference Design and industries likely to be housed within the Precinct, as defined by that design. The Reference Design is described in detail under Section 1.1 and Section 2 of this document. In brief, the expected operational industries include:

- Marine industry allotments including maritime infrastructure and vessel fabrication;
- Berth facilities including for trawlers, scientific and tourism vessels, provisioning activities, refuelling and for commercial and recreational users;
- Commercial and recreational chandlery;
- Defence force marine activities, including vessel maintenance
- Seafood industry cold storage and distribution facility;
- Small scale eateries to service industry within Precinct;
- Marine industry training facilities;
- Public and recreational use facilities including provision for 40 pile moorings; and
- A recreational marina.

The existing boats moored in Ross River appear to have impacted on water quality in the immediate vicinity of the moorings, with elevated concentrations of nutrients and minor inputs of hydrocarbons. Water quality in the Precinct basin and Ross River has the potential to be impacted if adequate controls on discharges from berths and moorings as well as the industries and activities that establish at the Precinct are not implemented.

General measures for the management of water quality impacts from the operation of the Precinct include:

- A condition of development on the Precinct will be that industries gain the appropriate environmental approvals and comply with the permit conditions and other relevant guidelines, standards and codes of practice for their industry;
- All owners/operators of activities and industries that establish at the Precinct will be required to prepare and implement an EMP for their activities; and
- Mooring leases will contain guidelines for boat owners in terms of waste disposal in particular and appropriate disposal facilities will be provided. Waste management impacts and mitigation measures appropriate for the Precinct facility have been considered under a separate report for the EIS studies.

Table 3-44 summarises the potential impacts on water quality, likely sources of these contaminants and proposed mitigation measures from operation of the Precinct facility.

Table 3-44 Potential Water Quality Contaminants from the Operation of the Precinct

Potential Contaminants	Likely Source	Mitigation Measures
◗ Nutrients	◗ Fertilisers on gardens ◗ Sewage from moored boats	Provision of appropriate waste disposal facilities for moored boats Compliance with the requirements of the Transport Operations (Marine Pollution) Act 2005 and Transport Operations (Marine Pollution) Regulation 2008
◗ Hydrocarbons	◗ Oil and grease from workshops ◗ Spills and leaks from construction equipment as marine industries are introduced ◗ Spills and leaks from mobile equipment and cars	Provision of appropriate waste disposal facilities for moored boats Installation of oil and grease traps in all workshops Adequate storage and bunding of fuels and oils Use of licensed waste disposal contractors and tracking of wastes where required
◗ Polyaromatic Hydrocarbons	◗ Runoff from hardstand areas due to deposition from incomplete combustion of fuels from cars, trucks and other mobile equipment	Only minor concentrations expected Install appropriate stormwater management measures
◗ Heavy metals	◗ Runoff from hardstand areas due to deposition from cars, trucks and other mobile equipment	Only minor concentrations expected Install appropriate stormwater management measures
◗ Antifoulants	◗ Waste from abrasive blasting and boat painting activities ◗ Leaching from moored and berthed vessels	All facilities to be licensed and comply with relevant standards, guidelines and codes of practice Adequate storage and bunding of chemicals and paints
◗ Sediments	◗ Runoff from exposed soil ◗ Dust creation during construction of marine industries	Protection of exposed ground surfaces with grasses or hydromulch prior to development Use dust suppression where required during construction of marine industries

Potential Contaminants	Likely Source	Mitigation Measures
◗ Hazardous chemicals	◗ Spills to ground or water from workshops and marine fabrication industries	Adequate storage and bunding of chemicals Use of licensed waste disposal contractors and tracking of wastes where required Appropriate emergency response equipment to be available at all businesses and at the moorings and berths Defined emergency response procedures for the Precinct
◗ Gross pollutants	◗ Inappropriate storage of wastes by individual industries and activities within the Precinct	Provision of adequate bins, including allowance for separation of recyclables Installation of gross pollutant traps on stormwater outlets Requirement for an EMP for each industry and activity that establishes at the Precinct

Legislation, Codes of Practice, Standards and Guidelines that should be applied to the operation of the Precinct include, but are not limited to:

- Transport Operations (Marine Pollution) Act 1995;
- Transport Operations (Marine Pollution) Regulation 2008;
- Environmental Protection Act 1994;
- Environmental Protection (Air) Policy 2008;
- Environmental Protection (Noise) Policy 2008;
- Environmental Protection Regulation 2008;
- Environmental Protection (Waste Management) Policy 2000;
- Environmental Protection (Waste Management) Regulation 2000;
- Environmental Protection (Water) Policy 1997;
- Abrasive Blasting Code of Practice 2004;
- Hazardous Substances Code of Practice 2003;
- Brisbane City Council – Operator's Environmental Guide – Pollution Solutions for Abrasive Blasters;
- ANZECC (2000) Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance; and
- Relevant Australian Standards (e.g. for storage and bunding of hazardous chemicals).

Maintenance Dredging

Maintenance dredging will be required on occasion to maintain the access channel, swing basin and harbour basin to their declared depths and to maintain shipping safety. Based on current maintenance dredging for the Ross River, it is likely that dredging will be required biannually and will be undertaken by a trailer suction dredger. Dredging in the harbour basin (Stage 2) should not be required as frequently and is likely to be undertaken by a cutter suction dredger.

The impacts of maintenance dredging will be similar to those of capital dredging, although the duration of the maintenance dredging programs will be less than the capital dredging programs. Sediment quality will be analysed prior to any dredging and appropriate disposal locations identified based on the physical and chemical properties of the material to be dredged. POTL will obtain all required permits for maintenance dredging and will implement mitigation measures and monitoring programs to minimise impacts on the receiving environment, in particular water quality.

3.9.3.4 Impacts on Sensitive Habitats

Potential Impacts of Turbidity and Sedimentation on Ramsar wetlands

The Bowling Green Bay Ramsar wetland area in the Townsville region is located approximately 10 km southeast of Townsville (by line of sight). Because of the considerable distance from the Ramsar wetland to the project area and the very localised nature of potential impacts from the TMPP it is not considered possible that any impacts on water or sediment quality from the TMPP will impact the Ramsar area. This is supported by coastal processes assessments (refer Section 3.8.2) that demonstrate longshore coastal transport occurs from the east to the west indicating any drift from the Precinct will move to the north west away from the wetland coastal area.

Potential Impacts of Turbidity and Sedimentation on Avifauna Protected by International Treaty Agreements

No removal of seabed or disturbance of marine habitats is proposed for the eastern bank area of the Ross River, across from the Lot 773 footprint. The area is heavily utilised by marine wading and migratory birds, which is reported under the Marine and Migratory Avifauna assessment for this EIS. Modelling indicates less than a 1mm change in sedimentation in the areas occupied by these species after two months of dredging and impacts to these species are not predicted from turbidity or sedimentation resulting from construction works. The identified populations currently persist under an existing regime of commercial activities, including dredging. Measures that should be considered to minimise potential to impact upon roosting birds are described addressed under Section 3.10.5.4. Under these measures the TMPP is not expected to impact upon international treaty obligations.

Potential Impacts of Turbidity and Sedimentation on Seagrasses

Seagrass meadows form an important component of coastal ecosystems and perform important functions such as nutrient trapping and recycling, providing food and shelter for many marine organisms, and assist sediment stabilisation (Roelofs *et al.* 2003).

The distribution of seagrass within the vicinity of the Project Area, described in detail under Section 3.10.5 includes a seagrass meadow in the subtidal area directly offshore from the Ross River mouth and low cover within the mangrove communities at East Bank on the southern side of the river mouth. The deepwater seagrass meadows seaward from the Project Area were described by Rasheed and Taylor (2008) as extensive but very patchy, low biomass seagrass. In the wet season, the majority of this meadow is *Cymodocea serrulata* with a mix of *Halophila* and *Halodule* species and in the dry season the seagrass species composition changed to form a monospecific *Halophila decipiens* meadow. This was supported by marine ecological investigations undertaken as part of the this EIS study and described under Section 3.10.5. This study also noted that the East Bank across from the Precinct facility site supported two seagrass species; *Zostera capricorni* and *Halodule uninervis* and two types of mangroves: red mangrove (*Rhizophora stylosa*) and grey mangrove (*Avicennia marina*) on the seaward margin of the mud flat.

Key potential impacts on these communities related to the proposed dredge works are elevated turbidity and sediment deposition or burial.

Seagrass communities are an important part of coastal ecosystems. Seagrass beds slow water movement, causing suspended sediment to fall out of the water column and trapping nutrients that would otherwise disperse into the surrounding ocean (McKenzie and Campbell, 2002). Several key functions of seagrass communities are summarised as follows:

- Seagrasses are the primary producers that contribute to the large quantities of fixed carbons, the basis of all food chains to coastal ecosystems;
- Seagrasses are important in stabilising bottom sediment as they slow water movement, promoting the sedimentation of particulate matter;
- Seagrasses are a part of the nutrient cycle in the aquatic system;
- Seagrasses supply shelter and refuge for both adult and juvenile animals; they also contribute large amounts of substrate for encrusting animals and plants; and
- Seagrasses are essential food for dugongs and also green turtles.

The distribution and growth of seagrasses is regulated by a variety of water quality characteristics such as temperature, salinity, nutrient availability, turbidity, and submarine irradiance (Dennison and Kirkman 1996; Abal and Dennison 1996). For example, it is well documented that the availability of nutrient resources affects the growth, distribution, morphology and seasonal cycling of seagrass communities (Short *et al.* 1995). In addition, seagrasses depend on an adequate degree of water clarity to sustain productivity in their submerged environment (Short and Wyllie-Echeverria 1996). Increased turbidity and sedimentation reduce water clarity, which can affect the health and productivity of seagrass communities (Abal and Dennison 1996).

The following details the likely impacts on seagrass communities associated with elevated turbidity and sediment deposition. There will be no physical removal of seagrasses as a result of the construction of the Precinct.

Elevated Turbidity

The level of impact that elevated turbidity during dredging and the disposal of dredged material will have on the seagrass will depend on the type of community that is present. Some seagrass species may be better adapted to variable light regimes and therefore tolerate high levels of suspended sediment and turbidity.

Variable turbidity regimes in the Project Area, including in relation to existing channel maintenance dredging activities, suggest that existing seagrass species distributions are adapted to temporal changes in turbidity. Rasheed and Taylor (2008) note that seagrasses in the vicinity of the Townsville port are likely adapted to high levels of turbidity both as a result of naturally occurring high turbidity for the area and also in response to existing levels of maintenance dredging and shipping activities. These compounding influences on turbidity are, however, recognised to be short-lived to which the meadows have resilience. Significant impacts may occur to the presence, taxonomic composition or biomass of meadows when the severity or duration of any particular impact exceeds levels of natural variation (Carruthers *et al.,* 2002, Erftemeijer and Lewis, 2006 and Orpin *et al*. 2004). Rasheed and Taylor (2008) and Collier and Waycott (2009) both note considerable risk of impact to seagrass meadow prevalence in the Townsville region from prolonged periods of reduced water quality resulting from compounding influences.

High levels of turbidity for long periods can place a major stress on primary producers such as algae, phytoplankton, and seagrasses. Seagrass has a relatively high light requirement, with most species requiring between 15 and 25% of surface irradiance to maintain key physiological processes (Biber *et al.* 2005, Cheshire *et al.* 2002). The reduction in light due to turbidity plumes from dredging has been previously documented as a key factor in seagrass mortality in Australia (Shepherd *et al.* 1989). Issues related to the maintenance of light availability are paramount to managing seagrass habitats (Deocadiz and Montano 1999). Prolonged turbidity such as that generated from extended dredging programs can lead to the attenuation of light, limiting photosynthesis and subsequently elevate the stress experienced by seagrass meadows.

Sedimentation

Seagrass may suffer impacts resulting in the smothering of existing substrates by sediments settling from the water column during the dredging process. Smothering of seagrass can weigh down leaves, restrict light penetration and cause stress on the plants.

The seagrass communities in the vicinity of the Project Area may experience an increase in sedimentation during dredging and marine construction activities (including ocean disposal of dredged material). Modelling undertaken for the Project indicates that when the dredge is positioned in the mouth of Ross River, sedimentation should not exceed ~1mm at the deepwater seagrass bed located offshore of the Ross River mouth over two months of dredging (Figure 3-56). Given the likelihood that these sediments will be resuspended by storm events or strong winds, it is not anticipated that the predicted level of sedimentation will have a significant negative impact on the seagrass beds in the vicinity of the Project Area.

Desktop assessment of ocean disposal also notes that seagrasses and other benthic communities within the area of potential impact (at the disposal site and up to 2 km from this site) have persisted through time with regular ocean disposal occurring at the spoil ground (Cruz 2000, Rasheed and Taylor, 2008 and refer Section 0). This demonstrates the ecological resilience of these communities to this activity and it not anticipated that the predicted level of ocean disposal will have a significant impact on the seagrass communities within the vicinity of the disposal ground.

Recovery of Seagrass Communities from Sedimentation

Despite the physical impact of sedimentation, seagrass communities maintain a natural resilience to the mobilisation and deposition of sediments (Figure 3-57). Physical disturbance is considered one of most important factors affecting the spatial structure and species diversity of seagrass communities (Fonseca and Kenworthy 1987, Clarke and Kirkman 1989). While disturbance is considered a significant factor in the distribution of species, tolerances to disturbance and sediment deposition vary between species. For example, large seagrass species such as *H. decipiens*, can maintain substantial photosynthetic surface even after large-scale burial. Small species such as *Halodule sp*. or *Halophila sp.* are often completely removed after very small sedimentation events. However these species tend to grow very quickly and recover to pre-event abundances in a short period of time (Duarte *et al.* 1997).

In a study undertaken by Sheridan (2004), the impact of sediment disposal from maintenance dredging on adjacent benthic habitats was measured. The study showed that seagrass populations in the area of disturbance were well established three years after dredging.

Figure 3-56 Plot of Indicative Sediment Depths (m) after Two Months of Dredging in the Ross River mouth (seaward corner of current reclamation). Yellow >2mm, dark blue <1mm

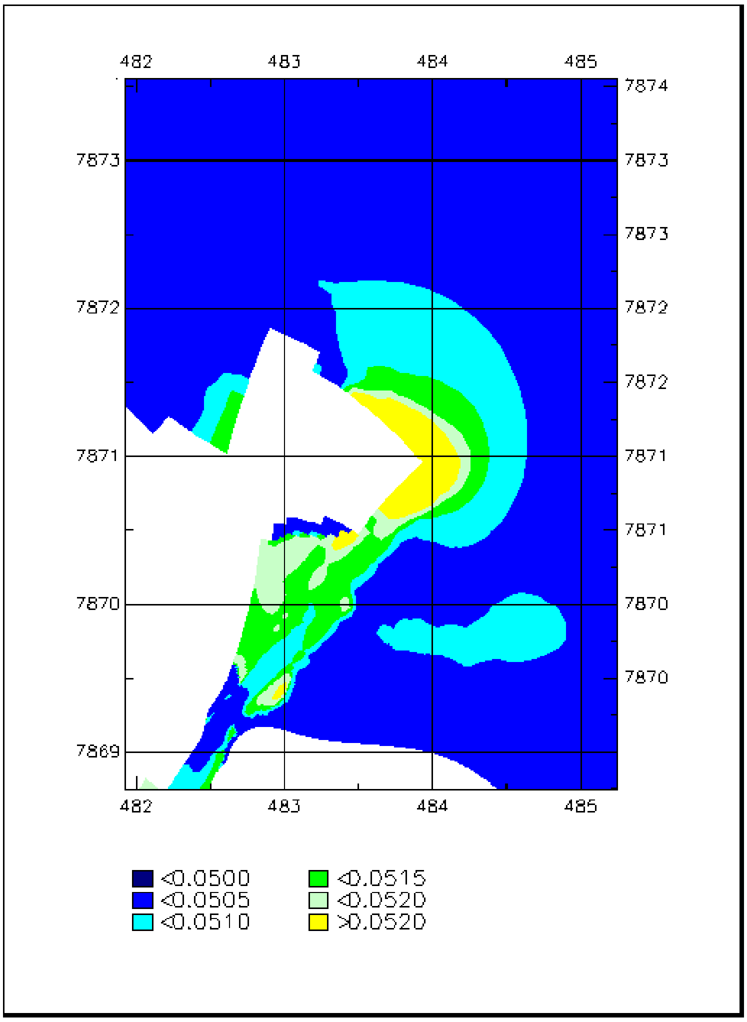
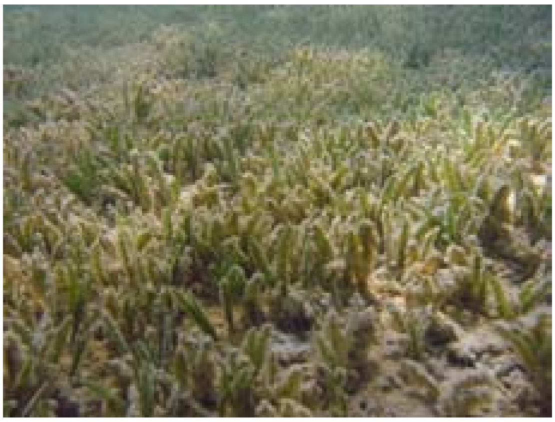


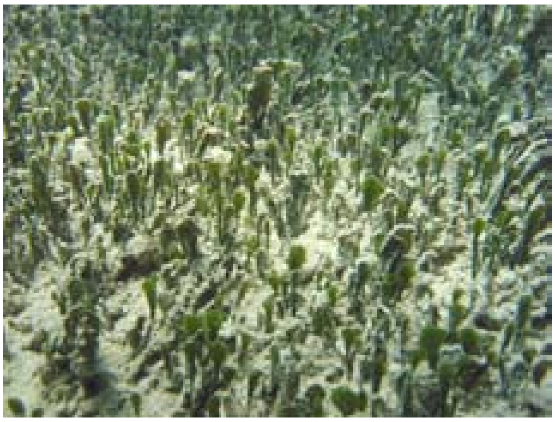
Figure 3-57 Seagrass and algal tolerance to sediment deposition events

Fine sediment deposition following suction dredge disposal (30 mm – 50 mm) (GHD 2002)



Natural deposition over near-shore seagrass beds (GHD 2004b)

Natural deposition over near-shore seagrass beds (GHD 2004b)



Natural deposition over near-shore algal bed (*Codium* sp.) (GHD 2004b)

Conclusions

Seagrasses established within the near-shore coastal waters surrounding the Project Area experience fluctuations in physical extremes, including variable salinity, light penetration, turbidity and sediment deposition regimes. Significant episodic elevations in turbidity occur naturally during wet season storm events and the passage of catastrophic events such as tropical cyclones. Despite these factors, and the history of dredging, ocean disposal and reclamation at the Port, seagrass communities continue to be present within 1 km of the Port and adjacent to the disposal ground.

Short term increases in turbidity associated with dredging, any required disposal and marine construction are considered unlikely to impact significantly on the broader distribution of seagrass within the Project Area for the following reasons:

- The documented survivorship of seagrasses in reduced light environments;
- The pulsed nature of turbidity impact over the dredging period resulting from broken cycles

of dredging and disposal and the physical influence of wave and tidal action on predicted/observed turbidity;

- The documented persistence of established meadows under existing, similar, levels of dredging and disposal; and
- Natural variability of the existing turbidity regime within the near-shore waters surrounding the Project Area.

Potential Impacts of Dredging and Sedimentation on Mangroves and Intertidal Communities

Impacts on mangrove and intertidal communities resulting from dredging and marine construction potentially include physical removal and elevated turbidity and sedimentation. The impacts of physical removal are summarised in Section 3.10.5.

Mangrove communities in the vicinity of the Precinct are adapted to the turbid near shore environments. These communities are adapted to estuarine environments that are typically turbid and generally act as traps for fine sediments in near-shore environments.

Modelling undertaken for the Project indicates that when the dredge is positioned in the mouth of Ross River, sedimentation should not exceed ~1mm around the mangrove communities in the vicinity of the Marine Precinct over two months of dredging (Figure 3-56). The intertidal and subtidal areas of the Ross River estuary generally consist of muddy bottom sediments (described in detail in Section 3.9.4). However, as the continuous water logger monitoring has demonstrated that resuspension of deposited sediments regularly occurs as a result of wind induced wave action, it is not anticipated that dredging will have a detrimental impact on the mangrove communities of the Project Area.

3.9.3.5 Site Specific Water Quality Objectives

The ANZECC (2000) guidelines favour the development of site specific water quality objectives, based on natural conditions and known tolerances of key sensitive species and habitats. The natural turbidity conditions recorded in the Ross River and offshore deepwater seagrass meadow are higher than the QWQG (2006), therefore it is appropriate to consider the development of site specific water quality objectives for turbidity for the construction phase of the Precinct. Turbidity is also the water quality parameter for which there is a large enough dataset across a range of environmental conditions at the sensitive habitat (WQ1, seagrass bed) to utilise in preparing site specific water quality objectives.

No site specific information is available on the physiological tolerance of the seagrass communities of the study area to increased intensities, frequencies and durations of turbidity. However, indirect information can be obtained by examining the natural fluctuations in ambient conditions under which the seagrass community is presently maintained. According to McArthur *et al.* (2004), the 95th percentile turbidity value represents a suitable tolerance threshold for a marine community in the absence of direct physiological response data. For WQ1, the 95th percentile turbidity value for the six months of continuous monitoring was 109 NTU. The approach of McArthur *et al.* (2004) recognises that sediment concentrations below this threshold are not of ecological significance, as the marine community has adapted to deal with the more frequent intensities and durations of turbidity to which they are exposed, including accompanying regimes of light attenuation and sediment deposition. The McArthur *et al.* (2004)

approach also considers intensities and durations to which the 95th percentile is exceeded and provides for these elevations as a set of allowable additional tolerance levels to which a duration of exposure is designated. This method has been used to develop indicative tolerances for this marine community, which are described in detail in Appendix J.

Data analysis indicates that the seagrass community at WQ1 regularly experiences turbidity levels of 109 NTU or greater for periods of 10 or 20 minutes. Occasionally, this community also experiences turbidity levels of 109 NTU or greater for extended periods, including one event of 13 hours in the six month monitoring program.

It is anticipated that the dredging program proposed for the Precinct will be undertaken in two separate stages:

- Stage 1: 38 weeks (8 weeks backhoe and 30 weeks cutter suction dredge)
- Stage 2: 30 weeks (8 weeks cutter suction and 22 weeks backhoe)

The dredging programs will extend for a similar length of time to the baseline monitoring program.

Based on the baseline turbidity data and likely length of the dredging program, Table 3-45 summarises the proposed water quality guidelines for turbidity during dredging to construct the Precinct. Compliance with these guidelines could be monitored via installation of continuous water quality loggers with remote download capability. Data would be downloaded regularly, with the frequency of download being relevant to onsite conditions and reviewed based on whether impacts were being observed at the sensitive habitats. Regular reports would be provided to the regulator, with exceedances of the durations and frequencies specified resulting in management actions, such as cessation of dredging to allow respite in elevated turbidity levels should these occur. The results of turbidity modelling outlined in this report suggest that it is unlikely that dredging will result in increases in turbidity above background levels at the sensitive sites that are of ecological significance and that any increase is likely to be over one tidal cycle only.

Table 3-45 Proposed Water Quality Guidelines for Dredging of Precinct

Duration (consecutive minutes in excess of 109 NTU)	**Frequency (number of incidences during dredging program)**
10	2 times per week
20	1 time per week
>30 minutes	14
>1 hour	10
>2 hours	10
>3 hours	7
>12 hours	1

3.9.4 Sediment quality and dredging – background

As previously summarised, the outcomes of geotechnical and acid sulfate soils investigations undertaken for the TMPP were that there is a large amount of material that is not suitable for use in construction of the Precinct, both from a geotechnical and acid generating potential, without substantial treatment and management and this material is likely to be dredged and disposed offshore. There is, however, potential for material reclamation to be considered during the detailed design process associated with finalisation of the Precinct configuration. For the purposes of this environmental impact assessment offshore disposal of the majority of material is considered as potentially more impactive than proportional reclaim of some material and, adopting a conservative approach, assessment against primarily disposing of material offshore has been conducted. Ability to reclaim material will reduce the level of impact described here.

The existing dredge spoil disposal permit for POTL is for five years from November 2007. This permit allows for disposal of a total of 2,750,000 cubic meters of material to the established offshore disposal ground within Cleveland Bay. The maintenance dredge spoil that is currently removed from the Ross River as required (currently every 2-3years) is a very minor component of the allowed total with an average of around 25,000 m^3/annum. Dredging assessments conducted under Section 2.4 indicate that volume of dredging required for construction of the Precinct that will require disposal to spoil is in the order of 866,000 m^3. The existing spoil ground has sufficient capacity to receive this material. Ongoing maintenance dredging volumes are not expected to increase following construction of the Precinct but may decrease as a result of the breakwater stopping longshore drift of material into the channel. Accordingly, existing permit disposal conditions are expected to be met following construction of the Precinct.

The environmental investigations and approvals for the offshore disposal component of this work are being addressed by POTL under a separate investigation and approvals process. The acid sulfate material in the sediments, their influence upon the construction scenarios and their potential management options are discussed in greater detail under Section 2.4 and Section 3.2 of this report.

3.9.5 Sediment Quality Guidelines

The National Assessment Guidelines for Dredging (NAGD) are a regulatory framework which is applied to ensure the impacts of dredged material loading and disposal are adequately assessed and, when ocean disposal is permitted, that impacts are managed responsibly and effectively (Australian Government, 2009). Sediment quality in the Precinct has been compared to the NAGD (2009) as these guidelines are most stringent guidelines under the National framework for marine sediments. A separate investigation and approvals process is being undertaken to fully characterise the sediments that may require offshore disposal as part of the construction of the Precinct in accordance with the NAGD (2009), therefore this is not dealt with in detail in this EIS.

The DERM Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland, were developed to provide best practice for managing land contamination through planning and development control process. The Environmental Investigation Levels (EILs) contained in these guidelines have been adopted to compare sediment concentrations against. The sediment contaminant concentrations have been assessed against these guidelines to inform any future placement in onshore reclamation areas of sediment from Ross River and as a preliminary overview of potential acceptability for ocean disposal under the NAGD (2009).

Comparison of sediment quality in the Ross River to various guidelines also provides an indication of whether the long term inputs of contaminants from the catchment have impacted on sediment quality in the vicinity of the Precinct. This will also provide a baseline against which future sampling can be compared.

In summary, the adopted guidelines for sediment quality are:

- National Assessment Guidelines for Dredging 2009
  - Interim Sediment Quality Guidelines - Maximum level (ISQG – High)
  - Interim Sediment Quality Guidelines - Screening level (ISQG – Trigger Value); and
- EPA Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland 1998 - Environmental Investigation Levels (EIL).

The guideline values are provided in Table 3-46.

Table 3-46 Sediment Quality Guidelines adopted for Precinct EIS

Chemical	**Trigger Values/Guidelines (mg/kg)**		
	Draft – Contaminated Land QLD - EIL	**NAGD (2009) – ISQG Trigger Value**	**NAGD (2009) – ISQG-High**
Metals			
Arsenic	20	20	70
Antimony	20	2	25
Cadmium	3	1.5	10
Chromium (III +IV)		80	370
Copper	60	65	270
Lead	300	50	220
Manganese	500		
Mercury	1	0.15	1
Nickel	60	21	52
Silver		1	3.7
Zinc	200	200	410
Total Petroleum Hydrocarbons			
C 6 – C9 Fraction	100		
C 10 – C14 Fraction	100		
C 15 – C28 Fraction	1000		

Chemical	Trigger Values/Guidelines (mg/kg)		
	Draft – Contaminated Land QLD - EIL	**NAGD (2009) – ISQG Trigger Value**	**NAGD (2009) – ISQG-High**
C 29 – C36 Fraction	1000		
Monocyclic Aromatic Hydrocarbons			
Benzene			
Polycyclic Aromatic Hydrocarbons			
Benz(a)pyrene	1		
PAHs (Sum of total)	20	10	50
Polychlorinated Biphenyls			
PCBs (sum of total)	1	0.023	
Organochlorine Pesticides			
4,4-DDE		0.0022	0.027
Aldrin + Dieldrin	0.2		
Chlordane		0.0005	0.006
DDD		0.002	0.02
DDT		0.0016	0.046
DDT+DDE+DDD	0.2		
Dieldrin		0.28	0.27 e / 0.62 f
Endrin		0.01	0.12 e / 0.22 f
g-BHC (Lindane)		0.00032	0.001
Organotins			
Tributyltin		9 μgSn/kg	70 μgSn/kg

3.9.6 Description of environmental values

3.9.6.1 Previous sediment quality studies

There is a substantial amount of literature and information available on the existing sediment quality environment, both in the study area and throughout Cleveland Bay. The following reports on sediment quality are applicable to the Precinct:

- Townsville Port Authority (1998). Sediment Monitoring Program Annual Report, July 1997 – June 1998; and
- POTL Sediment Quality Monitoring 1995 – 2008.

Mean heavy metal concentrations recorded from July 1997 to July 1998 for arsenic, barium, cadmium, cobalt, chromium, copper, manganese, molybdenum, nickel, lead and zinc at sites in Ross River did not exceed the ANZECC Soil Investigation Threshold, ANZECC Soil Clean – Up Threshold (TPA 1998).

Sediment quality is monitored as part of the POTL long term sediment monitoring program. This program encompasses a number of different locations throughout the Port of Townsville, but the only sites of interest to this report are the sites in Ross River (RR3, RR4, RR5, RR6, RR7, RR8 and RR9). An indication of which POTL long term monitoring sites correspond to which EIS monitoring sites is provided in Table 3-47.

Table 3-47 Comparison of POTL and GHD Sediment Quality Monitoring Sites in Ross River

POTL Long-term Monitoring Sites	POTL Monitoring at this Site	GHD EIS Monitoring Sites
RR9	Water quality and sediment quality	Near WQ3
RR8	Sediment quality	Near WQ5
RR7	Water quality and sediment quality	Near WQ7
RR6	Sediment quality	In between WQ2 and WQ10
RR5	Water quality and sediment quality	Just upstream of WQ10
RR4	Sediment quality	Near WQ12
RR3	Water quality and sediment quality	Upstream of WQ12

Samples have been collected at these locations quarterly since 1995. Sediment samples were analysed for arsenic, barium, cadmium, cobalt, chromium, copper, manganese, molybdenum, nickel, lead antimony, tin, silver and zinc.

Generally all sites over the POTL monitoring period were below the NAGD (2009) screening levels and the DERM EIL guidelines except for the following:

- In June 1998, all sites except RR3 had concentrations above the Screening level for Copper, Lead and Zinc, with two sites exceeding the high level. Chromium also exceeded the EIL at these sites;
- In January 2002, all sites except RR3 had concentrations above the Screening level for Copper, Lead, and Zinc, while two sites exceeded the Screening level for nickel. Four sites (RR4 – RR7) exceeded the ISQG-high level for zinc;
- Concentrations of nickel exceeded the ISQG trigger value at several sites over the course of the monitoring program and zinc and chromium both exceeded the ISQG trigger value at one site on one sampling event; and
- 56 out of the 164 samples collected for manganese exceeded the EIL of 500 mg/L. Manganese was no longer analysed after April 2002.

3.9.6.2 Baseline sediment quality monitoring

Surface Grab Samples

Sediment samples were collected at the 12 water quality monitoring locations during the first sampling event in September 2008 (Figure 3-50). Two additional samples were collected from randomly chosen sites as quality assurance samples. Samples were collected using a Van Veen benthic sediment grab sampler. The Van Veen sampler was decontaminated between the collection of samples at each site. Sediments were placed in laboratory supplied glass jars with Teflon lined lids, stored on ice and couriered overnight to the NATA accredited ALS Laboratory Group for analysis at the end of each day. Chain of Custody forms are provided in Appendix J.

Sediment samples were analysed for the following parameters:

- Particle size;
- Moisture content;
- Total organic carbon;
- Total heavy metals (arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, manganese, nickel, lead, vanadium, zinc, mercury);
- Nutrients (Total Nitrogen, nitrate, nitrite, ammonia, Total Kjeldahl Nitrogen, Total Phosphorus and Reactive Phosphorus);
- Herbicides;
- Organochlorine Pesticides (OCP);
- Organophosphorus Pesticides (OPP);
- Phenols
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Organotins; and
- Total Petroleum Hydrocarbons (TPHs) and BTEX.

As sediment quality does not tend to change rapidly over time and the concentrations of the potential contaminants were generally not present at concentrations exceeding the adopted sediment quality guidelines, further sediment sampling was not undertaken on a monthly basis. Low concentrations of some contaminants of concern were present at one or more sites, however it was considered that one round of sampling provided an adequate baseline dataset for sediments.

Additional Sediment Sampling

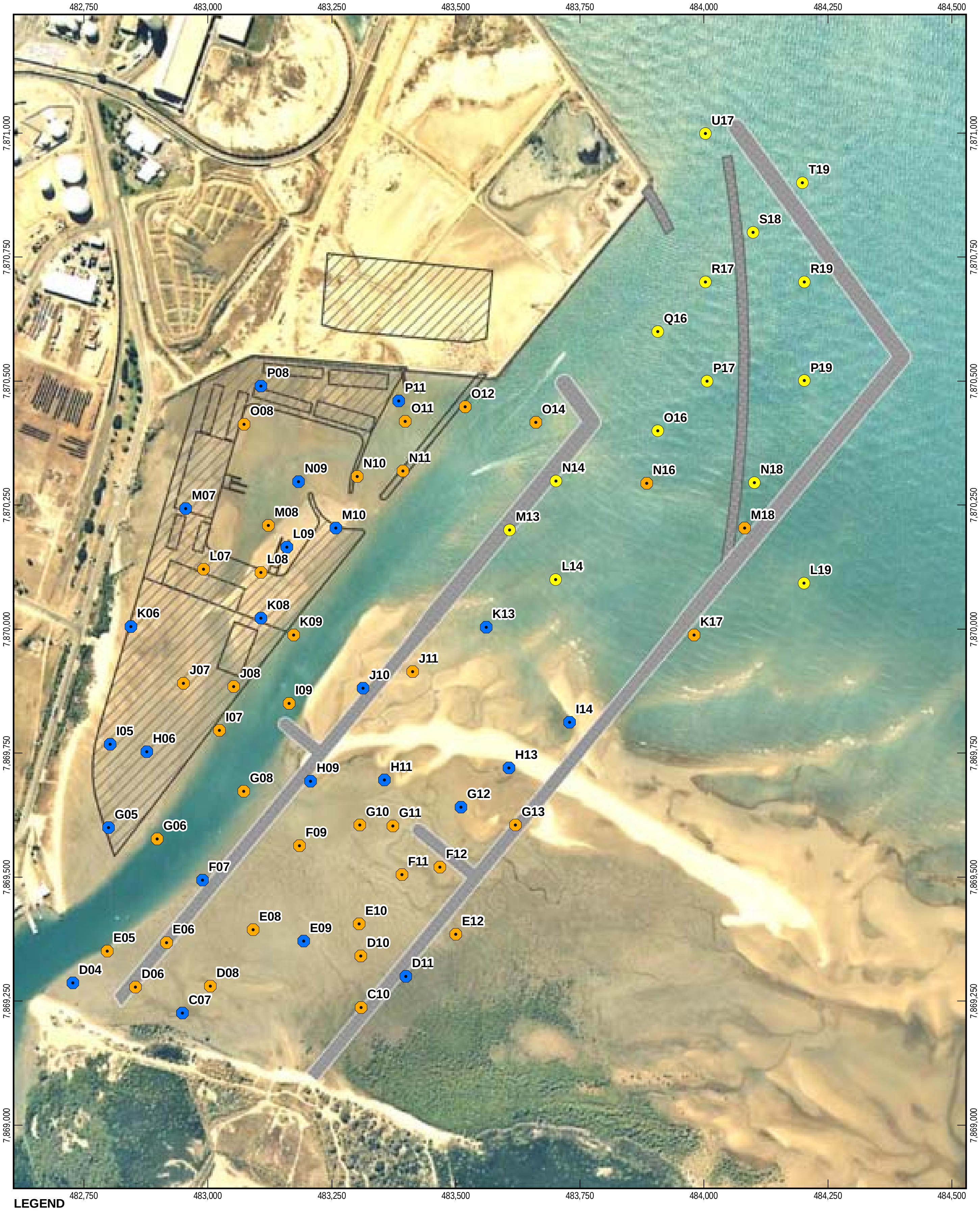
Additional sediment contamination analysis was conducted at various locations during the two acid sulfate soil sampling events. This was an opportunistic assessment as the acid sulfate soil sampling was conducted at different sites to the 12 sediment sampling sites. Contamination analyses were conducted at three of the acid sulfate soil sampling sites, at the following boreholes and depths (Figure 3-58):

- L19_4: 1.5 – 2m;
- L19_7: 0 – 0.5m;
- N14_3: 1.5 – 2.0m;
- N14_6: 0 – 0.5m;
- R17_1: 1.2 – 1.6m; and
- R17_4: 0 – 0.3m.

The samples were collected using a vibrocorer. Sediments were placed in laboratory supplied glass jars with Teflon lined lids, stored on ice and couriered overnight to the NATA accredited ALS Laboratory Group for analysis at the end of each day.

The samples were analysis of the following parameters:

- Moisture content;
- Total Petroleum Hydrocarbons (TPH);
- Organochlorine Pesticides (OCP);
- Organophosphorus Pesticides (OPP);
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Phenols;
- Semi-Volatile Organic Compounds (SVOC);
- Polychlorinated Biphenyls (PCB); and
- Metals (aluminium, antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium and zinc).



LEGEND

- Vibra-Core Sample Locations - Phase 1
- Vibra-Core Sample Locations - Phase 2
- Vibra-Core Sample Locations - Phase 3
- Proposed Marine Precinct
- Min and Max Options
- Breakwater Option C (Preferred)

1:10,000

0 50 100 150 200 250

Metres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Acid Sulphate Soil Sample Locations

Job Number	42-15399
Revision	B
Date	01 July 2009

Figure 3-58

G:\42\15399\GIS\Projects\EIS\42-15399_407_rev_b.mxd

Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Monitoring Locations - GHD 2009; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management). Created by: TH

3.9.6.3 Results of baseline sediment quality monitoring

The results of the sediment sampling conducted for the EIS are presented in detail in Appendix J. Following is a summary of key findings as they relate to environmental conditions.

The sediment sampling undertaken for this EIS demonstrated the presence of minor concentrations a number of anthropogenic contaminants. PAHs were identified in low concentrations in the vicinity of WQ10 – 12. PAHs are commonly associated with incomplete combustion of fuels and oils and are likely to be present in the Ross River estuary as a result of the presence of boat traffic and moorings, particularly in the vicinity of WQ10 - 12. Nutrient concentrations in sediments (as for water quality findings) were also higher in the vicinity of the boat moorings, indicating an input from this source or other land based anthropogenic activities in this area.

Minor concentrations of tributlytin (TBT) were identified in two sediment samples. TBT is an antifouling agent that was previously used on ships and boats to prevent growth of marine organisms on their hulls. The likely sources of TBT are boat maintenance activities that are currently based on the northern bank of the Ross River, west of the proposed Port Access Road and from boats and ships in both Ross River and the adjacent Port facilities. TBT is usually present in marine sediments heterogeneously.

Minor concentrations of herbicides were also identified in the sediments of the study area. As was the case with water quality, this indicates minor inputs of these anthropogenic contaminants from the Ross River catchment, but no long term build up of these contaminants was evident from this monitoring program.

Overall, the quality of sediments in the Project Area is compliant to the NADG (2009) and the EIL of the Draft Guidelines for the Assessment and Management of Contaminated Land.

3.9.7 Potential impacts and mitigation measures

3.9.7.1 Management of Sediment Quality

As summarised in the discussion of potential impacts on water quality, as a result of the construction and operation of the Precinct a number of marine related industries and activities are planned for the Precinct. Many of these are likely to relocate from the area upstream of the proposed Port Access Road. While significant contamination of the sediments in the Project Area has not been identified there is the potential for the construction and operation of the Precinct to introduce contaminants into the receiving environment and for this to impact on sediment quality. If sediment quality is impacted, this can impact on marine communities in the vicinity of the Project Area and can also impact on the ability to dredge and dispose of the sediments to maintain the declared depths of access channels and basins.

The potential impacts of the construction and operation of the Precinct on sediment quality are similar to those for water quality, as contaminants are often introduced into sediments through the water column. Contaminated sediments can also be introduced directly into the marine environment through runoff of contaminated soils. The potential impacts and mitigation measures are summarised in Table 3-44 of the water quality section.

3.9.7.2 Dredging and Disposal of Sediments

As discussed previously, a large proportion of the material to be dredged for the construction of the Precinct is unsuitable from both a geotechnical and acid generating potential perspective for use as fill in the Precinct without substantial treatment and management. POTL is undertaking a separate process to fully characterise and, if required, will apply for offshore disposal of these sediments. Studies indicate that approximately 25% of the material to be dredged for Stage 2 of the Precinct will be sand that is suitable for reuse as fill within the Precinct. This sand will be dredged using a small cutter suction dredger, be pumped into the Stage 2 reclamation and be placed below the water level.

Therefore, this impact assessment focuses on the potential impacts of dredging of sediments. The impact of dredging on coastal processes and sediment budgets is addressed in Section 3.8 of this EIS and the impacts of increased turbidity resulting from dredging of sediments was discussed in the water quality section of this report above.

The potential impacts of sediment quality on the marine environment have taken into consideration the guidelines for toxicants in sediments provided in the NADG (2009) and DERM Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland 1998 - Environmental Investigation Levels (EIL).

Potential Impacts

Mobilisation of seabed sediments into the water column during dredging and marine construction may increase the bioavailability of toxicants to marine organisms. The principle parameters that affect mobilisation of contaminants from sediment to water are clay type and content, organic matter content, cation exchange and capacity, reactive iron and manganese, oxidation reduction potential (redox), pH and salinity. Of these parameters clay type, organic matter, pH and redox conditions are considered the most important (Burt and Hayes 2005).

The process of dredging results in changes in physiochemical sediment conditions, favouring the mobilisation of contaminants into the environment. Potential contaminant pathways include release of contaminants from mobilised sediments into the water column (USACE and US EPA 2004). Water column impacts are usually water quality (chemical) and toxicity (biological). Primary contaminant groups that may impact the marine environment include heavy metals, hydrocarbons and persistent organic compounds (Burt and Hayes 2005).

Contaminants in Precinct Sediments

As there are only low levels of selected contaminants present in sediments analysed for this EIS, it is not anticipated that the process of dredging will introduce significant concentrations of contaminants into the water column. It is proposed to dispose potential acid sulfate material offshore, preventing oxidation and acid generation. Table 3-43 of the water quality section discusses the potential impacts and mitigation measures for dredging, including introduction of contaminants into the water column. Acid sulfate soils, including potential opportunities and approaches for treatment to enable reclamation, are discussed under Section 3.2.1.3 of this EIS.

One area of risk is the introduction of nutrients into the water column. This is discussed following.

Cyanobacterial Blooms

Cyanobacteria (*Trichodesmium sp.*) often bloom in Cleveland Bay as they do along other parts of the Queensland coast. The planktonic *Trichodesmium* sometimes forms blooms in tropical waters, and after the blooms die *Trichodesmium* is visible as a reddish slick on the surface of the water (www.reef.crc.org.au). Cyanobacteria are important to marine ecosystems because they fix atmospheric nitrogen and are considered an important factor for bloom initiation in oligotrophic tropical and sub-tropical waters (Sparrow and Heimann, 2007).

Conditions that favour cyanobacterial blooms include warm, still water conditions during the late dry season and early wet season. Sediment and nutrient loss from rural industries and the consequent effects upon terrestrial runoff quality have been identified as contributing factors for blooms as they introduce nutrients into the marine environment.

Studies in the Cleveland Bay area have determined that periods of strong winds and wave action and turbulence within shallow areas of the Bay cause the resuspension of bottom sediment, and when calmer conditions prevail, the sediment resettles and leaves nutrient enriched, comparatively clear sea water with good light penetration, which promotes phytoplankton growth (Stark *et al.* 1975). In the tropics a strong south-easterly wind blows almost continuously throughout the winter months, therefore the most of the productive periods are most likely to be during spring and summer, when the strong winds become intermittent. Phytoplankton blooms in the Bay are frequently accompanied by the production of vast orange to brown windrows, which can extend for many kilometres (Stark *et al*. 1975). *Trichodesmium* blooms seem to occur regularly after turbulent water conditions, and are apparently independent of water temperature, which shows a range varying from 20 – 33°C over the period when such blooms occur.

It has been established that during *Trichodesmium* blooms, labile forms of cadmium and dissolved and particulate forms of iron markedly increase, and that these increases occurred along with high concentrations of ‘marine humic acid’, associated with the presence of *Trichodesmium* (Jones *et al*, 1986).

During the six month water quality investigation conducted for this EIS, there was no visual evidence of any *Trichodesmium* bloom, nor were elevated concentrations of chlorophyll a recorded, suggesting that no blooms occurred in the vicinity of Ross River during the monitoring program. However, during the marine ecology surveys, a evidence of a bloom was observed as a red slick on the surface of sediments in the Precinct area during low tide.

It is possible that dredging to construct the Precinct will result in the introduction of nutrients into the water column. The reduction in turbidity that will occur when dredging ceases may also result in conditions that are conducive to algal blooms (i.e. clearer waters with good light penetration). However, the main forms of nutrients found in sediments were not biologically available forms and nutrients are already present in the water column in concentrations above the QWQG (2006). Existing observations of algal blooms in the Townsville region have not, to date, been correlated with previous dredging events. It is therefore considered unlikely that dredging activities to be undertaken during construction or operation of the Precinct facility would promote conditions conducive to algal blooms.

3.10 Nature conservation

3.10.1 Overview

This section details the existing nature conservation values of the project area. The environmental values of nature conservation for the affected area are described in terms of:

- Integrity of ecological processes, including habitats of rare and threatened species
- Conservation of resources
- Biological diversity, including habitats of rare and threatened species
- Integrity of landscapes and places including wilderness and similar natural places
- Aquatic and terrestrial ecosystems.

Terrestrial flora and fauna, avifauna and marine flora and fauna (including megafauna) are described in the following sections. Sensitive environmental areas and the biodiversity they support are described where appropriate. The presence and influence of pest and weed species is addressed under each ecological system section. Desktop literature reviews and field baseline assessments have been used to describe the communities and potential impacts from the project on these communities.

Reference is made, where appropriate, to relevant Queensland and Australian Government legislation and policies on threatened species and ecological communities including recovery plans and offsets of impacts.

Potential adverse and beneficial impacts associated with the project are described, as are the objectives for protecting or enhancing nature conservation environmental values.

Impacts during construction and operation of the project are assessed. Strategies for protecting any rare or threatened species are described, and any obligations imposed by state or commonwealth endangered species legislation or policy or international treaty obligations (i.e. JAMBA, CAMBA, ROKAMBA) are discussed. Measures to mitigate any impacts identified for the project are identified as are strategies to offset any impacts that are not able to be mitigated. The presence of any pest species is noted and strategies to reduce impacts through the project discussed.

3.10.2 Risk Assessment Approach

An assessment has been undertaken to identify any actions of the project or likely impacts that require an authority under the Nature Conservation Act 1992, and/or those that may be assessable development for the purposes of the Vegetation Management Act 1999 and the Fisheries Act 1994. A risk and impact assessment process was used in conducting this assessment and developing management and mitigation strategies for each identified impact.

This risk assessment addresses the construction and operational aspects of development of the Precinct. It has been developed in order to assess the risk posed to the terrestrial and marine environments by activities undertaken as part of the proposed project. The assessment identifies aspects of the works that pose an environmental risk, and classes these risks into one of four categories (Extreme, High, Medium and Low). The classification then allows priorities to be set for addressing and mitigating these risks.

3.10.3 Risk Assessment Methodology

No international standard exists for risk management and as a result the risk assessment methodology employed here is based on the Australian Standard AS/NZS 4360: 1999 *Risk Management* (the Standard) and HB 203: 2000 *Environmental Risk Management – Principles and Process* (the Guidelines). The Standard and Guidelines set out a generic framework for establishing the context, identifying, analysing, evaluating, treating, monitoring and communicating risks. The Best Practice Environmental Management in Mining, Environmental Risk Assessment (EA 1999) also adopts this standard though different definitions have been adopted by EA.

The objective of a risk assessment is to filter the minor acceptable risks from the major non-acceptable risks. It involves consideration of the sources of risk, the consequences and the likelihood that those consequences may occur.

Risk analysis may be undertaken to various degrees of refinement depending upon the risk information and data available. Analysis techniques include:

- Qualitative assessment;
- Semi-Quantitative assessment; and
- Quantitative assessment.

In practice, a qualitative analysis is often used to first obtain a general indication of the level of risk and then a more quantitative analysis is applied to refine the risk.

A quantitative risk assessment can be undertaken based on statistical analysis for various consequences and probabilities. In the absence of statistical data, an estimate may be made of the degree of the consequence and frequency (refer to section 4.3 of the Standard).

The risk assessment methodology for this EIS uses a semi-quantitative process for determining risk. The semi-quantitative process estimates the degree of the consequence and probability and assigns a score to each. The score allocated "does not have to bear an accurate relationship to the actual magnitude of consequences or likelihood" (refer to section 4.3.4 of the Standard). The risk and impact assessment process used here to assess and weight potential project risks was undertaken using an Environmental Risk and Likely Impact ("ERLI") approach. For each possible impact aspect, two key areas were addressed:

Environmental Risk

This essentially considers the risk of irreversible change to natural ecological processes and community interaction. Assessment addresses:

- Conservation significance of environmental, social and cultural values and regional context of these values;
- Current level of integrity of natural ecosystem processes;
- Known sensitivity of ecosystem processes/natural values to human induced change;
- Natural change and resilience of relevant ecosystem processes/natural values;
- Potential for cumulative social and environmental impacts; and
- Level of scientific certainty of the above factors.

Likely Impact

This considered the likely impact of the project, as modified and undertaken in accordance with mitigation strategies (including any environmental management plans or conditions from licensing/approval agencies) and includes:

- Geographic extent of the activities;
- Duration of the activities;
- Magnitude of potential environmental change;
- Confidence in prediction of impact;
- Confidence in mitigation strategies to minimise ecological and social risks; and
- Ability to monitor the impacts and detect change before irreversible change to system processes occurs.

The approach considered direct and indirect impacts, short and long term, cumulative, temporary and irreversible, and adverse and beneficial impacts.

The significance of the impacts was placed in an appropriate context in which to justifiably determine the impact's significance. In particular, the duration of the impact (temporary v permanent) and reversibility were considered. The ability of natural systems (including population, communities and ecosystems) to accept or assimilate impacts was also considered.

The above approach is used to provide the essential information that is used in the formal Risk Assessment as based on the Australian/New Zealand Standard 4360:2004. This methodology is outlined below.

Stage 1: Identification of Risk

This included identification of all relevant risks, addresses all known activities and related environmental aspects of the project.

Stage 2: Risk Analysis

An important feature is recognition of the fact that an event's consequence extends beyond the immediate impact. This methodology ensures that the full consequences of events are visible to risk owners and managers and that the effects on the project are all understood and treated. Each class of consequence is rated a score of 0 - 5, where "0" is nil consequence to "5" is catastrophic.

An analysis of each risk is undertaken to determine an environmental event's likelihood of occurrence and its consequences. A five-level qualitative description of the likelihood and consequences for each risk enables a semi-quantitative method to be used to calculate a 'score' for each risk.

Definitions and scales for Consequences are shown in Table 3-48 and definitions and scales for Likelihood are shown in Table 3-49.

Stage 3: Calculation of Risk Level

Two levels of risk are used:

The **Primary Risk Level (PRL)** is a conservative measure of risk, based on the most severe consequences across all the relevant criteria. PRL is calculated according to the equation:

Primary Risk Level (PRL) = Likelihood Rating X Maximum Consequence Rating

The **Secondary Risk Level (SRL)** is a less conservative measure of risk, which incorporates all relevant criteria, not just the most severe ones. SRL is calculated according to the equation:

Secondary Risk Level (SRL) = Likelihood Rating X Average Consequence Rating

In most circumstances PRL should be the preferred measure, as it is more conservative. Risk scores are banded into risk levels which provide a "plain English" view of the risk. Scores will always be visible to enable prioritisation within bands.

Table 3-50 and Table 3-51 show the bands, their threshold values and indicative management action.

Stage 4: Determination of Options for Treatment of Risks

Following the analysis of a risk it is necessary to investigate the options available for risk treatment and then determine the option or options that provide the greatest cost benefit.

Risks may be treated in one or a combination of ways[5]:

- Avoiding a risk by preventing the activity that leads to the risk eventuating;
- Reducing the likelihood of the risk eventuating;
- Reducing the consequences if the risk does eventuate;
- Transfer the risk; and
- Retaining the risk.

Table 3-48 Threat Criteria and Consequence Scales

Rating	Project Delivery Impacts	Environment	Community & Sustainability	Financial
0 **Nil**	No impact on schedules.	No environmental impact.	No social impact, damage to valued structures or locations of cultural significance or sacred value or loss of environmental resources.	No cost impact.
1 **Insignificant**	Some minor modification to planned activities may be necessary. Insignificant delays. Negligible performance impact.	Negligible release or damage that is contained on-site and is non-reportable. The damage is fully recoverable with no permanent impact on the environment.	Negligible social impact. Negligible damage to valued structures or locations of cultural significance or sacred value. Negligible loss of environmental resources.	Insignificant financial loss to remedy.

[5] After AS/NZS 4360:2004

Rating	Project Delivery Impacts	Environment	Community & Sustainability	Financial
2 **Minor**	Modification to planned activities can be expected. Minor delays. Minor performance degradation.	Minor violation of regulation or guideline with minimal damage to the environment and small clean up. Immediately contained on-site.	Minor impact on the community or public health. Minor damage to valued structures or locations of cultural significance or sacred value. Minor loss of environmental resources.	Minor financial loss to remedy.
3 **Moderate**	Most activities affected. No resumption of normal activities for up to 6 months. Significant delays resulting in some reduction in performance.	Moderate violation of regulation or guideline with moderate damage to the environment and significant clean-up cost.	Detrimental impacts on the community or public health. Damage to valued structures or locations of cultural significance or sacred value. Loss of scarce environmental resources.	Moderate financial loss to remedy.
4 **Major**	All normal activities curtailed. No resumption of normal activities for between 6 and 12 months. Major delays of capability delivery but at non-critical times. Failure to achieve some performance targets.	Significant environmental damage with widespread impacts. Damage may be permanent.	Significant detrimental impacts on the community. Major damage to highly valued structures or locations of cultural significance or sacred value. Significant loss of scarce environmental resources.	Major financial loss to remedy.
5 **Catastrophic**	All activities cease. No resumption for at least 12 months. Major unacceptable delays in delivery of capability occurring at critical times. Failure to achieve critical performance goals.	Long-term environmental harm. Permanent irreparable damage is caused to the environment. For example, acid sulfate soil generated into the estuary environment.	Significant, extensive, detrimental long-term impacts on the community or public health. Irreparable damage to highly valued structures or locations of cultural significance or sacred value. Permanent and significant loss of scarce environmental resources.	Extreme financial loss to remedy.

Table 3-49 Likelihood Rating

Rating	LIKELIHOOD The potential for risks to occur and lead to the assessed consequences			
1	Rare	Very low, very unlikely during the next twenty-five years	Probability less than 0.04	A similar outcome has arisen on a regional, state, national or international level and not unique to the project.
2	Unlikely	Not impossible, likely to occur during the next ten to twenty-five years	Probability 0.04 - 0.1	A similar outcome has arisen at some time previously but action has been taken to reduce the chance of recurrence.
3	Possible	Possible, may arise about once in a one to ten year period	Probability 0.1 - 0.5	A similar outcome has arisen at some time previously.
4	Likely	High, may arise about once per year	Probability 0.5 - 0.8	A similar outcome has arisen several times per year.
5	Almost certain	Very high, may occur at least several times per year	Probability over 0.8	A similar outcome has arisen several times per year in the same location, operation or activity

Table 3-50 Risk Assessment Matrix

Likelihood	Consequences: 1 – Negligible	2 – Minor	3 – Moderate	4 – Major	5 – Extreme
1 – Rare	1	2	3	4	5
2 – Unlikely	2	4	6	8	10
3 – Likely	3	6	9	12	15
4 – Almost Certain	4	8	12	16	20
5 – Certain	5	10	15	20	25

Table 3-51 Risk levels and Management Action (example)

Risk Level (PRL or SRL)	Descriptor	Indicative management action
1-4	Low	Manage by routine procedures, unlikely to need specific application of resources
5-10	Medium	Manage by specific monitoring or response procedures, develop more detailed actions as resources allow
10-16	High	Senior management attention needed and management responsibilities specified for further action
17-25	Extreme	Immediate action required, senior management will be involved

Limitations

As with any model, the relevance and applicability of the risk model revolves around a number of basic assumptions and limitations. The application of the risk model has been based on subjective ranges of consequences and probabilities.

Limitations of the application of the risk methodology for this study include:

- The assessment is based on the professional judgement of a limited number of experienced GHD staff and does not incorporate the collective experience of all parties involved with the project. The full range of risks and the most appropriate consequence and likelihood rating would be best completed in a workshop involving key stakeholders; and
- The assessment has been limited to a selected number of primary risks and the assessment of cumulative risk to the environment from multiple pollution sources or sources of environmental degradation has not been addressed. Cumulative risks are approached for

this study in a qualitative manner only.

Although a semi-quantitative methodology was used to conduct the risk assessment, the resultant risk estimation is purely relative. The risk estimations do not imply an absolute scale of risk that can be applied to any other situation or assessment.

3.10.4 Terrestrial ecology

3.10.4.1 Overview of terrestrial studies

The terrestrial footprint of the study area includes two parcels of land either side of the Ross River estuary. The largest parcel, for consideration of the largest breakwater footprint, comprises approximately 58 hectares on the southern bank of the estuary (often referred to as the south bank), and includes a portion of the foreshore/littoral zone. The second parcel of land (approximately 34 ha) on the north bank of the Ross River (often referred to as the north bank) includes a narrow strip of heavily modified vegetation. This small area (approximately 1.5 ha) is dominated by marine plants that have recruited at the base of the seawall on the north side of Ross River. This was the only natural habitat remnant in the northern footprint and was the only portion of that area examined.

The study area is located within the Brigalow Belt (northern) Bioregion as defined by the *Interim Biogeographic Regionalisation for Australia*. Specifically, the study area is within an area described as “Province 1 – Townsville Plains” under this biogeographic classification. Typically much of this province includes Quaternary coastal dunes and beaches, typically degrade dunes, sandplains, swales, dune lakes and swamps. Soils are predominantly siliceous/calcareous sands, with groundwater podzols or peats in some areas.

Information regarding the terrestrial ecology of the project area has been collated from a focussed desktop assessment of available information (including Government agencies databases and previous EIS and Environmental Management Plans commissioned for the site and adjacent areas) and from the results of a terrestrial fauna/flora baseline study. Full details of the assessments undertaken for this component of work, including the literature and database reviews, are provided under Appendix S. Information on avifauna was collected during both the terrestrial ecology study and also through a targeted wading and migratory bird assessment The terrestrial ecology study is reported following and the additional avifauna assessments are reported under Section 3.10.5.

3.10.4.2 Objectives and methodologies - terrestrial ecology

Field work for the baseline investigation was conducted in September 2008. Further information to reflect seasonal variations in detectable species composition (i.e. to locate species that may not be apparent in the dry season) was gleaned from three previous ecological studies conducted in the area in association with other infrastructure projects.

The objective of the terrestrial ecology baseline survey was to characterise the floral and faunal community assemblages of the foreshore, dune and mangrove systems within the immediate development area of the Precinct and adjacent Ross River banks using a combination of aerial photograph and on ground assessments. It is considered that if the connected, larger breakwater is to be built, the habitats on the banks in the mouth of the Ross River and to the east of the proposed Precinct area are at greatest risk. These areas include the greatest biodiversity values. By comparison the small area of the northern bank (1.5 hectares) represents reclaimed area and has limited vegetation and fauna habitat value. No formal fauna trapping was done in this area; incidental observation methods were employed.

The mangrove and dune communities adjacent to the south bank in the vicinity of the proposed Precinct development are readily delineated, as they are relatively homogenous, with limited to no ecotone between the communities. Given this homogeneity, and the limited terrestrial habitats present in the mangrove communities, fauna sampling was limited to the sclerophyll woodland on low dune and swale terrain, and the samphire mudflats, to the far east of the Precinct area.

In particular, field surveys had the following scope of activities:

- Vegetation community identification, using Queensland Herbarium regional ecosystem (RE) ground truthing procedures as outlined in Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland (Nelder *et al*., 2005);
- Identifying flora and fauna species diversity and abundance, and in particular species of conservation significance under State and Commonwealth legislation. Standard biodiversity assessment methodologies ratified by the Environmental Protection Agency were employed;
- Assessment of the regional significance of the project area in terms of the species known to utilise the site;
- Identifying presence of habitat resources such as hollows, fruiting trees, permanent water or streams etc, and the condition and integrity of habitats on the site; and
- Verifying presence of exotic species, in particular those listed as pest species.

Field surveys also noted whether any species of cultural, commercial or recreational significance were present in the footprint of Lot 773.

3.10.4.3 Description of environmental values - flora

Detailed description of the survey findings are provided under Appendix S. These findings are summarised here.

The survey found that there are four main terrestrial vegetation communities in the project area:

- Mangrove shrubland and tall shrubland;
- Mudflats in the upper reaches of the intertidal zone dominated by chenopodaceous plants, sedges and salt couch;
- Sclerophyll woodland on relict sand dunes dominated by Moreton Bay ash and grey paperbark, and with Burdekin plum and Acacia spp. sub-dominant. This community has a high degree of incursion by declared weeds such as chinee apple, rubber vine and lantana; and
- Closed shrubland of chinee apple on relict sand dunes.

A total of 127 flora species were detected, none of which are of conservation significance. None of the flora species of conservation significance previously found in the area, or that are predicted to occur here, have habitat requirements met on the site.

None of the Regional Ecosystems identified in the project area are considered to be of concern. A map of the terrestrial ecology site with regional ecosystems identified is provided as Figure

3-59.

No species of cultural, commercial or recreational species were detected in Lot 773. Landscape scale stands of mangroves are recognised to be culturally important for Indigenous people. They also can have commercial and recreational value providing habitat for fishery species. However, the mangroves detected fringing the edge of Lot 773 are highly fragmented and do not form a landscape stand community. These are not considered to provide significant commercial, cultural or recreational benefit.

3.10.4.4 Description of environmental values - fauna

The faunal survey program identified 44 bird, eight mammal, nine reptile, three amphibian and one crustacean species on the site, and it is likely that a number of other fauna species occur in the immediate vicinity. None of these species are of conservation significance, although some of the bird species are listed under the EPBCA as marine and marine migratory species. However, there at least seven species of wildlife not detected in the field survey but that are known to occur in the area, and that have habitat requirements met on the site. These species are:

- Radjah shelduck (*Tadorna radjah*) (rare under the NCA);
- Beach stone curlew (*Esacus magnirostris*) (vulnerable under the NCA);
- Black-necked stork (*Ephippiorhynchus asiaticus*) (rare under the NCA);
- White-rumped swiftlet (*Collocalia spodiopygius*) (rare under the NCA);
- Coastal sheathtail bat (*Taphozous australis*) (vulnerable under the NCA);
- Estuarine crocodile (*Crocodylus porosus*) (vulnerable, marine and marine migratory under the EPBCA and vulnerable under the NCA); and,
- Rusty monitor (*Varanus semiremex*) (rare under the NCA).

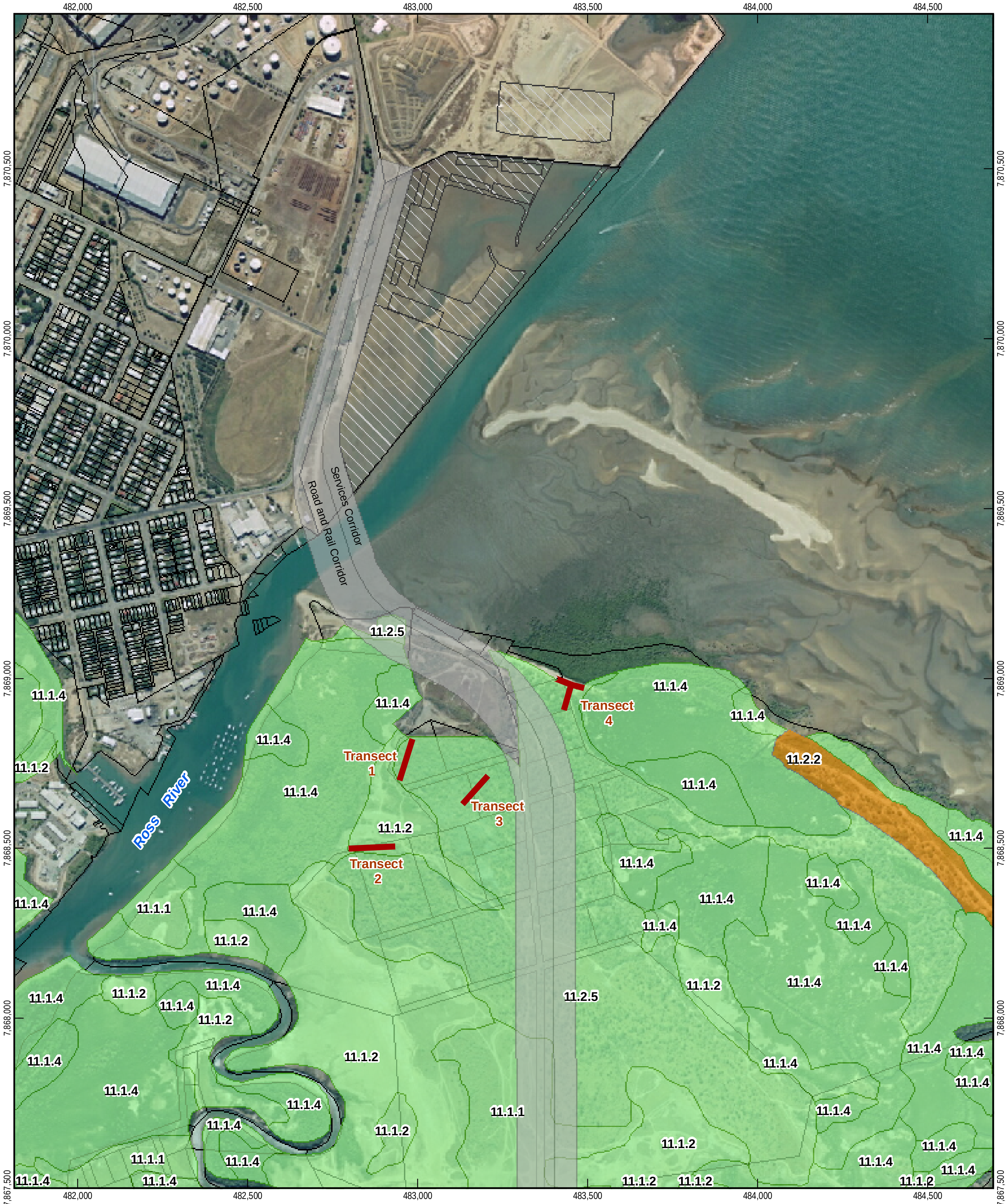
Two invasive species were detected during the survey:

- Feral pig (*Sus scrofa*); and
- Cane toad (*Rhinella marinus*).

Both of these species were detected on the Eastern bank of the Ross River and were not found within the Lot 773 footprint. It is possible that feral cats may occur within both areas, however, no evidence of this was detected.

No terrestrial fauna species of cultural, recreational or commercial significance were detected within the footprint of Lot 773. A number of culturally and recreationally important species (eg birds and bats) were, however, detected on the Eastern bank of the Ross River. In recognition of the areas importance for avifauna an additional study focussed on wading and migratory bird species, particularly CAMBA, JAMBA and ROKAMBA listed species, was undertaken. That is described in Section 3.10.5.

Impacts on terrestrial species identified during the October baseline assessment are discussed in the following section.



LEGEND

- Transect Lines
- Proposed Marine Precinct
- Proposed Transport and Services Corridor
- Cadastre

Regional Ecosystem

- Of Concern - Dominant
- Not Of Concern

Regional ecosystem linework reproduced at scale greater than 1:100,000, except in designated areas, should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100,000 is 100 metres. Regional ecosystem mapping reproduced with permission of Environmental Protection Agency [2006]. While every care is taken to ensure the accuracy of the Information Product, the Environmental Protection Agency makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason. Data must not be used for direct marketing or be used in breach of the privacy laws.

1:15,000 (at A4)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

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Port of Townsville
Marine Precinct EIS

Job Number 42-15399
Revision A
Date 01 July 2009

Terrestrial Ecology Site with Regional Ecosystem Mapping

Figure 3-59

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3.10.4.5 Potential impacts and mitigation measures – terrestrial ecology

The Townsville Marine Precinct Project (TMPP) is expected to have very limited impacts on the terrestrial ecological values of the area in which it is located. The majority of the impacts comprise the removal of a small area (approximately 1.5 ha) of low integrity marine vegetation on the northern precinct site (Lot 773).

No removal of vegetation or disturbance of fauna habitats is proposed for the south section of the precinct. The Port Authority has given the land studied in this survey to the State, and it is now reserved for conservation purposes.

3.10.4.6 Cumulative impacts and mitigation strategies – terrestrial ecology

Prior to the construction of the Precinct a road and rail link to the proposed port site will be constructed. This road and rail corridor will enter the port site from the east, passing through the land on the south side of the Ross River mouth studied in this terrestrial ecology survey. The corridor will follow the recently cleared high voltage power transmission line, and any impacts from the TMPP on this land will be largely cumulative impacts coming on top of the construction of this infrastructure. The actual design and construction of this infrastructure is the subject of another EIS by the Department of Main Roads. Cumulative impacts will mostly be in the order of increases in the intensity of use.

To address the potential for impact on terrestrial ecology values an assessment of the risk of each impact and mitigation measure is provided in Table 3-52. This assessment followed methodology described in Section 3.10.2.

Table 3-52 Risk assessment for terrestrial ecological values

Activity	Expected impact	Preliminary risk assessment (L,C) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (L,C) Score
Works in Ross River				
Pile driving and general construction in water	Increased sedimentation in the Ross River	(3, 4) 12 High	Sediment/silt traps and fences must be in place before any clearing occurs	(2, 3) 6 Medium
Permanent location of Port facilities				
Permanent location of traffic corridor	Permanent loss of small area of vegetation (1.5ha on Lot 773) on the northern bank.	(3, 4) 12 High	Vegetation is of low value, and loss of vegetation will be compensated by retention of land in the south precinct and revegetation activities in this area.	(2, 3) 6 Medium
Loss of ~ 1.5 ha of shoreline and terrestrial habitat on west bank	Loss of habitat for birds and small reptiles	(1, 5) 5 High	Offset by offering of >200 ha of remnant not of concern vegetation on east bank as environmental reserve.	(1, 2) 2 Low
	Loss of small area (<400 m^2) of poorly developed mangrove shrubland	(1,5) 5 High	Mangrove offset to be offered in accordance with Department of Primary Industries and Fisheries Offset Policy	(1, 2) 2 Low
Construction activities				
Use of earth moving machinery	Weeds spread from other sites to the Port site	(3, 4) 12 High	All machinery must be thoroughly washed down before moving to the site according to accepted industry standards	(3, 2) 6 Medium

Activity	Expected impact	Preliminary risk assessment (L,C) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (L,C) Score
	Weeds spread from Port site to other sites	(3, 4) 12 High	All machinery must be thoroughly washed down according to accepted industry standards as soon as possible after leaving the site and before moving to another job	(3, 2) 6 Medium
Construction and use of haul road on west bank for access to proposed breakwater	Dust contamination of air and water surface	(1, 4) 4 Medium	Haul roads must be watered regularly to hold dust down	(1, 2) 2 Low

Expected impacts on terrestrial fauna and flora values from this project are minimal, as the area studied will be largely left intact. The values identified for the site largely centre on the mosaic of coastal communities present (mangrove shrublands, sedge/chenopod dominated mudflats, sandy foreshore vegetation and sclerophyll woodland on relict dunes) in a relatively small area, and the likely presence of up to seven species of conservation significance recorded in the area previously. However, these values have been compromised in part by a thorough invasion of several declared and serious environmental weeds.

The proposal to construct a traffic corridor through this area has the potential to further compromise the value of this land as habitat for both least concern and conservation significant species. That proposal and its impacts are considered in another EIS by the Department of Main Roads, however cumulative impacts resulting from the port construction were considered above.

These impacts were:

- Dedication of 200 ha of land owned by the Port as conservation reserve (a positive benefit that has already taken place);
- Temporary dust and sedimentation impacts from construction activities;
- Loss of a small area of poorly developed non-remnant mangrove shrubland on the northern bank (approximately 1.5 ha); and
- Loss of 1.5 ha of weed infested shoreline and terrestrial habitat on the northern bank.

An assessment of the risk level associated with these impacts was completed and presented in Table 3-52.

Recommended mitigation strategies for the project, based on the known values of the area, are:

- A sediment/silt trapping fence must be erected in the water before any mangroves are cleared to catch sediment clouds;
- All machinery must be thoroughly washed down to accepted industry standards before movement onto the site, and before being moved to another site (using the nearest washdown facility);
- Haul roads must be regularly watered to prevent dust contamination of air and water surface; and
- Loss of habitat (mangroves and terrestrial) may be offset by the prawn farm restoration and the dedication of an Environmental Reserve on Port land on the south bank. Additional discussion on offsets of relevance to this project is provided under Section 3.10.8 below.

Recommended monitoring approaches for the project, based on the known values of the area, are a post construction phase inspection for possible pest species. The primary species of concern will be the terrestrial weed *Sphageneticola triloba* (Singapore Daisy). This species is an aggressive coloniser of disturbed areas on the intertidal margin, and has the proven ability to displace native intertidal grasses (notably *Sporobolus virgini*cus) and smaller mangrove species (*Ceriops*, *Lumnitzera*) on the landward side of the intertidal area. Singapore Daisy is a prominent species, easily identified, and monitoring should consist of a weekly post construction observational program for up to two months after works have ceased, or until landscaping and rehabilitation efforts have become established. Other potential weed species (such as the grass Mossman burr - *Cenchrus echinatus*) may also be problematic and similarly can be monitored on an observational basis post construction.

3.10.4.7 Conclusion – terrestrial ecology

The TMPP is not expected to represent a significant impact on any of these species. However, in order to avoid impacting on these species, the following guidelines should be adopted:

- Impacts to the foreshore and mangrove communities on the east bank should be avoided. This is a critical area for beach stone curlews, with suitable nesting locations in this area, and also for the water mouse (if present).
- Mudflats and other open areas should be retained and kept weed free. These areas offer suitable habitat for Radjah shelducks, black-necked storks and white-rumped swiftlets.
- Sedimentation from Port works should be carefully managed and contained to avoid impacting on crocodile habitat.
- Sclerophyll vegetation on the east bank should be retained. Standing stags and dead timber on the ground should be retained – if woody weeds are cut down the wood should be left in situ (with seeds and reproductive material removed). These areas offer important habitat resources for the rusty monitor, and the coastal sheathtail bat and the white-rumped swiftlet will utilise flyways over canopies to hawk for insects.

3.10.5 Wading and migratory bird studies

3.10.5.1 Overview of bird studies

Shorebirds, which are alternatively known as waders, include a large collection of long range, international migratory species that migrate to and from Australia every year. They also include a smaller grouping of resident species that breed and live within Australia. Over 65% of the 55 species of shorebird that regularly occur in Australia are migratory and subject to international conservation agreements. Also, some of the resident, or non-migratory shorebirds, appear on one or another list of species with conservation concerns (Appendix V).

The two main habitat requirements for shorebirds that migrate to Australia are sites for feeding and roosting. The birds' needs revolve around feeding on intertidal flats at low tide and roosting while the tide is high. The use of feeding grounds may be affected by their proximity to roost sites and vice versa because minimising the flight distance between feeding and roosting sites conserves important energy reserves (Appendix V). Shorebirds regularly congregate and roost in large mixed species flocks on high tide where they can be counted. The sites used for roosting are used habitually by the birds, have particular characteristics and serve as a safe haven for the birds to rest.

The Precinct, located in the mouth of the Ross River, will be adjacent to mangrove systems, mud and sand banks that support a diverse bird life community. Construction of the Precinct will remove an area of intertidal habitat. Construction and operation of the Precinct, therefore, has potential to impact upon birdlife and bird habitats in the vicinity of the mouth of the Ross River.

3.10.5.2 Objectives and methodology – bird studies

Specific studies were undertaken to determine the importance of the bird communities that may be affected by the planned development and to propose management strategies to help ameliorate any potential threats to important birdlife. Emphasis was given to migratory shorebirds, which are particularly prevalent within the environs of the river mouth, although other bird groups were also investigated. A full description of those studies is provided in Appendix V. A summary of findings is provided here.

The Environment Protection and Biodiversity Conservation Act 1999 (Cth) and the Nature Conservation Act (Qld) form the basis for the regulatory framework for assessing possible threats to birdlife and for evaluating management strategies designed to ameliorate any impacts.

Fieldwork at the mouth of the Ross River was undertaken to determine the importance of the area for birdlife and the possible threats to local bird communities from the Port of Townsville Marine Precinct project. Considerable past information on shorebirds is available for the area, which has been incorporated into the assessment of the status of local shorebird communities through comparisons with data from other sites in the same region and with information from other regions in the State.

Shorebirds are of particular importance at the site because they dominate the bird communities that may be impacted by the development, and because there are many migratory species in the area that are subject to international conservation agreements and are of concern to both State and Commonwealth Governments. Most of these migratory shorebirds breed in the arctic taiga and tundra. Other birds have also been considered including both marine and terrestrial species.

Shorebird behaviour is determined by the tide, regardless of the time of day. The birds require intertidal, low tide feeding habitat as well as places at high tide that they can use to rest when they are not feeding. These high tide roost sites are habitually used by shorebirds, have particular features and are an important habitat requirement that allows shorebirds to utilise local food resources at low tide.

Counts of birds were undertaken on intertidal feeding areas and on the main roost site in the area. Also, in order to describe all bird local communities close to the development site, transect counts were undertaken through nearby eucalypt and mangrove woodlands. Brief surveys were also made of the banks of the Ross River upstream of the mouth to better understand the extent of a local egret and ibis rookery and to identify possible movements patterns of birds between the river mouth and further upstream.

3.10.5.3 Description of environmental values – wading and migratory birds

Site significance

Shorebirds and other bird species use the sand bank out from the mouth of the Ross River at high tide for roosting (refer Figure 3-60). Almost the full length (800 m) of the bank remains partially exposed, even on the highest spring tides. The site offers a secure location for over 3000 shorebirds, isolated by water from mammalian predators. The site has all the features of a good high tide roost site. The birds that use the site are those that use the neighbouring intertidal feeding areas but, in addition, birds that feed farther away to the south east, also roost on the site and make up more than a third of the total number of total roosting birds.

Summary data for 29 sites in the region was compiled from datasets belonging to the Australasian Wader Studies Group, the Queensland Wader Study Group and the Townsville Region BOC (Bird Observation and Conservation Australia) and used with data for the Ross

River mouth to highlight regional importance shorebird sites.

The Ross River mouth ranks highest in the region in terms of the maximum shorebird count and the highest average summer count over a period of 25 years (Figure 3-60, Figure 3-61). Of the six highest ranking sites, four are very close to the Ross River mouth and actually represent the same community of shorebirds that utilise the sand bank at the mouth of the river as a high tide roost site.

Shorebirds occurred at markedly different densities on the three low tide feeding areas that were investigated. The highest density of feeding birds was on the flat on the southeast side of the river mouth while the extensive flats along the shoreline farther to the south east was used less intensively. The site of lowest density of feeding birds was Lot 773 on the north west side of the river, which is planned as the site for the Precinct development. The possible reason for the relative lack of shorebirds here is the high level of disturbance by people and their dogs on the site. It is currently a de facto recreational area for the local community.

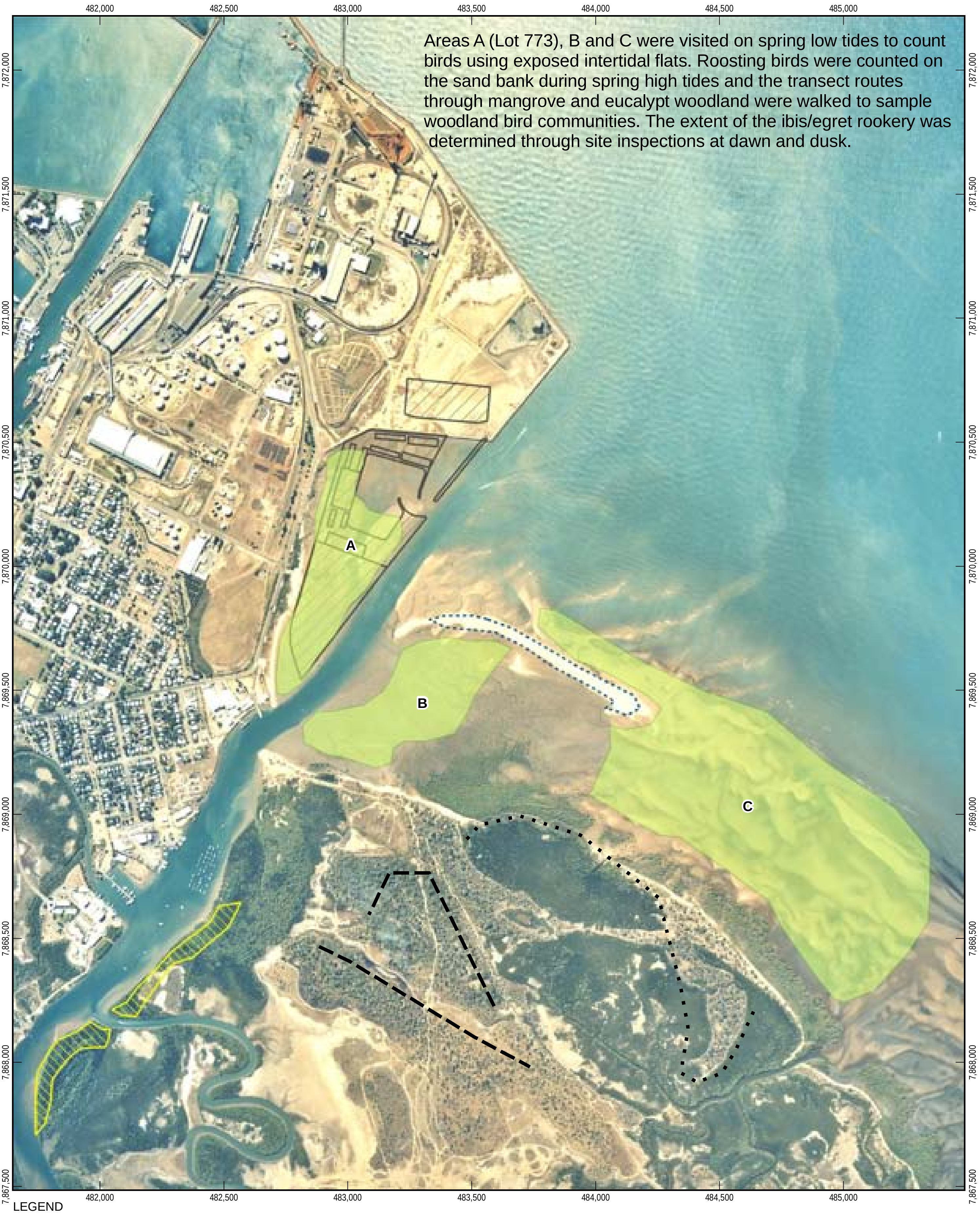
The egret and ibis rookery beside the Ross River, about 1.5 km from the mouth (Figure 3-60), caters for many birds that travel out to neighbouring areas in several directions. From field observations there did not appear to be a strong connection between birds using of the intertidal flats at the mouth of the river and birds that utilise the rookery.

Eucalypt and mangrove woodland transect counts

Thirty nine species were recorded from 223 counts of birds made during transects through eucalypt woodland (Figure 3-60, Appendix V). Fifteen of these species were not recorded elsewhere during the fieldwork. Noteworthy species unique to the habitat included the Red-tailed Black-Cockatoo, Blue-winged Kookaburra, Whitethroated Honeyeater and Fairy Gerygone. The species was found to be breeding in vegetation close to mangroves and is better known as a species of mangroves or rainforest rather than eucalypt woodland. The habitat was degraded with pest weed species and rubbish (refer Section 3.10.4 for a full discussion of this).

Thirty seven species were recorded from 194 counts of birds made during transects through mangrove woodland (Figure 3-60, Appendix V). Nine of these species were not recorded elsewhere during the fieldwork and included the Mangrove Gerygone, Mangrove Honeyeater, Black Butcherbird, Shining Flycatcher and Black-faced Monarch. The first four of these species are characteristic of mangrove woodland and their presence all together suggests that the local mangroves are functioning well as bird habitat. There are few signs of habitat degradation.

Eucalypt and mangrove woodland bird communities are unlikely to suffer from changes caused directly by the TMPP. However, they will be vulnerable to cumulative impacts from the TPAR through habitat destruction of eucalypt woodland and possible indirect impacts on mangroves in the area.



LEGEND

- Eucalypt woodland transect route
- Mangrove woodland transect route
- Extent of ibis/egret rookery
- High tide bird roosting positions
- Survey Area
- Proposed Marine Precinct

1:20,000 (at A4)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

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Port of Townsville
Marine Precinct EIS

Job Number 42-15399
Revision A
Date 01 July 2009

Ross River Mouth
Bird Sampling Locations

Figure 3-60

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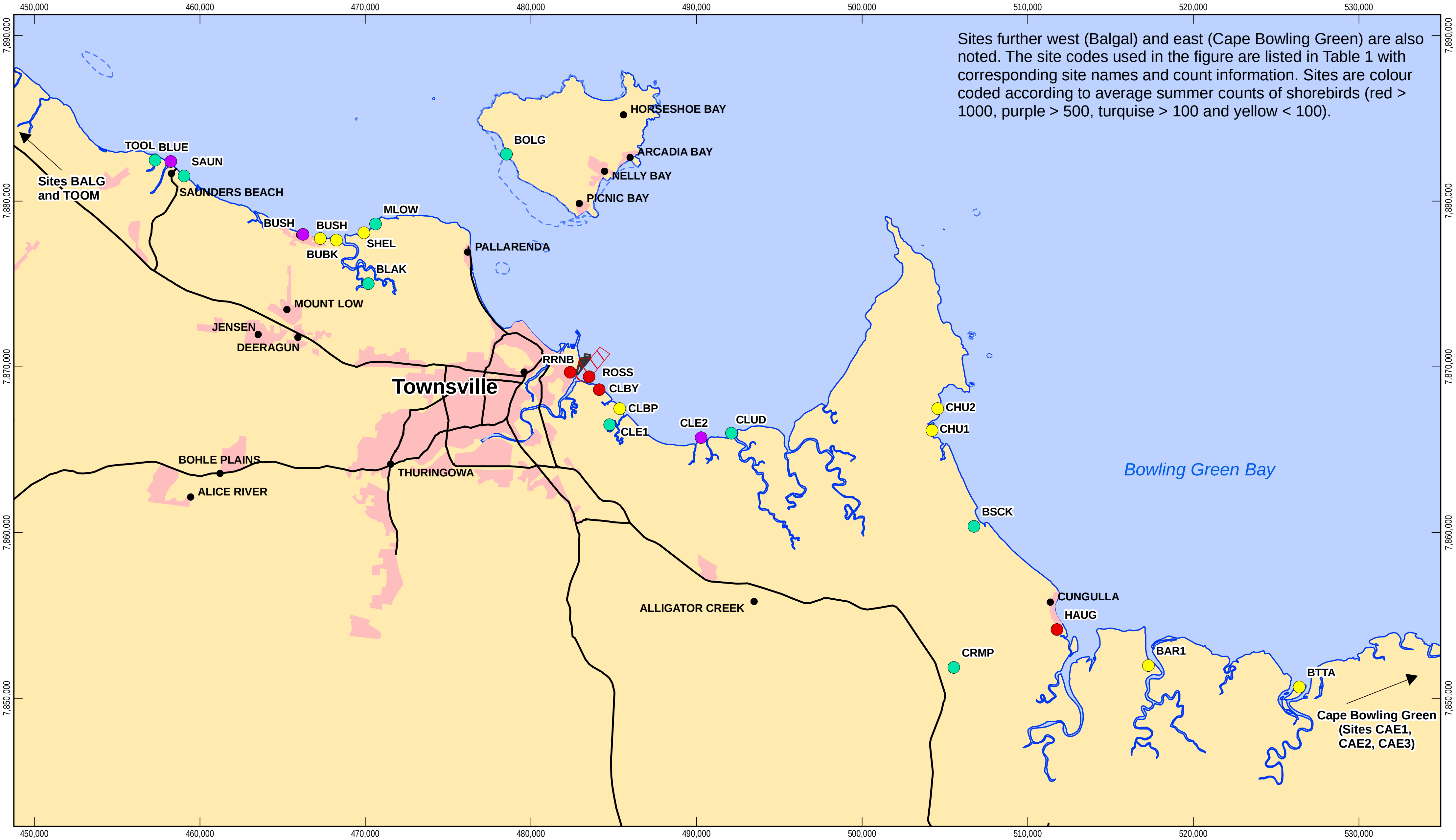
Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management). Created by: TH



1:300,000

0 2 4 6 8 10

Kilometres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

LEGEND

Average Summer Counts of Shorebirds

- > 1000
- > 500
- > 100
- < 100

Project Area of Interest

Builtup Area

Port of Townsville
Marine Precinct EIS

Wetland Bird Sampling Sites in the Vicinity of Townsville from Toolakea to Barratta Creek

Job Number	42-15399
Revision	A
Date	01 July 2009

Figure 3-61

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Data Sources: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; GBRMPA Data - ©Commonwealth of Australia (Great Barrier Reef Marine Park Authority); 250k Topo Data - ©Commonwealth of Australia (Geoscience Australia) 2007.

Table 3-53 Summary results for Townsville region shorebird sites

Site name	Site Code	Maximum Count	Average Summer Count	Average Winter Count	Occasions Site Counted
Ross River mouth	ROSS*	6459	1925	622	122
Cleveland Bay nth-Tns	CLBY	3843	1805	601	7
Haughton River	HAUG*	2779	1531	77	11
Cape Bowling Green 1	CAE1	7137	1411	3566	21
Ross River north bank and foreshore	RRNB*	1950	1143	63	7
Cleveland Bay 2	CLE2	921	921	93	1
Busland Beach east to Bohle R.	BUSH*	3970	832	158	84
Bushland Beach west to Black R.	BUBK*	4700	712	30	46
Bluewater Creek	BLUE*	1618	566	217	27
Blakey's Crossing Tns	BLAK	808	271	129	65
Black Soil Ck Bowling green Bay	BSCK	962	247	389	32
Cleveland Bay 1	CLE1*	4040	197	152	49
Cluden Flats	CLUD	280	167		6
Mt Low Beach	MLOW	261	162		2
Saunders Beach	SAUN*	1026	157		7
Cape Bowling Green 2	CAE2	802			2
Cleveland Rd mud flat (AIMS)	CRMF	324	120		26
Bolgers Bay, Magnetic Is	BOLG*	324	110	43	16
Toolakea Beach	TOOL*	374	106	26	28
Cleveland Bay STP	CLBP*	227	79	29	49
Shelly Beach, Cape Pallarenda	SHEL*	228		20	3
Barratta Creek	BTTA	214			2
Cape Bowling Green 3	CAE3	178			1

Site name	Site Code	Maximum Count	Average Summer Count	Average Winter Count	Occasions Site Counted
Bohle River mouth	BOHL*	144			3
Chunda Bay 1	CHU1	140	74	140	2
Balgal Beach	BALG	72	51		6
Toomulla Beach	TOOM*	92	39	31	33
Chunda Bay 2	CHU2	64			1
Barramundi Creek 1	BAR1	54			1

* indicates currently being monitored by Townsville Region Bird Observation and Conservation Australia (TRBOC).

Shorebird counts – low tide

Birds were counted on two low tides on intertidal flats within the study area, and a tabulation of the results for each subarea (A, B and C) is given in Table 3-54. A general assessment of the differences in shorebird counts between subareas A, B and C (Figure 3-60) is given below. Subarea A is intertidal flat on the northwest side of the river, Subarea B lies between the sand banks, the mangroves and the river mouth on the southeast side of the river, and Subarea C is the extent of intertidal flat to the southeast of the mangroves to as far as the first creek entrance. The size of each subarea has been estimated from aerial photographs as 20, 23 and 103 ha respectively.

The average shorebird counts per survey, for subareas A, B and C were 60, 1137 and 1223 birds respectively Table 3-54. The shorebird feeding densities, expressed with respect to the subarea size estimates, were 3, 49 and 12 shorebirds per ha for subareas A, B and C respectively. That is, the data show a sixteen-fold difference in feeding densities of birds between subareas A and B (B higher) and a four fold difference between subareas C and B (B higher). This suggests that the optimal feeding area during the period of the study was out from the river mouth on the southeast side of the river between the mangroves and the sand banks (area B). The second most used feeding area was farther to the south east along the foreshore (area C) and the least used site was area A (Lot 773).

The concentration of birds in subarea B was pronounced and the substrate here was generally very muddy with an obvious proliferation of benthic invertebrates. Also, counts of birds in subarea B have been understated because, unlike subareas A and C, this area was difficult to traverse due to deep, soft mud and feeding flocks were mostly counted from farther away than at the other two sites and birds would have been missed in the counts. The high number of birds here was also apparent on the rising tide when birds began to congregate into flocks ready for moving onto the high tide roost.

Table 3-54 Average counts over two low tides of shorebird species counted on intertidal areas A, B and C

(refer Figure 3-60 for areas, refer Appendix V for scientific names)

Area Label	A	B	C
Area (ha)	20	23	103
Australian Pied Oystercatcher	2		2
Pacific Golden Plover		2	2
Grey Plover	9		3
Red-capped plover	7		7
Lesser Sand Plover		9	33
Greater Sand Plover	24	1	59
Bar-tailed Godwit	10	60	37
Whimbrel	8	1	17
Eastern Curlew		2	20
Terek Sandpiper			1
Grey-tailed Tattler		8	9
Common Greenshank		4	1
Great Knot		750	89
Red Knot		2	2
Red-necked Stint		127	720
Sharp-tailed Sandpiper		172	225
Total	60	1137	1223
Total birds/ha	3	49	12

Shorebird counts – high tide

Birds were concentrated at high tide along the exposed sand bank near the mouth of the Ross River (Figure 3-60) The approximate locations where they were most concentrated is shown but their positioning can vary depending upon the tide height, weather conditions, the current shape of the sand bank and whether the flocks have been disturbed or forced to move by people, boats or natural predators. No other high tide roosts were located in the study area except for the probable use by birds of the eastern reclaim area of the port.

During the fieldwork, four high tide roost counts were undertaken on the sand bank and 31 species were recorded. The high tide counts confirmed the importance of the site for shorebirds and a full appraisal of the latest roost counts is made together with past data in the sections to follow.

Comparison with low tide scan counts

Shorebirds that feed in an area generally roost nearby and there is expected to be a correlation between birds counted roosting at high tide and those counted at low tide feeding. However, this correlation of numbers of birds roosting and feeding is influenced greatly by difficulties of sampling, by the mobility of the birds, by the large areas that can be available for feeding and often by the availability of alternative roost sites. Nevertheless, the link between the numbers of roosting and feeding birds around the mouth of the Ross River is quite reasonable (refer Appendix V) and clearly suggests that birds that forage nearby are using the roost site. Large numbers of birds were also observed moving from the feeding areas to the roost on rising tides.

Of the 35 bird species recorded from either the roost site or from the intertidal flats, 25 species were recorded in both sets of data. Of the species of shorebird, which made up for over 95% of total counts, 14 out of the 16 species were recorded from both roost site counts and from low tide feeding counts.

It is usual for shorebirds to feed and to roost at sites within 8 km of each other. Because the roost counts of shorebirds was higher then the feeding counts (refer Appendix V), data suggest that even more birds were using the roost site than were feeding on the neighbouring flats (higher counts on the roost site). It is most probable that shorebirds that feed even farther away along the shoreline of Cleveland Bay to the southeast return to roost on the sand bank at the Ross River mouth. There are many records of high feeding densities of birds at sites farther to the southeast of the sand bank, that is, at CLE1 (Figure 3-61) 4 km from the roost site.

Most abundant species

Over time, 23 species of migratory shorebird, 8 species of resident shorebird and 34 non shorebird species have been recorded on intertidal areas at the mouth of the Ross River. On any single visit to the site about 12 shorebird (9 migratory and 3 resident) and 4 other species of birds are present. Amongst the non shorebird species, seven species of tern, Little and Great Egrets, cormorants, ibis, and several birds of prey regularly use the site. Of particular note are Little Tern and Beach Stone-curlew. In order of overall abundance at the site the following nine species of migratory shorebird make up 85% of the total number of birds counted there:

- Great Knot;
- Rednecked Stint;
- Bar-tailed Godwit;
- Sharp-tailed Sandpiper;
- Eastern Curlew;
- Whimbrel;
- Lesser and Greater Sandplovers; and
- Grey-tailed Tattler.

Each species displays its own pattern of seasonal abundance at the site because of differences in migration behaviour and distribution within Australia (refer Appendix V).

Species of significance

The mouth of the Ross River was recognised in Watkins (1983) as being internationally significant for the number of Lesser Sandplover and Eastern Curlew that have been recorded there and nationally significant on the basis of the number of Whimbrel. Also, the site arguably has international significance on the basis of numbers of Great Knot and Red-necked Stint. Furthermore, migratory shorebirds generally are subject to international conservation agreements between Australia and three other countries. Species of particular interest on the basis of State Legislation are the Beach Stone Curlew, Eastern Curlew and Little Tern.

Other recent appraisals of shorebirds using the Ross River mouth sand bank and associated feeding flats (NRA 2008, Maunsell 2008) have also highlighted the significance of the area for shorebirds and in particularly the occasional very high counts of Great Knot and Red-necked Stint, which on at least three occasions for Great Knot and one occasion for Red-necked Stint, have been above 1% of the East Asian-Australasian Flyway pollution estimates for these species.

3.10.5.4 Potential Impacts and Mitigation Measures – wading and migratory birds

Loss of feeding habitat Lot 773

The development of Lot 773 as a Marine Precinct would mean the permanent loss of about 20 ha of feeding habitat for shorebirds. There is six times this extent of intertidal feeding habitat within 2 km of the Precinct. Furthermore, the quality of Lot 773 as feeding habitat is already compromised by the regular use of the area at low tide by people traversing, often with their dogs, disturbing feeding birds. Without the prospect of the Precinct, this disturbance could perhaps be minimised through controls on the activity of people on the flat. Nevertheless, preservation of Lot 773 as feeding habitat is not considered critical for maintaining the large numbers of shorebirds that frequent the area in general. On the south east bank of the river though, opposite the Precinct, there are important natural habitat features that are considered critical to local bird communities.

Offsite impact of the development on feeding habitat

The area of soft mud on the south-east side of the river between the sand bank and the inner mouth of the river (Area B, Figure 3-60) can be used intensively by shorebirds and, for the period of this study, carried far more shorebirds per hectare than the feeding flats farther to the east. Alteration, diminution or disturbance that affected shorebird feeding on this section of intertidal flat would represent a significant loss of amenity for shorebirds that frequent the area.

Physical changes to the substrate in this area through the encroachment of man made structures or through changed sedimentation patterns need to be minimised and carefully managed. Direct disturbance by people of shorebirds feeding here also needs to be managed but there is a natural safeguard that already exists in the form of deep, soft muds that form the local substrate, which practically precludes pedestrian access to anywhere other the edge of the site.

3.10.5.5 Cumulative impacts and mitigation strategies – wading and migratory birds

Even though the extensive feeding flats that extend to the south east of the sand bank (Area C and beyond, Figure 3-60) will not be directly affected by the Precinct development, other infrastructure that is being planned for the area, including the TPAR, will have the potential of giving far more people ready access to intertidal areas and will increase the likely levels of disturbance of feeding shorebirds by people and dogs. That is, all new infrastructure and plans for access to lands and marine areas on the south-east bank of the river have the potential to detract from a very important site for shorebirds. Movements of people need to be carefully managed to avoid these potential impacts.

The roost site is fundamental to the importance of the area for shorebirds. Without it, the nearby feeding flats will cater for far fewer birds. The roost site serves as a focal point of shorebird activity and a secure place for birds to rest twice every day during periods of high tide.

Threats to the site include:

- Loss or diminution of the extent of the high tide bank through changes in sedimentation patterns brought about by the breakwater(s) that may be built to protect the Precinct;
- Increased human access to the bank that may result from such a breakwater(s) of increased boating activity around the bank; and
- Short term intense disruption of birds using the bank during periods of construction of the breakwater(s).

These potential impacts were considered when assessing the appropriate breakwater footprint for the Precinct and area discussed under Section 1.4.2. A disconnected breakwater configuration was selected that provides protection to the sand bank roost site from direct access and from changes to sedimentation patterns and hydrodynamic flow influences resulting from the Precinct and breakwater construction.

3.10.5.6 Conclusion – wading and migratory birds

Given the significance of the environs of the Ross River mouth for birdlife, particularly the sand bank roost site for shorebirds, the following measures are recommended to ameliorate against adverse impacts from the Precinct and other developments in the area:

- Changes to intertidal bird feeding habitat must be restricted to Lot 773. There should be no direct or indirect consequences of the development on the nature of, or level of interference with other intertidal flats in the area;
- Mangroves on the southeast bank of the Ross River are in good condition with an intact mangrove bird community and should be protected as an important adjunct to neighbouring estuarine habitat;
- Breakwater placement and design should be such that there are no medium or long term threats to the integrity of the offshore sand bank, its extent or its height. It should remain separate from the mainland at high tide as an island refuge for roosting shorebirds and visitation rates by people should not increase;
- If there is to be any interim access to the sand bank during construction of a breakwater then that access needs to be subject to stringent conditions under an Environmental Management Plan to minimise disturbance to birds at the site;

- The roost site should be monitored in future to ensure its integrity does not come under threat from unpredicted changes in sedimentation patterns etc from new marine structures including the Precinct and any breakwater;
- Much is already known about the important features of high tide roost sites for shorebirds and many of these features can be engineered. This knowledge should be put to use if detrimental changes to the roost site do start to occur;
- The cumulative consequences of the TPAR, the Precinct and other developments in the area should be acknowledged through cooperative planning by all parties involved to protect bird habitat at the mouth Ross River. Appropriate management of access by people to this area should be put in place;
- The community should be informed of the significance of the area for shorebirds with appropriate signage and community consultation, including a cooperative approach to continued monitoring of birdlife at the site using organisations such as TRBOC, Queensland Wader Study Group (QWSG) and Australian Wader Study Group (AWSG); and
- Recognition of the area for shorebirds should be made through its listing with the Shorebird Site Network under the Asia Pacific Migratory Waterbird Strategy as noted in the Commonwealth Wildlife Conservation Plan for Migratory Shorebirds.

3.10.6 Aquatic ecology

3.10.6.1 Overview of aquatic studies

The Precinct area includes marine and intertidal habitats in the mouth of the Ross River. No freshwater aquatic habitats are present.

The Study Area surveyed for benthic marine ecology encompasses the TMPP area and reference sites from the immediate surrounds, including within Ross River and seaward of the Project area into Cleveland Bay. The TMPP Area, Lot 773, is located near the mouth of the Ross River and is approximately 32 hectares of shallow tidal sand/mud flats with a rocky foreshore along the northern edge bounding the Eastern Reclaim Area of the port (Figure 3-62). The only natural habitat remnant in this Lot 773 is a small area (approximately 1.5ha) of vegetation that has recruited at the base of the seawall. Impacts to this vegetation are assessed under the Section 3.10.4.

Reference sites in adjacent areas included in the Study Area are (refer Figure 3-62):

- The intertidal area under Lot 773;
- A Swing Basin directly in front of Lot 773;
- The Ross River and its channel;
- East Bank across Ross River from Lot 773 that has sand/mud flats,
- A foreshore area and a sand spit; and
- The areas seaward of Lot 773 in Cleveland Bay that are open water and further offshore some deepwater seagrass meadows.

Marine ecology studies have been collated from information sourced through a focussed desktop assessment of available information (including Government agencies databases) and from the results of a benthic marine ecology survey that enhances the existing knowledge of aquatic systems occurring within and adjacent to the Project Study Area.

The marine benthic survey findings come from a once off sampling event of 5 days in duration in October 2008 and may not reflect potential seasonality of marine fauna across the Study Area. However, the historical data and available information on the Project area and adjacent habitats is thorough and provides a strong seasonal perspective within which the survey data is used in assessing the potential impacts of the TMPP on the benthic marine ecology.

3.10.6.2 Objectives and methodology – aquatic ecology

The objective of the benthic marine ecology survey was to assess the current status of benthic taxa and characterise the benthic habitats in the TMPP area and adjacent habitats, defined as the Study Area. A review of available literature, databases and consultation with other researchers found that the most recent benthic surveys within the Project area were undertaken over seven years ago (Cruz 200, Neil 2001 and Neil *et al.* 2001) and thus previously reported species composition data are no longer current, although data regarding seasonal variability of tropical systems are relevant. The detailed findings from the literature review and consultation processes are provided in Appendix T.

The marine communities of the project area were characterised by surveying the subtidal and intertidal habitats of the Project area and immediate surrounds. Simultaneously the area was assessed for the presence of any marine pests of concern. The methodology utilised in this program is detailed in Appendix T.

Department of Primary Industries and Fisheries (DPI&F) undertook seagrass survey work for POTL in 2007 and 2008 and comprehensively assessed spatial and temporal variability of seagrasses within the Port of Townsville and adjacent marine environments (Rasheed and Taylor 2008). Considering this recent survey work, it was not necessary to undertake further broad scale seagrass meadow assessments. Instead focussed characterisation of seagrasses at sample sites was conducted during other field activities that built upon information collected during the DPI&F surveys. This enables ecosystem assessment of the meadows likely to be influenced by any proposed development works in the context of their use by other species.

The marine community assemblages (including seagrasses and any associated fish taxa) were characterised for diversity, spatial distribution and relative abundances. The surveys enhanced the existing information on these marine benthic communities and provided the ability to assess the potential impacts to benthic communities and any protected species and propose appropriate mitigation measures.

3.10.6.3 Survey design

To assess the current status of benthic taxa (fish and macroinvertebrates) and characterise the benthic habitats in the Study Area, areas to be surveyed were determined from observations made during a megafauna and intertidal seagrass aerial survey. The areas include all habitats potentially affected by the Precinct.

The sites were spatially stratified and not randomly distributed, a sampling approach that is appropriate for characterising soft sediment taxa that are characteristically disparate in their distribution (e.g. Cruz 2000, Neil *et al*. 2003, Roberts *et al.* 1998, Smith and Rule 2001). The number of sites investigated within each location was determined using methodology defined in Hayes *et al.* (2005a) that allowed representative samples of the benthic taxa within each location to be collected.

A once-off sampling event was undertaken to complete all benthic sampling and provide a baseline of species distributional data. Sampling was conducted both from shore and boat environments. The following locations, and number of sites within each location, were targeted for soft sediment and intertidal community assemblage sampling (refer Figure 3-63):

Subtidal

- The Marine Precinct Project Area and immediate surrounds (Lot 773, 5 sites);
- Seaward of the Marine Precinct Project area, in the proposed breakwater footprint area (2 sites), and in the seagrass area (3 sites); and
- Up Ross River adjacent to the currently in-use pile moorings (10 sites).

Intertidal

- Marine Precinct Project Area (Lot 773, 5 sites);
- Sand Spit (6 sites); and
- East Bank, along the foreshore edge of the sand/mud flats adjacent to the Sand Spit (5 sites).

Subtidal sites were sampled using a benthic sled and camera set up. Benthos captured in the sled net was identified to lowest taxonomic unit. Intertidal soft sediment habitats were sampled using 1m x 100m strip transects. Benthos within the footprint of the transect was identified to lowest taxonomic unit.

In addition, visual non-structured surveys were conducted at the rocky shore habitat in the proposed TMPP area in order to compare the current assemblages within the area to historical data (e.g. Neil *et al.* 2001, Neil 2001). Beach walks were done at the Sand Spit and along the Precinct area looking for recent signs of benthic faunal activity such as crab exuviae and moults. Cast nets and crab pots were deployed in the Ross River and the Precinct area to collect information on the fish and crab species present (Figure 3-63). Additional detail in regards to sampling methodology approaches is provided in Appendix T.

3.10.6.4 Description of environmental values

The TMPP area and adjacent areas include a number of key marine benthic habitats:

- The Marine Precinct Area is a shallow tidal sand/mud flat with small areas of intertidal beach, rocky foreshore and remnant natural vegetation;
- Seaward of the Precinct is an extensive deepwater seagrass meadow;
- Up Ross River the eastern side remains fairly natural with small tributaries while the western side has been greatly modified, with rock walls and industrial development;
- At the mouth of the Ross River, the East Bank is a mud flat area that abuts fringing mangroves; and
- At the edge of this mud flat there is a highly mobile Sand Spit that changes shape according

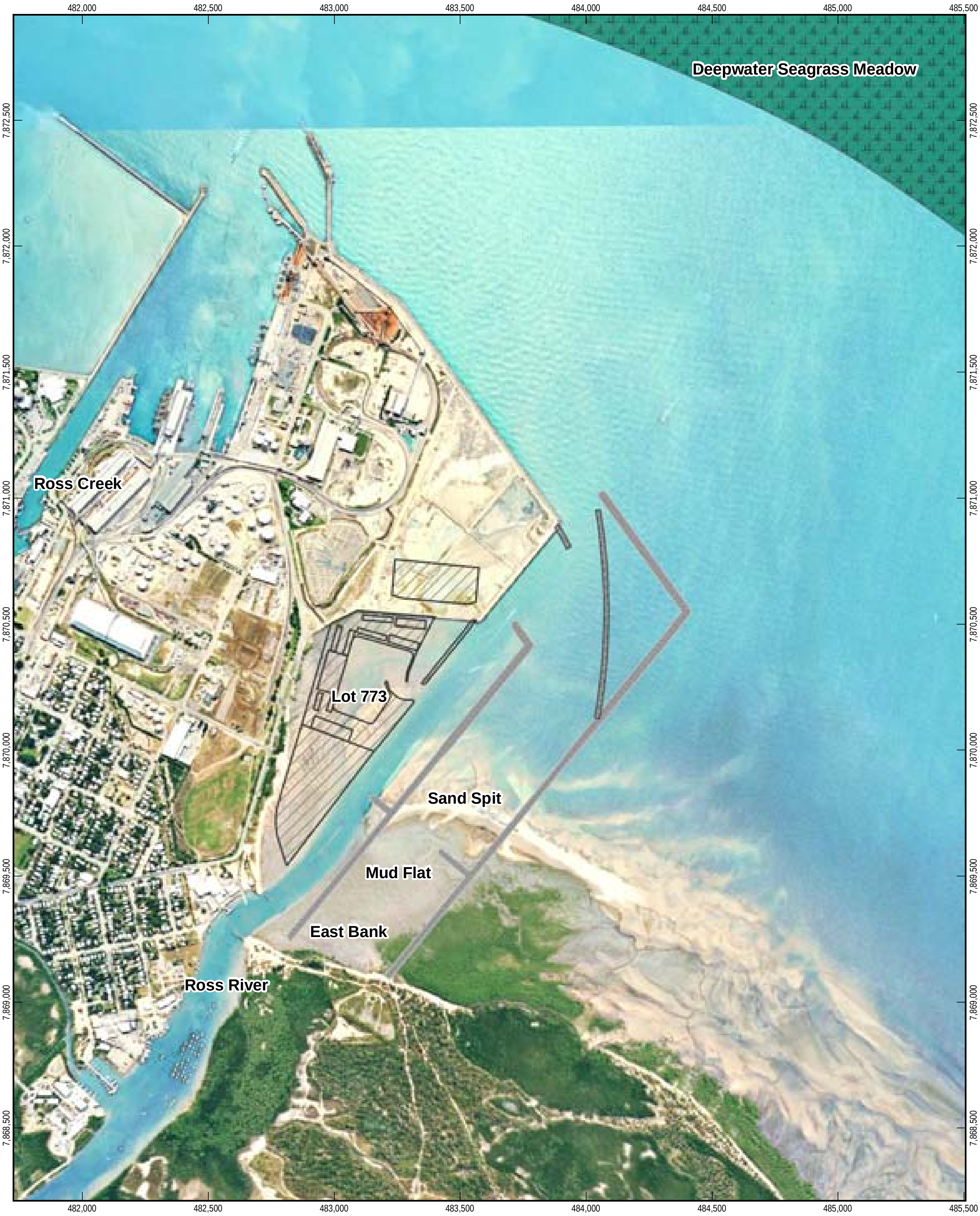
to seasonal and flood influences.

A range of communities was present across each of these habitats. The subtidal benthic communities were dominated by small marine molluscs, and to a lesser extent crustaceans (crabs and prawns), with animals from most other benthic groups present including marine worms, echinoderms (sea stars and sea urchins), fish and seagrass. The intertidal benthic communities were, similar to the subtidal communities, dominated by small molluscs, mostly snails. There were also large numbers of fiddler crabs, soldier crabs and marine worms. Thousands of crab burrows were observed.

No marine pests of concern for the Townsville region were detected in any of the samples collected during this survey. Species of concern were determined based on information provided in Hayes *et al*. (2005b) and through the National System for the Prevention and Management of Introduced Marine Pests.

The seagrass areas offshore from the Precinct and the East Bank habitats supported the greatest diversity subtidally and intertidally respectively. The majority of crabs were observed in this area and the mud flat forms a significant feeding ground for wading and migratory birds for the region, a matter reported under Section 3.10.5. A few seagrass species were also recorded among the fringing mangroves of this site. Fish assemblages, including juveniles of species targeted by commercial and recreational fishers, were more common and more diverse along the East Bank areas, typically associated with fringing mangroves. Rocky shore assemblages occupying the Eastern Reclaim Area breakwaters that form the northern edge of Lot 773 supported taxa that are common to the Townsville region.

The Precinct area had a subtidal benthic community of relatively low diversity, with 25 species present, however the intertidal area was more diverse with 28 species recorded (there are usually many more benthic species present in subtidal soft bottom communities compared with intertidal communities).



LEGEND

- Breakwater Option C (Preferred)
- Min and Max Breakwater Options
- Proposed Marine Precinct
- Deepwater Seagrass Meadow (Summer Baseline Survey 2007)

1:20,000 (at A4)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Marine Ecology
Sample Areas

Job Number	42-15399
Revision	A
Date	01 July 2009

Figure 3-62

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management); Townsville Summer Baseline Deepwater Seagrass Meadows 2007 ©The State of QLD (Department of Primary Industries and Fisheries). Created by: TH

LEGEND

- Cast Net
- Crab Pot
- Benthic Fauna Grab
- Beach Walk
- Intertidal Belt Transect
- Rocky Shore Transect
- Benthic Sled Transect
- Deepwater Seagrass Meadow (Summer Baseline Survey 2007)

1:20,000 (at A4)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Benthic Sample Locations

Job Number	42-15399
Revision	A
Date	01 July 2009

Figure 3-63

G:\42\15386\GIS\Projects\EIS\42-15399_212_rev_a.mxd

Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Aerial (flown 2004) - ©The State of Queensland (Department of Environment and Resource Management); Townsville Summer Baseline Deepwater Seagrass Meadows 2007 ©The State of QLD (Department of Primary Industries and Fisheries). Created by: TH

Across all these habitats, the surveys recorded 105 species from the subtidal waters and 44 taxa from the intertidal areas. This included taxa recognised to be protected and regulated under the Fisheries Act 1994. All marine plants are protected under the Fisheries Act 1994; this survey detected three seagrass species, 10 algal taxa and three mangrove taxa but only algae and mangroves were found within the Lot 773 footprint. All molluscs (bivalves and gastropods) and a large number of fish taxa are regulated under the Fisheries Act 1994. Subtidally 17 and intertidally 19 regulated taxa were detected. Over 80% of these were small molluscs (non-commercially targeted, mainly gastropods) although recreationally targeted mud crabs, were also found within the footprint of Lot 773. These were, however, also found elsewhere in the study area and were not unique to Lot 773.

One species of conservation significance was observed, a green turtle (*Chelonia mydas*) in the Ross River channel in front of the Marine Precinct Project area. One marine migratory listed species was also observed, a dugong (*Dugong dugon*) at the edge of the deepwater seagrass meadows. In addition a sea snake was observed at the mouth of the Ross River; sea snakes are listed as other protected matter species in the EPBCA. Habitat requirements for a number of other species of conservation significance, marine mammals and reptiles, were present in the Study Area, and these species may use the area from time to time, including nine species of NES, 14 migratory and 68 Other Protected Matter species.

Data analyses support the diversity descriptions of the study sites with the seagrass meadow being the most diverse assemblage and supporting taxa different to other areas surveyed. The channel and sand spit environs support the least diversity and the flora and fauna present in the Precinct were also found in other locations surveyed, although in differing relative proportions.

Taxa sampled during the survey were consistent with those detected previously by Neil *et al.* (2001) and Rasheed and Taylor (2008). This suggests that seasonal and long term temporal variability has had little influence on the biodiversity of this area with many of the species persisting over time and under the influence of various impacts, including storm and flooding events and dredging activities. This indicates these communities are either resilient to impacts and recover quickly (as shown by Neil 2001 for a subset of the taxa found here) or are able to recolonise habitats rapidly after disturbance events experience to date.

The TMPP is not expected to significantly impact on any of these NES, migratory or Other Protected Matter species. This conclusion is also discussed further in the marine megafauna Section 3.10.7 following and Wading and Migratory avifauna Section 3.10.5.

The TMPP is expected to impact on benthic invertebrate communities. In order to address what impacts and mitigation measures are appropriate to avoid impacting upon marine ecology values of the areas associated with development and operation of the Precinct facility, an impact risk assessment has been undertaken and is discussed in detail in Appendix T.

3.10.6.5 Potential Impacts and Mitigation Measures – aquatic ecology

The TMPP will have a number of permanent impacts on the marine ecological values of the area in which it is located. The majority of the impacts involve the removal of an area (approximately 32 ha) of intertidal sand/mud flat on the western bank of the Ross River that forms the bulk of Lot 773. Further, the loss of seabed associated with the footprint of the breakwater (approximately 2 ha in total) will also occur. In addition, a range of temporary impacts are expected as a result of construction activities, including dredge plume impacts and noise impacts.

In developing the Reference Design for the Precinct consideration was given to potential impacts upon marine species and care has been taken to incorporate features that address the 11 principals guiding development for fish-friendly structures, as provided by the Queensland Government Fish Habitat Guideline FHG 006.

No removal of seabed or disturbance of marine habitats is proposed for the eastern bank area of the Ross River, across from the Lot 773 footprint. The area is heavily utilised by marine wading and migratory birds, which is reported under the Marine and Migratory Avifauna assessment for this EIS. It also forms an important habitat for fish and crab species and is fringed by a variety of mangrove and seagrass species. Avoiding impact upon this area aligns with principals of FHG 006 including sustainable development, avoiding sensitive habitats and minimising disturbance and adopting an integrated approach to the development process. The East Bank, Sand Spit and mud flat area may be the subject of further studies in regard to potential siting of boat ramp facilities outside this EIS process. Data collected during this investigation may provide a baseline from which further studies can work. Impacts associated with the loss of any marine environs and taxa associated with potential boat ramp siting investigations, including cumulative impacts following on from development of the Precinct, would need to be considered at that time.

The proposed configuration of the Precinct with an inner harbour increases the opportunity for re-establishment of soft sediment communities affected during the construction process and provides appropriate flushing to not impact upon water quality and ergo marine species, including fishery species. The construction approach of using sloped rock revetment walls provides interstitial habitat both tidally and subtidally that may increase the habitat available in this area for fish and crab species. This integrated approach to design and construction with environmental considerations and avoidance of critical habitats recognises the risks and potential benefits that artificial structures may bring to improve the fish habitat values of the development footprint, adhering to the guiding principals of FHG 006.

Prior to the construction of the Precinct a road and rail link to the proposed port site will be constructed. This road and rail corridor will enter the port site from the east, passing through the land on the eastern side of the Ross River mouth and crossing Ross River to the south of Lot 773. The actual design and construction of this infrastructure is the subject of another approval process by the Department of Main Roads. A range of cumulative impacts may occur in regard to construction effects on marine megafauna species and removal of benthic species.

The impacts on marine ecological values expected to result from the Marine Precinct project, either during construction and/or operation, include:

- Direct impacts (both potential and probable);
  - Removal of individual organisms;
  - Damage to individual organisms from direct contact related to construction activities;
  - Removal of individual organisms as a result of Precinct user activities;
  - Damage to individual organisms as a result of Precinct user activities;
  - Impact to fauna by boat strike;

- Increased rubbish that may smother or damage individual organisms; and
- Decreases in water quality from dredging, construction, spills of fuel or other hydrocarbons, paint, solvents, cleaners or other pollutants.

- Indirect impacts (both potential and probable);
  - Decreased water quality from construction disturbance of sediments around the Precinct site;
  - An increase in sedimentation that may result in the smothering of adjacent benthic communities;
  - Degradation of habitats through continual human usage (including inappropriate waste management, boat fuel spills);
  - Increased disturbance to habitats from increasing visitation/usage;
  - Decreased water quality resulting from inappropriate waste management or an increase in sediments and pollutants as a result of construction waste or land use changes;
  - Noise and vibration impacts to marine reptiles and mammals from in-water construction or ongoing operational activities; and
  - Increased bioturbation from propeller activity reducing water quality and disturbing marine assemblages.

Decline in species diversity, removal of species or reduced use of the area by mobile marine fauna may occur as a consequence of these potential impacts. This may have flow on effects for the value of the marine ecosystems within the Townsville region. To address this potential for impact on marine species an assessment of the risk of each impact and mitigation measures is provided in Table 3-55.

Table 3-55 Risk assessment for marine ecological values (marine megafauna further addressed in following section)

Activity	Expected impact	Preliminary risk assessment (C,L) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (C,L) Score
Construction Works				
Pile driving, dredging and general construction in water	Increased sedimentation in the Ross River, declines in water quality, increased siltation.	(4, 4) 16 High	Consideration of use of sediment / silt mitigation devices like silt curtains as appropriate for construction/dredge methodology. Consideration of timing of dredging activity to not coincide with rough weather that would exacerbate impacts. Implement construction and dredge management plans including approaches to hopper de-watering, overflow, monitoring of water quality conditions and use of water quality triggers to halt dredging if unacceptable decline in water quality detected.	(2, 4) 8 Medium
	Acoustic impacts on marine fauna leading to avoidance of area.	(2, 4) 8 Medium	Use of warning strikes pre full drive of pile (if found to be effective). Avoid activities that will disturb breeding/migratory wading avifauna. Implement a megafauna management plan. Consider use of a megafauna spotter on vessel to manage conduct of activity when animals within 50m of vessel.	(1, 4) 4 Medium

Activity	Expected impact	Preliminary risk assessment (C,L) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (C,L) Score
	Vibration impacts on marine fauna leading to avoidance of area.	(2, 4) 8 Medium	Use of warning strikes or similar prior to commencement of pile driving (if found to be effective). Avoid activity if breeding of megafauna noted in project the area. Implement a megafauna management plan to mitigate impacts. Consider use of a megafauna spotter on vessel to manage conduct of activity when animals within 50m of vessel.	(1, 4) 4 Medium
	Direct impacts by dredge plant on marine megafauna leading to capture / reduction in biodiversity.	(3, 3) 9 Medium	Maintain visual check for megafauna activity in path of dredger and consider operational avoidance measures to reduce risk of impact to turtles, particularly when within 50m of operations. Use bucket dredge (backhoe). If possible use of trailer suction dredge should include turtle exclusion devices like tickler chains. Implement a megafauna management plan to mitigate impacts.	(2, 3) 6 Medium
Light spill from construction plant	Disorientation by marine fauna leading to inappropriate clustering of fauna to construction site.	(2, 3) 6 Medium	Install lighting that includes reduced risk of spill into marine environment through use of light screens. Consider lighting options and safety needs and use most appropriate wattage / lighting type for minimising impact on marine taxa. Use limited lighting adjacent to water. Adopt timed lighting to minimise light pollution. As no turtle nesting has been observed within immediate vicinity, monitoring of turtle nesting behaviour is not considered relevant, though consideration is given to hatchling dispersal and Precinct lighting as noted above.	(1, 3) 3 Low

Activity	Expected impact	Preliminary risk assessment (C,L) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (C,L) Score
Increased occurrence of rubbish from construction activities	Waste materials, domestic rubbish enter marine environment and smother marine systems, ingested by marine fauna leading to death or maiming.	(3, 3) 9 Medium	Implement waste management plans and measures including provision of solid waste containers for recycling or disposal of via a licensed contractor. Educate onsite users of facility in regards to appropriate waste management requirements.	(2, 2) 4 Low
Increased vessel traffic (construction vessels)	Increased boat strike of marine fauna leading to death or maiming.	(3, 2) 6 Medium	Provide education and training to vessel operators in regards to monitoring for and management of interactions with marine fauna. Implement fauna spotting and appropriate avoidance measures whilst dredging to reduce risk of impacting turtles. Consider working with regulatory agencies to implement Go Slow Zones in Port vicinity and over adjacent shallow foraging habitats. Implement a megafauna management plan to mitigate impacts. Consider extension of 6 knot speed restriction of Ross River to outer breakwater.	(2, 2) 4 Low
	Increased potential marine pest introductions.	(3, 4) 12 High	Adhere to national and state biofouling and ballast water management guidelines and requirements for both domestic and international shipping traffic. Precinct facility not established as first port of call for quarantine clearance of incoming vessels. International vessels to be of low risk of carrying marine pests prior to entering Precinct facility. AQIS procedures to be adhered to.	(2, 4) 8 Medium

Activity	Expected impact	Preliminary risk assessment (C,L) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (C,L) Score
Habitat removal as result of construction and dredging activities for both Precinct and breakwater facility	Benthic marine habitat, inter and subtidal, removed and communities supported by this habitat denuded. Habitat and communities represented elsewhere in region including Rowes Bay and Pallarenda.	(5, 2) 10 Medium	Implement a dredging and spoil disposal management plan considering avoidance of marine habitats used frequently by marine megafuna. Implement a construction environmental management plan. Consider offsetting impacts from benthic habitat removal by remediating or rehabilitating other degraded environs.	(5, 1) 5 Medium
	Reduced water quality from construction and dredging activities providing indirect impact on adjacent communities. Potential for reduced biodiversity.	(3, 3) 9 Medium	Implement construction and dredge management plans including approaches to hopper de-watering, overflow, monitoring of water quality conditions and use of water quality triggers to amend dredging approach (eg consider introducing silt curtains to the extreme of halting dredging) if unacceptable decline in water quality detected.	(2, 3) 6 Medium
Land use change	Removal of existing impacts to intertidal / subtidal habitats of Lot 773, including waste pollution.	Positive benefit	Existing impacts to be removed.	Positive benefit
	Loss of beach environment for recreational opportunities during construction activities.	(5, 2) 10 Medium	Consider opportunities to offset losses by creating alternative recreation in other locations. Maintain presence of sand bank and mud flat across river from Precinct to continue recreational activities in these areas as they currently occur.	(5, 1) 5 Medium

Activity	Expected impact	Preliminary risk assessment (C,L) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (C,L) Score
	Increased potential for fuel, hydrocarbon, chemical (etc) spill during construction activities.	(4, 3) 12 High	Identify hazardous material handling requirements and implement waste management and emergency response procedures. Suitable and sufficient oil and chemical spill response equipment to be available and easily accessible. Training in spill response and reporting to be undertaken.	(2, 3) 6 Medium
Operational Works				
Operation of breakwater facility	Alteration of local hydrodynamics	(2, 5) 10 High	Adopt design configuration to minimise impacts on hydrodynamics. Maintain smallest practical footprint of breakwater and disconnection from shore to minimise impacts.	(1, 5) 5 High
	Creation of interstitial habitat and provision of additional hard substrate subtidally.	Positive benefit	Provides benthic habitat that can be recolonised by taxa. Counteracts removal of existing rocky shore area that bounds northern edge of Lot 773.	Positive benefit
Operation of Precinct facility	Alteration of local hydrodynamics.	(2, 5) 10 High	Adopt design configuration to minimise impacts on hydrodynamics.	(1, 5) 5 High
	Acoustic impacts, interference with communication of marine fauna leading to temporary avoidance or displacement.	(2, 4) 8 Medium	Facilitate construction to consider design strategies for in-water noise reduction. Like facilities exist in Ross River currently and fauna currently use area.	(1, 4) 4 Medium
	Vibration impacts, interference with communication of marine fauna leading to temporary	(2, 4) 8 Medium	Facility construction to consider design strategies for in-water vibration impact reduction.	(1, 4) 4 Medium

Activity	Expected impact	Preliminary risk assessment (C,L) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (C,L) Score
	avoidance or displacement.			
	Creation of inner harbour habitat.	Positive benefit	Counteract removal of existing subtidal benthic substrate associated with footprint of Precinct in Lot 773. Provides benthic habitat that can be recolonised by taxa.	Positive benefit
Increased occurrence of rubbish in local area	Waste materials, domestic rubbish enter marine environment and smother marine systems, ingested by marine fauna leading to death.	(3, 4) 12 High	Implement waste management plans and measures including provision of solid waste containers for recycling or disposal of via a licensed contractor. Educate onsite users of facility in regards to appropriate waste management requirements.	(1, 4) 4 Medium
Light spill from Precinct Facilities	Disorientation by marine fauna leading to inappropriate clustering of fauna to Precinct site.	(2, 5) 10 High	Install lighting that includes reduced risk of spill into marine environment through use of light screens. Consider lighting options and safety needs and use most appropriate wattage / lighting type for minimising impact on marine taxa. Use limited lighting adjacent to water. Adopt timed lighting to minimise light pollution. As no turtle nesting observed within vicinity monitoring of turtle nesting behaviour not considered relevant.	(1, 5) 5 High
Land use change	Potential provision of designated public access facilities within Precinct.	Positive benefit	Consider provision of public access facilities within Precinct.	Positive benefit

Activity	Expected impact	Preliminary risk assessment (C,L) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (C,L) Score
	Increased potential for fuel, hydrocarbon, chemical (etc) spill during operational activities.	(3, 4) 12 High	Facilities to be designed to standards to mitigate pollution potential. Identify hazardous material handling requirements and implement waste management and emergency response procedures. Suitable and sufficient oil and chemical spill response equipment to be available and easily accessible. Training in spill response and reporting to be undertaken.	(2, 4) 8 Medium
Increased vessel traffic	Perceived increased boat strike of marine fauna leading to death, maiming. Vessel traffic is likely to remain at levels similar to present as no additional vessel accommodation is provided. Vessel traffic may at present temporarily displace fauna or disturb foraging behaviour in areas adjacent to the TMPP.	(3, 4) 12 High	Provide education and training to Precinct operators in regard to monitoring for and management of interactions with marine fauna. May include public education information provisions waterside. Provide designated shipping channels and go slow (6 knots) areas to decrease probability of collision.	(2, 3) 6 Medium
	Increased benthic disturbance due to prop wash.	(2, 4) 8 Medium	Provide designated shipping channels and go slow (6 knots) areas to decrease probability of benthic habitat disturbance. Channel depths to be maintained. Consider extension of 6 knot speed restriction of Ross River to outer breakwater.	(1, 4) 4 Medium
	Increased potential marine pest	(3, 4) 12	Adhere to national and state biofouling and ballast water management guidelines and requirements.	(2, 4) 8

Activity	Expected impact	Preliminary risk assessment (C,L) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (C,L) Score
	introductions.	High	Precinct facility not established as first port of call for quarantine clearance of incoming vessels. AQIS procedures to be adhered to.	Medium

3.10.6.6 Cumulative impacts and mitigation strategies – aquatic ecology

The TMPP involves the construction of an industrial marine precinct about the mouth of the Ross River. Consequently the marine benthic habitats in this area will be markedly disturbed. The main potential construction impacts include removal of benthic habitat, declines in water quality associated with construction events and potential impacts to marine megafauna from vessel operations. The main potential operational impacts include continuous disturbance of benthic marine systems, impacts to water quality, impacts to marine megafauna from vessel operations and increased potential of pollution to the marine environment from changed use. Mitigation strategies against each impact were identified in the preceding section under Table 3-55.

Within the Townsville region a number of other construction projects are occurring that have the potential to result in confounding or cumulative impacts. These other projects include the development of:

- The Townsville Port Access Corridor road and rail link, including a bridge across Ross River adjacent to the Precinct site;
- Development of Berth 12 to the north of the Precinct site in the outer harbour area of the port;
- Berth 8 and 10 expansion within the inner harbour of the port; and
- The Townsville Ocean Terminal (TOT) to the west of the port.

Each of these adjacent projects is likely to involve adverse effects on the marine environment including removal of benthic seabed habitat, dredging operations and construction operations that may impact upon water quality and vessel movements that may effect marine fauna utilisation of the area.

The benthos that will be directly affected by construction of the Precinct is known to occur in other locations within Townsville region including in other locations within the Port, Rowes Bay, Pallarenda and Magnetic Island. It is not considered to be a community or ecosystem of high value either in its own right or as a critical feeding ground for other, higher order, species. Cumulative removal of this type of seabed community is not expected to have a negative effect on the importance of the benthic marine habitats of the Townsville region. Nor it is anticipated to reduce biodiversity of the region significantly.

The mud flat across Ross River from the Project Area hosts a similar diversity to the benthos of the area that will be removed as a direct result of construction. Strategies to avoid impacting the mud flat site, and maintenance of the mud flat in perpetuity should be considered to provide opportunities within the immediate area of the Precinct for continued presence of taxa that will be removed as a result of construction of the Precinct. Development of the inner harbour of the Marine Precinct will provide future opportunity for some of the Lot 773 area to be recolonised with benthic taxa from adjacent environs like the mud flat. This may partially offset some of the habitat losses associated with direct removal. Creation of interstitial rocky shore habitat both intertidally and subtidally through provision of rock revetment walls of the Precinct and development of the breakwater may also partially offset some of the habitat losses associated with direct removal.

Megafauna species were noted within the Ross River area with only stingrays noted to be using Lot 773 as a potential feeding site. Stingrays could be targeting the benthic infauna and epifauna occurring within the sediments of Lot 773 and surrounding areas, including the small crustaceans and bivalve molluscs reported in this study. Similarly, crab and fish fauna were also noted within this area and are likely to also be targeting benthic fauna as a food source. As noted above, these benthic communities are not unique to the Townsville region and are well represented to the north and south of the Port environ. Removal of the benthic habitat associated with Lot 773 is, therefore, not likely to negatively affect the stingray, crab or fish populations of the Townsville region. This conclusion is also supported by sightings of similar taxa using the mud flat across Ross River from the Marine Precinct area. As noted above, maintenance of the mud flat environ would provide a continued opportunity for these fauna to use the mouth of the Ross River for feeding.

Construction activities associated with the TPAR, Berths within the PoT and the TOT will also all likely impact negatively upon the benthos occupying areas of the seabed in the direct vicinity of each development. The cumulative impact of this habitat removal in conjunction with the development of the Precinct is not expected to negatively effect prevalence of the benthic flora and fauna detected during this survey in the Townsville region given they are well represented. Including in areas that will not be affected by construction activities to the north and south of the Port environment such as Cape Pallarenda and around Magnetic Island.

Megafauna other than stingrays, including turtles, dugong or dolphins, were not noted using Lot 773. This is supported by a lack of key food groups for these megafauna within the area, including, but not limited to, seagrasses. Seagrasses were found offshore of the mouth of Ross River, a finding consistent with that reported by Rasheed and Taylor (2008). There is potential for degraded water quality to impact these offshore meadows particularly if dredging activities for the TPAR, Berth 12 and Precinct coincide and produce a larger or more persistent plume than anticipated by any single activity. Potential water quality impacts quality impacts are examined under a detailed study provided as Appendix J of this EIS and summarised in Section 3.9, which includes information on construction dredging assessments and dredge plume potential.

Seagrass communities are recognised as important ecosystems for maintenance of seabed stability, water quality and biodiversity (Collier and Waycott, 2009). In addition to their intrinsic value, seagrasses are known to act as nursery grounds for juvenile fish, which may be targeted by commercial and recreational fishers, or be an important food source for other fish and megafauna species. Seagrasses are also an integral food for marine megafauna including turtles and dugongs. Collier and Waycott (2009) identify a number of natural and anthropogenic activities that may impact the persistence of seagrass meadows and cite high sediment loads as a particular feature of the Townsville region. Rasheed and Taylor (2008) note that seagrasses in the vicinity of the Townsville port are likely adapted to high levels of turbidity both as a result of naturally occurring high turbidity for the area and also in response to existing levels of maintenance dredging and shipping activities. These compounding influences on turbidity are, however, recognised to be short-lived and events to which the meadows have some resilience. Significant impacts may occur to the presence, taxonomic composition or biomass of meadows when the severity or duration of any particular impact exceeds levels of natural variation (Carruthers *et al.,* 2002, Erftemeijer and Lewis, 2006 and Orpin *et al*. 2004). Rasheed and Taylor (2008) and Collier and Waycott (2009) both note considerable risk of impact to seagrass meadow prevalence in the Townsville region from prolonged periods of reduced water quality resulting from compounding influences.

Given the ecological importance of seagrasses within this region, and the considerable risk of cumulative impacts to seagrass meadows from concurrent project development, consideration should be given to monitoring the presence and prevalence of seagrass meadows and the quality of associated water bodies adjacent to the port to determine if any negative influences from construction and operational activities affect these sensitive ecosystem receptors. Management response plans to declines in water quality and / or prevalence of seagrass meadows linked to development of the Marine Precinct should be developed. These may include, for instance, cessation of dredging activities to enable water quality levels to return to background conditions if unacceptable declines in water quality during dredging from dredging activities were detected.

Additional cumulative impacts that may result from increased traffic activity associated with construction activities in the mouth of Ross River (TPAR and Precinct) include increasing potential for boat strike of megafauna or increased avoidance of the area by fauna. Development of a construction vessel management plan taking into consideration cumulative impact potentials and addressing management strategies including speed limitation, extension of 6 knot speed restricted area to the offshore breakwater, need for observation for marine megafauna, appropriate strategies to avoid interaction with megafauna and reporting of any interactions should be considered.

Direct impacts as a result of increased or changed utilisation of Lot 773 area will not likely be compounded by cumulative impacts from other projects once the reclamation activities for construction have occurred. This area is already heavily utilised by public groups undertaking activities including, but not limited to, dog walking, fishing, beach collection and picnicking. Beach collection activities range from shell collection through to sourcing of bait species for estuarine fishing. It is estimated that at least 30,000 people visit the beach on an annual basis for various recreational activities. Reclamation and construction of the industrial precinct will remove the capacity for this activity to continue. As adjacent areas subject to development do not offer the same/similar recreational opportunities there is little potential for any cumulative impacts from adjacent developments. Boating (tinny) activities and jet-ski activities that currently use the beach area for recreational purposes will still be able to access the Ross River for recreational activities after completion of the TPAR construction. Only vessels greater than 6m in height will be restricted entry to the river upstream of the bridge after completion of this access corridor. Fishing, picnicking and beach walking currently do not occur in the footprint of the other development projects occurring in the Townsville region and there are no anticipated cumulative impacts to the loss of these activities.

Coastal impacts of the proposed Precinct have been assessed under Section 3.8 of this EIS, a detailed report is provided as Appendix R. From that information it is known that the sand spit at the mouth of Ross River is highly mobile and changes shape according to seasonal and flood influences. This area is also currently utilised by all-terrain vehicles, including four-wheel drives and quad-motorbikes. Amphibious Army vehicles have also previously accessed the area. The mud / sand interface between the sand spit and mud flat area are also accessed and utilised by recreational fishers seeking bait for estuarine fishing. This practice occurs on an almost daily basis during calm fishing conditions. Thus, the sand spit does experience a degree of impact despite its isolation from the road. Avoiding impact on this area for extractive activities will assist in maintaining recreational opportunities for fishers and beach visitation for a subset of the current recreational users of Lot 773.

Dog walkers and beach picnickers would not have ready access to the sand spit area and given the sensitive nature of bird communities using the area (refer Appendix V) this should not be encouraged. Potential for monitoring utilisation of the sand spit/mud flat area to determine whether use increases as a consequence of installation of the Precinct should be considered. Increased or changed utilisation may result in unfavourable impacts upon these preserved marine environments and the communities they support. Opportunities to mitigate against any increased impacts may include development of public education information regarding bird nesting and include exclusion of access to sites during critical nesting periods. Overfishing of bait species, such as yabbies (*Callianassa sp.*), that are currently sourced from this habitat may eventuate in self-regulation of this activity. Increased effort would likely reduce yield and result in recreational fishers sourcing their bait from other areas where greater return for fishing effort is achievable. Otherwise, if overfishing is noted to be reducing populations of bait species to non-sustainable levels, measures to manage influences may also need to be considered including public education approaches. Exclusion of access to the sand spit area during bird breeding season would provide a level of indirect protection to the bait species being targeted. These mitigation opportunities would need to be considered if cumulative/additional or changed impacts to the sand spit/mud flat area were detected as a result of removal of recreational opportunities currently associated with Lot 773.

Expected construction activity impacts identified above in Table 3-55 are likely possibilities under any of the other proposed adjacent projects. As a consequence, concurrent construction impacts in adjacent sites and, therefore, compounding of the identified impacts is also possible. Consistency in application of mitigation measures identified above should be considered for all other projects to reduce potential for cumulative impacts. In particular development of management plans for dredging, construction, waste management and hazardous material risks should be undertaken for the Marine Precinct such that the potential for cumulative effects, from other adjacent developments are considered and accounted for. This project, under identified mitigation strategies, is not expected to have any significant or long term negative impacts upon the ecological communities supported within this region.

3.10.6.7 Conclusion – aquatic ecology

The Precinct Project Area and adjacent areas include a number of key marine benthic habitats:

- The Marine Precinct Area is a shallow tidal sand/mud flat with small areas of intertidal beach, rocky foreshore and remnant natural vegetation;
- Seaward of the Marine Precinct Area is an extensive deepwater seagrass meadow;
- Up Ross River the eastern side remains fairly natural with small tributaries while the western side has been greatly modified, with rock walls and industrial development;
- At the mouth of the Ross River, the East Bank is a mud flat area that abuts fringing mangroves; and
- At the edge of this mud flat there is a highly mobile Sand Spit that changes shape according to seasonal and flood influences.

A range of communities were present across each of these habitats. The Marine Precinct Project area (Lot 773) supported a subtidal benthic community of relatively low diversity, with 25 species present. However the intertidal area was more diverse with 28 species recorded (there are usually many more benthic species present in subtidal soft bottom communities compared with intertidal communities).

The TMPP involves the construction of an industrial marine precinct about the mouth of the Ross River. Consequently the marine benthic habitats in this area will be markedly disturbed. Within the Townsville region a number of other construction projects are occurring that have the potential to result in compounding or cumulative impacts.

The main potential construction impacts, including potential cumulative impacts, that may result from the Precinct development include:

- Removal of benthic habitat,
- Declines in water quality associated with construction events; and
- Potential impacts to fauna, particularly marine megafauna, from vessel operations.

The main potential operational impacts from the Precinct development include:

- Continuous disturbance of benthic marine systems;
- Impacts to water quality;
- Impacts to marine megafauna from vessel operations; and
- Increased potential of pollution to the marine environment from changed use.

Proposed mitigation strategies against each impact were identified in the preceding section under Table 3-55. In brief, these include:

- Implementation and use of designated shipping channels and consideration of go slow zones to avoid impacting upon benthic taxa and mobile species, including megafauna;
- Use of appropriate facility design to minimise ongoing pollution potential, including from light spill and slipways;
- Implementation of waste management plans and provision of waste facilities;
- Implementation of hazardous material handling requirements and provision of access to appropriate emergency response kits;
- Extension of Ross River Channel to the outer extent of the breakwater, once it is constructed, with consequent extension of the 6 knot speed limit zone;
- Development and implementation of a dredge management plant to mitigate impacts on water quality; and
- Consideration of provision of public access facilities and public education material to mitigate against potential pollution and disturbance impacts.

Under appropriate management plans for vessel activity the Port of Townsville project is not expected to significantly impact on any of the NES, migratory or Other Protected Matter species that may potentially use the area. Although areas of seabed habitat will be removed under the immediate footprint of the Precinct, these community types are well represented in the area and within the region and long term impacts on the ecological value of the benthic communities of

Townsville are not expected. Habitat will also be created through development of the Precinct with interstitial rocky shore habitats being provided along the rock revetment walls and breakwater. Loss of seabed environs may be offset by the prawn farm restoration and the dedication of an Environmental Reserve on Port land on the eastern bank.

3.10.7 Marine megafauna

3.10.7.1 Overview of marine megafauna studies

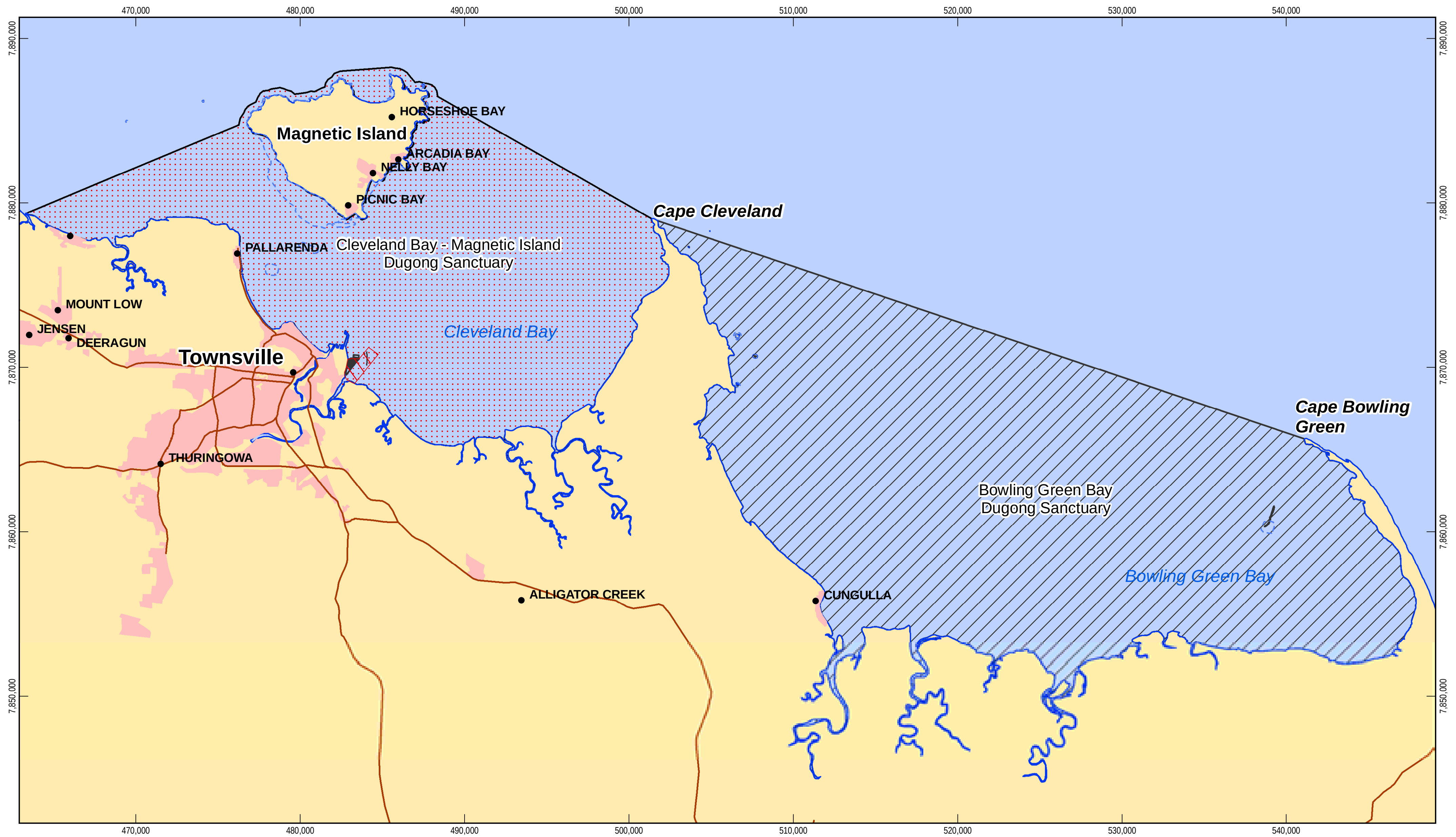
The coastal environment of northern Queensland supports numerous marine species that are vulnerable to anthropogenic impacts. Many key marine species in this area are of high conservation value and are afforded protection under State, National and International legislation and policy. (A summary of the legislation of relevance to marine megafauna is provided under Appendix U.)

The Precinct, located in the mouth of the Ross River, will be adjacent to Cleveland Bay, an area recognised to be of significant importance for a number of marine megafauna species, including turtle, dugong and dolphin. This is evidenced by the location of the site within a Species Conservation (Dugong Protection) Special Management Area ("Dugong Protection Area") (Figure 3-64).

Construction of the Precinct will remove an area of intertidal habitat and both construction and operation will change vessel usage patterns for the area. This has potential to impact upon these megafauna species. In recognition of this a targeted marine megafauna assessment study was completed.

The megafauna study collated information sourced through a focussed desktop assessment of available information (including Government agencies databases) and from the results of a marine megafauna habitat utilisation survey carried out to enhance and update existing knowledge of marine megafauna occurring within and adjacent to the Project Study Area.

This information is used to assess potential impacts to megafauna species from construction and operation of the Precinct and to derive mitigation strategies. The full report is detailed under Appendix U and summarised following.



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0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

LEGEND

Major Road
Builtup Area
Project Area of Interest
Reefs and Shoals

Dugong Protection Area Type

A
B

Port of Townsville
Marine Precinct EIS

Dugong Protection Area
in the Project Area

Job Number	42-15399
Revision	A
Date	01 July 2009

Figure 3-64

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data Sources: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Dugong Protection Area - ©The State of QLD (Department of Primary Industruies and Fisheries); GBRMPA Data - ©Commonwealth of Australia (Great Barrier Reef Marine Park Authority); 250k Topo Data - ©Commonwealth of Australia (Geoscience Australia) 2007.

3.10.7.2 Objectives and methodology – marine megafauna

The marine megafauna survey was undertaken over a seven month period from September 2008 – May 2009, and included three days of aerial surveys (two surveys per day, high and low tide) and seven monthly boat-based surveys (not including February and April). It noted that seasonality of species distribution in the Townsville region is not as influential on marine fauna distribution as other areas given that seagrass habitats remain relatively homogenous in standing crop throughout the year and Parra *et al* (2002) has observed no significant seasonality of dolphin presence. Marine turtles are likely to show an increase in presence leading up to the nesting period which has been captured in these surveys.

The main objective of the marine megafauna survey was to sample for the presence of key marine fauna species within the Project area and adjacent waters to enhance understanding of their habitat utilisation. This survey was designed and undertaken with key species specialists from the University of Queensland who have extensive experience in the Cleveland Bay region and are therefore able to provide independent evaluation of background information and survey results.

The survey design involved two components (aerial and boat-based surveys) that considered the behaviours of inshore dolphins, dugongs and marine turtle species that require frequent surfacing intervals. The surveys were conducted to enhance existing species distribution data at regional and finer spatial scales (Marsh and Sinclair 1989 a and b, Pollock *et al.* 2006, Lukoscheck and Chilvers, 2008, Chilvers *et al*. 2004, Groom *et al*. 2004; Parra *et al*. 2006).

3.10.7.3 Survey Design

Boat-based sampling

The boat-based survey was carried out according to a stratified design across a variety of depths taking into consideration habitat information from existing epi-benthic habitat mapping (Rasheed *et al.* 2008) and known marine turtle distribution in Cleveland Bay (pers comm., Ian Bell; DERM 2009). Each monthly sample comprised 22 spot sampling sites, four transects of approximately six km in length and a further five transects broken by the spot sampling sites. This mix of point and transect sampling was determined as the best method to capture the diversity of species in the Project area within a limited time frame, based on experience in other areas (Southern Moreton Bay, Abbot Point, Gladstone). Transects were undertaken at a steady speed of approximately 10 – 12 km/hr.

This design has the advantage of covering the heterogenous and patchy habitat in the port environment over a period of time which is not viable for aerial surveys; this increases the theoretical detectability of species which must surface to breathe, and permits a targeted survey area of known marine fauna habitat. For this multi-species survey, monthly surveys were necessary as most species will exhibit a degree of seasonality, or emigration and reimmigration in their movements over time.

Dugongs spend less than 2% of their time at the surface of the water and often surface cryptically (Anderson 1985; Churchward 2001). A 10 minute observation period for spot sampling was chosen because 90% of dugong dives are less than five minutes duration and dives greater than 10 minutes are very uncommon (Chilvers *et al.* 2004). Similarly, green turtles (*Chelonia mydas*) have recorded mean foraging dives of 4.5 mins (Rice *et al.* unpublished data). Cetaceans are also observed to surface regularly and have successfully been surveyed by undertaking boat-based transects (Lukoscheck and Chilvers 2008; Parra *et al.* 2006; Skrovan *et al*., 1999 and Stacey 1996).

Under good weather conditions (< 15 knots), boat-based spot sampling sites enable a sighting radius of approximately 200 m from the boat for surfacing megafauna with the exception of whales, which are clearly observed from distances over 500 m. Sighting distance is dependent upon sea state and weather conditions as a result, an approximate distance of 200 m is given as the maximum distance of detection at any given survey time. This distance increases greatly with favourable weather conditions and declines consequently with increased swell or wind affected sea surfaces. Figure 3-65 depicts the survey sites undertaken each month where red dots represent spot sampling sites and the red lines represent transects.

During the 10 minute spot sampling, experienced observers are positioned facing the bow and stern of the vessel with each observer scanning 180^0 this provides a combined search area of approximately 0.125 km^2 (x 22 sites). The following information is recorded:

- G.P.S location;
- Time and date;
- Depth;
- Species and number of individuals; and
- Age class of species (where discernable).

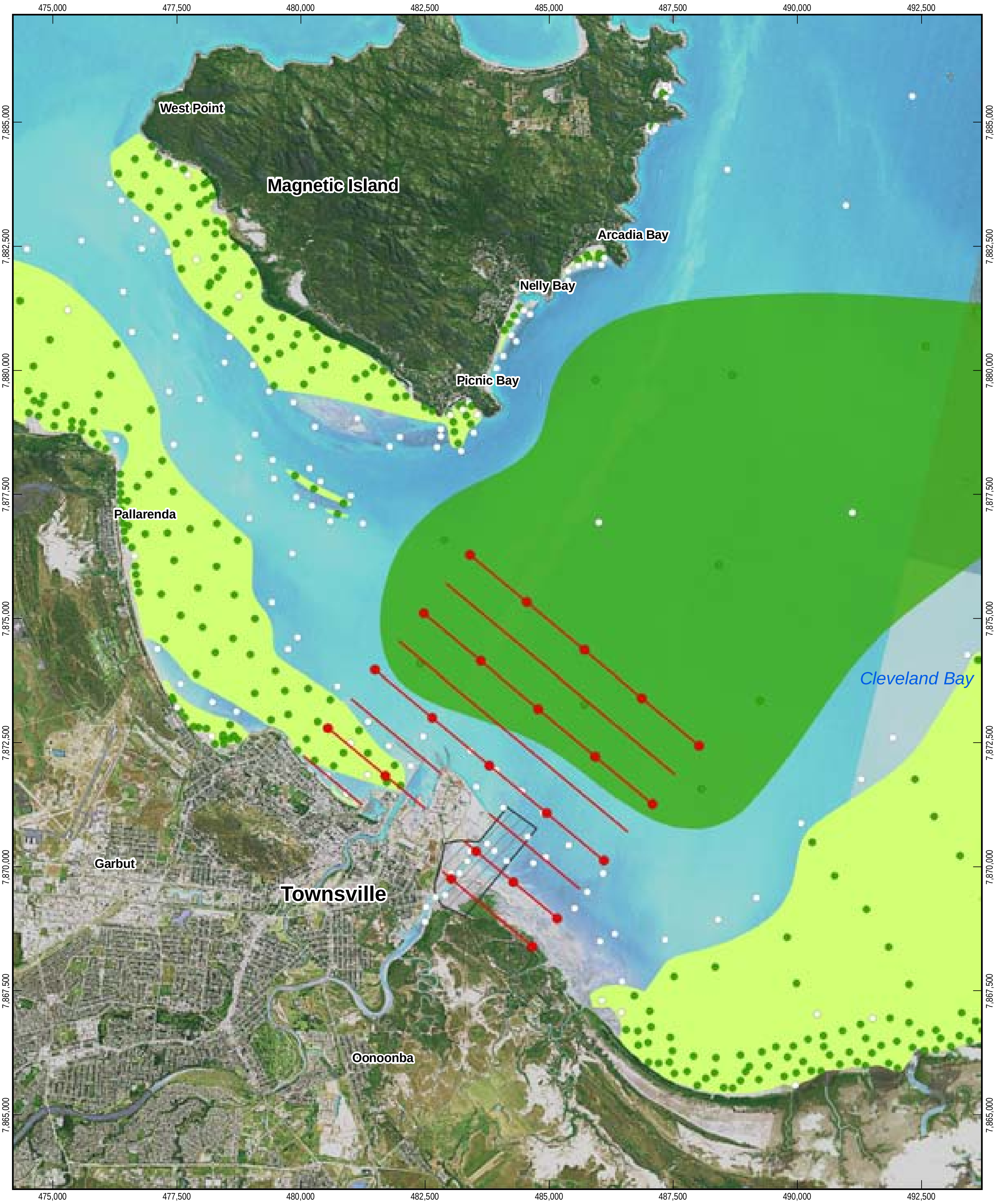
Species age class was defined as per Table 3-56.

Over the seven boat-based survey periods (September 2008 – May 2009, excluding February and April) approximately 48 km of transects were sampled, and 220 minutes of spot sampling carried out within the Project area. The sampling of sites was dependent upon tidal state, so that shallower sites (< 3 m) were sampled at high tide to account for animals that may be accessing food resources that would otherwise be tidally restricted. The surveys used a 6 m rigid boat with a high canopy where an observer could sit to improve the vantage point.

Table 3-56 Age class categories for green Turtle, the dugong and inshore dolphin species

Species	Age class	Size (curved carapace length for turtles)	Age range (years)
Green turtle (*Chelonia mydas*)	Adult	85 – 120 cm	32 +
	Subadult	65 – 90 cm	18 – 35
	Juvenile	40 – 65 cm	5 – 18
Dugong (*Dugong dugon*)	Adult	240 – 300 cm	6 - 70 +
	Calf	100 cm – 200 cm (closely associated with adult)	0.1 – 1.5
Indo-Pacific humpback dolphin *(Sousa chinensis)*	Adult	200 – 320 cm	
	Juvenile	150 – 200 cm	
	Calf	100 cm – 200 cm (closely associated with adult)	
Snubfin dolphin (*Orcaella heinsohni*)	Adult	200 – 275 cm	
	Juvenile	150 – 200 cm	
	Calf	<100 cm – 200 cm (closely associated with adult)	

Source: Adapted from - Chaloupka and Limpus, 2005, Marsh 2004, Jefferson *et al.* 1993



LEGEND

- Marine Megafauna Spot Sample Locations
- Marine Megafauna Transect Lines
- Project Area of Interest

Coastal & Deepwater Biomass Sites 2007
- Sites without seagrass
- Sites with seagrass

- Coastal Seagrass Meadows 2007
- Deepwater Seagrass Meadows 2007

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number 42-15399
Revision A
Date 01 July 2009

Proposed Marine Megafauna Survey Locations

Figure 3-65

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

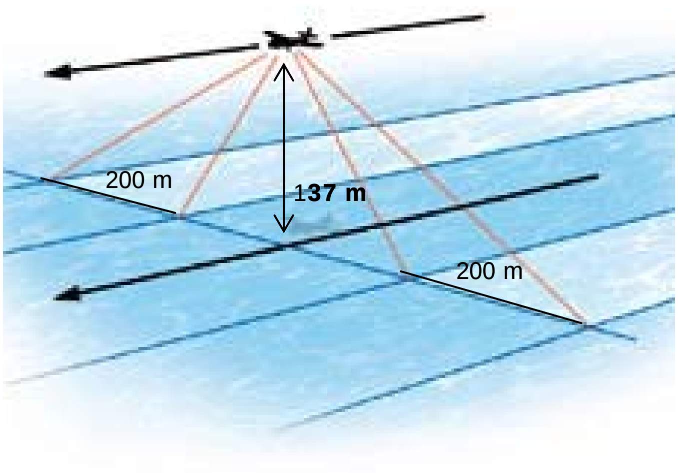
Aerial survey

The aerial survey was undertaken using a methodology adapted from Marsh and Sinclair (1989 a and b) and Pollock (*et al* 2006), which has been used to survey the entire Queensland coast for marine megafauna over several years. Aerial surveys used a high-wing twin-engine Partenavia 68B with survey markers attached to struts, which were fitted to the wings for this purpose.

Aerial transects were designed by Dr Hodgson of the University of Queensland to survey the whole bay, with a more intensive survey block around the Marine Precinct area. The aircraft flew along predetermined transects at a ground speed of 100 knots and at a height of approximately 450 ft or 137 m.

Two trained and experienced observers counted dugongs and other marine wildlife within a strip of sea defined by marker rods attached to ‘pseudo wing struts'. The strip thus demarcated on either side of the aircraft is 200m wide when the aircraft is flying at the nominal height (137m) (Figure 3-66).

Figure 3-66 Aerial survey flight parameters

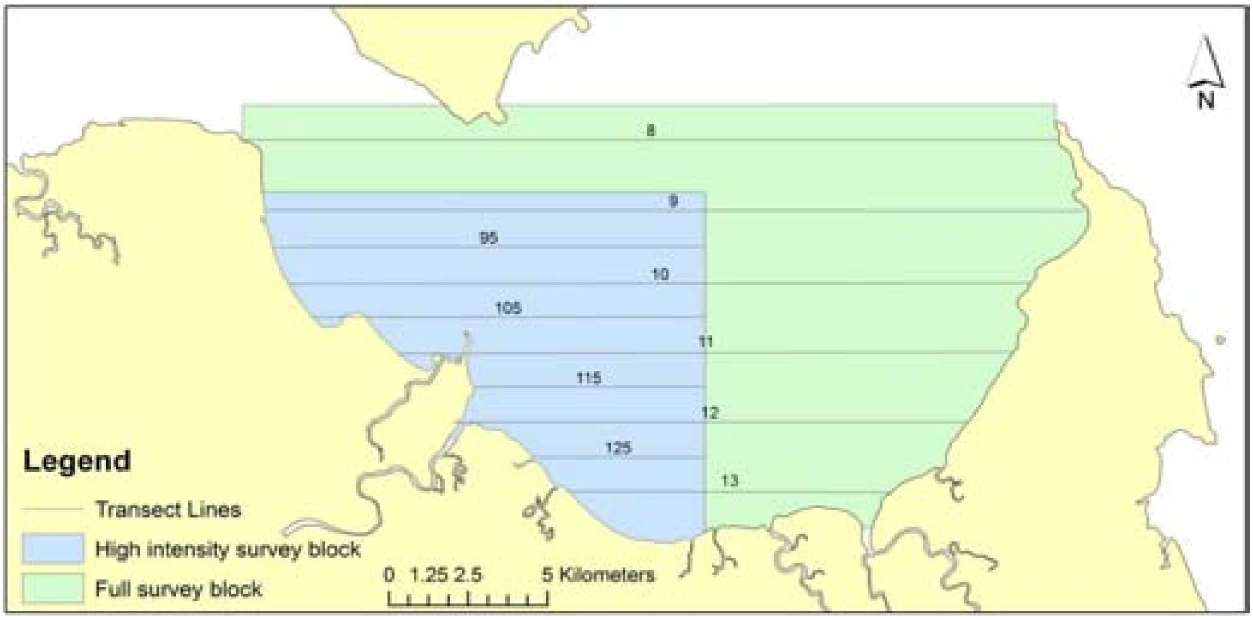


(Source: Hodgson *et al.* 2007)

Observers communicated with the survey leader at the front of the plane via an intercom system linked to a digital audio recorder. Information was recorded by the survey leader using a pocket computer programmed as a data logger and synchronised to a GPS. A micro-track digital voice recorder was also used for recording sightings and as back-up. The observer on each side scanned the transect on their side of the aircraft. The intercom tape recorder recorded all observations voiced by the survey team.

The survey area was divided into two blocks, the full survey area, and a higher intensity survey area that contained the region of the proposed Marine Precinct site (Figure 3-67). Transects were 2.5 nm apart for the full survey area, and 1.25 nm apart for the high intensity block adjacent to the TMPP. The population estimate calculated for the full survey block included only transects that spanned the whole survey area (i.e., transects 8, 9, 10, 11, 12, 13), while the high intensity block included the additional short transects (95, 105, 115, and 125) together with transect 9-13 truncated at the eastern edge of this block. The sampling intensity for the full survey block was 17.8% and for the high intensity block was 34.4%.

Figure 3-67 Transects in Cleveland Bay for the aerial survey



3.10.7.4 Description of environmental values – marine megafauna

Knowledge from Database Searches

A search of the Commonwealth EPBC Protected Matters online search tool revealed 21 listed marine fauna species that occur or have the potential to occur in proximity to the Precinct area. Table 3-57 lists each of these species, their current conservation status with respect to State (NCA) and National (EPBC) legislation, and their likelihood of occurrence within the Project area. These species are considered vulnerable as they are long-lived and slow-growing with a low rate of fecundity. For each of these species, their ecology, distribution and population potentially affected by the Precinct is summarised in Appendix U.

Cleveland Bay is recognised to be of importance for the Australian snubfin and Indopacific humpback dolphin, for dugongs and for a range of marine turtles. Along the urban coast of Queensland dugongs mostly occur in large, northward facing bays, including Cleveland Bay, that are sheltered from the prevailing southeast winds. These bays support the most seagrass along this coastline (Marsh *et al*. 2002) (Figure 3-68). The waters adjacent to the TMPP have also been recognised as an important habitat for Australian snubfin (*Orcaella hinsohni*) and Indo-Pacific humpback (*Sousa chinensis*) dolphins (Parra *et al*. 2006) (refer Figure 3-69).

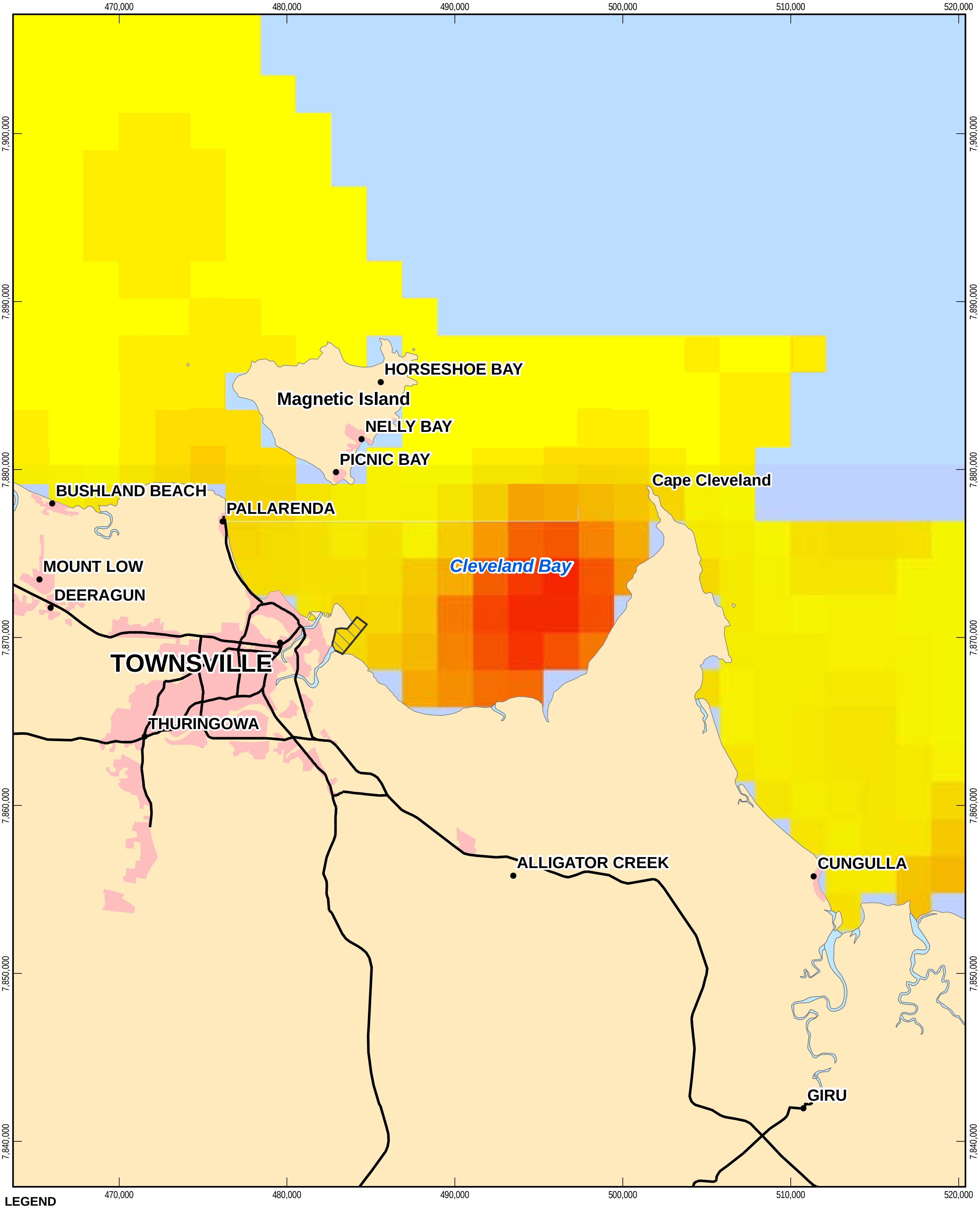
Table 3-57 Listed Marine Fauna potentially found within the Project area

Scientific Name	Common Name	EPBC	NCA	IUCN (World Conservation Union)[1]	Likely Occurrence within the Project area
Marine mammals					
Megaptera novaeangliae	Humpback whale	Vulnerable, Migratory (Bonn), Cetacean	Vulnerable	Least Concern	Possible
Marine reptiles					
Natator depressus	Flatback turtle	Vulnerable, Migratory (Bonn), Marine	Vulnerable	Data Deficient	Possible
Chelonia mydas	Green turtle	Vulnerable, Migratory (Bonn), Marine	Vulnerable	Endangered	Possible
Caretta caretta	Loggerhead turtle	Endangered, Migratory (Bonn), Marine	Endangered	Endangered	Possible
Lepidochelys olivacea	Olive ridley turtle	Endangered, Migratory (Bonn), Marine	Endangered	Vulnerable	Possible
Eretmochelys imbricata	Hawksbill turtle	Vulnerable, Migratory (Bonn), Marine	Vulnerable	Critically Endangered	Possible
Dermochelys coriacea	Leatherback turtle	Endangered, Migratory (Bonn), Marine	Endangered	Critically Endangered	Unlikely
Threatened sharks					
Pristis zijsron	Green sawfish	Vulnerable		Critically Endangered	Unlikely
Rhincodon typus	Whale shark	Vulnerable, Migratory (Bonn)		Vulnerable	Unlikely
Migratory marine mammals					
Balaenoptera edeni	Bryde's whale	Migratory (Bonn), Cetacean		Data Deficient	Unlikely
Orcaella heinsohni	Australian snubfin dolphin	Migratory (Bonn), Cetacean	Rare	Near Threatened	Likely

Scientific Name	Common Name	EPBC	NCA	IUCN (World Conservation Union)[1]	Likely Occurrence within the Project area
Sousa chinensis	Indo-Pacific humpback dolphin	Migratory (Bonn), Cetacean	Rare	Near Threatened	Likely
Orcinus orca	Killer whale	Migratory (Bonn), Cetacean		Data Deficient	Unlikely
Migratory Marine Reptiles					
Crocodylus porosus	Estuarine crocodile	Migratory (Bonn), Marine	Vulnerable	Lower Risk/least concern	Possible
Listed Cetaceans					
Balaenoptera acutorostrata	Minke whale	Cetacean		Least Concern	Unlikely
Delphinus delphus	Common dolphin	Cetacean		Least Concern	Unlikely
Grampus griseus	Risso's dolphin	Cetacean		Least Concern	Unlikely
Stenella attenuata	Spotted dolphin	Cetacean		Least Concern	Unlikely
Tursiops aduncus	Indian Ocean bottlenose dolphin	Cetacean		Data Deficient	Possible
Tursiops truncatus	Bottlenose dolphin	Cetacean		Least Concern	Possible
Threatened Species Potentially Occurring					
Dugong dugon	Dugong	Migratory, Marine	Vulnerable	Vulnerable	Likely

[1] IUCN Red List categories: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Lower Risk, Data Deficient (Source: 2002 IUCN Red List of Threatened Animals).

Cleveland Bay is not recognised as a major nesting area for marine turtles along the Queensland coast, however, low density nesting by green and flatbacks does occur. Cleveland Bay is recognised as an important foraging habitat for green turtles (Figure 3-70). In a regional context, Halifax, Cleveland and Bowling Green Bays are all important feeding sites where green turtles graze on the seagrass beds and flatback and loggerhead turtles forage for invertebrates (pers comm. I. Bell, DERM 2008). Hawksbills are found on the inshore reefs and the olive ridley can be found in the deeper waters around Magnetic Island and along the coast. Leatherbacks are rarely sighted off Townsville, and then only in deeper waters. Collectively, these areas form an important part of Queensland's sea turtle habitat.



LEGEND

Major Road | Project Area of Interest | Builtup Area | Relative Dugong Density: High : 10, Low : 0.01

1:300,000 (at A4)

0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Model of dugong relative density and distribution in Cleveland Bay, Queensland

Job Number 42-15399
Revision A
Date 01 July 2009

Figure 3-68

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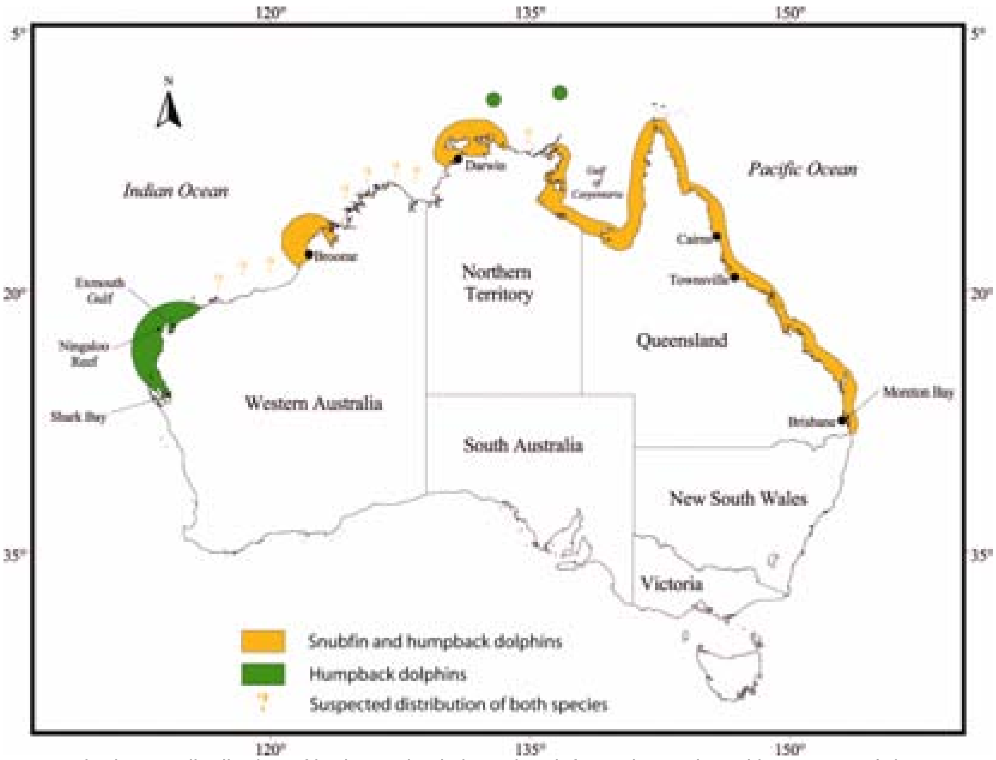
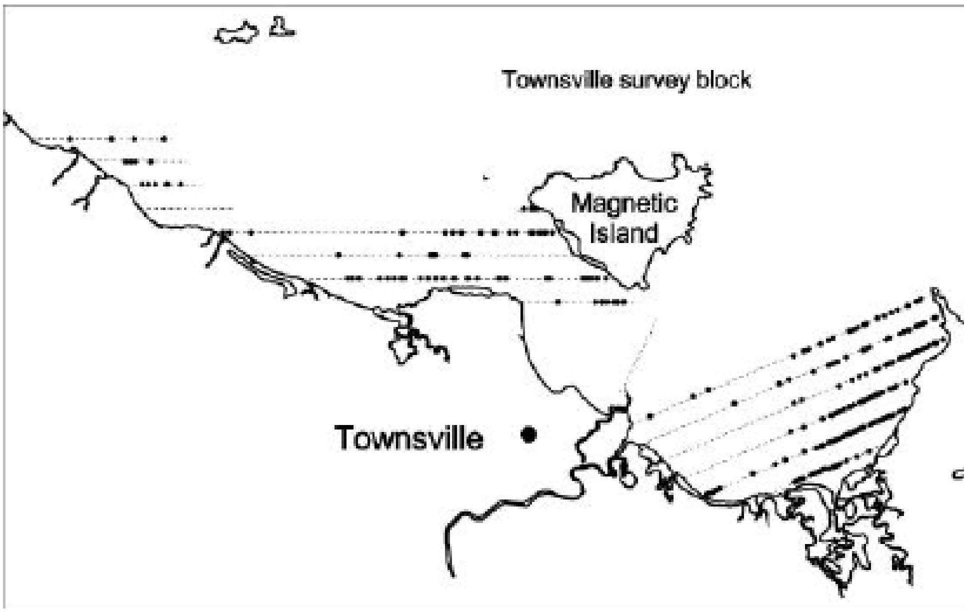
Data source: Dugong Density - Grech. A., and Marsh. H. (2007). Prioritising areas for dugong conservation in a marine protected area using a spatially explicit population model, Applied GIS, 3(2), 1-14; Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; 250K Topo Data - ©Commonwealth of Australia (Geoscience Australia) 2007. Created by: TH

Figure 3-69 Distribution of snubfin and humpback dolphins in Australian waters



Notes: The known distribution of both species is based on information reviewed in Parra *et al*. (2002; 2004). Question marks indicate areas of probable, but unconfirmed, distribution

Figure 3-70 Marine turtle aerial survey observations in Cleveland Bay



Field Result Findings

The aerial and boat-based survey results are consistent with current literature that acknowledges the importance of Cleveland Bay as a key habitat area for significant marine fauna species. The surveys identified a range of age classes using Cleveland Bay.

Megafauna species identified on boat-based and aerial surveys include:

- Marine turtles (majority of observations were green turtle, *Chelonia mydas*) *N* = 27;
- Dugong (*Dugong dugon*) *N* = 32;
- Australian snubfin dolphin (*Orcaella heinsohni*) *N* = 2 (adult and calf);
- Indo-Pacific humpback dolphins (*Sousa chinensis*) *N* = 6;
- Bottlenose dolphins (*Tursiops spp*.); *N* = 2;
- Sharks, rays and a seasnake; and
- Unknown dolphin species *N* = 1.

N= maximum number of individuals recorded for each species in one sampling effort (aerial or boat-based)

The larger spatial scale survey identified areas within Cleveland Bay of high value to dugong and marine turtles with numerous animals identified in the eastern part of Cleveland Bay associated with known seagrass habitats (Figure 3-71). Three dolphin species were also recorded in areas previously identified as representing preferential Indo-Pacific humpback dolphin habitat.

The finer spatial scale survey identified use of habitat in close proximity to the Precinct by Indo-Pacific humpback dolphins, Australian snubfin dolphins, dugong and green turtles (Figure 3-72).

None of the key marine fauna species (dugong, marine turtle and dolphins) surveyed were observed within the immediate footprint of the Marine Precinct, although they were in close proximity (< 2 km). This was expected as the Precinct is a shallow tidal sand/mud flat which does not support preferential feeding or nesting habitat. Parra (2006) observed snubfin dolphins concentrating their activity around two areas northwest of Cape Pallarenda, and south around Townsville's Port and Ross River mouth. Humpback dolphins show a similar distribution concentrating their activities mainly around the dredged channels and breakwaters close to the Port of Townsville, without a clear seasonal pattern (Parra 2006). Similarly, this survey recorded observations of both snubfin and humpback dolphins sharing the habitat around the Townsville port and Ross Creek mouth. It is expected that these key marine fauna species have a higher presence in areas of important habitat i.e. in close proximity to the port and seagrass meadows, though the requirement to transit between habitat patches needs to be acknowledged. As the whole bay is representative of important habitat it is necessary to consider movements when assessing potential impacts on migratory species (Grech and Marsh, 2007).

1:200,000 (at A4)

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Job Number	42-15399
Revision	A
Date	01 July 2009

All Dugong, Dolphin and Turtle Observations from Aerial Surveys

Figure 3-71

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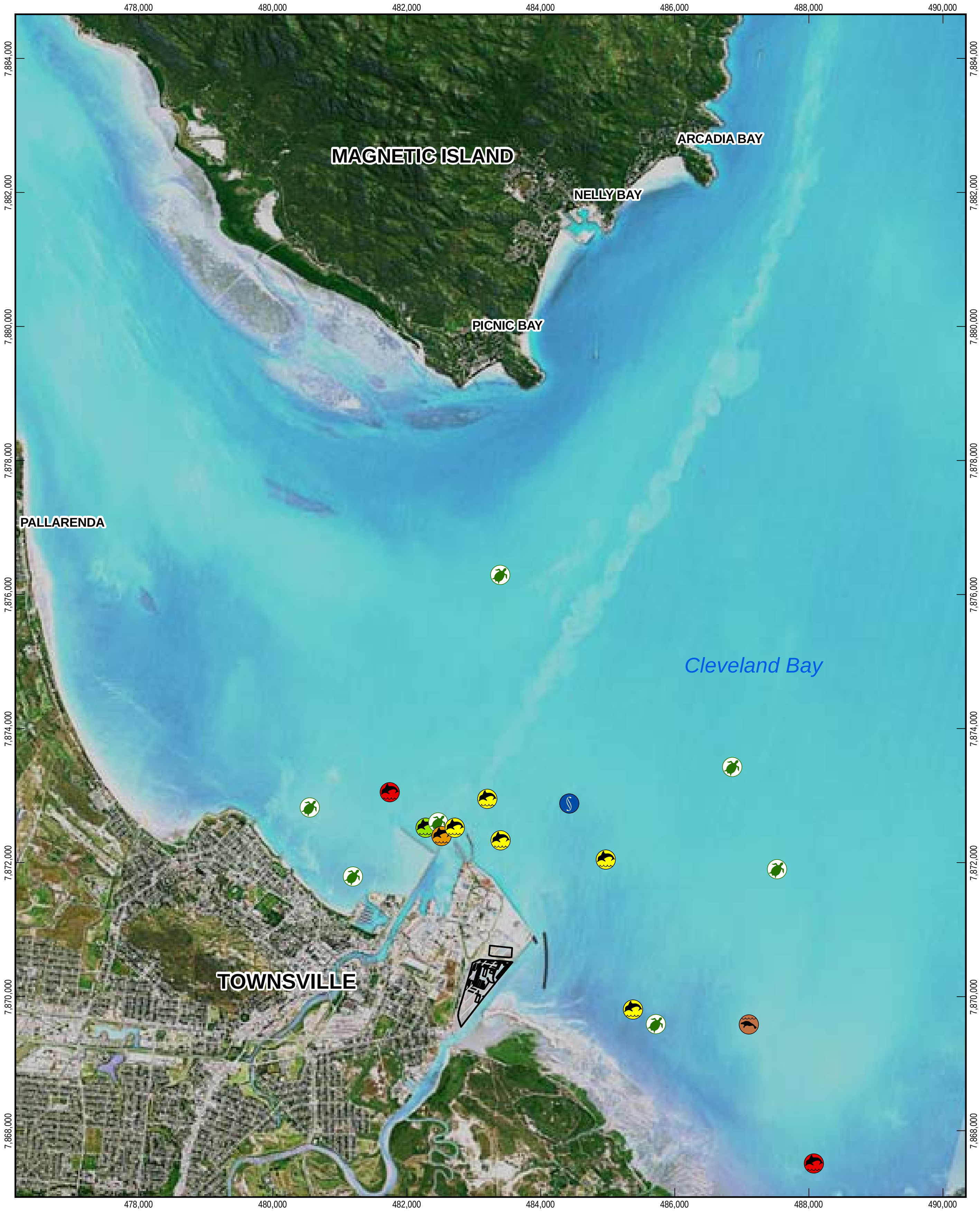
Data source: Marine Precinct - ©The State of QLD (Port of Townsville LTD) 2009; Landsat image - ©The State of Queensland (Department of Environment and Resource Management); 250K Topo Data - ©Commonwealth of Australia (Geoscience Australia) 2007. Created by: TH



LEGEND

- Australian Snubfin Dolphin
- Indo-Pacific Humpback Dolphin
- Bottlenose Dolphin
- Unknown Dolphin Species
- Dugong
- Turtle
- Sea snake
- Proposed Marine Precinct
- Breakwater Option

1:75,000 (at A4)

0 0.5 1 1.5 2

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Marine Fauna Sightings during Boat Surveys

Job Number	42-15399
Revision	B
Date	01 July 2009

Figure 3-72

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Seagrass distribution in the bay is broadly similar between seasons and covers the majority of port limits with 14,338 and 14,004 ha mapped in the wet and dry season respectively (Rasheed and Taylor, 2008). This suggests that given the dependence of dugong and green turtles on seagrass as a resource, their presence in Cleveland Bay would remain relatively unchanged throughout the year.

With respect to species distribution recorded on this survey and in previous years, the construction of the Marine Precinct by the Port of Townsville is not expected to have a significant impact on the key marine megafauna species, either in terms of direct impacts to important habitat, or disruption of transit routes between habitat patches. The construction phase of the Precinct is likely to impose a temporary increase in vessel traffic at the Ross River mouth. These vessels are likely to be slow-moving dredgers, which are of some concern to marine turtles that are known to rest on benthic habitats. Commercial vessels likely to utilise the Precinct already operate within the existing Ross River channel accessing upstream facilities that will be relocated into the Precinct. No new recreational boat ramps are planned as part of the Precinct and, accordingly, no increase in vessel access is anticipated. If additional recreational boating facilities are proposed for the Ross River in future site assessment studies would need to address potential impacts of that increased vessel traffic on megafauna. In order to assess the impacts and mitigation measures appropriate to avoid impacts likely from construction and operation of the TMPP on marine megafauna in the areas associated with development and operation of the Precinct, an impact and risk assessment has been undertaken and is described in the following section. This risk assessment follows methodology described under Section 3.10.2.

3.10.7.5 Potential impacts and mitigation measures – marine megafauna

Marine megafauna are subject to numerous anthropogenic impacts given their association with coastal habitats. Appendix U discusses threats to marine megafauna in the Cleveland Bay area. These threats and impacts are also discussed with respect to the proposed Marine Precinct development. Potential impacts are summarised following.

The TMPP will have a number of permanent impacts on the marine ecological values of the area in which it is located. The majority of the impacts comprise the removal of an area (approximately 32 ha) of intertidal sand/mud flat on the western bank of the Ross River that forms Lot 773. Further, the loss of seabed associated with the footprint of the breakwater (approximately 2 ha in total) will also occur. In addition, a range of temporary impacts are expected as a result of construction activities, including dredge plume impacts and noise impacts.

No removal of seabed or disturbance of marine habitats is proposed for the eastern bank area of the Ross River, across from the Lot 773 footprint. Prior to the construction of the Precinct a road and rail link to the proposed port site will be constructed. This road and rail corridor will enter the port site from the east, passing through the land on the eastern side of the Ross River mouth and crossing Ross River to the south of Lot 773. The actual design and construction of this infrastructure is the subject of another EIS by the Department of Main Roads. A range of cumulative impacts may occur in regards to construction effects on marine megafauna species and removal of benthos.

With respect to key marine fauna species, the impacts expected to result from the Marine

Precinct project, either during construction and/or operation, include:

- Direct impacts (both potential and probable);
  - Removal of potential foraging habitat for some marine turtle species; loggerhead and olive ridley (neither species recorded on survey (turtles not identified to species level on aerial surveys) though identified as potentially occurring from desktop survey);
  - Damage/mortality to individual animals from direct contact related to construction activities;
  - Impact to fauna by boat strike;
  - Lighting impacts to nesting turtles and hatchlings in the Townsville region (November – April);
  - Disturbance and displacement from increased noise and/or activity during construction on the local area;
  - Increased rubbish that may be ingested or entangle marine fauna;
  - Decreases in water quality from dredging, construction, spills of fuel or other hydrocarbons, paint, animal waste (feline pathogens) - feral or domestic, solvents and cleaners.
- Indirect impacts (both potential and probable);
  - Decreased water quality from construction disturbance of sediments around the Precinct site;
  - An increase in sedimentation that may result in the smothering of adjacent benthic habitat communities;
  - Degradation of habitats through continual human usage (including inappropriate waste management, boat fuel spills);
  - Decreased water quality resulting from inappropriate waste management or an increase in sediments and pollutants as a result of construction waste or land use changes; and
  - Noise and vibration impacts to marine fauna from in-water construction or ongoing operational activities.

Reduced use of the area by migratory marine megafauna may occur as a consequence of these potential impacts. This may have flow on effects for the value of the marine ecosystems within the Townsville region. To address this, an assessment of the risk of each impact and mitigation measures is provided below in Table 3-58.

Table 3-58 Risk assessment for marine megafauna

Activity	Expected impact	Preliminary risk assessment (L,C) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (L,C) Score
Construction Works				
Pile driving, dredging and general construction in water	Increased sedimentation in the Ross River, declines in water quality, potential displacement of marine megafauna in the local area.	(4, 4) 16 High	Consideration of use of sediment / silt mitigation devices like silt curtains as appropriate for construction/dredge methodology. Consideration of timing of dredging activity to not coincide with rough weather that would exacerbate impacts. Implement construction and dredge management plans including approaches to hopper de-watering, overflow, monitoring of water quality conditions and use of water quality triggers to halt dredging if unacceptable decline in water quality detected.	(2, 4) 8 Medium
	Acoustic impacts, interference with communication of marine fauna leading to temporary avoidance or displacement.	(2, 4) 8 Medium	Use of warning strikes pre full drive of pile (if found to be effective). Implement a megafauna management plan. Consider undertaking a desktop and field assessment of sound propagation in the Townsville Port region. Consider use of a megafauna spotter on vessel to manage conduct of activity when animals less than 50 m from vessel.	(1, 4) 4 Medium
	Direct impacts by dredge plant on marine megafauna leading to temporary displacement or	(3, 3) 9 Medium	Maintain visual check for megafauna activity in path of dredger and consider operational avoidance measures to reduce risk of impacting turtles, particularly within 50 m of operations.	(2, 3) 6 Medium

Activity	Expected impact	Preliminary risk assessment (L,C) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (L,C) Score
	mortality.		Use bucket dredge (backhoe). If possible, use of trailer suction dredge should include turtle exclusion devices like tickler chains. Do not start dredging operation until dredger head is on the seabed. Implement a megafauna management plan to mitigate impacts.	
Light spill from construction plant	Disorientation by nesting or hatchling marine turtles leading to inappropriate clustering of fauna to construction site.	(2, 3) 6 Medium	Install lighting that includes reduced risk of spill into marine environment through use of light screens. Consider lighting options and safety needs and use most appropriate wattage / lighting type for minimising impact on marine taxa. Use limited lighting adjacent to water. Adopt timed lighting to minimise light pollution. As no turtle nesting has been observed within immediate vicinity, monitoring of turtle nesting behaviour is not considered relevant, though consideration is given to hatchling dispersal and Precinct lighting as noted above.	(1, 3) 3 Low
Increased occurrence of rubbish from construction activities	Waste materials, domestic rubbish enter marine environment and smother benthic habitats, ingested by marine fauna leading to death or illness.	(3, 3) 9 Medium	Implement waste management plans and measures including provision of solid waste containers for recycling or disposal of via a licensed contractor. Educate onsite users of facility in regards to appropriate waste management requirements.	(2, 2) 4 Low
Increased vessel traffic (construction vessels)	Increased boat strike of or interaction with marine fauna	(3, 2) 6 Medium	Provide education and training to vessel operators in regards to monitoring for and management of interactions with marine fauna.	(2, 2) 4 Low

Activity	Expected impact	Preliminary risk assessment (L,C) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (L,C) Score
	leading to death or injury. These vessels are likely to be slow-moving dredgers, which are of some concern to marine turtles that are known to rest on benthic habitats.		Implement fauna spotting and appropriate avoidance measures whilst dredging to reduce risk of impacting turtles. Consider working with regulatory agencies to implement Go Slow Zones in Port vicinity and over adjacent shallow foraging habitats.	
Habitat removal as result of construction and dredging activities for both Precinct and breakwater facility	Benthic marine habitat, inter and subtidal, removed potentially removing habitat for marine megafauna prey items.	(5, 1) 5 Medium	Implement a dredging and spoil disposal management plan considering avoidance of marine habitats used frequently by marine megafuna. Implement a construction environmental management plan. Consider offsetting impacts from benthic habitat removal by remediating or rehabilitating other degraded environs.	(5, 1) 5 Medium
	Reduced water quality from construction and dredging activities providing indirect impact on marine fauna leading to illness or death.	(3, 3) 9 Medium	Implement construction and dredge management plans including approaches to hopper de-watering, overflow, monitoring of water quality conditions in impact site as and adjacent waters and use of water quality triggers to amend dredging approach (eg consider introducing silt curtains to the extreme of halting dredging) if unacceptable decline in water quality detected.	(2, 3) 6 Medium
	Increased potential for fuel, hydrocarbon, chemical (etc) spill during construction activities.	(4, 3) 12 High	Identify hazardous material handling requirements and implement waste management and emergency response	(2, 3) 6 Medium

Activity	Expected impact	Preliminary risk assessment (L,C) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (L,C) Score
			procedures. Suitable and sufficient oil and chemical spill response equipment to be available and easily accessible. Training in spill response and reporting to be undertaken.	
	Habitat loss and degradation resulting in displacement of snubfin and humpback dolphins from core habitats identified around the Port of Townsville and Ross River mouth	(1, 5) 5 High	Development of an impact management plan for coastal dolphins pre, during and post construction.	(1, 5) 5 High
Operational Works				
Operation of Precinct facility	Alteration of local hydrodynamics and potentially altered use by marine fauna.	(2, 5) 10 High	Adopt design configuration to minimise impacts on hydrodynamics.	(1, 5) 5 High
	Acoustic impacts, interference with communication of marine fauna leading to temporary avoidance or displacement.	(2, 4) 8 Medium	Facilitate construction to consider design strategies for in-water noise reduction. Like facilities exist in Ross River currently and fauna currently use area.	(1, 4) 4 Medium
	Creation of inner harbour habitat, increase in potential prey items and area for utilisation by marine megafauna.	Positive benefit	Provides benthic habitat that can be recolonised by taxa and provide a potential foraging and resting site for marine megafauna.	Positive benefit

Activity	Expected impact	Preliminary risk assessment (L,C) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (L,C) Score
Increased occurrence of rubbish in local area	Waste materials, domestic rubbish, enters marine environment and smother marine systems, ingested by marine fauna leading to death or illness. Pet waste (pathogens) enters marine environment, leading to illness or death in marine megafauna.	(3, 4) 12 High	Implement waste management plans and measures including provision of solid waste containers for recycling or disposal of via a licensed contractor. Educate onsite users of facility in regards to appropriate waste management requirements. No pets permitted on site.	(1, 4) 4 Medium
Light spill from Precinct Facilities	Disorientation by nesting and hatchling marine turtles leading to inappropriate clustering of fauna to Precinct site.	(2, 5) 10 High	Install lighting that includes reduced risk of spill into marine environment through use of light screens. Consider lighting options and safety needs and use most appropriate wattage / lighting type for minimising impact on marine taxa. Use limited lighting adjacent to water. Adopt timed lighting to minimise light pollution. As no turtle nesting observed within vicinity monitoring of turtle nesting behaviour not considered relevant.	(1, 5) 5 High
	Increased potential for fuel, hydrocarbon, chemical (etc) spill during operational activities.	(3, 4) 12 High	Facilities to be designed to standards to mitigate pollution potential. Identify hazardous material handling requirements and implement waste management and emergency response procedures. Suitable and sufficient oil and chemical spill response equipment to be available and easily accessible. Training in spill response and reporting to be undertaken.	(2, 4) 8 Medium

Activity	Expected impact	Preliminary risk assessment (L,C) Score	Standard Mitigation Measures	Residual Risk with Precautionary Measures Adopted (L,C) Score
Vessel traffic	Perceived increased risk of boat strike to marine fauna leading to death or injury. Vessel traffic is likely to remain at levels similar to present as no additional vessel accommodation is provided. Vessel traffic may at present temporarily displace dolphins from core habitats around the port of Townsville and Ross River mouth or disturb foraging behaviour in areas adjacent to the port of Townsville.	(3, 4) 12 High	Provide education and training to Precinct operators in regards to monitoring for and management of interactions with marine fauna. May include public education information provisions waterside. Provide designated shipping channels and go slow (6 knots) areas to decrease probability of collision. Work with regulatory agencies to implement Go Slow Zones in the Port vicinity and over shallow foraging habitats.	(2, 3) 6 Medium
	Increased habitat disturbance of megafauna species with increased turbidity and sedimentation of habitats due to prop wash.	(2, 4) 8 Medium	Provide designated shipping channels and Go Slow (6 knots) Zones to decrease and localise probability of habitat disturbance. Channel depths to be maintained. Consider extension of 6 knot speed restriction of Ross River to outer breakwater.	(1, 4) 4 Medium

3.10.7.6 Cumulative impacts and mitigation strategies – marine megafauna

The TMPP involves the construction of an industrial marine precinct at the mouth of the Ross River. Consequently the marine habitats in this area will be markedly disturbed. The main potential construction impacts include removal of benthic habitat, declines in water quality associated with construction events and potential impacts to marine megafauna from vessel operations. The main potential operational impacts include continuous disturbance of benthic marine systems, impacts to water quality, impacts to marine megafauna from vessel operations and increased potential of light pollution and pollution to the marine environment from changed use. Mitigation strategies against each impact were identified in the preceding section.

As the migratory marine fauna species discussed in this report utilise ecological scales for foraging and breeding of 100s of kilometres, it is pertinent to consider the impacts of the Precinct relative to a regional scale beyond Cleveland Bay, Townsville.

Within the Townsville region a number of other construction projects are occurring that have the potential to result in compounding or cumulative impacts. These other projects include the development of:

- The TPAR road and rail link, including a bridge across Ross River adjacent to the Precinct site;
- Development of Berth 12 to the north of the Precinct site in the outer harbour area of the port;
- Expansion of berths within the inner harbour of the port; and
- The Townsville Ocean Terminal (TOT) to the west of the port.

Beyond the Townsville region, port, sewage and other coastal infrastructure development plans are underway and likely to be developed and the environmental impacts assessed in isolation from Townsville developments.

Each of these projects is likely to include adverse effects on the marine environment including removal of benthic habitat, dredging operations and construction operations that may impact upon water quality and vessel movements that may affect marine fauna utilisation of the area.

The benthic environment that will be directly affected by construction of the Precinct is known to occur in other locations within Townsville region including in other locations within the Port, Rowes Bay, Pallarenda and Magnetic Island. The area to be effected by the Precinct is not considered to be a critical feeding ground for marine megafauna species. Quality seagrass habitats, dredged channels, rocky reef and estuarine interfaces have been identified as important habitat areas for key marine fauna species which are well represented beyond the Precinct.

Construction activities associated with the TPAR, Berth expansions and TOT will also all likely impact negatively upon the benthos occupying areas of the seabed in the direct vicinity of each development. The cumulative occurrence of this habitat removal and disturbance in conjunction with the development of the Precinct is not expected to negatively affect prevalence of marine megafauna fauna detected during this survey in the Townsville region given this benthic habitat is well represented in the area. Depending on the timing and extent of all the construction and development proposed for the region, marine megafauna species may be temporally or permanently displaced if projects are timed to incur multiple construction impacts at once. The construction of the TMPP in isolation is not likely to impact marine megafauna species. Construction management plans should include consideration of cumulative impact potential and appropriate mitigation measures.

Various conservation threats including vulnerability to low levels of mortality and habitat degradation and loss (described in detail in Appendix U) have likely depleted the Cleveland Bay marine megafauna populations and hindered recovery to abundance levels estimated for the middle of the 20th century. This is despite significant interventions to protect these species against further human impacts. Potential impacts of further development and increases in vessel activity in the area need to be considered in relation to the potential cumulative effects of all threats described above with the ultimate aim of reducing the overall effects of human activities on marine megafauna populations. Although the species in this report are considered migratory and capable of avoiding some impacts, their inherent ecology coupled with numerous anthropogenic impacts renders them particularly vulnerable.

Megafauna other than stingrays (observed in the baseline marine ecology survey described in Section 3.10.6), including turtles, dugong or dolphins, were not noted to use Lot 773 or the immediate tidal waters. This is supported by a lack of key foraging habitat within the area, including, but not limited to, seagrasses. Seagrasses were, however, found offshore from the mouth of the Ross River (Rasheed and Taylor 2008). There is potential for degraded water quality to impact these offshore meadows particularly if dredging activities for the TPAR, Berth 12 and Precinct coincide and produce a larger or more persistent plume than anticipated by any single activity. Potential water quality impacts are discussed in detail under Section 3.9 of this report.

Seagrass communities, which are particularly important for marine megafauna, are also recognised to be important ecosystems for maintenance of seabed stability, water quality and biodiversity (Collier and Waycott, 2009). Rasheed and Taylor (2008) note that seagrasses in the vicinity of the Townsville port are likely adapted to high levels of turbidity both as a result of naturally occurring high turbidity for the area and also in response to existing levels of maintenance dredging and shipping activities. These compounding influences on turbidity are, however, recognised to be short-lived to which the meadows have resilience. Rasheed and Taylor (2008) and Collier and Waycott (2009) both note considerable risk of impact to seagrass meadow prevalence in the Townsville region from prolonged periods of reduced water quality resulting from confounding influences. This again highlights the need to consider timing of multiple project impacts.

Given the ecological importance of seagrasses within this region to megafauna, and the considerable risk of cumulative impacts to seagrass meadows from concurrent project development, consideration should be given to monitoring the presence and prevalence of seagrass meadows and the quality of associated water bodies adjacent to the port to determine if any negative influences from construction and operational activities affect these sensitive ecosystem receptors. Management response plans to declines in water quality and / or prevalence of seagrass meadows linked to development of the Marine Precinct should be developed. These may include, for instance, cessation of dredging activities or use of silt curtains to enable water quality levels to return to background conditions if unacceptable declines in water quality are detected during dredging activities.

Additional cumulative impacts that may result from a temporary increase in slow-moving vessel traffic associated with construction activities in the mouth of Ross River (TPAR and Precinct) include increasing potential for deleterious interactions with megafauna (turtles being impacted whilst resting on the substrate) or displacement of megafauna from the area. Development of a construction vessel management plan taking into consideration cumulative impact potentials and addressing management strategies including speed limitation, the presence of marine fauna spotters on vessels, appropriate strategies to avoid interaction with megafauna and reporting of any interactions should be considered.

Expected construction activity impacts identified above are likely possibilities under any of the other proposed adjacent projects. As a consequence, concurrent occurrence in adjacent sites and, therefore, confounding, of each of the identified impacts are also possible. Consistency in application of mitigation measures identified above should be considered for all other projects to reduce potential for cumulative impacts. In particular project specific development and adoption of proposed management plans for dredging, construction, waste management and hazardous material risks should be undertaken such that potential for cumulative, flow on effects, from other adjacent developments are considered and accounted for.

The project, under identified mitigation strategies, is not expected to have any significant or long term negative impacts upon the marine megafauna supported within the Cleveland Bay region.

3.10.7.7 Conclusion – marine megafauna

Literature on previous studies within the region was reviewed prior to conducting field work to provide information on seasonal habitat distribution and species presence to assist in designing the survey to meet local conditions and anticipated marine fauna. A survey program over seven months was implemented and included aerial and boat-based surveys for marine megafauna at a regional and finer spatial scale. Habitat utilisation of these areas by key marine fauna species (marine turtles, dugong and dolphins) was recorded and interpreted in the context of the proposed development.

The surveys did not detect any marine megafauna within the footprint of the development though they were found to occur within approximately 2 km of this area. Megafauna species identified on boat-based and aerial surveys include:

- Marine turtles (majority of observations were green turtle, *Chelonia mydas*) *N* = 27;
- Dugong (*Dugong dugon*) *N* = 32;
- Indo-Pacific humpback dolphins (*Sousa chinensis*) *N* = 6;
- Australian snubfin dolphin (*Orcaella heinsohni*) *N* = 2 (adult and calf);
- Bottlenose dolphins (*Tursiops* spp.) *N* = 2;
- Sharks, rays and a seasnake; and
- Unknown dolphin species *N* = 1.

N= maximum recorded individuals of a species in one sampling effort (aerial or boat-based)

The marine megafauna study supported a number of key findings:

- Marine megafauna species are widely distributed throughout Cleveland Bay;

- The Townsville Port environment and adjacent waters represent important habitat for Indo-Pacific humpback and Australian snubfin dolphins of various age classes. Previous research in the area indicates waters close to the Port of Townsville and Ross River mouth, including areas immediately surrounding the TMPP site; represent the most important habitat for snubfin and Indo-Pacific humpback dolphins within Cleveland Bay,
- Nesting and preferential feeding habitats for marine turtles do not occur within the immediate vicinity of the Project;
- Good quality foraging habitats exist for green turtles throughout much of Cleveland Bay and low density nesting by green and flatback turtles occurs on beaches within close proximity to the PoT (The Strand, Pallarenda and Magnetic Island) though not on the eastern side of Cleveland Bay;
- Critical nesting populations for these species exist in regions several hundred kilometres north and south of the Project Area;
- Dugong distribution recorded during the survey supports previous aerial survey observations by Marsh *et al.* (2005) and a close association with seagrass habitats.

The TMPP involves the construction of an industrial marine precinct at the mouth of the Ross River. Consequently the marine environment at this local scale will be markedly disturbed. In conjunction, within the Townsville region a number of other construction projects are occurring that have the potential to result in confounding or cumulative impacts. These other projects include the development of:

- The Townsville Port Access Corridor road and rail link, including a bridge across Ross River adjacent to the Precinct site;
- Development of Berth 12 to the north of the Precinct site in the outer harbour area of the port;
- Expansion of berths within the inner harbour of the port; and
- The Townsville Ocean Terminal (TOT) to the west of the port.

Each of these adjacent projects is likely to include adverse effects on the marine environment including removal of benthic seabed habitat, dredging operations and construction operations. In conjunction with the Marine Precinct development there is potential for greater, cumulative, impact upon water quality and vessel movements that may effect marine fauna utilisation of the area.

The main potential construction impacts, including potential cumulative impacts, that may result from the Precinct development include:

- Removal of benthic habitat,
- Degraded water quality associated with construction events; and
- Potential impacts to fauna, particularly marine megafauna, from vessel operations.

The main potential operational impacts from the Precinct development include:

- Continuous disturbance of benthic marine systems;
- Impacts to water quality;

- Impacts to marine megafauna from vessel operations; and
- Increased potential of pollution to the marine environment from changed use.

Proposed mitigation strategies against each impact were identified. In brief, these include:

- Implementation and use of designated shipping channels and consideration of go slow zones to avoid impacting upon benthic habitats and mobile species, including megafauna;
- Use of appropriate facility design to minimise ongoing pollution potential, including from light spill and slipways;
- Implementation of waste management plans and provision of waste facilities;
- Implementation of hazardous material handling requirements and provision of access to appropriate emergency response kits;
- Development and implementation of a dredge management plant to mitigate impacts on water quality;
- Consideration of provision of public education material to mitigate potential pollution and disturbance impacts; and
- A construction and operational phase Environmental Management Plan (EMP) is recommended to address the potential impacts from this Project that explicitly addresses the aforementioned issues, e.g. water quality. This implemented with the knowledge of other regional Project impacts and communication with regulatory agencies will best address potential impacts to marine megafauna.

3.10.8 Unmitigated ecological impacts and potential offsets

A number of impacts identified above have either partial or no mitigation measures to counteract them. These impacts are related to the disturbance of marine resources and, accordingly, trigger the need for assessment under the Fish Habitat Management Operational Policy FHMOPOO5 — *Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss, 2005*, administered by the DEEDI (as described under Section 1.9). The predicted impacts from the TMPP that are not able to be mitigated against, a description of the impacts and partial mitigation/offsets to each impact are identified in Table 3-55 and Table 3-58.

An ecosystems services assessment conducted for this EIS (refer Section 5.2) estimates the value of the ecosystem services to be lost from the development of the TMPP to be $757,960. This did not, however, take into consideration creation of new habitat through the partial mitigation measures.

The information provided here in Table 3-59 notes that although there are net losses of benthic substrate resulting from the TMPP there are a number of environmental gains that also result from the development and operation of the Precinct. This information is provided to facilitate discussion by DEEDI to determine whether any additional offsets are required beyond those currently achieved by the TMPP and POTL to compensate for the net loss of seabed habitat.

Table 3-59 Potential impacts relating to offsets under consideration for the TMPP

Habitat	Area	Ecological Value	Predicted Impact	Relevant Section of EIS
Terrestrial vegetation	-1.5 ha	Mangroves fragmented with weed species. Thin strip of vegetation between existing beach and port access road. Considered low value habitat.	Loss due to construction of TMPP and services corridor.	3.10.4
Benthic substrate - soft	-32.5 ha	Intertidal and subtidal benthic seabed. Muddy/sandy environment. Supports mainly molluscs, crustaceans and worms. Moderate ecological value. No marine plants. Not considered critical habitat for wading and migratory birds or marine megafauna.	Loss due to construction on Lot 773.	3.10.5, 3.10.6 and 3.10.7
Benthic substrate - soft	-2 ha	Subtidal benthic seabed. Muddy/sandy environment. Supports sparsely distributed taxa, mainly molluscs and worms. Low-moderate ecological value. No marine plants. Not considered critical habitat for wading and migratory birds or marine megafauna.	Loss due to construction of breakwater.	3.10.5, 3.10.6 and 3.10.7
Benthic substrate – soft Inner harbour	+7.1 ha	Subtidal benthic seabed. Muddy/sandy environment. Expected to supports molluscs, crustaceans and worms. Expected to have moderate ecological value. Not expected to support marine plants. Not expected to be critical habitat for wading and migratory birds or marine megafauna.	Gain of subtidal benthic soft sediment due to creation of inner harbour of TMPP. Replacing some habitat lost during construction on Lot 773. Note does not include area of channel, as this effectively doesn't change habitat type from construction.	2 and 3.10.5

Habitat	Area	Ecological Value	Predicted Impact	Relevant Section of EIS
Benthic substrate – hard Precinct	+1.8 ha	Rocky subtidal habitat. Will support hard substrate taxa including crustaceans. May provide habitat that different taxa can colonise, such as sponges.	Subtidal habitat gain due to creation of Precinct rock revetment and quayline. Expected to act as niche refuge for fishes and crustaceans.	2 and 3.10.5
Benthic substrate – hard Precinct	+1.5	Rocky intertidal habitat. Will support hard substrate intertidal taxa including crustaceans, barnacles and molluscs.	Intertidal habitat gain due to creation of Precinct rock revetment and quayline. Expected to support intertidal taxa including crustaceans.	
Benthic substrate – hard Breakwater	+0.6 ha	Rocky subtidal habitat. Will support hard substrate taxa including crustaceans. May provide habitat that different taxa can colonise, such as sponges.	Subtidal habitat gain due to creation of offshore breakwater. Expected to act as niche refuge for fishes and crustaceans.	2 and 3.10.5
Benthic substrate – hard Breakwater	+0.8 ha	Rocky intertidal habitat. Will support hard substrate intertidal taxa including crustaceans, barnacles and molluscs.	Intertidal habitat gain due to creation of offshore breakwater. This and all above tidal habitat may act as an alternative roost or refuge for marine birds.	2 and 3.10.5
Saltpan – upstream of TMPP	+32 ha	Moderate ecological value. Rehabilitated post utilisation of area as a prawn farm. Expected to be recolonised by saltmarsh vegetation.	Habitat gain from rehabilitation of previously occupied commercial site.	Undertaken by POTL within last 12 months independently of the TMPP. Claimed as a credit.

Habitat	Area	Ecological Value	Predicted Impact	Relevant Section of EIS
Water quality	TMPP project area	High ecological value as good water quality intrinsically important for support of healthy marine ecosystems. Currently some levels of contaminants in areas adjacent to Precinct footprint.	Opportunity to co-locate commercial industries into a new, purpose built, facility. Potential for improving the water quality in the lower reach of Ross River.	3.9

3.11 Air quality

3.11.1 Description of environmental values

The DERM has a monitoring network of five sites in Townsville. Results from this monitoring, along with additional industry monitoring from the Townsville Port Authority and Sun Metals Corporation, are reported on monthly[6] and annually[7] by the DERM.

The gaseous pollutants of Ozone (O_3), Nitrogen dioxide (NO_2) and Sulfur dioxide (SO_2) are measured by the DERM at Pimlico (inland and to the South-east of the Port) while industrial monitoring of SO_2 is done by Sun Metals at Stuart (well inland and south of the Port). Respirable particulate matter (PM10) is measured at Pimlico (DERM) and the Townsville Port (industry). The DERM have a more extensive network for Dustfall and Total Suspended Particulate matter (TSP) at the Coast Guard, South Townsville, North Ward and Yarrawonga to supplement dustfall measured at Pimlico. These dust measurements, from March 2008, speciate for various metals[8] (TSP) and Lead (TSP and dustfall).

The following information, from DERM annual reporting for 2007 against the National Environment Protection (Ambient Air Quality) Measure requirements[9], summarises the air quality environmental values for the Townsville airshed:

- Carbon monoxide (CO) is not required to be monitored because “pollutant levels are reasonably expected to be consistently below the relevant NEPM standard”;
- Monitoring at Pimlico “over the period 2004 to 2007 has shown nitrogen dioxide levels to be consistently below 40 percent of the NEPM standards”;
- Lead falls into the same category as CO (however monitoring has commenced in Townsville around industrial sources from May 2008);
- Of the five regions reporting against the 24-hour PM10 NEPM standard (South-east Queensland, Toowoomba, Gladstone and Mackay), Townsville was the lowest;

6 http://www.epa.qld.gov.au/environmental_management/air/air_quality_monitoring/air_quality_reports/monthly_bulletins/

7 http://www.epa.qld.gov.au/environmental_management/air/air_quality_monitoring/air_quality_reports/

8 TSP measured one day in six and analysed metals are Copper, Zinc, Nickel, Arsenic, and Cadmium as well as Lead

9 http://www.epa.qld.gov.au/publications/p02572aa.pdf/Queensland_2007_air_monitoring_report.pdf

- For all 1-hour sulfur dioxide statistics at and above the 90th percentile, both Pimlico and Stuart are lower than for all other regions; and
- Similar to all regions, the 1-hour and 4-hour NEPM standards for ozone were always met.

3.11.2 Potential adverse and beneficial impacts

During construction and ongoing maintenance of the Precinct, dust will be generated principally via the following mechanisms:

- Mechanical disturbance: dust emissions brought about by construction and maintenance vehicles/equipment; and
- Wind erosion: dust emissions from exposed, disturbed soil surfaces under high wind speeds.

On-going maintenance of the Precinct is expected to generate little and only sporadic dust events. These can be considered normal construction activity not associated with a significant project and exposed open space is no longer considered in this report. The extent to which construction dust emissions may impact on the surrounding sensitive land uses will depend upon a number of site-specific factors. Once construction is completed, exposed surfaces will either be built over or minimised through rehabilitation of the site. Normal traffic associated with precinct activity will be no worse than any other port/marina. Key factors have been identified and are discussed in more detail in Appendix L.

3.11.2.1 Adopted Dust Emission Rates

National Pollutant Inventory (NPI) emission factors give an estimate of likely dust generation for each type of construction activity. A default silt content of 10% and a moisture content of 2% were assumed. This is conservative because material so close to the Ocean has potential to be wetter than default (overburden at coal mines). The excavator was used in loading the haul trucks while the grader (taken as a CAT 247B Multi-terrain Loader) and a CAT 323C Vibratory Soil Compactor were modelled in continuous tandem operation. The wheel-generated dust of the grader was calculated using the default emission factor based on an operating speed of 10 km/h. The compactor emission rate was calculated assuming operation on wet material with moisture content of 10% and a working speed of 5.0 km/h. Twenty (20) tonne capacity haul trucks with gross vehicle mass of 30 tonne were assumed to complete 18 dumping/loading cycles per hour. The operating speed of the haul trucks generating wheel dust was limited to 15 km/h (on-site speed limit). Wind erosion from stockpiles and exposed areas assumed the NPI default emission factor, independent of wind speed, of 0.4 kg/ha/h with PM10 being half this value. It has been assumed that the greatest exposed area at any one time is 13.72 hectares.

The hourly emission rates modelled are given in Table 3-60.

Table 3-60 Emission rates

Construction activity	Emission rate (kg/h)	
	TSP	PM10
Loading and dumping	16.8	6
Grader	10.8	3.4
Bulldozer	50.2	12.2
Compactor	1.5	0.7
Excavator	16.9	8.0
Hauling	5.5	2.7
Exposed stockpile and surfaces	16.8	6

3.11.2.2 Modelling Results

Modelling of dust emissions and dispersion was used to identify worst-case conditions and to give an indication of the radius of influence from construction activities to potential sensitive receptors. The results of dispersion modelling are shown in Figure 3-73 for PM10 dust concentration. For the residential zoning areas with sensitive receptors, dust concentrations are always below 50 $\mu g/m^3$ at distances greater than 800m from the construction activity. The modelling shows that, for the assumed default and uncontrolled emissions, dust concentrations will likely exceed the criteria at nearby residential receivers and therefore mitigation will be required.

3.11.2.3 Mitigation measures

Worst-case modelling suggests that the hourly dust concentrations may exceed 50 $\mu g/m^3$ at nearby dust sensitive receivers. The following commonly used dust mitigation actions were considered to reduce the estimated dust impact from the development.

- Level 1 watering on all exposed surfaces (2 litres/m2/h). This control method achieves a 50% emission reduction (NPI Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals Version 2.0, 2000).
- Access road to be surfaced (an asphalt seal results in near zero dust emissions) from site entry until at least 50 m north, beyond the coordinate (482810 East, 7869676 North).

The results of dispersion modelling including mitigation measures are shown in Figure 3-74 for PM10 dust concentration and in Figure 3-75 for dust deposition. For the suburban area to the south, dust concentrations are always below 50 $\mu g/m^3$ at distances greater than 250m from the construction activity. The dust deposition, expressed as annual average g/m^2/month, shows a similar pattern with all areas beyond 150m being below the recognised critical level for nuisance dust complaints.

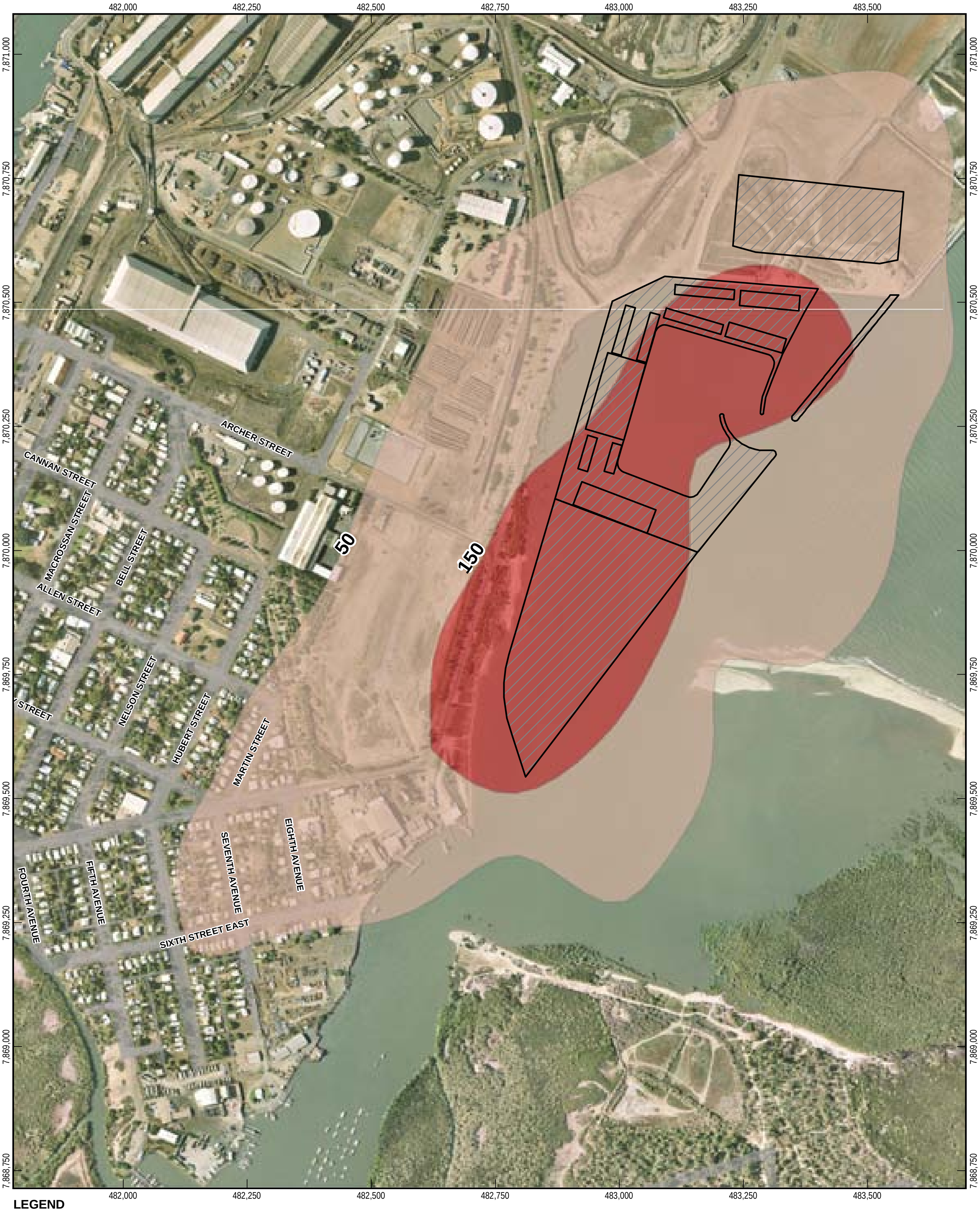
The dust deposition limit contours are well within the PM_{10} limit contours, so it is determined that that if dust emission is controlled using measures identified above to meet the PM criteria, dust deposition criteria will also be achieved.

3.11.3 Conclusions and recommendations – air quality assessments

The results of the air quality assessment suggest that construction-related dust from the TMPP would not significantly impact on the amenity of sensitive receivers provided appropriate management procedures as outlined in this report and Appendix L are implemented. An Environmental Management System will need to be implemented for the construction phase to control dust in the nearby residential area to the south. This will require that the mitigation measures outlined above are adopted.

The expansion of the Port monitoring network for dust deposition will assist in the ongoing management of dust impacts.

Air emission from proposed operational activities within the marine precinct have been assessed against relevant criteria. Results suggest that the operational activities assessed consisting of abrasive blasting, fuel storage and moored fishing trawlers will not have a significant impact on any nearby sensitive receivers and air quality objectives will be achieved.



LEGEND

Proposed Marine Precinct

Conc. (microgram/m3; 24 hour average)

150

50

1:10,000 (at A4)

0 50 100 150 200 250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Port of Townsville
Marine Precinct EIS

Daily Average PM10 Dust Concentration Worst Case Scenario

Job Number	42-15399
Revision	A
Date	01 July 2009

Figure 3-73

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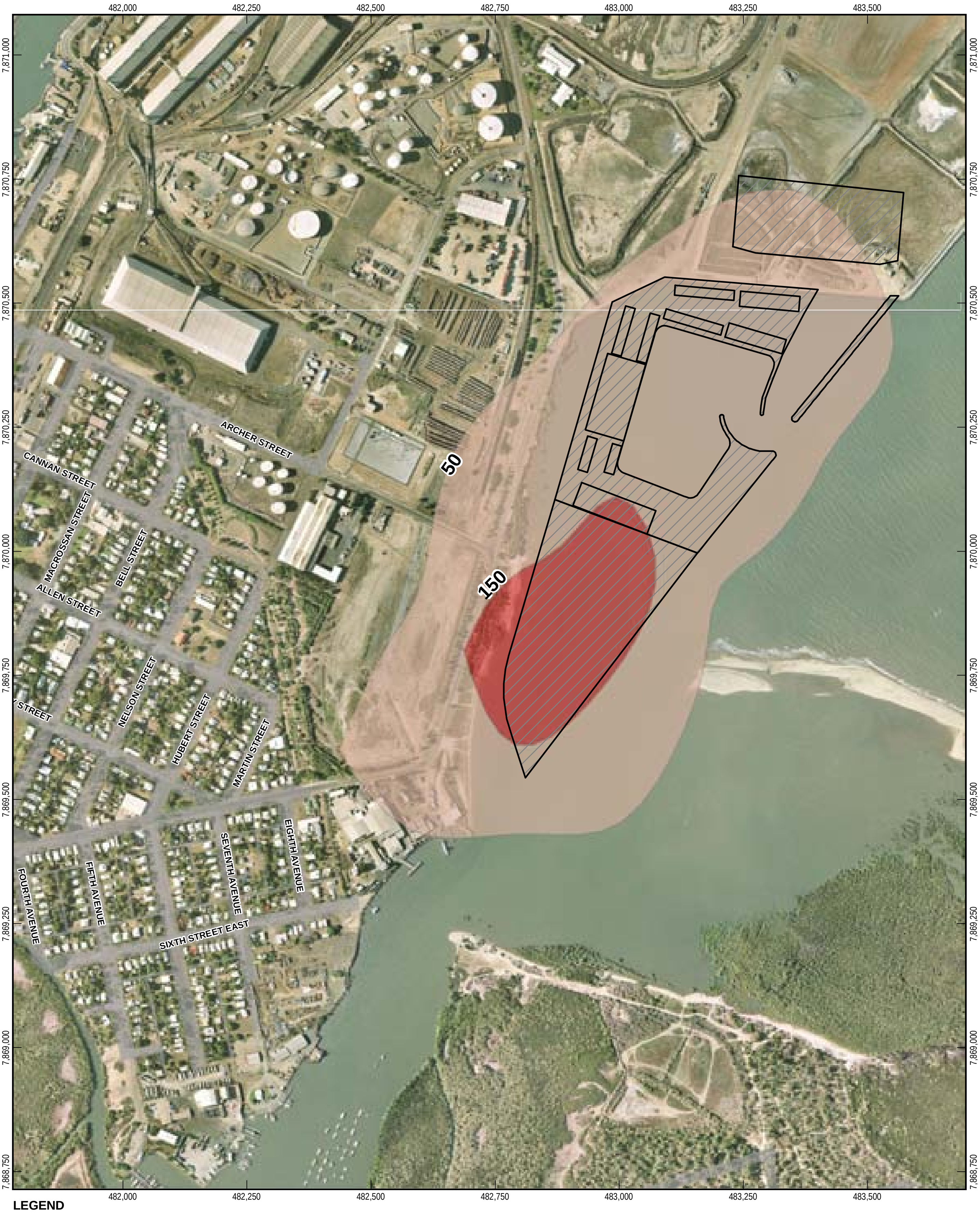
Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data source: Marine Precinct, Aerial image - ©The State of QLD (Port of Townsville LTD) 2009; DCDB - ©The State of Queensland (Department of Environment and Resource Management); Ausplume - GHD. Created by: TH



LEGEND

Proposed Marine Precinct

Conc. (microgram/m3; 24 hour average)

150

50

1:10,000 (at A4)

0 50 100 150 200 250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

PORT of TOWNSVILLE

Port of Townsville
Marine Precinct EIS

Job Number	42-15399
Revision	A
Date	01 July 2009

Daily Average PM10 Dust Concentration with Mitigation

Figure 3-74

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia **T** +61 7 3316 4496 **F** +61 7 3316 333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

LEGEND

Proposed Marine Precinct

Average Dust Deposition (g/m2/year)

- 50
- 40
- 20
- 10

1:10,000 (at A4)

0 50 100 150 200 250

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

GHD

PORT of TOWNSVILLE

Port of Townsville
Marine Precinct EIS

Average Dust Deposition (g/m2/year) from Daily Construction Operations with Mitigation Measures

Job Number	42-15399
Revision	A
Date	01 July 2009

Figure 3-75

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Level 4 201 Charlotte Street Brisbane QLD 4000 Australia T +61 7 3316 4496 F +61 7 3316 333 E bnemail@ghd.com.au W www.ghd.com.au

Data source: Marine Precinct, Aerial image - ©The State of QLD (Port of Townsville LTD) 2009; DCDB - ©The State of Queensland (Department of Environment and Resource Management); Ausplume - GHD. Created by: TH

3.12 Greenhouse gas assessment

3.12.1 Overview

A greenhouse gas assessment was carried out with due consideration of relevant protocols and agreements to assess potential sources of greenhouse gas emissions from the construction and operational phases of the Townsville Marine Precinct project. That assessment, and the methodologies employed, is detailed in Appendix W and key findings are summarised below.

3.12.2 Estimates of greenhouse gas emissions

Current estimates of annual greenhouse gas (GHG) emissions for the state of Queensland (DCC 2008) are 170.9 Mt of carbon dioxide equivalent (CO_2-e), which makes up approximately 29.7% of the national greenhouse gas emissions for Australia. Of the Queensland contribution, 11.9 Mt is from the manufacturing and construction sector, 18.5 Mt is from the transport sector and 3.7 Mt is from industrial processes with the remainder of contributions being from stationary energy, fugitives, agriculture, land use change and waste.

GHG sources from the existing site, prior to the development of the Precinct are primarily from the annual dredging operations carried out by the Port of Townsville. These operations currently vary in the amount of greenhouse emissions produced annually, depending on the amount of dredging required. Many of the facilities that will be located within the Precinct during the operational phase of the project are existing facilities currently located further upstream on the Ross River on nearby in south Townsville and on Ross Creek. These facilities are therefore already contributing greenhouse gas emissions through their existing operations.

The main sources of GHG emissions from the construction phase of the project were identified as:

- Fuel use from the transport of materials from the quarry for the construction of the breakwater and reclamation;
- Embodied emissions of the construction materials, specifically concrete used in the construction of the hardstand areas and building slabs;
- Fuel use from on site machinery; and
- Fuel use from the capital dredging operations including from the disposal of dredge material to the off shore spoil ground.

Based on Reference Design information and knowledge of construction methodologies (refer Section 2.4) an estimation of the GHG emissions from the construction phase was carried out (refer Appendix W). The initial estimate of these emissions totalled approximately 20,200 t CO_2-e.

The main sources of GHG emissions from the operational phase of the project were identified as:

- Electricity use for lighting, cooling/refrigeration and equipment use for each of the facilities;
- Fuel use from on site vehicles and equipment (land and water);

- Maintenance including transport and embodied emissions of materials etc;
- Fugitive emissions (HFCs) from refrigeration facilities;
- Fuel use from transport of staff/visitors and materials to the site;
- Waste generated on site including solid waste and waste water; and
- Maintenance dredging.

Although, from the Reference Design, sufficient information was not available to quantify the greenhouse gas emissions from the operational phase of the TMPP, it is expected that due to many of the industries already existing further up stream, and maintenance dredging requirements not expected to increase, that additional operational emissions from this project will be minimal. As industries currently occupying older facilities may relocate to newer facilities within the Precinct, improved technologies may also provide opportunities for reductions in GHG emissions.

When compared with the annual baseline emissions for Queensland, the GHG emissions potentially being generated from the main sources during the construction phase of this project could be expected to be approximately 0.01% of the annual emissions profile for Queensland. It should be noted that the quantitative estimation of emissions only covers significant sources for which a reasonable level of information was available.

Exact industry base of the Precinct is still being determined and, at this stage in the projects progression, full quantitative assessment of all industry base sources is not possible. A qualitative assessment has been performed for other sources considered likely for the Precinct area given the expected industry base and drawing upon experience within similar projects elsewhere; it would be premature to include these contributions into the total inventory.

Several mitigation options for the construction and operational phases of the project are outlined below. These included choosing options that minimise material use and sourcing materials from the closest possible locations. The possibility of incorporating eco-industrial precinct principles into the design and construction of the Precinct facilities is also noted.

3.12.3 Potential GHG abatement / mitigation options

Methods for reducing GHG emissions are generally based on the following themes:

- Avoid: Identify where and how GHG emissions associated with the proposal can be avoided;
- Reduce: Identify where behaviour or processes can be modified to achieve GHG emission reductions; and
- Switch: Identify where fuel and energy source switching can be used to reduce GHG emissions.

Although the contribution of this project to the overall Queensland GHG emissions profile is minimal (refer above), the following mitigation options could be deployed during the appropriate phase of the TMPP in order to reduce the quantity of GHG emissions as a result of the project.

3.12.3.1 Construction

- The selection of a breakwater option with a reduced footprint would result in a reduction in the quantity of materials required for the construction phase of the project thereby reducing the potential GHG emissions associated with the transportation of these materials. This has been achieved through a multi criteria assessment of various breakwater options described in Section 1.4.2. Six options for the breakwater design were assessed against cost, operational performance, construction, social and environmental impacts criteria. Option C, the smallest breakwater, provided the best solution across all criteria;

- The potential GHG emissions from the construction of the breakwater and reclamation area could also be significantly reduced by sourcing these materials from the nearest possible quarry. An appropriate source of quarry materials is currently being assessed in parallel with studies being conducted for this EIS. By sourcing quarry material from a quarry 17 km from the site (closest option) as apposed to 120 km (furthest option), the potential GHG emissions from the transportation of materials could be reduced by as much as 85%;
- If a large component of the fill material for the reclamation can be sourced from the capital and maintenance dredging operations close to the reclamation area, the GHG emissions from the transportation of materials will be able to be further reduced. It is understood that potential for acid sulfate soil contamination of sediments may reduce the volume of reusable material. Development options should consider opportunities to maximise reuse;
- There is also scope for GHG emissions to be reduced through the efficient design of the dredging operations to reduce the overall fuel use. These operations will be outlined in the dredge management plan included as Section 8.

3.12.3.2 Operation

- The potential design of the facilities to be constructed on the site could reduce GHG emissions during the operational phase if energy efficient design aspects are incorporated into the planning of the Precinct. Consideration should be given to using solar lighting sources where able in accordance with the Townsville’s investment into the Australian Governments Solar Cities program. The Green Building Council of Australia has released an Industrial Pilot rating tool that may be able to be utilised in relation to the design of the precinct buildings and facilities.
- Due to the relocation of the industries previously located upstream into a single location within the Precinct area, there will be an opportunity to investigate creating an eco-industrial Precinct. Because each of these new facilities will be developed in approximately the same timeframe, there is potential to share facilities such as heating ventilation and air conditioning (HVAC), recycling, fuel storage as well as potentially reusing waste heat from the engineering facilities. This requires establishment of appropriate infrastructure planning controls and collaboration between relevant stakeholders.
- Applying energy efficiency and GHG emissions considerations to the purchasing of equipment used on site in the Precinct will also have the potential to reduce overall operational GHG emissions. Making sure that operators within the Precinct are trained in energy efficient practices will also provide an opportunity to reduce overall GHG emissions.

3.13 Noise and vibration

3.13.1 Description of environmental values

The environmental values to be enhanced or protected under the Queensland Environmental Protection (Noise) Policy 2008 are the qualities of the environment that are conducive to:

- Protecting the health and biodiversity of ecosystems;
- Human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to sleep, study or learn and be involved in recreation, including relaxation and conversation; and
- Protecting the amenity of the community.

The *Environmental Protection Act 1994* outlines how to protect Queensland's environment from environmental nuisance. This includes noise disturbance from regulated devices such as air-conditioning systems and also building work, which includes excavating or filling.

For industrial developments there is another mechanism to assist in achieving a balance between the social and economic amenity of the community, and the needs of the individual for sleep and relaxation. The DERM has a guideline for setting conditions related to noise emitted from industrial premise, which are intended for planning purposes, - Ecoaccess Guideline Planning for Noise Control, 2004. The guideline also includes criteria for estimating the probability of sleep disturbance from transient noise.

To determine the existing noise environment of the proposed development area baseline noise monitoring was undertaken using unattended loggers and attended monitoring devices from 3 December 2008 to 10 December 2008 near the subject site. Refer to Appendix K for a detailed description of the methodology used for the monitoring.

Unattended monitoring results are summarised in Table 3-61 and attended noise monitoring results are summarised in Table 3-62. Details of each program are provided in Appendix K. Data was removed from the unattended data records for periods in which wind speeds were over 5 m/s or rainfall occurred as these events interfere with integrity of data recording. Periods of reporting relate to the day, evening and night-time periods defined by the Ecoaccess Planing for Noise Control.

Table 3-61 Summary of Noise Monitoring Results dB(A) – 27 Hubert Street

Logger	Background L_{A90} dB(A) Day (7 am to 6 pm)	Background L_{A90} dB(A) Evening (6 pm to 10 pm)	Background L_{A90} dB(A) Night (10 pm to 7 am)	Ambient L_{Aeq} dB(A) Day (7 am to 6 pm)	Ambient L_{Aeq} dB(A) Evening (6 pm to 10 pm)	Ambient L_{Aeq} dB(A) Night (10 pm to 7 am)
Wednesday 3rd Dec	39.8	36.5	-[10]	55.2	48.8	-
Thursday 4th Dec	39.8	35.8	32.8	52.3	45.7	47.3
Friday 5th Dec	39.0	34.5	32.3	49.9	44.7	45.3
Saturday 6th Dec	37.2	34.2	34.1	49.0	48.3	49.2
Sunday 7th Dec	38.2	38.0	34.7	49.2	43.8	44.9
Monday 8th Dec	39.7	38.4	36.9	52.6	49.6	-
Tuesday 9th Dec	40.3	38.8	37.7	51.4	48.1	47.3
Wednesday 10th Dec	41.6	-	35.9	50.2		47.6
RBL and L_{eq} Overall	**39.7**	**36.5**	**34.7**	**51.7**	**47.5**	**47.2**

Table 3-62 Attended Noise Monitoring Results

Location	Time and Duration	L_{A90}	L_{Aeq}	L_{A10}	Comment
282 Boundary Street	Day – 3/12/08 9am 15 mins	52.6	64.3	66.8	Road Traffic Noise (RTN), birds and insects, industrial noise such as reversing alarm.
282 Boundary Street	Evening – 2/12/08 9pm 15 mins	51.0	62.9	65.8	RTN, birds and insects, dogs, distant hum from port
282 Boundary Street	Night – 3/12/08 4.15am 15 mins	46.3	54.6	56.1	RTN on Boundary St, birds and insects, traffic in distance
76 Allen Street	Day – 3/12/08 7.20am 15 mins	47.5	52.0	55.2	Port noise, distant RTN, construction noise
76 Allen Street	Night – 3/12/08 4.20am 15 mins	43.7	51.3	54.9	RTN on distant streets, birds and insects,
5 Nelson Street	Day – 3/12/08 7.45am	43.6	51.9	55.8	RTN on Boundary Road, birds and insects, domestic noise i.e. doors slamming,
5 Nelson	Evening – 2/12/08	42.4	49.1	53.2	RTN on Boundary Road, birds

[10] Note: '-' refers to invalid data that has been excluded from the data set.

Location	Time and Duration	L_{A90}	L_{Aeq}	L_{A10}	Comment
Street	8.12pm				and insects, domestic noise.
5 Nelson Street	Night – 3/12/08 4.50am	42.3	48.3	52.4	Birds and insects, some traffic on Boundary Street, dogs.
50 Sixth Street	Evening – 2/12/08 9.37pm	45.7	51.2	53.0	Birds and insects, domestic noise (television) RTN from surrounding streets.
50 Sixth Street	Night – 3/12/08 6.55am	45.7	50.4	51.2	Birds and insects, industrial noise (impulsive) from nearby boat yard, construction noise, distant RTN noise.
50 Bell Street	Day – 3/12/08 8.14am	42.8	49.4	52.2	Heavy vehicles, distant construction noise, birds and insects, RTN on Bell Street.
50 Bell Street	Evening – 2/12/08 8.24pm	41.3	46.4	49.9	RTN in surrounding streets, birds and insects, dogs.
50 Bell Street	Night – 3/12/08 5.14am	40.9	46.3	48.9	Birds and insects, RTN on surrounding streets, distant heavy vehicles, motorbike.
27 Hubert Street	Day – 3/12/08 8.41am	50.8	56.3	59.7	Lawn mower at nearby church dominant noise source, birds and insects, RTN and distant heavy traffic from port.
27 Hubert	Evening – 2/12/08 7.42pm	48.9	55.9	58.7	RTN from local streets, distant port noise, birds and insects, some domestic noise from houses.
27 Hubert Street	Night – 3/12/08 5.37am	46.7	50.1	50.9	Distant RTN, birds, dog.
Ergon Energy Substation	Night – 3/12/08 6.28am	46.6	64.4	65.0	RTN including heavy vehicles (b doubles) and light vehicles. Industrial noise including reversing alarm, forklift, bulldozer, and domestic noise and wind in leaves.
9 Eighth Avenue	Day – 3/12/08 9.17am	44.4	53.6	55.7	Birds and insects, light and heavy vehicles on Boundary Road, domestic noise including children and dogs, intermittent blower and alarm, construction noise from easterly direction.

Location	Time and Duration	L_{A90}	L_{Aeq}	L_{A10}	Comment
9 Eighth Avenue	Evening – 2/12/08 8.48pm	43.9	52.9	55.0	RTN from Boundary Street, domestic noise, birds and insects, distant reversing/safety alarm.
9 Eighth Avenue	Night – 3/12/08 6.00am	43.1	50.2	50.6	Birds and insects, construction related noise from harbour cold stores, domestic noise, distant alarms, RTN from Eighth Avenue.

3.13.2 Potential impacts

3.13.2.1 Construction noise

Typical noise levels produced by construction plant anticipated to be used on site were sourced from AS 2436 – 1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites and from GHD's internal database.

The power levels were then distance attenuated from the proposed construction site. Propagation calculations take into account sound intensity losses due to hemispherical spreading, with additional minor losses such as atmospheric absorption, directivity and ground absorption ignored in the calculations. As a result, predicted received noise levels are expected to slightly overstate actual received levels and thus provide a measure of conservatism.

Received noise produced by anticipated activities, during the construction of the proposal is shown in Table 3-63 for a variety of distances, with no noise barriers or acoustic shielding in place and with each plant item operating at full power. The sound pressure levels shown are maximum levels produced when machinery is operated under full load.

Table 3-63 Predicted Plant Item Noise Levels dB(A)

Plant Activity/dB(A) L_w	Distance of Source to Receiver (m)						
	50	**250**[11]	**350**[12]	500	750	1000	2000
Crane 110	68	54	51	48	45	42	36
Backhoe 108	66	52	49	46	43	40	34
Compressor 100	58	44	41	38	35	32	26
Concrete Pump 109	67	53	50	47	44	41	35

[11] Approximate distance to nearest internal (fishing trawlers) noise sensitive receiver

[12] Approximate distance to nearest external noise sensitive receiver

Distance of Source to Receiver (m)							
Dump Truck 108	66	52	49	46	43	40	34
Water Tanker 109	67	53	50	47	44	41	35
Compactor 110	68	54	51	48	45	42	36
Pile Driving 130	88	74	71	68	62	56	50

Anticipated noise levels compare to existing daytime ambient noise levels at residential receivers outside the Precinct for all plant activity except pile driving.

Due to the distance between the construction works and the sensitive receivers, noise generating activities should be limited to week days between 6:30 am and 6:30 pm.

Construction of the Precinct will be undertaken in three stages and it is anticipated that fishing trawlers will be located onsite during construction of remaining stages. Noise impact on the fishing trawlers have been considered in terms of sleep disturbance. Due to the nature of trawling operations, occupants may be asleep at any time of the day, so greatest impact on sleep may occur during the daytime period during construction activities. An external noise level of 55 dB(A) L_{max} no more than 10-15 times per night is considered appropriate for assessment purposes (refer Appendix K).

Noise levels from construction activities will likely exceed sleep disturbance criteria during pile driving and some other activities and it is expected that some impact will occur on the sleep patterns of occupants of berthed fishing trawlers.

Occupants of trawlers should be notified of the proposed construction timing and methodology.

3.13.2.2 Construction Vibration

It is possible that construction vibration will be perceived at times by local sensitive receivers. However, the level of annoyance will depend on individuals. Such issues are practically best managed by site monitoring. Circumstances where vibration monitoring should be undertaken are outlined in the construction-related recommendations (refer to Section 3.13.3 of this report).

Distance between the potentially most impacted receivers and site construction activities will generally be in excess of 100m. However, it is possible that some infrastructure and road works be carried out at smaller distances.

The nature and levels of vibration emitted by the site will vary with the activities being carried out on site. Appendix K lists the types of vibrations that may be generated by the site.

From analysis of typical vibration levels of common construction activities the building damage lower limit is normally not exceeded by general construction activities at distances greater than 20m from the nearest sensitive receivers.

In the context of the Project, the nearest sensitive residential receivers will be located further than 350m of the construction activities and as such no appreciable impact from vibration is expected. The nearest commercial receiver is located at least 50m from the Precinct and as such no appreciable impact from vibration is expected.

3.13.2.3 Construction Road Traffic Noise

Construction related traffic would likely use Boundary Street as the major access route to site during Stage 1 construction and potentially during Stage 2 construction activities. Traffic impacts are assessed under Section 3.4 of this EIS. A Traffic Impact Assessment conducted for the area of the TMPP (GHD, 2009) states observed traffic counts for the existing road network, including Boundary Street, Saunders Street, Benwell Road and Archer Street. Predicted 2011 traffic volumes with and without construction traffic in the report reveal that the greatest traffic increases will be on Boundary Street and will represent an increase in traffic of less than 15%. Most of this traffic will be during the AM and PM peak periods and as this will occur during the day time a small increase in road traffic noise is not considered to be significant.

3.13.2.4 Precinct operation

The occupants of the TMPP are expected to include industrial activities such as boat building, abrasive blasting, surface coating, workshops, storage of goods, and packaging. Other noise generating activities associated with this will include trucks and forklifts, trawlers and boats.

To determine likely operational impacts sound power levels were sourced for several noise generating activities that may be located onsite. Although this list is not exhaustive, it includes some operations that could be considered as worse case. The power levels were then distance attenuated from the proposed Precinct. Propagation calculations take into account sound intensity losses due to hemispherical spreading, with additional minor losses such as atmospheric absorption, directivity and ground absorption ignored in the calculations. As a result, predicted received noise levels are expected to slightly overstate actual received levels and thus provide a measure of conservatism.

Received noise produced by anticipated activities, during operation is shown in Table 3-64 for a variety of distances, with no noise barriers or acoustic shielding in place and with each plant item operating at full power. The sound pressure levels shown are maximum levels produced when machinery is operated under full load.

During the Precinct operations, the average sound level experienced at nearby residence is expected to be around 46 dB(A) under worst case conditions. This is similar to existing noise levels in the area and equal to the daytime Project specific noise criteria. It is expected that further noise attenuation will likely occur due to the following:

- Some of these worse case activities will be located within buildings;
- Noise sources may be blocked from a direct line of site to receivers by Precinct infrastructure such as buildings, walls and barriers; and
- Many of these activities will be located further than 350m from the nearest sensitive receivers.

Locating these types of industry within the Precinct should not impact on the amenity of noise sensitive receivers with appropriate planning, design and management procedures in place.

Table 3-64 Predicted Operational Item Noise Levels dB(A)

Plant Activity/dB(A) L_w	Distance of Source to Receiver (m)						
	50	250[13]	350[14]	500	750	1000	2000
Sheet metal forming 105	63	49	46	43	39	37	31
Water jet pump 92	50	36	33	30	27	24	18
Forklift 85	43	29	26	23	20	17	11
Heavy Vehicle 104	62	48	45	42	39	36	30
Shunting 94	52	38	35	32	29	26	20

Not enough detail is known to assess evening and night time impacts of the potential Precinct users on the nearby sensitive receivers, however, night time operations may include loading and unloading of trawlers and some delivery trucks. Without management or mitigation, some activities may exceed the Project specific criteria and also cause sleep disturbance. It is recommended that each user of the Precinct be subject to a noise assessment if planned operations are outside the day time period.

3.13.2.5 Impact on Precinct Users

Potential noise impact on occupants of the Precinct (namely occupants who live aboard fishing trawlers) has been considered as part of this assessment. Noise criteria are expected to be slightly higher than for residential area of South Townsville due to this being an industrial area, however the proposed trawler berths are located closer to significant noise sources. Without detailed information on the Precinct users, it is difficult to assess potential impact. Noise levels identified in Table 3-64, are similar to the developed day time criteria of 48 dB(A) for the trawler location, however it must be noted that as addressed above, noise predictions are on the conservative side.

Noise sources should not exceed sleep disturbance criteria of 55 dB(A) as discussed above.

It is recommended that each user of the Precinct be subject to a noise assessment if planned operations are outside the day time period.

3.13.2.6 Operational road traffic noise

An assessment of operational road traffic noise was undertaken to determine potential increases in road traffic noise along Boundary Street as a result of the TMPP (refer Appendix K). Noise modelling suggests that noise levels in 2017 along Boundary Street will potentially be

[13] Approximate distance to nearest internal (fishing trawlers) noise sensitive receiver

[14] Approximate distance to nearest external noise sensitive receiver

above the DMR criteria of 68 dB(A), both without and with the TMPP. Noise levels have been predicted to be approximately 3.5 dB(A) higher along Boundary Street with the development.

3.13.2.7 Cumulative Impacts

Cumulative noise impact from the proposal and the Townsville Port Access Road corridor development have been considered. To that effect GHD reviewed the Townsville Port Access Road – Eastern Access Corridor Operational Road Traffic Noise Impact Assessment (Department of Main Roads, 2009), which assessed likely future noise conditions for a ten year traffic planning horizon. Sensitive receivers in the reviewed report were the same as receivers addressed in this assessment, including houses along Eighth Avenue, Sixth Street and Boundary Street.

Predicted noise levels at the nearby sensitive receivers ranged from 46 dB(A) to 54 dB(A) $L_{A10(18Hr)}$. The AUSTROADS Research Report , Modelling, measuring and Mitigating Road Traffic Noise (2005), states that the $L_{A10(18Hr)}$ descriptor can be converted equally to the $L_{Aeq(1Hr)}$ descriptor, which remains as 46 dB(A) to 54 dB(A) $L_{Aeq(1Hr)}$. These predicted road traffic noise levels are equal or higher than unmitigated predicted noise levels from the Precinct. Most operational activities within the Precinct will also be located further than the worse case 350m used in the predictions, and hence it is considered that cumulative impacts of the Precinct and the Townsville Port Access Road corridor development will not be a significant issue.

3.13.3 Mitigation measures

Construction activities have the potential to impact on the amenity of nearby noise sensitive receivers without appropriate management procedures in place.

The following management and mitigation measures should be implemented to minimise potential noise impacts:

- Noise generating construction activities should be, where possible, undertaken between the hours of 6.30am to 6.30pm Monday to Saturday. Any works outside these hours should be managed appropriately with actions listed below;
- Where practical, all vehicular movements to and from the construction site must be made only during normal working hours;
- Long term fixed plant such as generators should be located appropriately so as to minimise noise impacts on nearest sensitive receivers. This can include locating plant behind storage containers, stockpiles or other object that may act as a barrier to the sound;
- Residents to be notified of the construction timetable, with extra emphasis on noisy activities such as pile driving;
- Vehicles will be kept properly serviced and fitted with appropriate mufflers; and
- Machines found to produce excessive noise compared to industry best practice will be removed from the site or stood down until repairs or modifications can be made.

Noise and vibration monitoring should be undertaken by a qualified professional and with consideration to the relevant standards and guidelines. Attended noise and vibration monitoring should be undertaken in the following circumstances:

- Upon receipt of a noise and/or vibration complaint. Monitoring should be undertaken and reported within (say) 3 to 5 working days. If exceedances are detected, the situation should be reviewed in order to identify means to reduce the impact to acceptable levels. In case of vibration complaints, both building damage and human perception issues should be considered with regards to the vibration limits outlined in Section 3.13.2.2 – Construction Vibration.

Operation of the Precinct has the potential to impact on the amenity of nearby noise sensitive receivers in South Townsville and occupants of the Precinct (fishing trawlers) without appropriate management procedures in place. In order to protect the amenity of nearby sensitive receivers, any user of the Precinct shall ensure operational noise levels do not exceed the Project specific noise criteria of $L_{Aeq\ 1hr}$ day – 46dB, $L_{Aeq\ 1hr}$ evening – 40dB, and $L_{Aeq\ 1hr}$ night – 28dB for South Townsville and of $L_{Aeq\ 1hr}$ day – 48dB, $L_{Aeq\ 1hr}$ evening – 45dB, and $L_{Aeq\ 1hr}$ night – 31dB for the trawler berths.

The following management measures are available to ameliorate noise impacts:

- Locate the noisiest Precinct users the furthest away from the nearby sensitive receivers;
- Where practicable, limit operating times of noisy industries using the site (i.e. day time only);
- Public awareness for recreational boat users accessing the site outside day time period; and development approvals for individual sites should be subject to a noise assessment to ensure that all industrial premises on the Precinct cumulatively comply with the criteria.

3.13.4 Conclusions – noise and vibration assessments

The results of the assessment suggest that construction related noise and vibration from the Port of Townsville Marine Precinct will not significantly impact on the amenity of sensitive receivers in South Townsville, provided the noise management measures outlined in this report are implemented.

Noise levels from construction activities will likely exceed sleep disturbance criteria during pile driving and it is expected that some impact will occur on the sleep patterns of occupants of berthed fishing trawlers. Occupants of trawlers should be notified of the proposed construction timing and methodology.

Limited information is available at this time on the occupants of the Precinct. Sound power levels were sourced for several noise generating activities that may be located onsite. The power levels were then distance attenuated from the proposed Precinct to predict possible noise impact on nearby sensitive receivers. During the Precinct operations, the average sound level experienced at nearby residence is expected to be around 46 dB(A) under worst case conditions and around 49 dB(A) within the Precinct at the fishing trawler berths. This is similar to existing noise levels in the area and it is expected that further noise attenuation will likely occur.

Locating these types of industry within the Precinct should not impact on the amenity of noise sensitive receivers with appropriate planning, design and management procedures, as outlined in this report, in place.

It is recommended that development approvals for individual sites should be subject to a noise assessment to ensure that all industrial premises on the Precinct cumulatively comply with the criteria.

Increase in road traffic due to the Precinct has the potential to increase road traffic noise in the local road network. Road traffic noise modelling for the year 2017 has indicated that noise levels at a receiver on Boundary Street with the Precinct operational will potentially be 3.5 dB(A) higher than if the Precinct was not developed. Road traffic noise modelling suggests that noise levels will exceed the DMR Road Traffic Noise Management: Code of Practice 2008 criteria with or without the Precinct.

Therefore based on the information provided, assumptions made, and assessment of results it is expected that the TMPP can meet its relevant noise goals.

3.14 Waste management

3.14.1 Overview

The function of this section is to describe the existing environmental values that may be affected by wastes generated by the project in the context of environmental values as defined by the Environmental Protection Act 1994 and Environmental Protection Policies. This is fully discussed in Appendix X, which describes the waste management assessment undertaken for this project. The assessment provides a detailed assessment of potential waste impact and mitigation measures which may result from the development of the Project.

Waste is an important aspect of any new development both in the construction and operational phases and has the potential to have a significant environmental impact where not addressed properly.

3.14.2 Description of environmental values

3.14.2.1 Waste Definition

The definition of waste as outlined in the *Environmental Protection Act (1994)* (Qld) is as follows:

(a) Leftover or an unwanted by-product, from an industrial, commercial, domestic or other activity; or

(b) Surplus to the industrial, commercial, domestic or other activity generating waste.

3.14.2.2 Legislation, Guidelines and Objectives for Waste Management

Pollution of the marine environment by ships of all types, including fishing vessels, is strictly controlled by the *International Convention for the Prevention of Pollution from Ships 1973 (Amended 1978)* (known as MARPOL). Australia is a signatory to this convention, which is now enforced in over 100 countries.

This convention deals with all forms of waste disposal from ships except the disposal of land generated wastes (eg dredge spoil) by dumping and includes five technical Annexes as listed below:

- Annex I: Regulation for the prevention of pollution by oil (2 October 1983)
- Annex II: Regulations for the control of pollution by noxious liquid substances in bulk (6 April

1987)

- Annex III: Regulations for the prevention of pollution by harmful substances carried by sea in packaged forms (1 July 1992)
- Annex IV: Regulations for the prevention of pollution by sewage from ships (27 September 2003)
- Annex V: Regulations for the prevention of pollution by garbage from ships (31 December 1988)

Parties to the convention must cooperate in the detection of any violations and take action against violators.

Australia is a full member of the International Maritime Organisation and a signatory to MARPOL 73/78 (all annexes). Australia's jurisdiction and marine environmental responsibilities extend to the economic exclusion zone where the Protection of the *Sea (Prevention of Pollution from Ships) Act 1983* gives effect to the core provisions of the MARPOL 73/78 convention. The Australian Maritime Safety Authority (AMSA) applies the Convention in Australian waters. Its regulations are implemented through Commonwealth and State legislation.

It is assumed that all vessels will be required to clear quarantine prior to entering the Precinct and as such the specific requirements of quarantine are not relevant to this project.

In addition to the international and national conventions, legislation and regulations, waste management in ports, harbours, marinas, and shipping terminals in Queensland, at state level is governed by the following legislation:

- Environmental Protection Act (1994);
- Environmental Protection (Water) Policy (1997);
- Environmental Protection (Waste Management) Policy (2000);
- Environmental Protection (Waste Management)Regulation (2000);
- Transport Operations (Marine Pollution) Act (1995); and
- Transport Operations (Marine Pollution) Regulation (2008).

Specifically in Queensland, the *Transport Operations (Marine Pollution) Act (2008)* gives effect to the Annexures I, II, III and V of MARPOL 73/78 where Part Ten of the Act only enables the Queensland government to issue a directive to establish or have established by an owner occupier of a port, terminal or establishment, facility for the receipt or disposal of residues of ships as well as maintain the facility to enable ships to dispose of residues. The act prohibits the disposal of oils, garbage, harmful substances, noxious liquids and sewage in coastal waters.

The Australian Maritime Safety Authority (AMSA) is responsible for the application and enforcement of MARPOL 73/78 in areas of Commonwealth jurisdiction, which is to the limit of the 200 nautical mile exclusive economic zone. State government is responsible for costal waters up to three nautical miles (5.5 km) offshore.

The construction and operation of the TMPP must comply with relevant local, state, federal and international regulatory requirements regarding waste management and should aim to adopt best practice waste management and go beyond compliance where economically feasible options are identified. The "user pays" and "polluter pays" principals outlined in the

Environmental Protection (Waste Management) Policy (2000) (Waste EPP) are central to the management of wastes from such developments. These principals are defined as follows:

The polluter pays principle is the principle that:

> *All costs associated with the management of waste, if practicable, are borne by the persons who generated the waste.*
>
> *The costs associated with the management of waste may include the costs of:*
>
> *(a) Minimising the amount of waste generated; and*
>
> *(b) Containing, treating and disposing of waste; and*
>
> *(c) Rectifying environmental harm caused by waste.*

The user pays principle is the principle that:

> *All costs associated with the use of a resource should, if practicable, be included in the prices of goods and services.*

The project must comply with all regulations outlined in the Waste EPP and adopt the objectives of the legislation into the project's waste management practices. Specifically "minimising the impact of waste on the environment" and "…manage waste under principles of ecologically sustainable development".

With these principles in mind the waste management hierarchy that is also defined in the Waste EPP has been utilised as the basis for reviewing waste handling and management options for the project. The hierarchy encourages waste to be managed in the following order of preference

- Waste avoidance;
- Waste re-use;
- Waste recycling;
- Energy recovery from waste; and
- Waste disposal.

3.14.2.3 Waste Generation

Waste materials associated with the TMPP have been separated according to the waste generating activity.

Primarily, wastes have been divided into those waste streams associated with construction phase and those waste streams associated with the operational phase. Operational phase wastes have been further separated into shipping and boating wastes associated with commercial fishing and recreational boating and marina and associated industry wastes. Waste types likely to be associated with each of the waste generating activities are detailed, along with the associated legislation, typical management practices and the proposed management of the impacts of the waste streams for the TMPP.

Construction Phase Waste

Waste management practices for construction sites in Queensland are based on the principals and requirements outlined in the following documents:

- Environmental Protection Act 1994 (Qld);
- Environmental Protection (Waste Management) Policy 2000 (Qld); and
- Environmental Protection (Waste Management) Regulation 2000 (Qld).

Whilst detailed quantification of waste streams from the construction phase of works will be completed during preliminary design, this section outlines the likely waste streams.

The most significant wastes generated during the construction phase of the POTL project are likely to be excess spoil from earthworks and foundations, excess concrete and building material waste.

Liquid waste arising from the construction phase are likely to be limited to stormwater runoff, groundwater from dewatering, sewage from toilets and ablution facilities for construction workers and small quantities of chemicals which along with the sewage should be collected and disposed of off-site to an approved waste facility unless there is a trade waste permit in place for the site.

It is expected that only minor quantities of hazardous wastes such as paints and oils will be generated and authorised waste contractors can readily manage these.

Emissions to air are discussed in Section 3.11.

Table 3-65 summarises the primary waste materials, along with the source and provides a description of the wastes that are likely to be associated with the construction phase of the project.

Table 3-65 Construction Phase Waste Materials

Material	Source / Description
Fill	Excavated material such as sand, gravel, clay, soil and rock that has been mixed with another waste or excavated from areas that are contaminated with manufactured chemicals as a result of industrial, commercial, mining or agricultural activities.
Virgin Excavated Natural Material (VENM)	Excavated material such as sand, gravel, clay, soil and rock that is not mixed with any other waste or contaminated by any other activity.
Concrete	Mixture of cement, sand and aggregates. May include additives or substitutes such as fly ash.
Asphalt	Any materials containing bituminous hydrocarbons. May contain additives such as concrete. Includes recycled asphalt pavement (RAP)
Timber	Wood materials used for formwork or other construction purposes.
Besser blocks and other brick products	Broken or offcut besser blocks and other brick products may be mixed together. This can include small amounts of concrete or plaster render.
Glass	Sheet glass used for doors, windows, partitioning, etc.

Material	Source / Description
Plasterboard	Composite material of gypsum and cardboard used for interior panels of buildings.
Steel	Metal building products and materials e.g. reinforcing steel, sheet roofing (galvanised steel or zincalume), structural columns and beams, etc.
Non-ferrous metals	Metal building materials other than steel e.g. aluminium, brass, copper, etc.
Mixed waste	Mixed waste of which no one material comprises 50% or more of the load, e.g. paper and plastic packaging etc.
Paints and other chemicals	Paint and other chemicals used in various construction activities.

Operational Waste

Operational wastes have been broken into those wastes directly associated with shipping and boating (e.g. wastes produced onboard) and those associated with the operation of the marina (e.g. commercial / industrial operations).

Inventory of Shipping and Boating Wastes

The major components of the liquid and solid waste streams associated with shipboard operation include the following:

- **Solid**
  - General, non-hazardous wastes;
    - Paper;
    - Metals;
    - Glass;
    - Plastics;
  - Fishing nets and other equipment;
  - Medical wastes;
  - Hold sweepings;
  - Galley waste;
  - Fish / other animal wastes;
  - Batteries ; and
  - Fluorescent and mercury vapour lamp bulbs.
- **Liquid**
  - Waste oil;
  - Oily mixtures including fuel residues;
  - Oily mixtures containing chemicals;
  - Tank wash water;

- Noxious liquids;
- Sewage (grey water); and
- Sewage (black water).

An inventory of Precinct waste is summarised in Table 3-66.

Table 3-66 Inventory of Precinct waste

Material	Description / Source
Industrial	***Manufacturing, seafood processing and packaging, ship building, fit-out, repair, maintenance etc.***
Paper and cardboard	Paper from packaging of goods, cardboard boxes (e.g. packing of seafood products) etc.
Plastic	Plastic packaging form industrial operations, other waste plastic associated with repair maintenance of vessels, plastic containers from various industries (e.g. fish processing), shrink wrap and packing tape.
Foam	Foam containers (e.g. seafood storage / transport), packaging, protective covers, other foams used in vessels, floats and other items.
Non ferrous metals	Scrap metals such as aluminium / brass from maintenance or industrial operations, paint tins etc.
Steel	Scrap from maintenance or industrial operations.
Abrasive blasting material	Abrasive blasting material (e.g. sand) and associated contaminants.
Paint chips	Paint chips and material from maintenance/repair of boats.
Fibreglass and related products	Fibreglass, resin, hardener, foams from vessel maintenance / repair and other industrial process.
Biological waste	Fish and other waste from processing and packaging. Organisms from anti fouling maintenance.
Oil / fuel / residues	From service, repair, maintenance and other industrial processes
Chemical wastes	Anti-fouling, cleaning and other industrial chemicals, adhesives, glues, etc.
Sewage grey water / black water	Sewage from site facilities
Timber	Wood products used in repair and maintenance of vessels and in various industrial processes, pallets, formwork, etc.
Paint	Paint used in repair and maintenance of vessels.
Glass	Sheet glass, screens bottles and containers.

Material	Description / Source
Batteries	Lead acid and other batteries from vessels and other machinery used in the industrial processes at the site.
Commercial	***Retail, administration, restaurants, etc.***
Paper	Food packaging, wrapping, other product packaging, office paper, etc.
Plastic	Packaging, bottles, other containers, wrapping, shrink wrap, packing tape, etc.
Glass	Glass bottles, jars, etc.
Metals	Aluminium drink cans, other food cans, etc.
Food waste	Left over food from restaurants and other services.
Sewage grey water / black water	Sewage from toilets, showers, sinks, kitchens and other facilities.
Mixed waste	Mixed waste of which no one material comprises 50% or more of the load, e.g. paper and plastic packaging etc.

3.14.3 Potential impacts and mitigation measures

3.14.3.1 Overview

This section describes the existing environmental values that may be affected by the projects wastes. Waste streams identified and outlined in the inventory are assessed with reference to the environmental values described in other sections of this EIS.

Given the environmental values of the surrounding area of the project site, effective waste management will be an important aspect of any development in the area including the marine industrial allotments, trawler fleet, pile mooring and public boat ramp, car and trailer parking bays.

The waste streams expected to be generated by each component of the project are detailed with an assessment of the potential environmental impacts of the wastes and options for waste management aimed at protecting environmental values are also provided.

3.14.3.2 Construction Waste

As construction involves the change of an existing environment there is an inherent impact on the environment associated with all construction. The challenge in any construction activity or development is to undertake the construction with as little impact as possible. With regard to construction waste management, preplanning and adherence to the waste management hierarchy is integral to the minimisation of impacts associated with the construction phase of any project. Table 3-67 builds on the inventory of construction waste provided by detailing the environmental values affected by the waste type and the potential impacts on the environmental values associated with each waste type. Detail on management of the impacts highlighted and options for the implementation of the waste hierarchy are provided in the discussion that follows Table 3-67.

Table 3-67 Construction Waste

Material	Description	Environmental value / potential impacts	Management options
Fill	Excavated material such as sand, gravel, clay, soil and rock that has been mixed with another waste or excavated from areas that are contaminated with manufactured chemicals as a result of industrial, commercial, mining or agricultural activities.	Water, soil, flora, fauna. Degradation of water quality, contamination of other soils / sediments though leaching. Toxicity to aquatic flora and fauna.	Remediate contaminants (if present) and utilise fill on site. Remove fill from site to an appropriately licensed facility for treatment and resale. Ensure disturbance and stockpiling of fill is conducted in a manner that minimises the potential for environmental impacts e.g. implement appropriate sediment and erosion controls, do not mix with clean material etc.
Virgin Excavated Natural Material (VENM)	Excavated material such as sand, gravel, clay, soil and rock that is not mixed with any other waste or contaminated by any other activity.	Water, flora, fauna. Degradation of water quality, sediment and erosion control issues. Issues associated with high turbidity on aquatic flora and fauna.	Implement sediment and erosion controls prior to excavation or stockpiling. Only excavate where required and avoid excavation in the vicinity of waters. Locate stockpiles outside of drainage lines and area where there is potential for runoff during rain events.
Concrete	Mixture of cement, sand and aggregates. May include additives or substitutes such as fly ash.	Water, soil, flora, fauna. Degradation of water quality, increased turbidity. Toxicity to aquatic flora and fauna.	Ensure lined, bunded concrete wash out areas are provided. Ensure concrete and related products are stored / stockpiled appropriately e.g. covered, bunded, sediment and erosion control measures in place.

Material	Description	Environmental value / potential impacts	Management options
Asphalt	Any materials containing bituminous hydrocarbons. May contain additives such as concrete. Includes recycled asphalt pavement (RAP)	Water, soil, flora, fauna. Degradation of water quality. Contamination of soil and sediment. Toxicity to flora and fauna.	Ensure excess asphalt and related products are disposed of appropriately. Ensure tar and other related chemicals are stored in bunded, covered locations.
Timber	Wood materials used for formwork or other construction purposes.	Visual amenity.	Provide stockpile area for excess / waste timber. Utilise excess / waste timber in other construction processes where possible.
Besser Blocks and other Brick products	Concrete blocks and Clay bricks, which may be mixed together. This can include small amounts of mortar or plaster render.	Visual amenity Degradation of visual amenity	Provide stockpile area for excess / waste bricks / roof tiles. Utilise in other construction processes where possible. Dispose of to recycling facility.
Glass	Sheet glass used for doors, windows, partitioning, etc.	Visual amenity. Degradation of visual amenity.	Provide separated stockpile / storage where appropriate. Dispose of to recycling facility.
Plasterboard	Composite material of gypsum and cardboard used for interior panels of buildings.	Visual amenity. Degradation of visual amenity.	Provide separated stockpile / storage where appropriate. Reuse / recycle where possible (likely offsite).
Steel	Metal building products and materials e.g. reinforcing steel, sheet roofing, structural columns and beams, etc.	Water, soil, visual amenity. Contamination of water and soil through decomposition. Degradation of visual amenity.	Provide separated stockpile / storage where appropriate. Reuse where possible. Dispose of to recycling facility.

Material	Description	Environmental value / potential impacts	Management options
Non-ferrous metals	Metal building materials other than steel e.g. aluminium, brass, copper, etc.	Water, soil, visual amenity. Contamination of water and soil trough decomposition. Degradation of visual amenity.	Provide separated stockpile / storage where appropriate. Reuse where possible. Dispose of to recycling facility.
Mixed waste	Mixed waste of which no one material comprises 50% or more of the load, e.g. paper and plastic packaging etc.	Water, soil, visual amenity, flora, fauna. Contamination of water and soil. Kill or injure fauna through ingestion or entanglement.	Provide waste receptacles. Provide recycling receptacles to fit with local recycling system where possible. Avoid commingling with other separated waste streams.
Paints and other chemicals	Paint and other chemicals used in various construction activities.	Water, soil, flora, fauna.	Provide specific disposal facility. Provide covered / bunded facility for storage prior to disposal to appropriate facility.

Management of impacts

In order to manage the impacts of the construction of the project and to minimise the amount of waste generated by the construction process it is recommended that a waste minimisation strategy be developed for the construction phase. A number of key items are required to be addressed in order to achieve waste minimisation and capitalise on recycling opportunities, these are as follows;

- Coordinate and communicate the strategy to site project managers, supervisors, workers and contractors;
- Appoint a responsible person (site manager) to oversee the implementation of the waste minimisation plan, promote the plan and reward best performances where possible;
- Develop reporting arrangements to monitor waste minimisation; or alternatively, ensure disposal and recycling contractors separate monitor and recycle all site waste as far as practicable so that the objective of the plan are met;
- Involve any waste contractors before construction commences to ensure waste management strategies are compatible with collection systems; and
- Provide relevant training and ongoing education to ensure the strategy is effectively implemented.

In addition to the overall objectives of the waste minimisation strategy, specific options that can be utilised to address the principles of the waste management hierarchy in order of preference are provided below:

Waste Avoidance

- Use designs that minimise the generation of waste during construction and allow waste management facilities during the building operations;
- When selecting a product or material consider the durability of materials and future cost savings of buying an item once and reusing it in a number of ways over the life of the development;
- Include clauses in contracts that discourage over supply of materials and the generation of waste;
- As far a possible accurately estimate the quantities of materials required for the job to avoid over supply;
- Minimise the handling and transport of materials on and off-site; and
- Implement erosion and sediment control procedures to ensure that sediment content in stormwater is appropriately managed to minimise erosion on site.

Waste Reuse

- Ensure waste is separated into recoverable and non-recoverable streams. Also ensure new and undamaged recovered waste materials are kept separated;
- Establish a specific area within the site for the storage and removal of different streams of recovered waste materials. It should be secure and access restricted to authorised personnel;

- Mulch or chip and reuse vegetation wastes in landscaping (except for mangroves);
- Crush large quantities of concrete, brick and other suitable materials and use as roadbase footings (where specifications can be met) retaining walls, drainage etc.;
- Organise pallet returns with follow on deliveries with suppliers where possible;
- Plan to use excess or waste materials effectively, for example:
  - identify which waste materials will be generated (eg concrete, timber, plasterboard, fill etc) and determine how they could be reused;
  - coordinate use of material between jobs, excess materials can be used on other sites if required;
  - consider how excess or waste material could be used if they become available (e.g. fill, drainage material, soil conditioners, framing etc);
  - advertise the availability of free recovered waste materials locally;
  - maximise the separation of wastes and minimise the contamination of recoverable materials;
- Stockpile unused waste material for future use, ensure stockpiles are well managed;
- Reuse off-cuts where possible and store appropriately in the interim; and
- Engage a recovery contractor to remove recoverable materials from site.

Waste Recycling

- Consider using products and materials with recycled content where possible. Check the performance of recycled content products to ensure they meet engineering specification;
- Notify suppliers that recycled content products are preferred where other technical specifications are also met;
- Use fixtures / materials in fit-outs that can be reused in later refurbishments; and
- Consider using fly ash as a component of concrete to reduce the use of virgin materials.

Waste Disposal

- Collect data and record the movement of waste and recovered materials on and off site. Require contactors to supply this information as part of the contract;
- Identify the specific locations of potential sources of waste material (e.g. site sheds and offices, particular trades, particular work activities or areas);
- Develop disposal procedures such as the types of containers to be employed, clear and appropriate signage, suitable location for bins and stockpiles;
- Provide relevant training and ongoing education to ensure efficient disposal (e.g. minimal contamination, maximum resource recovery);
- Utilise chemical toilet and ablutions facilities for construction workers or drain waste water to holding tanks that can be emptied by a contractor; and
- Early installation of stormwater control devices and cut off drains to manage runoff from construction areas to ensure appropriate disposal and handling of stormwater sources.

Specific reference should be given to the typical types of construction materials likely to be used in North Queensland and at this development, namely:

- Sheet metal (galvanised corrugated steel etc) used for roofing and in shed construction;
- Concrete (besser) blocks used in building construction.

It is considered likely that these materials will form a large fraction of the materials used in construction.

Sheet metal can be recycled and should be separated from general mixed waste. A specific metal recycling bin should be provided during construction for waste metals to be placed. Generally scrap metal skips will be provided by scrap metal contractors on request.

Concrete blocks can also be recycled with waste concrete and should be separated from general waste. A designated waste concrete area should be provided during construction and concrete blocks (off-cuts or waste) should be stockpiled here prior to removal to a concrete recycling facility. It is noted that most landfills provide concrete recycling.

3.14.3.3 Operational waste

Wastes associated with the operation of the marina and the affected environmental values, potential impacts and management options have been further broken down into shipping and boating waste (wastes generated on board) and industrial and commercial wastes (wastes generated on land). Table 3-68 details the environmental values, potential impacts and management options associated with shipping and boating wastes whilst Table 3-69 deals with those wastes generated on land by industrial and commercial operations.

Table 3-68 Shipping and Boating Waste

Material	Environmental value	Potential impacts	Management options
Paper	Visual amenity, flora.	Degrade visual amenity. Kill / injure fauna via ingestion, entanglement	Provide receptacles for general waste and recyclables at appropriate locations. Provide separate facilities for commercial and recreational users.
Metals	Visual amenity, fauna.	Degrade visual amenity. Kill / injure fauna via ingestion, entrapment.	Provide receptacles for general waste and recyclables at appropriate locations. Provide separate facilities for commercial and recreational users.
Glass	Visual amenity, fauna.	Degrade visual amenity. Kill / injure fauna via ingestion, entrapment.	Provide receptacles for general waste and recyclables at appropriate locations. Provide separate facilities for commercial and recreational users.
Plastics	Visual amenity, fauna.	Degrade visual amenity. Kill / injure fauna via ingestion, entanglement, entrapment.	Provide receptacles for general waste and recyclables at appropriate locations. Provide separate facilities for commercial and recreational users.
Fishing nets and other equipment	Visual amenity, fauna.	Degrade visual amenity. Kill / injure fauna via ingestion, entanglement.	Provide receptacles for general waste and recyclables at appropriate locations. Provide separate facilities for commercial and recreational users.

Material	Environmental value	Potential impacts	Management options
Hold sweepings	Visual amenity, water, soil, fauna.	Degrade visual amenity. Increase nutrient loading in marina waters, or contaminate water and soil with toxic substances. Kill / injure fauna via contamination, ingestion, entanglement.	Ensure hold sweepings are contained and disposed of to an appropriate receptacle. Prescribe procedures for hold sweeping disposal such as removal by waste removal contractor.
Galley waste	Visual amenity, odour, water, fauna, flora.	Degrade visual amenity, create odour issues. Increase nutrient loading in marina waters which will inturn impact on flora and fauna. Create pest issues.	Provide specific receptacles for commercial users or ensure galley wastes are removed directly from vessel by waste removal contractor. Provide sufficient general waste receptacles for public use.
Fish / other animal wastes	Visual amenity, odour, water, flora, fauna.	Degrade visual amenity, create odour issues. Increase nutrient loading in marina waters which may inturn impact on flora and fauna. Create pest issues.	Provide specific receptacles for commercial users or ensure fish and other animal wastes are removed directly from vessel by waste removal contractor. Prescribe procedure for commercial users. Provide fish cleaning preparation areas with special disposal receptacles for public use.
Batteries	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Contaminate marina waters and / or sediment. Kill / injure flora and fauna via toxicity. Bioaccumulation and health and safety issues.	Provide battery recycling transfer area where customers can deposit battery before battery recycling contractor collection. Provide contact details of battery recycling contractor for pickup service.

Material	Environmental value	Potential impacts	Management options
Fluorescent and mercury vapour lamp bulbs	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Contaminate marina waters and / or sediment. Kill / injure flora and fauna via toxicity. Bioaccumulation and health and safety issues.	Provide a separate disposal receptacle where items such as these can be deposited prior to removal by contractor.
Waste oil	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Contaminate marina waters and / or sediment. Kill / injure flora and fauna via toxicity. Bioaccumulation and health and safety issues.	Provide pump out facility or appropriate access / locations for sucker trucks to remove [1]. Provide separate waste oil deposit facility for commercial and recreational users. Prescribe waste oil removal procedures for both commercial and recreational users.
Oily mixtures including fuel residues	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Contaminate marina waters and / or sediment. Kill / injure flora and fauna via toxicity. Bioaccumulation and health and safety issues.	Provide pump out facility or appropriate access / locations for sucker trucks to remove [1]. Provide separate deposit facility for commercial and recreational users. Prescribe removal procedures for both commercial and recreational users.

Material	Environmental value	Potential impacts	Management options
Oily mixtures containing chemicals	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Contaminate marina waters and / or sediment (may include contaminants such as soaps, cleaners or engine coolant). Kill / injure flora and fauna via toxicity. Bioaccumulation and health and safety issues.	Provide pump out facility or appropriate access / locations for sucker trucks to remove [1]. Provide separate facility for commercial and recreational users. Prescribe removal procedures for both commercial and recreational users. Avoid mixture of chemicals which may result in health and safety issues.
Tank wash water	Water, soil, flora, fauna.	Contaminate marina waters and / or sediment if containing contaminants (may include contaminants such as oils, fuel and residues, soaps, cleaners or engine coolant). Increase nutrient loading in marina waters where containing fish / food waste, which may inturn impact on flora and fauna. Kill / injure flora and fauna via toxicity / eutrophication. Bioaccumulation and health and safety issues.	Provide pump out facility or appropriate access / locations for sucker trucks to remove [1]. Provide separate facility for commercial and recreational users. Prescribe removal procedures for both commercial and recreational users. Avoid mixture of chemicals which may result in health and safety issues.

Material	Environmental value	Potential impacts	Management options
Noxious liquids	Water, soil, flora, fauna.	Contaminate marina waters and / or sediment. Kill / injure flora and fauna via toxicity. Bioaccumulation and health and safety issues.	Provide pump out facility or appropriate access / locations for sucker trucks to remove [1]. Provide separate facility for commercial and recreational users. Prescribe removal procedures for both commercial and recreational users. Avoid mixture of chemicals which may result in health and safety issues.
Sewage grey water / black water	Visual amenity, air, water, flora, fauna.	Degrade visual amenity. Objectionable odour. Contaminate marina waters. Increase nutrient loading in marina waters. Kill / injure flora and fauna via toxicity and eutrophication. Health and safety issues.	Provide pump out facility or appropriate access / locations for sucker trucks to remove [1]. Provide separate facility for commercial and recreational users. Prescribe removal procedures for both commercial and recreational users.

[1] The marina management may provide pump out facility for specified types and quantities of liquid waste or direct liquid waste disposal to an appropriate liquid waste management contractor. For example marina management may prescribe that “oily bilge water not contaminated with soaps, cleaners or engine coolant and less than 150L may be pumped via the onsite pump out facility. For oily bilge water contaminated with soaps, cleaners or engine coolant or more than 150L boat owners should contact the appropriate liquid waste management contractor for removal via sucker truck.

Table 3-69 Commercial and Industrial Waste

Material	Environmental value	Potential impacts	Management options
Industrial, manufacturing, repair, maintenance, etc.			
Paper Paper from packaging of goods, etc.	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Not readily biodegradable. Potential leaching of contaminants to water and soil. Contaminants may be toxic to flora and fauna.	Minimise packaging in production and select products with minimal packaging. Provide paper recycling facilities to commercial premises. Ensure waste receptacles have sufficient capacity and are emptied as frequently as required.
Plastic Plastic packaging form industrial operations, packing tape, shrink wrap, other waste plastic associated with repair maintenance of vessels, plastic containers from various industries (e.g. fish processing)	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Not readily biodegradable. Potential leaching of contaminants to water and soil. Contaminants may be toxic to flora and fauna. Kill / injure fauna via entanglement, entrapment, ingestion.	Minimise plastic waste in production processes, select products with minimal plastic packaging. Select / use / produce products with recyclable / reusable plastic. Provide plastic recycling receptacles to commercial and industrial clients. Include public place recycling receptacles to fit with local recycling practice.

Material	Environmental value	Potential impacts	Management options
Foam Foam containers, packaging, protective covers, other foams used in vessels, floats and other items.	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Not readily biodegradable. Potential leaching of contaminants to water and soil. Contaminants may be toxic to flora and fauna. Kill / injure fauna via entanglement entrapment, ingestion.	Minimise foam waste in production processes, select products with minimal foam packaging. Reuse where possible. Provide recycling receptacles for Expanded Polystyrene (EPS). Potential to include in recycling bins for separation at Material Recovery Facility (MRF).
Non ferrous metals Scrap metals such as aluminium / brass from maintenance or industrial operations, paint tins etc.	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Potential leaching of contaminants to water and soil. Contaminants may be toxic to flora and fauna.	Minimise scrap in production / repair / maintenance. Reuse in next or another process (e.g. repair / maintenance). Provide recycling facilities / collection service. Provide recycling receptacles in public places and for commercial users for cans / tins etc.
Steel Scrap metals from maintenance or industrial operations	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Potential leaching of contaminants to water and soil. Contaminants may be toxic to flora and fauna.	Minimise scrap in production / repair / maintenance. Reuse in next or another process (e.g. repair / maintenance). Provide recycling facilities / collection service.

Material	Environmental value	Potential impacts	Management options
Abrasive blasting grit Abrasive blasting grit and associated contaminants.	Air, water, soil, flora, fauna.	Contamination to air of fine particles including silica and heavy metals. Nuisance dust Contamination of water, soil by heavy metals and other contaminants associated with surfaces requiring blasting such as paints. Potential leaching of contaminants to soil and water. Contaminants may be toxic to flora and fauna.	Ensure abrasive blasting is conducted in contained environment to prevent discharge to air, water or soil. Ensure blasting material is collected and disposed of appropriately.
Paint chips Paint chips and material from maintenance / repair of boats.	Air, water, soil, flora, fauna.	Contamination of water and soil (sediment) by antifouling, anticorrosive paints and products (potential contamination by various metals and chemicals including TBT, PCB's lead, zinc, copper). (Contamination of air and subsequently water and soil via application of new paint) Contaminants may be toxic to flora and fauna. Bioaccumulation issues.	Ensure paint removal via abrasive blasting or high pressure water is conducted in enclosed, controlled facility. Abrasive blasting material to be collected and disposed of appropriately. High pressure water runoff to be controlled and treated to remove all contaminants prior to release to harbour (may require disposal to sewer via trade waste agreement)[1].

Material	Environmental value	Potential impacts	Management options
Fibreglass and related products Fibreglass, resin, hardener, foams from vessel maintenance / repair and other industrial process.	Air, water, soil, flora, fauna.	Release to air of toxic substances including vapours from mixing and curing processes, via evaporation etc. Objectionable odour. Contamination of water, soil from toxic chemicals. Contaminants may be toxic to flora and fauna. Contamination of other products such as rags etc. Potential fire or explosions.	Minimise production of waste through planning and good work practice. Include ventilation and treatment systems for air contaminants in facilities used for fibreglass related activities. Localise or isolate high emission and hazardous waste producing activities. Store in covered, bunded facility with at least 110% capacity bunding. Install spill containment infrastructure. Do not allow mixing of hazardous and non hazardous materials. Ensure waste chemicals and contaminated materials such as rags are collected and disposed of appropriately.
Biological waste Fish and other waste from processing and packaging. Organisms from anti fouling maintenance.	Visual amenity, air, water, flora, fauna.	Degrade visual amenity, create odour. Increase nutrient loading in marina waters which may inturn impact on flora and fauna. Create pest issues.	Fish and other related biological waste may be able to be reused in other processes such as fertilizer / feed production. Contain fish and other waste in sealable containers and dispose of to appropriate facility daily or as required. Prohibit disposal to waters also prohibit disposal of waters contaminated with biological waste to marina waters.

Material	Environmental value	Potential impacts	Management options
Oil / fuel / residues From service, repair, maintenance and other industrial processes.	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Contaminate marina waters and / or sediment. Kill / injure flora and fauna via toxicity. Bioaccumulation and health and safety issues.	Ensure facilities have spill containment infrastructure (e.g. triple interceptors).
Chemical wastes Anti-fouling, cleaning and other industrial chemicals, adhesives, glues, etc.	Air, water, soil, flora, fauna.	Release to air of toxic substances including vapours from mixing or via evaporation etc. Objectionable odour. Contamination of water, soil from toxic chemicals. Contaminants may be toxic to flora and fauna. Bioaccumulation issues. Potential fire or explosions.	Minimise production of waste through planning and good work practice. Include ventilation and treatment systems for air contaminants in facilities. Localise or isolate high emission and hazardous waste producing activities. Store in covered, bunded facility with at least 110% capacity bunding. Install spill containment infrastructure. Do not allow mixing of hazardous and non hazardous materials. Ensure waste chemicals and contaminated materials such as rags are collected and disposed of appropriately.

Material	Environmental value	Potential impacts	Management options
Sewage grey water / black water Sewage from site facilities.	Visual amenity, air, water, flora, fauna.	Degrade visual amenity. Objectionable odour. Contaminate marina waters. Increase nutrient loading in marina waters. Kill / injure flora and fauna via toxicity and eutrophication. Health and safety issues.	Ensure facilities are connected to town sewer system or onsite wastewater treatment system. Ensure pump out facilities are controlled and bunded as to minimise spillage. Ensure correct fittings are used when pumping into pump out facilities.
Timber Wood products used in repair and maintenance of vessels and in various industrial processes, pallets, formwork, etc.	Visual amenity, soil, water, flora, fauna.	Degrade visual amenity. May be contaminated with other chemicals from repair or maintenance works. Potential for contaminants to be released to waters and soil. Contaminants may be toxic to flora and fauna.	Minimise waste timber through good work practice and planning. Reuse timber where possible. Recycle uncontaminated timber products. Do not mix uncontaminated and contaminated timber waste. Dispose of contaminated timber products appropriately.

Material	Environmental value	Potential impacts	Management options
Paint Paint used in repair and maintenance of vessels.	Air, water, soil, flora, fauna.	Release to air of toxic substances including vapours from mixing or via evaporation etc. Objectionable odour. Contamination of water, soil from toxic chemicals. Contaminants may be toxic to flora and fauna. Bioaccumulation issues. Potential fire or explosions.	Minimise production of waste through planning and good work practice. Include ventilation and treatment systems for air contaminants in facilities. Do not allow painting in harbour waters, where painting is required vessels should be in dry dock and appropriate controls in place. Localise or isolate high emission and hazardous waste producing activities. Store in covered, bunded facility with at least 110% capacity bunding. Install spill containment infrastructure. Do not allow mixing of hazardous and non hazardous materials. Ensure waste paint and contaminated materials such as rags and brushes are collected and disposed of appropriately.
Glass Sheet glass, screens bottles and containers.	Visual amenity.	Degrade visual amenity.	Reuse containers, sheets etc where possible. Provide glass recycling receptacles for industrial users. Provide commingled recycling facilities that can accept glass for public use.

Material	Environmental value	Potential impacts	Management options
Batteries Lead acid and other batteries from vessels and other machinery used in the industrial processes at the site.	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Contamination of water, soil from toxic chemicals. Contaminants may be toxic to flora and fauna. Bioaccumulation issues.	Provide battery disposal facility for the marina or ensure waste management contractor is available to collect batteries as required. Store batteries in covered bunded facility prior to removal to battery recycling facility by appropriate waste contractor.
Commercial – Retail, administration, restaurants, etc.			
Paper Food packaging, wrapping, other product packaging, office paper, etc.	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Not readily biodegradable. Potential leaching of contaminants to water and soil. Contaminants may be toxic to flora and fauna.	Minimise packaging in service and select products for use / sale with minimal packaging. Provide paper recycling facilities to commercial premises. Provide public place recycling facilities. Ensure waste receptacles have sufficient capacity and are emptied as frequently as required.
Plastic Packaging, bottles, other containers, wrapping, etc.	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Not readily biodegradable. Potential leaching of contaminants to water and soil. Contaminants may be toxic to flora and fauna. Kill / injure fauna via entanglement, entrapment, ingestion.	Minimise plastic waste in service, use / sell products with minimal plastic packaging. Select / use / sell products with recyclable / reusable plastic. Provide plastic recycling receptacles to commercial clients. Include public place recycling receptacles to fit with local recycling practice.

Material	Environmental value	Potential impacts	Management options
Glass Glass bottles, jars, etc.	Visual amenity.	Degrade visual amenity.	Provide glass recycling receptacles to commercial premises. Include public place recycling receptacles to fit with local recycling practice.
Metals Aluminium drink cans, other food cans, etc.	Visual amenity, water, soil, flora, fauna.	Degrade visual amenity. Potential leaching of contaminants to water and soil. Contaminants may be toxic to flora and fauna.	Provide recycling receptacles to commercial premises. Include public place recycling receptacles to fit with local recycling practice.
Food waste Left over food from restaurants and other services.	Visual amenity, air, water, flora, fauna.	Degrade visual amenity, create odour. Increase nutrient loading in marina waters which may inturn impact on flora and fauna. Create pest issues.	Minimise production of food waste through good work practice and planning. Provide food waste receptacles to commercial premises such as restaurants. Ensure sufficient waste receptacles are located in public areas and ensure these are emptied as required.
Sewage grey water / black water Sewage from toilets, showers, sinks, kitchens and other facilities.	Visual amenity, air, water, flora, fauna.	Degrade visual amenity. Objectionable odour. Contaminate marina waters. Increase nutrient loading in marina waters. Kill / injure flora and fauna via toxicity and eutrophication. Health and safety issues.	Ensure facilities are connected to town sewer system or onsite wastewater treatment system.

Material	Environmental value	Potential impacts	Management options
Mixed waste Mixed waste of which no one material comprises 50% or more of the load, e.g. paper and plastic packaging etc.	Visual amenity, air, water, soil, flora, fauna.	Degrade visual amenity, create odour. Potential leaching of contaminants to water and soil. Potential to increase nutrient loading or waters, eutrophication. Contaminants may be toxic to flora and fauna.	Minimise mixed waste by providing and promoting recycling opportunities for both commercial premises and in public places. Provide separate receptacles for commercial premises and public. Ensure receptacles have lids, have sufficient capacity and are emptied as required.
Timber Wood products used in industrial processes, pallets, etc.	Visual amenity, soil, water, flora, fauna.	Degrade visual amenity. May be treated with chemicals. Potential for contaminants to be released to waters and soil. Contaminants may be toxic to flora and fauna.	Minimise waste timber through good work practice and planning. Reuse timber where possible. Recycle uncontaminated timber products. Do not mix uncontaminated and contaminated timber waste. Dispose of contaminated timber products appropriately.

[1] Runoff from high pressure cleaning (using water), unlike material from abrasive blasting, is often not associated with contamination of harbour waters and sediment; however this pathway may be a significant source of contaminants in harbour waters and sediment (Johnsen, A. and Engoy, T.)

3.14.4 Mitigation measures

Shipping and Boating

The waste facilities catering for shipping and boating (commercial and recreational), should be able to receive MARPOL 73/78 Annex V wastes (garbage) and Annex I wastes (waste oil and oily mixtures) as well as being capable of handling any other wastes in the quantities that would normally be handled or discharged (e.g. by a fleet of 50 trawlers and 40 potential recreational berths / pile moorings).

Management options for shipping and boating wastes for both commercial and recreational users are described below.

In the absence of any specific guidelines for marinas within Queensland, these management measures have been based on the ANZECC (1997) *Strategy to Protect the Marine Environment – Best Practice Guidelines for Waste Reception Facilities at Ports, Marinas and Boat Harbours in Australia and New Zealand*.

Solid Waste

- For general solid waste including galley waste specific receptacles are required. The location of receptacles should be accessible for both clients, marina personnel and removal contractor. Typically mobile garbage bins at the end of each pier of the marina would be required. In addition, receptacles at any public boat ramp and car and boat parking area would be required. Furthermore these facilities should be accessible to users of pile moorings;
- The sizing of bins would be dependent on the contractor however it is likely that the sizing would be one of the following:
  - 1 m^3 steel skip bins;
  - 240 L mobile plastic garbage bin (“wheelie bin”);
- Receptacles for all types of waste received at the facility should be clearly labelled and sign posted. Furthermore waste storage areas should be designed so that wind and pests including birds and other animals cannot cause spreading of waste and disease;
- Information on the correct use of each facility should be displayed and readily visible on signs at the containers or receptacles;
- Additional facilities should be provided for recycling and/or reuse of suitable materials including glass, aluminium and steel, paper, plastic and batteries. Appropriate facilities may include:
  - Centralised recycling area, where marina users can segregate their recyclable material; or
  - Co-location with general solid waste (garbage bins) for non hazardous recyclables;
  - Considering the Townsville Regional Council already operates a two bin system with a separate receptacle for recycling, it would be appropriate for the marina operators to fit into this system, as such, a separate receptacle for commingled recyclables (paper, plastic, glass, cans) would be recommended;

- Spare bins should be available to ensure there is always backup capacity;
- Procedures should be put into place with the selected waste management contractor for unscheduled collection in the event that receptacles become full; and
- People who have caught fish should be encouraged to take fish home to clean or an appropriate cleaning facility should be provided.

Liquid Waste

The provisions of liquid waste reception facilities should consider the following:

- Type of liquid waste being received, any risk associated with the storage combinations of liquid wastes, segregation where necessary;
- Use of standard fittings, with adaptors where necessary;
- Treatment and disposal methods;
- Transport access; and
- Statutory approvals to store and operate.

In addition reception facilities for sewage specifically need to consider the following:

- Type of sewage, namely; septic sewage, sullage, galley waste, chemical toilet sewage, grey water, sludge from anaerobic treatment systems;
- Frequency of use and necessary capacity;
- Constraints of the receiving sewage treatment systems such as maximum daily delivery rates;
- Limitations of sewage transfer such as pump capacity and pumping rates;
- Minimisation of odour releasee to the surrounding environment;
- Protection from accidental spillage during waste transfer; and
- Provisions of a freshwater hose for flushing out vessel sewage holding tanks.

A number of options are available for the reception of liquid waste (including sewage) at the marina, including:

- Direct discharge of sewage to onsite storage tanks in a centralised location via the use of pumping systems for treatment or storage prior to discharge or removal by an appropriate waste contractor. In addition this should include a centralised recycling station for waste oil and grey water, solvents and thinners;
- Discharge directly into the local sewage system; and
- Direct removal by a waste management contractor via sucker truck.

A combination of these options is likely to be required, which may involve direct removal by a waste management contractor via a sucker truck for trawling vessels and removal to a storage or treatment facility for recreational vessels.

For non-sewage liquid waste typical treatment includes a settling tank or pit, which may double as a flow equalisation tank, followed by a corrugated plate interceptor then a filter designed to suit the specific waste types encountered. Discharge may be to sewer or via a waste management contractor.

Commercial and Industrial Operations

Waste management at the commercial and industrial facilities at the marina including boat building, maintenance, repair facilities, restaurants and seafood processing or markets must comply with the regulations outlined in the Waste EPP and detailed in section 2.1.2 of this report. The operators of these facilities should adopt the objectives of the legislation into their operation and waste management practices. Specifically these facilities should adopt processes that achieve alignment with the waste management hierarch, which is as follows;

- Waste avoidance;
- Waste re-use;
- Waste recycling;
- Energy recovery from waste; and
- Waste disposal.

Specifically boat building, maintenance, repair and cleaning should be conducted only in designated area so as to optimally manage associated solid and liquid wastes. The following guidelines are provided as a means to minimise environmental impacts associated with wastes from maintenance, repair and cleaning:

- Maintenance work should be performed inside buildings or under cover where possible, to reduce contamination to stormwater;
- All maintenance activities should be performed over impenetrable surfaces that are properly drained to a collection facility to prevent contaminated or toxic materials entering the waters;
- Abrasive blast cleaning (eg sand blasting) should be performed within spray booths or suitable enclosures so all wastes and residues can be contained, collected and properly disposed of;
- High pressure water cleaning should also be performed within a controlled environment and waters from the process should be collected and treated. Washing of hulls on land by mechanical scraping is preferable to high pressure water cleaning as it can produce wastewater contaminated with marine organisms, hull paint and fragments of hull material. High pressure systems must only be used where proper collection, treatment and disposal facilities are available;
- Vacuum sanders and grinders should be used to minimise potentially polluting dust where possible;
- Boat cleaning should be performed in a way that minimises release of marine organisms and harmful paints into waters;
- Chemicals should be kept in a secure area and each container labelled clearly to make disposal and possible recycling easier;
- Areas used for storage of chemicals including paints should be covered and bunded to contain spills;
- Recycling of chemicals such as oils and solvents should be encouraged with remaining unwanted chemicals being disposed of to an appropriate facility or removed by an

appropriate waste management contractor;

- Spill plans should be developed and appropriate spill response kits should be stored and kept easily accessible;
- Appropriate legislative requirements in relation to the use and storage of chemicals should be adhered to in the design and operation of the marina area;
- Recycling facilities should be included and should fit with existing recycling program for commingled recycling. Recycling of batteries, fluorescent globes, etc should be conducted and appropriate waste management contractors should be engaged for collection; and
- Consideration should be given to access to waste and recycling receptacles by waste management contactors.

Wastes associated with seafood processing and packaging specifically include expanded polystyrene containers, cardboard boxes, shrink wrap, packing tape and other plastic products. There are various opportunities for reuse and recycling of these products which should be investigated with regard to the specific types, quantities and quality (e.g. contamination) of the wastes produced. Where possible existing recycling programs should be utilised.

3.15 Cultural heritage

3.15.1 Description of environmental values

3.15.1.1 Background

The proposed TMPP includes reclamation of approximately 34 hectares of land at Lot 773 adjacent to Benwell Road. The Precinct development area consists of a narrow strip of reclaimed land (Benwell Road beach) and sub-tidal areas at the mouth of Ross River.

The most notable feature of the development areas for the TMPP is the very high level of past disturbance and landscape/seascape modifications that date back to the earliest days of the European settlement of Townsville (circa 1864).

Appendix Y provides a history of the development of the ‘Townsville Harbour’, which illustrates the dramatic alterations to the natural environment (and the cultural landscape) of this section of the Townsville coastline and its waterways (refer Taylor 1980 for a detailed history of the Townsville Harbour).

In brief, in 1864, upon the European settlement of Townsville, Melton Black selected a site on Ross Creek for a harbour. At this time, a sand bar at the mouth of the creek and a rock bar inside the creek allowed only shallow vessels to navigate the creek channel (Pringle 1989). In the 1870s the need for a port at Townsville became urgent with the opening of the western goldfields. As early as 1871 major works were being undertaken at Ross Creek to remove rocks from the bed of the creek to make it navigable for vessels (Taylor 1980:25). In 1883-84 the first dredging of the Townville Harbour was undertaken.

Dredging has been carried out to maintain Townsville’s navigation waterways for over 100 years (SKM 1991:22). Pringle (1989) has carried out a detailed investigation of the long-term effects of dredging in Cleveland Bay (and especially at the Townsville Port) and notes that the history of dredging in Cleveland Bay is closely linked to the development of the Port of Townsville.

Pringle (1989) has reported that near the Ross River mouth large scale coastal changes have taken place and these are directly linked to dredging. A detailed investigation of recent coastal processes in the vicinity of the mouth of Ross River is provided under Section 3.8 of this EIS.

Benwell Road beach at Lot 773 (in the TMPP development area) is currently a narrow sandy beach with extensive mudflats exposed at low tide. Near the Port entrance on Benwell Road the shoreline is lined with mangroves which have colonised the area in relatively recent times. Benwell Road beach is a popular recreational area for local South Townville and Railway Estate residents and it is known to be a good area for collecting yabbies and bait. Social uses of the area are addressed in detail under Section 4 of this EIS.

The beach is reclaimed land that is permanently leased to the Port for port-related uses. It is designated as Strategic Port Land in the Port Land Use Plan. Tenure of Lot 773 is addressed in detail under Section 3.2 of this EIS. This beach was planned for redevelopment by the Port in the 1990s, but was not required at that time. Port of Townsville has allowed continued public access to the beach area until such time as the land is required - it is now required as part of the proposed TMPP.

Analysis of historical aerial photographs of the Port and the Benwell Road section of coastline dating from 1941 to 2007 shows that the existing Benwell Road beach did not exist prior to 1977 (Refer Appendix Y). In the 1941 and 1964 aerial photographs this area comprised extensive sand and mudflats on the western side of the mouth of Ross River. What appear to be some vegetated sand dunes or beach ridges near the mouth of the river (refer Figure 6 in Appendix Y) are no longer in existence. If these coastal deposits were in fact sand dunes or old beach ridges they might possibly have contained intact Aboriginal archaeological sites and remains.

By 1977 reclamation works had begun with much work conducted between 1964 and 1977 (Figures 7 and 8 in Appendix Y). Overall, the evidence from the aerial photographs illustrates that between 1941 and 2007 there have been dramatic changes to the configuration of the coastline near the mouth of Ross River and along the coastline that now forms the Benwell Road beach.

The high level of previous disturbance and landscape/seascape modification within the POTL project areas has important implications for archaeological and cultural heritage potential. These implications are discussed in detail following.

3.15.1.2 The Aboriginal cultural landscape

Approach and Methodology

Unfortunately, there are few detailed specific references to Ross Creek and Ross River in the ethnographical literature, and by necessity the following literature review refers to the broader Cleveland Bay coastline and the immediate Townsville coastal plain.

This literature review attempts to place the Ross River project area in the context of the wider Aboriginal cultural landscape of Townsville (Gurambilbarra). Before the European settlement of Townsville in 1864, the Aboriginal Traditional Owners occupied a vast area across the Townsville coastal plains. The existing Shire boundaries in the region are of course modern constructs, which are not particularly relevant to traditional Aboriginal territories, clan group boundaries and Aboriginal subsistence and settlement patterns.

Background ethnographical and anthropological information derives from extended research by

Nicolaas Heijm (Segue Pty Limited). Heijm's anthropological research in the Townsville region began in 1990. To the present, it has covered the bulk of ethnographic and oral history material dealing with the Murri (Aboriginal) society of the region. He has searched the correspondence files of the Queensland Colonial Secretary, the Queensland Aboriginal Protectorates and other records at Queensland State Archives, as well as the 19th century Townsville newspapers (including the Port Denison Times, Cleveland Bay Express, Cleveland Bay Herald, Townsville Herald, North Queensland Herald, Townsville Daily Bulletin and others). Heijm's research has included several dozen anthropological fieldtrips in the greater Townsville region (including Palm Island), which have involved standard anthropological participant observation methodology and directed oral history interviews with Aboriginal Elders and others.

Aboriginal History and Ethnography

An Historical Sketch of Townsville (Gurambilbarra)

As there are few detailed specific references to Ross Creek and Ross River in the ethnographical literature, a literature review was undertaken to support this study for the broader Cleveland Bay coastline and the immediate Townsville coastal plain. The review is provided in detail in Appendix Y. Key points are summarised following.

The Ross River study area is part of a traditional country called Gurambilbarra in the Townsville language[15]. Its name is derived from Gurambil, the language name of Cape Pallarenda, and can be translated as "people of Cape Pallarenda". The reference to Cape Pallarenda in the name is metonymic, for Gurambilbarra includes the catchment basins of the Ross and Black Rivers and extends inland as far as the Hervey Range and eastwards to include Magnetic Island. The Cape was the main living place of the area before the European settlement of the region. Historical records, among them Dalrymple (Dalrymple and Smith 1860) and Rowe (1931), indicate that a large number of people lived at Gurambil before the founding of Townsville in 1864.

Price's wordlists of 1885 provide local Aboriginal language names for areas located within or immediately adjacent to the TMMP. Relevant language names as follows (the phonemic transcriptions in brackets were produced by N. Heijm):

- Ross Creek "Cal'ghimg'a" (Galgimga);
- Ross River "Cal'bee'dee'ra" (Galbidira);
- Ross Island "Muth er'el" (Madhil); and
- Magazine Island "Go-Your" (Guyur).

Captain Cook's expedition of 1770 provides the earliest documented reference to Aboriginal people at Townsville. Our knowledge of the Aboriginal use of the shores of Cleveland Bay will now always be limited by the destruction of much of the prehistoric archaeological record of the area (cf. Kennedy 1947, 1948). However, documentary and ethnographic data show the area was an important part of a foraging territory that included Cape Pallarenda, the dunes, flats and

[15] The "Townsville language" might be thought a perverse way of referring to a language considerably older than the city. But although we know about names of particular dialects, no name has been recorded for the regional language as a whole, neither of the names that have historically been attached to it, neither "Coonambella" (in Price 1885) nor "Wulgurukaba" (in Tindale 1974), are proper language names. It is quite possible the language had no proper name. In the absence, a more descriptive but more cumbersome label might be the "the Palms Islands-Magnetic Island-Ross and Black River language" but for the purposes of this report, the "Townsville language" keeps things simple.

shores of the Town Common area and the riverine habitats of the Ross and Black River corridors. It further included Magnetic Island: the first European settlers observed a steady traffic of people canoeing over from the Cape to forage the island's rich resources[16].

The Traditional Owners of Townsville are placed in their country through the creation story of Gabul, the Carpet Python, for whom the central place or site on the Townsville mainland is the Ross River.

According to Heijm's anthropological research, the Ross River formed an important track of Gabul. Heijm's account of the Gabul myth cycle for the Herbert River and Ross River areas is outlined in summary in Appendix Y. The Gabul story recounts the travels of Gabul or Carpet Python down the Herbert River, through the Hinchinbrook channel to what are now the islands of the Palm group and Magnetic Island, and up the Ross River. The Gabul myth cycle highlights the point that the Ross River forms a significant and integral part of the Aboriginal cultural landscape, in a broad area of the coastline extending from the Herbert River to Townsville.

The Founding of Townsville and Early Settlement History

Early in November 1864 the partnership of Robert Towns and John Melton Black set in motion their plans for the construction of Townsville. On 5 November, Black and a work party of sixteen men arrived at Cleveland Bay (Black 1865). Actions taken to effect establishment of a new town resulted in conflict between the Europeans and Traditional Owners. Examples of some of the conflicts are provided in Appendix Y.

In the first decades of Townsville's existence, Kissing Point seems to have marked a frontier between the town and the quarter to which Aboriginal people were restricted. The city's first municipal boundary in fact ran just north of Kissing Point; joining the coast at Rowes Bay in the vicinity of the present Rowes Bay Caravan Park. The boundary had been gazetted early in 1866, a few months after the first buildings went up (Gibson-Wilde 1984:63).

In 1869, the first move to "letting them in" was made when a party of prominent "gentleman of Townsville" ventured to make peaceable contact with the Cape Pallarenda people. Their efforts reflected a shift in the character of the frontier engagement from open hostility to bringing Aboriginal people onto the stations.

Murri people paid several visits to Townsville in the weeks that followed. In June 1869 about 100 Murri people from "Dotswood and Hinchinbrook[17]" arrived on Ross Island. There they consulted with people "on the beach" before crossing to the mainland where they began to appropriate such items of European material culture as took their interest. Concerns regarding their inappropriate dress and incidents of theft, particularly of cattle, ensued. The Townsville Council was still attempting to restrict the entry of Aboriginal people into the town more than a decade later.

After about 1885, there are regular reports of Aboriginal people living along the shores of Cleveland Bay. Kissing Point appears to have remained one of the main living and meeting

[16] The canoe of the region, called a *wulguru* was constructed of three strips of bark sewn together with lawyer cane. The design enabled covering fairly large distances – say those between Kissing Point and the Palm Islands – by riding tidal currents.

[17] Presumably not Hinchinbrook Island, but from the area of Hinchinbrook Station inland from the southern half of Halifax Bay.

places. A detailed account of a review of the literature supporting this notion is provided under Appendix Y.

Around 1890 a new living place was established at Rowes Bay between Jason and Mundy Creeks. It is likely that military operations at Kissing Point, which began in earnest in 1889, pushed people out to Rowes Bay. The new camp was in a good spot for foraging, particularly for the "black prawn" and Burdekin Plum that occurred there, but the Town Common and the shores of Rowes Bay and Cape Pallarenda continued to be used. Cape Pallarenda was a favoured spot for oyster collecting and Shelley Beach, on the northern shore of the Cape, for spear fishing. Initially the Rowes Bay people had used gunyas - huts constructed of a framework of cane arches thatched with grass. In subsequent decades, they began to use sheet metal attached to timber frameworks, producing the humpy style of accommodation. The Rowes Bay people treated their camp as an exclusive area and allowed few whites into its inner precincts. Conversely, the people from the camp rarely ventured into the central part of Townsville although some of the children eventually attended Belgian Gardens State School.

In 1893 an additional camp was established on Castle Hill (North Queensland Herald, 22 February 1893). It was located above the present day Stagpole Street until cyclone Leonta destroyed it in 1903. The people who were living there are said to have moved to Rowes Bay at that time. By then the Rowes Bay camp had probably become the largest in Townsville (Townsville Daily Bulletin, 25 December 1902). It was arranged along a spit that in those days extended northwards from Kissing Point and was separated from the main shore at Rowes Bay by a mangrove swamp in the outlet of Jason Creek. The mangroves provided seclusion and enabled residents to control entry to the camp.

Oral history reports suggest that the population at the Rowes Bay camp began to decline after about 1920. Some reports attribute this decline to the influenza epidemic of 1919. This is certainly possible, but no records of the effect of the epidemics in the Townsville region have yet been found. Records show that areas adjacent to Townsville were affected. A major factor for the decline was probably the Queensland Government's regime of forcibly "removing" people not employed by Whites under employment "agreements", mostly to the settlements at Yarrabah and Palm Island.

Highland (1993) notes that Ross Island was a long-standing Aboriginal encampment area predating the 1920's. Highland notes that by 1889 there were two main living camps on the fringes of Townsville – one at North Ward and the other at Ross Island. Langan (n.d.) reports that from about 1868 there was a large native encampment on Ross Island and that the blacks in that area were in the habit of regularly visiting other tribes who lived at Rowes Bay and Cape Pallarenda. He reports that there was a rocky bar across Ross Creek and at low tide the local Aboriginal people used it as a crossing place.

The Aboriginal archaeological record

Cultural Heritage Register and Database Searches

A search of the Queensland Department of Natural Resources and Water (NRW) Cultural Heritage Register and Database is an established procedure for cultural heritage investigations in Queensland, and it is one of the criteria for addressing the Cultural Heritage Duty of Care Guidelines under the ACHA.

In response to the search request for POTL lands, the NRW advised the following:-

"…….no Aboriginal cultural heritage is recorded on the Cultural Heritage Database and Register in your specific search area, from the data provided by you. However, it is probable that the absence of recorded Aboriginal cultural heritage places reflects a lack of previous cultural heritage surveys of the area. Therefore, our records are not likely to reflect a true picture of the Aboriginal cultural heritage values of the area".

"All significant Aboriginal cultural heritage in Queensland is protected under the Aboriginal Cultural Heritage Act 2003, and penalty provisions apply for any unauthorised harm. Under the legislation a person carrying out an activity must take all reasonable and practical measures to ensure the activity does not harm Aboriginal cultural heritage. This applies whether or not such places are recorded in an official register, and whether or not they are located in, on or under private land".

"Aboriginal cultural heritage which may occur on the subject property is protected under the terms of the Aboriginal Cultural Heritage Act 2003, even if Natural Resources and Water has no records relating to it".

Searches were also carried out of Federal cultural heritage registers and databases, including the Australian Heritage Database and the Register of the National Estate. There are no listings on the Australian Heritage Database for the POTL project areas. The search results are presented in Appendix Y.

The Register of the National Estate contains one listing for the "Ross River to Alligator Creek Coastal Area". This area is listed as an 'Indicative Place' based on its 'Natural Values'. Cultural values are not included in this listing. The "Ross River to Alligator Creek Coastal Area" is located outside the boundaries of the TMPP. However, the northern boundary of this 'Indicative Place' (on the east bank of the Ross River) lies immediately adjacent to the Marine Precinct development area. The listing includes "about 3,880 hectares comprising the coastal plains east-south-east of Townsville from the south bank of Ross River to the west bank of Alligator Creek, and including the area along the coast to 1 km offshore". The listing also notes "Ross River south bank is an important wildlife habitat".

Previous Archaeological Research

Much of the following information relating to the Aboriginal archaeology of the Townsville region has been sourced from unpublished consultancy reports for Environmental Impact Studies or related impact assessment projects (eg: for infrastructure development such as roads, powerlines, pipelines, residential subdivisions, industrial developments, mining, coastal reclamation works, etc). A detailed review of some relevant archaeological research is provided in Appendix Y and was undertaken to provide a contextual and chronological framework for the current investigation for the TMPP (see also Bird and Heijm 2007). A summary of key findings follows.

Archaeological research in Townsville over the past two decades has recorded a diversity of Aboriginal archaeological sites, including shell middens, stone artefact scatters, rock shelters with paintings and cultural deposits, scarred trees, stone quarries, ceremonial places and burial sites. By far, the most common Aboriginal archaeological sites are coastal and estuarine shell middens and low-density stone artefact scatters. The results of many archaeological investigations clearly show that coastal beach ridges and hinterland granitic outcrops have the highest archaeological potential of all landforms in the wider Townsville region.

Several previous archaeological investigations provide a chronological framework for the Aboriginal occupation of the Townsville coastal plain. So far, the majority of the known (coastal) Aboriginal archaeological sites date to within the last 1,000 years. However, several hinterland sites (rock shelters with intact well preserved cultural deposits) have revealed basal dates for Aboriginal occupation approaching 4,000 years BP.

A highly significant Aboriginal cultural heritage site has been recorded at Sandfly Creek (on the Cleveland Bay coastline to the south of Ross River). Archaeologists first recorded the Sandfly Creek Aboriginal burial ground in the early 1990's. Hatte (1994) recorded at least ten human burials eroding from secondary sand dunes along an old Holocene shoreline south of Ross River. The burials were associated with other cultural material including shell, stone artefacts, stone manuports and hearthstone. Following Hatte's preliminary study, Bonhomme and Craib (1995) attempted to determine the full extent of the burial site by using ground-penetrating radar to detect possible sub-surface deposits of bone. The results of this latter work proved inconclusive.

In March 2004 a cultural heritage study was carried out at the proposed Happy Valley Reserve for Aboriginal Purposes (Bird, Heijm and Hatte 2004). This Reserve is located some 4 km northwest of Ross Creek and Ross River. Local Aboriginal people have used Happy Valley as a camping place for almost a century (in conjunction with the historical camps at Rowes Bay). Today, at any one time there may be between 30 and 100 people living on the site.

While the cultural heritage survey at Happy Valley did not locate any archaeological evidence for the prehistoric Aboriginal occupation of the area, anthropological research revealed that this location has continuing high socio-cultural significance to local Aboriginal people (Bird, Heijm and Hatte 2004).

The cultural significance of Happy Valley is particularly relevant to the current investigation at POTL, as it highlights that there are enduring (complex and integrated) indigenous cultural values along this sector of the Cleveland Bay coastline (incorporating Ross Creek, Ross River, Rowes Bay, Kissing Point and Cape Pallarenda). Bird and Heijm’s recent (2005) cultural heritage report regarding the Aboriginal cultural heritage values of Kissing Point (Garabarra) provides further confirmation that the Cleveland Bay coastline has an enduring cultural significance to Aboriginal Traditional Owners.

Detailed cultural surveys along the channel of Ross River were carried out in 2003 for the (then) Thuringowa Council’s Riverway Project (Bird 2003a). While the cultural surveys did not locate any tangible Aboriginal archaeological sites on the riverbanks, the Traditional Owners reported that the river maintains a high level of cultural significance to them. While landscape disturbance and modification since European settlement have greatly altered the natural landscape along the river channel, the cultural significance of the river to the Traditional Owners has not diminished (Bird 2003a). Both archaeological and ethnographic records indicate that major watercourses such as Ross River were focal points for Aboriginal subsistence and settlement, in the immediate post-contact and settlement period. In pre-contact times there is no doubt that Ross River and Ross Creek would have provided a plethora of natural resources, playing an important role in the local Aboriginal economy and subsistence cycles.

In October 1999 Bird undertook cultural surveys for the proposed Townsville Port Access Road

Project (Eastern Transport Corridor) by the Department of Main Roads (Bird 1999). The development corridor traverses Heleen Downs Station (Collinta Holdings) and sections of the east bank of Ross River. Three Aboriginal cultural sites were located, including a low-density shell scatter, a small scatter of stone artefacts and a small cluster of bone (the latter has since been confirmed as macropod bone, rather than human bone). All of the recorded sites were found on the beach ridges on the eastern side of Ross River. The shell scatter contained several shell species including *Telescopium telescopium, Nerita sp., Terebralia sulcata* and *Anadara sp*. Most of the shell was heavily fragmented. A single small flake of milky quartz was associated with the shell, scattered around the base of a large Burdekin plum tree.

Despite a general paucity of Aboriginal cultural remains, there was clear evidence in the form of shell scatters and stone artefacts that Aboriginal people occupied this area. Importantly, the surface archaeological evidence recorded near the mouth of Ross River is similar to the type and density of surface archaeological remains originally discovered at Sandfly Creek. The discovery of the extensive archaeological deposits at Sandfly Creek (including human burials) was made following clear and grade operations in preparation for sand mining. Hatte (1994) notes that the main cultural deposit at Sandfly Creek was buried within the beach ridge system, some 30 to 50 cm below surface level.

During the Port Access Road cultural heritage study, some oral history was recorded from Aboriginal Elders regarding the use and occupation of the coastal plains east and south of the Ross River (Bird 1999). There is surviving oral history to indicate that in post-contact times some Aboriginal camps were located under the large mango trees lining Stuart Creek. Some senior Traditional Owners noted that lagoons and wetlands on the coastal plains south of Ross River once had a plethora of food and other natural resources that were targeted and exploited by Aboriginal people (see also Bird 2006). The east bank of Ross River was reported to be a ‘well known place’ for collecting oysters.

In summary, and to reiterate the results of archaeological research round Townsville, the coast and immediate hinterland were a focus for Aboriginal activity, at least in the late Holocene period (over the last 4,000 years BP). There is increasing archaeological evidence to indicate that Aboriginal people targeted certain landforms for subsistence activities and occupation sites, including coastal beach ridges and sand dunes, major and/or reliable watercourses, and hinterland granitic rock outcrops and shelters. Archaeological research confirms that relict coastal beach ridges commonly contain Aboriginal shell middens, stone artefact scatters, hearth areas and sometimes, human burials. Rock shelters and overhangs often contain rock paintings (usually in red ochre) and cultural deposits (often with human burials). Both major and ephemeral watercourses tend to have archaeological evidence for campsites in the form of hearths and low-density stone artefact scatters. Highly disturbed areas on the Townsville coastal plain have frequently been found to contain very little intact or surviving archaeological evidence for Aboriginal occupation, given the prolonged and intensive European settlement of the region.

3.15.1.3 Site Inspection of the TMPP area

The literature review, provided in detail in Appendix Y and summarised above, highlights the fact that a diversity of Aboriginal archaeological sites has been recorded along the coastal fringes of Cleveland Bay, and in areas surrounding the proposed TMPP in Ross River. At this stage, a systematic archaeological survey of the TMPP area has not been undertaken and consultation with the Aboriginal Parties has generally indicated that a further cultural field inspection (in addition to the site inspection on 24 July 2008) is not warranted.

The majority of the TMPP development area is sub-tidal, inter-tidal or reclaimed land (Benwell Road beach). Based on the available geomorphological evidence and the history of Townsville Port reclamation works, the coastal beach deposits along this narrow strip of coast can reasonably be expected to be no more than a few decades in age. On this basis, there is no expectation that prehistoric Aboriginal archaeological sites will be located along this section of very recent coastline.

The only possible archaeological potential of the coastal deposits might be for historical archaeological sites. The term 'historical' is used very tentatively in this regard as it would seem unlikely that sites or relics more than a few decades in age will be located within these very recent (reclaimed) deposits.

Cursory inspection of the Benwell Road beach with the Aboriginal Parties on 24 July 2008 revealed that the narrow coastal fringe has dense cover of grasses and coastal dune vegetation such as *Ipomoea pes-caprae* (goat's-foot convolvulus). Vegetation of this area is discussed in greater detail under Section 3.10.4 of this EIS. Even if cultural (surface) surveys were attempted in this area (to assess the possible potential for historical archaeological sites), there is negligible to zero ground surface visibility at the current time. This was confirmed during a further recent site visit to Benwell Road beach by the project archaeologist on 23 January 2009.

The predicted cultural heritage and archaeological potential of the TMPP is further considered in the section below. It must be noted that based on the available geomorphological, historical and environmental evidence the project archaeologist has assessed the overall prehistoric archaeological potential of the development areas as negligible (with the exception of the east bank of Ross River in areas above highest astronomic tide [HAT]).

While the potential for historical archaeological sites in the development areas might also be reasonably assessed as low, the issue of cultural monitoring for existing land areas (Benwell Road beach and east bank of Ross River) during development works is considered below.

3.15.1.4 Aboriginal cultural values of the TMPP

Identified Aboriginal Cultural Values

This cultural heritage study has provided clear evidence that the Cleveland Bay coastline, including the TMPP project area at Ross River, have significant Aboriginal cultural heritage values. This evidence comes from various sources including ethnography, ethnohistory, anthropology, oral history, the (surrounding) Aboriginal archaeological record, and most importantly, from the Aboriginal Traditional Owners themselves.

This cultural heritage investigation has found that the enduring Aboriginal cultural heritage values of the TMPP area are as follows:-

- The TMPP project site is part of Gurambilbarra traditional homelands. Both the land and sea country in the project areas remain significant components of the Aboriginal cultural landscape of the greater Townsville region. The Traditional Owners (Aboriginal Parties) retain an enduring 'connection to country'. They describe the project area as having immeasurable cultural and spiritual values. Their 'connection to country' has not diminished despite the historical dispossession of land and sea country, and despite the dramatic alterations to the physical configuration and the cultural integrity of the landscape since European settlement;

- Ross River has an Aboriginal language names – "Cal'bee'dee'ra" (Galbidira) (after Price 1885 with phonemic transcriptions by N. Heijm). This language name is in itself of significant heritage value as very few language names survive for local landforms and landmarks in the Townsville region;
- Ross Creek and Ross River are integral components of the local Aboriginal creation story – the Gabul (Carpet Python) myth cycle - which explains the creation (and configuration of the landscape) of the Halifax Bay and Cleveland Bay coastlines;
- The coastal area now occupied by POTL (including Ross Creek, Ross River and what was once part of Ross Island) was used traditionally for fishing, foraging, camping and for other cultural purposes. There is some evidence to indicate that it was a popular meeting place for large gatherings of Aboriginal people and that corroborees were sometimes held in this area. It formed an integral part of a large foraging and living area on the Cleveland Bay coastline that included Cape Pallarenda, Rowes Bay, the Town Common, Ross River channel and Magnetic Island;
- Land areas adjacent to and surrounding the Cleveland Bay coastline, including POTL lands, contain tangible archaeological evidence for the Aboriginal use and occupation of this landscape, in the form of shell middens, stone artefacts, scarred trees, rock shelters with paintings, ceremonial sites and burial places (eg: Sandfly Creek Aboriginal burial ground south of Ross River). It is reasonable to assume that much archaeological evidence has been obliterated by the prolonged European settlement and alteration of this landscape (especially along the coastal fringe) and that many more archaeological sites once existed along the shores of the bay;
- Current archaeological evidence indicates that Aboriginal people occupied the Cleveland Bay coastline in the late Holocene period (over at least the last 4,000 years BP);
- Ross Creek, Ross River and Ross Island represented one of the historical frontiers between European and Aboriginal societies in the first decades of Townsville's existence. The picture that emerges from the historical record is that Aboriginal people continued to occupy this area for many decades following the European settlement and occupation of Townsville; and
- Parts of the TMPP area (Benwell Road beach) are visited by Traditional Owners and local Aboriginal people, mainly for the purposes of fishing, yabbying, collecting shellfish and other recreational activities.

Feedback from Endorsed Aboriginal Parties

Feedback from Aboriginal Parties regarding the TMPP was compiled during the various project meetings between July and September 2008, including the site inspection on 24 July 2008. A summary of the main discussion points, concerns and issues relative to cultural heritage and other matters is presented in Appendix Y. Matters of concern included:

- Aboriginal cultural values of the project area;
- Potential impacts to flora and fauna;
- Social impacts and the impact assessment process;

- Contemporary use by Traditional Owners of Benwell Beach Road;
- Recognition and acknowledgement of Traditional Owners; and
- Archaeological potential of sub-tidal areas.

This feedback has supported development of the potential impacts and mitigation measures in the following Section.

3.15.1.5 The European cultural landscape

To complement the Indigenous Cultural Heritage studies conducted for this project, similar studies examining potential for impacting European Cultural Heritage as a result of the TMPP have been undertaken. The detailed studies are also reported under Appendix Y.

An examination of the history of the area associated with the TMPP has identified two distinct locales within the current study area of importance from a European heritage perspective. The Port of Townsville and the suburb of South Townsville have inter-related but differing histories that have influenced their development and are discernible in their contemporary built environment and cultural landscape.

The suburb of South Townsville has a mature heritage environment, which is recognised by the listing of places on the QHR and the Townsville Local Heritage Database. This suburb has been surveyed as part of the creation of the (former) Townsville City Council's Local Heritage Database, a 1993 Urban Conservation Study undertaken by Woods Bagot Pty Ltd, and for register entries on the local heritage database and the Queensland Heritage Register.

This previous study means the suburb's heritage values and places are well known allowing the assessment of potential impacts and the recommendation of management practices designed to mitigate any potential impacts.

Searches of the relevant Commonwealth, State and local heritage registers for these key locales indicates there are nine places of heritage significance within the current study area. One of these places appears only on the Queensland Heritage Register (QHR), a further seven appear only on the Townsville City Council's Local heritage Database, and one place, the Victoria Park Hotel, appears on both registers. There are currently no places in the study area that appear on any Commonwealth registers.

A field survey confirmed the location and condition of each of the nine places of heritage significance and included a visual assessment of the proximity of each place to the Precinct.

The TMPP will take place entirely on reclaimed inter-tidal land and the site survey confirmed that there are no places of heritage significance in the footprint of the TMPP. The survey also confirmed that currently there are no places of potential heritage significance that are likely to be affected directly or by the project. Additionally, archival research undertaken as part of this study did not reveal any evidence that would suggest a high probability for the discovery of items of historic cultural significance during the reclamation works for this project.

Although direct impacts are unlikely there is potential for indirect impacts to identified places of European cultural importance. This is discussed further below.

3.15.2 Overview of potential impacts and mitigation measures

This defines and describes the objectives for protecting or enhancing cultural heritage environmental values, describes how nominated quantitative standards and indicators may be achieved for cultural heritage management, and how the achievement of the objectives will be monitored, audited and managed.

The environmental harm to Indigenous cultural heritage values in the vicinity of the project is to be managed under the cultural heritage management plan (CHMP) developed specifically for the project. The CHMP provides a process for the management of cultural heritage places both identified and sub-surface at the project sites. The development of the CHMP has been negotiated with all stakeholder representatives.

3.15.2.1 Assessment of potential Indigenous cultural heritage impacts

This cultural heritage investigation has provided clear evidence that the proposed TMPP at Ross River is located within a broad cultural landscape that retains significant Aboriginal heritage values. As assessment of the potential impacts of the proposed TMPP on these identified cultural heritage values is outlined below. The assessment of impacts is based on two main criteria: i) potential impacts to Aboriginal cultural values, and ii) potential impacts to the Aboriginal archaeological record.

3.15.2.2 Impacts to Aboriginal cultural values

All development projects along the Cleveland Bay coastline have the potential to negatively impact on the Aboriginal cultural heritage values of this significant cultural landscape. Consultation with Traditional Owner representatives during the course of this investigation has generally indicated that they have no major cultural heritage objections to the TMPP, and on this basis they have entered into discussions and a CHMP agreement with POTL. This is despite the fact that this project will significantly alter the current configuration of the coastline with reclamation of land and the possible construction of an additional breakwater.

The Traditional Owners generally feel that the current project will have no greater impact on cultural values than the many previous development projects which have resulted in dramatic alterations to the original configuration of the coastline and waterways of Cleveland Bay. As previously noted, reclamation and construction works for the Port have been undertaken periodically since the European settlement of Townsville in the 1860's (Taylor 1980). In more recent times major development works have been undertaken for the Strand redevelopment, construction of the Casino Complex and Townsville Entertainment Centre, existing marinas and breakwaters. Despite these many developments and alterations to the landscape, Aboriginal people maintain their 'connection to country'.

In short, while alterations to the environment in the further development of the Port of Townsville will impact Traditional Owner cultural values, Cleveland Bay, the Townsville coastline and major waterways such as Ross Creek and Ross River will nevertheless continue to be fundamental and significant places in their culture.

Throughout this investigation the Traditional Owners have reiterated that they maintain an active interest in 'caring for country'. On this basis, they wish to take an active role in managing the cultural heritage and environmental values of the project areas, via ongoing discussions with POTL and the existing CHMP.

3.15.2.3 Impacts to the Aboriginal archaeological record

The potential for locating intact prehistoric Aboriginal archaeological sites and materials is assessed as very low to negligible for the TMPP. The reasons for this assessment are outlined in detail in Appendix Y Any land areas with some predicted residual archaeological potential (for historical and/or prehistorical archaeological sites and/or values) are also considered and discussed (eg: Benwell Road Beach and the east bank of Ross River).

The archaeological potential of sub-tidal areas in Cleveland Bay can reasonably be assessed as very low to negligible on the basis of many factors, but primarily the prolonged history of major taphonomic disturbance and alteration to the seabed and watercourses, mainly as a result of dredging. This report has considered the long-term impacts of dredging at the mouth of Ross River and Ross Creek at Townsville Port (Pringle 1989). Over more than 100 years regular dredging has taken place at the Port to maintain navigable channels at Ross River and Ross Creek. The end result of the long-term dredging operations is that intact sub-tidal coastal deposits simply do not exist within the TMPP area.

Given the long history of dredging at the Port and the fact that maintenance and capital dredging works are still carried out by POTL on a periodic basis, the age of sediments in the upper layers of sub-tidal areas at Ross River and Ross Creek are relatively recent. Based on information provided by POTL and discussed at the project meeting on 24 July 2008, the age range of the upper layers of sub-tidal sediments (from maintenance and capital dredging works) for the TMPP are estimated at between 2 to 30 years old. If any prehistoric Aboriginal archaeological sites were once located in sub-tidal deposits in the TMPP area then it must be concluded that these would have long been obliterated by the prolonged and repeated dredging in this section of Cleveland Bay.

Some Traditional Owners have raised the issue of the archaeological remains (Aboriginal stone artefacts) found at the Nelly Bay Harbour development site on Magnetic Island and the possibility for similar archaeological finds within the TMPP area (cf. Gorecki and Greer 1988; Mardaga-Campbell, Greer and Hatte 1989; Northern Archaeology Consultancies 2002). From an archaeological perspective there is very little similarity between the two locations, and particularly their archaeological and geomorphological contexts. The stone artefacts at Nelly Bay were discovered on an old emerged intertidal reef flat, probably dating to 5 or 6,000 years ago. At the POTL project sites there are no emerged intertidal reefs and the project sites consist of sub-tidal and/or reclaimed lands (with the exception of the east bank of Ross River).

Many areas along the Cleveland Bay coastline that were inhabited by Aboriginal people no longer exist as a result of modern development and landscape modification. For example, from the ethnographic record we know that sizeable camps of Aboriginal people resided at Murder Island and Magazine Island. These areas were obliterated for ensuing developments, no doubt along with their prehistoric archaeological record. It is well documented that granite from Magazine Island was used as fill in reclamation works and for construction of major Port developments including breakwaters, jettys and bridges (Taylor 1980). Where archaeological evidence does survive on the coastal fringe it is often located in the more outlying (and less disturbed) areas of Townsville (eg: Sandfly Creek burial ground to the south of Ross River).

In addition to the long history of human impacts to the landscape and seascape of the TMPP this coastline has also been subject to periodic cyclonic events. Pringle (1989) and Taylor (1980) have described major erosion and deposition of sediments as a result of cyclones and storm surge at the mouths of Ross Creek and Ross River in the recent past. Cyclones have the potential to alter the configuration of the coastline and its archaeological record as demonstrated by Bird (1992) at Wunjunga in the Lower Burdekin region. Some 50% of coastal shell middens recorded in 1987 were obliterated by cyclonic storm surge in 1989 and 1992 as a result of cyclones Charlie and Aivu. The configuration of the coastline was dramatically altered by a major breach in coastal dunes as a result of the combination of storm surge and inland flooding pushing through a narrow weakened section of sandy coastline. It is reasonable to suspect that erosion and deposition of sediments as a result of past cyclones have had some impact on the archaeological record along the Cleveland Bay coastline and the TMPP area.

This cultural heritage investigation suggests that there are two areas associated with the TMPP where there may be some level of (residual) archaeological and cultural heritage potential.

The first area to be considered is the east bank of the Ross River. Potential impacts to the coastal margins on the east bank may occur if a breakwater is constructed as part of this project. Previous archaeological surveys of the east bank of the river for the Townsville Port Access Road project (Bird 1999) have located low-density Aboriginal archaeological sites such as shell middens and stone artefacts within the dune complexes on this eastern side of the Ross River. There is a high level of cultural sensitivity from the point of view of the Traditional Owners in this relatively undisturbed area of dunes and old beach ridges, given their contextual similarity and geographical proximity to the beach ridges at the Sandfly Creek Aboriginal burial ground.

Non-indigenous cultural sites including a concrete bunker dating to World War 2 and the remains of a 1930's Townsville City Council sewage plant (concrete tanks and other structures) are also located on the east bank of Ross River (see Appendix Y and Bird 1999 for a detailed discussion on the cultural finds on the eastern bank).

The Main Roads development corridor on the east bank for the Townsville Port Access Road is to be subject to a stringent cultural monitoring program during development works (as per an existing [2005] CHMP between Department of Main Roads and the Bindal and Wulgurukaba peoples). On that basis, any proposed work by POTL on the east bank of Ross River would therefore be expected to be subject to cultural monitoring. It is noted that at this stage, the potential impacts to the east bank as a result of the TMPP have yet to be fully determined, pending ongoing assessment of the various proposed breakwater options. A cultural monitoring program for any proposed works above highest astronomic tide (HAT) on the east bank would ensure that any unrecorded cultural sites or values could be identified, documented and managed appropriately during the course of the development project (see Recommendations below).

The second area to be considered for potential cultural heritage impacts is the coastal strip at Benwell Road beach. As previously noted in this report the prehistoric archaeological potential of this area is assessed as negligible, based on the fact that the beach is reclaimed land that is only a few decades old. There is some potential that historical archaeological sites or relics (Aboriginal and/or non-indigenous) might be located in these coastal deposits, but again the point is emphasized that the term 'historical' is used tentatively in this context, given the maximum age of this coastal strip.

Quite apart from the project archaeologist's assessment of cultural heritage potential, the Traditional Owners have indicated that they feel that cultural monitoring of the Benwell Road beach area is warranted for development works in this area. The Traditional Owners feel that there is some potential for historical 'Murri' camps to be located in this area.

The request for cultural monitoring by Traditional Owners along this section of coast (on the margins of Ross River) goes more to the issue of acknowledging the enduring and immeasurable Aboriginal cultural values of this area and its cultural sensitivity, than to addressing issues of 'archaeological potential'. That is, the request for cultural monitoring is more about addressing intangible cultural values and 'caring for country' than it is about management of the archaeological record. An Elder from the Aboriginal Parties made some important comments during the consultation process to sum up the Traditional Owners point of view regarding the need for cultural monitoring along Benwell Road beach, regardless of the archaeological assessment of this area.

"Townsville Port has had this land for many years; they have been using and changing this land since white people came; we have been locked out of this land; land that our ancestors owned and lived on; the sites left by our old people, middens and such, are gone now. We need to monitor the land to make sure there are no sites there and so we can still care for our country".

It is noted that the Department of Main Roads has advised that the Benwell Road beach and adjacent area is planned for resumption as part of the Townsville Port Access Road (Eastern Access Corridor) project. On that basis, there is a possibility that Main Roads will resume this land and begin to develop it for the road corridor, prior to any development works by POTL. Main Roads is addressing their cultural heritage duty of care in this regard via separate discussions with Aboriginal Parties (ongoing at the time of writing) and as part of an existing CHMP between Main Roads and the Bindal and Wulgurukaba peoples.

Since relative sea level stabilization some 6,000 years ago there is no doubt that Aboriginal people occupied and utilised the coastal fringes of Cleveland Bay, including the Ross Creek and Ross River project areas. As already noted, the inherent difficulty in locating traces of this early occupation along the present shoreline is the high degree of disturbance which has occurred from both modern developments (over the past 150 years), and ongoing natural geomorphic processes. Areas we know to have been frequented by Aboriginal people, at least in the early settlement period, were the immediate coastal fringe, the mouth of watercourses and associated sand bars, mangrove forests, sand dunes and beach ridges. All of these areas have been subject to dramatic change over time.

In conclusion, from an archaeological perspective it is predicted that it is highly unlikely that the proposed TMPP will have any major detrimental impacts to the prehistoric and historic Aboriginal archaeological record of Cleveland Bay (either along the coastal fringe and foreshore, or within the sub-tidal marine zone).

3.15.3 Project recommendations – Indigenous cultural heritage

The following Recommendations are made as a result of the Indigenous cultural heritage investigations for the TMPP (and Port Expansion projects).

These Recommendations are made following consultation with the Aboriginal Parties and as a means to address cultural heritage management issues for the proposed projects. It is noted that some of the listed recommendations have been addressed as per the existing (September 2008) project CHMP (as indicated below where appropriate).

[Postscript 18 March 2009: These recommendations were discussed and amended at a meeting between POTL and the Aboriginal Parties on 17 March 2009. Postscripts are added below where appropriate. Amended recommendations have been added to the project CHMP as Schedule 1].

Recommendation 1

It is recommended that a cultural monitoring program be implemented by POTL for any proposed extractive works to impact the east bank of Ross River above highest astronomic tide (HAT) as part of the Marine Precinct project.

At this time the potential impacts, if any, to the east bank of Ross River are not fully known as a result of the ongoing EIS investigations regarding proposed breakwater design and construction options for the Marine Precinct project.

The Aboriginal Parties request that POTL inform them of the outcomes of the ongoing EIS studies and the final project decision and recommendations regarding breakwater construction design and options.

It is recommended that there be further discussions between POTL and the Aboriginal Parties as a means to agree on and confirm the timing, duration, number of personnel, logistical and other arrangements for a cultural monitoring program for any extractive works to be undertaken above HAT on the east bank of Ross River.

[Postscript 18 March 2009: Updated information was provided by POTL relative to a new proposed breakwater option for the Marine Precinct project. It is noted at this time that no works are proposed for the east bank of Ross River and that the current proposed breakwater (as at 18 March 2009) is intended to be generally as shown in Figure 2-2 of this report). See also Schedule 1 of the project CHMP.]

Recommendation 2

The Aboriginal Parties request that a cultural monitoring program be implemented by POTL for any proposed development works to impact the Benwell Road beach (Lot 773) as part of the Marine Precinct project.

Considering the history of extensive reclamation of this area, it is recommended that there be further discussions between POTL and the Aboriginal Parties regarding any requirement for cultural monitoring at Lot 773.

[As already noted, it is possible that Main Roads will resume part of Benwell Road beach for the construction of the Townsville Port Access Road (Eastern Access Corridor) prior to the Marine Precinct project. In this case, the issue of cultural monitoring for this parcel of land will not be the responsibility of POTL. The duty of care to address cultural heritage management issues for the development of this land will pass to the landholder/developer, which in this case will be Department of Main Roads].

[Postscript 18 March 2009: Recommendation 2 amended and agreed upon as follows as per Schedule 1 of the project CHMP:-

"That a cultural monitoring program be implemented by POTL for any proposed extractive works to impact the Benwell Road beach above highest astronomic tide (HAT) as part of the Marine Precinct project. Provided that if monitoring occurs pursuant to a cultural heritage management plan prepared by Main Roads for the same area, monitoring under the POTL CHMP need not occur".]

Recommendation 3

Recommendation 3 refers to an adjacent project and is, accordingly, not reproduced here.

Recommendation 4

In the event that any Aboriginal cultural heritage sites, materials or values are discovered during development operations in the POTL project areas, the following recommendation should apply:-

All development work and other activities at that location should cease, pending a thorough inspection of the find/s by representatives of the Aboriginal Parties. Optimally, the finds should be demarcated and protected from any potential impacts with pegs, flagging tape and/or other appropriate temporary barriers with a reasonable buffer area around them (the 'reasonable' buffer zone to be determined by the Site Supervisor or other appropriate on-site personnel). Development work can continue outside the demarcated buffer zone. Following their assessment of the find/s, the Aboriginal Parties will provide advice on appropriate management action. Depending on the cultural significance of the find/s, the Aboriginal Parties and/or the development proponent may wish to seek independent technical advice from the project archaeologist and/or the Cultural Heritage Coordination Unit, Department of Natural Resources and Water. Development work at the location of the finds should not recommence until appropriate cultural heritage management action has been implemented to the satisfaction of all stakeholders (Refer CHMP, Section 3.7 and Schedule 1).

Recommendation 5

In the unlikely event that human skeletal material is discovered during development works, it is recommended that all development operations cease immediately within 100 m of the remains. Optimally, the finds should be demarcated and protected from any potential impacts with pegs, flagging tape and/or other appropriate temporary barriers. The Queensland Police, Cultural Heritage Coordination Unit of the Department of Natural Resources and Water, as well as Aboriginal Traditional Owner representatives should be contacted as a matter of urgency. Currently, the Queensland Police, Department of Natural Resources and Water and Aboriginal Traditional Owner groups have established policy and procedures to ensure that confirmed indigenous burials are treated in a manner consistent with Aboriginal traditions. Minimal disturbance to the remains should be a priority, and advice should be sought from Aboriginal Elders on ways to deal with the material in a culturally appropriate and sensitive manner. A copy of the Department of Natural Resources and Water 'Burial Policy' is available from NRW and/or the project archaeologist (Refer CHMP, Section 3.8 and Schedule 1).

Recommendation 6

Personnel and contractors involved in the development project should undertake a cultural heritage induction prior to commencement of development operations. Workers must be provided with information on the types of Aboriginal cultural heritage sites likely to be found in the project area, along with specific guidelines to follow in the event of the discovery of cultural finds, or suspected cultural finds. Workers should be made aware of the provisions of the Aboriginal Cultural Heritage Act 2003 and in particular, the ‘Duty of Care Guidelines’ under this legislation (Refer CHMP, Section 3.6 and Schedule 1).

Recommendation 7

During the course of this cultural heritage study the Traditional Owners have raised some concerns regarding environmental aspects relating to the proposed development project (such as potential impacts to sea grass beds, fish habitat, water quality, pollution, dugong and turtle populations in Cleveland Bay, etc). On this basis, the Traditional Owners request that they have the opportunity to review and provide feedback on expert environmental reports compiled as part of the EIS process.

[Postscript 18 March 2009: Recommendation 7 amended and agreed upon as follows as per Schedule 1 of the project CHMP:-

“POTL shall provide each of the Endorsed Parties with a CD copy of the Environmental Impact Statement (EIS) once it goes on public display. On each occasion that the Port meets with the Endorsed Parties, the Port shall provide an update on issues arising out of the EIS. The Port shall continue to provide to the Endorsed Parties Fact Sheets and newsletters on progress of the EIS”.]

Recommendation 8

The Traditional Owners request that POTL acknowledge and recognise the Aboriginal history, use and occupation of the Ross River and Ross Creek project areas via story boards, interpretive signage, naming of Port precincts and/or street names, or other appropriate means as agreed upon by the Parties, as part of the Marine Precinct and Port Expansion projects (Refer CHMP, Section 4 and Schedule 1).

Recommendation 9

Once endorsed by the Aboriginal Parties and POTL it is recommended that the above-listed recommendations are incorporated into the existing (September 2008) Cultural Heritage Management Plan for the Marine Precinct and Port Expansion projects, in the form of an appropriate Schedule or Addendum (see Schedule 1 of CHMP, dated 17 March 2009).

3.15.3.1 Assessment of potential European cultural heritage impacts

Potential direct impacts

The proposed project will be constructed entirely on reclaimed seabed where there are no identified places or items of European cultural heritage significance. As a result there are no known places or items of European heritage significance that will be directly impacted by the project. However, should an item of potential heritage significance be discovered during the construction phase of the project, work around the item should cease and an appropriately qualified heritage assessor should be contacted to provide an assessment on its significance and appropriate management measures.

Potential indirect impacts

Research and surveys undertaken to complete the European cultural heritage study indicated there are nine places of heritage significance in the study area that are adjacent to the proposed TMPP. These included the following locations:

- St John's Anglican Church Precinct;
- Victoria Park Hotel;
- St Patrick's Church;
- Souths Football Clubhouse;
- 265 Boundary Street – example of historical residential building type;
- 1 Hubert Street – example of historical residential building type;
- 25 Hubert Street – example of historical residential building type;
- 64 Allen Street – example of historical residential building type; and
- 77 Allen Street – example of historical building approach.

These places may be indirectly impacted by the project. Possible indirect impacts have the potential to affect the contributory nature of the environmental setting of places and the contribution this setting makes to their heritage significance. These potential impacts may include:

- Destruction or disturbance of an element of cultural heritage;
- Impact on its settings through inappropriate siting or design;
- Introduction of new environmental inputs such as noise or pollution;
- Potential damage to the physical fabric of historic buildings or historic landscapes; and/or
- Changes to the visual amenity of the place.

Importantly indirect impacts also have the potential to enhance a place's heritage significance through the restoration of a historical vista, removal of unsympathetic buildings or other built elements, and/or the re-instigation of a significant historical or community practice.

Potential indirect impacts to the heritage significance of places in the study area or to the historic themes associated with the project area that may occur during the construction and operation phases were identified and assessed. These are detailed in Appendix Y. All potential impacts were rated as highly unlikely to occur.

Although it is highly unlikely that the heritage values of places or areas within the current study area will be adversely affected by the TMPP, the study reinforced the need to adopt the mitigation measures proposed under the relevant sections of this report to mitigate against increased traffic, alteration of the visual amenity of the environment and increased noise potential associated with the construction and operation of the Precinct.

A potential enhance of the local areas heritage values may stem from potential increased patronage of the Victoria Park Hotel resulting from an increased demand on existing public services. Otherwise, there are not predicted to be any detractive indirect impacts to European cultural heritage values of areas adjacent to the TMPP area and, accordingly, no recommendations are proposed.

3.16 Health and safety

3.16.1 Description of environmental values

The main community values for public health and safety that may be affected by the construction, operations and decommissioning of the TMPP are air quality and noise levels. The Environmental Protection Policy (Air) and Environmental Protection Policy (Noise) goals are described separately in this EIS under Air Quality and Noise sections (refer 3.11 and 3.13).

The health and safety aspects of the dredging, and construction of a reclamation bund, operations at the Precinct and decommissioning include the following:

- Air environment:
  - Qualities of the air environment that are conducive to human health and well being;
  - Qualities of the air environment that are conducive to protecting agricultural use of the environment; and
  - Dust and odour.
- Noise environment:
  - Qualities of the acoustic environment that are conducive to human health and wellbeing, including ensuring a suitable acoustic environment for individuals to sleep, study or learn or be involved in recreation, including relaxation and conversation
  - Qualities of the acoustic environment that are conducive to protecting the amenity of the community.

Data recorded by Port of Townsville indicated that there were no events during the 2005/06, 2006/07 and the 2007/08 periods where PM_{10} exceeded the old EPP (Air) goal (up to end of 2008) of 150$\mu g/m^3$ as a 24-hour average. DERM annual reporting for 2007 states, carbon monoxide (CO) and lead levels are reasonably expected to be consistently below the relevant NEPM standard. Similarly, nitrogen dioxide levels are expected to be consistently below 40 percent of the NEPM standards. The 1-hour sulphur dioxide statistics at and above the 90th percentile at both Pimlico and Stuart are lower than for all other regions in Townsville. The 1-hour and 4-hour NEPM standards for ozone were always met. Further details are provided in the Section 3.11 of this EIS.

During the Precinct operations, the average sound level experienced at nearby residence is expected to be around 46 dB (A) under worst case conditions. This is similar to existing noise levels in the area and it is expected that further noise attenuation will likely occur. Further details are provided in the Section 3.12 of this EIS.

Mosquito and biting midge have public health implications. The location of the TMPP, within the coastal environs, will bring humans in close contact these biting insects. Mosquitos are known carriers of malaria, dengue fever, Ross River virus, Barmah Forest virus, Japanese encephalitis and Murray Valley encephalitis. Polluted waters, freshwater swamps, brackish waters, construction sites, water storage tanks and drains are breeding sites for mosquitos. Mosquito life cycle depends on environmental factors such as temperature and humidity. Townsville area has saltmarsh mosquitoes (*Aedes vigilax, Culex sitiens, Verrallina funerea*) dengue fever (*Aedes aegypti*) and freshwater mosquitoes (*Aedes aegypti, Aedes notoscriptus, Culex annulirostris, Verrallina funereal, Aedes vittiger, Aedes alternans and Mansonsia uniformis*).

Biting midge do not currently transmit human disease in Australia but can be a severe pest if adult midges are in abundance. Impact on humans is primarily due to irritation and skin reaction from bites. Blisters and weeping serum may occur from the site of bite. Biting midge are attracted to human settlement and are found resting on screens, fences and vegetation. They are active during dull still days with high humidity.

3.16.2 Potential impacts and mitigation measures

3.16.2.1 Potential Impacts on Workforce

A total of approximately 200 workers will be employed during the construction phase of the Project. The potential number of workers likely to be present during operational phases is estimated at approximately 550 (both direct and local flow-on). Flow on effects will, however, be largely dependent on the types of business and industry which locate within the TMPP. Potential safety hazards associated with construction and operation activities include drowning when working over water on barge or vessel, injury or fatality while handling dangerous goods, suffocation during working in confined space, electrocution and injury to self or others while undertaking lifting activities. Table 3-70 outlines potential health and safety hazards to personnel on site during the construction and operation of the Precinct. To increase site safety and to assist in preventing injuries during construction or operation phase it is recommended that persons on site wear appropriate Personal Protective Equipment (PPE) such as hard hat, safety glasses, steel capped boots, high visibility vests, ear protection, dust masks or any other specific PPE as required.

Details of wastewater treatment and reuse are not known at this stage. However, water recycling measures are being considered by the POTL within the Precinct. Individual facilities within the Precinct will also be encouraged to adopt the water recycling measures. The project area is likely to have breeding sites for mosquito and bitting midge. The recreational, commercial and industrial development is expected to expose a number of people including workers to mosquitos and bitting midges.

3.16.2.2 Impacts on Community

Air Quality Impacts

Dust is the predominant health and safety issue for communities during construction as well as operations. Odour has been considered and is likely to be well below levels of concern.

Dust impacts to the community during construction of the reclamation area are unlikely to be substantial due to separation distances and the moist nature of the dredged material being used to reclaim.

Dust emissions from construction and operation can be managed to ensure that adverse impacts do not occur at sensitive locations offsite. Mitigation measures for dust during construction and operations are outlined in the Section 8. Air dispersion modelling for PM_{10} dust concentration show that, using appropriate mitigation measures for construction, dust concentrations in the suburban area to the south are always below 50 $\mu g/m^3$ at distances greater than 250 m from the construction activity. The dust deposition, expressed as annual average g/m^2/month, shows a similar pattern with all areas beyond 150 m being below the recognised critical level (2 g/m^2/mth annualised = 24 g/m^2/year) for nuisance dust complaints.

Noise Level Impacts

Modelling of noise generation associated with construction activities under a scenario of no noise barriers or acoustic shielding in place and with each plant item operating at full power was shows that anticipated noise levels compare to existing daytime ambient noise levels for all plant activity except pile driving. Hence, the predicted noise levels are considered to be acceptable. In general the quietest equipment will be used in conjunction with appropriate management measures. Noise mitigation strategies will be considered and implemented during evenings and night time work periods. AS 2436-1981 “Guide to Noise Control on Construction, Maintenance and Demolition Sites” will be applied where possible.

Operational noise will largely be dependent on the types of business and industry that will locate within the TMPP. It is unknown at this stage the exact occupant details of the Precinct, however, it is expected that these will include industrial activities such as boat building, abrasive blasting, surface coating, workshops, storage of goods, and packaging, all of which are likely to operate within sheds. Other noise generating activities associated with this will include trucks and forklifts, trawlers and boats. Received noise produced by anticipated activities, during operation with no noise barriers or acoustic shielding in place and with each plant item operating at full power have been calculated. During the Precinct operations, the average sound level experienced at nearby residence is expected to be around 46 dB (A) under worst case conditions. This is similar to existing noise levels in the area and equal to the project specific noise criteria.

It is expected that noise attenuation will likely occur due to activities being located inside buildings, the blocking of noise sources from site receivers due to adjacent buildings, walls and barriers. In addition, the location of the Precinct, being at a distance of more than 350 m from the nearest sensitive receivers, further mitigates the potential for impact.

Mosquito and Biting Midge

Activities associated with the development and operation of the TMPP are likely to result in the creation of breeding sites for mosquito and biting midge. However, POTL and individual facilities will have to ensure that it does not enhance mosquito breeding and disease transmission.

Populated areas, which are in the path of the dominant prevailing wind from mosquito and biting midge breeding sites, may be regularly affected by biting insects that are carried by wind. The range could be from few metres to few kilometres depending on the climatic conditions and type of mosquito species.

Table 3-70 Qualitative Summary of Hazards, Consequences and Mitigation Measures

Activity	Hazard	Consequence	Mitigation Measures
Construction dust	Struck by wind blown particles, (i.e. from unloading trucks, traffic)	Injury to personnel, environment impact	HSE awareness, JSA, competent workers, dust suppression, PPE (eye protection must be worn at all times when onsite - signage), watering of roads
Construction works	Noise - excessively noisy Plant and equipment	Injury to personnel, damage and Environment damage	Competent workers, HSE awareness, JSA, PPE, in compliance with noise regulations, boundary noise criteria.
Exposure to chemicals/ dangerous goods	Inappropriate handling, leaks, inappropriate storage	Fatality, injury to personnel, time delays.	HAZOP used during design, maintenance to include inspection of storages, pipelines and connections of chemical storages, chemical storages designed in accordance with Australian Standards and *Dangerous Goods Safety Management Regulation 2001*, copies of MSDS at site.
Fitness for work	Drugs, alcohol, fatigue, mental state and stress	Injury to personnel, fatalities, environment damage, equipment damage	Pre-employment screening. Drug and alcohol policy. Fatigue awareness. Induction training
General site work	Poor housekeeping	Slips, trips and falls for persons. Obstruction to vehicle movements	JSAs, HSE awareness, supervisor monitoring, emergency response procedures and services.
Loading and unloading of goods and equipment	Dropped object, slips, trips, falls, moving loads, inappropriate rigging.	Injury to personnel, damage to equipment. time delays	Job Safety Analysis (JSA), safe work instructions, competent and certified personnel, controlled laydown areas, supervision and training.
Manual handling	Ergonomics, inappropriate body position, unstable footing, excessive loads, poor lifting practices.	Injury to personnel, loss of working hours, time delays	Induction to workers and re-training on safe manual handling practices, increase awareness on health and safety issues and first aid training.
Natural events	Lightning, strong winds, flooding	Injury to personnel, equipment damage	Controls as per the ERP, JSAs to specifically consider imminent weather conditions.

Activity	Hazard	Consequence	Mitigation Measures
Pre-inerted vessels, equipment and containers, fumes and vapours from paints.	Asphyxiation, chemical Inhalation, pressure	Injury to personnel, fatality, time delays	JSA, HSE awareness, competent workers, confined space entry procedure.
Security	Unauthorised access	Injury to personnel and environment damage	Security fencing, security personnel, controlled access, perimeter patrols.
Third Party onsite	Third parties are less familiar with site safety and environmental requirements and pose enhanced risk to themselves and others.	Injury to personnel, fatalities, environment damage, equipment damage	Inductions for all contractors and visitors, escort all short term visitors. Site entry procedure
Vehicle traffic on site	Vehicle collision, pedestrian and vehicle collision	Fatality, Injury to personnel, time delays damage to vehicle/ equipment	Vehicle movement plan for the site for construction as well as operation phase, signage, scheduling of larger deliveries. Only certified and authorised drivers on work-site, lower speed limits on site, high visibility clothes.
Working in wet weather	Wet conditions, slips, trips, falls, electrocution.	Injury to personnel, time delays	Proper drainage at the construction working area, proper laying of cables, insulated hooks and stands, earth leakage circuit breaker. Suitable undercover work areas to be provided.
Working in hot conditions	Dehydration, exposure to sun	Heat stress, heat stroke, sun burns, time delays	Health Safety and Environment (HSE) awareness programs, induction to include working in heat, use of PPE, provision of drinking water, JSA
Working with equipment and tools	Faulty tools, defective equipment.	Injury to personnel, damage to equipment. time delays	JSA, training to workers, competent workers, HSE awareness, inspection and maintenance program.
Working at heights on platforms, man boxes, baskets etc	Changes to scaffolding, fall from heights, dropped objects, manual handling, incorrect assembly.	Fatality, injury to personnel, time delays	JSA, training to workers, competent workers, HSE awareness, review of work packages, safe work instructions on use of equipments, procedure for working at height. All scaffolding will be constructed under the supervision of a certified scaffolder.

Activity	Hazard	Consequence	Mitigation Measures
Working in confined spaces	Dropped objects, manual handling issues, restricted access.	Injury to personnel, potentially poor body position, asphyxiation, long term health problems.	JSA, HSE awareness, training to workers, competent workers, confined space procedure, low voltage lights.
Working with compressed air	Hoses become uncoupled, hose burst, inappropriate use of air	Injury to personnel, time delays	JSA, HSE awareness, competent workers, inspection and testing.
Working with electrical	Contact with electricity - general (defective electrical leads, electric leads in contact with metal, electric leads in damp areas, etc.)	Electrocution, time delays	Elevating cables, insulated hooks and stands, earth leakage circuit breaker. Inspection and maintenance program including testing and tagging for all electrical tools/equipment onsite. Use of battery operated tools and low voltage lighting (where practicable).
Mosquito and biting midge	Biting to humans	Fever, fatigue, itching and skin reaction, time delays	Minimise areas of stagnant water or ponding of surface waters. Regular monitoring and control measures at breeding sites.

3.16.2.3 Management Plans

Health and Safety

The management plan for health and safety is summarised as follows:

<table>
<tr><th colspan="2">Health and Safety Management Plan</th></tr>
<tr><td>Elements</td><td>Incidents and hazards in the workplace</td></tr>
<tr><td>Management Objectives</td><td>To provide a healthy and safe workplace for employees, clients contractors and visitors.</td></tr>
<tr><td>Performance Criteria</td><td>Adhere to applicable Australian and other recognised standards, applicable code of practises and relevant statutory provisions, especially the Dangerous Goods Safety Management Act, 2004 and Workplace Health and Safety Act, 1995
Implementation of Hazard and Operability Study
Implementation of Safety Management System.
Implementation of Emergency Response Plan.
Preparation of JSA's to manage workplace risks.</td></tr>
<tr><td>Implementation Strategy</td><td>Responsibility</td></tr>
<tr><td>Develop and implement a Hazard and Operability Study (HAZOP) system during detailed design to identify all potential causes of chemical leakage and spillage or hazards to workers and ensure that appropriate protective systems are implemented.</td><td>Respective Industries within the Precinct through Design Contractor</td></tr>
<tr><td>Develop and implement a Safety Management System to address hazards associated with construction and operation and specify safe working procedures. Submit the Safety Management System to the Department of Emergency Services CHEM Unit for approval prior to the commencement of construction.</td><td>Construction Contractor/ Developers Project Manager</td></tr>
<tr><td>Develop and implement an Emergency Response Plan in conjunction with local authorities and emergency services. Submit the Emergency Response Plan to the Department of Emergency Services CHEM Unit for approval prior to the commencement of construction.</td><td>Construction Contractor/ Developers Project Manager</td></tr>
<tr><td>Maintain site security systems.</td><td>Construction Contractor/ Developers Project Manager</td></tr>
</table>

Ensure contractors working on-site adhere to the Safety Management System and complete JSAs as appropriate.	Construction Contractor/ Developers Project Manager
Provide personnel with training in chemical management and spill response and workplace health and safety.	Construction Contractor/ Developers Project Manager
Provide personnel involved in Emergency Response with appropriate training.	Construction Contractor/ Developers Project Manager
Monitoring	◗ Maintain a training register for all staff and contractors. ◗ Undertake regular monitoring of the performance of staff and contractors in terms of compliance with Safety Management System.
Reporting	◗ Daily or weekly reports (as appropriate) will be completed on-site and reviewed by each Supervisor and / or Superintendent. ◗ Immediately notify Superintendent and DERM in the event of an uncontained spillage. ◗ Report all incidents and investigate. ◗ Incident or non-compliance corrective action shall be closed out by senior management according to an agreed responsibility and timescale. ◗ Workplace Health and Safety representative will be responsible for enforcing all occupational and public health directives and keeping all related records and communications.
Corrective Action	◗ The Construction Manager and the Environmental Representative are to be notified in the event of non-compliance. ◗ Redesign control measure if inadequate. The following constitute incidents or failure to comply with occupational and public health policies: – directives and procedures contained in the site safety system are not being followed; – directives and procedures contained in the site safety system are not being enforced; – site safety system does not encompass all required topics and situations; – high rate of work-related injury and illness; or – the emergency response plan is not prepared or implemented. In the event of an incident or failure to comply, a selection of

	the following actions will be undertaken as appropriate: – investigate why the incident occurred and investigate and implement mitigating measures; – ensure safety information provided is adequate and up-to-date and revise regularly as – appropriate; – ensure employees, contractors and visitors to the site are familiar with the procedures and – policies relevant to their positions; – ensure safety directives and procedures are enforced; and ensure safety documents are readily available to everyone on the site.

Mosquito and Biting Midge Management Plan

The Local Government Association of Queensland has produced a Mosquito Management Code of Practice (LGAQ 2002) which contains detailed advice to be followed for the control of mosquitos in Queensland. It is necessary that this is followed by POTL and the facilities that will be housed within this Precinct. Queensland Health (2002) has published guidelines to minimise mosquito and bitting midge problems in new development areas. This document provided advice on how to prevent or minimise the impact of mosquitoes and other biting insects in new development areas. Water storage tanks must be constructed and installed in accordance with Division 2, Part 1A, Public Health Regulation 2005.

During the operational phase of the TMPP, the following should be considered:

- If POTL or Occupiers of the Precinct use recycled water for irrigation, surface ponding must be prevented by appropriate irrigation scheduling;
- Regular maintenance of all structures associated with storage or treatment of recycled water is necessary to minimise mosquito breeding. This will include clearing of water plants from the edges of the storage to reduce habitat for larvae;
- Open water recycled storages must be monitored regularly to identify presence of mosquito larvae; and
- If a potential health risk from mosquito breeding is identified, biological control using natural predations such as aquatic invertebrates or known fish that prey upon the larvae should be introduced.

The Management Plan for mosquito and biting midge is summarised as follows:

Mosquito/Biting Midge Management Plan	
Elements	Incidents and hazards due to mosquito and biting midges
Management Objectives	Policy: To prevent the occurrence of potential mosquito/biting midge breeding sites and the presence of adult mosquitoes/ biting midge.

Performance Criteria	The number of potential mosquito/biting midge breeding sites created on-site is to be minimised by preventing water from ponding.
Implementation Strategy	**Responsibility**
Depressions in the ground surface will be filled to prevent the ponding of water. Pools of stagnant water will be drained and/or the areas filled.	Construction Contractor/ Developers Project Manager
Storage containers capable of ponding water will be either discarded after use or stored in an inverted position (care will be taken to ensure that ponding does not occur in rubbish storage areas)	Construction Contractor/ Developers Project Manager
Avoid creation of continuous belt of dense foliage trees as a part of landscaping. Ensure removal and replacement of vegetation conforms to policies set by different government department.	Design Contractor/ Developers Project Manager
All ponds and on-site excavations filled with water will be inspected for the presence of mosquito larvae on a weekly basis by the Environmental Representative	Construction Contractor/ Developers Project Manager
Erosion and washdown practices will be controlled to prevent sediment and debris forming standing water pools in natural water courses adjacent to the site. Mosquitoes will not breed in flowing water	Construction Contractor/ Developers Project Manager
If larvae are detected in large numbers, contact Queensland Health for assistance in choosing a suitable treatment method. Treatment could either be aerial, ground or adulticiding (fogging).	Construction Contractor/ Developers Project Manager
Monitoring	The Environmental Representative will inspect any potential mosquito breeding areas following rain to monitor the presence of mosquito larvae. The representative will also monitor the frequency of mosquito bites on the site to identify where mitigation measures are not currently successful and to see whether adult eradication programs should be implemented. The Environmental Representative will inspect any potential biting Midges breeding sites including boulder covered foreshores where boulders lie on a mud-sand-shell base and wave action is moderate in a band near high tide levels, clean sandy sores subject to moderate tidal actions, sandy shores in canal estate developments, muddy sand to pure mud areas

	and subterranean tunnels.
Reporting	◗ The Environmental Representative will record when and where any larvae or mature mosquitoes are found on-site, as well as when and where any incidences of bites may occur. ◗ Should a large number of larvae or bites be experienced, the Townsville City Council will be contacted for advice on appropriate remedial measures.
Corrective Action	Should an incident or failure to comply occur, a selection of the following actions will be taken: ◗ An investigation will be undertaken into why directives are not being carried out; ◗ Employees will be re-educated on desired practices; and ◗ Work policies and procedures will be changed to improve the situation.

3.16.3 Summary

The potential risk to health and safety from the project construction and operations activities and their impact on the workforce and communities exists.

The implementation of workplace health and safety procedures and the management plans will minimise the potential risks to acceptable levels.

3.17 Cumulative impacts

Any proposed development has the potential to impact upon the environmental, social or economic values of a region as a result of its development. It also has the potential to produce a cumulative impact upon those values when the proposed activity is conducted in combination with other developments. The typical effect is a compounded impact resulting from the interaction of multiple stressors from different projects. To have complete understanding of the full impact potential of a proposed development it is necessary to assess the potential cumulative impacts that may result from the project in combination with other projects in addition to assessing the direct and indirect impacts attributable only to the project of interest.

An assessment of cumulative environmental impacts considers the potential impact of a proposed development in the context of:

- Previous developments to provide context to environmental resilience;
- Existing developments to understand direct potential confounding impacts; and
- Future developments to consider all potential and indirect environmental impacts.

The assessment enables all potential impacts of a project to be understood in relative context and not in isolation from other projects. Assessment of previous developments should be conducted in context of the current baseline conditions of the environment. In this regard for the

TMPP the existing environment has been characterised through studies conducted to complete this EIS and is reported in the preceding sections of this document. Economic and social impacts from the TMPP are presented under Sections 4 and 5 of this document and, in accordance with the ToR, the cumulative impacts of relevance to these sections are noted here and detailed in the following sections.

As discussed under Section 1 of this document the TMPP does not directly relate to any other actions being undertaken by the POTL. However, the TMPP is associated with the Department of Main Roads project (TPAR) for a low-level fixed bridge of 7 m at Highest Astronomical Tide (HAT) across the Ross River, which has a programmed construction completion of its 'last span' by mid 2011. Construction of the TPAR in conjunction with the TMPP has potential to result in cumulative impacts for a range of ecological and other variables. The resultant combined effect of the two projects in conjunction may be greater than the impact of each project in isolation and, therefore, it is important to assess the cumulative impacts that may result from these two developments.

A number of other coastal developments are also being undertaken in the Townsville region concurrently. These include:

- Investigations related to the Townsville Port Expansion (POTL);
- Development of Breakwater Cove and the Townsville Ocean Terminal (City Pacific Ltd) and
- Development and expansion of Berths 12, 10 and 8 within the Townsville Port (POTL).

While none of these projects is directly related to the TMPP in regard to construction and development processes, there is potential for cumulative environmental impacts to the region resulting from concurrent or successive developments, for example potential cumulative dredging impacts.

Beyond the Townsville region, port, sewage and other coastal infrastructure development plans are underway and likely to be developed and the environmental impacts assessed in isolation from Townsville developments.

Impacts from future developments related to the TMPP and of relevance to this cumulative impact assessment are not able to be quantified and, accordingly, it is appropriate to examine cumulative impacts across all developments from a qualitative perspective. In this regard the methodological approach to assessment of cumulative impacts for the TMPP has been to

- Describe the existing baseline conditions of relevance to the TMPP;
- Ascertain potential direct and indirect impacts from the TMPP development;
- Identify mitigation and management measures for each identified impact;
- Ascertain which of the identified impacts may be confounded by concurrent or successive other developments within the local region;
- Qualitatively describe how identified impacts are compounded; and
- Identify mitigation and management measures against the compounded impact potential.

This approach has been undertaken in each of the preceding sections where cumulative impacts identified have been discussed in detail. In accordance with the ToR the following summarises identified cumulative impacts and mitigation measures for each of the environmental considerations of the TMPP. The structure of this section mirrors that of the preceding sections for ease of cross reference.

3.17.1 Land

The Precinct and Breakwater will be developed wholly within port limits and within the Ross River. The land based components of the project will be developed on reclaimed land with limited existing use except for some public recreation. The proposed works are consistent with the POTL Land Use Plan 1996. No other projects being developed in parallel are predicted to impact upon public recreation and cumulative impacts for this are not expected. Relocation of upstream industries into the Precinct provides alternative opportunities for public access to the coast in addition to those being considered through the Precinct itself. Hence, there are not predicted to be any cumulative impacts in relation to land use and land use planning resulting from the TMPP.

3.17.2 Landscape character and visual amenity

The project site is located within an area that has existing industrial development including both port and land based activities. While individual developments may have a minimal impact on the visual landscape the cumulative impact is a continuing industrialisation of the visual environment of this area. This is particularly the case with the land reclamation, which will create additional land beyond that currently available or which has been intended for industrial development.

While the ongoing industrial and port development diminishes the naturalness of the visual outlook in this sector of the visual landscape, this development also provides a unique landscape that combines the background of the mountains with the inter-tidal zone of Cleveland Bay and the Ross River.

Residual impacts – construction

It is not anticipated that there will be any residual landscape or visual impacts arising from the construction phase of the project.

Residual impacts – operation

Some impacts resulting from the project are unavoidable and cannot be mitigated for during operation. The project will alter the surrounding landscape and the visual experience of the visual receptors. However, these changes must be seen within the context of the existing local environment.

Foremost amongst residual visual impacts is the creation of a new land area within Ross River adding to the existing port facilities, and the creation of the breakwater facilities. In addition the construction of industrial and port related development will increase the extent of this type of land use in the visual landscape. As industrial and port development is located immediately adjacent to the site it is not considered to be a new element in the visual outlook.

The change in view will be permanent form all viewpoints with increased prominence when viewed from a number of viewpoints as these either provide extensive uninterrupted outlooks over the site, or are located within close proximity and therefore not visually or physically separated from the impacts.

Site wide, in terms of the assessment criteria this equates to a moderate adverse residual landscape impact, with medium visual sensitivity due to proximity of the receptors to the site. Therefore, the assessment of significance of residual impacts is considered to be of moderate significance. The assessment of a moderate impact on the landscape and visual amenity, and not higher, considers the nature of the surrounding industrial development in this location, the duration of viewing opportunities, and the nature of the proposed works.

The management of the construction process through the site EMP and the requirements of the environmental approval will help ensure that any adverse impacts resulting from the construction of the project on landscape and visual amenity are minimised or mitigated.

3.17.3 Transport and associated infrastructure

The construction and operation of the Precinct and all other proposed developments in the PoT direct vicinity will result in an increase in traffic to and from this area of Townsville. There is also a need to develop infrastructure to support the proposed developments. Potential for cumulative changes in vessel movement impacts are addressed below under Nature Conservation.

Infrastructure

Given Lot 773 is currently an intertidal marine sand/mud flat there are no existing services and infrastructure in this area. As identified under Section 2.6, construction of the Precinct will require that services infrastructure (sewerage, storm water, telecommunications etc.) be developed to supply the Precinct for its lifespan. No cumulative impacts resulting from concurrent development of other projects upon these services are anticipated. Reduction of any potential direct impacts, particularly from reclamation works, could be achieved by concurrently developing the Precinct and the Services Corridor adjacent to the Precinct.

Transport

Operational completion of the first stage of the development will coincide with completion of the TPAR in December 2011. The transport corridors for construction activities of the TPAR, TMPP and other concurrent projects are expected to be the same up to the first stage of completion. It is expected that following completion of the TPAR construction traffic for all developments will be mobilised to the port district via the TPAR. This will facilitate completion of Stages 2 and 3 of the Precinct. Until that access is operational traffic routes through South Townsville are expected to be impacted in a cumulative manner. In particular, traffic assessments have considered routes that traverse along the Bruce Highway, Stuart Drive, Abbot Street, Saunders Street, Benwell Road and Archer Street.

This study has shown that the Boundary Street / Saunders Street intersection will require upgrade prior to 2011 to enable continued performance under an increased growth in background traffic in the area. This intersection upgrade is not a Precinct specific issue but one related to continued growth in the region realised to 2027. Consideration will also need to be given to upgrading the Benwell Road / Archer Street intersection prior to 2027 to accommodate predicted increases in background traffic.

The impact of the traffic generated by the development is not considered by DMR guidelines to be significant at a number of utilised intersections because the development traffic contributes less than 5% of the background traffic.

Construction related traffic generated by the site will have a negligible impact on the adjacent road network at the 2011 horizon at which time the TPAR will provide alternative access opportunities to the port industrial precinct. Hence, the assessment has demonstrated that there are no foreseeable traffic related impacts, including in response to cumulative impacts, that should prohibit the proposed development from proceeding.);

3.17.4 Climate and climate change

A number of climate change projections for temperature, rainfall, sea level rise and severe storm frequency have been noted for a 100 year time span for the Townsville region under Section 3.5. The impacts of climate change are likely to affect many infrastructure projects with a projected lifespan greater than 30 years. Therefore an assessment of this project's vulnerabilities to climate change was undertaken. It was noted that the detailed design process for the Precinct will need to consider future climate change predictions are addressed adequately to reduce risks to proposed infrastructure. However, none of the concurrent projects are expected to compound any identified influences of the predicted climatic changes on the TMPP.

3.17.5 Surface waterways and Groundwater resources

The TMPP site represents wholly intertidal and subtidal marine environment in its current state. During rainfall surface water runs off adjacent lands into this site and, hence, into the surrounding marine environment. Similarly, groundwater flows have been demonstrated to run from adjacent areas to the Precinct location. Reclamation works to be undertaken as part of the TMPP may impact upon the groundwater flows temporarily during construction of the TMPP and these potential impacts were addressed under Section 3.7. Given the location of parallel projects in relation to the Precinct, it is likely that only the TPAR could have any cumulative impact on surface and groundwater flows in the vicinity of the TMPP. This may be realised as a result of compounded impacts from mounding associated with construction of the TPAR in conjunction with the TMPP reclamation works. Groundwater levels may be raised and the direction of flow may alter until an equilibrium is reached during reclamation works. Surface water flow directions may be altered due to land built barriers to their natural progression downstream that exists currently. Inappropriate waste management could lead to contamination of the watertable or run off of contaminated material into the surrounding environment. Detailed design approaches for the TMPP and the TPAR should take these matters into consideration and develop appropriate construction and impact management strategies to address the potential cumulative impacts upon these systems.

3.17.6 Coastal processes and sedimentation

The coastal processes that operate in the vicinity of the proposed Precinct at the mouth of the Ross River have been investigated by examining sediment inputs and the processes that effect such including longshore sediment transport and historical sediment movement regime for the area. This has been done in conjunction with an assessment of the influence of waves on sediment movements. From this a description of the existing littoral transport regimes has been developed and is provided under Section 3.8. The effect of the proposed development on those processes has been assessed in the context of concurrent works and historical patterns of change and the likely operation issues for the Precinct in terms of sediment movement have been identified.

The existing Port development blocks any influence of coastal processes in the vicinity of the Precinct on the coastal areas north-west of the Port. The establishment of a Precinct, the TPAR or additional Port infrastructure will not influence this fact. The Port development (including the Port areas beyond the original coastline, breakwaters, other reclaimed areas, and the dredged entrance channel) effectively isolates the processes that occur south-east of the Port from the areas to the north-west.

The proposed Precinct will have no additional contributory effect causes of any existing coastal degradation to the west of the Port and hence will have no influence on the state of the beaches to the west in either the short or long term.

Breakwaters proposed to be parallel to the existing dredged channel will affect sediment movement into the channel near the outer sand banks. Where the breakwater crosses the active littoral zone, it can be expected that there will be a slow build-up against the breakwater extending away to the south-east. The rate of build-up will be commensurate with the prevailing longshore transport rate. Construction of the TPAR, the TOT or other port infrastructure not expected to compound this process or influence it in any way.

The coastal processes in the vicinity of the Precinct comprise both onshore/offshore and longshore components and are influenced by the proposed breakwater structures in a number of ways. However, the processes are capable of moving sediment at only relatively slow rates due to the low wave climate and hence any changes will take time to develop and will be restricted to the local area. It is concluded that it is unlikely that there will be any significant affects on coastal processes from the construction of the Precinct on the coastal areas beyond around 500m south-east of the breakwater structures and that the predicted effects on this area of coastline will not be compounded by parallel developments.

3.17.7 Hydrodynamic investigations

Hydrodynamic model investigations have been undertaken to examine potential impacts upon bed shear stresses, flushing, water circulation patterns, potential for sediment resuspension and flooding impacts resulting from the TMPP. These investigations have been conducted on the reference design footprint of the TMPP to understand the direct impacts of that development. Investigations have also been conducted to understand the potential compounded influences from the TPAR and Precinct on water movement within this local area. These are described in detail in Section 3.8.

Studies demonstrate that the breakwater provides protection and hence both the marina and navigation channels in the Ross River show little change in bed shear stresses with limited potential for any significant risk for erosion or siltation in this region during simulated storm wave conditions. The developed case maintains an adequate level of flushing with only minor influences on existing circulation patterns. These patterns are not expected to be effected by construction of the TPAR.

With the Ross River discharging directly into the Precinct area and the potential for the TPAR to constrict this discharge prior to the Precinct it is important to consider whether there are any potential implications for erosion or flooding. Information on the Precinct configuration has been provided to the TPAR project to assist in this assessment process. TPAR studies are continuing and finalised information to support examination of cumulative impacts is still pending. Information reviewed from the hydraulic assessment for the TPAR, provided in draft form in May (QDMR 2009), has been used to support development of the potential for cumulative impacts for this study.

It is understood that the optimum design configuration for the TPAR was determined with a number of bounding objectives, including achieving no more than 30mm afflux at adjacent suburbs in a 100 Year ARI event. It is also understood that the TPAR project has determined appropriate construction approaches to reduce potential for scouring and erosion of the TPAR footings. The Precinct is not expected to compound this potential and the breakwater may act to decrease erosion potential.

As reported QDMR (2009) assessment of potential flooding impacts was undertaken for the following cases:

- The preferred Eastern Access Corridor (EAC) design only;
- The preferred EAC design with the future railway corridor; and
- The preferred EAC design with a future marine precinct development.

The flood levels in both the base case and the design cases were used to assess afflux at surrounding suburbs. The velocities at the structures were used to review the potential for scour with scour protection measures identified. The model was also used to assess the changes in extents of tidal inundation.

The preferred EAC design has ensured affluxes less than 30 mm adjacent to the adjacent residential areas of Cluden, Oonoonba and South Townsville in a 100 Year ARI event. The construction of the railway corridor also maintains affluxes less than 30mm adjacent to the residential areas in a 100 Year ARI event. The inclusion of a marine precinct adjacent to the mouth of the Ross River increases potential flood levels between the Ross River Bridge and the Breakwater by no more than 50 mm. The increase in flood levels upstream of the Ross River Bridge is less than 0.01 m. The increases upstream result in a combined afflux of 30 mm immediately downstream of some properties in South Townsville. However, the report does not differentiate the relative impact of the TPAR compared to the Precinct in this assessment and the findings are for the cumulative impact of the two developments. It is noted that there are no significant changes in water levels at the bridges and major culverts between the design case and the design case including the marine precinct.

Overall, it is concluded that the combined influence of the TPAR and Precinct does not significantly affect the flood levels, with only minor impacts downstream of the Ross River Bridge (QDMR 2009) which will need to be considered as part of the detailed design for the Precinct.

The Ross River is highly regulated, with the Ross River Dam and several weirs constructed. This provides a mitigated pattern of flood flows discharging from the Ross River past the Precinct into Cleveland Bay. It is noted that for flood events occurring at low tide, the flood will tend to be contained largely within the existing channel, with shallow sandbanks to the north-east of the river mouth acting as a constraint. Under increased severity there is expected to be branching (separating) flow between the breakwaters and also along the tail of the eastern breakwater. These predicted changes at the ends of the proposed breakwaters have implications for breakwater design. From an environmental impact perspective, there will only be minor changes in erosional and depositional characteristics for these conditions. Completion of TPAR studies may provide additional information to support these findings but is unavailable at this time.

3.17.8 Water and sediment quality

Parallel development of projects in the Townsville region is not expected to impact upon the water and sediment quality in the area except for in regards to dredging impacts. The key impacts of a typical dredging and reclamation project are:

- Impacts on water quality and light penetration through the generation of turbid plumes;
- Direct impacts on marine flora through removal of actual or potential habitat and sediment deposition;
- Direct impacts on marine fauna through removal of habitat and food source; and
- Indirect impacts on marine flora through changes in coastal processes such as magnitude and direction of tidal currents, water levels, waves and flushing (either through dredging of new areas or introduction of new marine structures) and reduction in water quality, which impacts on light availability.

Key drivers that can change the extent and severity of these impacts is the length of the dredging campaign, the type of equipment used and the way in which it is operated, the type of sediments to be dredged and whether or not these dredging campaigns occur concurrently or sequentially.

For instance, if the capital dredging for the TMPP, as defined under Section 2 of this EIS, occurs while another dredging program occurs, the spatial extent of turbid plumes could overlap and, accordingly, the impact of the combined two plumes above background water quality concentrations would need to be considered. Dredging approaches considered for the TMPP include backhoe and cutter suction cutter suction dredgers. These typically generate less of a turbid plume compared to trailer suction hopper dredgers, reducing the extent and migration of turbid plumes resulting from the proposed capital dredging programs. Where there is a risk of confounding impacts of multiple dredging programs on water quality, the dredging approach, scheduling of the dredging and the concurrent locations of the dredgers should be considered to reduce the likelihood of confounding impacts beyond those likely from a single program.

Should reclamation activities for the TMPP coincide with construction works of the TPAR there is potential that water quality in the vicinity of the TMPP may be compound due to the combined effect of construction and decant activities. If this is likely to occur the measures that need to be employed to manage the quality of the decant waters from the TMPP to achieve the required water quality trigger values need to be appropriate to that construction timeline. This might involve construction of more internal cells to increase retention time and allow adequate settling of fine particles. This may also increase the length of time that the decant waters are being discharged, which would increase the length of time the receiving environment would be exposed to the discharge of turbid waters. However, if the decant waters meet the appropriate water quality trigger values, the impacts on the receiving environment should be appropriately mitigated. Water quality trigger values should be reviewed with this consideration in mind should multiple projects proceed concurrently.

Ocean disposal of material from construction of the TMPP has been examined during the conduct of this project through a desktop review of recently completed work (WBM 2009 Draft) in consideration of previous study findings. Disposal of material related to the TMPP is not predicted to have significant influence on the ecology of Cleveland Bay. Ocean disposal at the existing ground has occurred on a regular basis for some years and the seagrasses (eg see Rasheed and Taylor 2008) and other benthic systems (eg see Cruz 2000) in the immediate vicinity of the spoil ground have been shown to be well adapated to the existing disturbance regime (including dredge disposal) of Cleveland Bay and appear resilient to dredging impacts.

Impacts may occur, however, if spoil from a number of projects is deposited simultaneously. Likely impacts from cumulative disposal approaches would include an increase in the size and persistence of any disposal plumes, which could have flow on effects for light dependent sensitive ecosystem receptors, including seagrass meadows. Mitigation strategies for ocean disposal impacts relating to this project have been proposed under Section 3.8 and 3.9. Future projects will need to identify whether they might occur concurrently with the dredging activities associated with this project and whether mitigation and management measures need to be altered to provide adequate mitigation of impacts.

3.17.9 Nature conservation

3.17.9.1 Terrestrial ecology and wading avifauna

The project area (Lot 773) is currently intertidal and subtidal land that will be reclaimed to construct the Precinct. There is a small (<1.5 ha) patch of fragmented vegetation fringing the project area which will also be removed during the construction process to enable the services corridor for the Precinct to be developed. Given the limited relevance of the Precinct to the terrestrial ecology of the area, the identified impacts to the terrestrial ecology of the area from construction of the Precinct are not expected to be compounded by the parallel construction of the TPAR or other proposed projects.

Increases in traffic activity for the operation of the proposed facilities may affect a cumulative impact on the terrestrial ecology resulting from multiple developments in the area. Of principal concern are impacts to vegetation and terrestrial communities on the east bank of the Ross River associated with construction, operation and potential increased traffic use of the TPAR to access the Precinct. A byproduct of the TPAR may be an increased ability to access intertidal areas on the east bank of the Ross River. This area supports mangrove and sclerophyll communities, and subsequently also fauna, and the offshore area is of regional importance supporting wading and migratory avifauna that are protected under international conservation agreements. Increased access potential carries a risk of increased disturbance of vegetation, resident mammals and feeding shorebirds.

Measures to mitigate against potential impacts to the east bank from construction and use of the TPAR will have been identified in the studies conducted for the TPAR. Adoption of those measures by the TPAR project should seek to mitigate any cumulative impacts. However, to avoid any potential additional impacts the following guidelines should be considered for the construction of the TMPP:

- Impacts to the foreshore and mangrove communities on the east bank should be avoided. This includes avoidance of impacts to the presence and extent of the high tide bank through changes in sedimentation patterns from infrastructure construction. It also extends to avoiding increased access to the area from boating activity. This is a critical area for beach stone curlews and other avifauna, with suitable nesting locations in this area, and also for the water mouse (if present);
- Mudflats and other open areas should be retained and kept weed free. These areas offer suitable habitat for avifauna including Radjah shelducks, black-necked storks and white-rumped swiftlets;
- Sedimentation from Port works should be carefully managed and contained to avoid impacting on crocodile habitat; and
- Sclerophyll vegetation on the east bank should be retained. Standing stags and dead timber on the ground should be retained – if woody weeds are cut down the wood should be left in situ (with seeds and reproductive material removed). These areas offer important habitat resources for the rusty monitor, and the coastal sheathtail bat and the white-rumped swiftlet will utilise flyways over canopies to hawk for insects.

3.17.9.2 Aquatic ecology

Construction of the Precinct about the mouth of the Ross River will result in marked disturbance of the marine benthic habitats within this area. The main potential construction impacts include removal of benthic habitat, declines in water quality associated with construction events and potential impacts to marine megafauna from vessel operations. The main potential operational impacts include continuous disturbance of benthic marine systems, impacts to water quality, impacts to marine megafauna from vessel operations and increased potential of pollution to the marine environment from changed use. Mitigation strategies against each impact were identified in the Section 3.10.6 under Table 3-55.

Other proposed construction projects within the vicinity of the Precinct are likely to also involve adverse effects on the marine environment similar to those resulting from the TMPP. Parallel construction and operational approaches have the potential to result in compounding or cumulative impacts.

The benthos that will be directly affected by construction of the Precinct is known to occur in other locations within Townsville region including in other locations within the Port, Rowes Bay, Pallarenda and Magnetic Island. It is not considered to be a community or ecosystem of high value either in its own right or as a critical feeding ground for other, higher order, species. Cumulative removal of this type of seabed community is not expected to have a negative effect on the importance of the benthic marine habitats of the Townsville region. Nor it is anticipated to reduce biodiversity of the region significantly.

The mud flat across Ross River from the Project Area hosts a similar diversity to the benthos of the area that will be removed as a direct result of construction. Strategies to avoid impacting the mud flat site, and maintenance of the mud flat in perpetuity should be considered, as noted above, to provide opportunities within the immediate area of the Precinct for continued presence of taxa that will be removed as a result of construction of the Precinct. Development of the inner harbour of the Precinct will provide future opportunity for some of the Lot 773 area to be recolonised with benthic taxa from adjacent environs like the mud flat. This may partially offset some of the habitat losses associated with direct removal. Creation of interstitial rocky shore habitat both intertidally and subtidally through provision of rock revetment walls of the Precinct and development of the breakwater may also partially offset some of the habitat losses associated with direct removal.

Megafauna species were noted within the Ross River area with only stingrays noted to be using Lot 773 as a potential feeding site. Stingrays could be targeting (as a food source) the benthic infauna and epifauna occurring within the sediments of Lot 773 and surrounding areas, including the small crustaceans and bivalve molluscs reported in this study. Similarly, crab and fish fauna were also noted within this area and are likely to also be targeting benthic fauna as a food source. As noted above, these benthic communities are not unique to the Townsville region and are well represented to the north and south of the Port environ. Removal of the benthic habitat associated with Lot 773 is, therefore, not likely to negatively affect the stingray, crab or fish populations of the Townsville region. This conclusion is also supported by sightings of similar taxa using the mud flat on the eastern bank of the Ross River across from the Precinct area. As noted above, maintenance of the mud flat environ would provide a continued opportunity for these fauna to use the mouth of the Ross River for feeding.

Construction activities associated with the TPAR, Port Berths, Cove and TOT will also all likely impact negatively upon the benthos occupying areas of the seabed in the direct vicinity of each development. The cumulative impact of this habitat removal in conjunction with the development of the Precinct is not expected to negatively effect prevalence of the benthic flora and fauna detected during this survey in the Townsville region given they are well represented. Including in areas that will not be affected by construction activities to the north and south of the Port environment such as Cape Pallarenda and around Magnetic Island.

Megafauna other than stingrays, including turtles, dugong or dolphins, were not noted to be using Lot 773. This observation is supported by a lack of key food groups for these megafauna within the area, including, but not limited to, seagrasses. Seagrasses were found offshore of the mouth of Ross River, a finding consistent with that reported by Rasheed and Taylor (2008). As noted under Section 3.17.8 there is potential for degraded water quality to impact these offshore meadows particularly if dredging activities for proposed development activities coincide and produce a larger or more persistent plume than anticipated by any single activity. Potential water quality impacts quality impacts are examined under a detailed study provided as Appendix J of this EIS and summarised in Section 3.9, which includes information on construction dredging assessments and dredge plume potential. Cumulative impacts and mitigation measures are noted under Section 3.17.8 and further discussion is provided following.

Seagrass communities are recognised as important ecosystems for maintenance of seabed stability, water quality and biodiversity (Collier and Waycott, 2009). In addition to their intrinsic value, seagrasses are known to act as nursery grounds for juvenile fish, which may be targeted by commercial and recreational fishers, or be an important food source for other fish and megafauna species. Seagrasses are also an integral food for marine megafauna including turtles and dugongs. Collier and Waycott (2009) identify a number of natural and anthropogenic activities that may impact the persistence of seagrass meadows and cite high sediment loads as a particular feature of the Townsville region. Rasheed and Taylor (2008) note that seagrasses in the vicinity of the Townsville port are likely adapted to high levels of turbidity both as a result of naturally occurring high turbidity for the area and also in response to existing levels of maintenance dredging and shipping activities. These compounding influences on turbidity are, however, recognised to be short-lived and events to which the meadows have some resilience. Significant impacts may occur to the presence, taxonomic composition or biomass of meadows when the severity or duration of any particular impact exceeds levels of natural variation (Carruthers *et al.,* 2002, Erftemeijer and Lewis, 2006 and Orpin *et al*. 2004). Rasheed and Taylor (2008) and Collier and Waycott (2009) both note considerable risk of impact to seagrass meadow prevalence in the Townsville region from prolonged periods of reduced water quality resulting from compounding influences.

Given the ecological importance of seagrasses within this region, and the considerable risk of cumulative impacts to seagrass meadows from concurrent project development, consideration should be given to monitoring the presence and prevalence of seagrass meadows and the quality of associated water bodies adjacent to the port to determine if any negative influences from construction and operational activities affect these sensitive ecosystem receptors. Management response plans to declines in water quality and / or prevalence of seagrass meadows linked to development of the Marine Precinct should be developed. These may include, for instance, alteration of dredging activities (frequency, duration) to enable water quality levels to return to background conditions if unacceptable declines in water quality during dredging from dredging activities were detected.

Additional cumulative impacts that may result from increased traffic activity associated with construction activities in the mouth of Ross River (TPAR and Precinct) include increasing potential for boat strike of megafauna or increased avoidance of the area by fauna. Development of a construction vessel management plan taking into consideration cumulative impact potentials and addressing management strategies including speed limitation, extension of 6 knot speed restricted area to the offshore breakwater, need for observation for marine megafauna, appropriate strategies to avoid interaction with megafauna and reporting of any interactions should be considered.

Direct impacts as a result of increased or changed utilisation of Lot 773 area will not likely be compounded by cumulative impacts from other projects once the reclamation activities for construction have occurred. This area is already heavily utilised by public groups undertaking activities including, but not limited to, dog walking, fishing, beach collection and picnicking. Beach collection activities range from shell collection through to sourcing of bait species for estuarine fishing. It is estimated that at least 30,000 people visit the beach on an annual basis for various recreational activities. Reclamation and construction of the industrial precinct will remove the capacity for this activity to continue. As adjacent areas subject to development do not offer the same/similar recreational opportunities there is little potential for any cumulative impacts from adjacent developments. Boating (tinny) activities and jet-ski activities that currently use the beach area for recreational purposes will still be able to access the Ross River for recreational activities after completion of the TPAR construction. Only vessels greater than 6m in height will be restricted entry to the river upstream of the bridge after completion of this access corridor. Fishing, picnicking and beach walking currently do not occur in the footprint of the other development projects occurring in the Townsville region and there are no anticipated cumulative impacts to the loss of these activities.

Coastal impacts of the proposed Precinct have been assessed under Section 3.8 of this EIS, a detailed report is provided as Appendix R. From that information it is known that the sand spit at the mouth of Ross River is highly mobile and changes shape according to seasonal and flood influences. This area is also currently utilised by all-terrain vehicles, including four-wheel drives and quad-motorbikes. The mud / sand interface between the sand spit and mud flat area are also accessed and utilised by recreational fishers seeking bait for estuarine fishing. This practice occurs on an almost daily basis during calm fishing conditions. Thus, the sand spit does experience a degree of impact despite its isolation from the road. Avoiding impact on this area for extractive activities will assist in maintaining recreational opportunities for fishers and beach visitation for a subset of the current recreational users of Lot 773.

Dog walkers and beach picnickers would not have ready access to the sand spit area and given the sensitive nature of bird communities using the area (refer Appendix V) this should not be encouraged. Increased or changed utilisation may result in unfavourable impacts upon these preserved marine environments and the communities they support. Opportunities to mitigate against any increased impacts may include development of public education information regarding bird nesting and include exclusion of access to sites during critical nesting periods. Overfishing of bait species, such as yabbies (*Callianassa sp.*), that are currently sourced from this habitat may eventuate in self-regulation of this activity. Increased effort would likely reduce yield and result in recreational fishers sourcing their bait from other areas where greater return for fishing effort is achievable. Otherwise, if overfishing is noted to be reducing populations of bait species to non-sustainable levels, measures to manage influences may also need to be considered including public education approaches. Exclusion of access to the sand spit area during bird breeding season would provide a level of indirect protection to the bait species being targeted. These mitigation opportunities would need to be considered by managers of the sand spit, particularly if cumulative/additional or changed impacts to the sand spit/mud flat area were detected following completion of the TMPP and TPAR.

Expected construction activity impacts identified in Table 3-55 are likely possibilities under any of the other proposed adjacent projects. As a consequence, concurrent construction impacts in adjacent sites and, therefore, compounding of the identified impacts is also possible. Consistency in application of mitigation measures identified for this project should be considered for all other projects to reduce potential for cumulative impacts. In particular development of management plans for dredging, construction, waste management and hazardous material risks should be undertaken for the Marine Precinct such that the potential for cumulative effects, from other adjacent developments are considered and accounted for. This project, under identified mitigation strategies, is not expected to have any significant or long term negative impacts upon the ecological communities supported within this region.

3.17.10 Air quality

Dust is the predominant impact likely to occur from construction and operation of the Precinct. Dust impacts to the community during construction of the reclamation area are unlikely to be substantial due to separation distances and the moist nature of the dredged material being used to reclaim. Dust emissions from construction and operation can be managed to ensure that adverse impacts do not occur at sensitive locations offsite. Mitigation measures for dust during construction and operations are outlined in the Section 8 and include options like wetting or sealing of access roads. Parallel construction of adjacent projects, including the TPAR, have potential to increase the dust load within the local airshed. However, similar dust and air quality mitigation measures should be adopted by those adjacent projects to address the impacts likely from those projects. Hence, if all proposed mitigation measures are adopted no cumulative impacts on air quality are predicted.

3.17.11 Greenhouse gas assessment

Although, from the Reference Design, sufficient information was not available to quantify the greenhouse gas emissions from the operational phase of the TMPP, it is expected that due to many of

When compared with the annual baseline emissions for Queensland, the GHG emissions potentially being generated from the main sources during the construction phase of the TMPP could be expected to be approximately 0.01% of the annual emissions profile for Queensland (refer Section 3.12). The exact industry base of the Precinct is still being determined and, at this stage, full quantitative assessment of all operational impacts is not possible. However, it is noted that operation of the Precinct will make a contribution to the annual emissions profile for Queensland. However, as many of the industries likely to occupy the Precinct are already operating within the local area, and given that maintenance dredging requirements not expected to increase, additional operational emissions from this project are considered to be minimal. It is likely that relocation of industries using older facilities to the Precinct may provide for a reduction in current GHG emissions from those industries through the introduction of new technologies.

Several mitigation options for the construction and operational phases of the TMPP are outlined in Section 3.12. These included choosing options that minimise material use and sourcing materials from the closest possible locations. All other projects proposed for construction in the vicinity of the Precinct would also contribute GHG to the existing annual emissions profile of Queensland, however, the concurrent development of these projects is not predicted to increase the individual contribution of any of these projects and may, due to efficiencies in equipment mobilisation, provide avenues for decreasing the overall emission contribution. For instance, mobilising equipment to develop the services corridor at the same time as the Precinct increases the efficiency of the construction of both of these projects and would likely realise a small net decrease in GHG emissions compared to independent development of each of these projects.

3.17.12 Noise and vibration

Modelling of noise generation associated with construction activities under a scenario of no noise barriers or acoustic shielding in place and with each plant item operating at full power shows that anticipated noise levels from the TMPP construction compare to existing daytime ambient noise levels for all plant activity except pile driving, which will be managed through appropriate construction management plans so as to not impact upon sensitive receivers, including occupants of the Precinct. Hence the only predicted cumulative impact on noise and vibration from construction activities relates to underwater impacts resulting from dredging and construction of marine structures. Sequential or concurrent dredging and marine construction projects (eg TPAR plus TMPP) have the potential to result in impacts on marine fauna that are sensitive to changes in the underwater noise environment. As noted under Section 3.17.9.2, sensitive marine animals, including turtles, dolphins and dugongs, have not been found to be using the TMPP site during this EIS investigation. They are known to use the Port environment and the mouth of the Ross River. Mitigation measures to avoid impacting upon these sensitive megafauna have been proposed under Section 3.10.7 for this project. These are applicable to potential cumulative impacts, as noted under Section 3.17.9.2, and include measures like using a partial strike to warn nearby megafauna of construction activities to enable avoidance of the habitat during those periods. Future projects will need to consider the impacts of underwater noise on sensitive marine fauna should they occur concurrently or immediately following the TMPP.

Operational noise will largely be dependent on the types of business and industry that will locate within the TMPP. It is expected that these will include industrial activities such as boat building, abrasive blasting, surface coating, workshops, storage of goods, and packaging, all of which are likely to operate within sheds. Other noise generating activities associated with this will include trucks and forklifts, trawlers and boats. Modelling of worst-case scenarios predicts that noise generated from the Precinct during operation will be similar to existing noise levels in the area. This level of impact is expected to be attenuated given that many activities will likely be located inside buildings. This will block noise sources from site receivers due to adjacent buildings, walls and barriers. In addition, the location of the Precinct, being at a distance of more than 350 m from the nearest sensitive receivers, further mitigates the potential for impact from the Precinct alone. The presence of a compacted dirt ramp (supporting the TPAR) between the TMPP and the nearby receivers may further mitigate operational noise from the Precinct. Hence there are not predicted to be compounding noise and vibration impacts from the operation of the Precinct but the combined development of the Precinct and the TPAR may act to decrease noise and vibration impacts experienced at sensitive receptors originating from the TMPP.

3.17.13 Waste management

Given the environmental values of the surrounding area of the project site, effective waste management will be an important aspect of any development in the area. The waste streams expected to be generated by each component of the TMPP have been detailed in Section 3.14 with an assessment of the potential environmental impacts of the wastes and options for waste management aimed at protecting environmental values are also provided. Identified impacts could be expected to be compounded by uncontrolled parallel developments, however, these other developments will have in place similar waste management requirements and mitigation measures. The predicted impacts and mitigation / management measures identified for this project are considered directly applicable to management of any cumulative impacts.

3.17.14 Cultural heritage

There are no predicted impacts on European or Indigenous cultural heritage resulting from this project and assessment based on known information regarding potential future projects indicates there are no expected cumulative impacts on historical heritage from the proposed future projects. All proposed projects should, however, liaise with the traditional owners and Native Title claimants of the area to determine whether any of the projects are likely to impact on any aspects of indigenous cultural heritage.

3.17.15 Health and Safety, Hazard and Risk

Only transient impacts on health and safety are expected during the construction phase of the project. Some of these impacts may be increased should other dredging and marine construction projects occur concurrently with the TMPP. For instance traffic related risks with mobilisation of construction workforce to the port precinct may increase with an increased volume of workforce attendance. Mitigation measures provided for impacts related to this project in Section 3.16 are relevant to these potential compounded impacts. These should, however, be reviewed if projects are to occur concurrently to determine whether additional or modified management measures are required to achieve the required health and safety outcomes.

Similarly, many of the hazards and risks identified for the TMPP will occur during the construction phase and have the potential to be cumulative if a number of the proposed future projects occur concurrently. If projects are to occur concurrently, the mitigation measures proposed against the risks identified in this project (refer Section 6) will need to be reviewed to determine whether any additional mitigation measures are required. For instance, in the case of multiple dredging programs occurring at the same time, communication strategies to inform other vessels of dredging movements may need to be considered to adequately manage the risk of congested waterways and access to vessel facilities, including boat ramps, in Ross River. Any such approach would be determined in discussions with Maritime Safety Queensland.

3.17.16 Social values

Potential cumulative social impacts that may result if the TMPP and other proposed future projects proceed are primarily related to reduced access to the coast and impacts on recreational opportunities. This primarily relates, however, to the TMPP and in a small way to the TPAR as other projects are on lands that do not provide public access or provide only restricted access. Additional comment regarding this was provided above under Section 3.17.9.2. Many of the potential impacts are expected to be short lived during construction activities. Some long term impacts, such as loss of a dog walking area as a result of construction, may be offset through redevelopment of lands upriver currently occupied by industries that are likely to relocate to the Precinct.

While the TMPP will not place significant pressure on the local labour force or housing market, if other projects occur concurrently with this project, it will contribute slightly to the overall pressures on the Townsville region in terms of labour force, accommodation and community and social support services. Consideration should be given to this potential for future project planning.

3.17.17 Impacts on local economies

In general, developments such as the TMPP and others proposed within the Townsville region result in net economic benefits to the local, regional, state and sometimes national economy. However, while there may be a net economic benefit from each project individually, if a number of projects proceed concurrently, there may be impacts on some aspects of the economy such as increases in house prices, rental prices and the ability of labour market and support services to provide adequate levels of service to all projects. This may result in the import of some labour and services from outside the local area.

3.17.18 Summary

The TMPP is not considered to make a significant contribution to cumulative impacts associated with wider strategic policy such as greenhouse as emissions, regional resource consumption and waste disposal. The ability to upgrade some operational industrial facilities through relocation to the new Precinct in fact provides opportunity to realize some reductions in existing cumulative impacts, such as to GHG emission or water quality impacts. Although a number of potential cumulative impacts have been identified, the most significant area where cumulative impacts are likely from concurrent or successive project development within the port precinct in Townsville relate to the marine systems of the area. The TPAR construction is expected to commence prior to the Precinct construction and there may be overlap in construction activities. These projects, and others that may undertake dredging and disposal activities and in water construction need to consider the potential cumulative impacts identified here and adopt appropriate mitigation strategies.

PORT of TOWNSVILLE

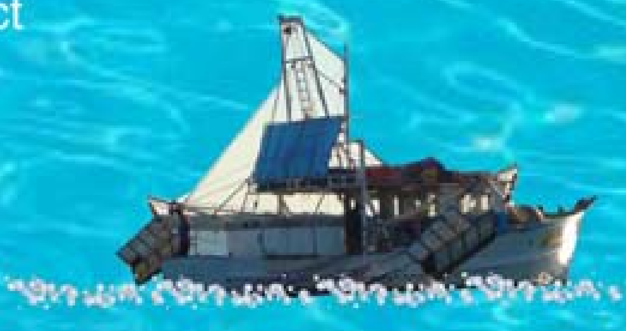
North Queensland

Section 4
Social values and management of impacts

Townsville Marine Precinct Project

Environmental Impact Statement

GHD



4. Social values and management of impacts

4.1 Overview

The objective of the social impact assessment for the TMPP is to describe and assesses the potential impact of the proposal on the objective social environment. It has excluded any detailed assessment of the economic impacts of the proposal which is being undertaken separately by AEC*group* and is reported under Section 5.

The description of the existing social environment included an assessment of:

- The social amenity and use of the project area and adjacent areas for fishing, recreational, tourism, industrial, residential and/or educational purposes;
- The population, demographic, social and cultural profiles at the local level with regional and state relative comparisons;
- The community infrastructure and services, access and mobility (including but not limited to housing, health and educational facilities);
- the recreational, natural, cultural, leisure and sporting facilities in relation to the affected area;
- The integrity of social conditions, including amenity and liveability, harmony and wellbeing, sense of community, access to social and community services and infrastructure; and public health and safety. The assessment of potential social impacts on the existing social environment included both construction and project completion impacts and addressed immediate and long terms impacts and potential cumulative or additive impacts.

Where potential social impacts were identified, possible approaches to mitigating and monitoring these impacts have also been described.

4.2 Description of existing social values

4.2.1 Methodology

The methodology that has been used to undertake this social impact assessment is based on:

- Community consultation notes taken as part of the one-on-one community consultation and social impact assessment for the EIS;
- Written submissions and completed questionnaires received as part of the community consultation and social impact assessment for the EIS;
- Australian Bureau of Statistics Census data; and
- Other available background information and reports (GHD Ltd Report for the Proposed Townsville Port Marine Precinct (Lot 773 and Benwell Road) Public Use and Traffic Surveys (June 2008)).

A number of engagement techniques were used in the community consultation and social impact assessments. These techniques included:

- Development and distribution of fact sheets, letters and questionnaires;

- Establishment of a dedicated project 1300 number with recorded message service;
- Establishment of a project website with on-line submissions form;
- Establishment of a project email address; and
- Newspaper stories and advertorials.

As noted under Section 1.6, at the time of consultation, artists impressions and detailed layouts of the TMPP were not available, and only an early conceptual diagram was used to assist community and stakeholders visualise the likely layout and footprint of the TMPP (refer Appendix AA). It is, therefore, likely that on review of more detailed visual representations of the TMPP there may be some changes to the type and extent of social impacts identified by community and stakeholders to date.

Community and stakeholders will have an opportunity to review the artists impressions and more detailed layouts of the TMPP when the EIS is released for public comment and in the public displays that will be held as part of that process.

4.2.2 Demographic profile

A detailed analysis of the demographic profile of the Project study area is included in Appendix AA. Key findings are summarised as follows:

In 2006 the resident population of South Townsville was 2,378 people, which represented a decline of 4% since the 2001 census period. The occupancy rate for South Townsville in 2006 was also slightly lower than that of the Townsville Local Government area and the State of Queensland.

South Townsville also has a relatively lower percentage of separate houses (60%) when compared to Queensland and the Townsville Local Government area, and a significantly higher percentage of flats, units and apartments (35%). The decline in separate houses and corresponding increase in flats, units and apartments has been a general trend evident in South Townsville at least since the 1996 census period.

South Townsville has relatively fewer private dwellings that are fully owned (20%) or being purchased (23%) and a relatively high percentage of dwellings that are being rented (40%).

The age profile of the South Townsville population shows that while the percentage of the population over 65 years is similar to that of the Townsville Local Government area and Queensland, the percentage of the population aged 14 years and below is significantly lower than that found in Townsville and Queensland. As a consequence the age dependency ratio, which is the proportion of the dependent population (aged below 14 years and over 65 years) to the working population (aged 15 to 64 years), is lower than that found in the Townsville Local Government area or Queensland. Table 2 also shows that lower age dependency in the population is a trend that has continued since the 1996 census period.

Although the labour force participation rate is similar to that found in Townsville and Queensland, the unemployment rate in South Townsville is marginally higher. In addition, while household incomes are similar to Townsville and Queensland, individuals incomes are significantly higher than that found in Townsville and Queensland.

In comparison to the Townsville Local Government area and Queensland, South Townsville is relatively more 'white collar,' with a relatively higher percentage of managers and professionals and a relatively low percentage of workers in clerical, administrative and sales occupations or who were machinery operators and labourers.

South Townsville has relatively fewer children attending pre-school, primary and secondary school and in comparison to the Townsville Local Government area, relatively fewer people attending university or other tertiary institutions.

In relation to family structure, South Townsville has a relatively higher percentage of couples with children and relatively fewer one parent families. However the percentage of people who were separated or divorced in South Townsville is higher than that found in Townsville or Queensland.

The socio-economic indexes for areas (SEIFA) shows that relative to other locations across Australia, South Townsville is only slightly more advantaged (6^{th} decile).

The Index of Economic Resources reflects the profile of the economic resources of families and the income and expenditure of families, such as income and rent. The relatively low score on this index in the South Townsville area (2^{nd} decile) indicates a relatively high proportion of households on low incomes and living in small dwellings.

The relatively high score on the SEIFA index of education and occupation indicates a high concentration of people in South Townsville with higher education qualifications or undergoing further education, with also a high percentage of people employed in more skilled occupations.

4.3 Potential impacts and mitigation measures

4.3.1 Potential impacts

4.3.1.1 Population and Demographics

The population and demographics of South Townsville is not expected to change significantly as a result of the construction or operation phases of the TMPP. As the construction workforce is expected to be sourced locally there will not be a significant influx of personnel from outside the region into the local suburbs of South Townsville, or surrounds as most of the workforce will already be established elsewhere within Townsville. In the operational phase of the project, particularly in phases 1 and 2, the workforce is expected to be similar in composition to what it is currently, particularly if the existing Ross River marine industries relocate to new premises within the TMPP. In phase 3 of the TMPP there may be an increase in the marine industry and associated workforce however it is not expected to result in any significant changes to the population and demographics of the local area.

4.3.1.2 Business and Employment[1]

The marine industries and businesses operating from the northern bank of Ross River either directly or through flow-on businesses employ over 600 staff. All of these businesses will be

[1] Please refer to AEC*Group* Townsville Marine Precinct Economic Impact Assessment for more detail on the potential business and employment impacts of the TMPP.

affected by the TMPP, with most expecting to relocate to the TMPP as the TPAR bridge will prevent most watercraft from accessing the current premises upstream (Townsville Ross River Marina, Rosshaven Marine, Pacific Marine Group, Riverside Marine, Water Police and AIMS would all have to relocate. Harbourside Coldstores could remain at their current site but would need alternative seafood unloading facilities located in proximity to the trawler fleet. The Department of Defence Ten Terminal Regiment facility would also remain at its current location).

While the TMPP is viewed positively by these industries and businesses (without which they would be forced to relocate elsewhere or close their businesses once the TPAR bridge is operational), there was concern about the potential negative impacts to business in relation to timing and relocation arrangements. If the Ross River marine industries and businesses do not relocate into the TMPP, they would be forced to cease business or relocate to other areas in the region (most likely outside of Townsville) as the opportunities for relocation elsewhere in Townsville are considered very low. This would result in loss of employment for those local residents employed by the marine industries and flow on impacts to local businesses in South Townsville, some of which rely on the marine industries for much of their business.

It is expected that during the construction stages of the TMPP the majority of the required workforce will be sourced locally. There are a number of local construction firms and associated sub-contractors already established in Townsville and North Queensland, therefore the additional employment from the construction phase of the TMPP is likely to be met from within the region's existing labour force. The current easing in the job market due to the economic downturn and the fact that a number of prominent construction firms in the region, with established local workforces, have recently completed large State and Commonwealth funded projects locally means that a local workforce will be available.

In the construction phase it is not anticipated that new skills and training will be required as most of the construction related activities will be able to draw upon an existing workforce and skills base. The operational phase of the TMPP in the initial stages (Stages 1 and 2) will not require an additional workforce with specialised skills not already available locally as it will most likely house the existing marine industries of Ross River. However if there is an expansion of existing marine industries or new marine industries establish in Stage 3, there may be demand for additional employees with specialised skills. The demand is not anticipated to be large enough to result in a skills shortage or the need for specialised training initiatives.

The construction phase of the TMPP will most likely result in positive flow on impacts to existing local and regional businesses, particularly in the manufacturing, whole-sale and retail industries. Businesses located in the South Townsville area will likely benefit from increased patronage due to proximity to the project site. AEC*group* (refer Section 5) provides detailed estimates of flow on of service revenue and work to existing communities in the area in the Economic Impact Report.

4.3.1.3 Housing and Essential Services

It was acknowledged if the existing marine businesses were not relocated and were forced to close there would be a flow on affect into South Townsville in relation to essential services such as schools, corner stores, take-away outlets and hotels. A decrease in demand could lead to the services closing or relocating out of the suburb to the detriment of the people currently using those services, especially the elderly. The TMPP was, therefore, considered likely to have a positive impact on local businesses and employment in the local area by supporting existing services and potentially leading to an increased demand.

In terms of housing and accommodation, it was considered unlikely that there would be a significant impact of the construction workforce on housing demand, community services or other essential services as the majority of the workforce are expected to already be based in Townsville. Because of the central location of the project it is unlikely that the established workforce would seek to relocate from other areas of Townsville into South Townsville or surrounding suburbs and thereby place demand on the existing housing and accommodation availability in those suburbs. Even if a portion of the workforce was required from outside the region, and were relocated into Townsville, it would most likely have a negligible affect on housing and accommodation availability as there has been a downward trend in accommodation and housing demand across Townsville. Further detail assessment of economic impacts resulting from the TMPP are addressed under Section 5 following.

The TMPP construction and operation phases are not anticipated to have an impact, directly or indirectly on local health or educational facilities. The majority of the workforce for both phases will be drawn locally and therefore it is not expected that there will be a significant influx of workers to Townsville or South Townsville in particular, requiring additional facilities.

During the course of the community consultation and social impact assessment, participants provided suggestions for the mitigation and management of potential negative impacts associated with the TMPP. These are outlined below.

4.3.1.4 Social and recreational amenity

A strong attachment to South Townsville was demonstrated by many residents, including both long term residents and new arrivals. Many residents commented on the character and heritage charm of South Townsville and that the suburb was at risk of becoming over industrialised. However, for many people the reclamation of the beach adjacent to Benwell road was considered to be the most significant negative impact of the TMPP. Similarly, people were concerned they were losing more public places and that something should be given back to the community to compensate for this loss. These comments are reproduced in detail in Appendix AA.

Owners of recreational vessels were concerned about whether public pile moorings and boat ramps would be included in the TMPP. While many acknowledged the fact that the predominant activities at the site should be commercial and industrial, there remained a view that it also needed to cater for recreational water pursuits that would be affected by the TPAR and the low level bridge across Ross River.

Residents, beach users, conservation interest groups and Traditional Owners expressed concern regarding adverse effects from the TMPP on the surrounding natural environment and the flow on effects to related recreational and traditional activities such as bird watching, fishing, crabbing, boating and swimming. Concerns regarding increased potential for pollution from industrial sources and effects on traffic flow have also been raised. Section 3 of this document addresses potential impacts to the natural systems associated with the footprint of the Precinct, including traffic, noise and air quality impacts. Social impacts are addressed following.

The TMPP construction and operation phases are not anticipated to have an impact, directly or indirectly on local recreational, leisure or cultural facilities. The majority of the workforce for both phases will be drawn locally and therefore it is not expected that there will be a significant influx of workers to Townsville or South Townsville in particular, requiring additional facilities.

The loss of the Benwell Road beach, however may have an indirect, localised impact on recreational facilities in that people who use the site for exercise and recreation will be displaced to other facilities in and around Townsville. However this is not expected to result in a significant increase in demand for existing facilities. It is also anticipated there would be little affect of the project, or associated workforce, on community infrastructure, services, access or mobility in South Townsville and elsewhere in the Townsville region. This is addressed further under Section 3.3 where infrastructure and transport demands are assessed.

4.3.2 Potential mitigation and management of impacts

4.3.3 Business and employment

Many local residents believed that the marine industries upstream of the future TPAR bridge should be relocated at government expense into the TMPP and compensated for any losses. They believed that the marine industries were essential to the suburb and the region and were being impacted by the TPAR through no fault of their own. Care needs to be taken in determining impacts and management measures for the Precinct to separate matters coming into effect as a result of the construction of the Precinct versus construction of the TPAR bridge, impacts from which are to be addressed under that development process.

POTL advises that a key purpose in developing a Precinct is to provide an alternative purpose-built location for businesses who may be affected by construction of the TPAR bridge, and to provide an opportunity to grow the existing maritime business base for the Townsville Region. If this is achieved, the resultant construction workforce and employment opportunities in the TMPP will provide flow-on benefits to South Townsville, rather than negative impacts.

4.3.4 Public space and the beach

With regards to losing public places, such as the beach, residents believed that something should be given back to the community to compensate for this loss. Statements included:

- The biggest social impact will be the loss of public space, I'd prefer to see the new residential zone rehabilitated and turned into public space. They can't take everything and give nothing back;
- You can't put all that commercial there and not give us anything back. It's got to be an equal compromise; and
- Surely there would be a compromise between the commercial developments, you just can't lock everyone out of it, and we need to cater for the public.

Others were concerned that the atmosphere, physical attributes and the "beach experience" could not be replaced and suggested a section of the beach be retained so people could continue to use the area for recreation. Comments included:

- You can't compensate for the beach, only with another beach;

- If the beach could be incorporated into the marina it will be even better;
- Leave half of it as a beach area. When we come into South Townsville to work at the weekends, we bring our dogs with us and give them a run on the way home;
- Leave some of the beach if possible; and
- There are so few areas where you can take your dog. You can't replace the beach.

Several respondents mentioned the port's environmental park and how that could be improved to cater for people once they could not access the beach, one comment "Once the beach is gone, the environmental park could be better maintained and cater more for people with dogs".

Even though most respondents understood the TMPP would be commercial, many believed that if some public space and/or facilities were provided in the TMPP it would go some way towards compensating for the loss of the beach. The community would continue to have somewhere to meet, fish, socialise, look at the view and relax. Suggestions made by the community included:

- Public boat ramps and parking;
- Boardwalk;
- Viewing platform;
- Parks and shaded areas;
- Eateries such as fish and chips;
- Fishing platform;
- Traditional owner signage for information to tourists;
- Port of Townsville museum;
- Toilets, drinking water;
- Marine life information; and
- Native plants and bush tucker.

If redevelopment of vacated upstream land occurs, it is envisaged that it will be required to meet the planning objectives for the South Townsville Precinct as identified in the Townsville City Plan. There will be specific recreation and public access opportunities created in the redeveloped upstream lands (e.g. boardwalks, fishing or viewing platforms, food outlets) that should enhance, rather than detract from, the character of the suburb and these will provide alternative recreation opportunities to those that currently exist for Lot 773.

4.3.5 Social amenity

To reduce negative impacts on resident's lifestyles, people suggested the precinct should:

- Be made more accessible and interesting to the public;
- Be aesthetically pleasing;
- Be built it in a style that was in keeping with the old buildings of South Townsville;
- Incorporate a green buffer zone.

Comments in relation to these suggestions included:

- Different to what I thought, no green buffer for residents from noise, air, pollution;
- If you said it was going to look like Airlie Beach, low density with pleasure craft and coffee shops, you could imagine it being a positive;
- It needs to be kept in the old-style we already have here;
- It you do it properly it could be an attraction, having shops and café there could definitely improve South Townsville;
- Just because it's a road to the port it doesn't mean tourists don't go down there, they don't want to look at a load of concrete businesses;
- The precinct could still be an interesting area. In places like Vancouver and Seattle they have boardwalks and fish markets. It could be quite attractive and you could potter about looking at the chandlers and tanks with fish; and
- It would be great to have an alternative to the Gold Coast look, something more real and working class, but built so people can use it.

POTL advises that although early concept drawings indicated the potential inclusion of public boat ramps in the TMPP, subsequent investigations during the EIS phase have indicated that inclusion of public boat ramps, parking and associated facilities is likely to compromise the commercial viability of a commercial marine facility. POTL has indicated it will not close any existing boat ramps on Port land until the Government has completed a regional boat ramp study and has put alternative facilities in place.

With regard to inclusion of boat ramps in any redevelopment of upstream lands, POTL will leave this decision until after the completion of the regional boat ramp assessment. However, it should be noted that recreational boat ramps in a new residential area have the potential to result in noise conflicts.

Construction of the Marine Precinct will not affect the existing use of Ross River by recreational boat users. It should in fact have a small beneficial effect by extending the calm water environment further seaward once the TMPP is constructed.

With regard to recreational boats currently utilising the pile moorings upstream of the proposed bridge, POTL advises that it has no plans to remove the existing pile moorings. Boats that are able to navigate under the proposed bridge will still be able to moor at the pile moorings.

4.3.6 Environmental impacts

Conservation interest groups felt that breakwaters should be avoided if at all possible and that compensatory bird habitat should be built into the project design if breakwaters were included in the TMPP.

The offshore, crescent-shaped breakwater configuration that has been chosen has been assessed as being an efficient design taking into account economic and environmental factors as well as the ability of the breakwater to fulfil its intended purpose of providing a protected wave environment for the Marine Precinct. Earlier breakwater options that connected to land were not progressed after further assessment revealed they were likely to have a significant impact on environmental values.

It is not anticipated that the chosen breakwater design will have any negative impact on bird habitat. Construction will be undertaken from the Port Eastern Reclaim area or by barge, not from land on the eastern side of Ross River. Modelling has shown that there may be some build-up of sand to the east of the breakwater over time (see the hydrodynamic modelling report). This may provide a beneficial impact of additional bird roosting or feeding habitat. It is also likely that the breakwater structure itself will be utilised by birds as a roosting structure. This assumption is supported by observations of birds using existing Port rock walls (see further detail in the migratory bird report).

Other potential environmental impacts are addressed in the technical reports.

4.3.7 Summary of mitigation and management measures

Table 4-1 below provides a summary of the potential management and mitigation measures for identified social impacts. These are consistent with detailed mitigation and management of impacts identified in the other sections of the EIS (refer Sections 3 and 8 in particular).

Table 4-1 Summary of social impact management and mitigation measures

Potential Impact	Management and Mitigation Measures
Marine industry and business	Clearly defined opportunity for relocation into Stage 1 and 2 of TMPP. Access to equivalent opportunities in the TMPP.
Public spaces	Provision of public spaces in the TMPP and recreational opportunities in the redeveloped lands upstream. Public access to retail outlets in TMPP. Alternative off-leash, dog walking area provided in local area.
Recreational boating	Provide opportunity for inclusion of pile moorings in TMPP subject to commercial viability. No loss of existing boat ramps as a result of development of the TMPP.
Natural environment	Management of construction impacts on marine megafauna and adjacent sea bird foraging and roosting sites. Extension of 6 knot vessel speed limit to outer extent of any new breakwater. Final breakwater configuration to minimise impact on sensitive environmental areas. Pollution control measures incorporated into TMPP design and operation in accordance with EPA requirements.

Potential Impact	Management and Mitigation Measures
Air and Noise pollution	Management of dust and noise during construction and operation. Management of dust and noise levels during operation. Appropriate restriction of dust creating activities through conditions on any Development Approval.
Visual Amenity	Final TMPP design to minimise visual impact as much as possible. Redevelopment of upstream land to be in accordance with amenity and height requirements in Townsville City Plan. Vegetation buffer in Environmental Park maintained between TMPP and residential areas.
Traffic	Discourage use of side streets by heavy vehicles accessing TMPP. Control density of buildings in redeveloped upstream lands through planning controls in Townsville City Plan.

PORT of TOWNSVILLE

Section 5
Impacts on state and local economies and management of those impacts

Townsville Marine Precinct Project

Environmental Impact Statement

GHD

5. Impacts on state and local economies and management of those impacts

5.1 Description of existing economic character

Except where otherwise indicated, data for Townsville City is for the newly amalgamated Townsville City Local Government Area. Information in this section was developed by AEC*group* on behalf of GHD. A full report of the findings is available from Appendix BB and a comprehensive extract follows.

Relevant catchment areas examined are the local South Townsville area (the SLAs of South Townsville and Railway Estate) between Ross Creek and Ross River, the Townsville City LGA, the Northern SD and Queensland. The characteristics of the existing economic environment are informed by:

- Consultation and data from local business and industry, key organisations, and State and local government;
- Data from the Australian Bureau of Statistics and Queensland Office of Economic and Statistical Research; and
- Economic profiling and modelling.

Much of the background information presented in the existing environment is sourced from the 2006 Census of Population and Housing. While it is acknowledged that the 2006 Census data is becoming dated, this data represents the most comprehensive, accurate and, for most topics examined in this section, up-to-date source of economic information available. As such it is considered appropriate to use this information to provide background context to the economic impact assessment. Where possible, this data has also been augmented with more recent data sets to provide the most up-to-date snap-shot of the catchment areas as possible.

5.1.1 Existing local economy

This section describes the existing economic environment of the project's catchment areas and the State of Queensland using the most recent and relevant available statistics. This section is intended to provide a baseline from which to measure the significance of the existing Ross River marine industry and the potential changes and impacts to the local, regional and State economies from the development of the TMPP.

5.1.2 Economy and development

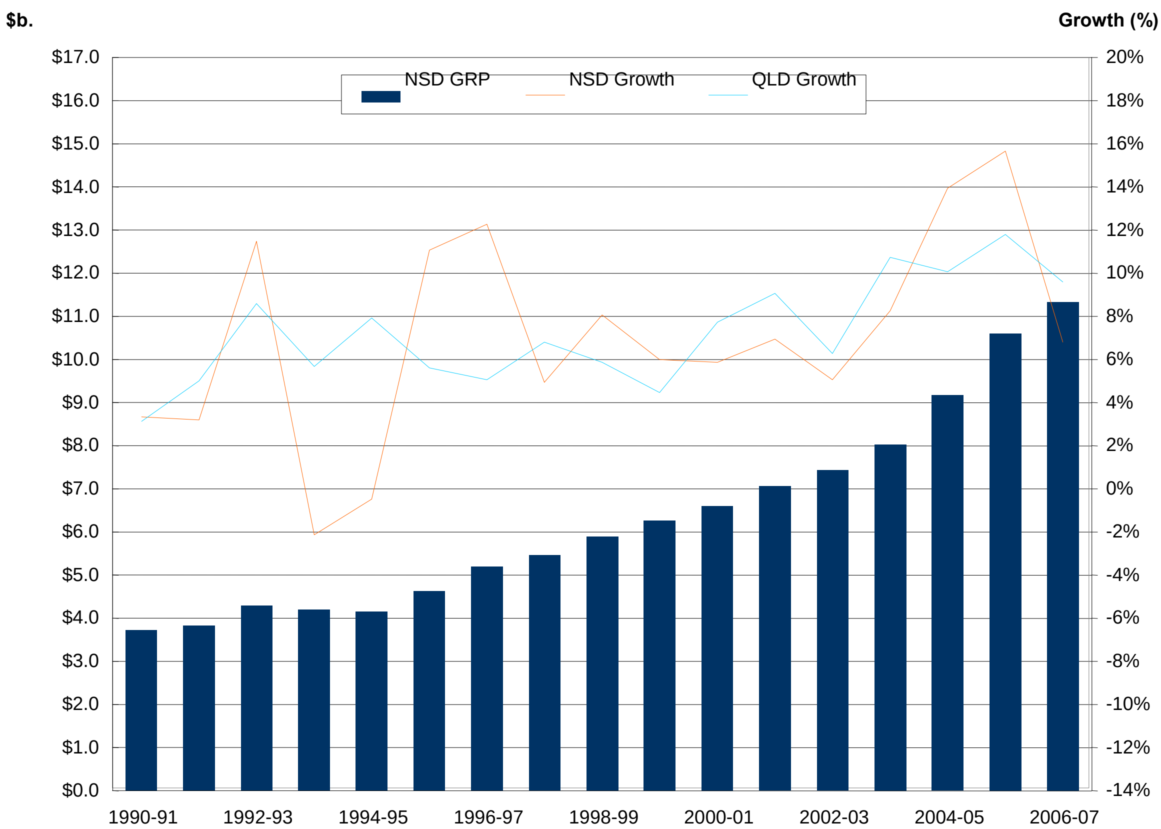
The Northern SD economy historically developed based upon the value adding and trade of mineral and agricultural resources. Townsville developed as the export port for the broader region's primary and manufactured products, a role that it continues today.

Today, the Northern SD economy is considered amongst the most diversified in regional Australia with strong contributions from the primary, secondary and tertiary sectors as well as high levels of both public and private sector activity.

5.1.3 Gross regional product

The Northern SD was estimated to have a Gross Regional Product (GRP) of $13.2 billion in 2006-7, growing 7.8% from the previous year. Over the past ten years, the Northern SD has recorded average growth in GRP of 8.1% per annum, comparing with the 10-year average annual growth rate for Queensland of 8.2%. The Northern SD is the third largest economic region in Queensland behind the Brisbane and Moreton Statistical Divisions, and accounted for 7% of the State's Gross State Product (GSP) in 2006-07 (Figure 5-1)

Figure 5-1 Northern SD gross regional product

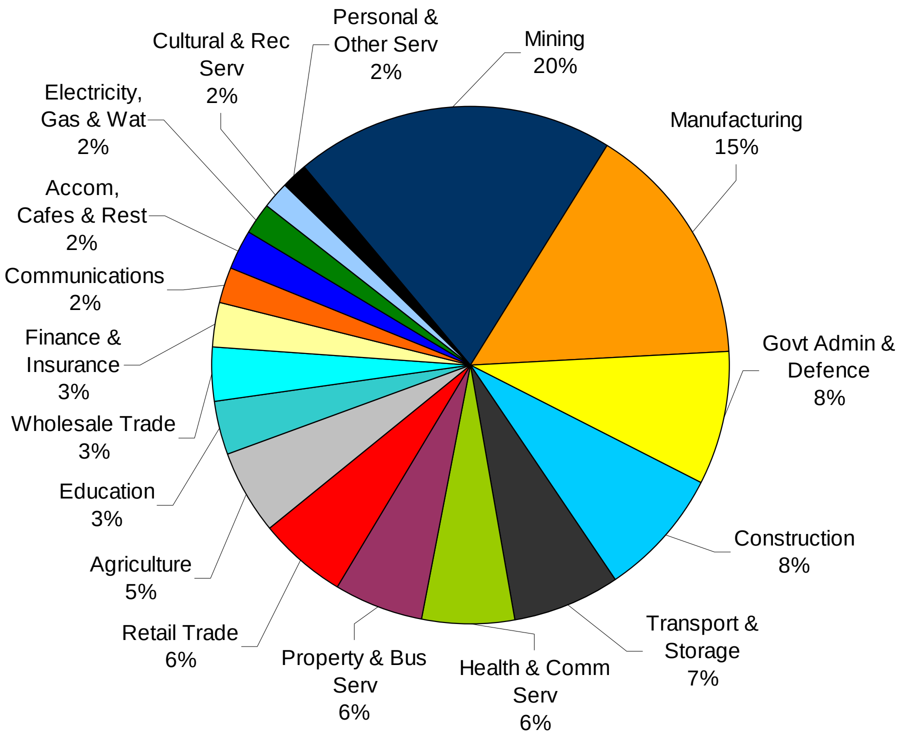


Source: AEC*group* (refer Appendix BB)

The Mining sector in the Northern SD contributed the largest proportion to GRP in 2006-07, accounting for 20% of industry value added activity; this was followed by Manufacturing (15%), Government Administration & Defence (8%) and Construction (8%). Over the past two years, the Mining sector has significantly increased in importance to the Northern SD economy, having increased from contributing 14% to GRP in 2004-05 to 20% in 2006-07, and has been an important driver of economic growth in the region. Other industry sectors have generally contributed stable proportions to GRP in this period, with the exception of the Agricultural sector that has declined from accounting for 8% of GRP in 2004-05, to 5% in 2006-07.

The existing Ross River marine industry's economic activity is distributed across the Manufacturing, Transport and Storage, Retail Trade, Agriculture (which includes Fishing and Forestry) and Wholesale Trade sectors.

Figure 5-2 Northern SD: industry contribution to GRP 2006-09



Source: AECgroup (refer Appendix BB)

5.1.4 Employment by Industry

The Retail Trade industry employs the largest share of the Northern SD labour force, with 14.6% of the labour force employed in this sector. The Health & Community Services sector (11.2%) and Government Administration & Defence (9.9%) respectively employ the second and third largest proportions of the labour force. The high level of employment in these industries is demonstrative of the strong presence of support services in the Northern SD, and Townsville's role as a service node to greater North Queensland.

In comparison to the Northern SD, South Townsville reports relatively lower levels of employees in the sectors of:

- Retail Trade (10.3% v 14.6% Northern SD); and
- Agriculture, Forestry & Fishing (1.2% v 4.3% Northern SD).

Conversely South Townsville area reports comparatively higher proportions of workers employed in the sectors of:

- Property & Business Service (9.2% v 7.8% Northern SD);
- Accommodation, Cafes & Restaurants (7.7% v 4.8% Northern SD); and
- Cultural & Recreational Services (2.4% v 1.7%).

The data displays a stronger presence of professional, personal and entertainment services employment of South Townsville residents in comparison to the broader Northern SD region.

This reflects that South Townsville has experienced revitalisation as an inner city suburb attracting a higher socio-economic demographic in recent years.

Data on employment in the marine industry in the Northern SD is scarce. According to the 2006 Census the Northern SD records:

- 106 employees in fishing, hunting and trapping (assumed primarily fishing); and
- 67 employees in water transport.

It is possible that these records are significant underestimates, however they are unlikely to be overestimates.

5.1.5 Labour market

The Northern SD labour force grew 3.0% in the year to the September Quarter 2008 to 118,759 workers (smoothed data series). Of these, 3.2% were reportedly unemployed, a figure comparable with the Queensland unemployment rate for the September Quarter 2008 of 3.7%.

The South Townsville labour force has a likewise recorded an increase of 4.3%, boosting the total labour force to 3,364 workers in the September 2008 Quarter. In comparison to the Northern SD, the South Townsville locality has a slightly higher rate of unemployment at 3.8% in the September Quarter 2008 compared to 3.2% for the Northern SD in the same period.

Employment in North Queensland has likely deteriorated considerably in late 2008 and early 2009 in the wake of the global financial crisis, as it has across Australia. There have been a number of published layoffs of workers in the region since the above unemployment estimates were produced. Unemployment rates in the Northern SD, Townsville and South Townsville have almost certainly risen since these unemployment estimates were released.

5.1.6 Cost of living

Prices in Townsville score similarly to the baseline measure of Brisbane (Brisbane base index is equal to 100.0), with relatively small differences between the two. In general, the relative cost of living in Townsville is slightly greater than in Brisbane for all categories, with the exception of clothing and footwear and financial and insurance services (refer Table 5-1).

Table 5-1 Index of retail prices in Townsville

Project Category	**Value Range**		**Townsville**
	Lowest	Highest	
Food	92.2	130.9	104.4
Alcohol and tobacco	92.5	119.2	100.6
Clothing and footwear	88.8	132.6	99.4
Housing	45.7	195.5	102.7
Household content and services	91.1	143.2	101.0

Project Category	Value Range		Townsville
	Lowest	Highest	
Health, education and communication	99.7	104.5	100.8
Transportation	88.7	108.0	101.8
Recreation	91.4	112.3	101.7
Financial and insurance services	95.4	100.5	98.2
All Items	**90.5**	**123.8**	**101.9**

The Townsville LGA has reported a relatively higher proportion of households renting in comparison to Queensland over the past three Censuses, with 34.5% of households renting in Townsville in 2006 compared to 31.1% in Queensland. The Townsville LGA also reported a higher proportion of households purchasing a home at 36.7% in 2006, compared to 33.8% for Queensland. Both of these figures reflect a younger and more itinerant population in Townsville compared to the Queensland average.

Living costs in the region were relatively lower than that recorded for Queensland in 2006 (refer Table 5-2), with the average monthly housing loan repayment being $84 lower in Townsville than the State average, and the average weekly rent $13 lower. This was in contrast to average weekly household income for the region which was $64 higher in Townsville in comparison to the State average.

Table 5-2 Household Ownership and Finances in Townsville and Queensland

To	wnsville			Queensland		
Household Finances	1996	2001	2006	1996	2001	2006
% of households fully owning home	31.8%	29.7%	25.5%	38.7%	36.6%	31.6%
% of households purchasing home	26.4%	28.8%	36.7%	24.8%	25.8%	33.8%
% of households renting	36.0%	34.8%	34.5%	30.1%	30.1%	31.1%
Average weekly household income	N/a	$942	$1,254	N/a	$885	$1,19 0
Average monthly housing loan repayment	$818	$887	$1,349	$821	$878	$1,43 3
Average weekly rent repayment	$124	$150	$198	$131	$156	$211

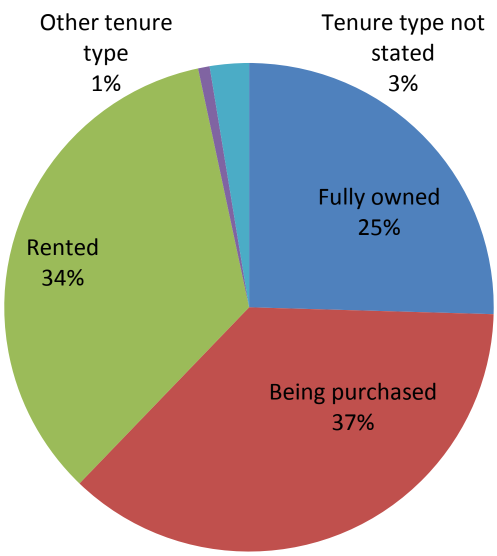
Source: 1996, 2001 and 2006 Censuses

5.1.6.1 Rental accommodation

Residential

Townsville recorded a total of 53,464 private dwellings in the 2006 Census. Being raw data, it is likely that this figure was an underestimate of the actual number of dwellings. The composition of these dwellings by tenure type is displayed in Figure 5-3. An estimated 34% of the total housing stock in Townsville was rented at the time of the 2006 Census.

Figure 5-3 Composition of housing tenure in Townsville



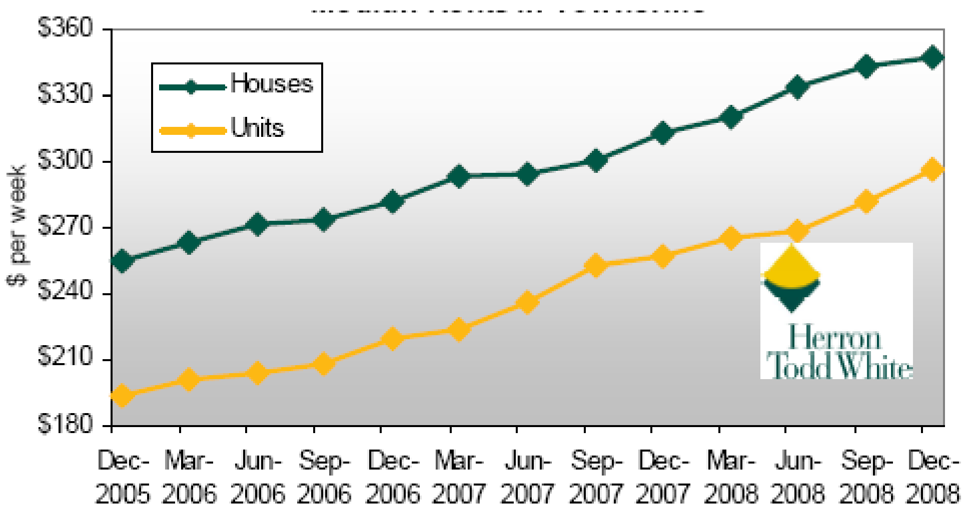
Source: Census data 2006

An estimated 5.5% of dwellings in Townsville are rented out under social housing schemes. The large majority of social housing stock is provided by the State Government (5.1% of total housing stock), with a small proportion provided by charitable organisations (0.4% of total housing stock).

Rental vacancy rates in Townsville have eased over the past year with preceding periods characterised by shortages of accommodation. February 2009 figures suggest vacancy rates in units have risen from 2.9% to 5.3% in one month. Herron Todd White's trend rental market indicator experienced a 3% increase in vacancy rates from January 2009 to February 2009. The recent increase in rental vacancy rates is attributable to recent additions to dwelling stock and softer demand.

Over the past three years, median rents in Townsville have recorded a consistent trend increase for both units and houses, despite the slowdown in demand for rental dwellings. Recent figures from Herron Todd White (2009) record median rents to be $345 per week for houses, and $290 per week for units in December 2008 (Figure 5-4).

Figure 5-4 Median rents in Townsville



Source: Herron Todd White (February 2009)

Short Term Accommodation

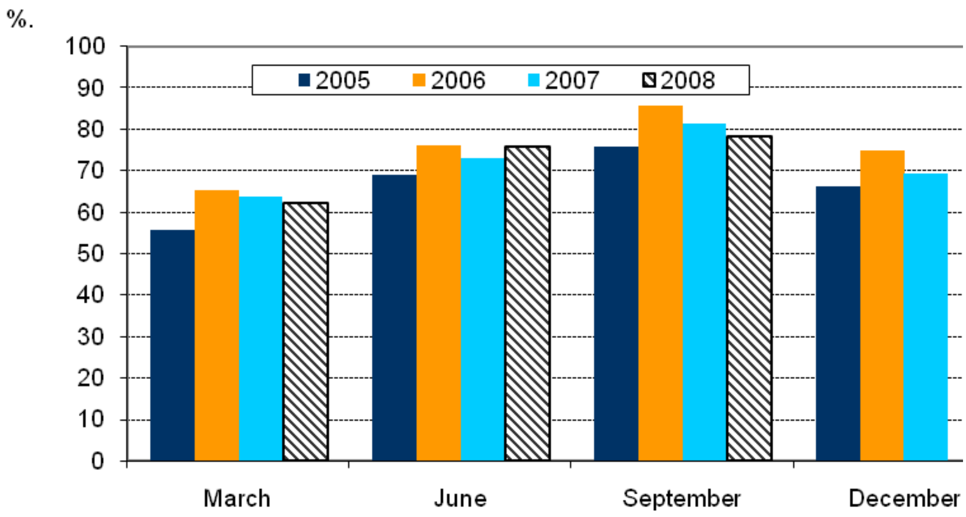
The Townsville LGA reported 59 short term accommodation establishments in the June Quarter 2008, the majority of which (38) comprised hotels, motels & serviced apartments with 15 or more rooms, followed by 11 caravan parks and 10 hotels, motels & serviced apartments with 5 to 14 rooms. These establishments were recorded as having 3,617 available rooms. Hotels with more than 15 rooms accounted for 61% (2,217) of rooms available, followed by caravan parks with 1,405 rooms/sites available, and small hotels with less than 15 rooms with 85 rooms in total.

It should be noted that 304 of the 1,405 rooms available in caravan park establishments were occupied by long term guests, with a further 11 permanently reserved for private use.

Quarterly occupancy data for hotels, motels & serviced apartments with 5 or more rooms show a clear season 'high' in demand in Townsville during the September Quarter. June Quarter appears as having the second-highest level of demand, followed by the December Quarter, with the March Quarter reporting the lowest level of demand for hotel rooms in Townsville. Figure 5-5, below, illustrates this quarterly trend over the past four years.

Demand for hotel rooms in Townsville is strongly driven by the climate, with the relatively cool and dry June and September quarters favoured for visits. The March Quarter, which is the wettest and hottest, is avoided by many travellers.

Figure 5-5 Quarterly hotel room occupancy rate Townsville



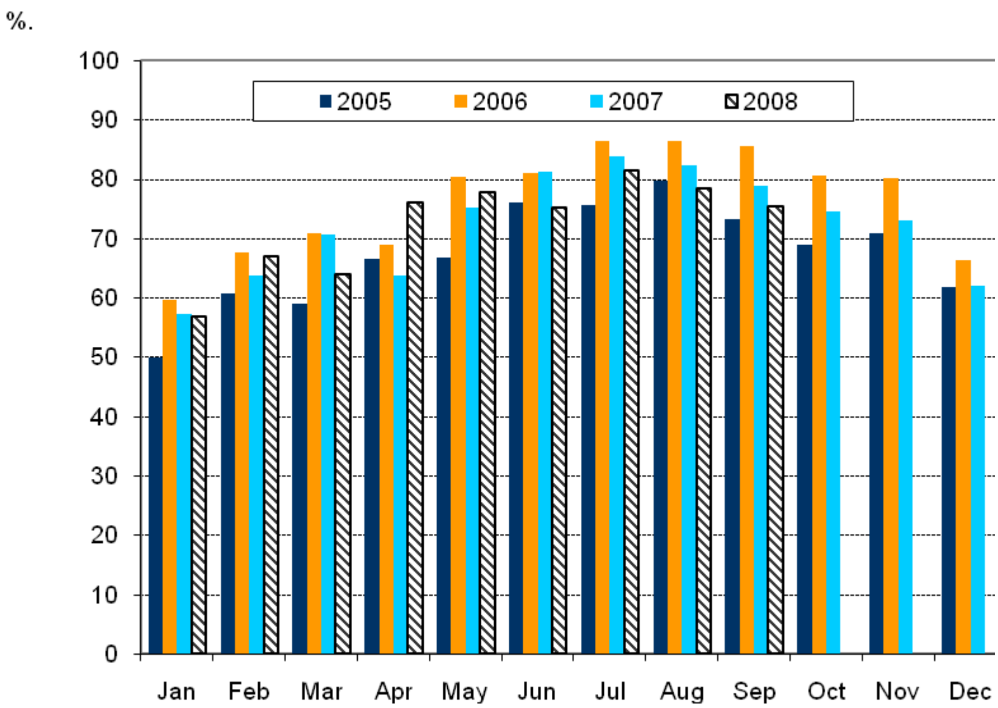
Note: Data is for the old Townsville LGA and for Hotels, Motels and Serviced Apartments with 5 or more rooms

Source: ABS 8635.3.

Monthly data obtained for hotel establishments with 15 or more rooms clearly demonstrate the high demand for hotel rooms from July through to September. January is recorded as the month with historically the lowest room occupancy rate, followed by December. The data strongly indicates that the autumn to winter season (April to September) attracts the highest level of visitors to the Townsville region (Figure 5-6).

Quarterly data for caravan park occupancy rates show a lower rate of occupancy in comparison to hotel data. However, occupancy of caravan parks follows the seasonal trend of hotels, with the September Quarter reporting the highest level of occupancy, followed by the June Quarter.

Figure 5-6 Monthly hotel room occupancy rate Townsville



Note: Data is for the old Townsville LGA and for Hotels, Motels and Serviced Apartments with 15 or more rooms

Source: QRSIS (2008b), ABS 8635.3.

Residential Sales

The Townsville LGA reported 3,792 residential sales in 2007, of which 2,632 were house sales, 570 unit sales and 490 land sales. Over the past ten years; the LGA has recorded an average of 3,300 residential sales per year, with a high of 4,533 sales in 2003.

Over the past five years, the average house price has increased considerably, growing 99.3% from $159,000 in 2002 to $317,000 in 2006. Land and unit average sale prices have also increased over this period, with unit prices increasing 78.8% to $276,000, and land prices increasing 111.5% to $175,600 in 2006. The increase in house, unit and land prices suggests a strong demand for residential dwellings in the Townsville LGA.

The South Townsville locality reported 165 residential sales in 2007, comprising 151 single unit dwellings, ten multi-unit dwellings and four vacant urban land sales. Total sales in 2007 declined from 178 sales in 2006, due to a decline in the number of single unit dwelling and vacant urban land sales.

Over the past five years, the average multi unit dwelling sale price in the South Townsville locality has increased 106% to $350,000 in 2008. There was also a notable spike in the average multi unit dwelling price in 2005, which was the result of the sale of several high-priced units in the locality. However, since 2005, the average sale price has returned to more 'stable' levels. Over this same period, single unit dwelling sales also increased, however at a relatively lower level of 54% to $390,000 in 2008.

Meanwhile, the average vacant urban land price significantly increased from $179,000 in 2004, to $815,000 in 2005, $1.3 million in 2006 to $8.3 million in 2007. This is due to several large purchases of inner city land for unit developments along with few traditional residential lots being available over this period, which has significantly impacted the calculated average price per sale.

5.1.6.2 Residential building approvals

The Northern SD reports 751 building approvals (588 houses and 163 other residential) to date in 2008-09, falling by 74.4% from 2,939 building approvals in 2007-08. The average value of building approvals in the Northern SD was $267,705 to date in 2008-09, falling slightly from $274,253 in the previous year. The Northern SD has historically recorded a slightly lower average value of residential building approvals than Queensland, however 2007-08 saw the average value of building approvals in the Northern SD ($274,000) grow to higher than the Queensland average value of building approvals ($250,000).

The South Townsville area reported seven residential building approvals in 2008-09, comprising five house approvals and two other residential approvals, following 147 residential approvals in 2007-08. The massive drop in residential approvals is indicative of a very uncertain building market. Current global issues will have considerable effect on confidence within the construction and investment sectors. Historical building approvals data for the area is visibly staccato, due to the small size of the area and the influence of apartment buildings in the area, which result in several dozen units in one approval.

Notably, the average value per approval in the South Townsville region demonstrates four consecutive years of growth, demonstrating trend growth in the average annual value of approvals if not in the annual number approved. The average value per approval in South Townsville in 2007-08 was $352,500, growing 42.6% from $247,000 in 2006-07. This has since declined to date in 2008/09 due to a weakening regional property market. 2008/09 figures indicate a fall in the average value to $331,500. The actual number of approvals shows no distinguishable trend. The relatively small size of South Townsville makes it difficult to be confident of trends in the data.

5.1.7 Business

5.1.7.1 Sector of Operation

The majority of businesses (by business count) in the Northern SD operate in the Property and Business Services sector (19.7%) although the proportion of businesses in this sector is notably lower than the Queensland average (19.7% v 24.2%, refer Table 5-3).

Other sectors of significance in the Northern SD in terms of business counts include the Construction, Agriculture, Forestry & Fishing and Retail Trade sectors. These sectors are typically dominated by small businesses and sole traders, providing for relatively high business counts. In contrast to the Property and Business Services sector the Northern SD records a higher proportion of businesses in these sectors than for the State average.

Table 5-3 Business Count Distribution: Northern SD, South Townsville, QLD

Northern	SD	South Townsville	QLD
Property and Business Services	19.7%	14.7%	24.2%
Construction	19.4%	25.3%	17.6%
Agriculture Forestry And Fishing	17.6%	4.0%	12.1%
Retail Trade	11.5%	7.3%	10.9%
Transport And Storage	6.3%	9.3%	5.9%
Health And Community Services	4.6%	6.0%	4.3%
Manufacturing	4.5%	4.7%	5.2%
Finance And Insurance	3.7%	2.7%	5.7%
Personal And Other Services	3.5%	4.7%	3.0%
Accommodation Cafes And Restaurants	2.7%	6.7%	2.7%
Wholesale Trade	2.7%	9.3%	3.9%
Cultural And Recreational Services	1.6%	4.0%	2.2%
Communication Services	0.8%	0.7%	1.1%
Education	0.7%	0.7%	0.8%
Mining	0.6%	0.0%	0.4%
Electricity Gas And Water Supply	0.1%	0.0%	0.1%
Total Businesses	**16,074**	**450**	**404,457**

5.1.7.2 Business Confidence

In line with the declining trend of the State, the Townsville Region has experienced declining business confidence since the March Quarter 2009, with a business confidence index of -10 in the March Quarter 2009. Despite significant declines in confidence for the region, general business confidence remains above the Queensland average level for the quarter.

5.1.7.3 Industry

AEC*group* (2008) estimated 5,625 hectares of industrial zoned land in Townsville, of which approximately 4,868 hectares is occupied. An estimated 757 hectares of land remains vacant, of which 407 hectares is suitable for general industry and support industrial services. Additionally, an estimated 237 hectares of industrial land is available in the Port of Townsville area for future Port associated use.

Sales of industrial land in Townsville are relatively low, with the September Quarter 2008 reporting no sales of industrial land. The December Quarter showed only small improvement with 2 units sold. The price of industrial land per square metre has however demonstrated a trend increase since 2005, growing from approximately $80 per square metre in the June Quarter 2005, to $250 per square metre three years later in the June Quarter 2008.

5.1.7.4 Industrial land availability

The 2008 study by AEC*group* found that Townsville has relatively good availability of industrial land at present and for the short to medium term future, with some notable gaps including land for future heavy industry and land-intensive manufacturing.

Industrial land with direct marine access is currently only available in Townsville at the Port of Townsville or at the currently occupied sites on Ross River and Ross Creek. There are no apparent new areas for development of industrial land with direct marine access in the foreseeable future.

5.1.8 Implications of the recent economic downturn

The global economy is currently experiencing one of the most severe economic shocks in decades. A collapse of lending standards in the world's major industrial economies, driven by a glut of cheap liquidity from some developing countries, has disrupted credit markets and the financial sector of these economies. This is now being transmitted to Australia and the rest of the world via export and financial linkages.

Global economic growth slowed sharply in 2008 and a further slowing is projected for 2009. In its latest update on the World Economic Outlook, the International Monetary Fund (IMF) forecasts global GDP to contract by 0.5% to 1.0% in 2009. This would be the poorest global GDP outcome since World War Two (International Monetary Fund, 2009).

The slowdown is expected to be most severe in the advanced economies where GDP is forecast to contract by 3.0% to 3.5% in 2009. This partly reflects a feedback between the financial sector and the real economy with slowing business activity and rising unemployment triggering more defaults on loans, posing further difficulties for already fragile financial institutions. Growth is also forecast to slow considerably in emerging economies due to falling export demand and constraints on funding from the advanced economies, however remain positive at 1.5% to 2.5% in 2009.

These forecasts from the IMF are considerably weaker than those prepared in late 2008 owing to (International Monetary Fund, 2009):

- Continued declines in asset values that are reducing household wealth;
- Further declines in business and consumer confidence; and
- Restraints on business and household investment caused by credit rationing.

The economic outlook for Australia has also deteriorated in the past few months. Some slowing in activity was always expected given the softer international environment. However, it was hoped the resources boom would create a softer landing in Australia than elsewhere. The resources boom has now clearly come to an end alongside slowing growth in China and other emerging economies. By the end of 2008 spot prices for iron ore, one of Australia's most valuable exports, had roughly halved from the peak achieved earlier in the year. Declines in spot coal prices have been similarly dramatic (Reserve Bank of Australia, 2009). More recently, there have been large scale layoffs by resources companies as they cut back production. The

Minerals Council of Australia estimates that around 9,000 jobs have been cut from Australia's mining industry since July (The Australian, 2009). Many of these cuts have been announced in January of this year.

The latest forecasts from the Reserve Bank of Australia (2008b) entail a slowing in GDP growth to 1.5% over the year to the June Quarter 2009 from growth of 2.7% over the year to June 2008. The unemployment rate is forecast to rise in the period ahead. It is likely these growth forecasts, prepared in November 2008, will be revised down to reflect the recent poor economic news.

5.1.9 Government investment

Government services are a large contributor to the Northern SD economy with Townsville also home to one of the largest Australian Army bases in Australia as well as the RAAF. In addition to this, the Army's Third Brigade is soon relocating to Townsville from Sydney, further adding to the region's demand for residential construction and enhanced infrastructure and amenities to support the increase in population.

A substantial number of public and private sector projects are under development in Townsville. In total, projects with a value equating to $8.3 billion were underway in the Townsville Local Government Area (LGA), as of late 2007 with $1 billion of these projects already completed. A list of projects is provided in Appendix BB.

5.1.10 Economic contribution of existing Ross River marine industries

The existing Ross River marine industry has the potential to be significantly impacted following the restriction of vessel access into the Ross River with the construction of the TPAR bridge in 2011. Hence the existing marine industry on the Ross River is an opportunity cost of not establishing the TMPP.

The following table (Table 5-4) summarises the estimated 2008-09 financial year output of the Ross River marine businesses and the proportion of that output estimated to be retained within the regional and State economies. Note that output from the trawlers has been accounted for in Seafood Processing and Seafood Trade. Retention in the regional and State economies has been estimated based on average industry import requirements as outlined in the regional and State industry transaction tables published by the Office of the Government Statistician (2001a and 2001b).

Table 5-4 Estimated Ross River marine industry output in 2008-09 ($2009)

Industry	Output ($M)	Retained in Northern SD		Retained in Queensland	
		%	$M	%	$M
Seafood Processing	$48.0	80.7%	$38.7	91.0%	$43.7
Boat Building/ Manufacturing/ Maintenance	$10.5	77.1%	$8.1	78.6%	$8.2

Industry	Output ($M)	Retained in Northern SD		Retained in Queensland	
Seafood and Marine Retailing	$5.0	79.0%	$3.9	90.7%	$4.5
Water Transport	$18.2	77.3%	$14.1	78.3%	$14.2
Total (Average)	$81.7	(79.3%)	$64.8	(86.5%)	$70.7

Note: Some totals may not sum due to rounding.

Source: EBC TMPP Consultation Reports, Office of the Government Statistician (2001a), Office of the Government Statistician (2001b), AEC*group*.

The total estimated economic contribution of the Ross River marine industry to the Northern SD is estimated to be:

- Approximately $113.0 million in output to the regional economy ($64.8 million directly and $48.2 million as flow on);
- Approximately $43.3 million in value added activity, or Gross Regional Product ($20.3 million directly and $23.0 million as flow on);
- Approximately $21.4 million in wages and salaries ($11.6 million directly and $9.8 million as flow on); and
- Approximately 504 FTE employment positions (234 FTE direct employment positions and 269 FTE flow on).

The economic contribution to the State economy is estimated as:

- Approximately $143.0 million in output to the State economy ($70.7 million directly and $72.3 million as flow on);
- Approximately $56.1 million in value added activity, or Gross State Product ($21.5 million directly and $34.6 million as flow on);
- Approximately $29.2 million in wages and salaries ($13.6 million directly and $15.6 million as flow on); and
- Approximately 670 FTE employment positions (277 FTE direct employment positions and 393 FTE flow on).

A disaggregation of impacts by industry shows that, in addition to being a direct contributor to the Manufacturing, Transport & Storage and Trade industries, the Ross River marine industry provides significant flow-on activity to the industries of Agriculture, Forestry & Fishing (in particular commercial fishing), Finance, Property & Business Services, Trade, Transport & Storage and Manufacturing.

5.2 Value of ecosystem services to be lost or disturbed

There are approximately 32 hectares of subtidal sand / mud flat ecosystem within the footprint of the TMPP, which provides habitat for a range of species including sipunculids, yabbies and crabs (refer Section 3.10). No seagrass or algae beds have been identified within the footprint of the TPAR corridor and TMPP, although there are some mangroves in the upper subtidal region. No species of conservation significance or protected species are observed within the footprint of the TMPP (Section 3.10, Appendix T).

There are also approximately 2 hectares of subtidal ecosystem under the breakwater footprint, which also provides habitat to species such as snails, worms and some crabs / crustaceans (Section 3.10, Appendix T).

An additional 1.5 hectares of coastal scrub vegetation will also be removed between the service corridor development, TPAR development and the TMPP. While this area is a highly fragmented and disturbed habitat of little ecological significance (Section 3.10, Appendix S), to provide a conservative assessment the value of this land provides in terms of ecosystem services has been valued at ‘Coastal scrub habitat’ values.

Table 5-5 below outlines the original ecosystem values intertidal flat and coastal scrub habitats in US 1994 dollar terms from Costanza *et al.* (1997), which have been inflated to Australian $2009 terms using the 1994 exchange rate of AUD$0.69/ USD, and an inflation multiplier for 1994 to 2009 of 1.54 (Reserve Bank of Australia, 2009a and 2009b).

Table 5-5 Ecosystem value by habitat type in $/Ha

Ecosystem Service	US$1994 Value/ Ha	AU$2009 Value / Ha
Intertidal flats, waterways and salt marshes	$9,990	$22,270
Coastal scrub habitat	$232	$520

Source: Costanza *et al.* (1997), Reserve Bank of Australia (2009a), Reserve Bank of Australia (2009b).

Based on the ecosystem values ascribed above, the annual environmental loss due to the development of the TMPP is valued as approximately $757,960, as outlined in the table below (Table 5-6).

Table 5-6 Annual environmental loss from TMPP

Ecosystem Service	Ha	$2009 Value / Ha	Annual Loss ($2009)
Intertidal flats in TMPP footprint	32.0	$22,270	$712,640
Intertidal flats in breakwater footprint	2.0	$22,270	$44,540
Coastal scrub habitat	1.5	$520	$780
Total Ecosystem Loss	35.5	-	$757,960

Source: Costanza *et al.* (1997), Reserve Bank of Australia (2009a), Reserve Bank of Australia (2009b).

5.3 Potential impacts and mitigation measures

5.3.1 Significance of the TMPP and Townsville Waterways Project on the Local and Regional Context

5.3.1.1 Construction impacts

Table 5-7 summarises the economic impact of the total $133.2 million expenditure over nine years for the construction phase including the direct and flow on elements for the regional and State economies. The construction phase impacts outlined in the table indicate the total economic impact associated with the entire nine year construction phase in 2009 dollars without discounting. Annual impacts will be portions of these total impacts, including for employment.

Value added production in the Northern SD economy is modelled to increase by $58.6 million, spread over the nine years, with an increase of $76.9 million in Queensland. In net terms, the Northern SD economy is currently estimated at $13.2 billion in 2006-07 (AEC*group*). Even in the unlikely scenario of no further growth in the Northern SD economy a value added production of $119 billion ($2009) would be realised over the nine years of the construction phase, Hence the construction phase is not anticipated to result in a appreciable impact in business and industry activity at the Northern SD or Queensland economy level in comparison to a scenario where the TMPP does not proceed with the Gross Regional Product contribution over the period being in the order of 1/20th of a percent of the Northern SD economy.

This result should not be interpreted to discount the value that the construction activity will have to those firms that take on the business. As a result of the construction activities, the Construction, Finance, Property & Business Services and Manufacturing industries are estimated to experience the greatest impact from the construction phase. These three industries are estimated to record the following gross impacts over the nine years:

- An increase in value added activity in the Northern SD Construction industry of $43.4 million directly;
- An increase in value added activity in Finance, Property & Business Services in the Northern SD of $0.9 million directly and $5.1 million as a result of flow-on activity; and
- An increase in value added activity in the Northern SD Manufacturing industry of $2.0 million as a result of flow-on activity from the construction phase.

Table 5-7 Construction phase economic impacts, $2009)[(a)]

Industry Northe	rn SD				Queensland			
	Output($M)	Value Add($M)	Income($M)	Emp(FTE)	Output($M)	Value Add($M)	Income($M)	Emp(FTE)
Construction of TMPP								
Direct	$81.7	$38.2	$19.4	272	$93.8	$39.6	$18.9	336
Indirect	$28.7	$12.1	$6.8	138	$65.9	$26.3	$14.4	239
Total	*$110.4*	*$50.3*	*$26.2*	*410*	*$159.7*	*$65.9*	*$33.3*	*575*
Construction of Townsville Waterways Redevelopment								
Direct	$11.1	$5.2	$2.7	37	$12.8	$5.4	$2.6	46
Indirect	$3.9	$1.7	$0.9	19	$9.0	$3.6	$2.0	33
Total	*$15.1*	*$6.9*	*$3.6*	*56*	*$21.8*	*$9.0*	*$4.5*	*79*
Marketing of Townsville Waterways Redevelopment								
Direct	$2.2	$0.9	$0.5	8	$2.5	$1.0	$0.6	13
Indirect	$1.2	$0.5	$0.3	5	$2.3	$1.0	$0.5	10
Total	*$3.3*	*$1.4*	*$0.7*	*14*	*$4.9*	*$2.0*	*$1.2*	*23*
Total								
Direct	$95.0	$44.3	$22.5	318	$109.1	$46.0	$22.1	394
Indirect	$33.8	$14.3	$8.0	162	$77.2	$30.9	$16.9	282
Total	$128.7	$58.6	$30.6	480	$186.3	$76.9	$39.0	676

Note: Some totals may not sum due to rounding. (a) This is the total economic impact experienced over the construction phase. Source: Office of the Government Statistician (2001a), Office of the Government Statistician (2001b), AEC*group*.

5.3.1.2 Operating impacts

The existing Ross River marine industry is estimated to contribute $113.0 million annually ($2009, including direct and flow-on activity) in output to the Northern SD economy and $143.0 million annually to Queensland.

The TMPP will eventually offer additional space for marine industry to expand and may offer an enhanced operating environment dependent on the final design and features. It is estimated that following the completion of the proposed Stage 3 of the TMPP in 2018 there will be potential to grow value added contribution of the marine sector above the existing Ross River marine industry by $9.0 million annually ($2009, including direct and flow-on activity) in the Northern SD economy and $11.1 million annually in the Queensland economy. This would represent an increase from the existing Ross River marine industry's economic value-add in the Northern SD by 21% and employment by 24%. Given likely continued strong growth in the region's population and overall economy the proportional contribution of the TMPP to the Northern SD after 2018-19 may, however, be similar or less than its current contribution. These impacts will likely take time to develop after 2018-19 with business ramping up over time and new markets being developed.

Table 5-8 Economic value of additional $28 million in boat maintenance expenditure ($2009)

Phase Northern	SD				QLD			
	Output ($M)	Value Added ($M)	Income ($M)	Emp (FTE)	Output ($M)	Value Added ($M)	Income ($M)	Emp (FTE)
Boat Building/ Manufacturing/ Maintenance								
Direct	$21.6	$6.4	$4.5	79	$22.0	$6.9	$5.5	97
Flow on	$6.2	$2.6	$1.6	42	$11.4	$4.2	$2.5	63
Total	$27.8	$9.0	$6.0	121	$33.4	$11.1	$8.0	160

Note: Some totals may not sum due to rounding.

Source: Office of the Government Statistician (2001a), Office of the Government Statistician (2001b), AEC*group*.

5.3.2 Economic impacts of the TMPP including distributional impacts

5.3.2.1 Construction impacts

The TMPP will result in the injection of approximately $95.0 million into the Northern SD regional economy over the course of the construction phase, and $109.1 million into the Queensland economy.

The initial expenditure from the reclamation phase will primarily support construction and related professional service industries in the local and State economies, as well as the manufacturing sector through flow-on business activity.

The construction phase will also provide incomes in the form of wages and salaries that will encourage additional consumer expenditure and activity. Household incomes are estimated to increase by approximately $30.6 million in the Northern SD over the course of the construction phase with approximately $39.0 million additional income in Queensland. This expenditure is effectively all new expenditure in the economy that would not otherwise occur if the TMPP does not proceed.

The expenditure will be positive for business confidence across a range of industry sectors due to the direct and indirect impacts of the reclamation phase expenditure, however quantitative impact may not be substantial due to the size of the project relative to the regional economy. Businesses directly involved in construction activities such as building contractors, businesses that support construction activity such as professional services and plant hire companies, and businesses that provide indirect support services to the construction sector, such as local accommodation providers and restaurants would all be expected to experience an increase in activity as a result of the TMPP. As the anticipated flow-on effects of the construction expenditure pass through the rest of the economy, sectors with no direct connection to the construction industry would also be expected to observe increased confidence from flow-on expenditure and consumption.

The increased traffic on Boundary Road associated with the construction activities may be of some benefit to those business on the road dependent on drive-past traffic for patronage.

Issues with current uncertainty regarding the potential relocation of existing marine businesses on Ross River are negative for business confidence and effect a large portion of Townsville's marine industry sector. Of the identified potential negative impacts to businesses, loss of leasehold improvements has been assessed as potentially of Very High impact, with loss of business and contract opportunities and costs of relocating and re-establishing businesses including opportunity costs of downtime experienced being assessed as potentially of High impact level.

Increases to activity and confidence in the construction and associated industries is of particular importance in the current economic climate. The majority of the project will, however, occur beyond the immediate term where the economy may have recovered the value of the stimulus not as high.

5.3.2.2 Operating impacts

During the operational phase of the development, marine industry worth $43.3 million in Gross Regional Product to the regional economy per year (in $2009) and directly or indirectly accounting for 504 jobs will be preserved. Additionally, there is potential for further expansion following the completion of Stage 3 due to be operational in 2018-19 with the potential to grow to an additional contribution of $6.4 million to the regional economy per year and account for an additional 121 direct and indirect jobs. Whilst a significant portion of this business is expected to be redirected from elsewhere in Queensland, some may represent new business to the State, or business that may have otherwise been lost to other States or overseas.

The TMPP has the potential to provide better quality facilities for existing marine businesses if they relocate from the Ross River. Of the identified benefits of the new facility the potential to develop new services / access new markets has been assessed as potentially of High impact level.

To the extent that businesses are along Boundary Street are dependent on drive-past traffic these businesses will benefit from any increases in traffic associated with the expansion of marine industry following 2018-19.

In the context of the Northern SD and Queensland, however, the quantitative impact of the TMPP, whilst anticipated to be positive is likely to be negligible. In gross terms, the operation phase of the commercial precinct of the TMPP is estimated to retain household incomes, through wages and salaries paid, of approximately $21.4 million in the Northern SD and $29.2 million in Queensland, with potential for an additional $6.0 million in the Northern SD and $8.0 million in Queensland to be generated by expansion of activity post 2018-19. In net terms, however, the commercial precinct is not expected to result in a significant material change in overall household consumption expenditure from what would be anticipated to occur if the project does not proceed.

5.3.3 Additional costs to government of infrastructure

5.3.3.1 Construction impacts

Commonwealth government costs

No net increase in costs to the Commonwealth Government is expected during to the construction phase of the development.

State government costs

As with the impact on the Commonwealth Government, it is unlikely that there would be a significant change in the level of State Government expenditure due to the development during the construction phase.

Local government costs

Townsville City Council has recently changed its developer contribution charges to represent the full cost of providing additional infrastructure. As such the TMPP and Townsville Waterways developments should not create a cost impost on Townsville City Council.

5.3.3.2 Operating impacts

Australian government costs

The loss of all the existing marine industry on Ross River would displace an estimated 504 direct and indirect FTE jobs. In the current economic climate a number of these displaced workers may have difficulty finding alternative work, and require Commonwealth Government unemployment and welfare assistance.

It is assumed that any loss of existing Ross River marine businesses would be offset by the establishment of new businesses at the TMPP or a transfer of their economic activity to elsewhere in Queensland, creating employment at the new locations. Hence the impacts on tax revenues and welfare payments at the net Commonwealth level may be minimal provided that marine business does not leave the country.

State government costs

The Port of Townsville Limited is a Queensland Government entity and any additional servicing costs for the TMPP would be borne by them. The Port of Townsville currently conducts dredging of the Ross River to ensure boat access.

Local government costs

The establishment of the TMPP will essentially result in a relocation or re-establishment of existing businesses with a transfer of council costs and revenues. Council will gain new residential rates from the establishment of the Townsville Waterways development and from likely increased valuations of land adjacent to the new residential area. Given that the development is likely to be a premium product it is assumed that the rates achieved will be more profitable for council than would be achieved if the future residents settled elsewhere in Townsville.

5.3.4 Implications for future development in the locality

The site of the TMPP is relatively disjointed from surrounding areas, being bounded by Benwell Rd and the Ross River. The site would not be suitable for other types of development.

5.3.4.1 Opportunity costs of the TMPP

The site on which the TMPP will be established has little alternative economic uses. The opportunity cost of proceeding with the project is represented by the ecosystems services of the area, valued as approximately $757,960 in 2009 dollar terms, and any social values of the area that may be lost (refer Section 4).

There are three main opportunity costs identified in not proceeding with the TMPP given that the TPAR bridge will proceed. These are:

- An estimated $113.0 million per annum ($2009) in direct and indirect output from the existing Ross River marine industry. This would be the immediate opportunity cost of not proceeding with the TMPP and relocating the existing Ross River marine industry;
- An estimated up to $140.8 million per annum ($2009) in direct and indirect output from the TMPP once all three stages are completed (post 2018-19). This would be the long term annual opportunity cost of not proceeding with TMPP; and

- An estimated one-off $128.7 million ($2009) over 9 years (2009-2018) in direct and indirect output from the construction activities associated with the development of the TMPP and Townsville Waterways residential development.

5.3.4.2 Impacts on local property values

The site of the TMPP is relatively distant from existing residences, and is in an area that would generally be considered to have an industrial character. The precinct essentially represents a relocation of industry within the local area and as such will not be seen as a significant improvement in local employment prospects. There is little reason to believe that the TMPP development would have a significant impact, positive or negative, on local residential land values near the TMPP site.

Some of the existing Ross River marine industry is located close to existing residences and although the relocation of these industries may have a positive impact on the values on some of these residences, there is little to suggest that the existing residences are impacted by the marine industry.

The establishment of the proposed Townsville Waterways residential development is considered likely to be positive for residential property values in the adjacent areas given that it will be a premium, waterfront development.

5.3.4.3 Impact on local labour market

Construction phase

The total (direct and indirect) estimated additional labour force needs created by the construction activity for the TMPP and Townsville Waterways project are summarised in Table 5-9.

Table 5-9 Estimated Total Employment Impacts from the Construction Phases of the New TMPP

Year Addition	al Employment Generated (Northern SD)	Additional Employment Generated (Queensland)
2009-10	46	64
2010-11	56	78
2011-12	82	115
2012-13	41	58
2013-14	41	58
2014-15	77	110
2015-16	76	107
2016-17	51	71
2017-18	10	14

Source: AEC*group*

At the time of writing the most recent estimate (September Quarter 2008) of the Northern SD labour force was 118,759 workers (smoothed data series, Queensland Regional Statistical Information System, 2008a). According to the 2006 Census the Northern SD was home to 8,492 persons employed in the construction industry (of a total estimated Northern SD workforce by the 2006 Census of 94,375 persons). The additional employment created by the construction and operating phases of the project should easily be met from within the region's existing labour force, particularly given the current easing in the jobs market due to the economic downturn. The skills requirements for the construction phase of the project are a relatively minor portion of the region's existing construction workforce.

The existing and proposed TMPP are located near to the CBD of Townsville and within easily commutable proximity for the majority of the region's labour force. There is no anticipated need for worker accommodation on site. The additional labour force needs are expected to be entirely or mostly met from existing residents of the region however if a portion of the workforce is temporarily required from elsewhere the size of the needs will not be of material concern to Townsville's existing accommodation capacity. A large number of similar or larger projects have been previously completed or are currently underway in Townsville without having placed significant stress on the accommodation capacity of the region.

Operating phase

Stage 3 of the TMPP is due to be completed by 2018-19. It is estimated that if, and when, marine industry expends to utilise this additional space that up to 160 additional operational jobs will be created in the marine industry.

The skills needs for any expansion of marine industry at the TMPP are more specialised and less abundant in the region and may take a period of time to acquire / develop post 2018-19.

There is also, however, potential for job losses from the non-quantified impacts on the existing Ross River businesses between 2009 and 2018. These job losses would occur if the affected businesses lost existing work due to uncertainties with the relocation or loss of functionality (including temporary). Additional costs expended by the businesses for relocation expenses etc may also require cost-cutting elsewhere, including through cuts to employment.

5.3.4.4 Mitigatory and enhancement strategies

Key mitigatory strategies for the development of the TMPP relate to the management of impacts on the existing Ross River marine industry. It is understood the Port of Townsville is in continued negotiations and planning for strategies to manage the impact on the Ross River marine industry. The results from these engagements and the final detailed design and operating structure of the Precinct will influence the most suitable mitigation measures.

Despite the significant challenges in managing the development of the TMPP with the existing Ross River marine industry there are a number of potentially positive operating impacts to be gained from the establishment of the TMPP. Potential measures to maximise these positive impacts that may be applicable are provided below in Table 5-10. Consideration to these measures should be given during detailed negotiations with the affected industries. The measures are not requirements but are potential opportunities to be managed through one-on-one negotiation with each business to obtain the most beneficial arrangement for each industry sector.

Table 5-10 Potential mitigating and enhancing measures that could be considered

Impact Type	Potential Mitigating / Enhancing Measures
Negative Impacts	
Loss of business and contract opportunities	Rapid resolution of TMPP features, relocation terms and operating terms. Provision of Port of Townsville Limited letters of support / letters of intention to avoid service disruptions to Ross River marine industry to include in tender submissions / contract negotiations. Promotion of the TMPP and the planning for smooth transmission of operations. Direct compensation. Rent / lease holidays.
Loss of financing opportunities	Rapid resolution of TMPP features, relocation terms and operating terms. Provision of State / Port of Townsville Limited credit security backing for affected financing activities of Ross River marine businesses. Direct compensation. Rent/ lease holidays.
Loss of leasehold improvements	Direct compensation. Rent/ lease holidays.
Costs from relocating and re-establishing businesses including opportunity costs of downtime experienced	Direct compensation. Direct relocation assistance. Rent/ lease holidays.
Costs of potentially operating between existing and new sites	Direct compensation. Rent/ lease holidays.
Potential increases in the cost of leasing or rents	Direct compensation. Rent/ lease holidays.
Positive Impacts	
Operational efficiencies from newer / better designed facilities	Consultation with marine industry and refinement of plans for the TMPP.
Operational efficiencies from better co-location with other marine businesses	Consultation with marine industry with regarded to appropriate co-location business types. Efficient transport networks within the precinct

Impact Type	Potential Mitigating / Enhancing Measures
Potential to develop new services / access new markets	Provision of space and features beyond like-for-like replacement of existing functionality.
	Promotion of the TMPP cluster to appropriate national and international markets.

Source: AEC*group*

5.3.5 Economic impacts associated with potential relocation of existing marine industries

POTL engaged Ryder Levett Bucknall (RLB) to conduct a separate economic assessment of the impacts related to the potential relocation of industries currently occupying lands upriver to the TMPP prior to closure of the Ross River by the TPAR. The RLB report contains confidential information relating to each of the businesses involved and, accordingly, is not appended to this report which forms a public document. The report has been provided to the CoG office for consideration in accordance with this EIS. A summary of relevant information, protecting the confidential data, from the RLB report follows.

Under direction from POTL RLB undertook a study to develop cost estimates to recreate facilities in the Precinct for selected current Ross River industries. These industries included:

- Harbourside Coldstores (trawler wharf and walkway;
- Rosshaven Marine (all buildings, hardstands, quays and wharves);
- Townsville Ross River Marina (all buildings, parks, hardstands and wharves);
- Pacific Marine Group (all buildings, hardstands and quay);
- Water Police (building and pontoon); and
- Riverside Marine (all buildings, hardstands and barge ramp).

The gross overall cost estimate for relocating all of these industries to like for like facilities within the Precinct, summed across all of these industries, totalled approximately $AUD43 million. POTL is engaged in ongoing negotiations with the various industry sectors that may choose to relocate to the Precinct, which may include industries other than those listed above. Negotiations will seek to provide greater definition to the required pavement area, infrastructure facilities and wharf space for each industry. Accordingly the ultimate refined cost to relocate groups to the Precinct will likely vary from that noted above and will be determined following those detailed negotiations.

PORT of TOWNSVILLE

Section 6
Hazard and risk assessment

Townsville Marine Precinct Project

Environmental Impact Statement

6. Hazard and risk assessment

6.1 Overview

A Hazard and Risk Assessment has been undertaken by GHD and is included as Appendix CC. The objective of the Hazard and Risk assessment is to provide a qualitative investigation of potential hazards and risks associated with the Project and to identify actions for mitigating or reducing these hazards and risks.

6.2 Dangerous Goods

The project will use a number of substances listed in the Australian Dangerous Goods Codes. Table 6-1 provides an indicative list of substances by chemical name, dangerous goods classification, raw and storage concentrations, UN number, packaging group and use of this substance.

Table 6-1 Indicative Lists of Hazardous Substances and Stated Dangerous Goods

Chemical Name (Shipping Name)	Raw conc., %wt	Storage conc., %wt	D.G. Class	Hazchem Code	UN Number	Packaging group	Purpose/ Use
Diesel (Diesel)	N/A	N/A	3 (Class C1)*	3[Z]	1202	III	Fuel for marine and heavy vehicle operations
Unleaded Petrol	N/A	N/A	3	3[Y]E	1203	II	Fuel for spark ignition engines
Oils (Lubrication/ Hydraulic Oils)	N/A	N/A	3 (Class C2)**	N/A	N/A	N/A	Lubricate plant and equipment and replenish hydraulic systems.
Liquefied Petroleum Gas (LPG)	Propane: 40-100% Propylene: 0-60%	Propane: 40-100% Propylene: 0-60%	2.1	2WE	1075	N/A	Fuel
Acetylene (Acetylene Dissolved)	> 98%	> 98%	2.1	2[S]E	1001	N/A	Fuel

1,1,1,2-Tetrafluoroethane (Refrigerant gas R134a)	>99%	>99%	2.2	2RE	3159	N/A	Refrigeration gas
Liquid Nitrogen (Liquid Nitrogen)	>99%	>99%	2.2	2RE	1977	N/A	Freezing application
Nitrogen gas	>99%	>99%	2.2	2T	1066	N/A	Pneumatic equipment

*: Class C1 – a combustible liquid that has a flashpoint of 150°C or less

**: Class C2 – a combustible liquid that has a flashpoint exceeding 150°C

N/A: None allocated

6.2.1 Construction Phase

Table 6-2 provides an indicative list of substances to be held at site during the construction phase. The table details rate of usage, indicative maximum storage at site, storage and handling details.

Table 6-2 Consumption Details of Hazardous Substances and Stated Dangerous Goods – Construction Phase

Chemical Name	Indicative maximum inventory onsite	Storage Details	Handling Details	Storage Location
Diesel (Diesel)	80 kL	80 kL aboveground storage tanks	Road transport by fuel tanker to mine site storage tanks, one trip per day. Manual transfer to vehicles on-site	Fuel farm
Oils (Lubrication/ Hydraulic Oils)	4 kL	Bulk and drums	Road transport to mine site	Fuel farm

6.2.2 Operation Phase

Table 6-3 provides an indicative list of substances to be held at site during the operation phase. The table details rate of usage, indicative maximum storage at site, storage and handling details.

Table 6-3 Consumption Details of Hazardous Substances and Stated Dangerous Goods – Operation Phase

Chemical Name	Indicative maximum inventory onsite	Storage Details	Handling Details	Storage Location
Diesel (Diesel)	75 kL	3 x 25 kL aboveground storage tanks	Road transport to site by 57 kL fuel tanker 27m B doubles type, 700 trips per year. Manual transfer to vehicles on-site	Fuel farm
Unleaded Petrol	50 kL	2 x 25 KL	Road transport to site by 57 kL fuel tanker 27m B doubles type, 700 trips per year. Manual transfer to vehicles on-site	Fuel farm
Oils (Lubrication/ Hydraulic Oils)	30 kL	Bulk and drums	Road transport to mine site by 30 kL fuel tanker 27m B double type, 6 trips per year. Manual transfer to vehicles on-site	Fuel farm
Liquefied Petroleum Gas (LPG)	1300 kg	45 kg bottles	Road transport to site by trucks. Manual transfer to storage	Store/ Work Shop
Acetylene (Acetylene)	245 m^3	35 x 7 m^3 bottles	Road transport to site by trucks. Manual transfer to storage	Store
1,1,1,2-Tetrafluoroethane (Refrigerant gas R134a)	40 kg	In standard bottles	Road transport to site by trucks. Manual transfer to storage	Store
Liquid Nitrogen (Liquid Nitrogen)	160 L	In standard bottles	Road transport to site by trucks. Manual transfer to storage	Workshop/ Store
Nitrogen gas	20 bottles per annum	190 m^3	6 x 7.2 m^3 bottles 3 x 4.1 m^3 bottles	Road transport to site by trucks. Manual transfer to storage

6.2.3 Dangerous Goods Management

Diesel

Diesel is a combustible liquid and will be used as a fuel for heavy vehicles. Diesel colour is variable – water white through to light brown/ straw colour light to fluorescent green. It has a flash point of > 61.5^{o}C, specific gravity 0.85 at 15^{o}C and vapour pressure < 1 mm Hg @ 25 ^{o}C. Contact with eyes and skin will cause irritation. Inhalation in high concentrations will result in headache, dizziness, nausea, vomiting, drowsiness or narcosis. Time Weighted Average (TWA) National Occupational Health and Safety Commission (NOHSC) exposure standard for oil mist is 5 mg/m^3. Spills can impact flora and fauna.

It is proposed to store diesel in two tanks each with a capacity to hold 400 kL of diesel. Both tanks will be above ground on impervious surfaces and located in the Fuel Farm. Designs including the bund capacities will be as per AS 1940 – The storage and handling of flammable and combustible liquids. All tank transfer operations will be on impervious surfaces with a spill collection system. An external concrete concourse has been proposed at the vehicle servicing workshop area for refuelling trucks.

Diesel is insoluble in water and incompatible with strong oxidising agents. Spillages will be prevented from entering drains or water courses. The drain valves to the bund will be designed to normally operate in a closed position. Inert absorbent material such as vermiculite, sand or dirt will be placed on the spillages. The material will be collected and placed in a labelled container for disposal. Build-up of electrostatic charges will be prevented by bonding. and grounding.

Personal protective equipment (PPE) for exposure control will consist of impervious material gloves for hand protection, safety glasses or face shield for eye protection and suitable personal clothing for body protection. All PPE will conform to relevant Australian Standards.

Suitable fire fighting systems will be provided. In the event of fire, emergency response will include the use of carbon dioxide, dry chemical or foam and personnel who engage in emergency response activities will wear breathing apparatus. Due to the properties of diesel, there is no risk of violent explosion with a diesel fire.

Petrol

Petrol is a flammable liquid and will be used as a fuel for vehicles. Petrol colour is yellow, red or purple. It has a flash point of < - 40^{o}C, specific gravity 0.73 – 0.78 at 15^{o}C, vapour pressure 35-90 kPa, LEL 1.00% v/v and UEL 8.00% v/. Contact with eyes and skin will cause irritation. Inhalation may cause irritation to the respiratory system. Prolonged and repeated skin contact may cause dermatitis. Time Weighted Average (TWA) National Occupational Health and Safety Commission (NOHSC) exposure standard for petrol is 900 mg/m^3.

It is proposed to store petrol in two tanks each with a capacity to hold 25 kL. Both tanks will be above ground on impervious surfaces and located in the Fuel Farm. Designs including the bund capacities will be as per AS 1940 – The storage and handling of flammable and combustible liquids. All tank transfer operations will be on impervious surfaces with a spill collection system.

Solubility of petrol in water is negligible. Contain the spills with sand or earth. Keep away from heat, naked flames and sparks. Use absorbent in suitable sealed containers. The drain valves to the bund will be designed to normally operate in a closed position. Inert absorbent material such as vermiculite, sand or earth will be placed on the spillages. Build-up of electrostatic charges will be prevented by bonding and grounding.

Personal protective equipment (PPE) for exposure control will consist of PVC gloves for hand protection, eye protection, PVC apron and sleeves and PVC or rubber boots. All PPE will conform to relevant Australian Standards.

Suitable fire fighting systems will be provided. Water sprays will also be provided to keep the tank cool. In the event of fire, emergency response will include the use of carbon dioxide, dry chemical or foam. Petrol is highly flammable with risk of violent explosion in fire.

Oils (Lubrication and hydraulic)

Oils are typically clear green viscous liquids with specific gravity of 1.01 to 1.03 and a boiling point of 100 – 105^{o}C. They are an irritant to eyes and skin after prolonged exposure.

Oils will be stored in bulk tanks and drums. Activities using oils will be conducted on a hard stand area, and drip trays will be provided at appropriate locations. All spillages will be prevented from entering drains or water courses. Absorbent material will be placed on the spillages which will be collected for disposal. Hand gloves and goggles will be used while handling the product.

Tarong Energy has Environment Management Procedure number T-SMP-8426 which documents action required for responding to oil spills and required clean up techniques.

Liquefied Petroleum Gas

Liquefied Petroleum Gas (LPG) is used mainly in the workshop as a fuel / heat source for miscellaneous equipment items. LPG is a colourless liquid (under pressure), colourless gas, with a pungent odour. It has a vapour pressure of 1,292 to 1,530 kPa at 40^{o}C and flash point of - 100^{o}C. Acetylene has a lower explosion limit of 2.3%. Propane and propylene which are the constituents of LPG are asphyxiant.

LPG is heavier than air and may accumulate in low lying areas such as drains where it can become a serious fire and explosion hazard. LPG is highly flammable and explosive. It will ignite on exposure to heat or an ignition source and may also ignite on exposure to a strong oxidising agent. Flashback may occur. Pressurised containers may result in a Boiling Liquid Expanding Vapour Explosion (BLEVE) situation. Emergency response will include use of water to cool closed containers to prevent pressure build-up and possible auto ignition or explosion, with personnel using full protective clothing. There is a risk of explosion with LPG releases and people will be evacuated from the workplace of the incident.

Acetylene

Acetylene is highly flammable and is used as a fuel. It is a colourless gas with garlic like odour with vapour pressure of 4700 kPa at 25^{o}C and flash point of < 23^{o}C. Acetylene has a lower explosion limit of 2.5%. It is non irritant and an asphyxiant gas with effects proportional to the oxygen displaced.

Bottles will not be stored near sources of ignition, oxidising agents, poisons, flammable liquids or combustible materials. Bottles will be kept upright, in a secure area on firm floor to prevent falling.

PPE will consist of safety boots, cotton or leather gloves and safety glasses. Where an oxygen deficiency risk exists, wear an air-line respirator. If the pressurised bottles are exposed to fire, the elevated temperatures may cause cylinders to explode. Emergency response will include use of water fog to cool the bottles with personnel using full protective clothing. For incidents involving acetylene cylinders a 200-metre exclusion zone will be establish and people evacuated from the immediate area.

Refrigerant Gas (R134a)

R134a is used as a refrigerant and is non-flammable. R134a is a clear liquid with slight ethereal odour having a vapour pressure of 665 kPa at 25^{o}C, vapour density of 1.21 and a boiling point of -26.4^{o}C. The Time Weighted Average (TWA) National Occupational Health and Safety Commission (NOHSC) is 1000 ppm. Exposure to eyes and skin will result in cold burns. When heated to decomposition, R134a may evolve toxic gases such as hydrogen fluorides and carbon monoxide. No known ecological damage is caused by this product.

Bottles will be kept upright in a secure area, on a firm floor to prevent falling. Bottles will not be kept near sources of ignition. If the cylinder is leaking, evacuate area of personnel.

PPE will include wearing of safety glasses, safety boots and leather gloves. When an inhalation risk exists, self contained breathing apparatus (SCBA) or air line respirators will be used. If the pressurised bottles are exposed to fire, the elevated temperatures may cause cylinders to explode. Emergency response will include use of water fog to cool the bottles with personnel using full protective clothing.

Liquid Nitrogen

Liquid Nitrogen has freezing applications. It is a non flammable, colourless and odourless liquid with a specific gravity of 0.967 and has a boiling point of – 195.8^{o}C. Exposure to eyes and skin will result in cold burns. Release of liquid to the atmosphere will generate a vapour fog cloud which must be treated as an asphyxiating atmosphere. Nitrogen will quickly disperse to the atmosphere. It is not toxic to plants and animals except at extremely high (asphyxiating) levels.

Liquid Nitrogen will be stored in bottles and kept upright, in a secure area on a firm floor to prevent falling. It is incompatible with oxidising agents, acids, heat and ignition sources and potentially violent with oxygen, halogens and metal halides.

Use of PPE will be specific to the situation and may include splash proof goggles or face shield, air line respirator and self contained breathing apparatus.. If the pressurised bottles are exposed to fire, the elevated temperatures may cause cylinders to explode. Emergency response will include use of water fog to cool the bottles with personnel using full protective clothing.

Nitrogen

Nitrogen is a non-flammable, colourless and odourless gas having a vapour density of 0.967 and a boiling point of -195.8^{o}C. It is a non-irritating asphyxiant gas with effects proportional to the oxygen displaced. Nitrogen is a major component of air and is non-toxic to plants.

Compressed nitrogen gas will be stored in gas bottles and kept upright in a secure area on a firm floor to prevent falling. If the cylinder is leaking, personnel will be evacuated from the area Any person affected by the gas will be removed from the area immediately by a rescuer using an air line respirator or SCBA. If the pressurised bottles are exposed to fire, the elevated temperatures may cause cylinders to explode. Emergency response will include use of water fog to cool the bottles with personnel using full protective clothing.

6.3 Natural Hazards

A natural hazard is a naturally occurring situation or condition with the potential for loss or harm to the community or environment (SPP 1/03, 2003). No snakes or other potentially venomous animals were detected during the ecological survey within the immediate construction footprint, however, there is the potential these taxa may occur and appropriate personal protective equipment is required to be worn by all visitors to the site during construction. As the Precinct is not proposed to be a clearance point for quarantine there is not expected to be a risk of introducing any diseases of concern as a result of construction or operational activities. Other potential natural hazards that could impact the facility are identified following.

6.3.1 Cyclone

Australia's tropical cyclone season is usually from November to April inclusive and affects most of the Queensland coast. Tropical Cyclone Warning Centre of the Bureau of Meteorology (BoM for Eastern region) at Brisbane issues a tropical cyclone warning when a cyclone or developing cyclone is likely to affect coastal or inland communities. The warnings identify the communities likely to be affected, the name of the cyclone, its position, intensity, severity and movement. Consequences of a cyclone can include a combination of flood, storm tide inundation, strong winds and landslide.

Selections of tropical cyclones occurring since last 100 years Source: www.bom.gov.au (accessed on 3 Feb 09) in the region of Townsville are as follows:

- On 9 February 1927, a tropical cyclone crossed the coast just to the north of Cairns. Many buildings were unroofed and 16 were totally destroyed. The sea wall at Cairns broke in several places. The tropical cyclone weakened into a disastrous rain depression. Many people drowned including one at Townsville. A total of 47 people lost lives. Several washaways of railway line and bridges occurred.
- In February 1929, two tropical cyclones crossed the coast at Townsville and Mossman, bringing heavy rain and widespread flooding. Damage in the Monto district very severe and low lying areas of Rockhampton inundated. Considerable damage to roads and bridges at Rockhampton and Mt Morgan. From the 26th to 28th February portions of Cairns were inundated and road and rail traffic severely disrupted.
- In January 1930, a non-damaging tropical cyclone crossed the coast at Mossman, bringing heavy rains and flooding to many areas of Queensland. Traffic between Townsville and Cairns completely disrupted, low-lying portions of Cairns and Mackay inundated. Other areas affected by flooding included Townsville, Cloncurry, Mt Isa, Hughenden, Winton, Longreach, Aramac, Adavale (3m of water in the streets) and Charleville. Three rail passengers drowned while being ferried across the Burdekin River and there were 3 other drowning. Cattle and sheep were drowned.
- *Tropical Cyclone Ada* was a 'Category 4' cyclone that severely damaged resorts on the Whitsunday Islands on 17 January 1970. It claimed resorts and boats on the Islands of Daydream, South Molle and Hayman, as well as homes near Proserpine where flooding also occurred. Fourteen people died and total estimated costs were $390 million (in 1970 values).
- *Tropical Cyclone Althea* was a 'Category 3' cyclone crossed the coast just north of Townsville. Three lives were lost in Townsville and damage costs in the region reached $50

million (1971). Severe winds damaged or destroyed many homes. On Magnetic island 90% of the houses were damaged or destroyed. Tornadoes damaged trees and houses in Bowen. A 2.9 m storm surge was recorded in Townsville Harbour, with a maximum storm surge of 3.66 m recoded at Toolakea, just north of Townsville. . The storm surge and wind generated waves, although occurring at low tide, caused extensive damage along Strand in Townsville and at Cape Pallarenda.

- On the night of 10 January 1998 *Cyclone Sid* dumped 549 mm of rain, the highest recording at Townsville airport. Unofficial figures from some suburbs were over 700 mm.
- In February 1999, Cyclone Rona was caused by severe flooding resulting in serious infrastructure and property damage and heavy crop losses Thousands of hectares of sugar cane and bananas in the Mossman -Townsville region were flattened or flooded. Five hundred homes were damaged injuring five people.
- *Tropical Cyclone Larry* crossed coast near Innisfail on 20 March 2006. Major damage to homes and other buildings was caused by Larry as well as extensive damage to local crops. Larry reached Category 5 for a time just before landfall. Very large storm surges (debris lines to 5 m above Mean Sea Level) were measured in the Bingil Bay area.
- *Tropical Cyclone Ellie* crossed the coast at Mission Beach, south of Cairns on 2 February 2009 and as reported till 10 February 2009, it dumped nearly 400 mm of torrential rain on parts, causing flash flooding. Nearly 250 mm of rain fell in Townsville flooding rivers and cutting roads. Ingham was worst affected with water over parts of airport runway and cutting off Bruce Highway both north and south of the town.

The TMPP is situated in a location which is historically known for cyclones and flooding. As for coastal water warnings noted below, the project proponent will monitor for such warnings and advise internally to clients at the Precinct.

6.3.2 Coastal Water Wind Warning

Coastal water warnings are issued by the Brisbane regional office of the BoM whenever strong winds, gale, storm force or hurricane force winds are expected within one or more coastal waters forecast areas. The warning attempts to provide a lead time of 24 hours and are renewed every 6 hours.

The project proponent will monitor for such warnings and advise internally to clients at the Precinct.

6.3.3 Earthquake

Earthquakes are unpredictable and strike without warning. They range in strength from slight tremors to great shocks lasting from a few seconds to a few minutes. In the last 80 years there have been 17 earthquakes in Australia registering 6 or more on the Richter scale. Australia's rate of earthquakes is about 1 every 5 five years, compared to a world average of about 140 per year. The size of earthquakes is commonly measured using the Richter scale.

The earthquakes with magnitude of 5 or greater recorded in Townsville region since last 100 years (Geoscience Australia, 2009) are summarised as follows:

- Earthquake of magnitude 5.7 was recorded at 13:54 hours on 18 Dec 1913 at Lat -20.0 and Long 147.0 which is approximately 93 km south of the Precinct.
- Earthquake of magnitude 5.0 was recorded at 09:12 hours on 01 Feb 1937 at Lat -16.5 and Long 148.5 which is approximately 333 km north-east of the Precinct in the sea.
- Earthquake of magnitude 5.0 was recorded at 10:35 hours on 01 Dec 1958 at Lat -16.5 and Long 145.5 which is approximately 326 km north-north-west of the Precinct.

Seismic hazards will be considered separately in the Precinct Development Project by the individual project proponents and POTL. Appropriate Australian Standards will be followed.

6.4 Preliminary Hazard Analysis

This section presents the assessment methodology and results for the hazards and risks associated with the construction, operation and de-commissioning phases of the TMPP through the use of Preliminary Hazard Analysis (PHA).

Following regulations, standards and guidelines are applicable:

- Australian Risk Management Standard AS 4360:2004;
- Australian Code for Transport of Dangerous Goods by Road and Rails (ADG Code);
- HB 203 2006: Environmental Risk Management – Principles and processes;
- Dangerous Goods Safety Management Act 2001;
- Transport Infrastructure Act 1994;
- NSW Department of Planning's Hazardous Industry Planning Advisory Paper (HIPAP) no 6 Guidelines for Hazard Analysis;
- NSW Department of Planning's Hazardous Industry Planning Advisory Paper (HIPAP) No 4 Risk Criteria for Land Use Planning; and
- State Planning Policy 1/03, Mitigating the Adverse Impacts of Floods, Bushfire and Landslide.

The risk assessment carried out in this study assumed that the safety assessment process will continue throughout the life cycle of the project to refine the outcome of the development approval/ environmental risk process.

The PHA includes:

- All relevant hazards, both natural and technological;
- The possible frequency of potential hazards, accidents, spillages and abnormal events occurring;
- Indication of cumulative risk levels to surrounding land uses;
- Life of any identified hazards;
- Effects of hazardous substances to be used, stored, processed, produced or transported;
- The rate of usage of substances; and
- Type of machinery and equipment used.

The key components of Preliminary Hazard Analysis are detailed further in Appendix CC and include the following:

- Stage 1: Hazard Identification;
- Stage 2: Consequence and Effect Analysis;
- Stage 3: Frequency Analysis; and
- Stage 4: Risk Reduction.

The Port of Townsville Risk Matrix used to rank each of the hazards and the definitions of each frequency and severity increment is enclosed in Appendix CC.

The PHA study identified a number of potential project improvements or areas for further study and/or investigation. The Risk Register is enclosed in Appendix CC. Matrix risk assessment of the 35 hazards resulted in 12 high risks, 15 substantial risks, five medium risks, three low risks before mitigation measures. After mitigation measures, it resulted in 1 high risks, three substantial risks, 13 medium risks and 18 low risks.

Key risks identified are summarised in Table 6-4. Item numbers in the table correspond to item in Risk Register for the Project enclosed in Appendix CC.

Table 6-4 Key Risks Identified for the TMPP

Item Number	Potential Hazardous Event Description	Potential for Offsite Impact
	High Risks	
6	Dredging channel - mobilisation of heavy metals	Yes
7	Dredging channel - mobilisation of nutrients	Yes
8	Dredging channel - light attenuation/ increased turbidity	Yes
9	Under scenario where all potential construction projects occur simultaneously accommodation/ services and social infrastructure in south Townsville may not be adequate (insufficient for workforce during both construction and operation phase). This is unlikely if Precinct construction proceeds on timeline disconnected to other potential developments.	Yes
13	Member of public accessing the site	Yes
16	Increased traffic along Benwell road	Yes
24	Poor acidic sulfate soil management	Yes
26	Inadequate hygiene/ quarantine practices for vessel mobilisation (e.g. vessels coming in for repairs)	Yes
27	Increased vessel traffic due to improved facilities	Yes
28	Vessel collision	Yes
31	Damage due to tropical cyclone	Yes

Item Number	Potential Hazardous Event Description	Potential for Offsite Impact
32	Damage due to Tsunami	Yes
	Substantial Risks	
1	Storage and handling of hazardous materials and fuels	No
2	Fire at the marine workshop due to ignition and spreading due to appropriate wind conditions.	No
3	Increased traffic during construction and operation phase.	Yes
5	Construction and operation waste	Yes
11	Negative publicity	Yes
12	Construction workplace accidents	No
15	Noise from project activities	Yes
17	Discharge outside of license limit due to inadequate water management or inadequate system capacity or equipment failure.	Yes
22	Abrasive blasting	Yes
23	General Flora and fauna	Yes
25	Maintenance of offshore structures	Yes
29	Events such as floods, storm and natural fires	Yes
30	Seismic event causing damage to facilities	Yes
34	Vessel falls during lifting operations at ship lift	No
35	Fire and explosion on vessels anchored	No

The recommendations / additional controls are shown in Table 6-5 and below. These correspond to the mitigation measures identified, which resulted in ranking of risk after mitigation measures. The item number corresponds to the item for which the recommendation / additional control was generated (see the Risk Register in Appendix CC). Responsibilities/ delegations have been assigned to each of these items as per TPA Risk management Guidelines and a signoff should take place to ensure that they are actioned appropriately. Item numbers in Table 6-5 and Table 6-6 correspond to items in the Risk Register for the Project.

Table 6-5 Summary of Mitigation Measures identified for High Risks

Item	Recommendations/ Additional Control	Implementation Stage	
		Construction	Operation
6	Implement control measures identified from the dredging studies – heavy metals	√	√
7	Implement control measures identified from the dredging studies – nutrients	√	√
8	Implement control measures identified from the dredging studies - turbidity	√	√
9	Interact with other projects and local government to enable appropriate construction timeline scheduling to mitigate impacts. Liaise with local Government to provide required infrastructure as needed.	√	√
13	More secure fences to prevent access to Precinct area.	√	√
	Increased patrols.	√	√
16	Implement recommendations of traffic study.	-	√
	A new road and rail link is proposed to be built over the mouth of Ross River.	-	√
	Conduct road safety audits.	-	√
24	Develop and implement suitable ASS management plan (QASSMAC Guidelines, 1998)	√	√
26	Implement proper monitoring mechanism for quarantine practises.	-	√
	Provide training to the persons responsible for monitoring.	-	√
27	Monitor traffic and if required explore possibilities of harbour access control.	-	√
28	Emergency response plan for spill control and medical emergencies	√	√
31	Emergency response plan.	√	√
	Trained staff to respond during emergencies.	√	√
	Liaison with Local government, QFRS, QAS, and SES	√	√

Item	Recommendations/ Additional Control	Implementation Stage	
		Construction Ope	ration
32	Emergency response plan.	√	√
	Trained staff to respond during emergencies.	√	√
	Liaison with Local government, QFRS, QAS, and SES.	√	√

Table 6-6 Summary of Mitigation Measures identified for Substantial Risks

Item	Recommendations/ Additional Control	Implementation Stage	
		Construction	Operation
1	Spill control kits. Drain valve of bund always in closed position. Ensure proper disposal through qualified contractors.	√	√
2	Increase more awareness amongst staff/workers.	√	√
	Contractors to include adequate fire fighting provisions while working at site.	√	-
3	Consider use of bus for carrying people to and from the worksite, which will reduce chances of fatality.	√	-
	Manage deliveries outside shift change timings.	√	√
	Conduct Road safety audit.	-	√
	Traffic controls to be part of construction management plan.	√	-
	Monitor and repair roadways.	-	√
	Consider installing crash barriers between roadways and infrastructure	-	√
5	Avoid generation of wastes, consider reuse of wastes, consider recycling and ensure proper disposal.	√	√
	Implement controls identified in the waste management plan	√	√
11	Continue consultation	√	√
12	Monitor and ensure compliance with WH&S requirements.	√	-
	Implement Safety plans	√	√

Item	Recommendations/ Additional Control	Implementation Stage	
		Construction	Operation
15	Implement Management Procedures identified in Noise Assessment section of this EIS.	√	√
	Match operations to noise limits during the day.	√	√
	Provide Hotlines to receive complains from people.	√	√
17	Consider pumping out of all waste waters, storm waters.	√	√
22	'Enclosed area for abrasive blasting over land	-	√
23	Implement control measures identified from the studies for protection of flora and fauna	-	√
25	Employ all controls. Comply with licence conditions for abrasive blasting	-	√
29	Emergency response plan.	√	√
	Trained staff to respond during emergencies.	√	√
	Liaison with Local government, QFRS, QAS, and SES.	√	√
30	Suitable emergency response plan.	√	√
	Trained response workers.	√	√
	Liaison with QFRS and QAS	√	√
34	Training to staff. Standard operating procedures.	-	√
35	Monitoring and control by each vessel operator	-	√

6.5 Management plans

6.5.1 Risk Management Plan

A risk assessment and management approach at the EIS stage has a major advantage. Safety studies can be used in a complementary way from the initial planning for the project and selection of a site, through to its construction and operation. It is fundamental to safety planning that all hazards are identified and appropriate safeguards employed to address them during different stages of the project. The components are discussed in following sections. The management of Precinct will also develop a management structure for safe operations at the precinct.

6.5.2 Hazard Analysis

High risks identified for the project include dredging impacts, strain on existing infrastructure, member/s of public entering the site intentionally to cause harm, increased traffic, PASS, vessel collision, tropical cyclone related hazards. Opportunities to manage these potential risks include development of a suitable Dredging Management Plan, liaision with local government regarding infrastructure upgrade requirements, , development of an acid sulphate soil management plan and an Emergency Management Plan to deal with situations related to intruders, vessel collision and tropical cyclones.

Substantial risks identified relate to hazardous materials, fire at workshops, increased traffic, waste generation, abrasive blasting, fire and explosion at vessels anchored, flooding and seismic hazards. Management of these risks will be achieved through continued liaison with community and local government and development, in accordance with POTL standard operating procedures, of suitable procedures for hazardous substance handling and an Emergency Management Plan to deal with situations related vessel collision fire and explosions and natural hazards.

6.5.3 Emergency Management Plans

6.5.3.1 Emergency Response Team

An Emergency Response Team will be provided by the Developer at the Precinct to ensure that adequately trained and equipped personnel are readily available in the event of an emergency. The team will consist of volunteers from each operations shift from the Developer staff plus the on-duty Essential Services staff. Each team will be adequately trained. Training will include the following aspects:

- Fire fighting for potential on-site and on vessels incidents;
- Oil spill;
- Dangerous goods spill (other than oil);
- Utility failure;
- Rescue situations such as person fallen in water;
- Use of air lines and self contained breathing apparatus;
- Confined space rescue;
- First aid; and
- Other aspects as deemed necessary due to operations at the Precinct.

6.5.3.2 Emergency Response Plans

A number of Emergency Response Plans will be prepared for the Precinct to guide those responding to a variety of potential emergency situations. These plans are discussed below and will be regularly reviewed during the life of the project.

Chemicals and Fuel Spill Emergency Response Plan

The Developer will prepare a suitable spill containment and cleanup procedure for the proposed Precinct. This plan will detail the specific planning, training and response requirements for oil spill management.

The plan for oil spill emergency responses will include reporting of the oil spill to the Emergency Controller. The oil spill will be assessed to identify the type of oil, location of the spill source, the quantity of oil and the environment, marine life, community, health and safety impact. The Emergency Controller will undertake immediate steps for spill containment/control, recovery of spill material, waste management, and for community communications and media management. Recovery operations will then be commenced, which includes provision of welfare, reconstruction/clean up and replenishment of material stocks.

The management plan detailed below will be followed:

Chemicals and Fuels Management Plan	
Elements	Spillage or leakage of chemical and petroleum products and regulated wastes to land or waters.
Management Objectives	To minimise contamination of land or waters from spilled chemicals and fuels.
Performance Criteria	Correct storage of fuel or chemicals including updated MSDS. Implementation of bunding, spill response training and spill response kits.
Implementation Strategy	**Responsibility**
Retain only the minimal required quantities of chemicals, fuels, oils etc at construction sites or contractor laydown areas at any particular time. Purchase the products on an ‘as required’ basis in accordance with the provisions of the *Workplace Health & Safety Act 1995*.	Construction Contractor
Store fuels, lubricants and chemicals in appropriate containment facilities away from water storage areas and at a distance of 100 m from natural or built waterways.	Construction Contractor
Undertake maintenance and servicing of vehicles at Contractor laydown areas or other appropriate facilities. Daily servicing only may be undertaken on site; however such activity will be undertaken at a minimum separation distance of 100 m from drainage lines or waterways.	Construction Contractor
Ensure safe handling techniques during refuelling to prevent spillage.	Construction Contractor
Immediately clean up petroleum product spillages with dry absorbent materials or sand or have the area remediated.	Construction Contractor

Chemicals and Fuels Management Plan		
Place absorbent materials used in the clean up of hydrocarbons or other chemicals in an appropriate container marked 'regulated waste' and consign to a waste contractor licensed to receive such waste.		Construction Contractor
Chemicals and fuels will be stored in accordance with AS:1940 – The storage and handling of flammable and combustible liquids.		Construction Contractor/ Developer's Project Manager
Locate Material Safety Data Sheets (MSDS) at the Site Construction Office / Site Administration Office for all hazardous and dangerous goods stored and used.		Construction Contractor/ Developer's Project Manager
Ensure temporary chemical storage is in accordance with Material Safety Data Sheets (MSDS) and store non-compatible chemicals separately, as required.		Construction Contractor/ Developer's Project Manager
Clean up spills in accordance with relevant Material Safety Data Sheets and Australian Standard AS:1940.		Construction Contractor/ Developer's Project Manager
Isolate chemical spills that occur in bunded areas from the trade waste system and ensure that the contaminated wastewater is removed by a licensed contractor.		Construction Contractor/ Developer's Project Manager
Contain and collect spills of hazardous materials for treatment at a licensed waste disposal facility.		Construction Contractor/ Developer's Project Manager
In the case of a spill to ground, initiate clean up immediately and seek the advice of a qualified professional to minimise the risk of groundwater contamination.		Construction Contractor/ Developer's Project Manager
Ensure spill kits including containment and treatment equipment and materials are available near storage areas of hazardous materials.		Construction Contractor/ Developer's Project Manager
Provide totally enclosed containment for all waste.		Construction Contractor/ Developer's Project Manager
Ensure persons handling dangerous chemicals wear appropriate PPE and receive appropriate training in its use.		Construction Contractor/ Developer's Project Manager
Monitoring	◗ In the case of a spill or other accident, monitoring of the receiving environment shall be undertaken by an experienced professional.	

Chemicals and Fuels Management Plan	
	◗ The Construction Supervisor or Workplace Health & Safety Officer shall regularly inspect all temporary chemical and petroleum product storage areas for leakages and release any clean stormwater accumulated in temporary bunded areas, after each rainfall event. Environmental Representative shall also audit the contractor's procedures to check for compliance.
Reporting	◗ Daily or weekly reports (as appropriate) will be completed on-site and reviewed by each Supervisor. ◗ In the case of environmental nuisance or harm, Environmental Representative is to report the incident to EPA and local council. ◗ If a spill occurs, a report detailing corrective actions and monitoring requirements shall be prepared.
Corrective Action	◗ The Construction Manager and the Environmental Representative are to be notified in the event of non-compliance. ◗ Redesign control measure if inadequate. ◗ Investigations/corrective actions undertaken as a result of complaints will be documented and compiled within the Complaints Register. Corrective actions shall be closed out by senior management according to an agreed responsibility and timescale. ◗ Construction Manager to identify sources of contamination and arrange for affected areas to be re-mediated in consultation with EPA. ◗ Immediately clean up any spilt chemicals and fuels and replace any spills kits. ◗ In the event of contaminant release to land or water that has the potential to cause environmental harm, the Construction Manager shall immediately arrange for any necessary works to contain the contaminant and control/stop the source of the release. The Construction Manager will notify the Project Environmental Representative and Project Manager. The Project Environmental Representative will advise the EPA as may be necessary. The following constitute an incident or failure to comply in relation to chemical and dangerous goods management: – significant chemical spill

Chemicals and Fuels Management Plan	
	– storage areas not meeting Australian Standards – chemicals stored in areas not containing suitable bunding – release of chemicals or dangerous goods to the environment Should an incident occur, a selection of the following corrective actions will be undertaken as appropriate: – contain and clean up spill material immediately and remediate or appropriately dispose of contaminated material – repair bunds – relocate chemicals to appropriately bunded or approved storage areas – in the case of a significant chemical spill, the Site Emergency Plan will be followed and the EPA and local Council notified as soon as possible

POTL has Draft Emergency Response Procedure[2] which can be activated in case of spills at the request of the Developer: This procedure applies to managing spills on the road or within the containment ponds. Spills: Hydrocarbon, chemical, metal concentrate, fertiliser, manure, herbicide or miscellaneous spills.

Fire/Explosion Emergency Response Plan

The plan for emergency response to a fire or explosion includes immediate actions of raising alarms and taking life saving actions. An assessment is made of the situation including the environmental impact and access control to the site. Planning is then initiated for a containment plan, plan for dealing with casualties and a survey for effects on the environment. The emergency is then responded to for issues including fire management and containment, rescue, casualty management, and environmental impact actions. Recovery operations are then initiated which include the restoration of essential services, provision of welfare, clean up, reconstruction and replenishment of stocks consumed during the emergency response.

The Developer will prepare a suitable fire/ emergency response plan for the proposed Precinct. This plan will detail the specific planning, training and response requirements for fire/ explosion emergencies and will also list contact details for state emergencies personnel.

The following procedures will be provided by the Developer and will be activated in the event of an emergency.

- Building Emergency Fire Procedure: This Handbook will provide emergency contact numbers and assists Fire Wardens by providing a step by step summary of actions required in the event of any building emergency;

[2] The Draft Emergency Response Procedure, EPBC Reference 2003/1011 Supplementary IAS Report Attachment D, Townsville Port Access Project – Eastern Access Corridor

- Emergency Notification System: The purpose of this document will be to inform all Precinct Users, Contractors, Staff and all other relevant parties, within the Precinct status and requirements in the event of an emergency and /or the requirement to evacuate part or wholly the Precinct area; and
- Whole of Precinct Evacuation Plan: The aim of this whole of Precinct evacuation plan is to identify arrangements for the relocation of Precinct employees, other users of the precinct, contractors, visitors and related personnel from a dangerous or potentially dangerous area to safer areas.

Total Power Outage Emergency Response Plan

The plan for response to a total power outage will include start-up of the diesel generators and ensuring that the emergency power is available. The plan to be developed will include steps for an assessment on the cause for the outage and how long it will take to restore full normal power. Recovery steps will involve pre-start tests and then re-establishment of power supplies from the state power supply grid.

Natural Hazard Emergency Response Plan

The plan for response to a flooding event includes immediate actions of providing an alert, monitoring of flood levels, and monitoring of road access. The emergency is then assessed for electrical, process, and environmental impact due to overflows of sewage, oil or any other substances and access to required areas including evacuation if required. Response to emergencies could be through activation of power cuts, chemical or fuel spill emergency response, access restrictions, and monitoring road conditions. Procedures for these will be developed. Closeout to emergency response will involve required clean ups, repair of damaged equipment and repair of infrastructure.

The TMPP is in a known cyclone prone area. The Developer will prepare an Emergency Response Plan for Cyclone Emergencies. The procedure will be developed to ensure the maximum protection of people and assets against the effects of tropical cyclones. The strategy adopted will be in:

- Responsible housekeeping and appropriate preparation;
- Timely assessments of a developing cyclonic event; and
- Effective responses.

The priorities in an emergency situation are the safety of employees and port users, the minimisation of damage to Precinct infrastructure and protection of the environment.

This procedure will detail the preparatory steps to be taken by Developers employees to ensure readiness in the event of a cyclone; the actions to be taken when a cyclone threatens the Precinct and the recovery activities necessary to resume normal operations as soon as possible after the cyclonic event has passed.

In a worst case scenario that the facility was impacted by a cyclone, the largest inventory available to be spilled would be from the petrol or diesel storage tanks. If this were to occur then the bunding system would be easily able to contain a spill. Another scenario could be spillage of hydrocarbons into the water in which case the Fuel Spill Management Plan will be activated.

Other Emergency Response Plans

Included here is the relevant response to terrorist or bomb threat. The following procedures will be developed by the Developer for the Precinct and will be activated as required.

- Security Personnel Procedure for Precinct; and
- Emergency Response Plan Bomb Threat.

6.5.3.3 Emergency Services

The Developer of the Precinct will provide regular training to staff members on first aid, other safety courses and conduct seminars. For any major incident, additional support will be provided from PoT and other facilities in Townsville as required.

Townsville is covered under the northern region of the Queensland Fire and Rescue Services (QFRS). Northern Region has 20 urban fire stations and an operational staff of 165 full-time and 215 auxiliary firefighters. Northern Region Headquarters, Fire Communications Centre and functional area managers are located in Townsville. The permanent station of the QFRS is located at Morey Street in Townsville, which is close to the proposed Precinct.

Townsville is the Queensland Health tertiary referral centre for North Queensland. Northern Region plays an active role in the Queensland Emergency Medical System (QEMS), with involvement in numerous retrieval and primary response tasks with The Townsville Hospital, Queensland Rescue and the Royal Flying Doctor Service. Appropriately qualified Townsville officers respond to retrievals on the Queensland Rescue helicopter service. The Communications Centres receive calls via 000 and also through direct contact with the centre on listed numbers. Any 000 call made to the centres gets directed to the most appropriate (closest) centre for response. Townsville Communications Centre has Caller Line Identification (CLI) systems installed so that callers to 000 have their address displayed on a computer screen. This provides an advantage to Communications staff if information regarding location of an emergency is difficult to obtain, eg if caller is panicking or unable to speak due to illness, or if the call is lost. The CLI only provides location for landlines, not for mobile phones.

A Police Station is also located close to the proposed Project Area.

6.5.4 Construction and decommissioning safety

The construction phase of a development, as well as de-commissioning, is critical to overall safety in two important respects: (a) the hazards which arise in the construction and decommissioning process can result in significant levels of risk to surrounding land uses, and (b) for the Precinct to operate safely, it is essential that it is constructed in accordance with design intent, and to an appropriate level of quality.

Construction and decommissioning safety studies will relate to:

- The construction and de-commissioning program;
- The safety and emergency procedures; and
- Safeguards required ensuring safety on site and in surrounding areas during the construction phase of the Precinct.

The following are the key elements of construction and decommissioning safety:

- Familiarisation with past, existing and proposed operations and preliminary review of construction program;
- Identification of hazards specific to construction operations and assessment of associated safeguards. Assessment of operational safeguards for the construction period;
- Review of safety assurance system;
- Finalisation of construction/commissioning programs; and
- Review of procedures for management of change during construction/commissioning.

The objectives of the Construction and Decommissioning Safety Study are to:

- Identify all of the hazardous events associated with the construction of the Precinct Project;
- Assess the level of risk posed to the site, the surrounding community and the environment by these hazardous events; and
- Document the existing control measures in place to prevent or mitigate the risks posed by these hazardous events, with the focus being on potential incidents with impacts`.

POTL will ensure that the Developer conducts a separate Construction Safety Study before the actual construction phase after identification of the construction contractor.

6.6 Conclusions

The Hazard and Risk assessment has identified the nature and scale of hazards that may occur during the design and construction, operation and decommissioning of the TMPP. The study identified a total of 35 hazards which resulted in 12 high risks, 15 substantial risks, five medium risks and three low risks before mitigation measures. After mitigation measures, it resulted in 1 high risks, three substantial risks, 13 medium risks and 18 low risks. These risks along with mitigation measures have been listed in Table 6-4, Table 6-5, and Table 6-6.

The Precinct will not significantly impact on the amenity of sensitive receivers, providing appropriate management procedures are implemented as identified in the assessment studies.

Based on the assessments conducted by GHD, it can be concluded that there are no hazards that have offsite impacts. The controls in place adequately safeguard against safety, asset and environmental consequences from hazards associated with stated dangerous substances.

It is important to note that the hazard and risk studies conducted are the start of the process, not the end. A successful outcome depends on methodical close out of the recommendations and additional controls identified in the assessment process.

Section 7
Matters of national environmental significance

Townsville Marine Precinct Project

Environmental Impact Statement

7. Matters of national environmental significance

7.1 Controlling provisions

The TMPP was determined to be a controlled action under the under the EPBC Act on 3 November 2008 (EPBC 2008/4497) the controlling provisions under the Act are:

» Sections 12 and 15A (World heritage properties);

» Sections 15B and 15C (National heritage place);

» Sections 16 and 17B (Wetlands of international importance);

» Sections 18 and 18A (Listed threatened species and communities); and

» Sections 20 and 20A (Listed migratory species).

How the project relates to each of these matters is described following.

7.2 Impacts on world heritage properties

The operational areas of the port are excluded from the GBRMP, however, the World Heritage Area is more extensive and extends to mean low water mark along the coast. The TMPP will consequently occur wholly within the GBRWHA. Direct, indirect, permanent and temporary impacts on the benthic marine systems within the GBRWHA are expected from construction and operation of the TMPP. The majority of the impacts involve the removal of the intertidal sand/mud flat on the western bank of the Ross River that forms Lot 773 and the loss of seabed associated with the footprint of the breakwater. Temporary impacts expected as a result of construction activities include dredge plume impacts and noise impacts. Impacts to the natural beauty of the GBRMP are not expected as the development will blend within the existing industrial landscape. Potential impacts and appropriate mitigation measures associated with construction and operation of the Precinct include provision of new benthic habitat as a result of construction of the Precinct and use of dredge and waste management approaches to reduce potential for indirect impacts. Under the identified mitigation measures the Precinct is not expected to have significant impact on the marine ecological values of the Townsville region. Further detail regarding potential impacts on the World Heritage Properties is, however, provided following.

7.2.1 Impact to Habitats

Marine ecology information of relevance to the Precinct, including intertidal assemblages, has been collated through a focussed desktop assessment of available information (including Government agencies databases) and from the results of baseline ecological surveys. The surveys were designed to collect information that enhanced the existing knowledge of aquatic systems occurring within and adjacent to the Project Study Area and the communities they support.

The marine benthic survey findings come from a once off sampling event of 5 days in duration in October 2008 and may not reflect potential seasonality of marine fauna across the Study Area. However, the historical data and available information on the Project area and adjacent habitats is thorough and provides a strong seasonal perspective within which the survey data is used in assessing the potential impacts of the TMPP on the benthic marine ecology.

The TMPP will have a number of permanent impacts on the marine ecological values of the area in which it is located. The majority of the impacts involve the removal of an area (approximately 34 ha) of intertidal sand/mud flat on the western bank of the Ross River that forms Lot 773. Further, the loss of seabed associated with the footprint of the breakwater (approximately 2 ha in total) will also occur. In addition, a range of temporary impacts are expected as a result of construction activities, including dredge plume impacts and noise impacts.

The Ross River south-eastern Bank, sand spit and mud flat area may be the subject of further studies in regard to potential siting of boat ramp facilities. Impacts associated with the loss of any marine environs and taxa associated with that activity, including cumulative impacts following on from development of the Precinct, would need to be considered at that time.

Lot 773 was found to support a subtidal benthic community of relatively low diversity, with 25 species present, however the intertidal area was more diverse with 28 species recorded (there are usually many more benthic species present in subtidal soft bottom communities compared with intertidal communities). The subtidal benthic communities were dominated by small marine molluscs, and to a lesser extent crustaceans (crabs and prawns). The intertidal benthic communities were, similar to the subtidal communities, dominated by small molluscs, mostly snails. Fiddler crabs, soldier crabs and marine worms (sipunculids) were also present.

Prior to the construction of the Precinct a road and rail link to the proposed port site will be constructed. This road and rail corridor will enter the port site from the east, passing through the land on the eastern side of the Ross River mouth and crossing Ross River to the south of Lot 773. The actual design and construction of this infrastructure is the subject of another approval process by the Department of Main Roads. A range of cumulative impacts may occur in regard to construction effects on marine megafauna species and removal of benthic species.

The impacts on marine ecological values expected to result from the TMPP, either during construction and/or operation, include:

» Direct impacts (both potential and probable);
  – Removal of individual organisms;
  – Damage to individual organisms from direct contact related to construction activities;
  – Removal of individual organisms as a result of Precinct user activities;
  – Damage to individual organisms as a result of Precinct user activities;
  – Impact to fauna by boat strike;
  – Increased rubbish that may smother or damage individual organisms;
  – Impacts on biodiversity from dredging, construction, spills of fuel or other hydrocarbons, paint, solvents, cleaners or other pollutants;
  – Removal of potential foraging habitat for some marine turtle species; loggerhead and olive ridley (neither species recorded on survey (turtles not identified to species level on aerial surveys) though identified as potentially occurring from desktop survey);
  – Lighting impacts to nesting turtles and hatchlings in the area (November – April);

- Disturbance and displacement from increased noise and/or activity on the local area; and
- Increased rubbish that may be ingested or entangle marine fauna.

» Indirect impacts (both potential and probable);

- Decreased biodiversity from construction disturbance of sediments around the Precinct site;
- An increase in sedimentation that may result in the smothering of adjacent benthic communities;
- Degradation of habitats through continual human usage (including inappropriate waste management, boat fuel spills);
- Increased disturbance to habitats from increasing visitation/usage;
- Decreased biodiversity resulting from inappropriate waste management or an increase in sediments and pollutants as a result of construction waste or land use changes;
- Noise and vibration impacts to marine reptiles and mammals from in-water construction or ongoing operational activities; and
- Increased bioturbation from propeller activity reducing water quality and disturbing marine assemblages; and
- An increase in sedimentation that may result in the smothering of adjacent benthic habitat communities**.**

Decline in species diversity, removal of species or reduced use of the area by marine fauna may occur as a consequence of these potential impacts. This may have flow on effects for the value of the marine ecosystems within the Townsville region.

Potential mitigation measures associated with potential impacts that may result from construction and operation of the Precinct have been assessed and established. These include the following measures:

» Creation of habitat to offset habitat losses;

» Use of fauna spotters and equipment soft starts to minimise potential impacts to marine megafauna;

» Appropriate management of any reclamation tailwater through settlement ponds to minimise water quality impacts from reclamation activities;

» Adoption of lighting appropriate to minimising impact upon marine fauna;

» Use of designated channels to minimise disturbance to marine fauna and adjacent benthic habitats;

» Implementation of dredging, spoil disposal and construction management plans considering avoidance of marine habitats used frequently by marine fauna; and

» Implementation of appropriate onsite waste management practices to mitigate potential for offsite impacts on water and sediment quality and to avoid ingestion by marine fauna.

Under these mitigation measures the Precinct is not expected to have significant impact on the marine habitat ecological values of the Townsville region.

7.2.2 Water quality

The TMPP is located in the tidally influenced river mouth of the Ross River. The Ross River discharges into Cleveland Bay, which forms part of the Great Barrier Reef World Heritage Area.

Potential influences on water and sediment quality from the urban areas and Port operations include stormwater run off, accidental spills of hydrocarbons and other products and dust and spillage of bulk commodities that are imported and exported through the Port. Other impacts on water and sediment quality within the Project Area include inputs of heavy metals, hydrocarbons, pesticides and herbicides from catchment activities such as urbanisation, agriculture, Ross River Dam and the presence of light industry.

A review of existing data and the collection of baseline water quality data was undertaken to provide a means of assessing the current state of the environment and to allow for the assessment of potential impacts from the development of the Precinct.

Results for turbidity (monthly and continuous data) and suspended solids indicate that the Ross River estuary and the area immediately offshore from the river mouth is a naturally turbid system (average 35 NTU) and that turbidity is fairly uniform across the water column. The spatial trend shows that turbidity is generally higher in the Ross River sites than the offshore sites and the seasonal trend shows slowly decreasing turbidity leading up to December with a rapid increase post December during the heavy rain period. Two environmental variables appear to influence sediment concentrations in the water column in the Project Area; wave induced resuspension of bottom sediments and the inflow of sediments from the Ross River estuary during rainfall events. Both of these are natural events, although clearing for agriculture and housing estates in the catchment will have increased the input of sediment in runoff into the estuary from rainfall since development of the catchment began.

Both the long term POTL monitoring data and the EIS vessel based monitoring data showed elevations of nutrients above the QWQG (2006) guidelines in many of the samples collected. Results from the vessel based water quality monitoring program showed substantially higher nutrient concentrations at sites in the vicinity of the existing boat moorings in Ross River, indicating that these moorings are having an impact on water quality.

There appear to be only very minor inputs of pesticides into the lower estuary of the Ross River, with one compound present above laboratory limits of reporting in the first monitoring event. Pesticides are likely to be sourced from the upstream rural and urban catchment. Inputs of other anthropogenic contaminants from urban areas and the Port operations also appear to be low, with the exception of some localised, minor elevations in oil and grease surrounding the existing boat moorings in the upper estuary.

The potential impacts of construction and operation of the Precinct on water quality are:

» The generation and migration of turbid plumes from capital and maintenance dredging;

» The mobilisation of contaminants into the water column (including nutrients and acid sulfate soils) during capital and maintenance dredging; and

» The discharge of contaminants from various marine industries into Ross River.

The results of turbidity modelling outlined in this report suggest that it is unlikely that dredging will result in increases in turbidity above background levels at the sensitive sites that are of ecological significance and that any increase is likely to be over one tidal cycle only.

Overall, the quality of sediments in the Project Area is compliant to the NADG (2009) and the Environment Investigation Levels (EIL) of the Draft Guidelines for the Assessment and Management of Contaminated Land. Therefore it is not expected that dredging will result in the release of contaminants to the water column.

The existing boats moored in Ross River appear to have impacted on water quality in the immediate vicinity of the moorings, with elevated concentrations of nutrients and minor inputs of hydrocarbons. It is anticipated that water quality in the vicinity of the current boat moorings will improve if vessels currently positioned on these moorings relocate to the Precinct. However, water quality in the Precinct basin and Ross River has the potential to be impacted if adequate controls on discharges from berths and moorings as well as the industries and activities that establish at the Precinct are not implemented.

General measures for the management of water quality impacts from the operation of the Precinct include:

» A condition of development on the Precinct will be that industries gain the appropriate environmental approvals and comply with the permit conditions and other relevant guidelines, standards and codes of practice for their industry;

» All owners/operators of activities and industries that establish at the Precinct will be required to prepare and implement an EMP for their activities; and

» Mooring leases will contain guidelines for boat owners in terms of waste disposal in particular and appropriate disposal facilities will be provided. Waste management impacts and mitigation measures appropriate for the Precinct facility have been considered under a separate report for the EIS studies.

7.2.3 Sediment quality

The sediment sampling undertaken for this EIS demonstrated the presence of minor concentrations a number of anthropogenic contaminants. PAHs were identified in low concentrations in the vicinity of WQ10 – 12. PAHs are commonly associated with incomplete combustion of fuels and oils and are likely to be present in the Ross River estuary as a result of the presence of boat traffic and moorings, particularly in the vicinity of WQ10 - 12. Nutrient concentrations in sediments (as for water quality findings) were also higher in the vicinity of the boat moorings, indicating an input from this source or other land based anthropogenic activities in this area.

Minor concentrations of TBT were identified in two sediment samples. TBT is an antifouling agent that was previously used on ships and boats to prevent growth of marine organisms on their hulls. The likely sources of TBT are boat maintenance activities that are currently based on the northern bank of the Ross River, west of the proposed Port Access Road and from boats and ships in both Ross River and the adjacent Port facilities. TBT is usually present in marine sediments heterogeneously.

Minor concentrations of herbicides were also identified in the sediments of the study area. As was the case with water quality, this indicates minor inputs of these anthropogenic contaminants from the Ross River catchment. No long term build up of these contaminants was evident from this monitoring program.

Overall, the quality of sediments in the Project Area is compliant to the NADG (2009) and the EIL of the Draft Guidelines for the Assessment and Management of Contaminated Land. If ocean disposal of dredged material is required to complete the TMPP investigations for the required sediment sampling and analysis plan will address management of any detected contaminants to mitigate any impacts upon the ecological values of the marine environment.

7.2.4 Hydrodynamics and coastal processes

Coupled hydrodynamic, wave and sediment transport modelling was undertaken in order to describe the existing hydrodynamic characteristics of Cleveland Bay, and in order to assess potential impacts associated with the construction of the Precinct and associated breakwaters. The modelling exercise provides an understanding of general circulation patterns in Cleveland Bay (as driven by tide and waves) as well as informing details of circulation, sedimentation and flushing patterns in the vicinity of the proposed marina and breakwater development within the Precinct.

Predicted impacts are low, leading to a limited need for formal mitigation measures.

The following conclusions can be derived from this study.

- There is no significant impact on water levels as a result of the proposed development under the driving forces of tide and wave (both prevailing and 1 year storm wave) conditions. However an increase in water level of up to 0.20 m is observed behind the proposed eastern breakwater during 100 year floods in the Ross River, albeit that this increase occurs at low tide;
- Current magnitudes are expected to be reduced significantly at the proposed Marina site while an increase in current between the breakwaters is predicted. This will lead to an increased potential for sedimentation within the marina, which will need to be catered for in estimating ongoing maintenance requirements;
- Absolute values of shear stress appear to remain relatively low (i.e. less than the 1 N/m2 threshold for erosion) under the majority of conditions, with increases in bed shear typically less than 0.5 N/m^2. Hence, under the majority of conditions, changes to stresses appear unlikely to require mitigation;
- Under flood conditions, bed shear stresses could potentially increase by 5 – 8 N/m^2 in the entrance and at the tail of the eastern breakwater. This imposes a risk of scour, which will need to be addressed during design;
- The flushing time for contaminants increases by approximately 12 hours (i.e. an increase of 35%) over the existing conditions for most sites within the Precinct, including the proposed marina. This potential increase in flushing time is not like to have a high impact as most passive contaminants are flushed within 1.6 days, which is a relatively short time. No mitigation measures are recommended, other than ongoing monitoring of water quality; and

» Dredge plume modelling was undertaken for a period of one month to assess the potential impacts of dredging in the navigation channel closest to the breakwater entrance. The sediment plume has maximum concentration of approximately 20 mg/l in the vicinity of the dredge source and extends a few hundred meters radially outwards. Management of the dredge program will require monitoring, as undertaken for similar programs. Given the low magnitude of predicted turbidity, the modelling suggests that measures such as silt curtains are unlikely, though use of one near the mouth of the Ross River should be considered.

Depths of sediment deposition are estimated to be of the order of 2 to 3mm per 2 month period. Actual values will depend on ambient wind and wave conditions, the dredge used, and the amount of material in suspension during natural turbidity events, which have been measured at an order of magnitude higher than those predicted for the dredging activity. If dredging were to continue for a period of 6 months, then 6 to 9mm of material is predicted to settle.

The Ross River and its current dredged channel form the boundary of longshore sediment movement from the beach and tidal flats to the south-east of the marina precinct. The sediment movement in this area is a mixture of onshore and alongshore at the outer margins of the tidal flat and predominantly along the beach towards the Ross River close to the river entrance. Further to the south-east away from the river, sediment movement is predominantly onshore.

The coastal processes in the vicinity of the Precinct are influenced by the proposed Option C breakwater structures in a number of ways. However, the processes are capable of moving sediment at only relatively slow rates due to the low wave climate and hence any changes will take time to develop and will be restricted to the local area.

It is unlikely that sedimentation will cause major changes at the main entrance to the marina, due to the depth of the dredged channel reducing the ability of the currents to mobilise the bed sediments and the very limited sediment transport around the outside of the breakwater.

However, at the south eastern end of the breakwater, the water depths are much less and any currents generated by flood flows or tidal flows will have a much greater influence on sediment movement. In addition, it is here that the longshore sediment transport potential is the greatest. Due to the “shadowing” effect of the breakwater, the longshore sediment transport will tend to accumulate in the lee of the breakwater and extend out to the south east over time. The growth of this sedimentation towards the end of the breakwater will be limited by the flood and tidal flows between the end of the breakwater and the sand bank.

Flood flows and ebb tide flows will push sediment from shallow areas inside the marina and from the accumulated longshore transport deposition area, out of the marina onto the outer margins of the tidal flats to the south east. Flood tidal flows will cause sediment to move into the marina depositing sediment in the dredged areas adjacent to the end of the breakwater and areas where the current velocities are low.

It is concluded that it is unlikely that there will be any significant affects on coastal processes from the Option C breakwater structures forming the Precinct on the coastal areas beyond around 500m south-east of the breakwater structures.

The Port development blocks any influence of coastal processes in the vicinity of the Precinct on the coastal areas north-west of the Port. The establishment of a Precinct will not influence this fact. The Port development (including the Port areas beyond the original coastline, breakwaters, other reclaimed areas, and the dredged entrance channel) effectively isolates the processes that occur south-east of the Port from the areas to the north-west. Changes to the river hydraulics (through the construction of weirs and dams affecting both the supply of sediments to the river and the flushing of these from the river) and sand mining of existing river resources have also influenced regional coastal processes.

Notwithstanding the reasons for the degradation of the coastline west of the Port area, the proposed Precinct will have no additional contributory effect on either of the causes of the degradation outlined above and hence will have no influence on the state of the beaches to the west in either the short or long term.

7.2.5 Introduced marine pests

The Project area was assessed for the presence of marine pests as part of the survey of subtidal and intertidal habitats. No marine pests of concern for the Townsville region were detected in any of the samples collected during this survey. Species of concern were determined based on information provided in Hayes *et al*. (2005b) and through the National System for the Prevention and Management of Introduced Marine Pests.

The Precinct will not be the first port of call for international vessels and, hence, will not act as an area for quarantine clearance of vessels. National and state biofouling and ballast water management guidelines and requirements for both domestic and international shipping traffic will be implemented to minimise the potential for future introduction of marine pest species.

7.3 Impacts on National Heritage Places

The GBRWHA is a place of national heritage significance within the project site and potential impacts to this have been addressed under Section 7.2 above. Kissing Point Fort is a National Heritage Place situated approximately 4.5 km to the north-west of the Precinct footprint (by line of sight across land, refer Figure 2-3). Significant infrastructure already exists between Lot 773 and Kissing Point which will buffer any off-site effects and this area is not expected to be impacted by the TMPP.

7.4 Wetlands of International Importance

The Bowling Green Bay Ramsar wetland area is located approximately 10 km southeast of Townsville (by line of site, refer Figure 2-3) and is listed on the Department of Environment, Water, Heritage and the Arts, '*Directory of Important Wetlands*'. Under this directory the Project area falls adjacent to the Ross River Reservoir (QLD008) and Bowling Green Bay (QLD002) (www.environment.gov).

Wetlands south of the Ross River are designated as being within an Area of State Significance (natural resources) by virtue of their listing within the Queensland chapter of the '*Directory of Important Wetlands*' in Australia. If a use or activity has the potential to adversely affect this area, it must demonstrate an overriding net benefit for the State as a whole. Findings from hydrodynamic, coastal processes and ecological assessments conducted during this study indicate no impacts to the Ramsar wetland will occur as a result of the TMPP.

7.5 Impact on a listed threatened species and ecological communities

7.5.1 Bird species

Five threatened terrestrial bird species listed as protected matters under the EPBC Act were identified as potentially occurring within the project area (see Table 7-1). However, none of these species were identified during the field survey. Habitat suitable for each of these species with the exception of the Star finch was found within the study area. Listed threatened wading and migratory avifauna are addressed in detail in the following section.

Table 7-1 Threatened bird species

Species name	Common name	EPBC Act status	Survey status	Habitat availability on site
Erythrotriorchis radiatus	Red goshawk	V	Not detected	Habitat suitable to this species was present within the study area.
Geophaps scripta scripta	Squatter pigeon (southern)	V	Not detected	Habitat suitable to this species was present within the study area.
Neochmia ruficauda ruficauda	Star finch (eastern), Star finch (southern)	E	Not detected	Habitat suitable to this species was **not** present within the study area.
Poephila cincta cincta	Black throated finch (southern)	E	Not detected	Marginal habitat represented within the study area.
Rostratula australis	Australian painted snipe	V	Not detected	Marginal habitat represented within the study area.

The TMPP is expected to have very limited impacts on the terrestrial ecological values of the area in which it is located. The majority of the impacts comprise the removal of a small area (approximately 1.5 ha) of low integrity marine vegetation adjacent to Benwell Road on Lot 773.

No removal of vegetation or disturbance of fauna habitats is proposed for the south-eastern bank of Ross River. POTL has given much of the land studied in this survey to the State, and it is now reserved for conservation purposes.

7.5.2 Turtles and reptiles

Cleveland Bay is not recognised as a major nesting area for marine turtles along the Queensland coast, however, low density nesting by green and flatbacks does occur. Cleveland Bay is recognised as an important foraging habitat for green turtles. In a regional context, Halifax, Cleveland and Bowling Green Bays are all important feeding sites where green turtles graze on the seagrass beds and flatback and loggerhead turtles forage for invertebrates (pers comm. I. Bell, EPA 2008). Hawksbills are found on the inshore reefs and the olive ridley can be found in the deeper waters around Magnetic Island and along the coast. Leatherbacks are rarely sighted off Townsville, and then only in deeper waters. Collectively, these areas form an important part of Queensland's sea turtle habitat.

Potential impacts to marine turtles are summarised following.

» Direct impacts (both potential and probable);
  – Removal of potential foraging habitat for some marine turtle species; loggerhead and olive ridley (neither species recorded on survey (turtles not identified to species level on aerial surveys) though identified as potentially occurring from desktop survey);
  – Damage/mortality to individual animals from direct contact related to construction activities;
  – Impact by boat strike;
  – Lighting impacts to nesting turtles and hatchlings in the area (November – April);
  – Disturbance and displacement from increased noise and/or activity on the local area;
  – Increased rubbish that may be ingested or entangle marine turtles;
  – Decreases in water quality from dredging, construction, spills of fuel or other hydrocarbons, paint, animal waste (pathogens), solvents and cleaners.
» Indirect impacts (both potential and probable);
  – Decreased water quality from construction disturbance of sediments around the Precinct site;
  – An increase in sedimentation that may result in the smothering of adjacent benthic habitat communities;
  – Degradation of habitats through continual human usage (including inappropriate waste management, boat fuel spills);
  – Increased disturbance to habitats from increasing visitation/usage;
  – Decreased water quality resulting from inappropriate waste management or an increase in sediments and pollutants as a result of construction waste or land use changes; and
  – Noise and vibration impacts to marine turtles from in-water construction or ongoing operational activities.
  – Reduced use of the area by mobile marine turtles may occur as a consequence of these potential impacts. This may have flow on effects for the value of the marine ecosystems within the Townsville region.

Potential mitigation measures include the following:

» Use of fauna spotters and equipment soft starts to minimise potential impacts to marine megafauna;
» Adoption of lighting appropriate to minimising impact upon marine fauna;
» Use of designated channels to minimise disturbance;
» Implementation of dredging, spoil disposal and construction management plans considering avoidance of marine habitats used frequently by marine fauna; and

» Implementation of appropriate onsite waste management practices to mitigate potential for offsite impacts on water and sediment quality and to avoid ingestion by marine fauna.

Under these mitigation measures the Precinct is not expected to have significant impact on the marine turtles of the Townsville region.

Prime habitat for the yakka skink *(Egernia rugosa)* consists of dry sclerophyll forest or woodland with dense ground vegetation, log hollows, rocks and tree root systems (DEWHA, 2008c). The yakka skink has not been recorded in the project area previously and the habitat on the project site is considered to be unlikely to offer high quality habitat for this species. The yakka skink was not observed during the field investigation for this project, and it is considered highly unlikely that this species will be impacted by this project.

7.5.3 Mammals

Two threatened terrestrial mammal species, the spectacled flying fox and false water rat, are identified as potentially occurring within the study area. Neither species were observed during field surveys, however habitat suitable for each species is represented within the study area.

The spectacled flying fox is a specialist frugivore found primarily in rainforest habitats from Ingham to Cooktown, with a disjunct population in eastern Cape York Peninsula (TSSC, 2002). Although the project site does contain fruiting trees it is unlikely to serve as an important source for this species and it is considered highly unlikely that this project will impact on this species.

This false water rat is an intertidal zone specialist and is found in coastal areas in Queensland. Its primary habitat is the intertidal zone in mangrove forests, salt marshes, and sedge/reed-lined lakes near foredunes. Suitable habitat is present in the project area for this species. The project proposal will mostly impact on the western edge of the foreshore, with some degraded mangrove areas to be cleared. However, permanent removal of habitat for this species will be minimal (<1.5ha), and if it is present (there are no known records for the water mouse in the project area), impacts are unlikely to be significant.

Humpback whales (*Megaptera novaengliae)* generally occur in offshore areas and are observed off Magnetic Island. Given the inshore location of the TMPP and the shallow waters of the area (<10m) it is unlikely that the project will have any affect on this species.

7.5.4 Shark

The whale shark (*Rhincodon typus*) has been identified as potentially occurring within or adjacent to the Project site. No whale sharks have previously been recorded in the Port limits and their presence is highly unlikely. Whale sharks are filter feeders and generally prefer clearer, offshore waters. The project is unlikely to affect this species as they are widespread and migratory.

7.6 Impact on a listed migratory species

7.6.1 Migratory bird species

Wading and migratory bird usage of the project area and surrounding environment was assessed during October and November 2008. Existing literature regarding avifauna for the

Townsville region is substantial and provides seasonal and regional perspective within which the survey data is used in assessing the potential impacts of the TMPP on the intertidal avifauna assemblages associated with the Precinct.

The south-east Bank of the Ross River, directly across the river from the Precinct, is heavily utilised by marine wading and migratory birds with over 1000 individual birds using this area during low tide. This equates to an average of 49 shorebirds per hectare. Studies indicate this area is clearly an important habitat for species protected under international conservation agreements between Australia and three countries (China, Japan and Rebulic of Korea: CAMBA, JAMBA and ROKAMBA) and protected under the Nature Conservation Act and EPBC Act. Species of relevance found to be using the area include the Lesser Sandplover, Eastern Curlew, Beach Stone Curlew, Whimbrel, Great Knot, Red-necked Stint and Little Tern. These species were not found to commonly occur on Lot 773.

Within Lot 773 shorebirds are much less common with an average usage of only 3 birds per hectare (60 shorebirds per low tide on average). The different utilisation relates to Lot 773 already being a disturbed habitat that provides recreational activities including dog walking. The East Bank area is not accessed by dog walkers and provides adequate habitat to accommodate any shorebirds displaced by removal of Lot 773 habitat.

No removal of seabed or disturbance of marine habitats is proposed for the eastern bank area of the Ross River. No impact from construction or operation of the Precinct is, therefore, predicted to effect wading and migratory birds in the project area. However, given the significance of the environs of the Ross River mouth for birdlife the following measures are recommended to ameliorate against adverse impacts from the Marine Precinct project and other developments in the area:

- Changes to intertidal bird feeding habitat should be restricted to Lot 773. There should be no direct or indirect consequences of the development on the nature of, or level of interference with other intertidal flats in the area;
- Mangroves on the southeast bank of the Ross River are in good condition with an intact mangrove bird community and should be protected as an important adjunct to neighbouring estuarine habitat;
- Breakwater placement and design should be such that there are no medium or long term threats to the integrity of the offshore sand bank, its extent or its height. A breakwater should not compromise the condition of the sand bank as being separate from the mainland as an island refuge at high tide for roosting shorebirds. Visitation rates by people should not increase;
- If there is to be any interim access to the sand bank during construction of a breakwater then that access needs to be subject to stringent conditions under an Environmental Management Plan to minimise disturbance to birds at the site;
- The roost site needs to be carefully monitored in the future to ensure that its integrity does not come under threat from unpredicted changes in sedimentation patterns etc from new marine structures including the Marine Precinct and any breakwater;

- Much is already known about important, typical features of high tide roost sites for shorebirds and it is possible to engineer, or artificially create many of these features. This knowledge should be put to use if detrimental changes to the roost site do start to occur;
- The cumulative consequences of the Port Access Corridor, the Marine Precinct and other developments in the area should be acknowledged through cooperative planning by all parties involved to protect bird habitat at the mouth Ross River. Appropriate management of access by people to this area should be put in place;
- The community should be informed of the significance of the area for shorebirds with appropriate signage and community consultation, including a cooperative approach to continued monitoring of birdlife at the site using organisations such as Townsville Regional Bird Observation and Conservation Australia, Queensland Wader Study Group and Australasian Wader Studies Group; and
- Recognition of the area for shorebirds should be made through its listing with the *Shorebird Site Network* under the *Asia Pacific Migratory Waterbird Strategy* as noted in the Commonwealth *Wildlife Conservation Plan for Migratory Shorebirds*.

7.6.2 Migratory mammals

The project area is located within a Species Conservation (Dugong Protection) Special Management Area (“Dugong Protection Area”). Marine megafauna survey findings occurred over a 7 month period from September 2008 to May 2009 and included boat based and aerial survey techniques. Available literature regarding seasonal use of Cleveland Bay by marine megafauna supported assessment of potential impacts of the TMPP on marine megafauna.

Marine mammal species identified on boat-based and aerial surveys include:

- Dugong (*Dugong dugon*); N = 32
- Australian snubfin dolphin (*Orcaella heinsohni*) *N* = 2 (adult and calf);
- Indo-Pacific humpback dolphins (*Sousa chinensis*) N = 6;
- Bottlenose dolphins (*Tursiops* sp.) N = 2; and
- Unknown dolphin species N = 1.

N= maximum number of individuals recorded for each species in one sampling effort (aerial or boatbased)

None of the key marine fauna species surveyed were observed within the immediate footprint of the Precinct, although they were in close proximity (< 2 km). This was expected as the Precinct is a shallow tidal sand/mud flat which does not support preferential feeding or nesting habitat. Parra (2006) observed snubfin dolphins concentrating their activity around two areas northwest of Cape Pallarenda, and south around Townsville’s Port and Ross River mouth. Humpback dolphins show a similar distribution concentrating their activities mainly around the dredged channels and breakwaters close to the Port of Townsville, without a clear seasonal pattern.

It is expected that these key marine fauna species have a higher presence in areas of important habitat i.e. in close proximity to the port and seagrass meadows, though the requirement to transit between habitat patches needs to be acknowledged. As the whole bay is representative of important habitat it is necessary to consider movements when assessing potential impacts on migratory species (Grech and Marsh, 2007).

Seagrass distribution in the bay is broadly similar between seasons and covers the majority of port limits with 14,338 and 14,004 ha mapped in the wet and dry season respectively (Rasheed and Taylor, 2008). This suggests that given the dependence of dugong and green turtles on seagrass as a resource, their presence in Cleveland Bay would remain relatively unchanged throughout the year.

With respect to species distribution recorded on this survey and in previous years, the construction of the TMPP is not expected to have a significant impact on the key marine megafauna species, either in terms of direct impacts to important habitat, or disruption of transit routes between patches. The operational phase of the Precinct may alter vessel traffic at the Ross River mouth, however, significant increases in traffic are not anticipated and an increased potential for vessel strike is not anticipated. Potential impacts and mitigation measures to marine mammals were assessed and are summarised in Section 3 and above.

As discussed in Section 7.5.3 the humpback whale is uncommon within the project area and is unlikely to be impacted.

The killer whale *(Orcinus orca)* is found in all oceans and most seas; however, they prefer cooler temperate and polar regions. Although sometimes spotted in deep water, coastal areas are generally preferred to pelagic environments. The killer whale is uncommon in the Project area and is not likely to be impacted by the proposed development.

7.6.3 Reptiles

The potential impact of the project on species of marine turtles is discussed in Section 7.5.2.

The estuarine crocodile *(Crocodylus porosus)* inhabits tidal estuaries, beaches and offshore islands, and freshwater swamps, rivers and lagoons as far south as Gladstone (and possibly further south in historical times). Suitable habitat for this species is present within the mouth of the Ross River and along the foreshore. This species was not detected during terrestrial fauna survey, nor was it recorded in the project area by previous surveys reviewed for this report but it is expected to occur in the Ross River. However, given the highly mobile nature of the species, and the very small area of habitat to be affected, it is considered to be very unlikely that this project will present any significant impact to the estuarine crocodile.

A sea snake was observed at the mouth of the Ross River; sea snakes are listed as other protected matter species in the EPBC Act. Given the highly mobile nature of sea snakes, and the very small area of habitat to be affected, it is considered to be very unlikely that this project will present any significant impact to sea snakes in the region.

7.6.4 Sharks

As detailed in Section 7.5.4 the whale shark (*Rhincodon typus*) has not previously been observed within the project area and is therefore unlikely to be impacted by the Project.

Section 8
Environmental management plan

Townsville Marine Precinct Project

Environmental Impact Statement

8. Environmental management plan

8.1 Introduction

The following draft Environmental Management Plan (EMP) details the measures to be adopted to address identified impacts during the construction and operation phases of the Project. The EMP comprises of a number of elements, each with an overall associated management policy, mechanisms of policy implementation, proposed monitoring programs and potential corrective actions as described in Table 8-1.

Table 8-1 Structure of Environmental Management Plan

EMP Element Component	Description of Content
Element	The environmental aspect of construction or operation requiring management consideration.
Policy	The guiding operational policy that applies to the element.
Policy Implementation	The mechanisms and actions through which the policy will be achieved.
Performance Requirements	The criteria by which the success of the implementation of the policy will be determined.
Monitoring and Reporting	The process of measuring actual performance, or how well the policy has been achieved, including the format, timing and responsibility for reporting and auditing of the monitoring results.
Corrective Action	The action to be implemented and by whom in the case where a performance requirement is not met.

The Construction Contractor is responsible for preparation of a detailed construction phase EMP (EMP (Construction)), which must address the requirements set out in this draft EMP. The EMP (Construction) will take into consideration the specific construction methods proposed, including capital dredging, and tailor appropriate mechanisms, monitoring and reporting requirements to these methods.

For the purposes of this EMP, construction is taken to include all land and marine based construction activity, including dredging.

Operational phase environmental management will be addressed by the Principal as part of the Port's Environmental Management System (EMS). Operational requirements set out in this draft EMP will be incorporated into the EMS as appropriate given final marina design.

8.2 Objectives of the Environmental Management Plan

The following draft Environmental Management Plan (EMP) details the measures to be adopted to address identified impacts during the construction and operation phases of the project. This Plan is specific to the TMPP and will be finalised following completion of the EIS process as that will assist in identifying the nature and magnitude of potential impacts requiring management.

The EMP provides:

- A practical framework for establishing best practice environmental management standards and guidelines to mitigate potential environmental harm for each activity undertaken;
- A mechanism to assist managers, supervisors and construction crews to comply with current legislation;
- A means of identifying environmental issues and to provide general procedures which must be considered when undertaking construction and operational activities;
- A mechanism to reduce the potential impacts of construction and operational activity; and
- A preliminary basis for establishing environmental due diligence during the construction and operational phases.

In essence, the EMP is to provide the proponent and the contractors with a practical guide to ensure compliance by all parties with the environmental requirements. The EMP achieves this by providing a framework for comprehensive monitoring and control. The aim is to minimise the potential for negative environmental impact on the environment.

The EMP identifies corrective actions if monitoring indicates that the performance requirements have not been met.

8.3 Environmental Training

The proponent will ensure that all employees, subcontractors and visitors receive environmental instruction in relation to the EMP.

Each person will be made aware of and have an understanding of their obligations and duties detailed in this EMP.

8.4 Monitoring Responsibility

The primary responsibility for monitoring the potential impacts of the project will be with the proponent. However, the proponent may contract a third party (e.g. a consultant) to undertake any sampling and analysis and other monitoring works that may be required.

The proponent will be responsible for ensuring that all employees, officers, subcontractors and agents associated with the project are familiar with the elements of the approved EMP and the relevant permits, and comply with these, the requirements of environmental legislation and are committed to ensuring environmentally sound practices are implemented during all activities.

8.5 Auditing

The EMP and its inherent procedures and controls will be audited periodically during construction and operation of the TMPP. An independent auditor will undertake regular auditing as set out in approval conditions. Appropriate action shall be taken to ameliorate any deficiency in implementation of the EMP and any elements that prove to be unworkable. The proponent may audit compliance to the EMP at any time during the project.

8.6 Management Responsibility

A number of parties have responsibilities in relation to the implementation of the EMP. All project staff have a responsibility under the General Duty of Care of the *Environmental Protection Act 1994* and must adhere to the procedures outlined in the EMP at all times.

Specific management responsibilities are summarise in Table 8-2.

Table 8-2 Management Responsibilities

Role	Responsibilities
Principal – the proponent	◗ Implementation and monitoring of the EMP; ◗ Ensure all supervisory and management staff are aware of and understand their responsibilities under this EMP; ◗ Ensure that appropriate and adequate resources are allocated to allow for the effective implementation and maintenance of the EMP; ◗ Ensure periodic reviews of environmental performance are conducted; ◗ Report any major environmental incidents that may have a significant impact on the surrounding environment; ◗ Ensure that its employees and contractors receive the relevant environmental instruction in relation to the EMP and be made aware of and understand their obligations and duties; and ◗ Incorporate appropriate requirements into an EMS for the facility.
Construction Contractor	◗ Be aware of and understand the contents of and the reason for implementing the elements of the EMP and ensure all personnel including subcontractors adhere to these requirements; ◗ Incorporating appropriate requirements into a Construction EMP; ◗ Ensure adequate training in the elements of the EMP is provided to all personnel, including contractors; ◗ Ensure that personnel involved in the project, including subcontractors and visitors, have received any environmental training required to provide them with awareness and understanding of their responsibilities under the EMP as well as understanding of the environmental approvals that adhere to the strategies outlined in the EMP; ◗ Carry out all work in accordance with the procedures outlined in the EMP; ◗ Make sure that all environmental safeguards and precautions are in place and adhered to at all times at the site and activity; ◗ Regularly inspect and monitor all activities for adherence to proper environmental safeguards; ◗ Ensure that all equipment used is properly serviced and that all

Role	Responsibilities
	precautions are in place to prevent the likelihood of an environmental incident occurring; and ◗ Report all environmental incidents to the Superintendent's Representative as soon as practicable, but within 24 hours.
Superintendent's Representative All employees and sub-contractors	◗ Be aware of and understand the contents of and the reason for implementing the elements of the EMP; ◗ Exercise environmental due diligence and achieve compliance with the EMP; and ◗ Report all environmental incidents to the Principal as soon as practicable, but within 24 hours of them occurring.

8.7 Environmental Management Plan

8.7.1 Element 1: Marine Water Quality

8.7.1.1 Potential Impacts

The key potential impacts on water quality will be from dredging, reclamation and spoil disposal and include:

- Depending on the composition of the fill material(s) used to construct the reclamation there may be potential for degradation in the quality of groundwater within the fill material as a result of dissolution of minerals, including metals, and leaching of salts from the fill into groundwater. This could occur if the pH of groundwater within the fill material were to become acidic from infiltration of water through oxidised sulfidic materials;
- Potential for degradation in the quality of the groundwater that will establish within fill placed in Lot 773 as a result of the migration of existing groundwater onto Lot 773 from up gradient sources containing components including dissolved metals, TPH and nutrients;
- Potential for degradation of the quality of surface water in Cleveland Bay as a result of the discharge of groundwater from within Lot 773 to the ocean;
- The generation and migration of turbid plumes during construction and maintenance dredging; and
- The introduction of contaminants into the water column.

8.7.1.2 Performance Objective

To minimise the migration of turbid plumes and the introduction of contaminants in the marine environment (e.g. oils and fuel) during dredging and spoil disposal operations.

8.7.1.3 Management Actions

Construction

- An Acid Sulfate Soils (ASS) Management Plan will be developed which will detail ASS management options and monitoring for dredging and reclamation activities. Considerations should include:

- Use of clean, non-ASS in preference to PASS with all services and footings;
  - Maintenance of a watertable above the top of the PASS to minimise oxidation;
  - Containment of the PASS to minimise potential for environmental harm;
  - Regular monitoring during reclamation operations and longer term monitoring once the site has been developed, including groundwater monitoring; and
  - If excavation has the potential to disturb placed PASS, an area specific ASS investigation should be undertaken, including appropriate management if required;
- Development and implementation of a Water Quality Monitoring Plan based on water quality objectives detailed in the EIS and any subsequent baseline monitoring;
- Engage appropriate dredging plant to undertake the works in order to minimise the duration of works;
- Precautions should be taken by the dredge to minimise the risk of spillage of pollutants, such as fuels, oils, greases and other chemicals associated with the dredging and spoil disposal operations, into the water;
- Contain all wastes and spillages and implement appropriate storage and disposal practices to ensure no wastes enter marine waters;
- Provide a spill clean-up kit to deal with spills on the dredger;
- Have contact details for the relevant authorities to report any oil spills to water to allow a rapid emergency response;
- Consider removal of soft material from foundation prior to construction of revetment/breakwater to reduce the potential for placement of rock to stir up bottom sediments;
- Clean rock should be utilised to provide the material for the revetment and breakwater walls subject to meeting Queensland Draft Guidelines for the Assessment and Management of Contaminated Land Environmental Investigation Levels, (1998); and
- If a marine based source of fill is used in the reclamation manage and monitor reclamation tailwater quality including use of silt curtains where appropriate and rehandling and disposal of unsuitable finer material from within the finished reclaim.

Operation

- Mooring leases will contain guidelines for boat owners in terms of waste disposal in particular and appropriate disposal facilities will be provided;
- Provision of appropriate waste disposal facilities for moored boats;
- Compliance with the requirements of the Transport Operations (Marine Pollution) Act 2005 and Transport Operations (Marine Pollution) Regulation 2008;
- Use of licensed waste disposal contractors and tracking of wastes where required;
- Installation of oil and grease traps in all workshops;
- Adequate storage and bunding of fuels and oils;
- Appropriate emergency response equipment to be available at all businesses and at the moorings and berths; and

- Defined emergency response procedures for the Marine Precinct.

8.7.1.4 Performance Indicators

- To minimise the duration of elevated turbidity;
- Minimal impact on water quality around the dredge and spoil disposal sites;
- No visible water contamination; and
- The concentration of turbid plumes should not significantly exceed predicted values from modelling.

8.7.1.5 Monitoring

- Monitor suspended sediment concentrations as part of a turbidity monitoring program;
- Monitor water quality at sensitive habitats for compliance to site specific water quality objectives;
- Monitor reclamation tailwater decant water quality;
- Monitor of the potential impacts of dredging on seagrass communities; and
- The Construction Contractor should monitor the operation on a continual basis and will report any incidents that are likely to cause environmental harm to the project location and surrounding areas.

8.7.1.6 Responsibility

- The Project Superintendent is responsible for ensuring the monitoring programs are implemented. The Project Superintendent may subcontract a specialist sub-consultant to undertake the monitoring program; and
- The Construction Contractor is responsible for monitoring the dredging operation.

8.7.1.7 Reporting

- Reports following the monitoring studies are to be sent to relevant agencies;
- Monthly analysis of turbidity monitoring results will be provided to the above agencies; and
- Monthly compliance reports comparing results of water quality monitoring to predicted modelling values will be provided to the Project Superintendent.

8.7.1.8 Corrective Action

- The dredging strategy will be reviewed with appropriate agencies if any adverse impacts, other than those identified within the EIS are observed;
- In the event of an environmental incident (e.g. fuel spillage), implement appropriate contingency and emergency response measures; and
- Implementation of a reactive monitoring program to assess the impacts of dredging and spoil disposal on sensitive habitats.

8.7.2 Element 2: Surface and Ground Water

8.7.2.1 Potential Impacts

Construction of the land based components of the project has the potential to impact on surface-water and groundwater quality off-site if contaminants such as those listed below are accidentally released and are not sufficiently contained:

- Fuel and hydraulic fluid from plant and equipment, fuel storage and refuelling areas;
- Chemicals such as paint;
- Liquid wastes, including sewerage and grey water from the Site Yard; and
- Sediment-laden run-off from construction work sites.

8.7.2.2 Performance Objective

To limit the discharge of contaminated surface-water to the surrounding environment.

8.7.2.3 Management Actions

Construction

- All potentially contaminated water must be collected and treated on site prior to discharge, or removed from site in the event that treatment is not effective;
- All working areas and storage areas will be designed to meet surface-water quality criteria that will be agreed with DERM as part of the Construction EMP;
- As a minimum, design of working areas will include:
  - Dedicated fuel and chemical storage areas that meet the requirements of AS 1940, and are appropriately signed with content and volume. The storage areas will be sited in locations that pose low risk to surrounding waters. All storage areas will be bunded and all associated infrastructure (that is, hoses, pipework, etc) will be contained within the bund. All bunds will contain an oily water interceptor and sump;
  - Spill kits will be available at all fuel and chemical storage areas and will include response equipment specific to the intended purpose. Personnel will be trained in the use of spill kits and in general emergency response;
  - Refuelling of plant, equipment and vehicles will take place in designated areas only (signed, bunded and provided with an interceptor) and in accordance with the documented refuelling procedure. All personnel will receive training on the correct refuelling procedure;
  - All fixed plant will be equipped with drip trays. Drip trays will be checked after significant rainfall events, and any oily water will be collected and disposed of in such a way that prevents contamination of surface waters;
  - All plant and machinery (particularly hydraulic hoses, fuel lines, etc) will be inspected daily and any defaults or signs of wear and tear reported to the Site Foreman for repair as part of a preventative maintenance program;
  - Sewerage and grey water produced at the Site Yard will be collected and disposed of appropriately (e.g. at a Municipal WWTP);

- All oily water collected from sumps, interceptors and drip trays will be disposed at a suitably licensed waste disposal facility;
- As part of the EMP (Construction), the contractor will develop a Stormwater Management Plan prior to construction commencing;
- The minimum requirements for the Stormwater Management Plan are outlined below:
  - As far as reasonably practicable, uncontaminated stormwater will be diverted and/or segregated from work area runoff;
  - Stormwater detention basins will be constructed to collect site runoff and minimise the direct release of stormwater from the site;
  - Excavated soil will be stockpiled in such a way as to minimise release of sediment. There will be no stockpiling in close proximity to watercourses;
  - Pre-construction drainage will be required to divert excess water away from excavations and working areas to minimise sediment-laden run-off; and
  - Any water pumped or drained from excavations will be filtered through a suitable medium (straw bales, break tank, geotextile membrane, or settling pond) prior to being disposed of to vegetated land. There will be no direct discharge of silty water to watercourses.

Operation

- A condition of development of the Marine Precinct will be that industries gain the appropriate environmental approvals and comply with the permit conditions and other relevant guidelines, standards and codes of practice for their industry;
- All owners/operators of activities and industries that establish at the Marine Precinct will be required to prepare and implement an EMP for their activities;
- Mooring leases will contain guidelines for boat owners in terms of waste disposal in particular and appropriate disposal facilities will be provided;
- Provision of appropriate waste disposal facilities for moored boats;
- Compliance with the requirements of the Transport Operations (Marine Pollution) Act 2005 and Transport Operations (Marine Pollution) Regulation 2008;
- Use of licensed waste disposal contractors and tracking of wastes where required;
- Installation of oil and grease traps in all workshops;
- Adequate storage and bunding of fuels and oils;
- Appropriate emergency response equipment to be available at all businesses and at the moorings and berths; and
- Defined emergency response procedures for the Marine Precinct in the event of a spill that could contaminate surface or groundwater.

8.7.2.4 Performance Indicators

- No visible water contamination; and
- Surface water monitoring indicates no significant impacts to surface- water quality based on monitoring results.

8.7.2.5 Monitoring

- All monitoring will compare results against the stated standards; and
- During construction, daily visual site inspections will be carried out to determine if there is any silty run-off from the site visible within the relevant water bodies.

8.7.2.6 Responsibility

- The Project Superintendent is responsible for ensuring the monitoring programs are implemented. The Project Superintendent may subcontract a specialist sub-consultant to undertake the monitoring program.

8.7.2.7 Reporting

- Monthly analysis of water quality monitoring results will be provided to relevant agencies.

8.7.2.8 Corrective Action

- Should any parameters monitored fall outside of the stated water quality standards or differ by 10% or more from the baseline measurement, the EMP (Construction) will be reviewed and amended as necessary.

8.7.3 Element 3: Terrestrial Flora and Fauna

8.7.3.1 Potential Impacts

Expected impacts on terrestrial fauna and flora values from this project are minimal, as the studied area on the east bank of the Ross River will be largely left intact. The values identified for the site largely centre on the mosaic of coastal communities present (mangrove shrublands, sedge/chenopod dominated mudflats, sandy foreshore vegetation and sclerophyll woodland on relict dunes) in a relatively small area, and the likely presence of up to seven species of conservation significance recorded in the area previously. However, these values have been compromised in part by a thorough invasion of several declared and serious environmental weeds.

8.7.3.2 Performance Objective

To limit the negative impacts on the flora and fauna habitat of communities potentially affected by the project.

8.7.3.3 Management Actions

- Limit the clearing of vegetation to that essential for the project;
- Where practicable, locating Site Yard and other project facilities to avoid vegetated areas;
- Install protective fencing in areas that are within the development footprint but are planned for non-disturbance;
- Rehabilitation of disturbed areas of the site where no permanent structures are to be installed, to minimise the total amount of permanent habitat loss;
- Fauna inhabiting the area are to be allowed to relocate naturally. Construction crews will be educated regarding management of fauna (that is, not to kill fauna including snakes);

- All machinery must be thoroughly washed down to accepted industry standards before movement onto the site, and before being moved to another site (using the nearest washdown facility) to avoid translocating or introducing any weed species;
- Topsoil stripped from the site (if any) will be stockpiled separately from subsoil and used for rehabilitation, where practicable. Topsoil stockpiles will be protected from erosion and water-logging to ensure the natural seed bank stored in the soil remains viable;
- Where applicable, on completion of the works, disturbance of rehabilitated areas will be minimised by fencing to facilitate revegetation;
- A weed management strategy will be developed for the operational life of the Precinct to assist in preventing the introduction of weeds and diseases to the site. This should include revegetation of available areas with non-invasive species following construction to minimise potential establishment of pest species and will include a program of weed eradication in affected areas;
- A feral animal management strategy will be developed for the operational life of the Precinct to assist in preventing the introduction of feral animals and diseases to the site. This should include a program of eradication in affected areas and may encompass trapping for feral cats and rats;
- A sediment/silt trapping fence must be erected in the water before any fringing vegetation is cleared to catch sediment clouds; and
- Haul roads must be regularly watered to prevent dust contamination of air and water surface.

8.7.3.4 Performance Indicators

- Disturbance to flora and fauna habitat is restricted to footprint areas and adjacent areas are not significantly impacted;
- No invasive taxa are introduced and, if detected, areas affected are rehabilitated.

8.7.3.5 Monitoring

- For areas of the site that are to be rehabilitated, a photographic record will be prepared prior to construction commencing. This will be used as a baseline against which to measure the success of rehabilitation;
- Following construction for a period of up to two months weekly site inspections of the established Precinct reclamation will be conducted to detect possible invasive weed and other species; and
- On completion of the works, monthly visual inspections of the rehabilitated areas will be carried out, for a period of 12 months. If pest or weed species are determined to be present during inspections an appropriate management response plan will be determined to rehabilitate the affected area.

8.7.3.6 Responsibility

- The Project Superintendent is responsible for implementing site controls.

8.7.3.7 Reporting

- Ensure any fauna injury or mortality is reported to the Project Superintendent and the proponent Representative immediately; and
- The proponent Representative will ensure that the relevant regulatory agencies are informed of the incident within 24 hours including DERM.

8.7.3.8 Corrective Action

- Review of the management actions.

8.7.4 Element 4: Marine and Intertidal Flora and Fauna

8.7.4.1 Potential Impacts

Potential impacts of dredging on marine flora and fauna include:

- Dredging of the sediments and construction within marine waters can remove benthic habitats and the associated species;
- Suspended sediments and sediment deposition can smother benthic organisms, in particular seagrass and benthic infauna;
- Dredging can result in disturbance of marine fauna;
- Marine fauna can suffer direct physical injury through contact with the dredge head or from vessel movement;
- Invasive species may be introduced to an area from dredging works; and
- Increased operational risk associated with pollution discharges from the changed use of the area.

8.7.4.2 Performance Objective

To ensure marine and intertidal fauna and flora is not adversely impacted by construction or operation (maintenance dredging) activity.

8.7.4.3 Management Actions

Construction

- Development and implementation of a dredge management plant to mitigate impacts on water quality;
- Dredging should be undertaken as quickly as possible to minimise the duration of stress to marine flora and fauna;
- Dredging and construction equipment should be free of biofouling considered to be of high risk of carrying invasive marine pests;
- Where cetaceans are identified within proximity to the dredging management of operations will be to avoid contact wherever possible; and
- The area of soft muds on the east side of the river between the sand bank and the inner mouth of the river (See Area B in the Avifauna Assessment as part of the EIS) should not be disturbed if possible. Alteration, diminution or disturbance that affected shorebird feeding on

this section of intertidal flat would represent a significant loss of amenity for shorebirds that frequent the area.

Operation

- Pedestrian access to lands and marine areas on the south east bank of the river may increase as a result of works undertaken for the project (such as the Port Access Corridor). Access to feeding flats and critical shorebird sites should be restricted as part of the project development;
- Implementation and use of designated shipping channels and go slow zones to avoid impacting upon benthic taxa and mobile species, including megafauna;
- Use of appropriate facility design to minimise ongoing pollution potential, including from light spill and slipways;
- Adherence to legislated ballast water discharge requirements, biofouling management guidelines and legislation relating to disposal of waste from vessels (including material scraped from hulls) should be undertaken to minimise the risk of introducing any invasive taxa;
- Implementation of waste management plans and provision of waste facilities;
- Implementation of hazardous material handling requirements and provision of access to appropriate emergency response kits;
- Development and implementation of a maintenance dredge management plant to mitigate impacts on water quality. This plan should consider outcomes of capital and previous maintenance dredging campaigns to identify monitoring and management requirements; and
- Consideration of provision of public access facilities and public education material to mitigate against potential pollution and disturbance impacts.

8.7.4.4 Performance Indicators

- No fauna mortalities or injuries occur during the dredging campaign;
- No marine pest taxa introduced;
- Impacts to the seagrass communities and shorebird sites are minimised; and
- Public assess is restricted from feeding flats and critical shorebird sites.

8.7.4.5 Monitoring

- Implementation of a seagrass monitoring program; and
- Consideration given to ongoing marine megafauna monitoring to assess any influence on habitat utilisation of threatened and listed species.

Townsville is considered a site for ongoing marine pest monitoring under the National System for the Prevention and Management of Introduced Marine Pests. The Precinct area would be captured under that process and, accordingly, no separate monitoring for marine invasive taxa is considered necessary outside of that national framework.

8.7.4.6 Responsibility

- The Project Superintendent is responsible for ensuring seagrass monitoring programs are implemented. The Project Superintendent may subcontract a specialist sub-consultant to undertake the monitoring program; and
- The Project Superintendent is responsible for monitoring public access to restricted areas.

8.7.4.7 Reporting

- Ensure any fauna injury or mortality is reported to the Project Superintendent and the proponent Representative immediately; and
- The proponent Representative will ensure that the relevant regulatory agencies are informed of the incident within 24 hours including the Queensland Parks and Wildlife Service Marine Stranding and Injury Hotline (1300 360 898).

8.7.4.8 Corrective Action

- If marine fauna are spotted during dredging activities, the dredge should avoid moving towards that area if possible if capture or strike is likely; and
- Implementation of a reactive monitoring program to assess the impacts of dredging and spoil disposal on sensitive habitats.

8.7.5 Element 5: Storage and Handling of Hazardous Substances

8.7.5.1 Potential Impacts

Incorrect storage and handling of hazardous substances may result in environmental harm.

8.7.5.2 Performance Objective

- To minimise the potential for environmental harm from the release of hazardous substances to the surrounding marine, terrestrial or air environment;
- Adhere to applicable Australian and other recognised standards, applicable code of practises and relevant statutory provisions, especially the *Dangerous Goods Safety Management Act 2004* and *Workplace Health and Safety Act 1995;*
- Implementation of Identified Hazards;
- Implementation of Safety Management System;
- Implementation of Emergency Response Plan; and
- Preparation of Job Safety Analysis to manage workplace risks.

8.7.5.3 Management Actions

- Implement a Hazard and Operability Study (HAZOP) system during detailed design to identify all potential causes of chemical leakage and spillage or hazards to workers and ensure that appropriate protective systems are implemented.

Construction

- Submit Safety Management Plan to the Department of Emergency Services CHEM Unit for approval prior to the commencement of construction;

- Job Safety Analysis (JSA), safe work instructions, controlled laydown areas and provision of appropriate supervision to be undertaken during construction;
- Hazardous substances handling is to be carried out by suitably trained personnel only;
- Only essential maintenance to be undertaken while on-site;
- Contain all wastes and hydrocarbon spillages and implement appropriate storage and disposal practices;
- Ensure training is provided for handling and storage of hazardous substances to all personnel working on site;
- All hazardous waste (eg: waste oil and maintenance waste such as oily rags and oil filters) shall be retained in secure containers and removed to an appropriate location for disposal to a licensed facility;
- The Construction Contractor is to provide on-site spill clean up kits. All personnel on the site will be familiar with the use of the clean up kit and dispose of waste in the prescribed manner; and
- Copies of MSDS for all hazardous materials to be maintained on-site.

Operation

- Develop a Safety Management System for operation of the TMPP;
- Develop an Emergency Response Plan in conjunction with local authorities and emergency services. Submit Emergency Response Plan to the Department of Emergency Services CHEM Unit for approval prior to the commencement of construction; and
- Maintain the hazardous goods storage area in a clean, safe and environmentally acceptable manner.

8.7.5.4 Performance Indicators

- Maintain a training register for all staff and contractors.

8.7.5.5 Monitoring

- The Construction Operator shall regularly visually monitor the area around the construction site for hydrocarbon spillages;
- The Principal will undertake regular monitoring of the performance of staff, tenants and contractors in terms of compliance with Safety Management System; and
- The Principal will undertake periodic inspection of storages, pipelines and connections of chemical storages, chemical storages designed in accordance with Australian Standards and *Dangerous Goods Safety Management Regulation 2001*.

8.7.5.6 Responsibility

- The Construction Contractor is responsible for monitoring the storage and handling of hazardous substances on the construction site; and
- The Principal is responsible for monitoring the storage and handling of hazardous substances within the operational Precinct.

8.7.5.7 Reporting

- Daily or weekly reports (as appropriate) will be completed on-site and reviewed by each Supervisor and / or Superintendent for the duration of construction activity;
- Immediately notify the Principal and DERM in the event of an uncontained spill;
- All spills should be reported immediately to the Project Superintendent and cleaned up with the contaminated materials removed and disposed to an approved site;
- In the event of a spill the Construction Contractor is to complete an Environmental Incident Report and Corrective Action Report and forward on to the Project Superintendent;
- Incident or non-compliance corrective action shall be closed out by senior management according to an agreed responsibility and timescale; and
- Workplace Health and Safety representative will be responsible for enforcing all occupational and public health directives and keeping all related records and communications.

8.7.5.8 Corrective Action

In the event of an incident or failure to comply, a selection of the following actions will be undertaken as appropriate:

- Investigate why the incident occurred and investigate and implement mitigating measures;
- Ensure safety information provided is adequate and up-to-date and revise regularly as appropriate;
- Ensure employees, contractors and visitors to the site are familiar with the procedures and policies relevant to their positions; and
- Ensure safety directives and procedures are enforced; and ensure safety documents are readily available to everyone on the site.

8.7.6 Element 6: Waste Management

8.7.6.1 Potential Impacts

Incorrect handling and storage of waste materials may result in the introduction of wastes into the marine environment.

8.7.6.2 Performance Objective

To ensure best practice management for the handling and storage of all waste materials on the construction site and Precinct.

No waste, other than treated wastewater is to be released into the marine waters.

The waste facilities catering for shipping and boating (commercial and recreational), should be able to receive MARPOL 73/78 Annex V wastes (garbage) and Annex I wastes (waste oil and oily mixtures) as well as being capable of handling any other wastes in the quantities that would normally be handled or discharged (e.g. by a fleet of 50 trawlers and 40 potential recreational berths / pile moorings).

Management of shipping and boating wastes should meet the ANZECC (1997) *Strategy to Protect the Marine Environment – Best Practice Guidelines for Waste Reception Facilities at Ports, Marinas and Boat Harbours in Australia and New Zealand*.

Waste management at the commercial and industrial facilities at the marina including boat building, maintenance, repair facilities, restaurants and seafood processing or markets must comply with the regulations outlined in the Waste EPP.

8.7.6.3 Management Actions

Construction

- Collection and disposal of waste from the construction site and the Precinct facility should be by a licensed contractor and disposed of at a licensed waste disposal facility;
- Ensure that all construction wastes and rubbish is contained in bins or other appropriate containers; and
- Ensure the removal of all rubbish and other waste from the dredge to an appropriate location at the cessation of dredging and spoil disposal.

Operation

- Ensure general solid waste receptacles are provided for marina operation, including galley waste;
- Receptacles for all types of waste received at the facility should be clearly labelled and sign posted. Furthermore waste storage areas should be designed so that wind and pests including birds and other animals cannot cause spreading of waste and disease;
- Information on the correct use of each facility should be displayed and readily visible on signs at the containers or receptacles;
- Additional facilities should be provided for recycling and/or reuse of suitable materials including glass, aluminium and steel, paper, plastic and batteries; and
- Liquid waste reception facilities should be provided to cater for sewage and other liquid wastes at the marina.

8.7.6.4 Performance Indicators

- All waste materials are handled and stored in a safe and appropriate manner; and
- There is no environmental impact on, and disturbance to, the surrounding marine area from waste.

8.7.6.5 Monitoring

- The Construction Contractor will monitor the storage of waste materials including the disposal of waste from on board the dredge and other floating plant; and
- The Principal will monitor the management and disposal of waste for the marina facility.

8.7.6.6 Responsibility

- The Construction Contractor is responsible for ensuring the appropriate waste handling and storage procedures are implemented on the construction site; and

- The Principal is responsible for ensuring the appropriate waste handling and storage procedures are implemented on the marina facility.

8.7.6.7 Reporting

- In the event of the release of wastes into the marine environment, the Construction Contractor is to complete an Environmental Incident Report and Corrective Action Report and forward on to the Project Superintendent; and
- The Principal to immediately notify the DERM in the event of an uncontained spill.

8.7.6.8 Corrective Action

- Implement appropriate management and preventative measures to reduce the potential for an environmental incident.

8.7.7 Element 7: Noise

8.7.7.1 Potential Impacts

Dredging and construction activities may result in increased noise levels at surrounding facilities. Construction activities may reduce the amenity of surrounding areas.

Operation of the marine precinct has the potential to impact on the amenity of nearby noise sensitive receivers in South Townsville and occupants of the marine precinct (fishing trawlers) without appropriate management procedures in place.

8.7.7.2 Performance Objective

To reduce or minimise the impact of noise associated with the dredging and construction activity on surrounding facilities, users and visitors.

In order to protect the amenity of nearby sensitive receivers, any user of the marine precinct shall ensure operational noise levels do not exceed the project specific noise criteria of LAeq 1hr day – 46dB, $L_{Aeq\ 1hr}$ evening – 40dB, and $L_{Aeq\ 1hr}$ night – 28dB for South Townsville and of $L_{Aeq\ 1hr}$ day – 48dB, $L_{Aeq\ 1hr}$ evening – 45dB, and $L_{Aeq\ 1hr}$ night – 31dB for the trawler berths.

8.7.7.3 Management Actions

Construction

- Normal construction hours will be 6.30 am to 6.30 pm Monday to Saturday. All work outside of these hours will require approval in advance by the appropriate authority, and will need to comply with the stated noise limits;
- Dredging, reclamation and protective rockworks are proposed to be conducted 24 hours a day, 7 days a week;
- Prior to the opening of Townsville Port Access Road (TPAR), vehicle deliveries are expected to be routed through South Townsville during normal construction hours;
- Where practical, prior to the TPAR opening, all vehicle movements to and from the construction site must be made only during normal working hours;
- Subsequent to the opening of the TPAR, vehicle deliveries are expected to include traffic routed on the TPAR 24 hours a day, 7 days a week;

- Ensure that all equipment is properly maintained and silencers are operational and put in place action plan if requirements are not met;
- Long term fixed plant should be appropriately located so as to minimise noise impacts on the nearest sensitive receivers;
- Maintain and operate all equipment on board the dredge in a safe and efficient manner;
- Carry out non-essential maintenance during day-light hours;
- All plant and machinery will be turned off when not in use. Equipment found to be producing excessive noise will be taken out of use, and repaired or removed from site; and
- Residents should be notified of the construction timetable, particularly when noisy activity is to be undertaken such as pile driving.

Operation

- Potentially noisy Precinct users should be located the furthest away from the nearby sensitive receivers;
- Where practicable, limit operating times of noisy industries using the site (i.e. day time only);
- Provide public awareness notice for recreational boat users accessing the site at night; and
- Development approvals for individual sites should be subject to a noise assessment to ensure that all industrial premises on the marine precinct cumulatively comply with the noise criteria.

8.7.7.4 Performance Indicators

- Absence of complaints from people directly affected by construction and operation noise.

8.7.7.5 Monitoring

- Maintain a record of any noise complaints in a log book, including the date and time of complaint, name of complainant, nature of complaint, action taken and follow up; and
- Where required, upon receipt of a noise complaint monitoring should be undertaken within 3 to 5 working days. If exceedances are detected, the source should be investigated and equipment and operational procedures reviewed to identify means of reducing noise to acceptable levels.

8.7.7.6 Responsibility

- The Project Superintendent is responsible for logging and responding to all noise complaints during construction; and
- The Principal is responsible for logging and responding to all noise complaints during operation.

8.7.7.7 Reporting

- All construction phase complaints are to be reported to the Project Superintendent;
- All operational phase complaints are to be reported to the Principal; and
- Maintenance of a record of any noise complaints in a log book.

8.7.7.8 Corrective Action

- All complaints are to be responded to within 24 hours of receiving the complaint;
- Maintain all equipment so that noise levels do not exceed specified guidelines; and
- Modify operational practices where appropriate.

8.7.8 Element 8: Air Quality

8.7.8.1 Potential Impacts

Air emissions, including dust, will be generated on site during construction and could potentially impact on nearby sensitive receptors.

8.7.8.2 Performance Objective

To minimise the air emissions produced during dredging operations and construction activity to ensure that ambient air quality is maintained in the vicinity of the Marine Precinct construction zone.

8.7.8.3 Management Actions

- All plant and equipment will be regularly serviced and well maintained in order to reduce emissions of greenhouse gases;
- Haul routes to be defined and located to minimise disturbance to sensitive areas;
- Vehicular speeds will be limited to 20 km/h on areas of unconsolidated or unsealed soil associated with the immediate site works;
- Regular sweeping of access roads to ensure material is not transported onto roads around the site;
- Water spraying will be utilised as required (that is, when in close proximity to sensitive receptors such as houses) to dampen dust on working areas and/or access tracks;
- Review of daily weather updates from the Bureau of Meteorology, or a private meteorology service provider, to give warning of likely strong winds to assist with daily management of wind blown dust from unconsolidated soil surfaces and material stockpiles; this includes:
  - All haulage vehicles are to have their loads covered while transporting material to the work area;
  - Southern site boundary fence to be 3 m high and cyclone-mesh fence with 90% shade cloth covering;
  - Areas of disturbed soil, stockpiles and temporary spoil containment are to be covered by mulch or tarpaulins as best as practicable; and
  - If necessary to meet environmental management requirements, earthworks will cease during strong wind conditions.

8.7.8.4 Performance Indicators

- All local dust complaints responded to within 12 hours; and
- Mitigation measures implemented within 24 hours of receiving a verified dust complaint.

8.7.8.5 Monitoring

- Visual inspections of working areas and access tracks will be carried out regularly to monitor dust levels;
- Visible observations of dust moving off-site; especially during dry and/or windy weather;
- Daily audit of mitigation equipment and dryness of exposed surfaces by site manager; includes logging complaints and action taken;
- Dust deposition gauges operated in front of representative residences if construction activity likely to be within 500 m for more than 30 days; and
- Free-call number available for public complaints.

8.7.8.6 Responsibility

- The Project Superintendent is responsible for visual monitoring and control of emissions from the construction site.

8.7.8.7 Reporting

- The Construction Contractor is to report any visible emissions from the site to the Project Superintendent; and
- A community complaints register will be maintained in order to identify areas where dust management is a significant problem.

8.7.8.8 Corrective Action

- Stabilisation of surface silt content through application of localised water sprays, or the use of appropriate chemical dust suppressants (suitable for stockpiles and spoil dumps);
- Control of mechanically induced dust emissions (from clearing, scraping, excavation, loading, dumping filling and levelling activities etc.) by application of water sprays; and
- Awareness of operational areas more frequently exposed to higher winds, and the predominant wind directions in these areas at various times of the year. Temporary wind barriers may be employed where necessary.

If a higher level of control is deemed to give added protection to residential areas to the south of the site, particularly if sealing the entry road is impracticable, a high-level of dust control can be achieved by developing a proactive and reactive dust management regime. This measure involves real-time particulate monitoring using a real-time aerosol monitor, with PM10 size selective inlet, which will be located between construction operations and identified sensitive receptor sites (near Boundary Street and Eighth Avenue).

The real-time monitor can be configured to provide a warning (via an audible, or visible signal or as a communication link) of short-term elevations in concentrations of respirable dust so that immediate dust suppression and remediation steps can be initiated. Reactive mitigation measures may include application of water sprays, reducing the intensity of operations, or even altering the type of construction operations until suitable meteorological conditions prevail. The threshold particulate concentration for alarm/warning activation would be based on a criteria level established by the Coordinator-General as an intervention level for respirable dust; typically 150mg/m^3 as a short term (15-minute) trigger which will result in the daily dust exposure being below the daily EPP (Air) limit.

If a higher level of control is deemed required, the following actions could be implemented:

Real-time dust monitoring conforming to:

- Australian Standard AS2922-1987 Ambient Air – Guide for the siting of sampling units; and
- AS/NZ 3580.12.1 2001 Methods for sampling and analysis of ambient air Method 12.1: Determination of light scattering - Integrating nephelometer method.

All other monitoring and reporting for 'typical' management including: visible observations; daily audits; dust deposition gauges; logging complaints and corrective actions; and public free-call number.

When real-time monitoring indicates PM10 dust levels above 150mg/m^3 over a rolling 1-hour average:

- Increase water application rates;
- Reduce speed restrictions on vehicular traffic to 10 km/h; and
- Cease mechanically generated dusty activity.

8.7.9 Element 9: Environmental Emergency Procedures

8.7.9.1 Potential Impacts

Environmental incidents have the potential to result in environmental harm during construction and operation.

8.7.9.2 Performance Objective

To identify and reduce the potential for an environmental incident before it occurs so as to prevent damage to the surrounding marine environment and the public.

To respond quickly and effectively in the event of an emergency or environmental incident.

8.7.9.3 Management Actions

Construction

- Prevent and reduce the potential for an environmental incident by ensuring the implementation of Best Practice Management throughout the construction and dredging operations and by implementing the EMP;
- The Construction Contractor is to suspend, relocate or amend dredging operations immediately if an environmental incident occurs that may be aggravated by continued dredging operations;
- The Construction Contractors is to notify the Project Superintendent and relevant emergency response agencies immediately in the event of an environmental incident;
- Initiate response and corrective action procedures pending the Project Superintendent and the proponent's directive;
- Identify any near miss incidents and put in places corrective actions to prevent reoccurrence;
- The Construction Contractor shall:

- Retain only the minimal required quantities of chemicals, fuels, oils etc at construction sites or contractor laydown areas at any particular time;
- Store fuels, lubricants and chemicals in appropriate containment facilities away from water storage areas and at a distance of 100 m from natural or built waterways;
- Undertake maintenance and servicing of vehicles at Contractor laydown areas or other appropriate facilities. Daily servicing only may be undertaken on site; however such activity will be undertaken at a minimum separation distance of 100 m from drainage lines or waterways;
- Ensure safe handling techniques during refuelling to prevent spillage;
- Immediately clean up petroleum product spillages with dry absorbent materials or sand or have the area remediated;
- Place absorbent materials used in the clean up of hydrocarbons or other chemicals in an appropriate container marked 'regulated waste' and consign to a waste contractor licensed to receive such waste;
- Store chemicals and fuels in accordance with AS:1940 – The storage and handling of flammable and combustible liquids;
- Locate Material Safety Data Sheets (MSDS) at the Site Construction Office / Site Administration Office for all hazardous and dangerous goods stored and used;
- Ensure temporary chemical storage is in accordance with Material Safety Data Sheets (MSDS) and store non-compatible chemicals separately, as required;
- Clean up spills in accordance with relevant Material Safety Data Sheets and Australian Standard AS:1940;
- Isolate chemical spills that occur in bunded areas from the trade waste system and ensure that the contaminated wastewater is removed by a licensed contractor;
- Contain and collect spills of hazardous materials for treatment at a licensed waste disposal facility;
- In the case of a spill to ground, initiate clean up immediately and seek the advice of a qualified professional to minimise the risk of groundwater contamination;
- Ensure spill kits including containment and treatment equipment and materials are available near hazardous materials storage areas;
- Provide totally enclosed containment for all waste; and
- Ensure persons handling dangerous chemicals wear appropriate PPE and receive appropriate training in its use.

Operation

- A number of Emergency Response Plans will be prepared for the Marine Precinct by the Principal to guide those responding to a variety of potential emergency situations. These include:
  - A Chemicals and Fuel Spill Emergency Response Plan. This plan will detail the specific planning, training and response requirements for oil spill management;
  - A Fire/Explosion Emergency Response Plan;
  - A Total Power Outage Emergency Response Plan; and

- A Natural Hazard Emergency Response Plan; and

- The Principal will prepare a suitable spill containment and cleanup procedure for the proposed Marine Precinct.

8.7.9.4 Performance Indicators

- Maintain public and navigational safety;
- Maintain the ecological integrity of the surrounding marine environment;
- Minimise the potential for an environmental incident;
- Correct storage of fuel or chemicals including updated MSDS;
- Implementation of bunding, spill response training and spill response kits; and
- Facilitate the timely and effective implementation of the appropriate emergency response procedures in the event of an environmental incident.

8.7.9.5 Monitoring

- The Construction Contractor or Workplace Health & Safety Officer shall regularly inspect all temporary chemical and petroleum product storage areas for leakages and release any clean stormwater accumulated in temporary bunded areas, after each rainfall event. Environmental Representative shall also audit the contractor's procedures to check for compliance;
- Monitor and record all unusual and inappropriate procedures and events; and
- The Principal to undertake regular monitoring of the performance of staff, tenants and contractors in terms of compliance with the Emergency Response Plans.

8.7.9.6 Responsibility

- The Construction Contractor is responsible for monitoring for and immediate response to all environmental incidents under the direction of the Principal; and
- The Principal is responsible for ensuring the implementation and monitoring of the Emergency Response Plan.

8.7.9.7 Reporting

- The Construction Contractor will report environmental incidents to the Principal and relevant government agencies immediately;
- In the event of an environmental incident, the Construction Contractor is to complete an Environmental Incident Report and Corrective Action Report and forward on to the Project Superintendent; and
- Incident or non-compliance corrective action shall be closed out by the Principal according to an agreed responsibility and timescale within the facility EMS.

8.7.9.8 Corrective Action

- The Project Superintendent and/or Principal will determine the appropriate emergency response and corrective actions to be implemented depending on the type and magnitude of the event; and

- Establish twenty four (24) hour contact details for the Project Superintendent (eg: mobile phone and pager).

8.7.10 Element 10: Visual and Amenity

8.7.10.1 Potential Impacts

Impacts on visual amenity as a result of construction activity including equipment and stockpiles.

Conflict between site design and the existing amenity values.

8.7.10.2 Performance Objective

To reduce and/or manage adverse visual impacts of construction and operation on landscape and visual amenity.

To achieve a balance between the site design and use requirements and achieving an optimal visual outcome so as to minimise the detrimental effects on the landscape and visual character.

8.7.10.3 Management Actions

Construction

- Avoid loss or damage to landscape features including minimisation of clearance of mangroves. Where possible, protect trees prior to construction and/or trim vegetation to avoid total removal;
- Temporary hoardings, barriers, traffic management and signage to be removed when no longer required;
- Materials and machinery to be stored tidily during the works;
- Lighting of work sites is restricted to approved working hours and those which are necessary for security;
- Roads providing access to the site and work areas to be maintained free of dust and mud as far as reasonably practicable, and dust management techniques to be used; and
- Use of appropriate soil erosion prevention techniques.

Operation

- Building and structure design should respond to the surrounding environment with consideration to viewpoints through consideration of:
  - Building form and style;
  - Finish, including use of less reflective materials, appropriate colours, textures, and roofing; and
  - Building bulk and location.
- Establishment of landscaping works as soon as possible after the completion of construction operations, or if appropriate, during the construction stage;
- Mitigation of light pollution through:
  - Appropriate lighting design to ensure the site is not over-lit;

- Use of specifically design lighting that minimises the spread of light and glare towards visual receptors;
- Specify appropriate luminaries to reduce light spill, sky glow and glare;
- Consider the potential for solar power for lighting; and
- Sensitive placement and specification of lighting to minimise any potential increase in light pollution within the natural environment.

8.7.10.4 Performance Indicators

- No complaints received about visual impacts during construction; and
- No complaints about light spill from operation.

8.7.10.5 Monitoring

- Visual inspections of the construction area to ensure no vessels are within the area.

8.7.10.6 Responsibility

- Project Superintendent is responsible for ensuring that construction activities are planned and undertaken so as to minimise visual impact; and
- The Principal is responsible for ensuring visual impacts are considered in the facility design and that the design is sympathetic to the surrounding land uses.

8.7.10.7 Reporting

- The Project Superintendent to advise the Principal of any complaints.

8.7.10.8 Corrective Action

- Tidy up construction site; and
- Restore or rectify areas of damage.

8.7.11 Element 11: Traffic and Site Access

8.7.11.1 Potential Impacts

Construction and operational traffic will not exceed road design capacities for road interfaces with the external road network. Based on the results of the traffic impact study, the development can take place with no significant impact on the external road network.

Minor interruptions to commercial and recreational fishing activity are possible during construction.

Potential risks to safety if unauthorised vessels are too close to the dredge or disposal areas.

8.7.11.2 Performance Objective

To maintain functionality of the internal and external road network.

To prevent the access of unauthorised vessels too close to the dredge spoil disposal area and construction sites.

Ensure that dredging operations do not unduly interfere with vessel movements in the Port.

8.7.11.3 Management Actions

Construction

- MSQ to provide a notice to mariners advising the commencement of construction and expected duration of operations;
- The Project Superintendent is to place a public notice prior to works commencing; and
- Dredge operator to liaise with the Harbour Master regarding vessel movements.

Operation

- A roundabout or signalised intersection is the recommended option for the Benwell Road / Archer Street intersection as it allows for the greater free flow of traffic and provides for the best operating conditions when compared to priority intersections;
- The recommended option for the Benwell Road / Secondary Access intersection is a give-way priority intersection which will provide satisfactory conditions for all approaches is likely to be the most affordable option; and
- Additional studies on the intersection between Boundary Street and Saunders Street will be require to assess future traffic management needs.

8.7.11.4 Performance Indicators

- All vessels remain well clear of the dredging and disposal sites;
- No complaints received about shipping access to and from the Port during construction; and
- No complaints regarding road function within and leaving the port/marina precinct.

8.7.11.5 Monitoring

- Visual inspections of the construction area to ensure no vessels are within the area; and
- Traffic monitoring during marina operation to confirm the outcomes of the traffic study should intersection queues cause complaint.

8.7.11.6 Responsibility

- MSQ and the Project Superintendent are responsible for ensuring that notice of the dredging works is provided to all users and visitors to the Port;
- The Construction Contractor is responsible for liaising with the Harbour Master regarding vessel movements; and
- The Principal for ensuring adequate internal traffic design capacity and functionality.

8.7.11.7 Reporting

- MSQ are to advise the Project Superintendent of any complaints or incidents.

8.7.11.8 Corrective Action

- Increase the number of signs/buoys and/or relocate them to ensure they are effective;
- Contact boat owners who approach too close and explain the hazards; and
- Remodel traffic study.

8.7.12 Element 12: Management and Staff Responsibilities

8.7.12.1 Potential Impacts

Ineffective or inadequate communication will restrict the management of environmental incidents and Port access during the construction program potentially placing people and the environment at risk.

8.7.12.2 Performance Objective

To ensure that there is an identifiable chain of command and available procedures in place for communication and reporting of environmental issues during construction.

To ensure that adequate information is available to boating users as to the duration and nature of the operation and any restrictions placed on port users.

8.7.12.3 Management Actions

- A written chain of command indicating authority and responsibilities should be available for both the Project Superintendent, the Construction Contractor and Harbour Master. This is to be established with the Construction Contractor prior to the commencement of works;
- The Project Superintendent is to be responsible for ensuring that all relevant staff and the Construction Contractor are familiar with reporting procedures and comply with the EMP and all approval and permit conditions;
- The Construction Contractor is to inform the Project Superintendent of any environmental incident or a potential environmental incident, which has the potential to cause environmental harm as soon as possible;
- On-site personnel are responsible for reporting an incident or potential incident if he/she is the first to notice or cause an incident;
- Report forms are to be available on-site at all times;
- Report forms are to include:
  - A complaints register;
  - An environmental incident and corrective action report; and
  - A site inspection/progress report.

8.7.12.4 Performance Indicators

- The Project Superintendent, the Construction Contractor and Harbour Master know the procedures for communication of information between all relevant parties;
- The establishment and implementation of a practical framework for the reporting and amelioration of potential environmental incidents is in place; and
- All regular operators in and out of the harbour are aware of the nature and duration of the operation and any restrictions that may apply during the operation.

8.7.12.5 Monitoring

- The Project Superintendent is responsible for ensuring that reporting procedures are being followed.

8.7.12.6 Responsibility

- The Project Superintendent is responsible for ensuring that reporting procedures are being followed.

8.7.12.7 Reporting

- The Project Superintendent is responsible for ensuring that reporting procedures are being followed.

8.7.12.8 Corrective Action

- The Project Superintendent should ensure that the Dredge Operator and subcontractors are familiar with reporting procedures; and
- Modify reporting procedures as required.

8.7.13 Element 13: Staff Environmental Training

8.7.13.1 Potential Impacts

Environmental impacts are not appropriately mitigated due to lack of staff and contractor awareness and training.

8.7.13.2 Performance Objective

To ensure that relevant Project Superintendent staff and Construction Contractor personnel are adequately trained in environmental awareness with regard to the marine environment.

To ensure Marine Precinct tenants are appropriately aware or notified of management requirements for the Precinct.

8.7.13.3 Management Objectives

- Appropriate environmental training appropriate to the Project should be given to all personnel involved in construction and associated operations;
- The Project Superintendent is to ensure that tenant environmental training needs are identified and addressed; and
- The Principal is to ensure that environmental training needs are identified and addressed.

8.7.13.4 Performance Indicators

All relevant Project Superintendent, staff Construction Contractor personnel and tenants understand the environmental issues associated with the proposed marina construction and operation.

8.7.13.5 Monitoring

- The Project Superintendent should ensure that the Construction personnel have been given adequate training in the areas outlined above and are familiar with the EMP and their environmental responsibilities; and
- The Principal should ensure that tenants have been given adequate training in the areas outlined above and are familiar with the EMP and their environmental responsibilities.

8.7.13.6 Responsibility

- The Project Superintendent is responsible for ensuring that the Construction personnel have been given adequate training in the areas outlined above; and
- The Principal is responsible for ensuring that tenants have been given adequate training in the areas outlined above.

8.7.13.7 Reporting

- The Project Superintendent should maintain records of staff and contractors who have undergone training in relation to the EMP and general environmental responsibilities.

8.7.13.8 Corrective Action

- The Project Superintendent and Construction Contractor should ensure that anyone who appears to lack an understanding in the above areas undergoes adequate retraining.

8.7.14 Element 14: Cultural Heritage

A draft Cultural Heritage Management Plan (CHMP) has been prepared as part of this project. The proponent is required to implement the CHMP in conjunction with Traditional Owners and DERM.

8.7.15 Element 15: Greenhouse Gas Management

8.7.15.1 Potential Impacts

Greenhouse gas emissions are not appropriately managed to reduce release.

8.7.15.2 Performance Objective

To ensure best practice management for the conduct of activities that have potential to release greenhouse gas (GHG) emissions.

Management of emission generating activities should address legislated standards for emissions release with reporting of emissions if annually more than 125 kilotonnes CO_2-e, in accordance with the National Greenhouse and Energy Reporting (NGER) Act (2007).

Adherence to the Queensland Government *ClimateSmart* 2050 climate change strategy.

Precinct industries releasing emissions must comply with any regulations introduced regarding emissions over the lifespan of the Precinct's operation.

8.7.15.3 Management Actions

Construction

- Minimise emissions by reducing transportation distances for imported material where possible; and
- Assess potential emissions for different construction approaches and adopt the least impactive approach, particularly for dredging scenarios.

Operation

- Consider use of solar solutions for lighting and other energy requirements within the Precinct;
- Consider smart sharing solutions for emission generating activities (including ventilation, air-conditioning) among users of the Precinct during detailed design for construction of topside facilities;
- Apply energy efficient and GHG emission considerations to the purchasing of equipment used onsite at the Precinct; and
- Train operators in energy efficient practices, including minimisation of lighting requirements during non-critical periods, to reduce overall GHG emissions.

8.7.15.4 Performance Indicators

- GHG emissions are minimised.

8.7.15.5 Monitoring

- The Construction Contractor will monitor activities and adopt approaches to minimise impacts;
- The Principal will report annual GHG emissions if required under the NGER Act (2007); and
- Review of GHG emissions, conduct of audits, and review of facilities as required during the operational life of the Precinct to continue to meet ongoing legislative requirements, which may be subject to change.

8.7.15.6 Responsibility

- The Construction Contractor is responsible for ensuring the appropriate approach to construction activities to minimise GHG emissions, where able; and
- The Principal is responsible for ensuring the appropriate reviews or audits are conducted during the operational phase.

8.7.15.7 Reporting

- In the event of the release of annual GHG greater than 125 kilotonnes CO_2-e, the Principal will complete reporting in accordance with the NGER Act (2007).

8.7.15.8 Corrective Action

- Implement appropriate management and preventative measures to reduce the potential for excessive emissions.

Section 9
Conclusions and recommendations

Townsville Marine Precinct Project

Environmental Impact Statement

9. Conclusions and recommendations

The TMPP involves the construction of an industrial marine precinct about the mouth of the Ross River. The Precinct is proposed to be located on intertidal land to the south-east of existing Port operations. The TMPP comprises both onshore and offshore elements, including construction of an offshore breakwater and an onshore reclamation of approximately 34 hectares of Strategic Port Land. The TMPP project is registered as a Significant Project under the auspices of the *State Development and Public Works Organisation Act 1971* and will be assessed under that Act.

This EIA study has investigated potential environmental impacts, including social, economic and cultural impacts, resulting from the construction and operation of the Precinct. Consideration has been given to the need and alternatives of the project. Desktop literature reviews, database searches and baseline field studies have been undertaken to provide context to the assessment of impacts and identification of mitigation and management measures.

Timing of the project coincides with construction of the TPAR restricting vessel access to upstream Ross River, which will impact upstream marine industries. It also aligns with an increasing demand for industrial maritime construction and maintenance facilities in the Townsville region.

Concurrently within the Townsville region a number of other construction projects are occurring that have the potential to result in compounding or cumulative impacts. These other projects include the development of:

- The Townsville Port Access Corridor road and rail link, including a bridge across Ross River adjacent to the Precinct site;
- Development of Berth 12 to the north of the Precinct site in the outer harbour area of the port;
- Berth expansions within the inner harbour of the port; and
- The TOT to the west of the port.

Each of these adjacent projects is likely to include adverse effects on the environment. In conjunction with the Marine Precinct development there is potential for greater cumulative, impact upon environmental values of the Townsville region and this has been addressed in the impact assessment undertaken for the TMPP.

Within this study construction and operational impacts have been identified and mitigation and management strategies described for a range of environmental values including nature conservation, social, economic and cultural values. Potential impacts to matters of NES have been described and mitigation strategies developed.

No impacts considered to be significant were identified that could not be ameliorated or mitigated. Some habitat losses are expected, however, these can be offset. Design considerations are required to ensure the project meets a number of the potential impacts identified, including meeting potential climate change adaptation needs. Economic benefits to the region are likely if the project proceeds.

An environmental management plan has been developed for the Project, which outlines specific actions and measures, designed to mitigate potential impacts identified through the environmental assessment process. The environmental management plan is implemented in addition to existing management policies and regulations. Several detailed monitoring studies are also proposed to be undertaken in order to assess potential impact and to provide an indication of the longer-term impacts associated with the Project and recovery of impacted areas. These recommended studies will include (but are not limited to):

- Marine Water Quality Monitoring
  - Suspended sediment concentrations as part of a turbidity monitoring program;
  - At sensitive habitats for compliance to site specific water quality objectives;
  - Reclamation tailwater decant water quality;
  - Potential impacts of dredging on seagrass communities; and
  - The construction operations reporting incidents likely to cause environmental harm to the project location and surrounding areas.
- Marine Habitats and Megafauna
  - Monitor the health of adjacent seagrass communities as indicators of water quality impacts and to act as an indicator for potential impacts to marine megafauna;
  - Temporal and spatial persistence of meadows to existing baseline data should be assessed; and
  - Consideration be given to ongoing marine megafauna monitoring to assess any influence on habitat utilisation of threatened and listed species. If marine fauna are sighted during dredging activities the dredge should avoid moving into that area if capture or strike is likely.
- Noise
  - Log any received complaints regarding noise; and
  - Upon receipt of a noise complaint where required undertake monitoring within 3 to 5 working days. If exceedances are detected, the source should be investigated and equipment and operational procedures reviewed to identify means of reducing noise to acceptable levels.
- Air Quality
  - Regularly undertake visual inspections of working areas and access tracks to monitor dust levels;
  - Note visible observations of dust moving off-site; especially during dry and/or windy weather;
  - Conduct daily audit of mitigation equipment and dryness of exposed surfaces;
  - Use dust deposition gauges in front of representative residences if construction activity is likely to be within 500 m for more than 30 days (considered unlikely); and.
  - Make available a free-call number for public complaints and information.

The principal impacts of concern associated with the proposed works are in relation to marine fauna and flora and water quality. Effective mechanisms are in place to manage potential impacts on marine fauna and the studies identified above will assist in the monitoring of predicted impacts on marine flora. However, the most effective mitigation measure identified to manage potential impacts is to minimise the period of works.

To assist with management of potential impacts from the TMPP the following is recommended:

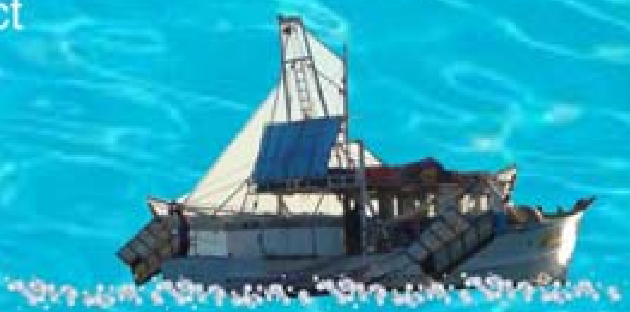
- Construction, dredging and operational management plans be developed and implemented for the project;
- The Environmental Management Plan drafted for this study should be implemented and adhered to during all phases of the project
- Environmental monitoring programs should be undertaken during construction and operational works, as recommended, to provide ability to detect any adverse environmental impacts and facilitate management response;
- Further sediment quality analysis be undertaken to assist in determining the full extent of reclaimable material;
- Megafauna spotters be used during construction activities to avoid interaction with these species; and
- The critical wading and migratory bird habitats on the eastern side of the Ross River should not be impacted to avoid any flow on effects to the communities using this area.

Under the mitigation strategies identified for each of the environmental values assessed the TMPP is not expected to have any significant long term effects on the regional or local environmental values of the Townsville region or Ross River environ. Importantly the TMPP is not predicted to impact upon protected species including dolphins, dugongs, turtles and birds. Economic benefits to the region accrue if the project proceeds and the project mitigates potentially significant negative impact of other development in the region.

Section 10
References

Townsville Marine Precinct Project

Environmental Impact Statement



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PORT of TOWNSVILLE
Nexus North Queensland

Townsville Marine Precinct Project

Environmental Impact Statement

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