Attachment 1

1. General topic: Consultation

Issues and comments raised in the submission:

Lack of open public consultation and/or inadequate process – 'public reference meetings were closed to the public'. Considerable feed-back on perceived flaws in the consultation process. For example, '.... along comes more meetings and a 'reference group' was formed, headed by TMR, facilitated by Queensland Government. I attended some of these meetings (guest capacity) with local conservation groups, to share my knowledge......give local advice about site conditions at Clump Point. I left these meetings thinking that sense and reason would prevail after lengthy discussions of pros and cons for various options. Upon reading the minutes of various meetings, I was astounded and dismayed at the outcomes presented in print. The outcomes were heavily biased towards larger than required developmentmany non-supportive comments to this vision (got) omitted entirely. The end result led to the current proposal put forth for approval by TMR to GBRMPA. The process has been a sham and a waste of time and money.'

TMR to address in 'Supplementary Information - Public Information Package report'

- Provide comment on the adequacy and suitability of the public consultation and engagement process, with respect to ensuring equitable representation of public and private interests.
- Comment on whether final project design was/was not biased toward 'larger commercial interests'?

Response

Consultation has already been addressed in the Public Information Package (PIP). For convenience relevant points from that document are included below and additional information included to provide a comprehensive response.

The Project was developed by the Queensland Government as a response to community requests to enhance marine infrastructure in Boat Bay, Mission Beach, to improve boating safety and amenity. The (then) Department of State Development, Infrastructure and Planning (DSD) worked with a wide range of Mission Beach stakeholders through individual meetings and workshops between 2012 and 2015 and proposed an overtopping breakwater in front of the existing Perry Harvey jetty plus enhanced boat ramp, road and parking facilities at Clump Point.

The proposed breakwater at Perry Harvey jetty was strongly opposed by both environmental and boating groups and concerns were raised about other aspects of the Project. The Queensland Government responded to the strong broad feedback and determined that the Project would focus on provision of safer boating infrastructure at Clump Point only, with the Perry Harvey jetty serving as a good-weather facility to support the Clump Point upgraded works.

A broad range of Mission Beach stakeholder groups and individuals was invited to an independently facilitated community information session at Mission Beach on 18 May 2016. A wide range of information was presented, and feedback sought from those attending. That feedback made it clear that there were different views within the Mission Beach community about how the Project should proceed.

The Project objectives summarised at the meeting were:

- provision of safer boating infrastructure
- facilitation of local economic development
- · reduced conflict arising from joint commercial and recreational use
- respect for the rich natural environment and cultural heritage of Mission Beach.

In response, a Community Reference Group (Reference Group) was established by DSD to oversee the preparation of a Development Plan and associated investigations for a new proposal. The Reference Group member organisations were selected to be representative of the full range of views in the Mission Beach community and the aim was for the Reference Group to consider, and if necessary debate, and get feedback from the community, to ensure views about relevant Project issues were understood and if possible resolved.

The Reference Group included representatives from the following community groups and government agencies:

- Community for Cassowary and Coastal Conservation (C4) run by a management committee and has about 75 members in Mission Beach
- Cassowary Coast Safe Boating Association (CCSBA) information about membership or governance not provided.
- Mission Beach Boating Association (MBBA) run by a management committee with about 85 members of whom over 90% reside in Mission Beach
- Mission Beach Cassowaries Inc (MBC) information about membership or governance not provided
- Mission Beach Community Association (MBCA) run by a management committee with about 640 Mission Beach residents and rate-payer members
- Cassowary Coast Regional Council (CCRC)
- Department of State Development (DSD)
- Department of Transport and Main Roads (TMR).

The community group membership numbers can be compared with the 2016 census, which recorded 815 people living in Mission Beach with adults making up 79% of the population (over 19 years old). The 2011 census recorded that Mission Beach and the surrounding villages (Bingil Bay, Wongaling Beach, South Mission Beach and Carmoo) had a total population of 3,181 people.

The Reference Group agreed at its first meeting in June 2016 that it would:

- receive and discuss information
- provide advice during the preparation of a Development Plan for the Clump Point project
- monitor and represent community views regarding issues, impacts and benefits
- provide information about the project to other community members.

The extensive work undertaken by the Reference Group members to ensure the emerging Project information was shared with their members, and other interested members of the public, resulted in extended consultation with the Mission Beach community, and timely feedback that guided the Project studies and concept design development.

The Reference Group met formally seven times over nine months, in addition to members having numerous informal meetings with the Project team. The formal meetings were held across afternoons and evenings, and several full day sessions. Individuals from Mission Beach with relevant information or views were also identified by the Reference Group members and invited to meetings to discuss their views.

Outcomes from the formal Reference Group meetings were agreed and documented. The documented outcomes from every formal meeting were agreed by all the Reference Group members who attended the meeting. The Reference Group also prepared and signed two Advice Statements noting preferred elements, concerns with, and approaches to the Project. Not all members of the Reference Group support the Project proposal or all aspects of the proposal. The signed Advice Statements setting out the formal advice from each group are included in the Public Information package.

The final Project design is not considered to be biased toward 'larger commercial interests'. Commercial organisations were not directly included in the Reference Group. MBBA members generally own a vessel or have an interest in boating or maritime activities and either live in the area or have direct interests in the area. MBBA noted that their members include recreational boaters, some of whom are local business owners, and local commercial maritime operators. The MBCA generally considered the Project objectives (listed above) and provided advice on all issues considered by the Reference Group including the needs of both the recreational and commercial boating communities, as did all other Reference Group members.

The Reference Group was not a decision-making body but rather offered advice. The proposed design was advanced by DSD after considering the Reference Group advice offered, and after consultation with CCRC and TMR, who will be responsible for the construction and operation of the terrestrial and marine aspects of the Project respectively. DSD, TMR and CCRC considered the Project objectives listed above when determining a project design that they could collectively support, including consideration of the provision of safer boating infrastructure for recreational and commercial users, the facilitation of local economic development, and respect for the rich natural environment and cultural heritage of Mission Beach. The aims and reasons for the provision of limited commercial activities as part of the Project are set out in section 2.1.2 of the Public Information Package.

The proposed boating infrastructure provides safer conditions for the launching and retrieval of boats, and improved opportunities for access to and from boats in the water.

The current Clump Point boat ramp and floating walkway are used for both commercial and recreational boat access as they offer better wave protection during rougher weather than the Perry Harvey jetty. There is, however, only a limited area of protected water adjacent to the ramp. During periods of peak demand, over-utilisation of the current boat ramp and its floating walkway has led to congestion in the navigation channel, and traffic congestion on land where vehicles compete for limited parking and manoeuvring space. Boats are moored in Boat Bay, protected somewhat by the boat ramp breakwater and Clump Point, but the protection is limited during northerly and north-easterly weather.

The proposed detached breakwater will provide substantially improved protection to boats moving to and from the boat ramp, shelter for boats in the lee of the breakwater, and shelter for pontoons for the safer transfer of both commercial and recreational passengers. The proposed design will benefit many recreational users, and a limited number of commercial users. That limited number of commercial users is considered important for the ongoing economic development of Mission Beach and to allow members of the public without a boat to access the Great Barrier Reef Marine Park.

2. General topic: Consultation

TMR to address in 'Supplementary Information - Public Information Package report'

Not enough public consultation (resulting in a design that is not good enough). '...disappointed that such valuable and commendable development is not complete in planning with the required supporting infrastructure and basic facilities such as toilets, drinking water....'

Issues and comments raised in the submission:

- Comment on the basis for why 'supporting infrastructure' such as toilets, mains water, power and sewage will not be installed.
- Comment on whether any service infrastructure (water, sewage, fuel pipes) has been incorporated into the final design for proposed and future use including any attached to the floating walkways and pontoons?

Response

Table 3-4 of the PIP provides a "Description of Project Design Elements".

The last two elements of this table indicate that the Project includes composting toilets in the southern carpark and the connection of mains water supply to the facility.

The development of the Project scope via the Reference Group consultation and separate discussions with commercial operators identified that toilets, water supply and the ability to refuel were essential Project elements. Other services such as power and sewerage were deemed desirable but not essential and are not included in the Project scope.

Reasons for the adopted choice of elements were:

Power – Power was not considered essential by the target stakeholders for the small number of pen berths proposed (given they typically have on-board generators). For this reason the limited available budget was allocated to deliver essential elements. TMR currently uses solar lighting for most of the marine facilities under its control. Solar lighting is considered suitable for the proposed Clump Point facility.

Toilet facility – A composting toilet in the southern carpark was chosen as the best outcome within the Project budget. A sewer for the toilet facility was considered but found to be unaffordable within the Project budget, would have required mains power for its operation with further costs beyond the Project budget that would significantly increase maintenance requirements and costs for CCRC. The toilet facility is placed in the southern carpark both because of space limitations in the northern carpark next to the boat ramp and to locate it in a more sheltered area during severe weather.

Refuelling – A permanent refuelling facility was not deemed to be justified for the scale of the marine infrastructure being provided, especially in terms of the maintenance required for fixed infrastructure and the need to ensure spills do not occur during severe weather. The facility design includes a single-lane access road to the start of the jetty. The jetty will be capable of supporting a 12.5m rigid fuel tanker of GCM (Gross Combination Mass) 22.5t, and will incorporate a bunded area to contain any spills. The fuelling point is adjacent to a berth protected from prevailing sea conditions by the detached breakwater (see plan in **Appendix C**) with fuel delivered by flexible hose operated from the fuel tanker. There will be no fixed fuel lines or fuel storage at the facility.

The fuelling facility will be subject to the same controls and approvals as are in place at the Perry Harvey jetty. The fuel delivery operator will need to hold a permit, which will incorporate strict protocols for fuelling, to avoid impacts on the marine environment. Vessel operators will deal directly with approved fuel suppliers. Access to the facility will occur in low-use periods, which will be defined in the site Operational Management Plan. This plan will set out approvals, conditions and guidance to minimise conflict between users. Commercial and recreational users have provided clear advice through the Reference Group process that refuelling at the proposed new Clump Point facility is strongly preferred to the Perry Harvey jetty due to the risks associated with the more exposed wave conditions at Perry Harvey jetty.

Water supply – The design includes a mains water supply to the proposed jetty and pontoons. This supply will service fire-fighting hydrants and hoses, potable water to the pen berths and a potential wash down area on the eastern side of the carpark turning area. If the berthing pontoons are designed to be sunk prior to a cyclone then they will be connected to the mains supply and filled with fresh water to support the sinking process and avoid future corrosion. The outcome of the design cyclone event testing with respect to breakwater overtopping indicates the final pontoon design may not need to be a sinking structure for it to resist design cyclone loadings.

3. General topic: Consultation

TMR to address in 'Supplementary Information - Public Information Package report'

Reference Group – 'The permit applied for is NOT for the proposal formally considered by the government-appointed Reference Group...'

Issues and comments raised in the submission:

Comment on the status of the Reference Group and whether they have endorsed the final design (and if the design did change then provide details of what elements have changed).

Response

The Development Plan distributed to the Reference Group in February 2017 informed the Final Advice Statement prepared by the Reference Group. The Final Advice Statement is attached to the Public Information Package. Section 2.7 of the Development Plan says 'To maximise value gained by the Project budget, TMR's proposed delivery strategy is as follows:

- submit environmental approvals based on existing preliminary design
- tender for and undertake detailed design works for the breakwater, boat ramp and carpark works
- complete environmental approval process
- tender for and undertake construction.'

The Reference Group accepted that this delivery strategy would likely result in minor changes to the concept design.

Since June 2017, TMR has undertaken detailed design works for the proposed breakwater, boat ramp and carpark works. The final design is for all intents and purposes the same design with the same elements as that considered by the Reference Group when preparing the Final Advice Statement.

The detailed design process requires high accuracy engineering design, going down to a level of detail well in access of that used in the concept development. The concept development identified the need for minor changes in response to detailed engineering calculations to further rationalise layout requirements. While there have been design refinements made since completion of Reference Group activities in February 2017, the Public Information Package and design submissions to approval authorities specify clearly the extent of works, the impacts of the works, and the mitigating measures proposed to avoid indirect impacts.

The concept design reviewed by the Reference Group is shown in Appendix A and the design submitted for approval is shown in Appendix B. The differences between the two are detailed on page 18 of the PIP and have been included below for ease of reference:

"Detailed Design and Physical Modelling

The preliminary design presented in the Development Plan was subject to further investigation and refinement in the detailed design and physical modelling phases. These processes led to the following changes:

- shift in alignment of detached breakwater to be more parallel to and in alignment with the
 existing breakwater, to better meet the objective of providing protection from northerly
 conditions.
- slightly larger footprint (i.e. cross-section width from ~37m to 42m) of the detached breakwater and slightly higher crest (from 4m AHD to 4.5m AHD).
- larger footprint on the eastern side of the carpark and existing breakwater. This represents a maximum expansion of ~13m of the carpark and ~11m of the breakwater at the westernmost point of the existing carpark (adjacent to the boat ramp), and ~8m of the carpark and ~2m of the breakwater at the northeast corner of the existing carpark.
- single fall of carpark from east to west from 2.9m AHD to 2.5m AHD, providing greater protection from wave run-up without need to raise carpark significantly in the centre."

4. General topic: Administrative process

TMR to address in 'Supplementary Information - Public Information Package report'

'.... It is our view that the detached breakwater, as outlined in the Proposal....is prohibited unless the proponent has obtained an artificial reef permit under section 18 of the Environmental Protection (Sea Dumping) Act 1981 (Cth) (EPSDA). 'Artificial reef' is defined under section 4(1) of the EPSDA as a structure or formation placed on the seabed for the purpose of being used in human recreational activities...'

Issues and comments raised in the submission:

Provide comment on this statement.

Response

TMR has gained the following written advice from the federal Department of Environment and Energy which administers the *Sea Dumping Act 1981*:

"The Department has reviewed the information you have provided and considers that a permit is not required under the Environment Protection (Sea Dumping) Act 1981 (Sea Dumping Act) for the Mission Beach Clump Point Boating Infrastructure Project.

The Department considers that sufficient information to demonstrate that the placement of material is for a purpose, specifically a breakwater, and is not for the mere disposal thereof. Additionally, the Department considers the action is not compatible with the definition of an Artificial Reef as provided in the Sea Dumping Act (Definitions), specifically that an:

artificial reef means a structure or formation placed on the seabed:

- (a) for the purpose of increasing or concentrating populations of marine plants and animals, or
- (b) for the purpose of being used in human recreational activities,

and includes anything prescribed by the regulations to be an artificial reef for the purposes of this definition, but does not include anything prescribed by the regulations not to be an artificial reef for the purposes of this definition.

Please note although a permit is not required under the Sea Dumping Act, this does not affect obligations to comply with any other laws of the Commonwealth, state or territory that are applicable to the action."

5. General topic: Administrative process

TMR to address in 'Supplementary Information - Public Information Package report'

How has the LTSP2050 been considered? I.e. what are the 'net-benefits' of the project? Have cumulative impacts' been considered? How have impacts been avoided or mitigated? What 'off-sets' have been proposed for impacts that cannot be mitigated?

Issues and comments raised in the submission:

Comment on what consideration has been given to the Long Term Sustainability Plan 2050 - see link at bottom of table.

Response

LTSP2050

LTSP2050 notes on page 5: 'This Plan will guide long-term protection and management of the Reef and ensure the Great Barrier Reef continues to be among the best managed and protected world heritage areas in the world'. On page 7 the plan acknowledges that: 'The Great Barrier Reef is strongly valued by the national and international community and is critical to the cultural, economic and social wellbeing of the more than one million people who live in its catchment and to Australians more generally'.

Page 18 notes: 'The Australian Constitution establishes the overarching legal authority for environmental management. In common with other federated nations, responsibility is divided between the national government and individual state governments. Within this constitutional structure, the Australian and Queensland governments have successfully worked together for over 40 years to protect, conserve and manage the Great Barrier Reef'. And then 'A suite of complementary Australian and Queensland legislation has been enacted to secure preservation for future generations of the Outstanding Universal Value and other natural, cultural and Indigenous values of the Great Barrier Reef, while allowing multiple-use activities to continue in an ecologically sustainable manner.

The principal Acts relevant to the World Heritage Area are the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which puts into law Australia's obligations under the World Heritage Convention, the Great Barrier Reef Marine Park Act 1975 (Cth) and the Marine Parks Act 2004 (Qld)'.

The requested approval of the proposed Project is being assessed under the relevant legislation consistent with LTSP2050.

LTSP2050 seeks to provide a coordinated approach to the long term-term protection and management of the Great Barrier Reef across a wide range of stakeholders including all levels of government. While the approval process is acknowledged as occurring under the relevant legislation, it is appropriate to reflect on some of the relevant objectives set out in LTSP2050. Key risks are set out on page 22 of LTSP2050 and 'can be grouped into four influencing factors: the long-term risks associated with climate change and immediate considerations around land-based run-off; coastal land-use change; and direct use'.

In regard to climate change risks LTSP2050 notes on page 22: 'Damage to reefs as a consequence of climate change comes from ocean acidification, sea temperature increases, altered weather patterns (such as more intense storms) and rising sea levels.' While some may take an extreme view that all human activity can potentially impact climate change, the proposed Project will not have any direct effect on climate change other than very minor potential impacts from fuel usage during construction. LTSP2050 notes on page 22: 'Australia has more than met its emission reductions target for the first commitment period of the Kyoto Protocol while increasing real GDP by 88 per cent'. The Project will not have a discernible effect on the Australian emission reduction targets.

In regard to land-based runoff, LTSP2050 notes on page 24: 'Throughout the 1980s and early 1990s the focus was strongly on minimising rubbish and sewage disposal within the Marine Park, particularly from coastal communities, island resorts, tourism infrastructure and vessels' and 'In the early 1990s management attention also turned to the impacts of the significant sediment and nutrient loads in floodwaters following severe storm and cyclonic activity'. To date, upgraded facilities remove an estimated 834 tonnes of nutrients annually (approximately 80 per cent of the original total nutrient load from this source) that would have otherwise entered the World Heritage Area. The provision of composting toilets will avoid sewage discharge to the World Heritage Area and mitigate the potential for minor discharges from vessels, which is responded to in item 35. The Project will not result in any significant sediment discharges. Construction Environment Management Plans (CEMP) will control any sediment discharge risks during construction, and during the sealing of the road and carparks. Dispersed stormwater discharge will reduce the potential for long-term sediment discharges to coastal waters.

In regard to coastal land use changes, these matters are addressed by the CCRC planning scheme. The proposed Project provides safer boating for recreational and commercial users. While it may result in some increase in economic activity in Mission Beach, the Project is not likely to be a driver for significant land use changes.

In regard to direct use, LTSP2050 notes on page 29: 'There are multiple activities within the Great Barrier Reef World Heritage Area, collectively referred to as 'direct use'. These include marine tourism, defence activities, fishing, ports, recreation, research and educational activities, shipping and the use of marine resources by Traditional Owners'. Also on page 29: 'The Great Barrier Reef plays an important role in community life. Local residents and visitors from within Australia and around the world are drawn to the Reef for its exceptional natural beauty, and many people have strong connections with the Reef through culture, occupation or familiarity. Human wellbeing — happiness, good health and prosperity — is inextricably linked to environmental health. Through sustainable fishing, the Reef is also a healthy food source for people in Queensland and around the world'.

Actions set out on LTSP2050 page 45 include: 'Industry, community and governments work together to implement policies and programs that address tourism and recreational use of the Great Barrier Reef Marine Park:

- maintain visitor satisfaction through high quality presentation and tourism services, including quality world heritage interpretation
- maintain recreational opportunities for Reef visitors (e.g. recreational fishing, sailing and diving)
- provide adequate and well-maintained visitor infrastructure such as public moorings, reef protection markers, island facilities and interpretive signs.'

Objectives on the same page include:

- 'A healthy Reef that supports sustainable lifestyles and livelihoods, and provides coastal communities with protection from extreme weather events.
- Community benefits provided by the Reef, including its superlative natural beauty and the sense of place, are maintained for current and future generations.
- Local, regional and Reef wide community benefits are understood and the community is actively engaged in managing Reef activities.'

The provision of safer boating facilities and improved opportunities for the public to visit the Great Barrier Reef are consistent with these actions and objectives.

LTSP2050 notes on page 46: 'The Reef is a critical economic asset, providing income and jobs for the community. Reef-dependent industries and Reef-associated industries support diverse and sustainable communities. These industries and communities need to be able to continue to prosper, while ensuring protection of the Reef's Outstanding Universal Value'. This Project will enable suitably scaled marine tourism ventures to prosper by providing safer facilities and more predictable operating conditions. Opportunities for recreational boating users to access and, even more importantly, leave the Marine Parks will have an ongoing positive impact on the Mission Beach economy, providing jobs and business income. These outcomes will support a more diverse and sustainable community, without significant population growth.

Net-benefits, cumulative impacts, impacts including avoidance and mitigation and offsets

The remaining issues in the submission include: 'what are the 'net-benefits' of the project? Have cumulative impacts' been considered? How have impacts been avoided or mitigated? What 'off-sets' have been proposed for impacts that cannot be mitigated?' These do not directly relate to the matters set out in LTSP2050. However, responses to these general matters are set out below.

The Project benefits are set out in the Public Information Package. Relevant information has been summarised below.

The Project will enhance marine infrastructure in Boat Bay, Mission Beach, to improve boating safety and amenity.

The Project will provide facilities and conditions that allow safer boat launching and retrieval, the safer transfer of passengers and goods, and lee shelter for a limited number of boats in non-extreme wave conditions.

The Project will provide safer boating access than the existing Perry Harvey jetty. The Perry Harvey jetty is significantly exposed to the south-east and east-south-east prevailing winds and has no protection from north-easterly winds and waves that typically occur in the late afternoon. As the jetty has no protection from waves approaching from the north-east direction, this pre-dominant pattern results in the jetty often being an unsafe berthing location. Reference Group members provided feedback from boat operators that the wave conditions at the jetty often present a safety hazard, and this hazard is perceived to have led to a decline in local tourists.

The Project will provide a protected mooring or berthing location for a limited number of vessels. These berths and moorings will replace the current inappropriate and sometimes illegal mooring in Boat Bay. They will reduce the safety hazards associated with potential dislodgement of vessels, and reduce environmental impacts associated with damage from anchors and chains.

The opportunities for limited commercial activities provided by the Project include:

- Safer reliable public access to the Marine Parks. Unless a member of the public owns or
 has access to a boat, the only other option to dive, sightsee or stay in the Marine Parks
 is through a commercial operator.
- Public access to the Marine Parks, which will build public awareness and support for this globally significant natural environment.
- A unique experience to visitors coming to Mission Beach through visiting the Marine Parks directly from tropical rainforest with its own unique values.
- Strong and desirable benefits to the local economy, both through direct income from boating-related business activities, and through increasing visitors to the Mission Beach area throughout the year.
- Opportunities for a limited number of local commercial fishing enterprises, which will support the local economy through employment and the supply of local fish.
- Safer commercial operations with benefits for the whole community, including families and rescue services.

Potential impacts relevant to the GBRMPA application and how they will be mitigated are set out in the Public Information Package. Relevant information has been summarised below:

- **GBR Marine Park** Detached breakwater. To protect the values of GBR, including allowing tidal flushing close to the shoreline, and to avoid reclamation of the Marine Park, the breakwater extension will be separated from the land.
- **Bommies** The design will avoid direct impacts and minimise potential impacts on these features while providing safe navigational access.

- Seagrass The design will avoid impact on seagrass areas (based on recent and historical surveys). The design minimises as much as possible the footprint of the works and hence reduces the impact on potential habitat. The Project will not cause any loss of existing seagrass meadow habitat within the GBR Marine Park. While the breakwater is immediately adjacent to an area of historical seagrass that is no longer present, the historical changes suggest that while seagrass meadows may be strongly impacted by cyclonic events, reestablishment occurs relatively quickly afterwards. It is possible that the proposed breakwater may create more sheltered areas that provide protection to seagrass meadows that may establish after construction is completed. New seagrass friendly moorings will be installed in the lee of the detached breakwater.
- **Soft sediments and rubble** The proposed Project is not expected to have any significant impacts on the marine soft sediments and rubble. Sediment modelling suggests that the Project may in fact reduce sediment build-up and possibly even reduce sediment in the area landward of the existing breakwater.
- Reefs and rocky shores While the Project will cause the loss of some benthic habitats and associated ecological values, the proposed detached breakwater and jetty will have limited impacts on the small area of corals within and immediately adjacent to the proposed works area. The proposed breakwater rock walls are expected to be colonised by reef-associated benthos and fish following completion of works. Shading of the seafloor by the jetty will lead to indirect effects to the marine environment. It is expected that shading will lead to assemblages being dominated by species that do not require high light levels, such as hydroids, bryozoans and a variety of heterotrophic hard and soft coral species. The loss of reefs and rocky shores habitat will occur across an area of 772m2 within the GBR Marine Park. This includes a small area of reef assemblages under the footprint of the new breakwater, and within the Clump Point reef and intertidal zone under the expanded footprint of the existing breakwater. Actions have been taken to limit the extent of reefs and rocky shores habitat loss in the Project design. These actions include designing the new breakwater to minimise the loss of rock and bommie habitat in the footprint, removing the existing breakwater return (which improves navigation in the area without the need to relocate or remove any bommies), and designing the new access jetty to avoid coral habitat impacts.
- **Fish trap** This is an important indigenous cultural heritage feature to the south of the existing boat ramp and will not be impacted by proposed works.
- Dredging No initial or regular maintenance dredging is planned over the design life of the new facility, as a result of construction of the Project. The exception is for potential significant geomorphological change to occur as a side effect of a severe tropical cyclone (which has the potential to occur at the existing facilities).

- Water quality The Project will not cause significant changes to tidal flushing and water quality, and therefore there will be low impacts to habitat values associated with such small changes. Construction activities may temporarily increase suspended sediment concentrations in local waters. These potential impacts will be managed through the preparation and implementation of a Construction Environmental Management Plan (CEMP). There is potential for water quality to be impacted during the operational life of the boat ramp and associated infrastructure. This includes water quality impacts from spills and pollutant discharge from vessels and vehicles. These potential risks will be managed by designing infrastructure to withstand storm events without the discharge of pollutants to the environment, establishing permit conditions requiring a refuelling quideline (which will need approval by GBRMPA), ensuring vessels depart and seek shelter during extreme weather, implementing spill/pollutant discharge contingency plans for both construction and operational phases, and taking a dispersive stormwater management approach to avoid erosion associated with concentrated flows. A Water Quality Monitoring Program will be implemented to inform both construction and operational environmental management. This will develop a water quality baseline for the Project area, through sampling and the use of existing data.
- Mangroves The Public Information Package noted that the proposal will result in a loss of mangroves on the eastern side of the northern carpark. This is a total mangrove loss of 1,014sq.m for the Project, which is 268sq.m more than the previous proposal, which only included a boat ramp upgrade. TMR's detailed design process reduced this additional permanent loss down from 400sq.m to 268sq.m in the concept design. TMR officers have explained throughout the development of the Project and in the development application documents that "offsets" will be required for this loss. The state approvals require TMR to provide a suitable offset for this loss. The provision of the offset is explained in more detail in item 36.

The need for the Project is also discussed in item 8.

Funding has been provided for the Project by both the Commonwealth and Queensland governments to deliver the benefits noted above. While there will be some impact on the environment during both the delivery and operation of the Project, these will be mitigated as far as is reasonably practical. The Project will deliver significant benefits to the Mission Beach community, and those visiting Mission Beach to access and enjoy the Great Barrier Reef Marine Park. The Project team considers that the Project delivers a strong net benefit, after all considerations and impacts are taken into account.

The cumulative impacts from the issues noted above are considered acceptable and are balanced by the strong community benefits that will be delivered by the Project. The studies carried out indicate that while there will be some ecological changes as a result of the Project (described above) the resulting marine environment will continue to be healthy, diverse, and play a positive role in the overall health of the Great Barrier Reef Marine Park. Some of the anticipated outcomes may produce improved conditions such as the removal of the existing breakwater return and the accompanying effects on sediment movements, improvements to land runoff sediment loads, and the installation of seagrass friendly moorings.

6. General topic: Administrative process

TMR to address in 'Supplementary Information - Public Information Package report'

Unacceptable under Cassowary Coast Regional Council (CCRC) Planning Scheme. e.g. port services not separated from recreational use...and (does not comply with) Reserve conditions.

Issues and comments raised in the submission:

Provide comment on how this proposal is consistent with the CCRC Planning Scheme

Response

CCRC was represented on the Reference Group during the development of the Project scope and its advice was incorporated into the final concept design, both from a technical standpoint and from a future operational perspective.

Following the finalisation of the Reference Group process, two meetings (28 February 2017 and 28 March 2017) were held with CCRC councillors, which resulted in full support for the Project at a subsequent council meeting. CCRC executed a Deed of Agreement with TMR on 31 March 2017 committing council to management of the state-owned facility in accordance with the *Transport Infrastructure Act 1994* and its *Transport Infrastructure (Public Marine Facilities) Regulation 2011*. This agreed facility manager appointment is consistent with arrangements for state-wide marine facilities owned by TMR.

Following completion of the Reference Group process TMR received advice (on 31 October 2017) from CCRC planners confirming that this development is not assessable under CCRC Planning Scheme. On this basis, from a legislative perspective, this development does not need to meet the requirements of the CCRC Planning Scheme. This is typically the case across the state because local government planning schemes do not include elements to regulate marine infrastructure. TMR has reviewed CCRC's planning scheme and cannot find any elements of the proposed development that are in conflict with the scheme.

The proposal is not a port under the *Transport Infrastructure Act (1994)* and hence any reference to a port in CCRC Planning Scheme is not relevant to this proposal.

TMR sought advice from CCRC's Manager Planning Services and received the following:

"As discussed the development has no triggers under the planning scheme as Lot 550 on NR7351 sits outside the scheme as it is not zoned etc. The reserve is for Boat Harbour purposes and the proposed development is considered consistent with the intent of the reserve."

The Project only includes works on the road reserve immediately adjacent to Lot 540 on SP287493. The detailed design project has no development works on Lot 540 on SP287493.

The Project includes works on Lot 550 on NR7351 (the Boat Bay reserve).

7. General topic: Need for project

TMR to address in 'Supplementary Information - Public Information Package report'

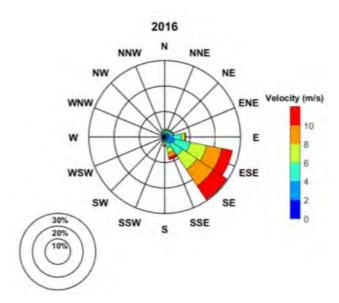
The prevailing conditions mean that there is rarely good conditions for boating in the area......facility underutilised 350 days of the year. Concern that much of the year (7 months it will be underutilised) and the rest of the time crowded. For example '....the 5 months of the year when it is possible to go boating will be mayhem....' Will be a 'white elephant'.

Issues and comments raised in the submission:

What were the key factors, and documents used, to establish a clear need for the project and determine it would not be a 'white elephant'?

Response

The wind rose below from the modelling report at **Appendix F** shows the long-term wind statistics for Clump Point up to 2016. This data shows that there is a significant percentage of time where high winds occur at Clump Point, which was a primary driver for the proposed infrastructure rather than an argument against it.



The proposed detached breakwater is designed to provide a lee (calmer water conditions) in accordance with AS3962 Guidelines for the Design of Marinas (AS3962-2001) Table 4.2 for the berths and the swing mooring area. The standard requires less than 0.3m wave height, for a one year Average Recurrence Interval (ARI) storm. The proposed Project meets this standard.

On this basis, outside of cyclone conditions, and during the generally prevailing south-east winds, the proposed facility provides the following benefits at Mission Beach:

- The facility provides calm water overnight berthing, which will enable commercial vessel operators to be based in Mission Beach with resulting roll-on benefits to the community.
- The calm water area will significantly improve emergency access, which will benefit all members of the community.
- The calm-water area will provide significantly improved safety for recreational users in situations where weather deteriorates when they are out, providing calm water trailer vessel recovery in an area separate from commercial passenger operations.
- The calm water area will enable safer transfer of passengers in situations where vessel voyages are essential in non-ideal conditions (for example, transfer of passengers from Dunk Island).
- The calm water area will expand the time window for use of the facility for all users.
- With a calm launching/access area and improved time access window, boaties are more likely to use the facility to access other protected Marine Park locations, thus improving access to the Marine Park.

The Development Plan, drafted by DSD with advice from TMR and following detailed consultation on the Project, clearly defines the objective of the Project to improve boating safety and amenity. The introduction to the Development Plan has been included below for reference showing that the proposed Project scope has been developed to meet the defined needs:

"The Queensland Government, through the Department of State Development (DSD), has responded to community requests to enhance maritime infrastructure within Boat Bay, Mission Beach, to improve boating safety and amenity. The objective of the Mission Beach Safe Boating Infrastructure Project ('the Project') is to provide conditions which allow the safe transfer of passengers and goods in non-extreme wave conditions. Existing facilities within Boat Bay include the Perry Harvey jetty at Narragon Beach (owned and maintained by the Cassowary Coast Regional Council (CCRC)) and the Clump Point boat ramp (owned and maintained by the Department of Transport and Main Roads (TMR)). Current supporting infrastructure at the Clump Point boat ramp includes a rock breakwater, floating walkway and car and boat trailer parking facilities. Historically, the jetty has operated as the principal transport link to the Great Barrier Reef and offshore islands (Dunk and Bedarra Islands) and has supported tourism in the region since its initial construction in the early 1900's. However, the jetty has no wave protection, and safe access to the jetty is significantly restricted during periods of adverse wave conditions.

The Clump Point boat ramp has been used for both commercial and recreational boat access since it was constructed as it offers better wave protection during rougher weather. It has become the preferred access point for both recreational and commercial vessels. There is however only a limited area of protected water adjacent to the ramp. During periods of peak demand, over-utilisation of the boat ramp has led to vessel congestion within the navigational channel, and traffic congestion on land where vehicles compete for limited parking and manoeuvring space. Boats are moored in Boat Bay, protected somewhat by the boat ramp breakwater and Clump Point, but the protection is limited in some weather conditions including major storms and cyclones. DSD has previously proposed improvements to the boat ramp facilities at Clump Point and an overtopping breakwater to provide calmer conditions at the Perry Harvey jetty under some weather conditions. DSD undertook extensive consultation about the proposal starting in 2011 but it was not broadly supported by the community.

Many stakeholders raised concerns about the limited wave protection to the Perry Harvey jetty that would be provided by the suggested overtopping breakwater. They strongly suggested that a better outcome could be achieved if the Project focused on the delivery of infrastructure at Clump Point, including the key aspects of the improvements to boat launching facilities in the previous proposal.

Many boat operators were concerned about using the jetty during rough weather due to potential damage (especially those with fiberglass, thinner aluminium or wooden hulled boats) and the safety of transferring passengers. Concerns were also raised about the available water depths at the jetty, especially during rougher conditions. It was suggested an extended breakwater at Clump Point could provide safer berthing and mooring conditions, and be a more efficient use of the available Project funds. In response to the concerns raised from their members about the suitability of the jetty, the Mission Beach Boating Association proposed a design they considered could provide the outcomes they sought within the available Project budget.

A community information session was held on 18 May 2016 to discuss the Project with a range of groups and individuals representing commercial and recreational boating, community and environmental stakeholders. The high-level Project objectives summarised at the meeting were:

- (1) provision of safe boating infrastructure
- (2) facilitation of local economic development
- (3) reduce conflict arising from joint commercial and recreational use
- (4) respect the rich natural environment and cultural heritage of Mission Beach.

DSD confirmed that, in response to the community feedback, the Project would refocus on delivering the improved safer boating facilities at Clump Point. It was agreed however that the Project will not seek to provide a safe haven in cyclonic or major storm events. Work on the boat ramp improvements was postponed until an integrated design was completed for the Clump Point safe boating infrastructure."

8. General topic: Need for project

TMR to address in 'Supplementary Information - Public Information Package report'

Economic benefit – what information/studies were used to demonstrate a clear economic benefit from the project? 'There is no evidence presented that the proposal will bring any economic benefit to the community...'... Concerns that the project will only benefit '....a certain few...' as opposed to the broader community.

Issues and comments raised in the submission:

Comment on concerns that the project will not have broad community benefits. Provide any supporting documentation (e.g. cost-benefit analysis).

Response

The Commonwealth and Queensland governments allocated funding as a response to community requests to enhance marine infrastructure in Boat Bay, Mission Beach, to improve boating safety and amenity, and to assist the community's recovery from Tropical Cyclones Larry (2006) and Yasi (2011). As discussed in the PIP in section 2.1, the Project was developed by the Queensland Government in response to the requested improvements. The objective of the Project is to provide facilities and conditions that provide safer boat launching and retrieval, safer transfer of passengers and goods, and shelter for a limited number of boats in non-extreme wave conditions.

The allocated funding has been used to carry out the required studies and design processes to both help define the form of the Project and to demonstrate that it can be delivered while meeting all legislated requirements. The funds will be used to deliver the Project, or as much of it as is possible, with the final achieved scope dependent on the cost of the winning tender.

The Development Plan is aimed at achieving as many of the desirable Project outcomes as possible against a fixed budget allocation. Therefore, no dollar-based cost-benefit analysis has been done. Instead, cost estimates have been used to guide what can be achieved with the available funds.

The net benefits have been discussed in the response to item 5 above. To some extent the clear benefits are difficult to express as a dollar amount given the main objective is to deliver safer boating facilities with a corresponding reduction in the risk of death, accidents, and injury. In those matters, for this facility, the question is not whether the funds spent are matched by some monetary benefit, but rather: Is the cost acceptable given the safety outcomes? Given the funds have been allocated already, the cost is acceptable to the Commonwealth and Queensland governments and thus to the community.

While provision of safer boating facilities is the key focus of the Project, a secondary consideration is the associated provision of an economic benefit to Mission Beach. The anticipated social and economic benefits are set out in responses to items 5 and 7 above.

The PIP explains on pages vii and viii that the leasing of berths and moorings will be managed by CCRC, with an emphasis on favouring leases to commercial operators who contribute to the Mission Beach economy. The leasing process will be carried out using robust evaluation approaches. CCRC has arranged for TMR input to lease drafting, leasing arrangements, and assessment of applications.

Many recreational boating users come to Mission Beach for shorter periods and their purchase of accommodation, food and other services is an economic input to Mission Beach. The improved and safer boating facilities are anticipated to maintain, enhance and extend throughout the year the opportunities for recreational boat users to access the Marine Park from Mission Beach.

The improved and safer boating facilities are expected to significantly improve the economic benefits from the Project to the Mission Beach community and surrounding areas.

The Cassowary Coast Regional Council Economic Development Reference Group was reformed as the Cassowary Coast Economic Development Inc. This council reference group was established in late 2010 to improve communication between council and the local business community. On 20 March 2017 DSD received a letter noting:

As the peak business and economic development body in the Cassowary Coast region, Cassowary Coast Economic Development Inc. (CCED) would like to express its wholehearted support for the proposed safe boating infrastructure development at Clump Point. Mission Beach.

Our member bodies, which include Chambers and business groups from throughout the Cassowary Coast region, can see the strong regional economic benefit that would accrue from this project.

The improvement of facilities at Clump Point will not only positively impact the community at Mission Beach, but also have clear additional benefits for business, tourism and economic development throughout the Cassowary Coast.

Considering the ongoing challenges that regional communities and economies, such as the Cassowary Coast, continue to face infrastructure projects such as this are precisely the kind of strong economic stimulus that is likely to have a significant impact across the region.

9. General topic: Need for project

TMR to address in 'Supplementary Information - Public Information Package report'

Better option would be to open old (recently closed ramps) – '....the concentration of use at one site – will lead to even more congestion on some days...'

Issues and comments raised in the submission:

Comment on concerns that concentrating use (at Clump Point) will lead to greater congestion than opening old ramps and 'spreading use'.

Response

A TMR-owned ramp at Mission Beach caravan park (Porter Promenade) was destroyed by Cyclone Yasi in 2011 and not reopened. It was on an open unprotected beach (no lee protection). Rebuilding it would not affect the demand for sheltered boat launching facilities such as the ones in the lee of Clump Point.

The Macquarie Dictionary define the noun 'lee' as 'the side or part that is sheltered or turned away from the wind'. The term lee can only apply to shelter from the currently blowing wind direction.

Clump Point provides the only lee protection along the Mission Beach coast. There is no lee at the jetty to the north of Clump Point (except in rare westerly weather). The Project will extend the natural and artificial lee at Clump Point whenever the winds are blowing from the south-west through south and round to east. The most regular winds come from the south-east and east-south-east. These are the 'trade winds' so named because of their reliability to blow consistently in both strength and direction. No other sites offering a lee are available in the Mission Beach area.

The concept, mentioned in a submission, of 'spreading use' among several boating facilities is desirable, but is not practicably achievable on the Mission Beach coast.

Congestion will occur on a few peak days each year at the upgraded Clump Point facility. Such occasional congestion was accepted by the Reference Group as an offset to the essential retention of existing environmental and heritage values.

Existing land at Clump Point is being assigned its highest and best use in the Project design.

10. General topic: Need for project

TMR to address in 'Supplementary Information - Public Information Package report'

Concerns about the cost of the project versus what will be the final outcome to the community. For example '....I've heard two figures to build this project: \$20 mil and \$40 mil. That's \$3.3 mil and \$6.6 mil per berth. Is that a good use of taxpayer money?'

Issues and comments raised in the submission:

Comment on estimated cost of the complete project and what analysis has been done (cost-benefit) to support the ongoing maintenance for the completed project (in terms of cost).

Response

The total available Project budget is currently \$18.4 million, which will be spent on construction and on any ongoing studies required during construction of the Project. No further funding has been proposed. The design is likely to be achievable within the available budget. Some desirable but not essential elements have been tagged as optional. Their inclusion is dependent on the successful tender price. The optional items are identified in the PIP.

The Project includes many elements such as the detached breakwater, widened boat ramp, car park upgrades, changes to the existing breakwater, the jetty, two pontoons, and the pen berths, along with other items set out in the PIP.

The breakwater is the highest cost item, with quarry rock being the largest cost variable. The breakwater has been designed for a 50 year design life with no maintenance costs anticipated over that period. Beyond that period no maintenance is anticipated but may be required. In the event of damage to the breakwater and other in-water infrastructure. TMR, as owner of all in-water infrastructure built by the Project, is covered by the Queensland Government Insurance Fund (QGIF) for disaster recovery repairs.

The pen berths are only one of a number of elements in the Project so the attribution of all Project costs to the proposed pen berths does not give a realistic estimate of their actual cost, which will be much lower than the figures suggested in the submission. The actual cost component for each pen berth will be low due to the need anyway to provide the length of detached breakwater for shelter, and to provide a jetty to access the outer pontoon situated in deeper water for deep-draught vessel access.

Maintenance of land-based infrastructure (car-parks and road) will be funded by CCRC as owner/manager. CCRC costs will be funded from a combination of commercial vessel landing/mooring fees and regular rates collection.

Funding of structural maintenance of in-water infrastructure will be covered by TMR as owner from the Marine Infrastructure Investment Program, as is done for several hundred other TMR-owned boating facilities in Queensland. Storm damage is covered by QGIF.

Pen berths have a design life of 50 years with zero maintenance projection for the first 25 years.

The jetty has a design life of 50 years. Five yearly structural inspections are expected to result in minimal maintenance costs until a 25-year mid-life refit of decking, and berthing furniture.

Floating infrastructure (two pontoons and two floating walkways) have a design life of 25 years in accordance with Australian Standards. Annual maintenance inspections and attention are planned to check for wear and tear of moving parts, cleats, fendering, and gangway non-skid surfaces.

Day to day maintenance of in-water infrastructure (for instance cleaning) will be carried out and funded by CCRC as facility manager.

There is no need for dredging (either initial or maintenance) and therefore seabed maintenance costs, other than at the toe of the boat ramp, are forecast as nil.

Lease fees have not yet been set. CCRC will set them after Project completion based on comparison to other berthing/mooring fees in north Queensland.

11. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

The project is different to what was reviewed by the Commonwealth Department of Environment and Energy (under the EPBC Act).

Issues and comments raised in the submission:

What is the status of the final project design in relation to the EPBC Act (Department of Environment and Energy)? Have they been consulted regarding changes to the original submission?

Response

TMR has provided Department of Environmental and Energy (who administers the *Environmental Protection and Biodiversity Act 1999 (EPBC Act (1999)))* with an update on the final scope of works to ensure TMR's obligations under the *EPBC Act (1999)* continue to be met.

12. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

The Project is bigger than required for the Mission Beach area. The Perry Harvey jetty was available (and suitable for upgrade).

Issues and comments raised in the submission:

Comment. How was it determined that the Perry Harvey jetty was not to be part of the upgraded boating facilities package?

Response

The PIP FAQ on page v confirms why the Project focused on Clump Point and has been included below for easy reference:

Why are the works being undertaken at Clump Point and not the Perry Harvey jetty?

Works at the Perry Harvey jetty did not meet the Project objectives, including provision of safer boating access, without the construction of a breakwater structure in front of the jetty. The proposed development of a breakwater structure in front of the jetty was broadly rejected by the Mission Beach community.

The Perry Harvey jetty will remain a good weather access facility and provides services that will complement the upgraded Clump Point facility.

The Queensland Government, represented by the Minister for State Development, Dr Anthony Lynham, made the following statement in response to a parliamentary Question on Notice on 5 July 2016:

"Following an analysis of the various options available to provide safe boating infrastructure at Mission Beach, the previous government committed to undertake works at both Perry Harvey jetty and Clump Point.

Due to concerns raised by the community in relation to the use and condition of Perry Harvey jetty (a council-owned asset) and requests for the project scope to be reviewed, the Department of State Development held a community information session in Mission Beach on 18 May 2016.

The information session provided an opportunity for open discussions to take place between key stakeholders and for expert advice to be provided directly by representatives from the Great Barrier Reef Marine Park Authority and Maritime Safety Queensland.

The session proved invaluable in working through a number of community concerns and was well attended by representatives from local boating organisations, the Cassowary Coast Regional Council and environmental groups.

There is now support from leading community groups and the local council to work closely with the department to refocus the project and deliver the necessary boating infrastructure at Clump Point, in lieu of the works previously planned at Perry Harvey jetty."

For clarification purposes the previous proposal at Perry Harvey jetty included the addition of a fixed access ramp on the jetty with berthing piles and the installation of a submerged breakwater offshore to attenuate waves and improve berthing conditions.

The primary reasons this proposal was rejected were:

- Conservation groups objected to the breakwater structure despite it being designed as low as possible to minimise impacts on scenic and visual amenity.
- Other industry groups objected to the proposal for the following reasons: insufficient
 water depth at the jetty for safe commercial operations, proposed breakwater provided
 negligible protection, and, proposed ramp access presented safety risks when boarding
 vessels.

A large breakwater to suitably protect the jetty head from all winds and an extension of the existing jetty to deeper water with the installation of a berthing pontoon could provide a solution to meet the concerns outlined in item 2, however at a cost of in excess of 200% of the Project budget. Without a breakwater (in any location) the objective of the Project to provide safer landing facilities could not be achieved at the Perry Harvey jetty.

The Clump Point combined-facility option provides the following additional benefits:

- The breakwater being placed near the headland has less impact on visual amenity and can be smaller, while still providing an effective lee (calmer water). This is because it uses the natural headland protection more efficiently.
- Natural water depths exist at Clump Point to facilitate proposed uses.
- The detached breakwater provides lee protection for recreational vessels when waiting to access the boat ramp. This is of particular importance for trailer boat recovery when weather comes up during an outing.

13. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

The project is not big enough – it needs to have a longer breakwater. 'Vessel draft capacity (1.7m) is only the same as the existing PHJ' (because the wall does not extend into deeper water).

Issues and comments raised in the submission:

Comment on concerns that the final design does not provide for larger draught vessels than the Perry Harvey Jetty?

Response

The notional design vessel (which has a draught of 1.9m) chosen for the facility is based on the largest tourist vessel that is likely to operate out of Mission Beach (based on potential future operational need and commercial viability). The draught of this vessel does not reflect the depths available for berthing at the facility. The outer pontoon is located on the -3.5m LAT contour and the inner pontoon is located between the -2.5m LAT and -3m LAT contours, with the six pen berths being positioned between these. On this basis the new facility provides a significant improvement to berthing depths compared to Perry Harvey jetty, and does so in a reliably calmer water location.

The scale of the development proposed is consistent with Reference Group advice to cover the present and future needs of the Mission Beach area.

A larger facility than proposed cannot be built at this site because such a development would require significant additional land-based infrastructure to support it, which would have unacceptable impacts on the very high environmental and cultural heritage features of the area.

14. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Needs to include toilets and disabled access

Issues and comments raised in the submission:

What facilities and design features will be provided for disabled access?

Response

The Project includes composting toilets at the upper southern carpark, and disability access to the northern berthing pontoon. This is described in the PIP on pages 21 and 22 – *Table 3-4 Description of Project Design Elements*, but has been included below for easy reference.

Page 21 of the PIP notes:

"Two pontoons are proposed to be accessed from the jetty (subject to available funding), one of which will be primarily for commercial uses and equipped with a DDA-compliant access gangway"

[&]quot;Pontoons"

The non-DDA inner pontoon is subject to available funding. The DDA-compliant outer pontoon will be included as an essential part of the Project.

Page 22 of the PIP notes:

'Upgraded upper (southern) carpark, access road improvements and composting toilet. Improvements to the upper carpark and Clump Point Road will be undertaken in accordance with the 2015 DSD tender package, including the installation of a composting toilet.'

See response item 2 above for details about the reason for the choice of toilet and location.

15. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Concerns raised about a lack of quantifying information for the new design. For example '...the PIP talks of modelling for the breakwater but no details supplied to support the claim..'

Issues and comments raised in the submission:

Provide final Modelling (in relation to breakwater design) and Engineering design information to support (final) project design

Response

TMR has provided in **Appendix D** the Preliminary Design Report element, which includes the documentation supporting the detached breakwater design.

16. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Larger gap in breakwater needed to allow for tidal currents. Comments about the lack of data (modelling) to demonstrate how the proposed design will not cause siltation, require dredging.

Issues and comments raised in the submission:

Provide comment and supply modelling data.

Response

A detailed analysis of the required gap width to maintain tidal flows, avoid significant geomorphological changes and provide the required level of calm water conditions was undertaken as part of TMR's concept design development modelling work. The full concept stage modelling report is attached in **Appendix E**. The concluding outcome was as follows:

"Based on the modelling assessments it is recommended that the gap between the new breakwater structure and the existing breakwater should not greatly exceed 30 m as the protection benefits of the structure are compromised by the larger gap size." While siltation modelling was undertaken as part of the concept stage modelling work in **Appendix E** above, which reflected minimal siltation impacts, TMR repeated wave protection and siltation potential modelling of the final design. This is provided in **Appendix F**, outlining that the proposed design layout does not create any significant siltation impacts.

17. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Have the potential impacts of northerly winds (on turbidity, sedimentation) been fully investigated? Where are the results?

Issues and comments raised in the submission:

As above. Have the effects of northerly conditions (on turbidity and sedimentation rates) been fully considered and modelled? Provide the modelling study and where this is addressed.

Response

Appendix F details the modelling undertaken showing the wave protection and siltation assessment for the proposed Project. This assessment reflects the long-term statistics of dominant wave conditions which drive sediment transport processes and hence influence siltation trends.

Specific analysis of the impact of north-easterly wave conditions on siltation trends was not performed in this report. However TMR's modelling consultant BMTWBM has assessed the potential influence of this wave condition in a technical note (see **Appendix G**). In summary they concluded:

- North-east waves occur 1.3% of the time.
- The breakwater wave shelter modelling results for the dominant wave condition from the south-east showed a clear correlation between reduced wave energy and the modelled siltation trends. The north-easterly wave shelter modelling result was reviewed and showed (as expected) that the facility provides less sheltering of wave energy from the north-east and hence less potential for siltation for this wave condition.

Based on the above assessment, the siltation modelling outlined in **Appendix F** is an accurate reflection of siltation potential for the proposed development.

18. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

More swing moorings required. One comment suggested there used to be up to 19 in the bay. Another suggested that TMR had advised them that GBRMPA would not allow any more.

Issues and comments raised in the submission:

 How was the final number of swing moorings established? How were GBRMPA's site management arrangements taken into account? See Links below Table.

- How will moorings be allocated for equitable commercial and recreational use?
- Provide details of any mooring and anchoring plan developed for the area.

Response

In 2005 the GBRMPA Site Management Arrangements for Clump Point, Mission Beach noted: 'At the time of preparation of the Site Management Arrangements, there were 15 moorings installed in the Bay, three (3) of these had Maritime Safety Queensland buoy mooring approvals. The remainder do not have a Marine Park permit or Maritime Safety Queensland buoy mooring approval'.

The Site Management Arrangements document was supported by an Activity Plan (map) showing the then current infrastructure at Clump Point and GBRMPA's preferred management of moorings at this site at the time the documents were prepared.

The PIP notes (page i) that the Project was developed based on a Development Plan (DSD, 2017) prepared by DSD in consultation with a Reference Group, made up of Mission Beach community groups, TMR representatives, and a CCRC representative. The Project includes five or six pen berths (for commercial lease), and five to six swing moorings (for a mixture of recreational and commercial use) (PIP page iii).

TMR is seeking approval to construct the pen berths and buoy moorings along with other elements of the Project. Pen berths allow for a vessel to be secured between piles and the jetty in the protected area behind the breakwater. Pen berths allow more vessels to be moored in a given space compared to mooring the same number of vessels using swing moorings, allowing the breakwater to be kept as short as possible (PIP page v).

The PIP notes on page 12 that moorings, pens and berths should be provided to a maximum of 11, subject to discussions with GBRMPA. These should provide a balance between recreational and commercial users on the understanding that the number of berths for commercial operators would be limited and available only to operators whose activities benefit the local economy. The Project design includes 11-12 moorings, pens and berths based on the following (indicative) breakdown:

- 4 moorings permanently leased to commercial operators
- 2 moorings available for casual occupation by larger visiting recreational vessels
- 5-6 pen berths for commercial lease.

The PIP notes on page 23:

A small number of environmentally friendly moorings (EFMs) will be installed in the lee of the new breakwater. It is intended that there will be up to 6 in total, 4 of which are proposed to be permanently leased to commercial operators and 2 available to casual occupation intended mainly for larger visiting recreational vessels. The total number will be subject to the area of protected water provided by the new breakwater following detailed design and GBRMPA approval. To service these moorings the detailed design is to include an option for dinghy storage.

NOTE: TMR is aware of two existing approved moorings in this part of Boat Bay which will not be impacted by the additional moorings proposed.

GBRMPA officers were kept informed and consulted throughout the consultation and design processes to ensure they were aware of the process and potential Project, and that GBRMPA's requirements are addressed. Discussions with GBRMPA officers suggested there may be a limit to the number of swing moorings that could be approved due to the limited space available, with a total of about 11 discussed.

That GBRMPA-supplied information was discussed with the Reference Group along with the limited area of protected water that would be created by the proposed breakwater. The concept of pen berths was introduced to the Reference Group by TMR to provide a way of accommodating more vessels in the limited space available, and at the same time make the berthing infrastructure cyclone wave resistant.

The views of how many vessels should or could be accommodated initially varied considerably among the various Reference Group members. There was considerable debate leading eventually to a more consensus-based set of views. The range of final views on mooring and berth numbers by each of the member groups is shown in the PIP table 3-3 on page 14, and while there are differences in the breakdown of mooring/berth types the overall numbers are similar between the groups.

The February 2017 Development Plan was based on Reference Group advice provided at the preceding meetings and was considered by the Reference Group when preparing their Final Advice Statement (attached to the PIP), which sets out some of the conclusions reached and the berthing and mooring spaces recommended by each of the member organisations. Key points set out in the Development Plan included:

There needs to be a balance between capacity and environmental protection. The future demand for berths for larger boats will not be able to be met. An acceptable number of berths should be provided for commercial operators whose operations will have a beneficial impact on the local economy.

Short term loading and unloading access should be provided for recreational and commercial users from a public pontoon.

The development should not be a 'marina' catering for a large number of boats.

Safe haven (but not in a cyclone, tsunami or storm wave conditions) for commercial operators may come from a mixture of permanent berths, swing moorings or pens.

It is recommended that commercial access will need to be bid for at regular intervals, possibly with some method of considering the benefits provided by an operator to the local economy.

Commercial operators, including fishing, need access for offloading and berthing or mooring.

While some commercial operators may want permanent berth access, many could work with loading and unloading access combined with a safe mooring or pen.

A margin is needed for under keel clearance of up to 0.3m to 0.7m in normal sea-states (low wave heights).

The total berths, pens and moorings should not exceed 11, although some members suggested this should be discussed with GBRMPA.

The Development Plan noted that on-water access space is needed to allow ramp, berth and mooring movements without conflicts. A new breakwater will create a safer area for all boats to wait for access to the boat ramp or pontoons. This area needs to be kept clear of permanent moorings and anchored boats. The proposed development will require an update to the GBRMPA Site Management Arrangements 2005 to reflect the changed navigational arrangements, and will effectively be making improvements to the existing use arrangements.

Appendix H outlines the proposed mooring plan. This plan includes five new mooring locations and an existing approved mooring located in the lee of the breakwater providing "good wave conditions" in accordance with table 4.2, *AS3962-2001* during a one year ARI (average recurrence interval) event.

19. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Re-fuelling – questions raised about how this would be done including concerns about the jetty/infrastructure being able to support fuel vehicle

Issues and comments raised in the submission:

- Provide details on re-fuelling procedures planned for commercial and/or recreational vessels.
- How they will be undertaken (including location of fuel lines and storage facilities (if any) and who will manage such activities?

Response

Appendix C provides a plan of the proposed refuelling arrangement. The management arrangement is described in item 2 above.

The upgraded breakwater and the first section of the jetty to the location of the first pontoon as shown in **Appendix C** provides suitable access and loading design to support a 12.5m rigid fuel tanker. The choice of this design vehicle was made following consultation with a local fuel supplier.

Given the budget constraints of the Project the final design layout of the jetty and refuelling berth may be amended from what is shown in **Appendix C**. In the event there is insufficient budget for the southern pontoon, a series of berthing piles and a ladder will be included in the jetty design to facilitate calm water refuelling from the same location.

Management arrangements are covered in item 50.

20. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Design of facility in relation to vessel movements – concern that inward and outbound vessels could collide (lack of visibility at some points)

Issues and comments raised in the submission:

Provide details outlining how the navigation of vessels will be managed appropriately for the area.

Response

Vessel movement safety is governed by:

(1) International Regulations for Preventing Collision at Sea 1972, which provides guidance to all vessel operators.

For instance: Keep to starboard side of a channel when risk of collision is deemed to exist.

And: 'Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped with a distance appropriate to the prevailing circumstances and conditions.' In setting a safe speed, vessels are required to take into account the state of visibility and the traffic density.

Smaller vessels in close quarters situations are required by the collision regulations to keep themselves clear of yachts and other large vessels restricted in their ability to manoeuvre, or constrained by their draught.

When backing out of a berth (such as the proposed pen berths), vessels are required to sound three short blasts on their whistle to warn other vessels.

(2) The 'general safety obligation' placed on all vessel operators by Queensland's Transport Operations (Marine Safety) Act 1994 and the Transport Operations (Marine Safety) Regulation 2016.

These requirements will make marine safety at Clump Point essentially self-regulating.

Details of navigational aids as recommended from initial consultation with the Regional Harbour Master include:

- Port lateral mark immediately adjacent the new breakwater head (with navigation lights): mono-pile structure, standard Marine Safety Queensland (MSQ) design with access ladder for maintenance.
- Yellow 'special mark' buoy at western extent of entrance into the boat ramp basin: Sealite SL-B601 with SL-15 light.

The location of these elements are shown in Appendix H.

The final navigational requirements of the project will be subject to formal approval by the Regional Harbour Master.

21. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Impacts of passing vessels on moored/penned vessels

Issues and comments raised in the submission:

How will final design and lay-out minimise effects of wash/vessel wakes? What are the ongoing (proposed) management options for this?

Response

Vessels operating in the lee of the Clump Point breakwaters are expected to self-regulate to slow speed and therefore produce minimal wash/wake.

If deemed necessary, TMR's Regional Harbour Master can exercise powers to create a speed limit or no-anchoring area in the lee of the Clump Point breakwaters.

22. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Suitability/design capacity of the project (final design) – previous damage from cyclones (other nearby examples such as cyclone damaged Port Hinchinbrook mentioned).

Issues and comments raised in the submission:

Comment on concerns that the project will not withstand cyclonic conditions. Provide details of design specifications showing capacity. See also comments below about concerns raised about responsibilities post-cyclone.

Response

This Project design has been heavily influenced by the need to resist potential cyclone impacts. The occurrence of Tropical Cyclones Larry and Yasi in the recent record have significantly increased the statistical storm tide and wave design requirements under Australian Standards *AS4997-2005 Guidelines for the design of maritime structures* and *AS3962-2001*. **Appendix I** details the process followed for developing the Project design wave and storm-tide conditions used in the detailed design. **Appendix D** includes the preliminary design process for the detached breakwater and the associated transmitted wave climate to be applied for the pontoon design.

The design objectives are:

- Design a facility that provides calm water conditions (less than 0.3m wave) in accordance with AS3962-2001 for all ambient operational conditions (up to a 1 year ARI event)
- 2. Design a facility that minimises the environmental footprint in meeting the overall functional objectives.
- 3. Design a facility with components that best resist cyclone forces and hence enable minimal impacts on serviceability following cyclone events.

In accordance with TMR standards the floating walkways and pontoons are designed for a 25 year design life and are hence designed to resist at 1 in 50 year ARI event. While the breakwaters, jetty and carpark are designed for a 50 year design life and hence are designed to resist a 1 in 200 year ARI event.

For context the 1 in 50 year ARI event utilised is equivalent to the storm tide conditions from TC Larry at Clump Point before sea level rise is applied (IE this is a larger event). The breakwaters are designed to resist the 1 in 200 year ARI event with less than 5% damage. However physical modelling showed that minimal damage occurred to the structure (maximum 8%) from the overstress testing which equated to an event equivalent to TC Yasi at Clump Point (see details **Appendix D**).

With respect to the pontoon pile height the design pile height is 5m AHD which is 0.5m higher than the TMR standard of +2.5m HAT (4.5m AHD). For context this height is sufficient to contain the pontoons during a TC Yasi event which is well in excess of the design event.

On this basis the structural design will meet AS4997-2005 in resisting cyclone impacts using the latest storm tide and wave statistics. All elements have been designed to reduce damage from extreme events that exceed the design event intensity. As an asset owner who will be responsible for future structural repairs and any associated clean-up, TMR always strives to meet the highest design standards and in this case the design suits the intended use and overall objectives of the project.

23. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Turn-around areas. 'On a busy day it is bedlam...the space to grow the facility is just not there the existing turnaround onto Alexander Drive cannot deliver safe turning dynamics for either buses or trucks....'. Note – this (and several comments below) is considered relevant to Marine Park issues in terms of areas of reclaimed tidal lands and ultimately 'use and amenity' of marine facilities.

Issues and comments raised in the submission:

How will busy periods with (potentially) buses, trucks and cars/trailers be managed? How can it be ensured the design will adequately cater for these future levels of use? Is the intention to grow or maintain proposed design into the future?

Response

The facility is not designed to grow.

The proposed facility was developed in consultation with the Reference Group to meet the present and future needs of Mission Beach and represents the full extent of the proposed development at Clump Point.

The design has produced a carefully balanced Project outcome that recognises the need to ensure the significant environmental and cultural heritage values of the Great Barrier Reef Marine Park and World Heritage Area at Clump Point are protected.

With respect to access via Alexander Drive/Porter Promenade, TMR highlighted in the PIP section 6.3 'Traffic and Parking' that an upgrade to this intersection would be considered following review of initial usage:

"Alexander Drive/Porter Promenade is the north/south route between Mission Beach and Bingil Bay. The change of name from Alexander Drive to Porter Promenade occurs at the intersection with Clump Point Road. TMR is responsible for management of Alexander Drive/Porter Promenade as a state-controlled road and will consider the need for and timing of an upgrade to this intersection following completion of the Project and review of the first months of usage."

24. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Car parking – number of trailer parking spaces. Comments made that TMR guidelines recommend 40/ramp but this number is not being supplied.

Issues and comments raised in the submission:

How will car-parking designs be adequate for proposed increase in boating facility? Will there be a future push for further reclamation?

Response

TMR's guideline (not a compulsory requirement) is for 22.5 car-trailer unit (CTU) parking bays per lane.

The Project design represents a compromise between moderate upgrade in lane capacity, moderate increase in CTU parking capacity, and retention of Clump Point natural features and cultural heritage.

Congestion will occur on a few peak days each year at the upgraded Clump Point facility. Such occasional congestion was accepted by the Reference Group as an offset to the essential retention of existing environmental and cultural heritage values.

CCRC intends monitoring usage over the first year of operation of the upgraded facility. If needed, options will then be investigated for provision of additional parking near Porter Promenade and within walking distance of the upgraded boat launching facility on Clump Point.

Commercial operators will be required (by permit) to avoid passengers parking in the two car-trailer parks on Clump Point, typically by mini-bus shuttle arrangements.

The Project presented in the PIP is the maximum size and footprint requested for approval. This means that no reclamation beyond that currently proposed will be possible in the future. TMR is proposing that this be a condition of GBRMPA project approval.

25. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

The entrance (road) and car-park are not big enough. People will have to walk too far from ramp to car. Need to manage to ensure no 'ramp-rage' during busy periods. Concerns that with the upgraded marine facilities bring more use the road, turnarounds and car-parks will not be able to cope.

Issues and comments raised in the submission:

Comment.

Response

The proposed facility was developed in consultation with the community Reference Group to meet the present and future needs of the Mission Beach community and represents the full extent of the development at Clump Point.

This is a balanced project outcome which recognises the need to ensure the significant environmental and cultural heritage values of the Great Barrier Reef Marine Park and World Heritage Area at Clump Point are protected.

Congestion will occur on a few peak days each year at the upgraded Clump Point facility. Such occasional congestion was accepted by the Reference Group as an offset to the essential retention of existing environmental and cultural heritage values.

CCRC intends monitoring usage over the first year of operation of the upgraded facility. If needed, options will then be investigated for provision of additional parking near Porter Promenade within walking distance of the upgraded boat launching facility on Clump Point.

26. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Concerns raised about future increases in size/design. 'What is proposed in this PIP is an incremental approach (foot-in-the-door)....not the 'whole of project. Some commented on MBBA website/Facebook site that talked about future upgrades/increases.

Issues and comments raised in the submission:

Comment on concerns raised about this project being the 'first-stage' towards a larger facility such as a marina. Is it the intention that this will eventually become a marina or not?

Response

The PIP clearly defines TMR's intentions in the Section 8 conclusion:

'The Project does not represent the first stage of a future marina development and no expansion in the facilities is planned or supported other than what is set out in the Development Plan and this Public Information Package.'

TMR is proposing that this be a condition of GBRMPA project approval.

27. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

Navigation lights – will there be adequate lights for night-time use?

Issues and comments raised in the submission:

Comment on proposed design in relation to navigation lights and access after dark. Provide details of proposed navaid installations and locations.

Response

Navigational lighting is included as part of the design in accordance with Marine Safety Queensland requirements. Response item 20 (and specifically Appendix H) includes the preliminary navigational aids proposed which will be subject to final approval from the Regional Harbour Master, as is the case for all Queensland waters.

All Project-associated lighting is solar powered and designed specifically to avoid impact on marine and terrestrial fauna, while providing a suitable level of lighting for safety of use and access to the facility.

28. General topic: Size/design

TMR to address in 'Supplementary Information - Public Information Package report'

How will the new lane of the boat-ramp be functional when there is a rock (coral bommie) preventing full operation? Will a guard-rail (or some other system) be installed to prevent collisions? Is there some other way of managing this issue.

Issues and comments raised in the submission:

- Provide statements regarding final design in relation to tidal access to boat ramps.
- Is there a need to relocate any coral bommies/rock from this area?

Response

This item is covering in PIP – Project Description and Design Considerations – page 12 and is included below for easy reference.

'No relocation of the coral bommies is needed -

The removal of the return from the existing breakwater will not only provide a more direct access path to the boat ramp lanes, but also allows the two bommies identified for removal in the previous proposal to be retained. The bommies will be marked as navigation hazards and the removed rock used in the new works.'

Discussions with the Regional Harbour Master have outlined the need for placement of a yellow special mark buoy (discussed in item 20) marking the location of the bommie on the edge of the channel, with the removal of the existing breakwater return providing the required 18m access channel width as shown in **Appendix H**.

29. General topic: Environmental

TMR to address in 'Supplementary Information - Public Information Package report'

Climate change – predicted climate change impacts include sea-level rise and increased cyclone intensity (larger waves, larger storm surge)

Issues and comments raised in the submission:

How have climate change predictions (sea-level change, cyclone intensity) been incorporated in to the design (for the predicted design life of the project)?

Response

As with many TMR boating infrastructure projects, the application of sea level rise needs to be applied carefully. Unlike other coastal developments, a boat ramp needs to be designed to function at the current tidal levels. For this reason designs are often undertaken on the basis of allowing for a future retrofit of the facility subject to sea level rise, rather than a blanket design application. TMR has adopted this philosophy with this Project.

As discussed at Reference Group meetings, the northern carpark has been raised by an approximate average of 0.5m to bring it half a metre above the level of Highest Astronomical Tide (HAT) and hence avoid spring tide and wind-driven ('meteorological effect') inundation. However, in the design of the reclamation area and changes to the existing breakwater, TMR has chosen not to include an additional vertical increase for sea level rise. This decision was made because the inclusion of an additional allowance for sea level rise would create a need to extend the boat ramp south (into 'cut'), eating into the turning area and resulting in a significant increase to the development footprint to maintain car-trailer parking capacity.

The detached breakwater and associated infrastructure has been designed with the application of 0.3m of sea level rise which exceeds that recommended in *AS4997-2005*. The design storm tide and wave conditions have been generated using the entire dataset from Clump Point and have hence captured TC Larry and TC Yasi. On this basis the design conditions fully reflect the increase in storm intensity seen in these two cyclones.

30. General topic: Environmental

TMR to address in 'Supplementary Information - Public Information Package report'

Construction of the breakwater (and road reclamation) will result in the generation of turbid plumes.

Issues and comments raised in the submission:

Comment. How will turbid plumes (and their potential impacts on adjacent environments) be limited/managed during construction?

Response

Construction of the breakwater will be undertaken in accordance with Construction Environmental Management Plan (CEMP) measures. These measures will include, where it is needed, washing rock offsite to remove dust and fine particles, plus monitoring to ensure the measures are in place and effective.

Control of turbid plumes and marine turbidity generally will be addressed by the CEMP monitoring and management measures, which will include erosion and sediment control measures and checks.

The CEMP prepared for the Project identifies a management regime that aims to achieve the following performance criteria:

- Water Quality Objectives (WQOs) for Boat Bay and open coastal waters are met throughout the construction process.
- Erosion and sediment control installations remain fit-for-purpose throughout the construction phase.
- No collapse or evidence of significant erosion from stockpiles.
- No generation of visual turbid plumes >10m from works area.

TMR has committed to establishing a pre-construction water quality baseline to update these performance criteria if necessary.

Achievement of these performance criteria will be subject to strict controls on stormwater runoff, erosion, turbidity generated from placed rock and reclamation, and spills – including the use of bunding and silt curtains where needed during construction. All material being brought to the site will be certified as clean fill prior to placement. Works will be continually monitored to ensure effectiveness of controls and immediately address any uncontrolled discharges of sediment into the marine environment.

31. General topic: Environmental

TMR to address in 'Supplementary Information - Public Information Package report'

Impacts to megafauna (turtles, dugong, whales and dolphins). Numerous concerns raised about the risks of boat-strike on megafauna - '...turtles, dugong and dolphins are sighted nearly every time I go down there and leave by boat...'.

Issues and comments raised in the submission:

How will this issue be managed during both construction and operation of the facilities at Clump Point?

Response

In the context of tropical environments, marine megafauna consists of cetaceans (dolphins and whales), sirenians (dugongs), marine reptiles (turtles, crocodiles), sharks and rays, and large bony fishes. While marine ecology surveys conducted at Clump Point focused primarily on habitat (for example seagrass, coral reefs) rather than the presence of specific megafauna species, a Project assessment was conducted of the likely presence of megafauna species in the area.

This assessment identified the following species as potentially occurring in the area:

- Humpback whale (*Megaptera novaeangliae*)
- Green turtle (Chelonia mydas)
- Loggerhead turtle (Caretta caretta)
- Hawksbill turtle (*Eretmochelys imbricata*)

- Flatback turtle (*Natator depressus*)
- Olive ridley turtle (Lepidochelys olivacea)
- Saltwater crocodile (*Crocodylus porosus*)
- Australian snubfin dolphin (Orcaella heinsohni)
- Australian humpback dolphin (Sousa sahulensis)
- Common dolphin (Delphinus delphis)
- Dugong (*Dugong dugon*)
- Dwarf sawfish (*Pristis clavata*)
- Green sawfish (*Pristis zijsron*)
- Whale shark (Rhincodon typus).

Of these species, those most likely to occur near to Clump Point are turtles, dolphins and dugong.

Green turtles and dugongs primarily feed in seagrass meadows, including those occurring within Boat Bay, while other marine turtles are omnivorous, feeding on seagrass, reef species, and jellyfish. Dolphins feed in a range of habitats, including shallow waters such as occur around the boat ramp.

DEHP marine wildlife stranding data shows:

- There is only one recorded vessel strike incident to marine megafauna (humpback whale) at Clump Point/Boat Bay region since 2000.
- At broader (Mission Beach/Dunk Island) regional scale, there are four other records where boat strike may have been a cause of death to marine megafauna (several species of whale).
- There are no recorded incidences of vessel strike to dugongs or dolphins in the Clump Point/Boat Bay region since data collection commenced in 2000.
- Turtle strike data is based on 1º latitude blocks (that is, covers area from Cairns to 20 km south of Clump Point). Therefore it is not possible to distinguish comparable numbers of turtle strikes for the Mission Beach area.

This data suggests that the existing levels of fauna strandings in the area due to boat strike are very low. While there is some uncertainty in terms of turtle strike numbers, the low levels for dugongs (a slow-moving species that frequents seagrass meadows) provides some indication that turtle strikes are also likely to be low.

Improvements to the boat ramp facility are expected to increase the number of boats launching from Clump Point. This increases the risk of vessel strike to marine megafauna, especially slow-moving species that utilise seagrass meadows and reef habitat near Clump Point, such as dugongs and turtles.

Assuming a significant increase in vessel movements at Clump Point, and a commensurate increase in vessel strikes, the risk of impacts to the population status of megafauna species is low. GBRMPA and/or state agencies could implement designated 'go slow' zones for Boat Bay should boat strike become a key hazard to wildlife or vessels.

The Construction Environmental Management Plan(CEMP) will implement best practice measures to avoid impacts on Marine Megafauna during the construction phase of the project.

32. General topic: Environmental

TMR to address in 'Supplementary Information - Public Information Package report'

Marine surveys – corals were not identified to species (making it hard to identify if any were threatened species). No surveys of fish populations were undertaken.

Issues and comments raised in the submission:

Provide comments on the extent of marine ecological surveys and their adequacy for an assessment of the project.

Response

Marine ecological surveys focused on the identification and mapping of marine habitats and benthic communities in the area. This information informed the design of the Project as part of an environmental constraints assessment, as well as the impact assessment. This approach is consistent with both federal and state policy as it focuses on the habitat values that underpin assemblages of marine fauna.

No coral species are listed as threatened or near-threatened under Commonwealth or Queensland legislation. As discussed in the documentation, there are several coral species known from the GBR region that are listed as threatened on the 'IUCN Red List'. IUCN listed threatened hard corals known from the GBR region include members of *Acroporidae* (staghorn corals), *Dendrophyllidae* (cup corals) and *Faviidae* (brain corals).

Surveys recorded hard coral colonies (including the above families) in the proposed upgrade to the existing breakwater (that is, in the area already approved by GBRMPA and the Queensland Government). The isolated rocks in the footprint of the proposed new detached breakwater mostly support assemblages of soft coral and other filter-feeders, with occasional hard coral colonies. On the conservative assumption that threatened corals are present on these rocks, and given their low abundance and limited extent of area affected, significant impacts to these species are unlikely to occur at the local (Clump Point) or regional scale.

33. General topic: Environmental

TMR to address in 'Supplementary Information - Public Information Package report'

Ecological data collected (for project studies) was collected post-Cyclone Yasi – therefore not representative of the 'base-line' conditions of the bay (i.e. seagrass/coral in particular in poorer condition).

Issues and comments raised in the submission:

How was it ensured that collected ecological data was representative of the marine environment in a stable condition as opposed to a damaged post-cyclone condition (i.e. baseline versus perturbed condition)?

Response

Seagrass distribution presented in benthic habitat maps (PIP Page 36 Fig 4-5 *Benthic Habitats of the Project Area* and Page 37 Fig 4-6 *Project footprint impacts to Benthic and Intertidal Habitat*) reflect three surveys:

1997 surveys reported by Roder et al. (1998)

- 2013-2014 surveys undertaken by Aurecon
- 2016 surveys undertaken by BMT.

This shows that the extent of seagrass occurrence and potential impacts explicitly considered distributions pre and post cyclone events.

In terms of corals, it has been conservatively assumed that all reef habitat supports potential habitat for corals, irrespective of the condition of corals. High resolution hydrographic survey was used to identify the details of all seabed features which assisted in the application of this approach.

34. General topic: Environmental

TMR to address in 'Supplementary Information - Public Information Package report'

Wash-down areas – these present a risk to the marine environment. 'A wash-down area will allow more contaminants into the bay – fish, debris, dirt, oil etc.' Also concerns about the road surfaces in general and risk of pollutants washing off roads and into marine environment

Issues and comments raised in the submission:

- How will wash-down areas be designed and managed to minimise impacts to marine environments?
- Are there any gross pollutant traps or other stormwater management design features proposed?

Response

An outcome of the extensive Reference Group consultation was to consider the effects of concentrated stormwater flows and associated erosion from the existing access road and recreational boat launching facility – and the resulting impact on water quality.

For this reason, one objective of the design of proposed upgrade works is to reduce run-off impact on water quality in Boat Bay and Narragon Beach via a dispersive stormwater management approach. This approach provides water to adjacent high value vegetation.

A potential wash-down area has been included in the proposed upgrades as part of a rigging area on the eastern side of the boat ramp turning area because the mains water goes beside this area.

If included in the final design this area is intended to be used only for washing off saltwater (to clear salt from wheel bearings and brakes), and is not intended for general vessel or vehicle washing. This will be made clear with signage, as will the requirement to not use detergents or chemicals.

To improve the capture of potential contaminants within wash-water (e.g. hydrocarbons, chemicals) a strip grate drain will be installed west (that is, 'downhill') of the re-rigging/wash-down area, and be connected to a hydrocarbon separator near the top of the ramp with a 150 mm outlet on the western side ramp shoulder. This separator will allow a first flush filter for the wash down area which will be maintained.

35. General topic: Environmental

TMR to address in 'Supplementary Information - Public Information Package report'

Permanently moored vessels present an environmental risk (anti-fouling paint, discharge of waste)

Issues and comments raised in the submission:

How will it be ensured that permanently (or long-term) moored vessels do not contaminate the marine environment of the area?

Response

The Project is an upgrade to existing boating facilities at Clump Point, which includes a small number of berths and moorings to support tourism at Mission Beach.

This small number of commercial vessels will have a vested interest in maintaining the natural beauty of the area, which is the basis of their business. Their lease agreements will require them to manage all waste in accordance with the *Transport Operations (Marine Pollution) Act 1995* and its *Transport Operations (Marine Pollution) Regulation 2008*.

Recreational use is currently occurring at Clump Point and, as with any public facility, can be subject to the inconsiderate few who do the wrong thing with respect to waste management. However the proposed development will improve waste management facilities, making it easier for boaties to comply.

36. General topic: Environmental

TMR to address in 'Supplementary Information - Public Information Package report'

Loss of mangrove habitat. Concerns raised about the project removing and damaging this habitat. Links to concerns about mitigation, 'net-benefits' and 'off-sets'

Issues and comments raised in the submission:

How will the project not result in negative impacts to mangrove habitat? Have off-sets been considered?

Response

The PIP addresses loss of mangrove habitat (Executive Summary page iii):

'The proposed works will cause limited permanent loss of the following habitat values:

Mangroves 1,013.5m2 (the increased boat ramp turning area and breakwater access footprint.'

There is further mangrove discussion at PIP section 4.3.4 on page 43:

'The proposed Project will have an impact on a small area containing existing mangrove patches within the footprint of the expanded carpark and roadway covering an area of 1,013.5 m2 (which is 400 m² more than the previous proposal). Impacts on mangroves have been minimised as much as possible, while ensuring the Project design provides safe access to the boat ramp, and vehicle turning space to reduce existing congestion conflicts.'

The detailed design work has resulted in the 400m² referenced above now being reduced to 268m².

Figure 4.9 Mangrove Habitats of the Project Area on page 44 of the PIP shows the areas of mangrove loss.

TMR has gained agency approvals and is required to provide an offset for this mangrove area loss. The Development Approval No. 1711-2484 SDA Condition is:

"Enter into an agreed delivery arrangement to deliver an environmental offset in accordance with the Environmental Offsets Act 2014 to counterbalance the significant residual impacts of the matter/s of state environmental significance being 1013.5m2 of marine plants."

37. General topic: Environmental

TMR to address in 'Supplementary Information - Public Information Package report'

Operation (effects) of breakwater will result in changes to hydrodynamics of area which will cause greater siltation and impacts on marine benthic flora and fauna.

Issues and comments raised in the submission:

- Provide final coastal modelling (in relation to breakwater design) and engineering design information to support (final) project design.
- Provide comment in response to concerns raised.

Response

Appendix F includes the modelling investigation to assess hydrodynamic impacts of the structures and the potential for siltation impacts as a result. These investigations are the basis for the conclusion that the proposed breakwater will not result in significant changes in siltation trends.

38. General topic: Environmental

TMR to address in 'Supplementary Information - Public Information Package report'

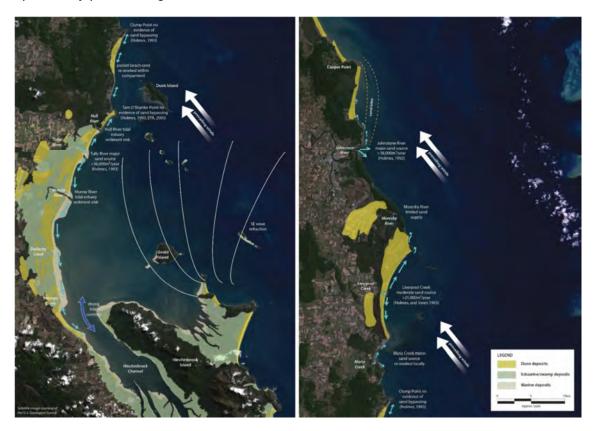
Impacts on beaches – concerns raised that the new breakwater would impact (erosion) on beaches to the north and south.

Issues and comments raised in the submission:

Comment and provide data to demonstrate how project design will/will not impact on sandy beach areas.

Response

Appendix F provides description of coastal processes in the Clump Point area, and specifically provides figure 2.1 below:



This diagram reflects accepted understanding of coastal processes on this section of coastline in which longshore sediment transport along the entire coast is negligible with trapped sand being transported north and south along embayment beaches in response to seasonal wave conditions.

Because of this trend, negligible longshore transport occurs around Clump Point and so the proposed development will not interrupt sand supply to the adjacent beaches. The beach is already located in the lee Clump Point provides from dominant south-easterly trade winds. The detached breakwater does not extend sufficiently far offshore to impact on the wave climate approaching Narragon Beach. The detached breakwater will not therefore influence sediment transport on the beach. The protection provided by Clump Point has resulted in a generally calm-water environment on the shore west of the proposed facility, which supports a shoreline of mangroves. The proposed development will not change these natural features.

39. General topic: Environmental

TMR to address in 'Supplementary Information - Public Information Package report'

Impacts to marine wildlife during construction.

Issues and comments raised in the submission:

How will work be managed in terms of wildlife? Will there be qualified observers and appropriate measures in place?

Response

The Construction Environmental Management Plan (CEMP) for the Project will include environmental best practice for the protection of marine wildlife during construction works and this plan will require approval from GBRMPA prior to the start of any works. However given the construction is in one location and likely to be constructed primarily from land or from a stationary barge, and as outlined in item 31, there is no evidence that the area is a high-use zone for marine megafauna, The potential for significant impacts to marine wildlife is considered to be low. TMR frequently undertakes marine construction works of this nature and has developed strategies to avoid marine wildlife impacts. These strategies will be written into the CEMP for implementation by the contractor.

The construction methodology will determine the critical activities for the use of spotters and application of specific management measures.

40. General topic: Cultural/heritage/social

TMR to address in 'Supplementary Information - Public Information Package report'

Djiru Traditional Owners – 'understand they have not (indicated) support. Where is consultation at?'

Comment made – '...I note some effort has been made to preserve some features of significance to Traditional Owners such as the fish trap but are these people being heard by the right people? I urge GBRMPA to undertake an independent expert review of the process without delay...'.

Issues and comments raised in the submission:

- Are consultations with the Djiru Traditional Owners ongoing?
- What meetings have occurred with Djiru representatives?
- What level of support have they indicated for the project?
- How have the interests and concerns of Djiru Traditional Owners been addressed to ensure cultural and heritage values are maintained?
- Comment on concerns that consultation with the Djiru Traditional Owners is not occurring with the right representatives.

Response

DSD consulted with the Djiru people (the Djiru Warrangburra Aboriginal Corporation) throughout the preparation of the Development Plan and received valuable advice and feedback about emerging information from ongoing studies and design options. The Djiru people were invited to join the Reference Group but preferred to be consulted separately to provide their advice.

Meetings took place with the Djiru board, and others they invited including their legal representative, on 16 August 2016, 18 October 2016, 21 February 2017 and 27 April 2017. All meetings were formally setup through discussions with the Djiru representative and a DSD director. Advice was provided throughout the process to the Project team by the Native Title and Cultural Services section of DSD. Each meeting was attended by about a dozen people. The first two meetings took place at Clump Mountain as requested by the Djiru and information about the Project was presented using A3 booklets. By mutual agreement the subsequent meetings took place at the Castaways Resort so that available information could be projected on a screen.

The independent Reference Group facilitator attended all meetings, and initially the DSD director responsible for the Project, and once the Project was handed over by DSD to TMR the two senior TMR Project team members attended. The meetings were warm, helpful, very productive. The Djiru were appreciative of being kept up to date with the Project studies and outcomes, and provided considerable useful advice. They noted areas of cultural heritage importance, the need to respect both the marine and terrestrial environments at Clump Point, and the need for more employment opportunities for all in the Mission Beach community, including the Djiru.

The Djiru were consulted and kept informed about site investigations and provided monitoring representatives for potentially high impact activities during the geotechnical investigations.

A range of opportunities for the Project to provide benefits to the Djiru were discussed but have not yet been concluded. The next meeting is tentatively scheduled by the Djiru for Saturday 14 April at Mission Beach. GBRMPA will be kept updated with the outcomes of any future discussions.

41. General topic: Cultural/heritage/social

TMR to address in 'Supplementary Information - Public Information Package report'

Significant increase in 'out of town' access by fishers – impacting on and competing for fish stocks

Issues and comments raised in the submission:

Please respond to concerns about how the project may result in significant increase in competition for access to fish stocks for recreational fishing.

Response

TMR had, prior to incorporation into this Project, already allocated funds for an upgrade to the Clump Point boat ramp from two to three lanes, based on demand forecast assessment of recreational vessel ownership in the area.

This Project is delivering that response to the existing local need. There will be some increased non-local use of the upgraded facility (extending to the whole Cassowary Coast local government area), but the dominant user group is expected to be local Mission Beach residents.

The Project does not provide a significant expansion of boating access capacity that would impact on fish stocks.

42. General topic: Cultural/heritage/social

TMR to address in 'Supplementary Information - Public Information Package report'

Aesthetic impacts. Many comments on the extent to which the breakwater (and associated boating infrastructure) will impact on the current aesthetic values of Boat Bay and many comments linked this more broadly to the current Mission Beach 'village lifestyle'. For example, '....will kill our 'village scene' that we have fought to preserve for many years'. Concerns also raised about impacts to current scenic views from adjacent vantage points such as Narragon Beach.

Issues and comments raised in the submission:

- How will the final design minimise impacts on local aesthetic values and not significantly change what is perceived as the current low-key coastal development in the area?
- Provide comment on how amenity values may be impacted by increased vessel use and permanently moored vessels.
- Provide clearer labelling of RL levels on drawings.

Response

The PIP notes on FAQ's page vii:

(11) How will the new breakwater impact on visual amenity?

The new breakwater is of a detached design on the same alignment as the existing breakwater at Clump Point. The Reference Group consultation process identified the small scale of marine development needed now and into the future to meet the requirements of the Mission Beach community. The design was developed to provide a facility with the smallest environmental, cultural and visual impact while meeting functional objectives. The breakwater and infrastructure behind have been designed to minimise the height, width and length of the breakwater required to meet its operational objectives

Artists impressions in Section 6-2 (the figure from the PIP is reproduced in **Appendix J**) shows a visualisation of the developed scenario comparative to the existing facility, showing the visual amenity impacts of the Project from the perspective of the existing Clump Point carpark and the Perry Harvey jetty which are the two public access points where the facility is most visible. There is already a breakwater and marine facility at Clump Point and this upgrade from a visual perspective is a significant but not unsightly extension of the existing structure from both viewing locations. The design process, which has included considerable refinement, has kept the new breakwater crest as low as possible and for this reason the structure does not interrupt views from the lower carpark and the proposed access jetty.

The artist's impressions (**Appendix J**) include the design vessel and other vessels occupying the pen berths and moorings to clearly show the visual amenity impacts.

The southern end of Narragon Beach, as the closest viewing point to the development, is for all intents and purposes the same outlook as the view from the end of Perry Harvey jetty depicted in **Appendix J**.

An assessment of visual amenity is highly subjective, however GBRMPA's Site Management Arrangements of 2005 currently indicates 15 vessel moorings within the bay. The current boat ramp, floating walkway and breakwater are existing visual features of Clump Point. On the basis of these existing uses, and hence visual features, the proposed development does not significantly further impact on visual amenity values.

The Project cross-section drawings in the PIP clearly define the RL levels, **Appendix K** is included with a redraft of the Project cross-sections with the tidal planes at the same scale as the cross-sections for reference.

43. General topic: Construction

TMR to address in 'Supplementary Information - Public Information Package report'

Concerns about marine access during construction. How will TMR allow for ongoing marine access during the 6-9 months of construction?

Issues and comments raised in the submission:

What are the full range of options for recreational and commercial operators during periods of closure (or limited access) at Clump Point?

Response

The PIP notes on FAQ's page vi:

(7) What impacts will construction have on use of the boat ramp?

During the construction phase, it will be necessary to close the Clump Point facility, including the boat ramp and parking areas completely from recreational use. Access to a single boat ramp lane will be provided whenever possible for essential commercial use but this is subject to the outcomes of the construction tender process, after which a detailed schedule of works and methodology for managing access will be provided.

It is TMR's intent to minimise the impact on ramp access to recreational and commercial users as much as possible in planning the project, but because of the spatial constraints of the site periods of closure are unavoidable. The duration of the works will be subject to the contractor's methodology and the timing of approvals given seasonal constraints on working windows, but the works are expected to take in the order of 9 months to complete. Notification of closure periods and advice on alternative ramp access arrangements will be provided to the community as soon as the timing of works are known.

Opportunities for improved access will be determined once the accepted construction approach has been selected and a construction contract drawn up. The work site will be under contractor control for the period of works.

North of Clump Point the nearest boat launching facilities are (in order of distance north):

- Maria Creek (sheltered)
- Kurrimine Beach (open beach ramp)
- Cowley Beach (open beach ramp)
- Mourilyan Harbour (sheltered all-tide ramp, with floating walkway)
- Fitzgerald Esplanade in Innisfail town (sheltered boat ramp in Johnstone River)

- Coconut Point, north bank of Johnstone River (sheltered, with floating walkway)
- Flying Fish Point (north bank of Johnstone River (partly sheltered)).

South of Clump Point the nearest boat launching facilities are (in order of distance south):

- South Mission Beach (open beach ramp)
- Jacky Jacky Street, South Mission Beach (sheltered creek ramp)
- Carmoo (sheltered creek ramp)
- Hull Heads, south bank of Hull River (sheltered)
- Tully Heads (sheltered creek ramp)
- Meunga Creek, north Cardwell (sheltered creek ramp)
- Sheridan Street, Cardwell (open beach ramp)
- Port Hinchinbrook (sheltered, with floating walkway)
- Fishers Creek (sheltered creek ramp)
- Dungeness, Lucinda (sheltered near all-tide ramp, with floating walkway)

44. General topic: Construction

TMR to address in 'Supplementary Information - Public Information Package report'

Disturbance to both terrestrial and the marine benthic soils will no doubt lead to further sediment and nutrient build up, which, among other disasters, is the precursor to further Crown of Thorns Starfish outbreaks....' Concern about construction impacts leading to COTS outbreak

Issues and comments raised in the submission:

Comment – how will nutrient/water quality issues be managed?

Response

The Construction Environmental Management Plan (CEMP) prepared for the Project identifies a management regime that aims to achieve the following performance criteria:

- Water Quality Objectives (WQOs) for Boat Bay and open coastal waters are met throughout the construction process.
- Erosion and sediment control installations remain fit-for-purpose throughout the construction phase.
- No collapse or evidence of significant erosion from stockpiles.
- No generation of visual turbid plumes >10m from works area.

TMR has committed to establishing a pre-construction water quality baseline to update these performance criteria if necessary.

Achievement of these performance criteria will be subject to strict controls on stormwater runoff, erosion, turbidity generated from placed rock and reclamation, and spills, including the use of bunding and silt curtains where needed during construction. All material being brought to the site will be certified as clean fill prior to placement. Works will be continually monitored to ensure effectiveness of controls and immediately address any uncontrolled discharges of sediment into the marine environment.

Impacts from the construction works on the marine environment will not extend beyond the immediate vicinity of the Project.

45. General topic: Construction

TMR to address in 'Supplementary Information - Public Information Package report'

Concerns raised about the (potential) 2000m³ of dredging (upper intertidal areas) for road reclamation. Comments note that this information was not in PIP but found following access to submissions made in relation to *State Planning Act* approvals.

Issues and comments raised in the submission:

 Comment. Provide further final design (engineering) and construction details on how reclamation works will be undertaken including any need to remove unsuitable benthic material.

Please provide an additional concept plan showing a translucent / clear footprint of works over existing satellite image (in high resolution).

Response

TMR's application under the *Planning Act 2016 (Qld)* for an Environmental Authority to remove up to 2000cu.m of sediment under the western reclamation area is mentioned on page 21, figure 3-3 of the Public Information Package. The bottom cross-section on the left in the figure indicates "remove unsuitable material".

The geotechnical investigations showed that there is a layer of soft material under the western part of the reclamation. This material needs to be closely managed in design.

TMR had two design options:

Option 1: Remove the unsuitable material off site and reclaim on sound material. On this basis TMR applied for an environmental authority (under the *Environmental Protection Act 1994*) to undertake this for up to 2000cu.m. Early estimates indicate volumes would be less than half this but, given the uncertainty with depths, TMR applied for 2000cu.m. In the event this was to occur the Construction Environmental Management Plan (CEMP) would outline measures required to avoid water quality impacts.

Option 2: Design the revetment to ensure the soft material is contained and settlement will be avoided.

The detailed design has shown that Option 2 is achievable and this is the approach TMR proposes to implement. TMR no longer proposes to remove material from site for the purposes of the reclamation design.

46. General topic: Future management

TMR to address in 'Supplementary Information - Public Information Package report'

Concern about lack of responsibility for future management and clean-up and repair following future major weather events. Concerns raised about site being 'high cyclone' area. It may '...become another environmental eyesore in near future'. 'The floating ramps from the boat-ramp are still in the mangroves from the last cyclone...'.

Issues and comments raised in the submission:

- How is it demonstrated that the final design will withstand all predictable weather conditions?
- Who will be responsible for repairs, clean-up and any required re-building following a cyclone?
- Who is (was) responsible for the (apparent) ramp structures still in the adjacent mangroves?

Response

Item 22 outlines how the facility has been designed to withstand predictable weather conditions in accordance with Australian Standards.

While regular maintenance of in-water infrastructure is the responsibility of CCRC as appointed facility manager, storm damage invokes an insurance claim. Claims can only be lodged by the owner. Therefore TMR, as owner, will be responsible for lodging any claim on the Queensland Government Insurance Fund (QGIF) and arranging repairs to damaged inwater infrastructure. TMR is covered by QGIF for all its boating infrastructure assets.

Clean-up costs directly associated with any insurance claim will be part of the claim.

Clean-up not directly associated with structural damage repair will be arranged and funded by CCRC as appointed facility manager.

Should the boat ramp immediate approaches require sediment removal round the toe of the ramp after a storm, TMR will fund the costs. This is because seabeds, and damage to them, are not insurable.

On Project completion, TMR will become owner of both new floating walkways.

The existing and previous floating walkways on the ramp are CCRC-owned.

TMR and CCRC will investigate incorporating as part of the Project removal of any stray floating walkway modules in nearby mangroves, if this can be achieved without significant environmental impacts.

47. General topic: Future management

TMR to address in 'Supplementary Information - Public Information Package report'

Commercial barge ramp'. A number of submissions raised concerns about the proposed (and potential future) use of the heavier duty (barge) ramp. Other points raised included whether there is enough turning room for trucks and the risk of hazardous materials and rubbish being mishandled. Points were also made about how it was possible/likely post-cyclone that the ramp would not be accessible for emergency response because the road would be washed out.

Issues and comments raised in the submission:

- Clarify if the facility is intended to be used as a barge landing area? If so how will access to the ramps be managed for barge access?
- What are the proposed conditions under which the ramps can be used for private (commercial) barge access?

Response

The additional boat ramp lane at Clump Point is needed to meet projected recreational demand, and was planned by TMR prior to and independent of this Project.

The ramp and associated infrastructure is not being designed for frequent barge use. Breasting piles normally seen at barge ramps have not been included in the design. The floating walkways are not being modified to allow for any regular barge usage. Depths in the approaches to the boat ramp will be such that any infrequent barge use will be restricted to higher tides.

The lower (northern) car-park is not being designed for regular barge access. For instance, there is no waiting lane for vehicles. The turning area will be adequate for occasional truck use – including, for instance, fuel truck/trailer access to the jetty.

The ramp design is to barge load rating to protect it from damage caused by once-off or occasional barge use.

The PIP at 'Frequently asked Questions' in the Executive Summary (page v) stated:

'Why does the Project propose a barge-accessible boat ramp lane?

A third boat ramp lane has been proposed as part of the current project and was included in the designs for the 2015 Department of State Development (DSD) tender. It is not the intention for this ramp lane to be frequently used for barges. However, the western ramp lane is being designed as a heavy-duty ramp to enable infrequent barge access. In particular, the ramp lane will allow for emergency supplies to be barged to or from Mission Beach during recovery from cyclone events when road access cannot be relied on. In addition, the wider 6m lane will make it easier to launch and recover larger trailerable vessels. From TMR experience as an asset owner, if there is any chance a ramp will be used for barge access it is sensible to design it for these loads and avoid high repair costs that could result from damage that can occur from a single use by a barge

Any barge access will be subject to strict conditions issued as part of a commercial access permit by the facility manager (CCRC). Commercial barge operations will also require a joint state/Commonwealth Marine Park permit.'

Need for barge access occurred following Cyclone Larry in 2006 to assist with cyclone recovery and to get bananas to market.

As facility manager, CCRC will be obliged to consider any request for commercial use of the facility (pontoons, boat ramp, floating walkways, pen berths), including use by any barge of the additional boat ramp lane. CCRC is required to get TMR's consent (with conditions) for any commercial use of any part of the proposed facility. These requirements allow for strict permit conditions to be applied by either CCRC or TMR, or for an application to be rejected.

Any and each application for commercial use will be considered by CCRC and TMR on its merits, taking all issues into account.

48. General topic: Future management

TMR to address in 'Supplementary Information - Public Information Package report'

'...proposed facility would be invaluable to us as it would allow us to unload product directly from the smaller East Coast trawlers & Trout boats that work in the area..' Linked to concerns about separation of commercial and recreational uses.

Issues and comments raised in the submission:

- Is it intended to include opportunity for commercial fishers to load/unload product and equipment from the jetty/pontoons?
- How will this be managed to limit impacts between user groups?

Response

Commercial use of berthing facilities will require a permit from CCRC (with agreement and conditions from TMR). On this basis any permit will be issued based on the need for the Operational Management Plan requirements to be met. This document will include one clear intent (among many): minimising conflict between users.

The facility is not currently designed for vehicle access by commercial operators to pen berths, as jetty width is subject to available budget. The currently 'essential' vehicle access on the inner half of the jetty is to facilitate safe refuelling operations.

The current intent is that the supply to or unloading of commercial vessels will be undertaken via trolley access to allow concurrent use of the full length of the jetty by all users.

49. General topic: Future management

TMR to address in 'Supplementary Information - Public Information Package report'

Future need for dredging. Concerns raised that dredging will be required in particular near the boat-ramp. '....the current boat-ramps dry on low tides, adding an additional ramp to the west will be of little use unless dredged'.

Issues and comments raised in the submission:

Comment on any proposed dredging (applied for) and potential for future needs in this area.

Response

The existing boat ramp at Clump Point has a tidal works approval granted in 1999, which includes maintenance of an approved shallow basin for access to the boat ramp. The facility was originally designed to be three lanes in total with allowance being made for a future third lane in the original design and approvals application.

TMR intends to maintain the boat ramp access, via occasional removal of sediment and disposal to land (as required, anticipated to be infrequently). The expansion to three lanes would have been completed much earlier, however TMR has been waiting on the DSD capital works Project so works can be done while equipment is mobilised to site, providing significant cost savings.

Since 1999 approximately 650cu.m of sedimentation has occurred in this area and TMR removed approximately 250cu.m in 2015 to improve navigational access near the boat ramp. These works were undertaken with the basin fully contained by a silt curtain and under a detailed CEMP approved by GBRMPA to avoid water quality impacts. The same will continue to be applied for future boat ramp toe maintenance of seabed.

TMR currently has a permit application with GBRMPA to continue this boat ramp toe maintenance activity. This type of maintenance activity is common throughout the state and is not markedly different to the clearing of stormwater outlets by local governments.

With respect to ongoing need for maintenance in this area, anecdotal evidence is that the majority of the siltation since 1999 occurred as a result of the major cyclones. Some locals have also suggested that erosion from Clump Point Road was a source, however this has not been verified. In any case, the carparks will be sealed as part of the Project, and drainage managed as described above at items 5, 30, 34, and 44.

TMR's modelling as part of the upgrade Project indicates that removal of the existing breakwater return is expected to reduce siltation in the basin area. The road and carpark upgrade, with a stormwater management approach to disperse flows and the sealing of the road surface, will also greatly reduce further erosion potential.

The Project team expects that the upgrade Project will reduce the already small maintenance need of this boat ramp basin area. However, because of its location in the intertidal zone there will be a need for future maintenance subject to major weather events.

50. General topic: Future management

TMR to address in 'Supplementary Information - Public Information Package report'

Re-fuelling - costs to small operators. Concerns raised about how these costs (to support this activity) may be passed on to small operators.

Issues and comments raised in the submission:

How will proposed re-fuelling activities occur and be managed? Who will be responsible for managing this? Who will bear the ongoing operational costs of this activity?

Response

The proposed refuelling arrangement and management measures are detailed in response to items 2 and 19.

The facility is being designed to accommodate refuelling by a mobile rigid tanker, or truck/ fuel trailer from the inner jetty or pontoon berth. The fuel supplier will need to hold a permit from CCRC as facility manager to undertake fuelling activities in accordance with the Operational Management Plan so as to meet best practice and ensure safety as well as environmental protection. No fixed fuelling infrastructure is proposed with the exception of firefighting equipment.

The firefighting equipment and jetty design elements (such as the bunded area) will be provided by TMR as the asset owner and maintained by CCRC as facility manager, to ensure refuelling can be undertaken ensuring the safety of the community and the marine environment. Any structural repairs identified by CCRC will be subject to refund of costs to CCRC.

Fuelling will be a user pays system. If you want to fuel a vessel you will pay a permitted supplier for the service.

51. General topic: Future management

TMR to address in 'Supplementary Information - Public Information Package report'

Re-fuelling. 'This is available at Perry Harvey jetty.'

Issues and comments raised in the submission:

Comment on justification for providing here (at new facility).

Response

Refuelling is also addressed in responses to items 2, 19 and 50. Perry Harvey jetty has shallow-draught depths and is exposed to a wave climate that significantly increases the potential for spills and associated impacts to the marine environment.

Because the proposed Project will provide a calm water berth in most conditions, it will provide the most appropriate location for safer refuelling activities.

52. General topic: Future management

TMR to address in 'Supplementary Information - Public Information Package report'

Public access to moorings and berths. 'The major problem with the breakwater is that its benefits are solely for the few commercial operators at Mission Beach, with the recreational boating community excluded from using the moorings or berths'.

Issues and comments raised in the submission:

Provide comment including on how the pen berths and moorings will be allocated and the terms of any such leases (including fees)

Response

The proposed development is not a marina for recreational vessel mooring or berthing and, given the level of cyclone protection provided, it is not suitable for long term unattended vessel storage. The facility will provide improved boating facilities for commercial and recreational users. Only a small number of overnight berths and moorings are being provided, specifically for vessels that contribute significant economic benefit to the Mission Beach community through employment and increased sustainable economic activity.

The allocation of pen berths and swing moorings will be via a formal process run by CCRC as facility manager with assistance from TMR. Details of the intended users of the moorings and berths is described in the response to item 18.

The terms of the commercial leases have not yet been developed. However a primary element will be that the users will need to operate in strict accordance with the Operational Management Plan to meet the functional and environmental objectives of the development. The lease terms and fees applied will be subject to CCRC consideration (with TMR input) after comparison with fees charged elsewhere in far north Queensland.

Specific benefits to recreational users include:

- Recreational users will have have two floating walkways on the boat ramp. These
 floating walkways will no longer be subject to sharing with commercial vessel passenger
 embarkation and disembarkation. Passenger activities will be at the larger gangwayaccess pontoon(s). Commercial trailer vessels will use the floating walkways only for
 launch and retrieval operations.
- The proposed inner pontoon berth will include a public berthing side dedicated for recreational use.
- The detached breakwater provides a protected lee for recreational vessels to shelter prior to accessing the ramp in busy periods.
- It is intended that casual use of one or more swing moorings will be available for recreational use – targeted chiefly at overnight use by recreational deep-draught boats on coastal passage.

53. General topic: Future management

TMR to address in 'Supplementary Information - Public Information Package report'

Design includes two new user groups (barges, yachts) – 'both of which are incompatible with recreational users'

Issues and comments raised in the submission:

How will new user groups (yacht operators - permanently moored) and commercial barges be managed to minimise conflict?

Response

Barge access has been dealt with above in the response to item 47.

Yachts will be able to access the outer pontoon and, for shallower draught yachts, the inner pontoon.

No particular conflict is envisaged associated with yachts. Yachts have the same right of access as other vessels to any TMR-owned public pontoon or jetty in Queensland.

Potential navigational conflict has been addressed above in the response to item 20.

54. General topic: Future management

TMR to address in 'Supplementary Information - Public Information Package report'

Safe Harbour – comments on how the design does not present 'safe harbour' in cyclonic (or even strong wind) conditions. Some submissions claimed this was a 'repeated aim' of the project ('...conveniently overlooking the existence of Mourilyan Harbour and Port Hinchinbrook...') i.e. they believe it was promoted as a 'safe-harbour' (even though the PIP says it is not) and necessary when in fact other alternatives existed.

Concerns that vessels will get 'trapped' (behind the breakwater) prior to cyclonic weather and eventually be destroyed creating more damage/waste within the adjacent mangroves etc.

Issues and comments raised in the submission:

- On what basis was the decision made not to pursue a 'safe-harbour' option?
- Explain management arrangements (including role of relevant government agencies) in event of forecast cyclonic weather event. How can it be ensured vessels won't get 'trapped' i.e. not have time to go to other locations (pre-cyclone) and end up being destroyed (because facility is not designed to be a 'safe-harbour')?

Response

From a TMR perspective the use of the word "safe" to describe anything in the coastal zone is not appropriate, because 'safe' implies certainty.

To give this some context, the reason for the Bureau of Meteorology having only five levels of classification for tropical cyclones is because a Category 5 cyclone presents a level of intensity that will likely destroy most built environments and hence removes the need for further classification levels.

On this basis, coastal developments are built to provide a specific level of protection. In this circumstance the scale and robustness of the Project infrastructure is controlled by the following factors:

- The Reference Group advised the Project team on the scope of the Project required and this scope has been taken forward.
- The environmental and cultural values of the area mean there is no scope to provide more land-based infrastructure to support a larger marine development. The terrestrial impacts associated with a larger development are not justified.
- The finite Project budget cannot accommodate a bigger Project scope. To provide a boat harbour level of protection from cyclones, this development would require hundreds of metres of breakwaters (with walls 3m higher than the one proposed for the Project detached breakwater) to enclose the Bay at a cost more than five times the allocated budget.

The Project will provide an expanded lee and improve the safety of marine facilities for commercial and recreational users at a scale that suits the community need, the site characteristics, and the available budget.

The current marine facilities at Mission Beach include no calm water commercial-only berthing (for the safe transfer of passengers) and no calm water overnight moorings or berths to provide commercial operators with piece of mind for the day to day operation of a business, or for leaving their vessels unattended overnight.

The proposed development has been carefully designed to provide a world class standard Disability Discrimination Act (DDA) accessible pontoon berth and a small number of pen berths in the lee of a breakwater that will provide effective "calm water" under most operational conditions (in accordance with AS3962-2001) for a one year ARI event (that is, for a storm condition that statistically occurs once a year). In weather conditions stronger than this, the structure will still provide protection for vessel mooring and berthing but wave conditions will exceed "calm water".

TMR's design consultant undertook detailed investigations to define the event size based on wind speeds in which evacuation of the facility is recommended. The facility's Operational Management Plan will detail these in the evacuation strategy. The commercial berths and moorings are designed for users who hold a permit or lease from CCRC. These permit or lease arrangements will be conditional on them operating in accordance with the Operational Management Plan and hence the evacuation strategy. In addition, signage will be provided at the site to ensure all users are aware of the limitations of the facility and that the facility is not a cyclone shelter.

Ultimately the vessel master or owner is responsible for their vessel and safety of their crew and passengers under the *Transport Operations (Marine Safety) Act 1995* and its *Transport Operations (Marine Safety) Regulation 2016.* All commercial vessel masters who operate in north Queensland have a cyclone shelter strategy as part of their commercial 'survey certificate'. Typically, a significant period of lead time (24 hours+) is available for evacuations to occur before winds associated with a cyclone preclude such measures. This activity is part of life for vessels operating in North Queensland. For the Mission Beach coast, aside from the Hull and Tully Rivers, the nearest cyclone shelters are in Mourilyan Harbour to the north and Hinchinbrook Channel to the south. Vessels will, when a cyclone threatens, need to make a timely departure from the Clump Point facility to their selected sheltered anchorage.

The Project design strategy is to build infrastructure that has an acceptably small environmental footprint and is designed to survive extreme cyclone conditions with minimal damage allowing use of the facility as soon as possible after cyclones.

55. General topic: Future management

TMR to address in 'Supplementary Information - Public Information Package report'

Emergency services responding to a call for help should not be tide dependant. The provision of a pen berth for Coast Guard or intermittent Marine Park and Water Police use, eliminates this issue. Emergency Services – will there be a permanent berth for this?

Issues and comments raised in the submission:

Comment on the Projects proposed capacity and future management for a permanent or semi-permanent berth (or access) for Emergency Services vessels.

Response

The local Australian Volunteer Coastguard was consulted by Reference Group members and the feedback was that their current vessel needed to be stored on shore in a shed protected from vandalism and weather. On this basis, a request was made to include a storage shed into the facility design scope.

In the concept development process, the Project team concluded that insufficient space was available at Clump Point for the requested shed and reclamation of a dedicated area could not be justified on the basis of both environmental impact and cost. Hence Reference Group and the Project team concluded that a Coastguard storage shed would need to be offsite and was therefore outside the scope of this Project. Such a shed could be located close to the Project but not on Clump Point.

However in the event Coastguard, QPWS or Water Police wish to apply for a berth, they may have a clear justification for being granted one on the basis of their contribution to the Mission Beach community and economy. However CCRC as the facility manager, will make final decisions based on their formal berth and mooring allocation process.

Attachments

Appendix A – Reference Group Concept Design Layout

Appendix B - Final Design Layout

Appendix C – Refuelling Layout plan

Appendix D - Preliminary Breakwater Design

Appendix E – Concept Design Modelling Investigation

Appendix F – Final Design Modelling Investigation

Appendix G – tech Note - North Easterly wave impact on siltation

Appendix H – Proposed Mooring layout and navigation features

Appendix I - Design wave and storm tide assessment

Appendix J – Visual Amenity images

Appendix K – Updated cross-section images

Link to Clump Point Site Management Arrangements:

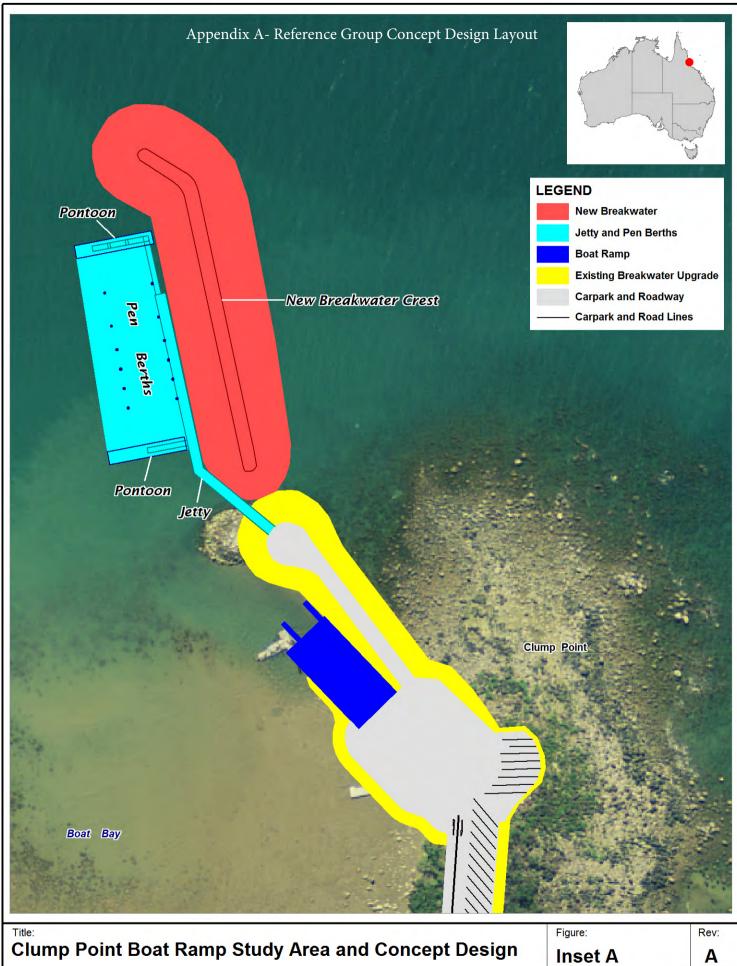
http://www.gbrmpa.gov.au/ data/assets/pdf file/0007/3877/gbrmpa ClumpPointSiteManagementArrangements 2005.pdf

Link to Clump Point Activities Map:

http://www.gbrmpa.gov.au/ data/assets/pdf file/0004/8959/clump point locality map.pdf

Link to Long Term Sustainability Plan 2050: http://www.environment.gov.au/marine/gbr/long-term-sustainability-plan

Note: The 'project' (referenced in table) means all parts of the boating facility upgrade described in the PIP.



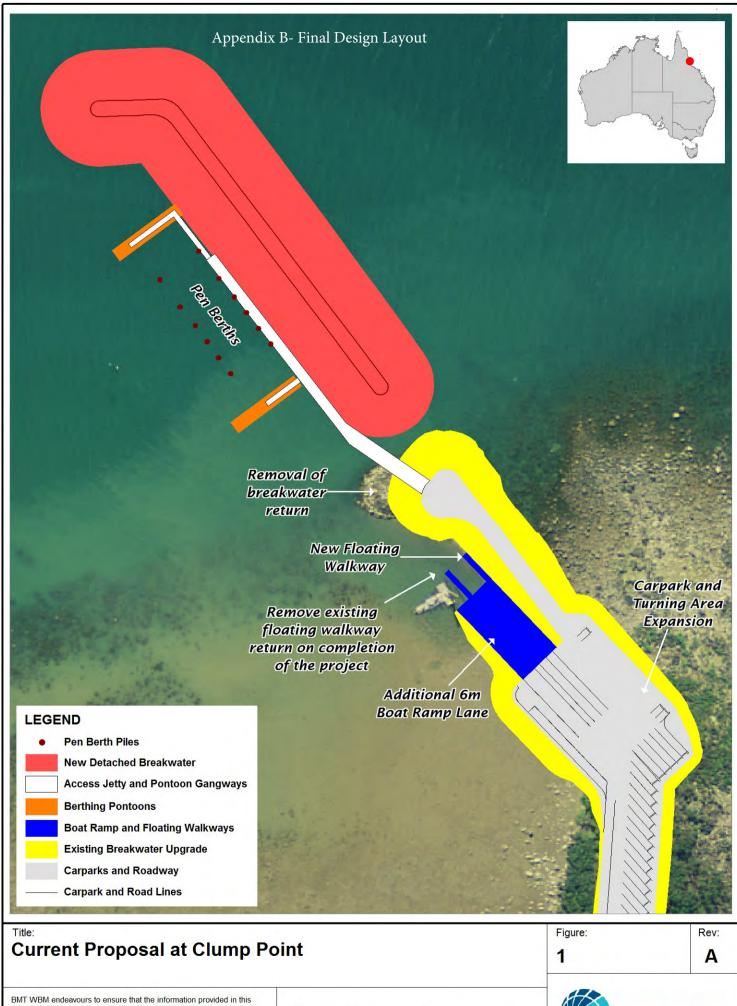
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Filepath: I:\B22205_I_JLB Clump Point Development Plan SH\DRG\ECO_022_170201_Concept Design Inset A.wor

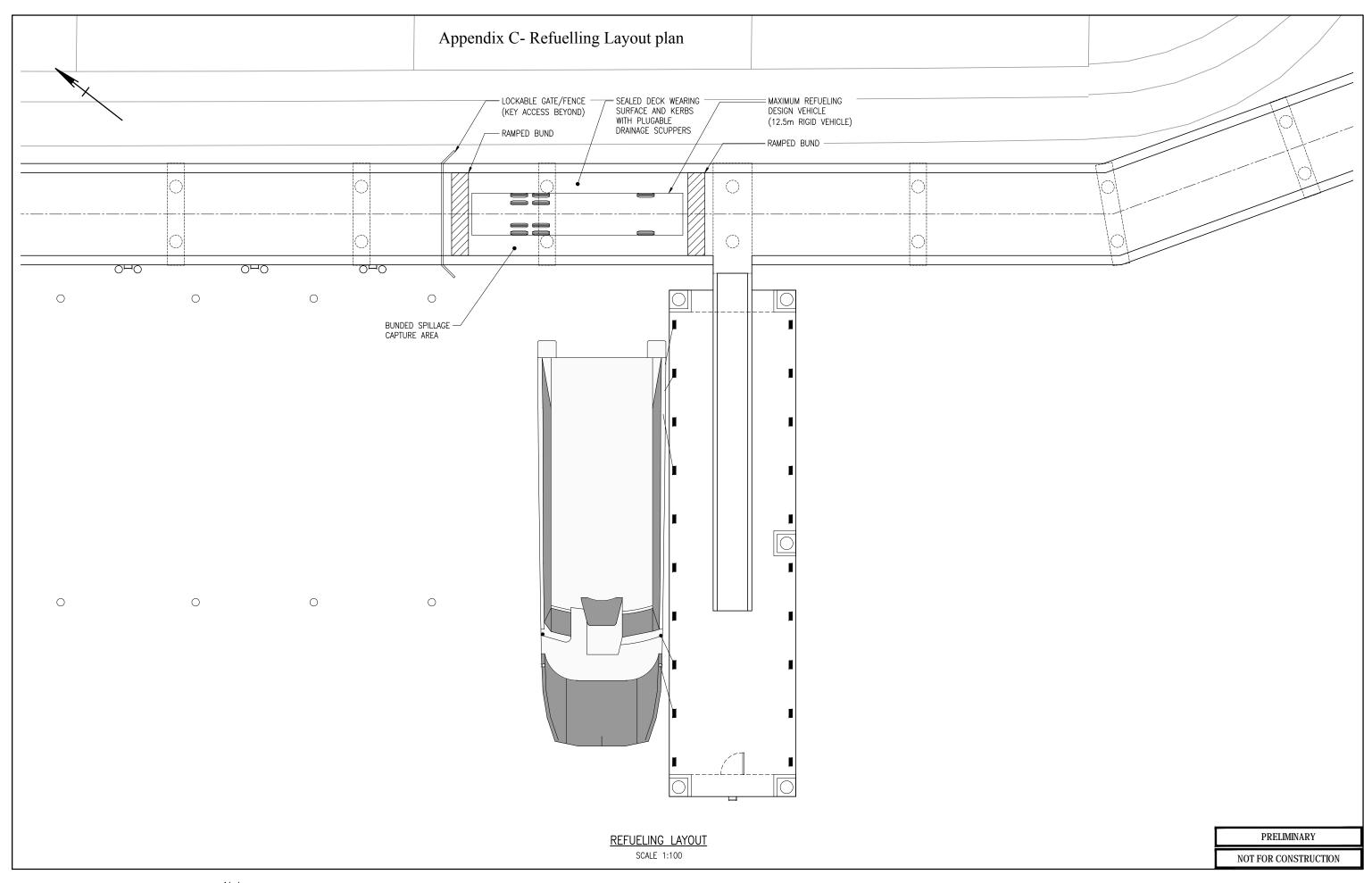


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Filepath: I:\B22856_I_JLB Clump Point State Approvals JDV\DRG\ECO_012_171025_Current Proposal at Clump Point.wor





<u>Notes:</u>

1. BUNDED SPILLAGE CAPTURE AREA VOLUMETRIC CAPACITY IS MIN. 2000I IN ACCORDANCE WITH AS1940:2017, SECTION 8.2.6.2 (b) (MAX. 2 MINUTE SPILL VOLUME).

2. BUNDS ARE RAMPED TO PROVIDE DDA COMPLIANT ACCESS.
3. BUND TRIP HAZARD LINEMARKING TO BE PROVIDED FOR PEDESTRIAN ACCESS (AS REQUIRED).



CLUMP POINT BOATING INFRASTRUCTURE REFUELING LAYOUT

Appendix D- Preliminary Breakwater Design

6 Detached breakwater

6.1 DESIGN STUDIES

Following KBR's concept design review, the performance of the updated concept design for the Detached Breakwater was assessed via physical model testing and numerical wave disturbance modelling. These assessments are each briefly discussed in the following sub-sections.

Physical model testing

Concept physical model testing was undertaken to confirm an effective cross-section design for the detached breakwater, including assessment of overall stability under wave attack, together with transmitted wave energy (both as overtopping and transmission through the breakwater). Concept model testing was undertaken at the Water Research Laboratory (WRL), and comprised flume testing at 1:20 non-distorted scale. The model cross-section is shown in Figure 6.1.



Figure 6.1 Concept physical model testing - Model cross-section (Test sequence A4)

The model setup, wave calibration, and testing results for the concept model testing are summarised in WRL's memo Results for Clump Point Boating Infrastructure Preliminary Testing (Test Series A & B & C) (Ref. WRL20171010_FF – 10 October 2017) which is provided as Appendix F.

Wave disturbance modelling

Numerical wave disturbance modelling was undertaken by BMT WBM to assess operational conditions in the lee of the detached breakwater (and at the boat ramps), to assess conformance with the Project Brief requirements for 'Good' conditions per AS 3962-2001. Preliminary assessment of extreme conditions was also completed in order to inform design wave conditions at the jetty and pontoon structures.

Key results of the completed assessment are provided in spatial results figures in Section 6.3.



6.2 CROSS-SECTION DESIGN

The general cross-section design of the detached breakwater is comprised of two layers of primary armour rock, a filter layer, followed by a coarse 'quarry run' core, plus rock armour toe protection as generally depicted in Figure 6.2.

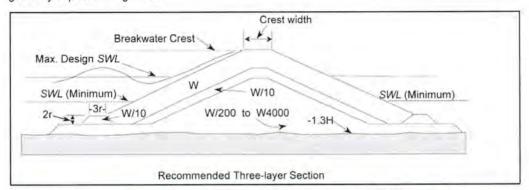


Figure 6.2 Typical rubble-mound breakwater cross-section (Source: CEM 2008, Fig. VI-5-55)

The seaward and leeward slopes have both been set at 1:1.75 in place of the earlier concept design slopes of 1:2 (seaward) and 1:1.5 (leeward), in order to slightly improve stability on the leeward crest and slope.

Armour stability

Armour stability was assessed as part of the concept physical model testing. The subsequent nominated armour design is summarised in Table 6.1.

Table 6.1 Preliminary Armour Grading Specification - Detached Breakwater

Description	Material Class	Material Specification - EN 13383-1	Target M ₅₀ Mass
Primary Armour	Class I	HMA3000/6000 - 3.0-6.0 t	4.5 t
Secondary/Toe Armour	Class III	HMA _{1000/3000} - 1.0–3.0 t	2.0 t
Filter	Class IV	HMA _{300/1000} - 300-1000 kg	600 kg
Core	Class VI	LMA 5/40 - (Coarse Quarry Run)	10–20 kg

6.3 WAVE DISTURBANCE

The wave disturbance results from the numerical modelling and physical model testing are summarised in the following sections for operational and extreme conditions.

6.3.1 Operational conditions

The results of the numerical model simulations for the two tested operational (1 year ARI) conditions are provided as spatial figures of significant wave heights in Figure 6.3 and Figure 6.4 for the north-east and south-east conditions respectively. The figures include the general marine infrastructure layout, together with contours for significant wave heights of 0.3, 0.375 and 0.5 m.

In addition to the spatial results figures, the design wave climate for the northern and southern berthing pontoons, derived from both the numerical and physical model test results, are provided in Table 6.2.



Table 6.2 Provisional pontoon design wave climate - Operational conditions

Design Event Info			Trans	mitted/Ov	ng Waves	Diffracted Waves					
Event ARI (Years)	WL (mAHD)	Offshore H _s (m)	H _s (m)	H _{max} (m)	T _p (s)	Mean Wave Dir. (deg)	H _s (m)	H _{max} (m)	T _p (s)	Mean Wave Dir. NP (deg)	Mean Wave Dir. SP (deg)
1	1.34	1.5	0.1	0.2	9.0	35–60	0.3	0.6	6.7	350-10	90-45

The presented results indicate the following:

- The detached breakwater achieves the requirement for 'Good' conditions at the pontoon and pen berth locations under south-east conditions, and 'Moderate' conditions for the north-east conditions.
- There is a small amount of wave transmission through the breakwater under operational conditions –
 this is due to the low crest level and very high permeability of the filter and armour layers. The
 transmitted waves exhibit a longer peak wave period than the incident waves.
- Under north-easterly wind/wave conditions, vessels should use the southern sides of both pontoon berths, and the reverse for south-easterly conditions.
- Under north-easterly conditions, only a limited area in the lee of the breakwater will be suitable for swing moorings. Under south-easterly conditions, a much larger area could be utilised.
- · 'Good' conditions are generally achieved at the boat ramp.

6.3.2 Extreme conditions

The results of the numerical model simulations for the 50 year ARI design conditions are provided as spatial figures of significant wave heights in Figure 6.5 and Figure 6.6 for the north-east and south-east conditions respectively. The figures include the general marine infrastructure layout, together with contours for significant wave heights of 0.6, 0.75, and 1.0 m. It is noted that these figures represent diffracted waves only in the lee of the structure, and do not include the effects of overtopping and wave transmission (which are significant for this design event).

In addition to the spatial results figures, the design wave climate for the northern and southern berthing pontoons, derived from both the numerical and physical model test results, are provided in Table 6.3.

Table 6.3 Provisional pontoon design wave climate – Extreme conditions

Design E	vent Info	Transmitted/Ov				ing Waves		Diffracted Waves			
Event ARI (Years)	WL (mAHD)	Offshore H _s (m)	Hs (m)	H _{max} (m)	T _p (s)	Mean Wave Dir. (deg)	H _s (m)	H _{max} (m)	T _p (s)	Mean Wave Dir. NP (deg)	Mean Wave Dir. SP (deg)
50	2.55	2.8	0.6	1.6	17.0	35–60	0.7	1.1	8.2	350-10	90-45
200	2.67	3.3	1.0	2.4	20.0	35-60	0.8	1.2	8.6	350-10	90-45



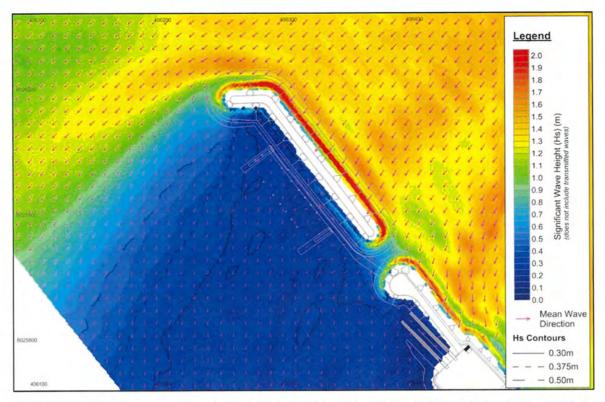


Figure 6.3 Developed Case Wave Heights – 1 Year ARI – NE Conditions (Diffracted Waves Only – Does not include Transmitted Waves))

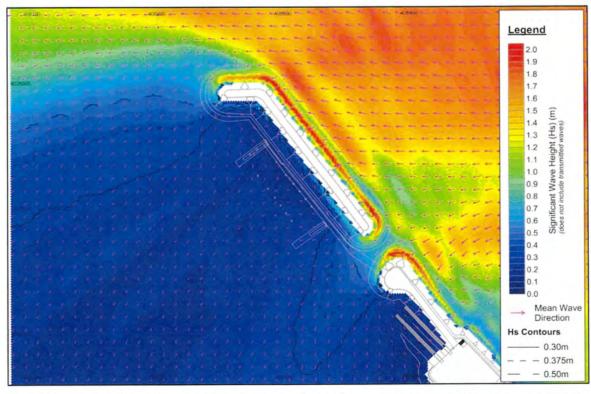


Figure 6.4 Developed Case Wave Heights – 1 Year ARI – SE Conditions (Diffracted Waves Only – Does not include Transmitted Waves))

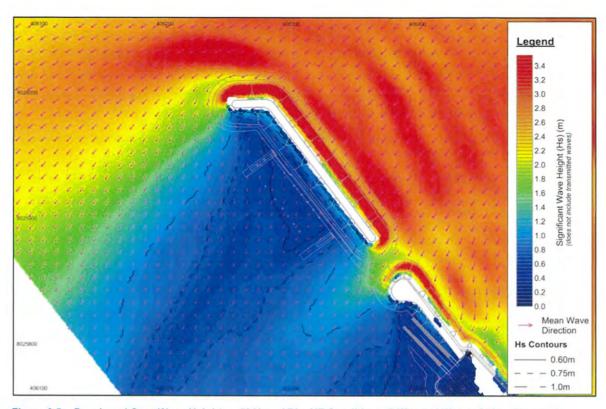


Figure 6.5 Developed Case Wave Heights – 50 Year ARI – NE Conditions (Diffracted Waves Only – Does not include Transmitted Waves)

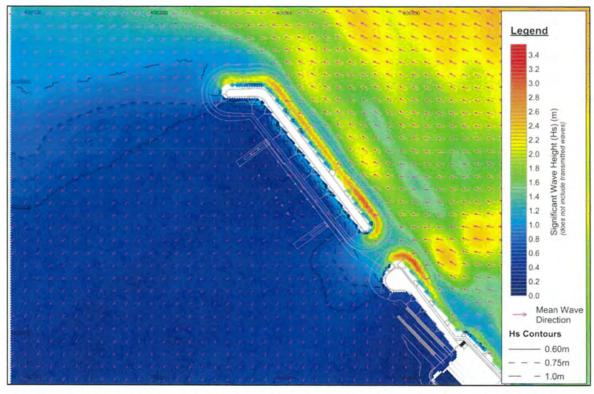


Figure 6.6 Developed Case Wave Heights – 50 Year ARI – SE Conditions (Diffracted Waves Only – Does not include Transmitted Waves))



The presented results for the extreme conditions indicate the following:

- Due to the low crest level, significant wave overtopping and wave transmission occurs under the 50 and 200 year ARI design conditions.
- Diffracted wave heights are generally comparable between the 50 and 200 year ARI design events, but the transmitted wave heights are appreciably higher for the 200 year ARI event.
- The critical design case for extreme events is the north-east case (refer comparison between Figure 6.5 and Figure 6.6)
- The detached breakwater does not achieve the requirements for 'Good' or 'Moderate' conditions per AS 3962-2001 for 50 year ARI design conditions (noting that this was not a requirement under the Project Brief).
- The conditions at the boat ramp for the 50 year ARI event would generally meet the requirements for 'Moderate' conditions (H_s < 0.75 m)

6.4 PRELIMINARY DESIGN PHYSICAL MODEL TESTING

The performance of the preliminary design cross-section will be assessed during further physical model testing at WRL in late November and early December 2017. This testing will assess wave transmission, armour stability, and overall stability under operational and extreme design wave conditions, and will contribute to defining the nominated design conditions for the jetty and pontoons, as well as the finalisation of the breakwater cross-section.





Water Research Laboratory Memorandum

To: Jared Stewart

From: Francois Flocard

Ref: WRL20171010_FF

Subject: Results for Clump Point Boating Infrastructure Preliminary Testing (Test Series A & B & C)

1. Introduction

KBR are currently undertaking detailed design of offshore coastal protection works for the Clump Point Jetty in Boat Bay. KBR engaged the Water Research Laboratory (WRL) of the School of Civil and Environment Engineering at UNSW Sydney (UNSW) to undertake two dimensional (2D) physical modelling of the coastal protection works.

This document provides a summary of the 2D physical modelling testing and associated results undertaken in WRL's 1.2 m flume during the week of the 3/10/2017. All testing was performed in the presence of KBR representative, except for Test Series C, which was performed on the 9/10/2017.

Testing was performed in three distinct series which main specificities are summarised below:

- Test Series A: seabed level at the toe set to -5.50 m AHD, Class I armour M50 = 5.1 t;
- Test Series B: seabed level at the toe set to -4.75 m AHD, Class I armour M50 = 4.2 t; and
- Test Series C: seabed level at the toe set to -5.50 m AHD, Class I armour M50 = 4.2 t.

Additional details regarding model setup and results will be provided in a draft report in the following weeks.

2. Model Setup

Model Design and Scaling

Model scaling was based on geometric similarity between mode and prototype, with an undistorted Froude scale of 20 being used for all tests and parameters, expect for the scaling of the porous rock core where a Froude scale of 13.9 was used after applying the commonly used methodology described in (Burcharth, 1999).

Breakwater Rock Armour

Model rocks for Class I, II and II armour were sorted and grading based on rock mas distributions were checked against those specified by KBR. The model rocks were sourced predominantly from the Bass Point Quarry on the NSW south coast, the rock type being basalt with a representative dry density of 2.68 t/m³ and saturated density of 2.70 t/m³

Table 2.1: Armour Specifications

Armour Rock	Parameter	Design Values (kg)	Scaled Model Values (kg)(1
700 0.40 500	M ₁₅	4,000	3,580
Class I (Test Series A - Front and Back)	M ₅₀	5,100	4,930
	M ₈₅	7,300	6,780
	M ₁₅	4,000	2,980
Class I (Test Series B & C - Front)	M ₅₀	5,100	4,220
	M ₈₅	7,300	5,920
	M ₁₅	4,000	3,420
Class I (Test Series B & C - Back)	M ₅₀	5,100	4,380
	M ₈₅	7,300	6,310
	M ₁₅	1,400	1,410
Class II	M ₅₀	1,900	1,820
	M ₈₅	3,500	3,130
	M ₁₅	170	240
Class III	M ₅₀	570	560
	M ₈₅	1,360	1,120

Note: (1) Model armour values are given at prototype scale to give an indication of potential differences with the design values.

It should be noted that Class I was modified after Test Series A to investigate the overall performance of the structure with a reduced primary armour size. This resulted in two different Class I armour categories (Front and Back) being used for Test Series B and C.

3. Wave Climate Test Results

Wave data was collected at three locations in the model domain with Table 3.1 documenting these locations. The wave climate calibration process was undertaken such that the target wave conditions presented in in Table 3.2 were closely matched at the "nearshore" three probe array location.

Table 3.1: Summary of Wave Measurement Locations

Location Name	Description	Bed Level (m AHD)	Wave Data Includes Reflections?	
3PA _{Offshore}	Offshore Three Probe Array	-20.0	No	
3PA _{nearshore}	Nearshore Three Probe Array	-6.0	No	
Pontoon	2 Probes located 9 m and 10 m behind the breakwater	-5.5	Yes	

Wave probes recorded both incident and reflected waves; the 3PA records have reflected waves removed using the method of Mansard and Funke, (1980).

Measured wave statistics for the calibrated test conditions are shown in Table 3.2, this wave data was collected prior to building the test breakwater structure in the flume in order to minimise the effects of reflected waves on the wave measurements. Attention was given to match significant wave height as much as possible, except for the 50 MLW (which was not calibrated but used the calibration information from 50Y MHWS with the MLW water level) and the Overstress wave conditions, due to wave paddle limitations.

It can be observed that measured wave periods in flume are slightly longer than the target wave period. Based on WRL's experience, this is mainly due to wave breaking taking place both offshore and even more on the relatively flat bathymetry seaward of the tested structure.

Table 3.2: Target and Calibrated Wave Climates

		Targe	t		Offs	shore 3	PA	Nearshore 3PA			
	WL	Hs	Тр	Tm	Hs	Тр	Tm	Hs	Тр	Tm	
Description		(at Toe)									
	(mAHD)	(m)	(s)	(s)	(m)	(s)	(s)	(m)	(s)	(s)	
1Y	1.34	1.5	6.7	4.8	1.9	6.5	5.1	1.5	6.7	5.4	
20Y Surge	2.46	2.5	8	5.8	3.2	7.8	6.1	2.5	8.9	6.6	
50Y MLW	-0.67	2.8	8.2	5.9	2.8	8.1	6.3	2.0	7.6	6.8	
50Y MHWS	1.34	2.8	8.2	5.9	4.3	7.8	6.5	2.8	8.9	7.2	
50Y Surge	2.55	2.8	8.2	5.9	3.7	7.9	6.2	2.8	8.7	6.8	
200Y Surge	2.67	3.3	8.6	6.2	5.0	8.3	6.7	3.3	9.3	7.3	
Overstress	2.85	3.9	9.1	6.6	6.2	8.7	7.3	3.5	9.8	7.8	

Note: Model measured wave climate parameters values are given at prototype scale to give an indication of potential differences with the design values.

4. Test Series A Results

Wave Conditions and Transmission

Table 4.1: Measured Wave Conditions during Test Series A

Location	Test	Hs	Hm	H10%	H5%	H2%	H1%	Hmax	Тр	Tm
		(m)	(s)	(s)						
3PA _{Offshore}		1.93	1.22	2.40	2.63	2.87	3.01	3.31	6.6	5.2
3PA _{nearshore}	A1 - 1Y	1.54	0.98	1.91	2.07	2.27	2.39	2.62	7.0	5.4
Pontoon		0.09	0.05	0.11	0.12	0.13	0.14	0.19	9.1	4.2
3PA _{Offshore}	12 501	4.31	2.81	5.21	5.62	6.06	6.34	7.18	7.8	6.5
3PA _{nearshore}	A2 - 50Y MHWS	2.77	1.96	3.14	3.29	3.46	3.54	3.90	8.5	7.1
Pontoon	IVITIVIS	0.27	0.15	0.36	0.41	0.46	0.50	0.71	30.6	6.9
3PA _{Offshore}	12 504	3.74	2.36	4.58	4.98	5.41	5.68	6.76	7.8	6.2
3PA _{nearshore}	A3 - 50Y Surge	2.81	1.82	3.31	3.50	3.69	3.81	4.30	8.7	6.7
Pontoon	Julge	0.58	0.34	0.79	0.91	1.06	1.17	1.61	17.2	4.1
3PA _{Offshore}		5.01	3.22	6.06	6.50	6.98	7.37	8.60	8.2	6.7
3PA _{nearshore}	A4 - 200Y	3.27	2.22	3.72	3.92	4.15	4.30	4.99	8.8	7.2
Pontoon		0.95	0.54	1.35	1.57	1.78	1.91	2.27	17.3	4.1
3PA _{Offshore}	45	6.31	4.18	7.48	8.00	8.61	8.98	10.23	8.7	7.2
3PA _{nearshore}	A5 - Overstress	3.51	2.49	3.96	4.13	4.33	4.45	5.00	10.1	7.9
Pontoon	Overstress	1.40	0.74	2.02	2.26	2.54	2.76	4.75	23.7	5.0

Note: Model measured wave climate parameters values are given at prototype scale.

Armour Stability and Damage

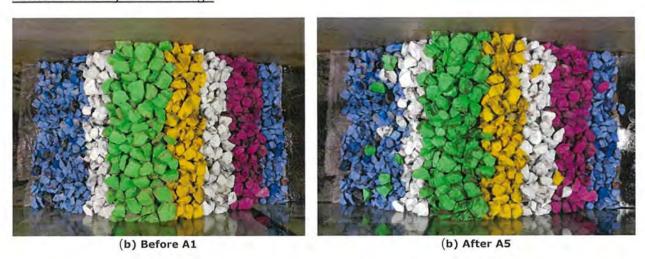


Figure 4.1: Overview of Tested Breakwater During Test Series A (left = leeward; right = offshore)

All tests were performed in a cumulative manner (i.e. no rebuild in between tests). Video footage was recorded on both sides of the detached bre4akwater to support visual observations in assessment of armour damge. Still photographs of the armour were also taken of each structure prior to and following each armour stability test. A colour banding system was used to facilitate the tracking of primary armour rocks.

Armour damage classification was based on the guidelines presented in the Coastal Engineering Manual (USACE, 2006) and the Rock Manual (CIRIA; CUR; CETMEF, 2007). Damage was defined as rocks which were displaced a distance greater than the Dn50 (median nominal rock diameter, equivalent cube). The damage percentage for each rock class was determined by relating by the number of rocks displaced as a proportion of total number of rocks in the complete associated reference area (i.e. colour band). Rocking of armour during the test was also recorded and provided but not accounted as damage. Due to the elevated water levels, discerning rock movement for the fully submerged areas, such as the toes of the breakwater was difficult, and is not reported.

Table 4.2: Summary of Test Series A Armour Stability Tests

	Zone	Back Toe Blue	Back Primary White	Crest Green	Front Pri	Front Toe		
Test	Colour				Yellow	White	Purple	Blue
A1 - 1Y	Damage	0%	0%	0%	0%	0%	0%	0%
A1-11	Rocking	0%	0%	0%	0%	1%	0%	0%
A2 - 50Y MHWS	Damage	0%	0%	0%	0%	1%	1%	0%
	Rocking	0%	0%	0%	6%	3%	0%	0%
A3 - 50Y	Damage	0%	0%	1%	1%	0%	0%	1%
Surge	Rocking	0%	0%	5%	2%	2%	0%	0%
A4 - 200Y	Damage	0%	0%	2%	1%	0%	0%	0%
A4 - 2001	Rocking	0%	0%	3%	1%	3%	0%	0%
A5 -	Damage	0%	0%	2%	1%	0%	0%	0%
Overstress	Rocking	0%	0%	3%	1%	3%	0%	0%
Cumulative	Damage	0%	4%	5%	3%	1%	1%	1%

5. Test Series B Results

For Test Series B, the bathymetry directly in front of the tested structure was locally raised7 to achieve a seabed level of -4.75 mAHD. Only a complete rebuild was performed on the structure with the front toe reshaped to a higher level (one additional layer of rocks).

Wave Conditions and Transmission

Table 5.1: Measured Wave Conditions during Test Series B

Location	Test	Hs	Hm	H10%	H5%	H2%	H1%	Hmax	Тр	Tm
		(m)	(s)	(s)						
3PA _{Offshore}	54 504	4.29	2.76	5.23	5.64	6.07	6.36	7.19	7.8	6.4
3PA _{nearshore}	B1 - 50Y MHWS	2.67	1.84	3.05	3.20	3.37	3.48	3.91	8.4	6.8
Pontoon	IVITIVIS	0.24	0.14	0.32	0.36	0.41	0.44	0.55	82.3	7.8
3PA _{Offshore}	50 500	3.76	2.39	4.61	5.00	5.44	5.73	6.83	7.8	6.2
3PA _{nearshore}	B2 - 50Y	2.74	1.81	3.21	3.39	3.58	3.71	4.22	8.6	6.7
Pontoon	- Surge	0.46	0.28	0.61	0.69	0.78	0.85	1.15	17.7	4.8
3PA _{Offshore}		5.09	3.26	6.17	6.64	7.23	7.63	9.47	8.3	6.8
3PA _{nearshore}	B3 - 200Y	3.27	2.19	3.74	3.95	4.18	4.32	5.10	8.8	7.1
Pontoon		0.72	0.42	1.00	1.18	1.44	1.62	2.38	20.0	4.5
3PA _{Offshore}	120-	6.28	4.20	7.45	7.96	8.55	8.94	10.10	8.7	7.3
3PA _{nearshore}	B4 -	3.45	2.47	3.89	4.07	4.28	4.43	4.92	10.0	7.8
Pontoon	Overstress	1.12	0.60	1.66	1.93	2.22	2.43	4.08	23.8	4.8

Note: Model measured wave climate parameters values are given at prototype scale.

Armour Stability and Damage

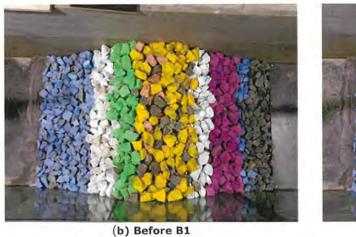




Figure 5.1: Overview of Tested Breakwater During Test Series B (left = leeward; right = offshore)

Table 5.2: Summary of Test Series B Armour Stability Tests

Test	Zone	Back Toe r Blue	Back Pri	mary	F	Front Toe		
	Colour		White	Green	Yellow	White	Purple	Blue
B1 - 50Y	Damage	0%	0%	0%	0%	0%	0%	0%
MHWS	Rocking	0%	1%	0%	3%	4%	1%	0%
B2 - 50Y	Damage	0%	0%	0%	1%	0%	0%	0%
Surge	Rocking	0%	0%	2%	5%	2%	0%	0%
	Damage	0%	3%	2%	1%	0%	0%	0%
B3 - 200Y	Rocking	0%	0%	0%	5%	1%	0%	0%
B4 -	Damage	0%	3%	2%	1%	1%	0%	0%
Overstress	Rocking	1%	0%	0%	6%	1%	0%	0%
Cumulative	Damage	0%	6%	4%	3%	1%	0%	0%

6. Test Series C Results

For Test Series C, the bathymetry directly in front of the tested structure was lowered back down to achieve a seabed level of -5.50 mAHD. Only a minor rebuild was performed on the structure tested during Test Series B with the front toe reshaped to a profile similar to the one tested during Test Series A (about 70 rocks removed).

Wave Conditions and Transmission

Table 6.1: Measured Wave Conditions during Test Series C

Location	Test	Hs	Hm	H10%	H5%	H2%	H1%	Hmax	Тр	Tm
		(m)	(s)	(s)						
3PA _{Offshore}	64 507	3.76	2.36	4.61	5.00	5.45	5.74	7.02	7.8	6.2
3PA _{nearshore}	C1 - 50Y	2.86	1.90	3.35	3.54	3.74	3.86	4.34	8.7	6.9
Pontoon	Surge	0.50	0.29	0.70	0.80	0.92	1.02	1.42	16.6	4.5
3PA _{Offshore}		6.28	4.19	7.44	7.93	8.51	8.89	10.71	8.8	7.3
3PA _{nearshore}	C2 -	3.57	2.55	4.01	4.19	4.38	4.49	5.15	10.0	7.9
Pontoon	Overstress	1.29	0.67	1.92	2.17	2.48	2.71	4.56	23.6	4.9

Note: Model measured wave climate parameters values are given at prototype.

Armour Stability and Damage

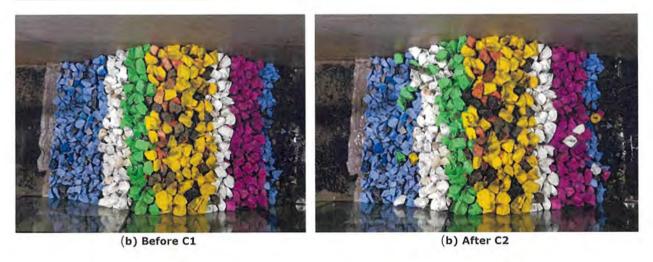


Figure 6.1: Overview of Tested Breakwater During Test Series C (left = leeward; right = offshore)

Table 6.2: Summary of Test Series C Armour Stability Tests

	Zone	Back Toe	Back Primary		Fr	Front Toe		
Test	Colour	Blue	White	Green	Yellow	White	Purple	Blue
C1 - 50Y	Damage	0%	0%	0%	0%	1%	1%	0%
Surge	Rocking	0%	0%	0%	4%	1%	1%	0%
C2 -	Damage	0%	8%	6%	2%	2%	0%	0%
Overstress	Rocking	0%	0%	4%	7%	1%	0%	0%
Cumulative	Damage	0%	8%	6%	2%	3%	1%	0%



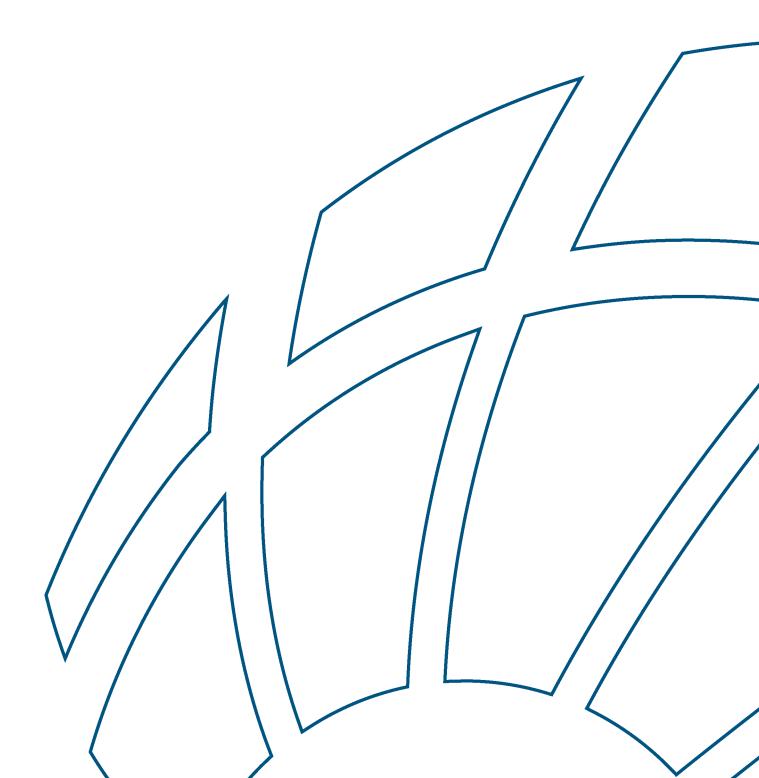


Clump Point Boat Ramp Development Plan – Coastal Process Modelling Study

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1 Introduction

The Queensland Government, through the Department of State Development (DSD), plans to enhance maritime infrastructure within Boat Bay, Mission Beach, to improve boating safety. The objective of the Mission Beach Safe Boating Infrastructure Project is to provide conditions that allow the safe transfer of passengers and goods during ambient conditions. A risk for the project is the potential for siltation in the lee of the proposed structure that may require regular ongoing costs in the form of maintenance dredging.

BMT WBM Pty Ltd has been commissioned to undertake a coastal process and impact assessment for the proposed marine structure works at Clump Point. The goal is to assess the wave climate behind the proposed infrastructure, and assess the resulting siltation potential. A number of project design configurations have been assessed in order to provide information which (along with other considerations) can be used to inform a decision on the preferred configuration.

This report details the works undertaken to develop numerical modelling tools to inform the potential reduction in wave action behind the structure, and also quantify any impacts and potential for siltation. High spatial resolution, phase-resolved wave modelling has been performed to investigate the wave-structure interactions and the degree of sheltering offered by the structure. The siltation impact predictions have been undertaken using a coupled hydrodynamic, wave and sediment transport modelling approach.



2 Coastal Environment and Geomorphology

Clump Point is a coastal promontory comprised of Cainozoic basalts. Clump Point forms a shallow, north-facing coastal embayment known as Boat Bay. Due to its shallow depths and the plentiful supply of fine terrigenous sediments from rivers in the wider region, wind and tidal currents regularly result in re-suspension of sediments and high turbidity within Boat Bay and adjacent coastal waters. These features and processes exert a significant influence on the water quality and biodiversity values of the study area.

Clump Point and Boat Bay are part of the 'Kurramine to Cowley Beach Coastal Sector' described by Holmes and Jones (1993). While there is a general trend of sand movement south to north along the coast, sand is not known to pass around Clump Point (BMT WBM 2016 – see Figure 2-1). As a result, there is no active source of sand supply to the study area. Holmes and Jones (1993) identified Liverpool Creek as the major source of sand for the Kurramine to Cowley Beach coastal sector, with an estimated annual average supply rate of 25,000m³ per year. This supply is supplemented by sediment from Maria Creek which is located approximately 6km to the north of Clump Point.

Tidal Planes Water Levels (m AHD) Highest Astronomical Tide (HAT) 1.94 Mean High Water Springs (MHWS) 1.04 Mean High Water Neaps (MHWN) 0.33 0.05 Mean Sea Level (MSL) Australian Height Datum (AHD) 0.00 -0.19 Mean Low Water Neaps (MLWN) Mean Low Water Springs (MLWS) -0.89 Lowest Astronomical Tide (LAT) -1.68

Table 2-1 Clump Point Tidal Planes (MSQ, 2012)

Seabed sediment grab sampling within Boat Bay and associated Particle Size Distribution (PSD) analysis was undertaken during July 2016 and is detailed in the Marine Ecology, Water Quality and Sediment Sampling report (BMT WBM, 2016). The majority of samples were silty-sand material, with in excess of 70% sand size fraction (0.06–2.00 mm). The proportion of silt/clay fines was generally less than 30%, except for two samples adjacent to the existing Clump Point boat ramp break-water, which had fines proportions exceeding 55%.

A state government storm tide monitoring station has been operating at Clump Point since 1976. Tidal planes for Clump Point (MSQ, 2012) are summarised in Table 2-1.

Current measurements from a metocean data collection campaign described in the Metocean Data Collection technical note (BMT WBM, 2016) indicate that prevailing current speeds in the vicinity of Clump Point are typically in the range of 0.0–0.3 m/s. In open lagoon waters flood tide currents flow towards the south and ebb tide currents towards the north. Current speeds and directions are



Coastal Environment and Geomorphology

influenced by tidal range and stage as well as by the local wind conditions. The highest current speeds occur in spring tide periods and also during strong onshore wind conditions.

The prevailing winds at Clump Point are south-easterly trade winds, strongest in May to October, with generally more light variable winds for the remainder of the year, and occasional high wind events associated with low pressure systems and tropical cyclones.

Wave data was collected during a 14 day instrument deployed during July 2016 to the north east of Clump Point, in approximately 6 m depth. The deployment period included periods of South-Easterly winds with speeds exceeding 30 km/h, as measured at the Lucinda AWS. Under these conditions, significant wave heights exceeding 0.9 m were measured.

Clump Point provides a moderate level of protection to Boat Bay from the prevailing south-easterly winds and waves (Aurecon, 2014a). However, there is little natural protection from waves generated by north-easterly winds. The 1 year Average Recurrence Interval (ARI) significant wave height at the Perry Harvey Jetty is 1.3 m (in the absence of cyclonic conditions) while the median significant wave height (50th percentile) is 0.21 m (Aurecon, 2015).

The entire foreshore within the study area is within the erosion prone area, as mapped under the *Coastal Protection and Management Act 1994*. This includes the area 40 m from highest astronomical tide (HAT) and the area likely to be inundated by a sea level rise of 0.8 m by 2100. In addition, the foreshore is within the future climate storm tide inundation area, based on a 1% Annual Exceedance Probability (AEP) storm event in the year 2100.

Modelling undertaken by BMT WBM as part of the CCRC Coastal Hazard Assessments (2015) indicates a current climate 1% AEP (equivalent to the 100 year ARI) design water level of 2.7 m AHD at Clump Point (not including the influence of waves). The design water level statistics derived by BMT WBM considered the influence of both non-cyclonic and cyclonic events. Overtopping of the car park at the Clump Point boat ramp already occurs during storm events as most of this area is only 0.5 m above HAT.



Coastal Environment and Geomorphology

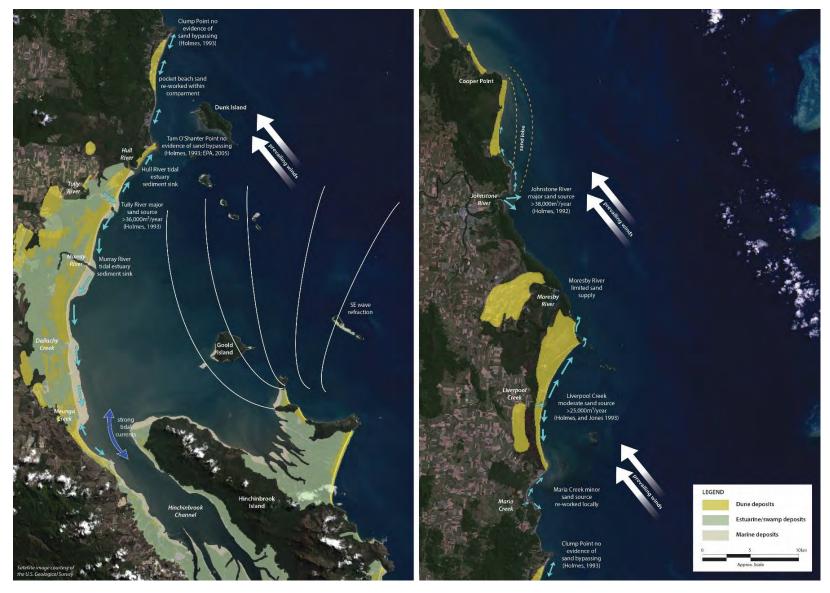


Figure 2-1 Conceptual model of sand movements at study area and surrounds



3 Numerical Model Description

3.1 Digital Elevation Model

Bathymetry for the numerical models has been derived from the following sources in descending priority:

- Bathymetry and seabed topography of Clump Point collected for DSD in July 2016;
- Australian Hydrographic Service Navigation Chart AU259 (Hinchinbrook Channel);
- Australian Hydrographic Service Navigation Chart AU828 (Pal Isles to Brook Islands and Palm Passage); and
- James Cook University Project 3DGBR (Beaman, 2010).

3.2 **Boundary Condition Datasets**

In order to provide suitable boundary conditions during a hindcast period, several datasets were acquired from global models.

The model boundary water level was forced offshore with predicted tidal water levels. These were sourced from the Oregon State University (OSU) Topex/Poseidon global tidal inversion model harmonic analysis (http://volkov.oce.orst.edu/tides/global.html).

Atmospheric data were sourced from the National Oceanic and Atmospheric Administration (NOAA) Climate Forecast System version 2 (CFSv2) global model. Wind and mean-sea-level pressure were extracted for the entire domain at hourly intervals.

3.3 Wave Models

A wave modelling system has been established in order to investigate the penetration of the waves into Boat Bay (in behind Clump Point). This combines two models; (1) the industry standard Simulating WAves Nearshore (SWAN) wave model, simulating the broad-scale wave environment from off the continental shelf to inside the GBR lagoon, and (2) the sister model Simulating WAves till SHore (SWASH) which simulates the detailed propagation of waves penetrating the bay and interacting with the proposed structures.

3.3.1 SWAN Modelling

SWAN (Delft University of Technology, 2006) is a third-generation spectral wave model, which is capable of simulating the generation of waves by wind, dissipation by white-capping, depth-induced wave breaking, bottom friction and wave-wave interactions in both deep and shallow water. SWAN simulates wave/swell propagation in two-dimensions, including shoaling and refraction due to spatial variations in bathymetry and currents. This is a global industry standard modelling package that has been applied with reliable results to many investigations worldwide.

A regional SWAN model that extended off the continental shelf was forced with design wind conditions. Four nests of increasing resolution were then used to resolve the waves closer to the area of interest. Finally, the spectral output of these nested SWAN models was used to force the SWASH model, which has then been used to simulate these spectra over ten minutes.



The resolutions (spacing of grid elements) and extents of the various SWAN domains are shown in Figure 3-2.

3.3.2 SWASH Modelling

SWASH (Delft University of Technology, 2010) is an advanced numerical wave-flow model capable resolving the transformation of waves from offshore through dispersive regions and into the beach front. SWASH employs the non-hydrostatic non-linear shallow water equations (NH NLSWE) to model the agitation of the water's surface with time-varying resolution. Unlike SWAN, SWASH can accurately resolve the fine-scale effects with spatial scales down to sub-metre and sub-second temporal scales. SWASH has been adopted for this study to accurately resolve the propagation of waves around the breakwater and also model the accurate wave breaking and overtopping of the structures. A snapshot of model water level predictions from a SWASH model simulation are shown in Figure 3-1.

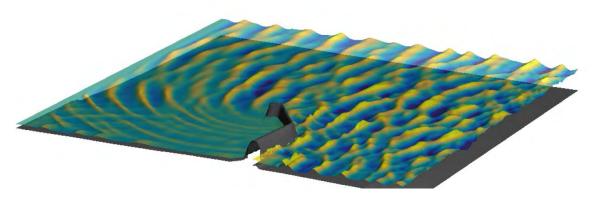


Figure 3-1 SWASH model example water level snapshot

The SWASH model has been forced with spectral output from the finest SWAN grid, generating a stochastic distribution of the wave field at that point. Figure 3-2 shows the extent of the SWASH model nested within the SWAN grid.

3.4 Siltation Modelling

In order to understand the potential for siltation and erosion around the region, a coupled hydrodynamic and sediment model has been developed. BMT WBM's in house TUFLOW FV model (https://www.tuflow.com/Tuflow%20FV.aspx) has been used to model the depth-averaged regional currents and the associated sediment transport. TUFLOW FV is a numerical hydrodynamic for the Non-Linear Shallow Water Equations (NLSWE), suitable for modelling a wide range of hydrodynamic systems of vastly different scales. The Finite-Volume (FV) numerical scheme employed by TUFLOW FV is capable of solving the NLSWE on both structured rectilinear grids and unstructured meshes extending from high resolution areas of particular interest, to lower resolution in the far-field without requiring domain nesting. Further details regarding the numerical scheme employed by TUFLOW FV are provided in the TUFLOW FV Science Manual (BMT WBM, 2013).



Numerical Model Description

Figure 3-3 shows the TUFLOW FV mesh, which extends 27 km from Cleveland Bay in the south to Cairns in the north. The resolution ranges from 7 km along the offshore boundary to 5 m in the immediate area of interest with 35386 2D cells over the whole domain.

The hydrodynamic model has been configured with forcing from tides, atmospheric wind and pressure. These inputs have been collected from the output of global models developed by third-parties. Outputs from the SWAN wave models (described in 3.3.1) were also used to force the sediment model.

The sediment transport model was configured with both a sand-sized and silt-sized sediment fraction in order to represent the bi-modal sediment characteristics observed at the site. The particle size distribution through the model domain was "warmed up" prior to undertaking the siltation assessment simulations.

3.5 Model Calibration

Metocean data collection was undertaken at Clump Point for the period between 19th July 2016 and 1st August 2016. Measurement of currents, waves and turbidity were taken over this period. Field collection equipment used for this included:

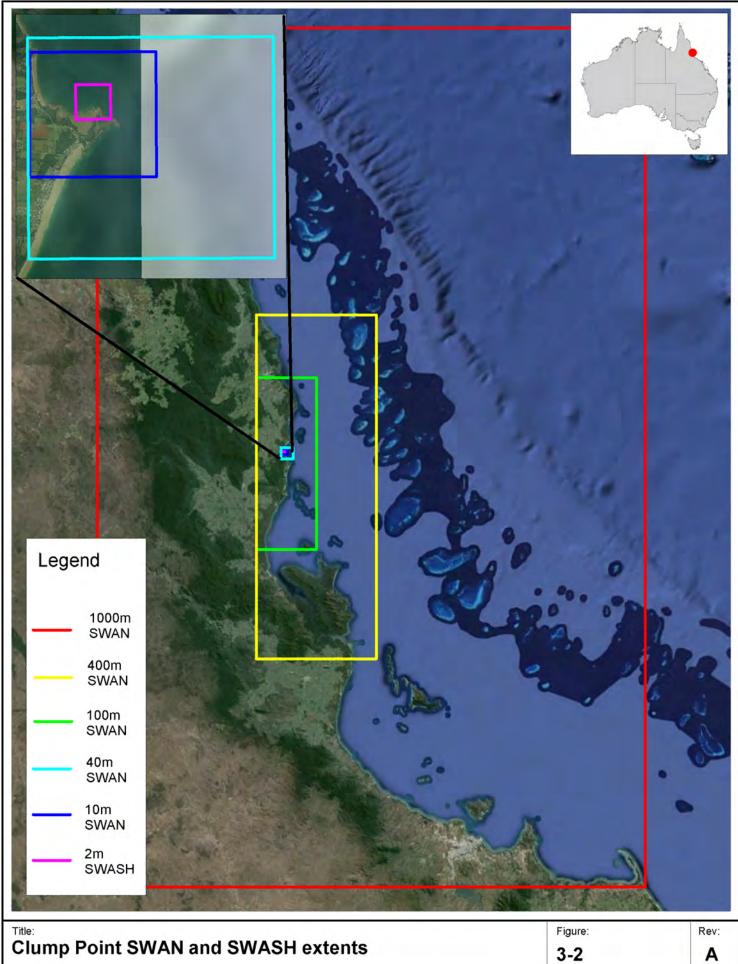
- A seabed mounted 1000kHz Nortek Acoustic Wave and Current Profiler (AWAC) Deployed 19/7/2016-1/8/2016
- A McVan Analite Turbidity Probe Deployed 19/7/2016-1/8/2016
- A boat mounted 1200kHz Teledyne RD Acoustic Doppler Current Profiler (ADCP) Operated 20/7/2016 and 21/7/2016.

The location of the boat-mounted transects and bed mounted deployment are shown in Figure 3-5.

Comparisons of the water level and current velocity magnitude between the measured ADCP observations and the modelled TUFLOWFV simulation are shown in Figure 3-6. The model matches the water level observations well. Currents speeds and directions are reasonably well represented noting that the tidal currents in the area are quite low (<0.2 m/s). Several comparisons of current magnitude and direction for the observed ADCP transecting are shown in Figure 3-8 to Figure 3-11. The transect comparisons show the model captures the complicated directional changes of the currents near to Clump Point.

The SWAN wave model calibration to the AWAC measurements is shown in Figure 3-8 and demonstrates that the model performed well at predicting the peak wave conditions during the deployment period, however it frequently overpredicted wave heights during calmer conditions. It is thought that this result is due to the use of NCEP CFSRv2 model hindcast wind conditions as model boundary conditions which will not include seabreeze / landbreeze effects and which may have a tendency to overestimate inshore windspeeds.





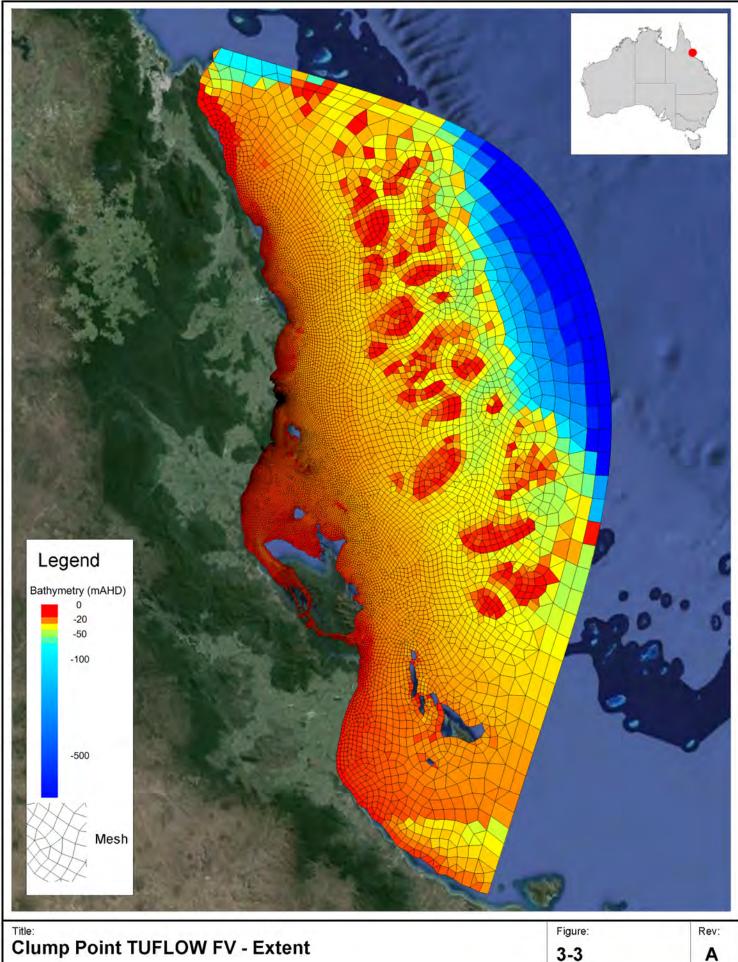
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Clump Point TUFLOW FV - Extent

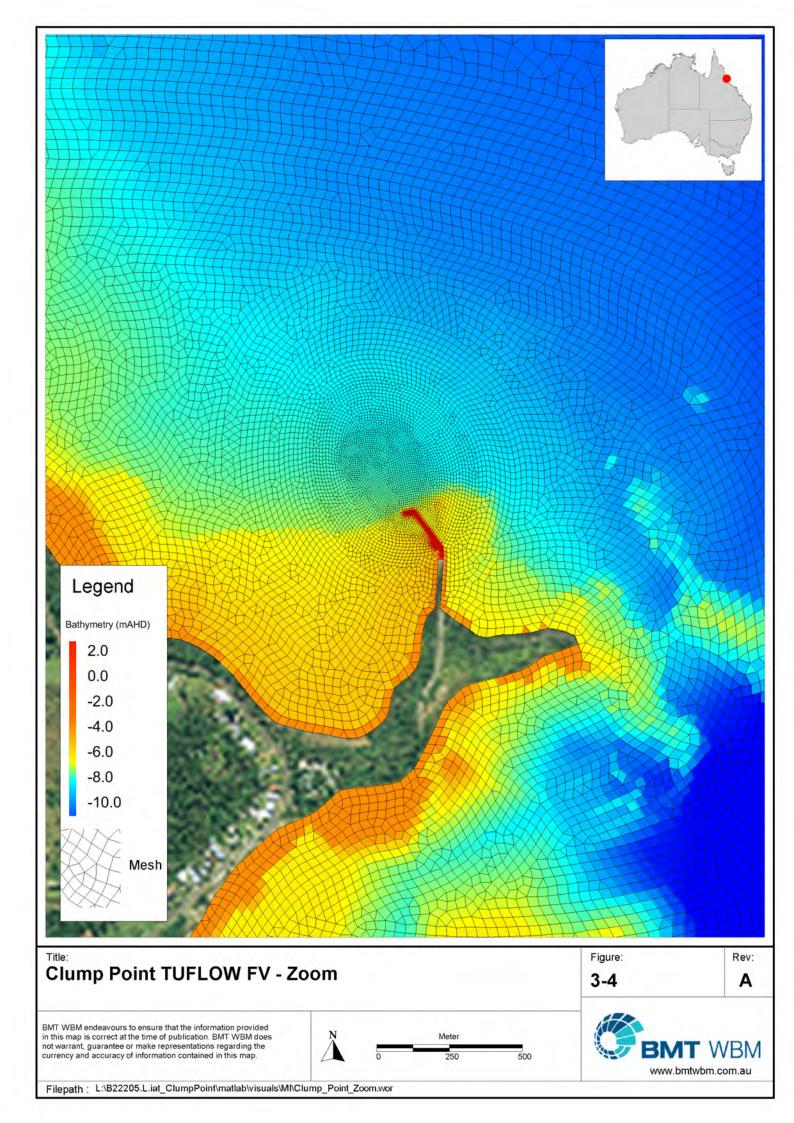
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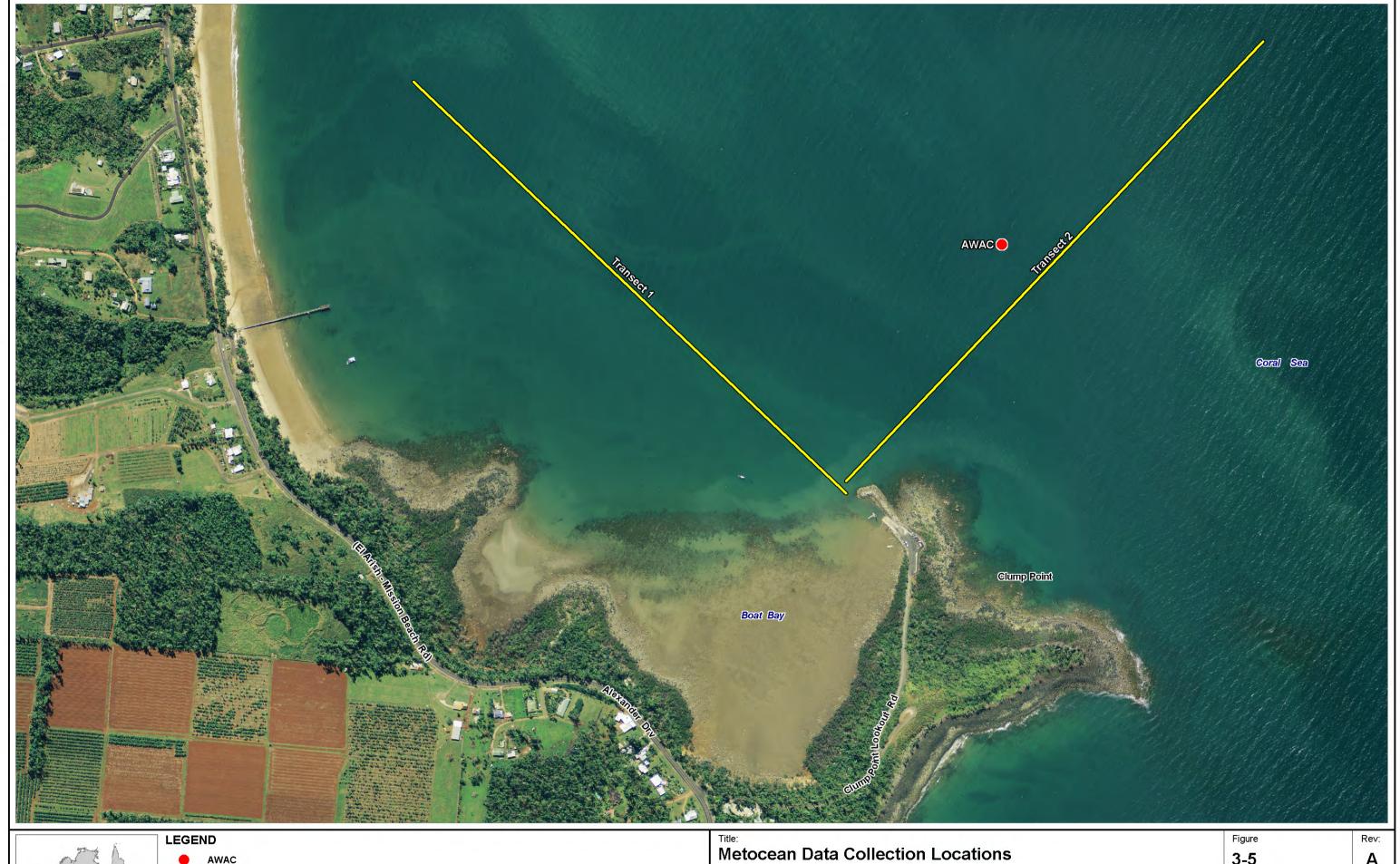
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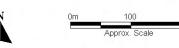








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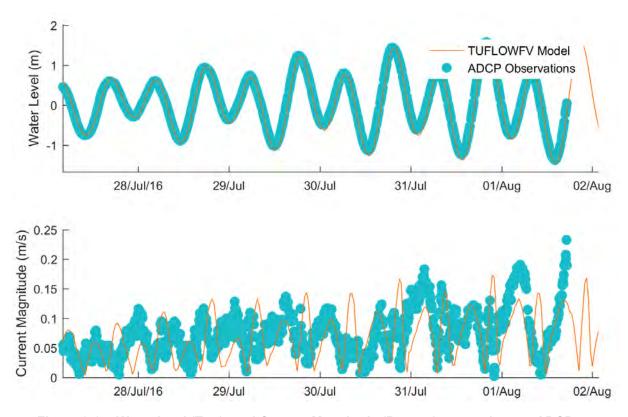


Figure 3-6 Water level (Top); and Current Magnitude (Bottom) comparison at ADCP

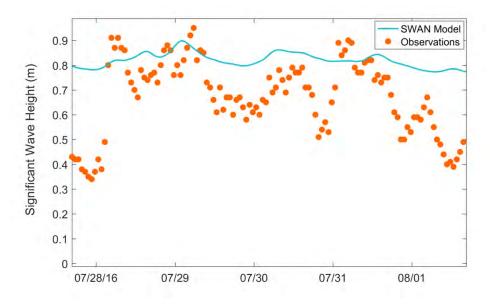


Figure 3-7 Significant Wave Height Comparison



Numerical Model Description

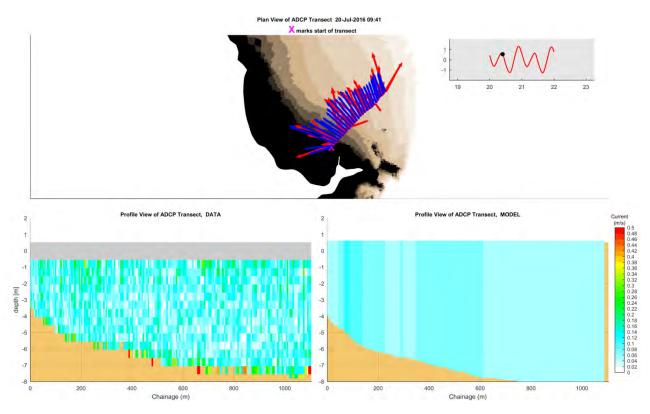


Figure 3-8 ADCP Transect Comparison 20/07/2016 09:26

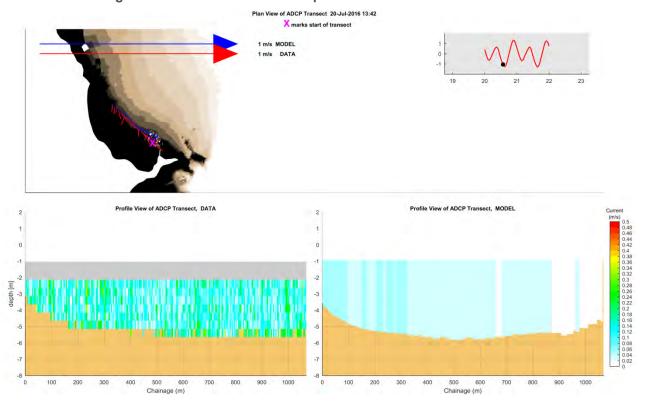


Figure 3-9 ADCP Transect Comparison 20/07/2016 13:42



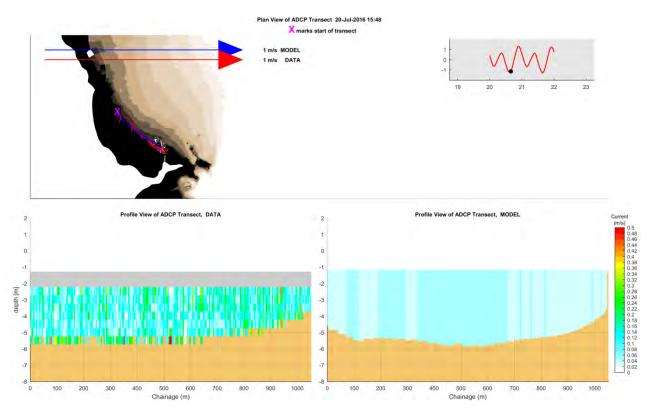


Figure 3-10 ADCP Transect Comparison 20/07/2016 15:48

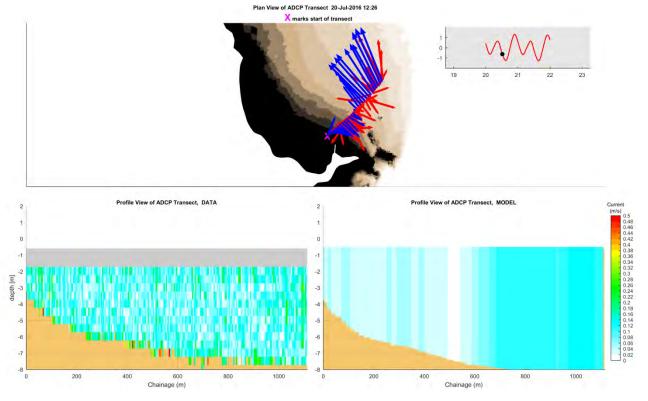


Figure 3-11 ADCP Transect Comparison 20/07/2016 12:26



4 Impact Assessment

4.1 Scenarios

The proposed development consists primarily of the development of a new and larger break-water and an associated jetty/landing structure and moorings leeward of this structure along with associated upgrades to onshore facilities including car park facilities, toilets and pull-off bays. Three concept design options have been proposed in terms of marine infrastructure:

- Option 1 120 m long detached breakwater structure, with a 30 m gap to the existing breakwater. This option will be supported by a pontoon/landing structure and berths/moorings in the lee of the break-water, in addition to upgrades to the existing break-water. There are two concept options for the breakwater:
 - Option 1A Fully detached breakwater with 5 m wide crest at an elevation of 4 m AHD, 1:2 front batter, 1:1.5 back batter
 - Option 1B Breakwater with a 3.5 m wide road connected to the existing breakwater by a bridge, 8 m wide crest at an elevation of up to 5.5 m AHD,1:2 front batter, 1:1.5 back batter
- Option 2 A proposal by the Mission Beach Boating Association (MBBA) and designed by Mager Construction Pty Ltd, which consists of a 200 m long detached breakwater structure, with a road on top connected to the existing breakwater by a bridge over a 20 m gap.

For the purpose of a comparative options assessment, the Option 1B case is likely to have the greatest impact as it has a higher crest elevation and a wider footprint. As such, only this Option 1B case has been assessed alongside the MBBA Option 2 design for comparison.

From the interest of wave propagation, the two designs differ on length, angle, and the size of the gap between the proposed structure and the existing breakwater. Option 1(B) also involves removing the return at the end of the existing breakwater, which may further open the effective gap in between the two structures. Option 2, has a proposed new boat ramp at the end of this return, which may serve to further restrict this gap.

As the wave penetration through this gap and around the end of the proposed structure is important for both the waves and potential for siltation behind the structures, and the siltation potential within the gap itself, a series of sensitivity test have been undertaken. The following three (3) additional options have been assessed:

- Option 1 with a 20 m gap;
- Option 1 with a 45 m gap; and
- 70m long detached breakwater (Option 1 alignment) with a 30 m gap.

Layouts and the bathymetry of these options are shown in Figure 4-1.



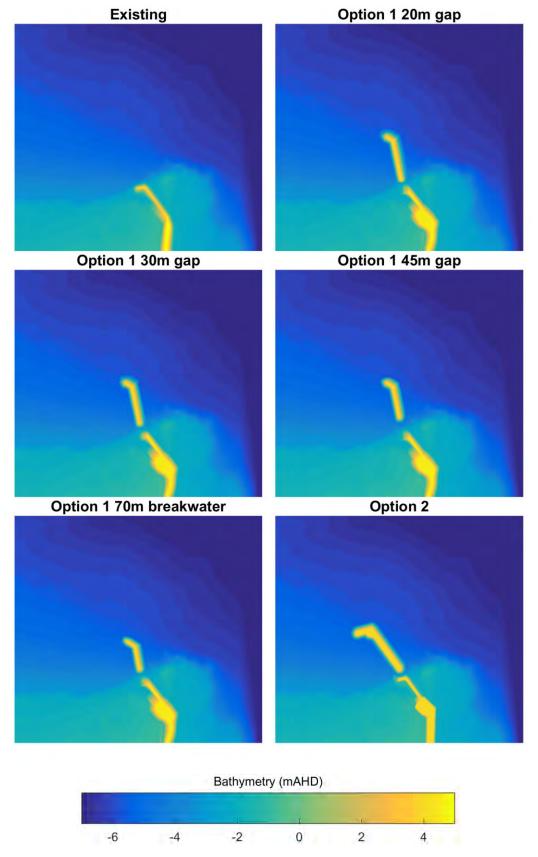


Figure 4-1 Design Scenario Bathymetry and Layouts



4.2 Wave Penetration Investigation

An assessment of the wave penetration in and behind the breakwater has been carried out using the SWAN / SWASH modelling system. In order to assess the breakwater's response in both typical and extreme conditions, a 1 year Average Recurrence Interval (ARI) and 50 year ARI design conditions were chosen to be assessed. Aurecon (2014) reported design wind speeds of 15.5 m/s (30 kt) for a 1 year ARI and 34.7 m/s (67 kt) for a 50 year ARI.

The design wind speeds were modelled for a range of incident directions from southeast through to northeast in order to assess the sensitivity of wave penetration to direction. The Aurecon (2014) study recommended 1 mAHD as a 1 year ARI water level and 2.25 mAHD for a 50 year ARI design condition, which were adopted in the wave penetration investigation scenarios. While these wind speeds and coincident water levels provided a sound basis for the current preliminary options assessment it is recommended that they should be further refined before undertaking detailed design

The adopted design winds and water levels were applied to the nested SWAN models which were run in a stationary mode in order to simulate a fully developed sea state for those wind conditions. Spectral wave outputs from the SWAN models were then applied to the SWASH model eastern boundary. The SWASH model was run for a 10 minute simulation to allow the waves to fully develop throughout the domain, and a significant wave height was then calculated by statistically sampling the final 9 minutes of the simulation.

Spatial plots of the modelled significant wave height of the Option 1 30m gap scenario under a 1 year ARI wind speed are presented for the south-easterly, easterly and north-easterly wind conditions in Figure 4-2 to Figure 4-4. These figures show the base case, the developed case and the impact to the base case for each scenario.

As the easterly condition is most strongly impacted by the breakwater, spatial plots of the modelled significant wave height for the one year return period of an easterly wind condition for all the scenarios are presented in Figure 4-5 to Figure 4-9.

Criteria for 'good' wave climate in small craft harbours (as reproduced in Table 4-1 below) were used to assess the protection benefits of the structure options. Wave penetration was largely correlated with size of the gap and the length of the breakwater. The larger gap sizes increased the wave penetration, resulting in a smaller protected area. The shorter breakwater option also resulted in reduced sheltering, with more waves penetrating around the end of the breakwater and into the bay. In the case of Option 2, both the longer breakwater, and the smaller effective gap (due to the boat ramp at the end of the existing breakwater extent) both contributed to a higher level of sheltering behind the structure.



Table 4-1 AS3962 Guidelines for Design of Marinas (Table 4.2)

CRITERIA FOR A 'GOOD' WAVE CLIMATE IN SMALL CRAFT HARBOURS

Direction and peak period	Significant wave height (H _s)						
of design harbour wave	Wave event exceeded once in 50 years	Wave event exceeded once a year					
Head seas less than 2 s	Conditions not likely to occur during this event	Less than 0.3 m wave height					
Head seas greater than 2 s	Less than 0.6 m wave height	Less than 0.3 m wave height					
Oblique seas greater than 2s	Less than 0.4 m	Less than 0.3 m wave height					
Beam seas less than 2 s	Conditions not likely to occur during this event	Less than 0.3 m wave height					
Beams seas greater than 2 s	Less than 0.25 m wave height	Less than 0.15 m wave height					

NOTE: For criteria for an 'excellent' wave climate multiply wave height by 0.75, and for a 'moderate' wave climate multiply wave height by 1.25. For vessels of less than 20 m in length, the most severe wave climate should satisfy moderate conditions. For vessels larger than 20 m in length, the wave climate may be more severe.

Source: Adapted from MERCER, A.G., ISAACSON, M. and MULCAHY, M.W. Design wave climate in small craft harbours. 18th Conference on Coastal Engineering, Capetown. 1982.

A spatial plot of modelled significant wave height for option 1 (30 m gap) scenario under a 50 year return period is shown in Figure 4-10. This demonstrates the incoming height exceeds 4 m, which on top of the 2.25 m AHD water level results in significant overtopping of the breakwater with wave crest levels exceeding 2 m above the design deck level. As such extreme conditions are well beyond the reasonable limits for consideration of wave penetration benefits no further figures for the 50 year case have been presented.

The wave impact plots shown in Figure 4-5 to Figure 4-9 indicate that there would be some wave reflection from the eastern side of the breakwater, which would generate standing wave interactions between incoming and reflected waves. These standing waves would in turn be expected to result in increased wave-induced shear stresses acting on the seabed within 1-2 wavelengths (~100m) of the eastern side of the structure. The seabed in this area is sandy and there may be some localised morphological response to the changed conditions. The potential for siltation in the lee (to the west) of the breakwater structure is considered further in Section 4.3.



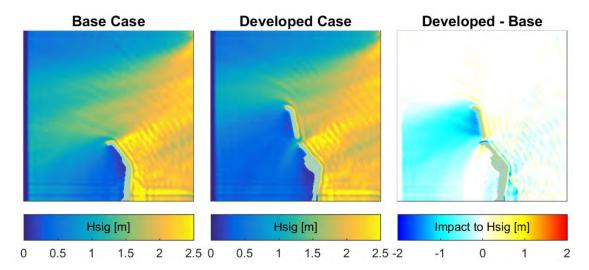


Figure 4-2 Option 1 – 30m gap, 1 year ARI North-Easterly

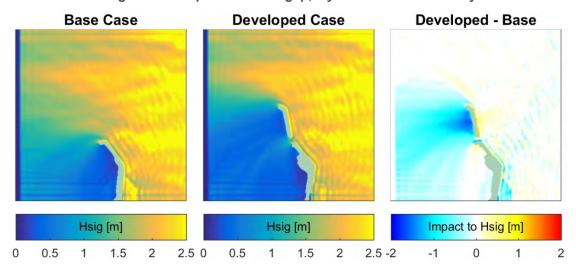


Figure 4-3 Option 1 – 30m gap, 1 year ARI Easterly

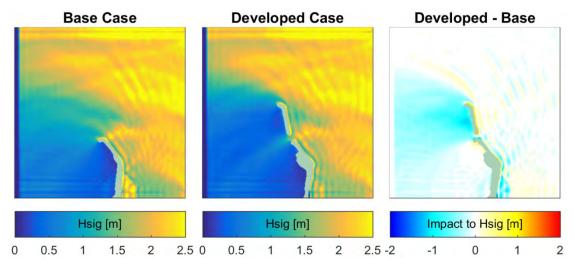


Figure 4-4 Option 1 – 30m gap, 1 year ARI South-Easterly



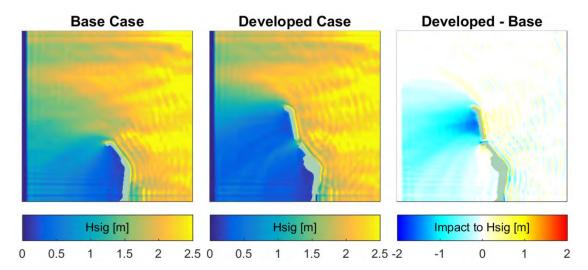


Figure 4-5 Option 1 – 20m gap, 1 year ARI easterly

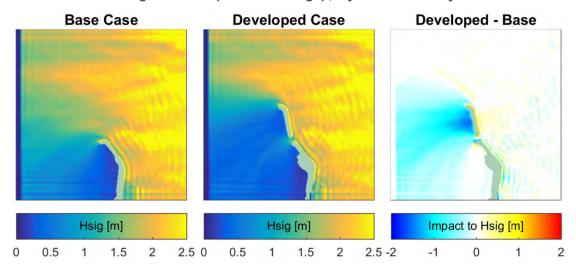


Figure 4-6 Option 1 – 30m gap, 1 year ARI easterly

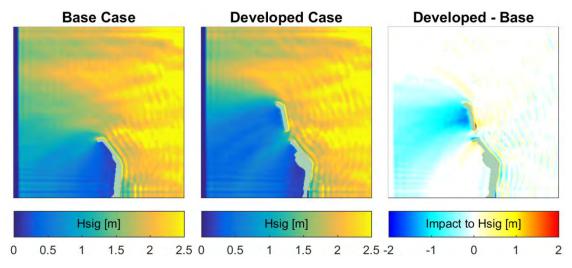


Figure 4-7 Option 1 – 45m gap, 1 year ARI easterly



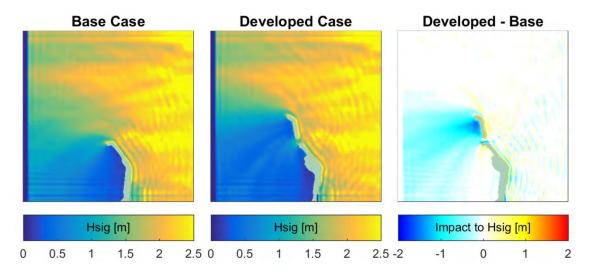


Figure 4-8 Option 1 – 70m breakwater, 1 year ARI easterly

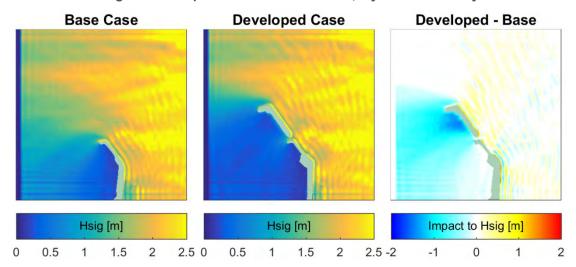


Figure 4-9 Option 2, 1 year ARI easterly

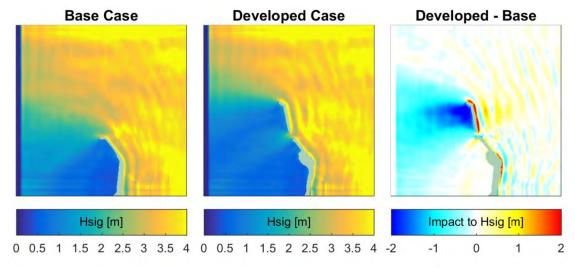


Figure 4-10 Option 1 – 30 m gap, 50 year ARI easterly





Figure 4-11 Significant wave height exceedance envelopes for 1 year ARI waves (all directions)



4.3 Siltation Investigation

The siltation assessment used the coupled TUFLOW FV – SWAN models to simulate sediment transport over a one-month period. This period was selected as the 20/07/2016 to 20/08/2016, which encompasses the end of the data collection period, and has wind conditions reasonably typical of the long-term prevailing conditions (Figure 4-12).

Multiple options were modelled and siltation impacts were derived in relation to an existing case scenario. The resulting change in bed material at the end of the design month was converted to an equivalent annual quantity, with the computed volume of deposition in the lee of the structure (including the existing facility) presented in Table 4-2.

Scenario	Total Siltation (m³/y)
Existing (base)	26
Option 1 (30m gap)	80
Option 2	84
Option 1 20m gap	78
Option 1 45m gap	173
Option 1 70m breakwater	58

Table 4-2 Modelled Siltation Volumes

Spatial plots showing the distribution of siltation, as well as the difference in the siltation to the existing case for each scenario are shown in Figure 4-13 to Figure 4-23.

The existing case siltation predictions are in line with the historical experience that there is only very limited potential for siltation in the immediate lee of the existing breakwater, under typical prevailing conditions. The model predicts that only 26m³/year of siltation occurs for the base case, which is a relatively small quantity and consistent with there not being a requirement for regular maintenance removal of sediment.

The modelling has determined that the development options considered are also unlikely to be constrained by siltation impacts and would be unlikely to require regular maintenance dredging. Furthermore, the proposed structures are shown to have no significant impacts to hydrodynamic, wave or sedimentation processes across the bay (to the west).

While both Option 1 and Option 2 scenarios predict higher siltation that the existing case neither present levels of siltation that could expect routine maintenance dredging campaigns to be required. It is possible that following extreme events (such as tropical cyclones) there will be a need to undertake works to manage material deposited in the lee of the structures, which is consistent with the requirements presented by the existing breakwater.

The sensitivity test assessing the effect of shortening the breakwater showed a reduction in the annual siltation expectation. This is in line with expectations, as there is additionally a reduction in the sheltered area.



Impact Assessment

When assessing the sensitivity of the gap size, quite different results were observed. The smaller gap size had a limited effect on the observed siltation. However, increasing the gap size to 45 m resulted in a significant increase in predicted siltation rates relative to the other options (however still only 173 m³/year). Closer inspection of the mechanism driving this result indicated that it was mainly due to removal of return on the end of the existing breakwater, which resulted in greater wave energy reaching an area that was currently sheltered from wave action. This drove the redistribution of sediment from this area. It is likely that this effect is transient, and upon eroding this available material back to harder substrate this sediment movement would stabilise and thereafter should be similar to the other scenarios.

Silt-sized material is unlikely to deposit within the gap, regardless of the spacing as the wave and current conditions within the gap is predicted to be too energetic within the gap to allow fine material to fall out of suspension there.

The scope of works for the options modelling assessment included consideration of the potential benefits of tidal ducts in the breakwater for reducing siltation impacts. As the assessments have indicated that siltation is unlikely to be a substantial impact there is unlikely to be a benefit in increasing the breakwater design complexity and cost with the inclusion of pipes. It is also unlikely that there would be substantial water level gradients across any such tidal ducts and therefore they would be unlikely to convey significant flows or therefore improve flushing behind the breakwater.



Impact Assessment

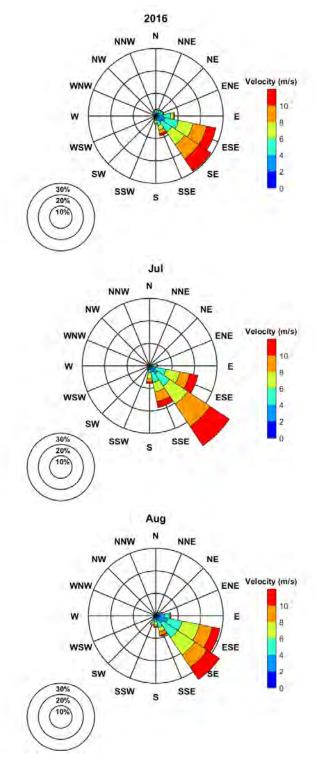


Figure 4-12 Wind Roses for Long-Term (Top); July (Middle); and August (Bottom)



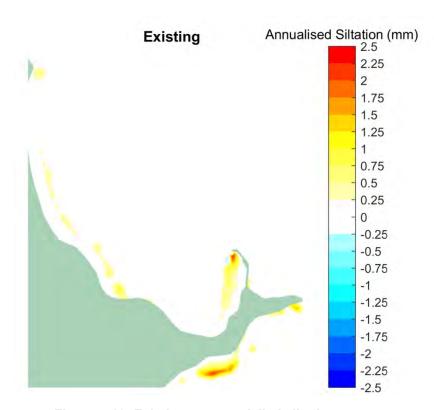


Figure 4-13 Existing case modelled siltation



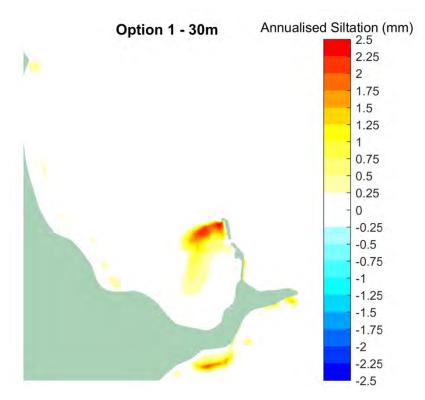


Figure 4-14 Option 1 with 30m gap modelled siltation

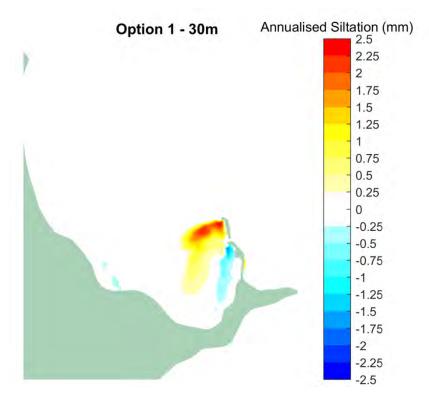


Figure 4-15 Option 1 with 30m gap modelled siltation impact



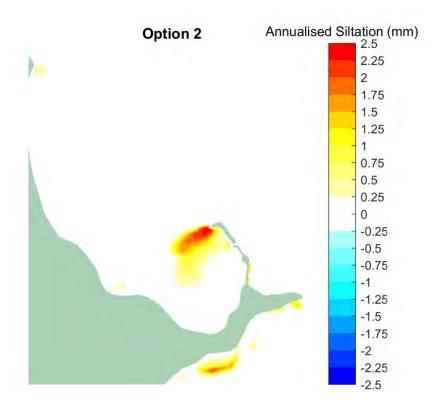


Figure 4-16 Option 2 modelled siltation

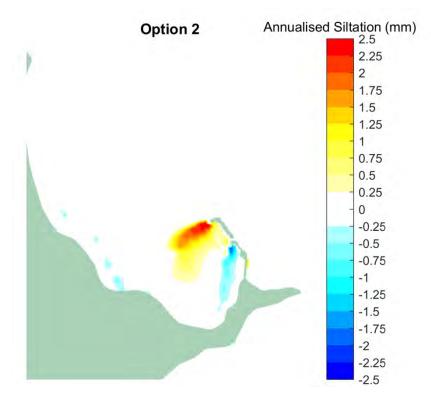


Figure 4-17 Option 2 modelled siltation impact



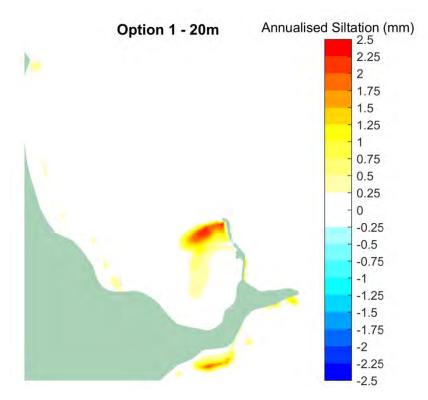


Figure 4-18 Option 1 with 20m gap modelled siltation

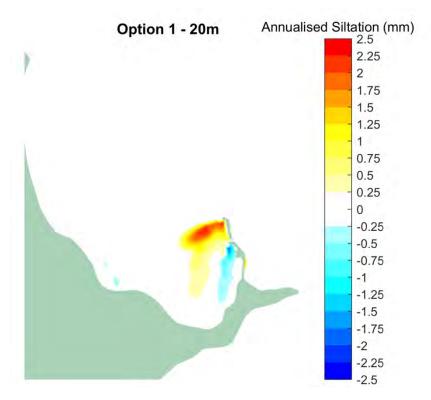


Figure 4-19 Option 1 with 20m gap modelled siltation impact



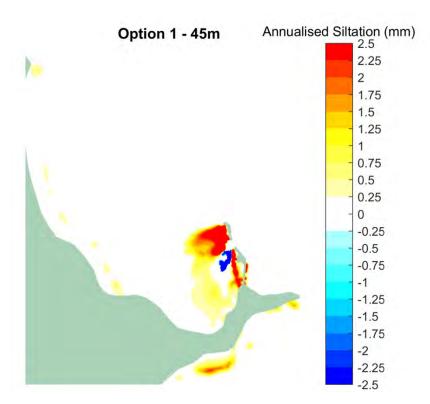


Figure 4-20 Option 1 with 45m gap modelled siltation

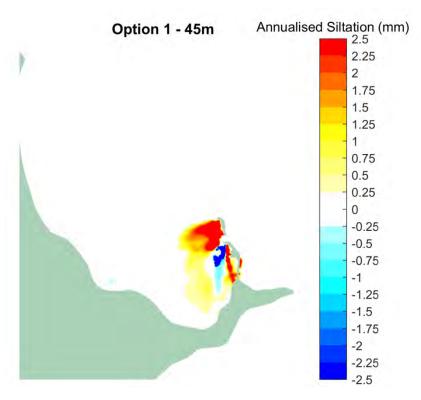


Figure 4-21 Option 1 with 45m gap modelled siltation impact



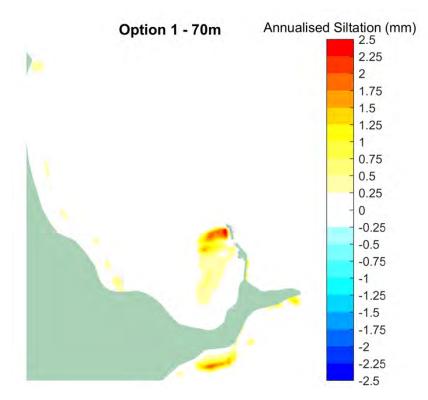


Figure 4-22 Option 1 with 70m breakwater modelled siltation

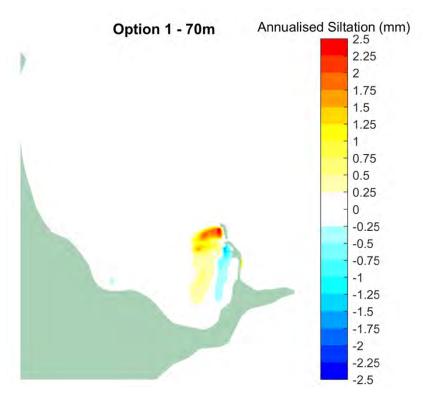


Figure 4-23 Option 1 with 70m breakwater modelled siltation impact



5 Conclusions and Recommendations

This numerical modelling assessment to support the Clump Point Boat Ramp Development Plan has considered multiple option configurations for the proposed development. The assessment has considered both the wave protection benefits of the structure and the potential for longterm siltation as an impact from the development.

Based on the modelling assessments it is recommended that the gap between the new breakwater structure and the existing breakwater should not greatly exceed 30 m as the protection benefits of the structure are compromised by the larger gap size.

The overall length of the detached breakwater structure should be optimised to accommodate the planned boating infrastructure (pontoon, access jetty and mooring pens) with sufficient protection from both prevailing wave conditions. There will be risk of substantial structure overtopping of the proposed breakwater design during extreme wave conditions and this should be taken into consideration with the design of the associated boating infrastructure.

A sediment transport modelling assessment has concluded that while there will be potential for some increased siltation in the lee of a new breakwater structure it is unlikely that this will occur to an extent that would require regular ongoing maintenance dredging. There may however be a need for some maintenance works following a severe tropical cyclone event.





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Appendix F- Final Design Modelling Investigation

Mission Beach Clump Point Boating Infrastructure Project: Coastal Modelling Report

Reference: R.B22856.003.02.Modelling_Report.docx

Date: November 2017

Confidential



Document Control Sheet

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Modelled Siltation Volumes

The Queensland Government plans to enhance maritime infrastructure within Boat Bay, Mission Beach, to improve boating safety. The objective of the Mission Beach Clump Point Boating Infrastructure Project is to provide conditions that allow the safe transfer of passengers and goods during ambient conditions. A risk for the project is the potential for siltation in the lee of the proposed structure. If the siltation potential is significant then regular ongoing maintenance dredging may be required, with associated environmental impact and cost implications.

BMT WBM Pty Ltd has been commissioned by the Department of Transport and Main Roads (TMR) to undertake a coastal process and impact assessment for the proposed marine structure works at Clump Point. The goal is to assess the wave climate impacts behind the proposed infrastructure, and assess the resulting siltation potential. A previous coastal process modelling study was undertaken as part of the development plan options assessment (BMT WBM, 2017c). From the development plan work the design concept has been refined through the first stage of detailed design, currently being undertaken by KBR.

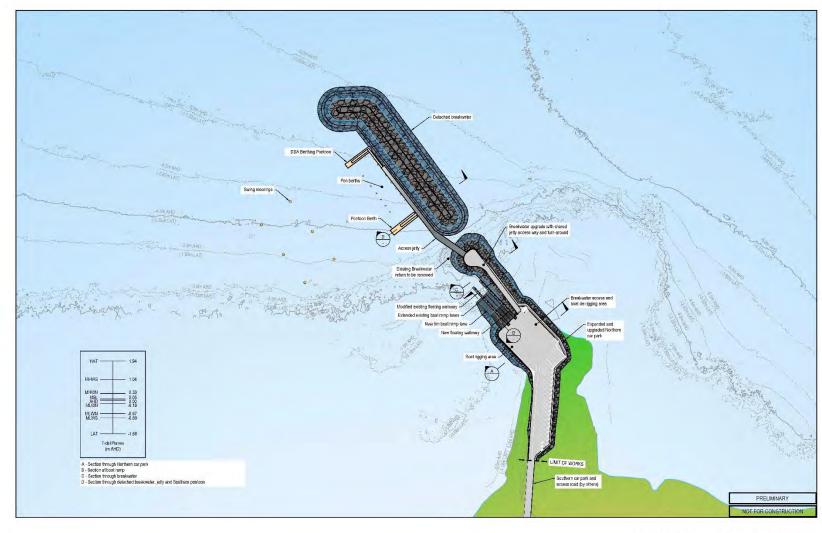
The refined concept is shown as a schematic layout in Figure 1-1. Typical sections through the northern carpark are shown in Figure 1-2. Sections through the upgraded breakwater and new detached breakwater are shown in Figure 1-3.

In summary the refined concept involves the following key elements of relevance to potential coastal process impacts:

- Upgrade of existing breakwater, including removal of the "return";
- Upgrade and expansion of existing boat ramp;
- Construction of new detached breakwater, with the following dimensions:
 - Crest length of 145 m.
 - Crest elevation of 4.5 mAHD
 - Cross-section width ~42 m (varies)
- Northern carpark expansion and raise.

This report details the works undertaken to develop numerical modelling tools to inform the potential reduction in wave action behind the structure, and also quantify any impacts and potential for siltation. High spatial resolution, phase-resolved wave modelling has been performed to investigate the wave-structure interactions and the degree of sheltering offered by the structure. The siltation impact predictions have been undertaken using a coupled hydrodynamic, wave and sediment transport modelling approach.





CLUMP POINT BOATING INFRASTRUCTURE PROJECT SCHEMATIC LAYOUT

BEJ754-DW-CV-SKT-0019 Rev B 1 Navember 2017



Figure 1-1 Refined Concept Schematic Layout



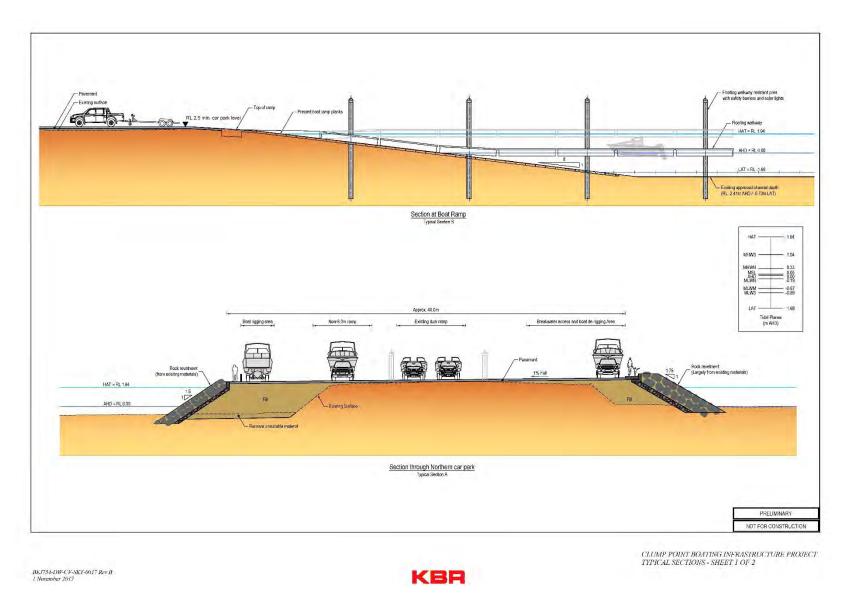


Figure 1-2 Refined Concept Northern Carpark Typical Sections



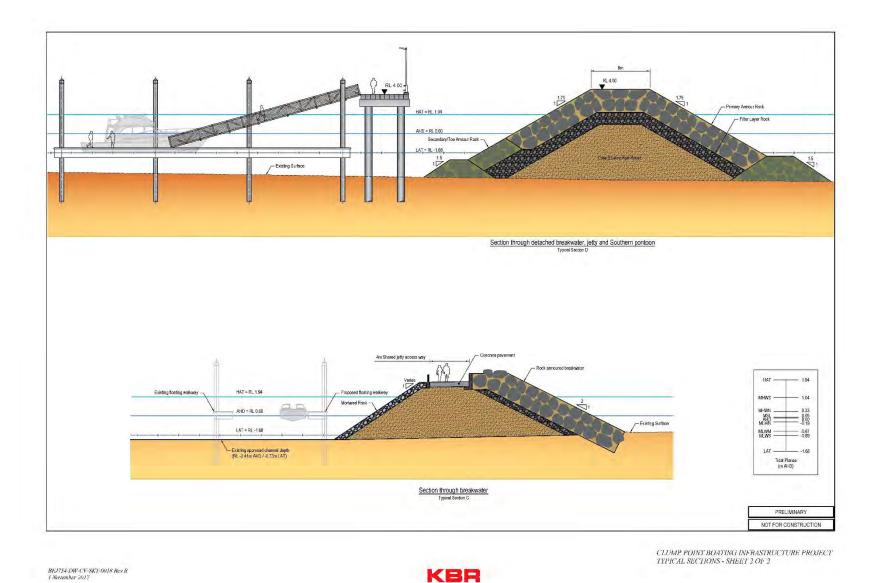


Figure 1-3 Refined Concept Breakwater and Detached Breakwater Typical Sections



2 Coastal Environment and Geomorphology

Clump Point is a coastal promontory comprised of Cainozoic basalts. Clump Point forms a shallow, north-facing coastal embayment known as Boat Bay. Due to its shallow depths and the plentiful supply of fine terrigenous sediments from rivers in the wider region, wind and tidal currents regularly result in re-suspension of sediments and high turbidity within Boat Bay and adjacent coastal waters. These features and processes exert a significant influence on the water quality and biodiversity values of the study area.

Clump Point and Boat Bay are part of the 'Kurramine to Cowley Beach Coastal Sector' described by Holmes and Jones (1993). While there is a general trend of sand movement south to north along the coast, sand is not known to pass around Clump Point (BMT WBM 2016 – see Figure 2-1). As a result, there is no active source of sand supply to the study area. Holmes and Jones (1993) identified Liverpool Creek as the major source of sand for the Kurramine to Cowley Beach coastal sector, with an estimated annual average supply rate of 25,000m³ per year. This supply is supplemented by sediment from Maria Creek which is located approximately 6km to the north of Clump Point.

Tidal Planes Water Levels (m AHD) Highest Astronomical Tide (HAT) 1.94 Mean High Water Springs (MHWS) 1.04 Mean High Water Neaps (MHWN) 0.33 Mean Sea Level (MSL) 0.05 0.00 Australian Height Datum (AHD) Mean Low Water Neaps (MLWN) -0.19 -0.89 Mean Low Water Springs (MLWS) -1.68 Lowest Astronomical Tide (LAT)

Table 2-1 Clump Point Tidal Planes (MSQ, 2012)

Seabed sediment grab sampling within Boat Bay and associated Particle Size Distribution (PSD) analysis was undertaken during July 2016 and is detailed in the Marine Ecology, Water Quality and Sediment Sampling report. The majority of samples were silty-sand material, with in excess of 70% sand size fraction (0.06–2.00 mm). The proportion of silt/clay fines was generally less than 30%, except for two samples adjacent to the existing Clump Point boat ramp break-water, which had fines proportions exceeding 55%.

A state government storm tide monitoring station has been operating at Clump Point since 1976. Tidal planes for Clump Point (MSQ, 2012) are summarised in Table 2-1.

Current measurements from a metocean data collection campaign described in the Metocean Data Collection technical note indicate that prevailing current speeds in the vicinity of Clump Point are typically in the range of 0.0–0.3 m/s. In open lagoon waters flood tide currents flow towards the south and ebb tide currents towards the north. Current speeds and directions are influenced by tidal range



Coastal Environment and Geomorphology

and stage as well as by the local wind conditions. The highest current speeds occur in spring tide periods and also during strong onshore wind conditions.

The prevailing winds at Clump Point are south-easterly trade winds, strongest in May to October, with generally more light variable winds for the remainder of the year, and occasional high wind events associated with low pressure systems and tropical cyclones.

Wave data was collected during a 14 day instrument deployed during July 2016 to the north east of Clump Point, in approximately 6 m depth. The deployment period included periods of South-Easterly winds with speeds exceeding 30 km/h, as measured at the Lucinda AWS. Under these conditions, significant wave heights exceeding 0.9 m were measured.

Clump Point provides a moderate level of protection to Boat Bay from the prevailing south-easterly winds and waves (Aurecon, 2014a). However, there is little natural protection from waves generated by north-easterly winds. The 1 year Average Recurrence Interval (ARI) significant wave height at the Perry Harvey Jetty is 1.3 m (in the absence of cyclonic conditions) while the median significant wave height (50th percentile) is 0.21 m (Aurecon, 2014b).

The entire foreshore within the study area is within the erosion prone area, as mapped under the *Coastal Protection and Management Act 1994*. This includes the area 40 m from highest astronomical tide (HAT) and the area likely to be inundated by a sea level rise of 0.8 m by 2100. In addition, the foreshore is within the future climate storm tide inundation area, based on a 1% Annual Exceedance Probability (AEP) storm event in the year 2100.

Modelling undertaken by BMT WBM as part of the CCRC Coastal Hazard Assessments (2015) indicates a current climate 1% AEP (equivalent to the 100 year ARI) design water level of 2.7 m AHD at Clump Point (not including the influence of waves). The design water level statistics derived by BMT WBM considered the influence of both non-cyclonic and cyclonic events. Overtopping of the car park at the Clump Point boat ramp already occurs during storm events as parts of the carpark are only at HAT or slightly above.



Coastal Environment and Geomorphology

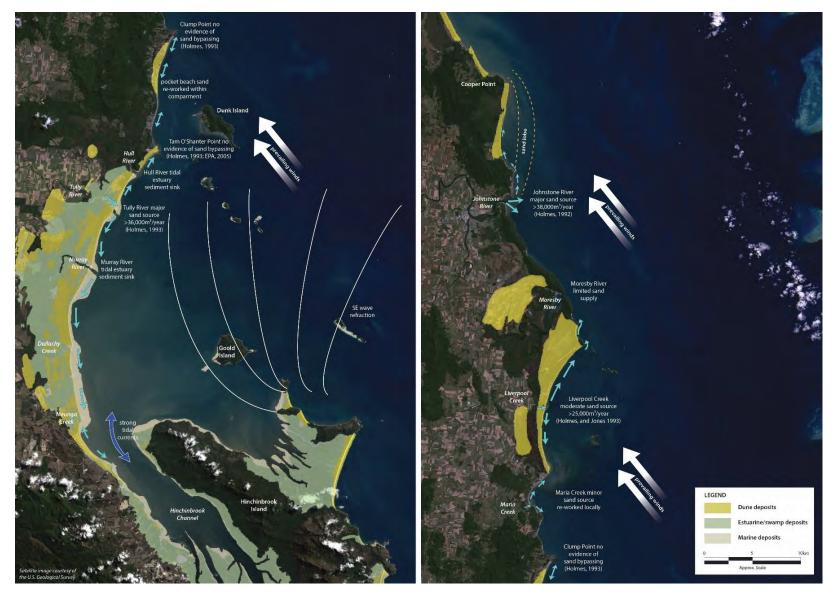


Figure 2-1 Conceptual model of sand movements at study area and surrounds



3 Numerical Model Description

3.1 Digital Elevation Model

Bathymetry for the numerical models has been derived from the following sources in descending priority:

- Bathymetry and seabed topography of Clump Point collected for DSD in July 2016;
- Australian Hydrographic Service Navigation Chart AU259 (Hinchinbrook Channel);
- Australian Hydrographic Service Navigation Chart AU828 (Pal Isles to Brook Islands and Palm Passage); and
- James Cook University Project 3DGBR (Beaman, 2010).

3.2 **Boundary Condition Datasets**

In order to provide suitable boundary conditions during a hindcast period, several datasets were acquired from global models.

The model boundary water level was forced offshore with predicted tidal water levels. These were sourced from the Oregon State University (OSU) Topex/Poseidon global tidal inversion model harmonic analysis (http://volkov.oce.orst.edu/tides/global.html).

Atmospheric data were sourced from the National Oceanic and Atmospheric Administration (NOAA) Climate Forecast System version 2 (CFSv2) global model. Wind and mean-sea-level pressure were extracted for the entire domain at hourly intervals.

3.3 Wave Models

A wave modelling system has been established in order to investigate the penetration of the waves into Boat Bay (in behind Clump Point). This combines two models; (1) the industry standard Simulating WAves Nearshore (SWAN) wave model, simulating the broad-scale wave environment from off the continental shelf to inside the GBR lagoon, and (2) the sister model Simulating WAves till SHore (SWASH) which simulates the detailed propagation of waves penetrating the bay and interacting with the proposed structures.

3.3.1 SWAN Modelling

SWAN (Delft University of Technology, 2006) is a third-generation spectral wave model, which is capable of simulating the generation of waves by wind, dissipation by white-capping, depth-induced wave breaking, bottom friction and wave-wave interactions in both deep and shallow water. SWAN simulates wave/swell propagation in two-dimensions, including shoaling and refraction due to spatial variations in bathymetry and currents. This is a global industry standard modelling package that has been applied with reliable results to many investigations worldwide.

A regional SWAN model that extended off the continental shelf was forced with design wind conditions. Four nests of increasing resolution were then used to resolve the waves closer to the area of interest. Finally, the spectral output of these nested SWAN models was used to force the SWASH model, which has then been used to simulate these spectra over ten minutes.



Numerical Model Description

The resolutions (spacing of grid elements) and extents of the various SWAN domains are shown in Figure 3-2.

3.3.2 SWASH Modelling

SWASH (Delft University of Technology, 2010) is an advanced numerical wave-flow model capable resolving the transformation of waves from offshore through dispersive regions and into the beach front. SWASH employs the non-hydrostatic non-linear shallow water equations (NH NLSWE) to model the agitation of the water's surface with time-varying resolution. Unlike SWAN, SWASH can accurately resolve the fine-scale effects with spatial scales down to sub-metre and sub-second temporal scales. SWASH has been adopted for this study to accurately resolve the propagation of waves around the breakwater and also model the accurate wave breaking and overtopping of the structures. A snapshot of model water level predictions from a SWASH model simulation are shown in Figure 3-1.

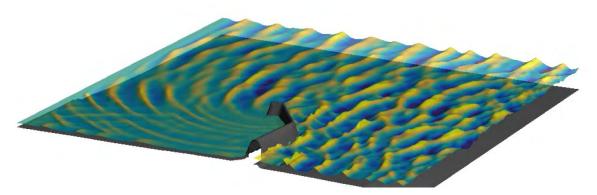


Figure 3-1 SWASH model example water level snapshot

The SWASH model has been forced with spectral output from the finest SWAN grid, generating a stochastic distribution of the wave field at that point. Figure 3-2 shows the extent of the SWASH model nested within the SWAN grid.

3.4 Siltation Modelling

In order to understand the potential for siltation and erosion around the region, a coupled hydrodynamic and sediment model has been developed. BMT WBM's in house TUFLOW FV model (https://www.tuflow.com/Tuflow%20FV.aspx) has been used to model the depth-averaged regional currents and the associated sediment transport. TUFLOW FV is a numerical hydrodynamic for the Non-Linear Shallow Water Equations (NLSWE), suitable for modelling a wide range of hydrodynamic systems of vastly different scales. The Finite-Volume (FV) numerical scheme employed by TUFLOW FV is capable of solving the NLSWE on both structured rectilinear grids and unstructured meshes extending from high resolution areas of particular interest, to lower resolution in the far-field without requiring domain nesting. Further details regarding the numerical scheme employed by TUFLOW FV are provided in the TUFLOW FV Science Manual (BMT WBM, 2013).



Numerical Model Description

Figure 3-3 shows the TUFLOW FV mesh, which extends 27 km from Cleveland Bay in the south to Cairns in the north. The resolution ranges from 7 km along the offshore boundary to 5 m in the immediate area of interest with 35386 2D cells over the whole domain.

The hydrodynamic model has been configured with forcing from tides, atmospheric wind and pressure. These inputs have been collected from the output of global models developed by third-parties. Outputs from the SWAN wave models (described in 3.3.1) were also used to force the sediment model.

The sediment transport model was configured with both a sand-sized and silt-sized sediment fraction in order to represent the bi-modal sediment characteristics observed at the site. The particle size distribution through the model domain was "warmed up" prior to undertaking the siltation assessment simulations.

3.5 Model Calibration

Metocean data collection was undertaken at Clump Point for the period between 19th July 2016 and 1st August 2016. Measurement of currents, waves and turbidity were taken over this period. Field collection equipment used for this included:

- A seabed mounted 1000kHz Nortek Acoustic Wave and Current Profiler (AWAC) Deployed 19/7/2016-1/8/2016
- A McVan Analite Turbidity Probe Deployed 19/7/2016-1/8/2016
- A boat mounted 1200kHz Teledyne RD Acoustic Doppler Current Profiler (ADCP) Operated 20/7/2016 and 21/7/2016.

The location of the boat-mounted transects and bed mounted deployment are shown in Figure 3-5.

Comparisons of the water level and current velocity magnitude between the measured ADCP observations and the modelled TUFLOWFV simulation are shown in Figure 3-6. The model matches the water level observations well. Currents speeds and directions are reasonably well represented noting that the tidal currents in the area are quite low (<0.2 m/s). Several comparisons of current magnitude and direction for the observed ADCP transecting are shown in Figure 3-8 to Figure 3-11. The transect comparisons show the model captures the complicated directional changes of the currents near to Clump Point.

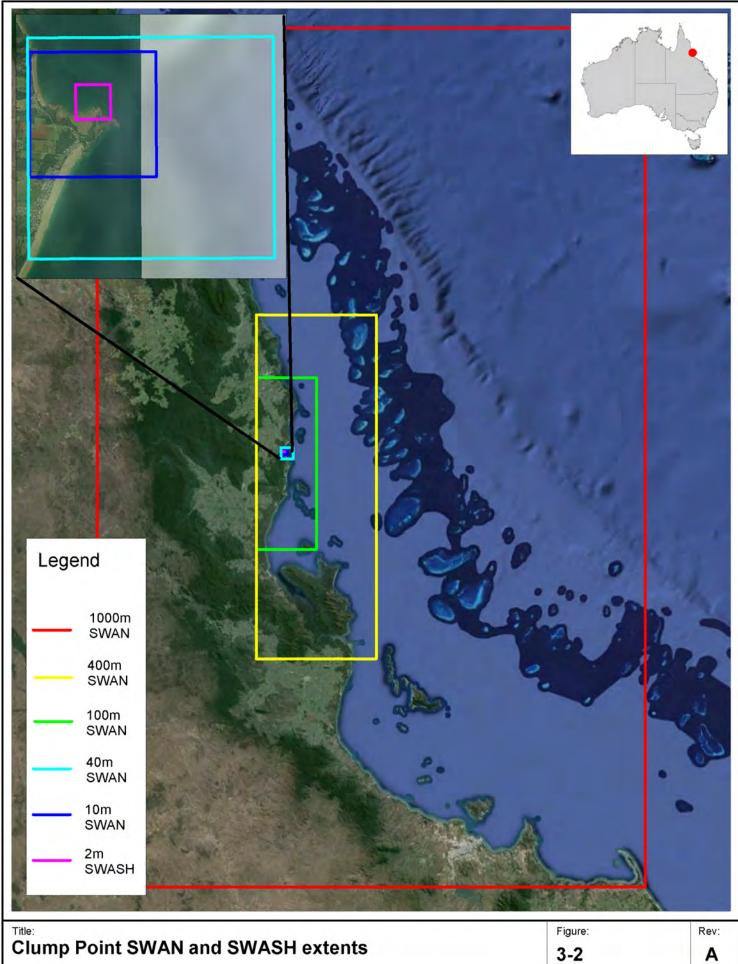
The SWAN wave model calibration to the AWAC measurements is shown in Figure 3-8 and demonstrates that the model performed well at predicting the peak wave conditions during the deployment period, however it frequently overpredicted wave heights during calmer conditions. It is thought that this result is due to the use of NCEP CFSRv2 model hindcast wind conditions as model boundary conditions which will not include seabreeze / landbreeze effects and which may have a tendency to overestimate inshore windspeeds.



3.6 Design Wave Assessments

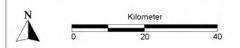
Wave modelling assessments have been conducted and reported separately as part of the design wave criteria development for the Clump Point Boating Infrastructure Project (BMT WBM 2017a, 2017b). These assessments have further refined the model calibration and derived a hindcast dataset of wave conditions at the site. Design wave conditions at recurrence intervals from 1-year ARI to 200-year ARI were derived. The updated 1-year and 50-year ARI conditions have been considered in the context of coastal process impacts in this report.





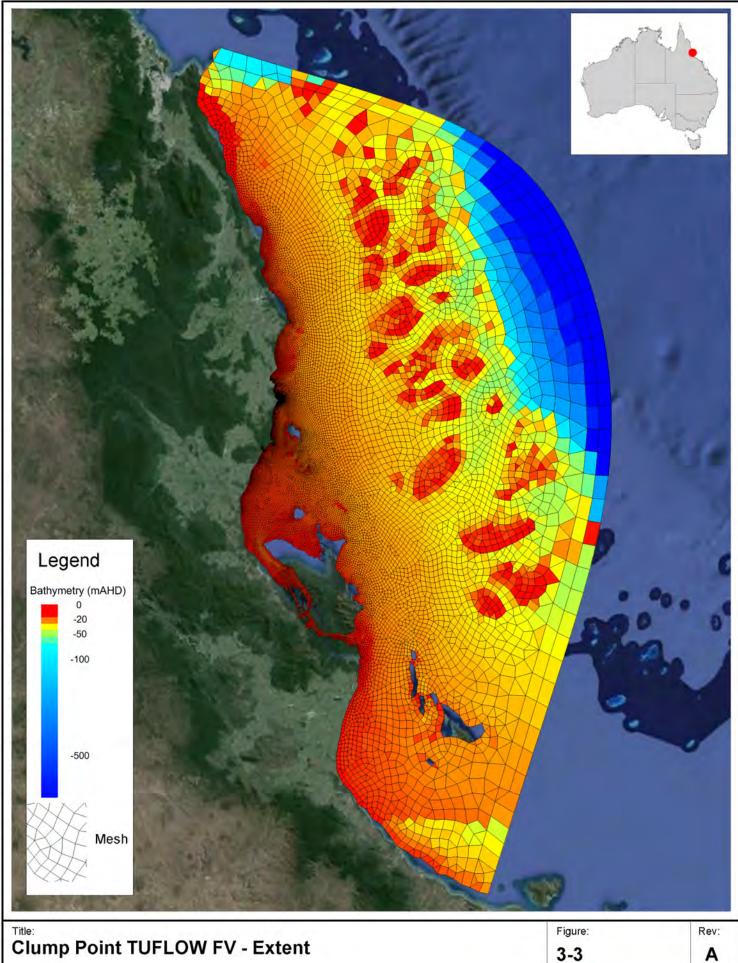
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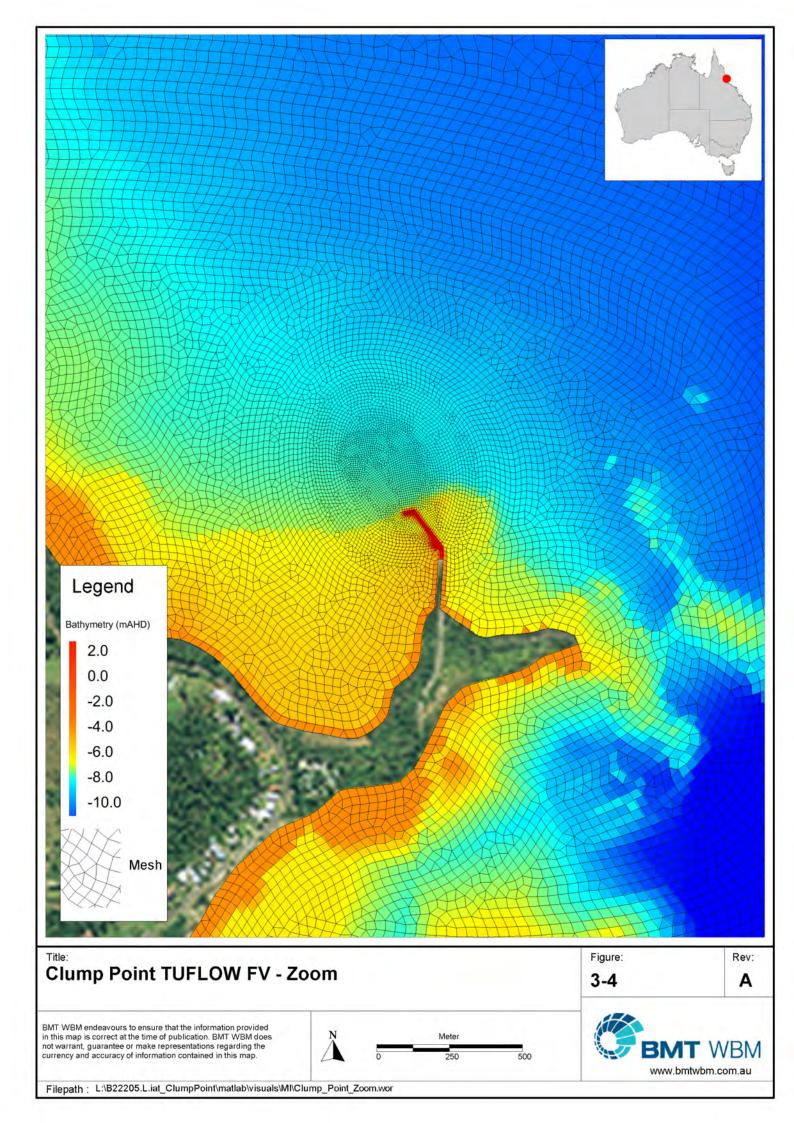


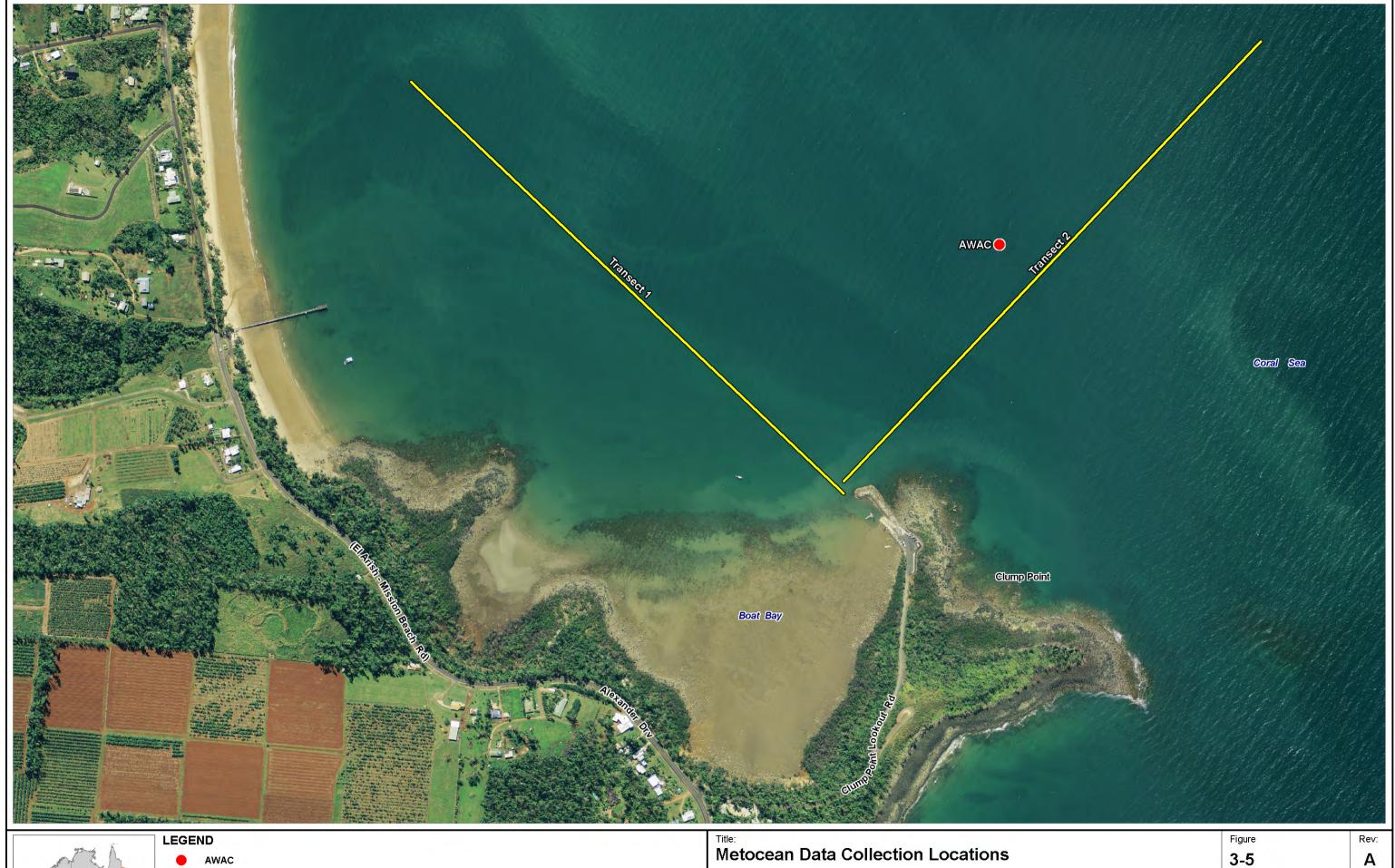
Clump Point TUFLOW FV - Extent

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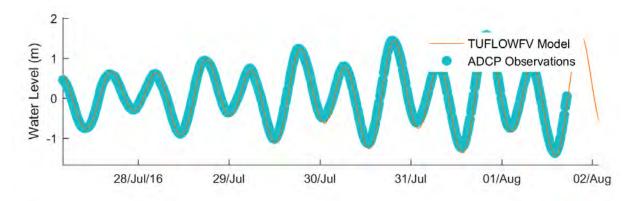


AWAC Transects

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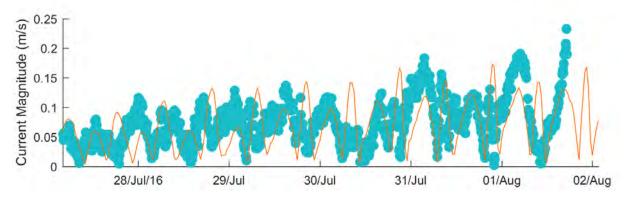


Figure 3-6 Water level (Top); and Current Magnitude (Bottom) comparison at ADCP

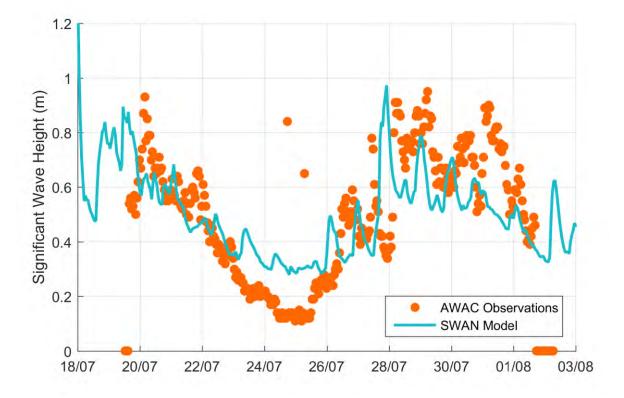


Figure 3-7 Significant Wave Height Comparison



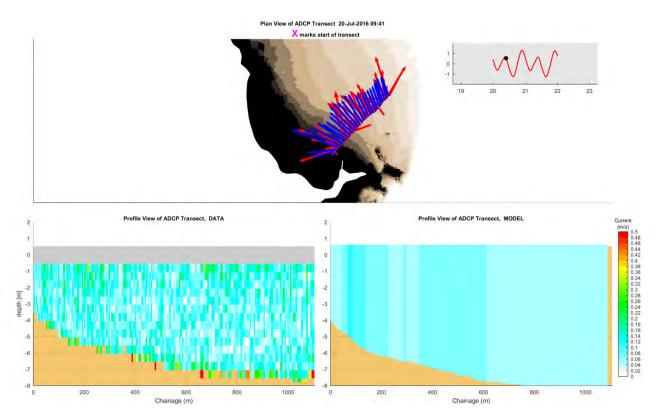


Figure 3-8 ADCP Transect Comparison 20/07/2016 09:26

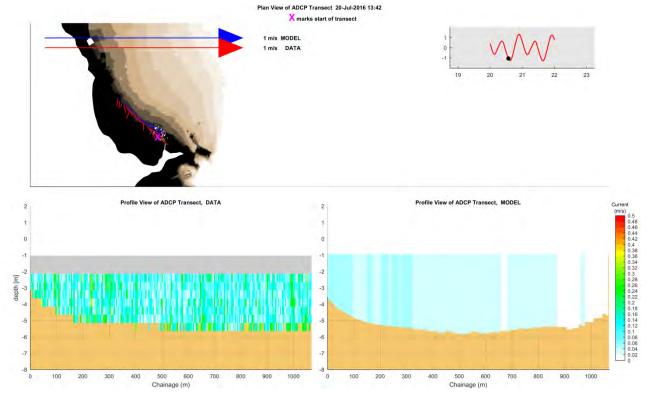


Figure 3-9 ADCP Transect Comparison 20/07/2016 13:42



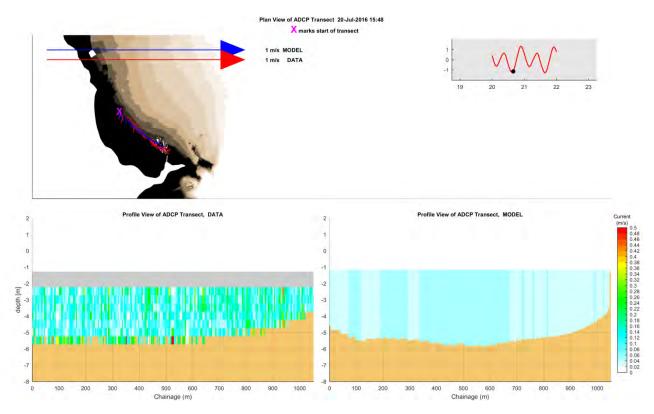


Figure 3-10 ADCP Transect Comparison 20/07/2016 15:48

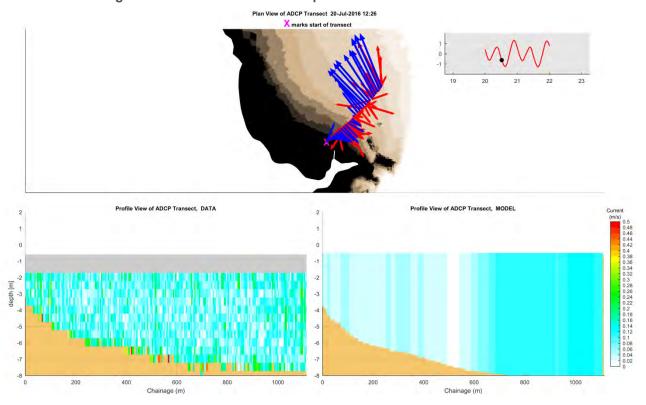


Figure 3-11 ADCP Transect Comparison 20/07/2016 12:26



4 Impact Assessment

4.1 Methodology

The proposed development consists primarily of the development of a new and larger detached break-water and an associated jetty/landing structure and moorings leeward of this structure along with associated upgrades to onshore facilities including car park facilities, toilets and pull-off bays.

The wave and siltation impact assessments are based on numerical simulation of existing case and developed case configurations and derivation of differences (impacts) due to the proposed design. The existing case was derived from bathymetric datasets described in Section 3.1. The refined concept design was supplied as a Digital Elevation Model by TMR's design consultant (KBR).

Layouts and the bathymetry of the base and developed case are shown in Figure 4-1.

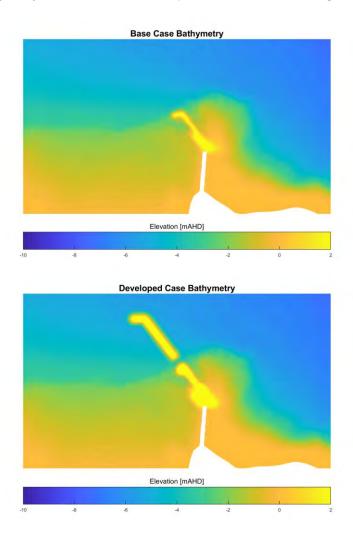


Figure 4-1 Design Scenario Bathymetry and Layouts



4.2 Wave Penetration Investigation

An assessment of the wave penetration in and behind the breakwater has been carried out using the SWASH modelling system. In order to assess the breakwater's response in both typical and extreme conditions, a 1-year Average Recurrence Interval (ARI) and 50-year ARI design conditions were modelled. The derivation of design conditions is detailed in BMT WBM (2017b) and the offshore design wave conditions are summarised in Table 4-1.

Average Recurrence Interval (years)	Water Level (m AHD)	Offshore Significant Wave Height <i>H</i> _s (m)	Peak Wave Period T_p (s)	Mean Wave Period T_{m01} (s)
1	1.34	2.0	6.7	4.7
50	2.55	3.0	8.2	5.9

Table 4-1 Design Wave Condition Summary

Spatial plots of the modelled significant wave height for both 1-year and 50-year ARI conditions is presented in Figure 4-2 and Figure 4-3 respectively. These figures show the base case, the developed case and the impact to the base case for each scenario.

Criteria for 'good' wave climate in small craft harbours (as reproduced in Table 4-2 below) were used to assess the protection benefits of the refined concept.

Table 4-2 AS3962 Guidelines for Design of Marinas (Table 4.2)

CRITERIA FOR A G	OOD WAVE CLIMATE IN SMALL CRAFT HARBOURS
	Significant wave height (H)

Direction and peak period	Significant wave height (H _s)			
of design harbour wave	Wave event exceeded once in 50 years	Wave event exceeded once a year		
Head seas less than 2 s	Conditions not likely to occur during this event	Less than 0.3 m wave height		
Head seas greater than 2 s	Less than 0.6 m wave height	Less than 0.3 m wave height		
Oblique seas greater than 2s	Less than 0.4 m	Less than 0.3 m wave height		
Beam seas less than 2 s	Conditions not likely to occur during this event	Less than 0.3 m wave height		
Beams seas greater than 2 s	Less than 0.25 m wave height	Less than 0.15 m wave height		

NOTE: For criteria for an 'excellent' wave climate multiply wave height by 0.75, and for a 'moderate' wave climate multiply wave height by 1.25. For vessels of less than 20 m in length, the most severe wave climate should satisfy moderate conditions. For vessels larger than 20 m in length, the wave climate may be more severe.

Source: Adapted from MERCER, A.G., ISAACSON, M. and MULCAHY, M.W. Design wave climate in small craft harbours. 18th Conference on Coastal Engineering, Capetown, 1982.

The wave impact plots shown in Figure 4-2 and Figure 4-3 indicate that there would be some wave reflection from the eastern side of the breakwater, which would generate standing wave interactions between incoming and reflected waves. These standing waves would in turn be expected to result in increased wave-induced shear stresses acting on the seabed within 1-2 wavelengths (~100m) of the eastern side of the structure. The seabed in this area is sandy and there may be some localised morphological response to the changed conditions. The potential for siltation in the lee (to the west) of the breakwater structure is considered further in Section 4.4.



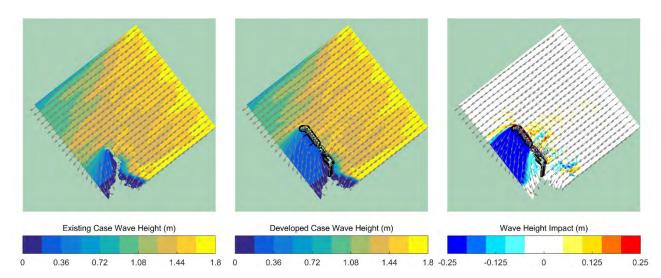


Figure 4-2 Refined Concept, 1 year ARI North-Easterly

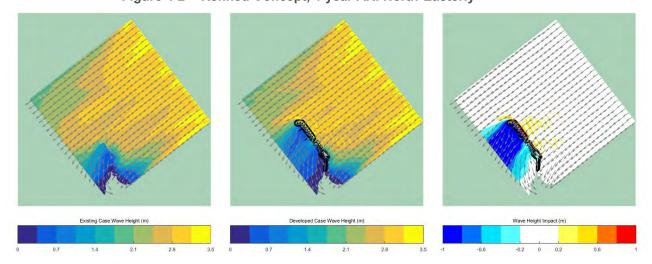


Figure 4-3 Refined Concept, 50 year ARI North-Easterly

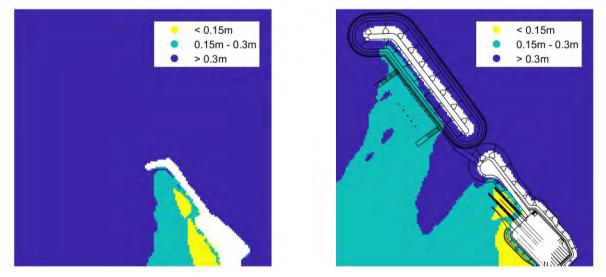


Figure 4-4 Significant wave height exceedance envelopes for 1 year ARI waves



4.3 Wave Sheltering Investigation

The degree of wave sheltering to the west of Clump Point is an important consideration for potential shoreline alignment and siltation impacts associated with the proposed development. This has been assessed using the 10 m resolution SWAN model simulating both 1-year ARI and 50-year ARI conditions. The wave sheltering investigation results are shown in Figure 4-5 and Figure 4-6 for the 1-year ARI and 50-year ARI's respectively.

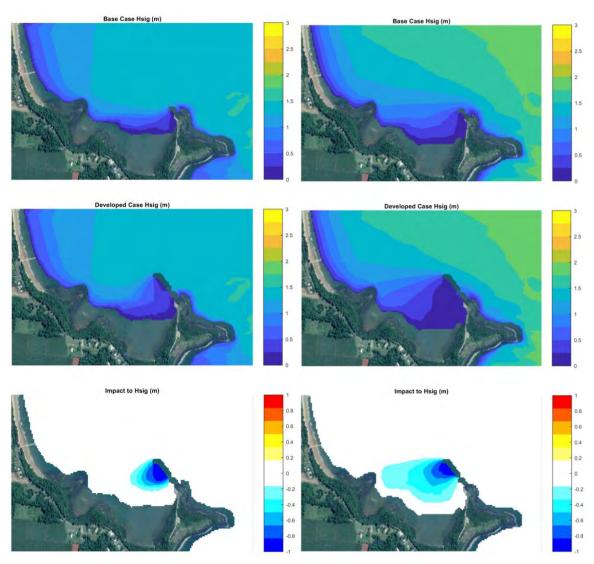


Figure 4-5 Wave height impacts for 1-year ARI conditions. Left – North-Easterly direction; Right – South-Easterly direction.



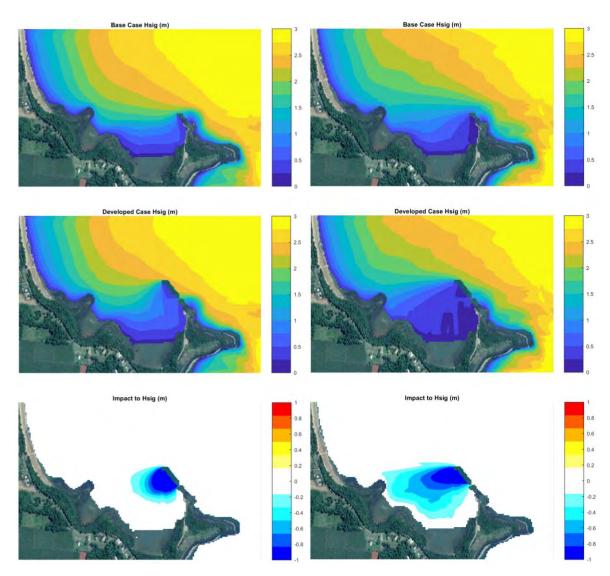


Figure 4-6 Wave height impacts for 1-year ARI conditions. Left – North-Easterly direction; Right – South-Easterly direction.



4.4 Siltation Investigation

The siltation assessment used the coupled TUFLOW FV – SWAN models to simulate sediment transport over a one-month period. This period was selected as the 20/07/2016 to 20/08/2016, which encompasses the end of the data collection period, and has wind conditions reasonably typical of the long-term prevailing conditions (Figure 4-7). The resulting change in bed material at the end of the design month was converted to an equivalent annual quantity, with the computed volume of deposition in the lee of the structure (including the existing facility) presented in Table 4-3. These siltation rates are based on changes from the proposed structure across to the mainland.

ScenarioTotal Siltation (m³/y)Existing (base)26Refined Concept72

Table 4-3 Modelled Siltation Volumes

Spatial plots showing the distribution of siltation, as well as the difference in the siltation to the existing case are shown in Figure 4-8. The refined concept reduces the siltation rate in the lee of the existing breakwater and generates a larger zone of low intensity siltation potential in the lee of the detached breakwater. The predicted rate of fine-sediment accumulation in the lee of the new breakwater is only 1-2 mm/year.

The existing case siltation predictions are in line with the historical experience that there is only very limited potential for siltation in the immediate lee of the existing breakwater, under typical prevailing conditions. Based on surveys approximately 650cu.m of siltation has occurred since the boat ramp was upgraded in 1999 to when removal works were undertaken in 2015. Increased rates of siltation are expected to have occurred during the landfall of TC Larry and TC Yasi (pers comms Chris Voisey TMR). The model predicts that only 26m³/year of siltation occurs for the base case, which is a relatively small quantity and consistent with the observed siltation.

The modelling has determined that the siltation rates associated with the refined concept are very low and subsequently there is unlikely to be a need for maintenance dredging. Furthermore, the proposed structures are shown to have only relatively minor impacts to hydrodynamic, wave or sedimentation processes across the bay (to the west). While the developed case scenario has predicted higher siltation than the existing case, neither present levels of siltation that would require maintenance dredging. It is however possible that during extreme events (such as a major tropical cyclone), sedimentation has the potential to occur that may instigate the need for some maintenance works, which is consistent with the requirements of the existing facility.

Silt-sized material is unlikely to deposit within the gap, regardless of the spacing, as the wave and current conditions within this zone is predicted to be too energetic to allow fine material to fall out of suspension there.



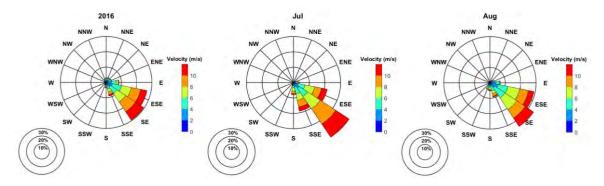


Figure 4-7 Wind Roses for Long-Term (Left); July (Middle); and August (Right)

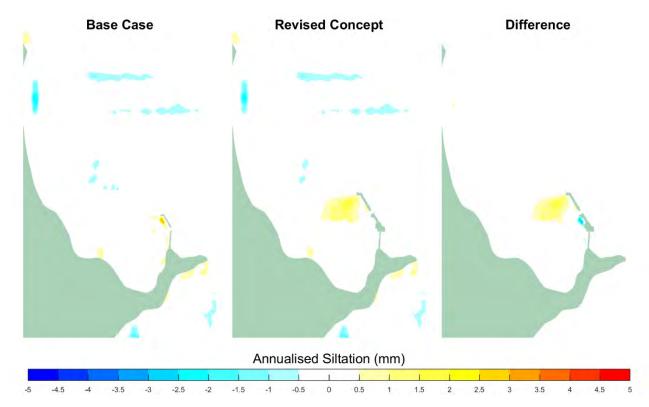


Figure 4-8 Siltation modelling impact results, showing reduced siltation in the lee of the existing breakwater and a zone of low intensity increased siltation behind the new detached breakwater.



5 Conclusions

This numerical modelling assessment to support the Clump Point Boat Ramp Development Plan has considered potential impacts of the refined design concept (as of November 2017). The assessment has considered both the wave protection benefits of the structure, wave sheltering to the west of the structure and the potential for longterm ambient siltation as an impact from the development.

A sediment transport modelling assessment has concluded that while there will be potential for some increased siltation in the lee of a new breakwater structure it is unlikely that this will occur to an extent that would require regular ongoing maintenance dredging. There may however be a need for some maintenance works following a severe tropical cyclone event.



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Appendix G- tech note- NE wave impact on siltation

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Dear Chris

RE: RESPONSE TO GBRMPA COMMENT

This memorandum has been prepared as a response to the following query raised by GBRMPA in rreferring to the *Mission Beach Clump Point Boating Infrastructure Project: Coastal Modelling Report* (R.B22856.003.02.Modelling_Report, November 2017).

Have the potential impacts of northerly winds (on turbidity, sedimentation) been fully investigated? Where are the results?

The *Modelling Report* described impact assessments comprising a Wave Penetration Investigation, a Wave Sheltering Investigation and a Siltation Investigation. The latter investigation considered a 1-month numerical model simulation of the period from the 20/7/2018 to 20/8/2018, which was shown to be typical of the long-term prevailing conditions, i.e. dominated by winds from the SE to ESE sectors. The model simulation showed a region of low-level siltation in the lee of the new detached breakwater and a reduction in siltation behind the existing breakwater. The overall quantity of predicted siltation was sufficiently low that a requirement for regular maintenance dredging was considered to be unlikely.

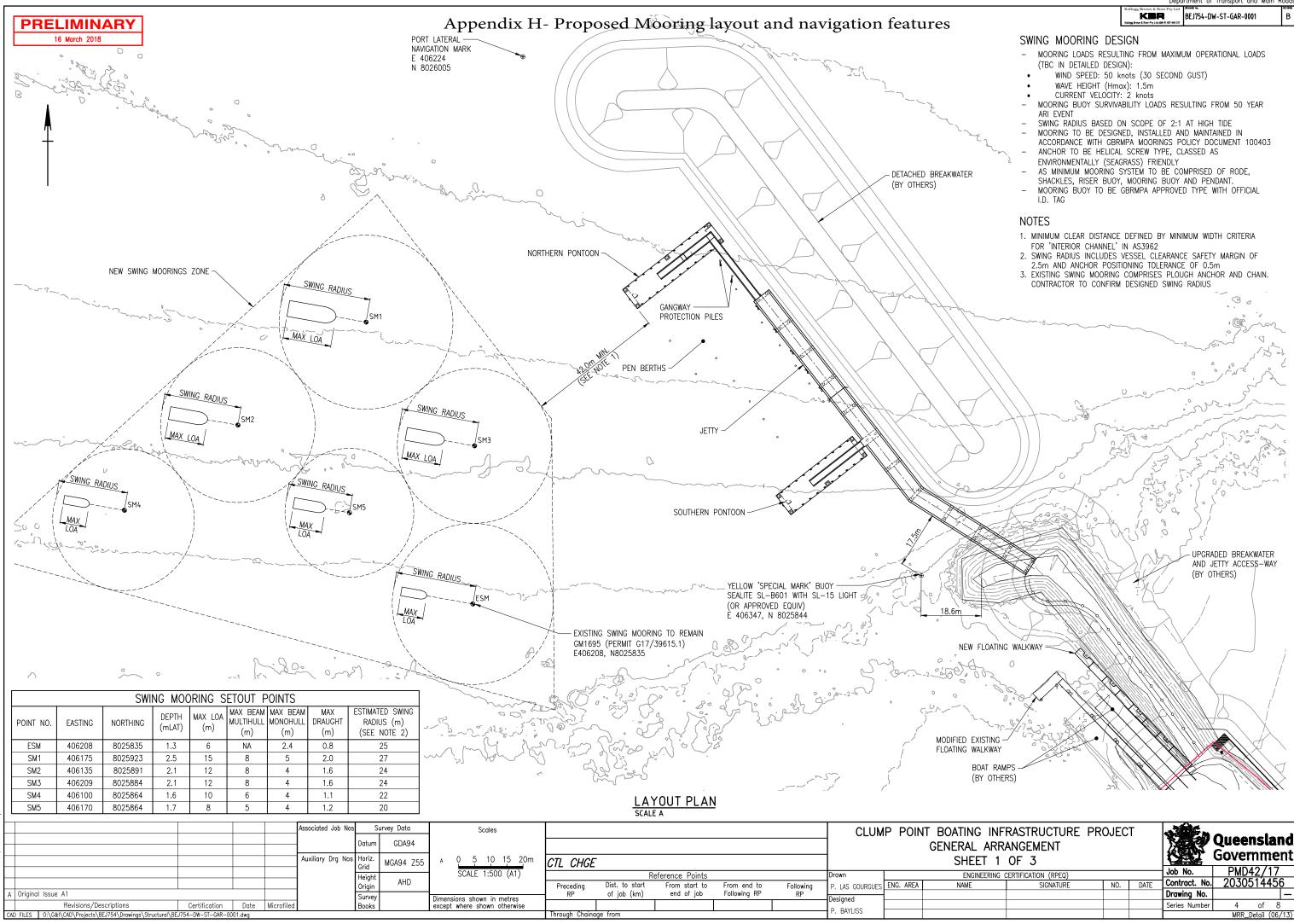
The GBRMPA query asks whether the potential impacts of northerly winds have been fully investigated. As shown in Figure 4-7 of the *Modelling Report*, only a very small percentage (~1.3%) of the long term wind record is from the N to ENE sectors and stronger than 6 m/s (required to generate appreciable wave action). That is, the GBRMPA query relates to a relatively unusual set of conditions.

The wave penetration and sheltering investigations explicitly considered both SE and NE wave conditions, as the latter (while rarely occurring) are important from a mooring design perspective. It can be seen that the pattern of predicted siltation impacts behind the new detached breakwater (Figure 4-8 of the *Modelling Report*) are broadly similar to the zone of wave sheltering that was assessed for the 1-year ARI SE wave condition (RHS of Figure 4-5 of the *Modelling Report*). This indicates that the increased siltation is predominantly a function of decreased wave energy behind the proposed structure. The overall rate of siltation is limited by the relatively low levels of re-suspended sediment in the water column.

Comparing the 1-year ARI NE wave condition (LHS of Figure 4-5 of the *Modelling Report*) with the SE wave condition (RHS of same figure), indicates that the wave sheltering impacts of the structure are in fact most pronounced for the SE case. On this basis it is considered likely that SE dominated conditions would yield higher siltation impacts for the Developed Case than NE conditions. Furthermore, given that NE conditions

represent only a very small fraction of the long term conditions, the siltation investigation provided in the *Modelling Report* is considered to be a representative depiction of the overall impacts to siltation.

In summary, the conclusions stated in the *Modelling Report* related to the scale and intensity of siltation impacts would not be expected to differ based on a simulation of the rarely occurring NE wave condition.



Appendix I- Design wave and storm tide assessment

Document	M.B22205.001.01.DesignWaves.docx						
Title	Clump Po	int Design Wave Assessment					
Client	Departme	nt of State Development					
Revision Number	1						
Date	17 th May 2	2017					
Issued by	IAT	Dull					
Checked by	MJA	M & andus					

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Technical Note

CLUMP POINT DESIGN WAVE ASSESSMENT

1 Background

The Queensland Government, through the Department of State Development (DSD), has responded to community requests to enhance maritime infrastructure within Boat Bay, Mission Beach, to improve boating safety and amenity. The objective of the Mission Beach Safe Boating Infrastructure Project (the Project) is to provide conditions which allow the safe transfer of passengers and goods in non-extreme wave conditions.

The Clump Point Boating Facilities Upgrade Development Plan (Draft) was released in February 2017 (DSD 2017) and presented a concept design for an upgraded breakwater and new detached breakwater to protect an upgraded boat ramp, vessel berths and pontoons as shown in Figure 1-1. It should be noted that detailed design has not yet been undertaken for the project and it is expected that both size and position of the detached breakwater will be refined as part of detailed design.

The Scope of Work addressed by this technical memorandum is the derivation of suitable design wave and storm tide conditions to inform the detailed design assessment for offshore elements of the Project.

In accordance with AS4997 Table 2-1 the proposed facility is considered a normal maritime structure which is recommended to have a 50-year design life (given the low hazard risk) and hence is expected to be designed for a 1 in 200 annual probability of exceedance design wave event.

Design wave assessments have previously been undertaken by Aurecon (2014) for a proposed facility at the Perry Harvey jetty, which is located approximately 1 km WNW of Clump Point. From this assessment, the 200 year ARI significant wave was estimated to be 3.2 m with a concurrent peak wave period of 9 s. The 1 year ARI significant wave height estimate was 1.3 m with a concurrent peak wave period of 6 s.

Cassowary Coast Regional Council (CCRC) completed an updated Storm Tide Study for their coastline, including Clump Point in 2015 (BMT WBM, 2015). The updated storm tide study derived design water storm tide and wave conditions under extreme tropical cyclone conditions up to the 1 in 10,000 year ARI using a Monte Carlo simulation methodology. Non-tropical cyclone extreme water levels were also derived from analysis of water levels measured at the Clump Point tide gauge.

As part of the Clump Point Boating Facilities Upgrade Development Plan (DSD, 2017), metocean data including wave measurements was collected offshore from Clump Point for the period between 19th July

2016 and 1st August 2016 (BMT WBM, 2016a). A numerical modelling assessment was also undertaken (BMT WBM, 2016b) to compare breakwater development options specifically looking at performance with respect to assessing the following:

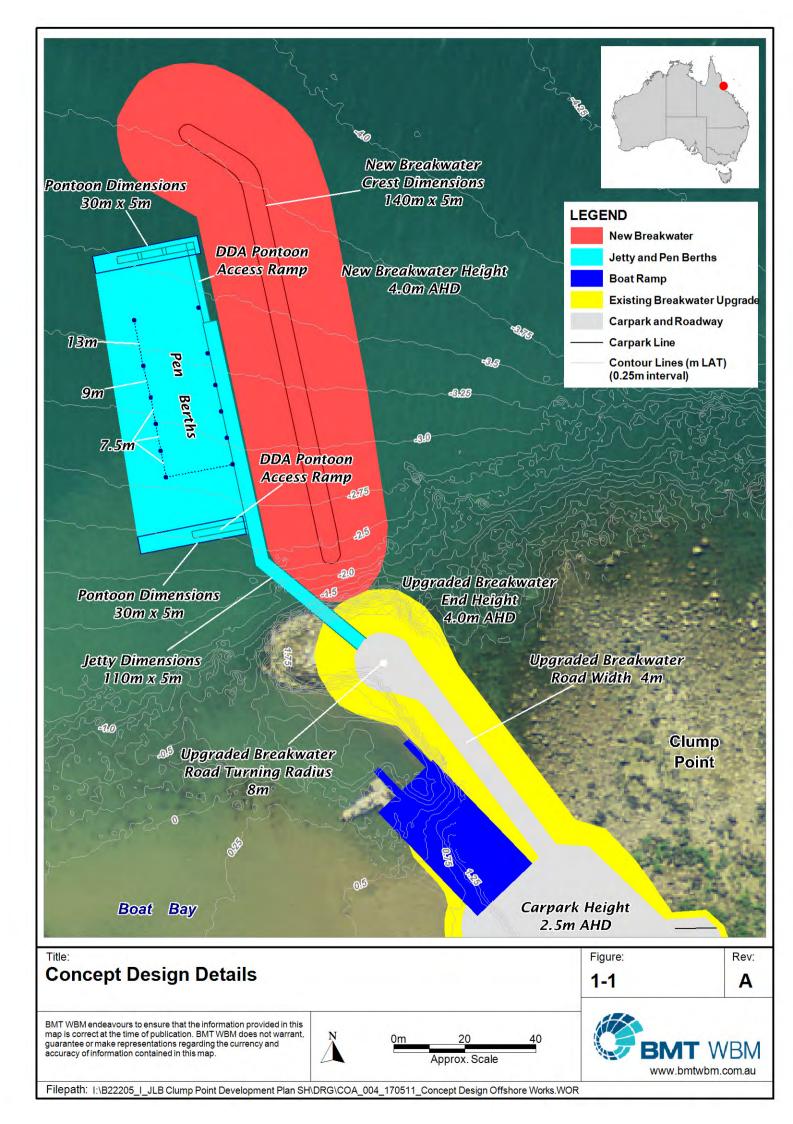
- leeward wave protection provided by specific options for operational wave conditions;
- likely siltation trends associated with specific options; and
- different breakwater gap widths and how these influence coastal processes.

Wave penetration modelling was undertaken for the following derived wave and water level conditions:

- 1 in 1 year: Water level = 1 m AHD and Wind speed = 15.5 m/s. The predicted significant wave height was approximately 2.5 m (on the eastern side of Clump Point).
- 1 in 50 year: Water level = 2.25 m AHD and Wind speed = 34.7 m/s. The predicted significant wave height was approximately 4 m.

BMT WBM (2016b) recommended that while these wind speeds and coincident water levels provided a sound basis for preliminary options assessment, they may be overly conservative and should be further refined before undertaking detailed design. The current Scope of Work addresses this recommendation as outlined below.

A numerical model hindcast of Clump Point wave conditions has been performed as described in Section 2. Based on the wave hindcast and results from the CCRC Storm Tide Study, design Wave conditions have been derived for the Clump Point Boating Facilities Project, as described in Section 3. A summary of the recommended design conditions is provided in Section 4.



2 Clump Point Wave Hindcast

2.1 Model Description

A numerical model hindcast of Clump Point wave conditions has been performed using an updated version of the SWAN wave modelling system described in BMT WBM (2016b). SWAN (Delft University of Technology, 2006) is a third-generation spectral wave model, which is capable of simulating the generation of waves by wind, dissipation by white-capping, depth-induced wave breaking, bottom friction and wave-wave interactions in both deep and shallow water. SWAN simulates wave/swell propagation in two-dimensions, including shoaling and refraction due to spatial variations in bathymetry and currents. This is a global industry standard modelling package that has been applied with reliable results to many investigations worldwide.

A regional SWAN model that extended offshore of the Australian continental shelf was forced with both wind and offshore swell boundary conditions. Four nests of increasing resolution were then used to resolve the waves closer to the area of interest. The resolutions (spacing of grid elements) and extents of the various SWAN domains are shown in Figure 2-1.

Offshore swell boundary conditions were derived from the NOAA WaveWatch 3 global hindcast dataset. The wind boundary condition was derived from the Bureau of Meteorology's Lucinda AWS, which is located on a jetty in an exposed coastal location approximately 80km south of Clump Point. Where data from this site was not available, the wind boundary condition timeseries has been patched with wind extracted from the NOAA CFSRv2 global model hindcast. The inner nest was provided with time-varying water levels derived from the Clump Point storm tide gauge (DSITI).

The modelling system was validated against wave measurements obtained as part of the 2016 Metocean monitoring (BMT WBM, 2016a), with a comparison shown in Figure 2-2.

The wave model used in this assessment is forced by a spatially-uniform windfield derived from the Lucinda AWS and is therefore does not resolve rapidly varying windfields which are typically associated with the inner regions of tropical cyclones. The CCRC storm tide study (BMT WBM, 2015) undertook a Monte Carlo simulation of tropical cyclone storm waves using a Holland parametric windfield approach. The CCRC storm tide study results have been used along with the 11-year hindcast simulation results to inform the design wave statistics assessment.

2.2 Hindcast Period

The wave hindcast was performed for an 11-year period from 1/1/2006 to 1/1/2017, which includes several severe coast-crossing Tropical Cyclones, most notably Yasi in February 2011. The wind rose for the hindcast period is shown in Figure 2-3.

2.3 Results

Hourly timeseries of wave parameters (Hs, Tm01, Tp, Dir, PDir) were derived from the hindcast simulation at two locations described below.

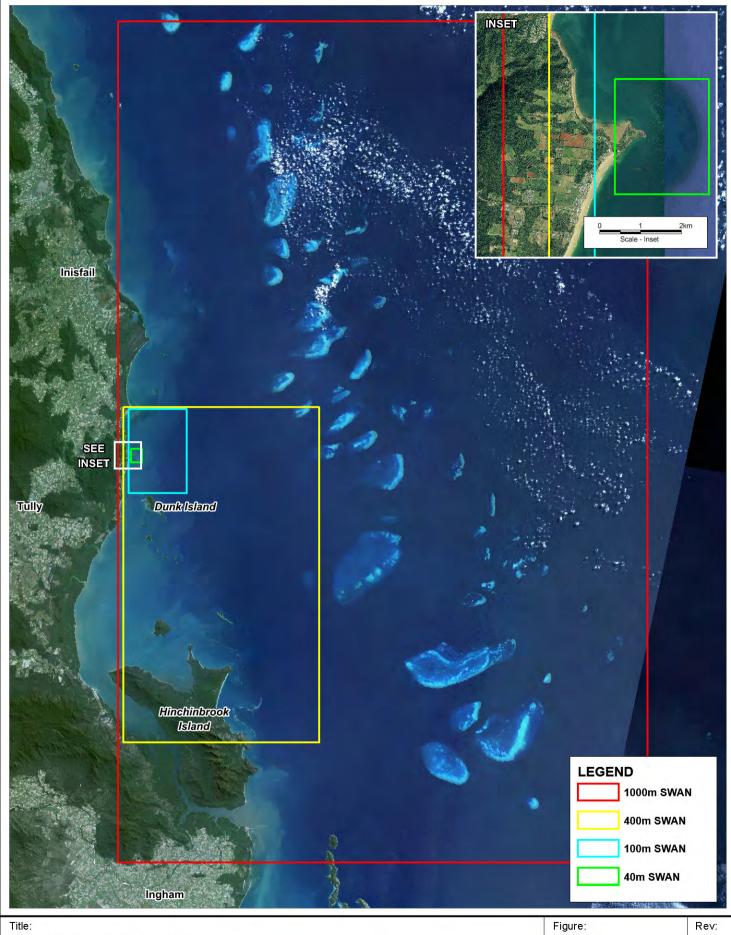
- Location 1: 500 m east of the proposed breakwater in 7.5 m water depth (below AHD)
 Longitude, Latitude = [146.1211°, -17.8515°]
- Location 2: Adjacent to the proposed breakwater in 5.9 m water depth (below AHD)
 Longitude, Latitude = [146.1164 °, -17.8515 °]

The reporting locations are shown in Figure 2-4.

A snapshot plot of modelled wave field during a 25 knot SE wind condition is shown in Figure 2-5. This figure provides an indication of the spatial distribution of waves under prevailing strong wind conditions.

A timeseries of modelled significant wave height at Location 1 is shown in Figure 2-6.

Where wave directions are reported, these are directions that the waves are coming from, measured clockwise from due North.



SWAN Model Extents

Figure:

Rev:

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

N

0 15 30km Approx. Scale BMT WBM www.bmtwbm.com.au

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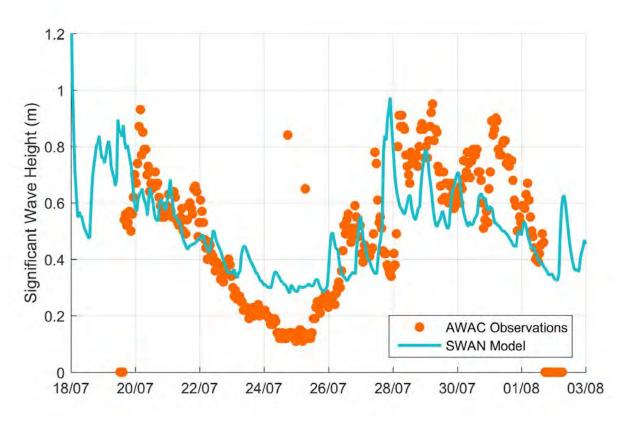


Figure 2-2 Modelled versus Measured Wave Height Comparison (July/August 2016).

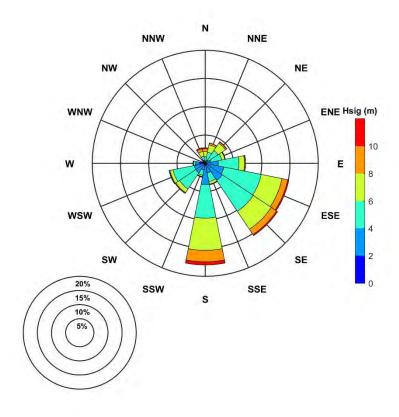
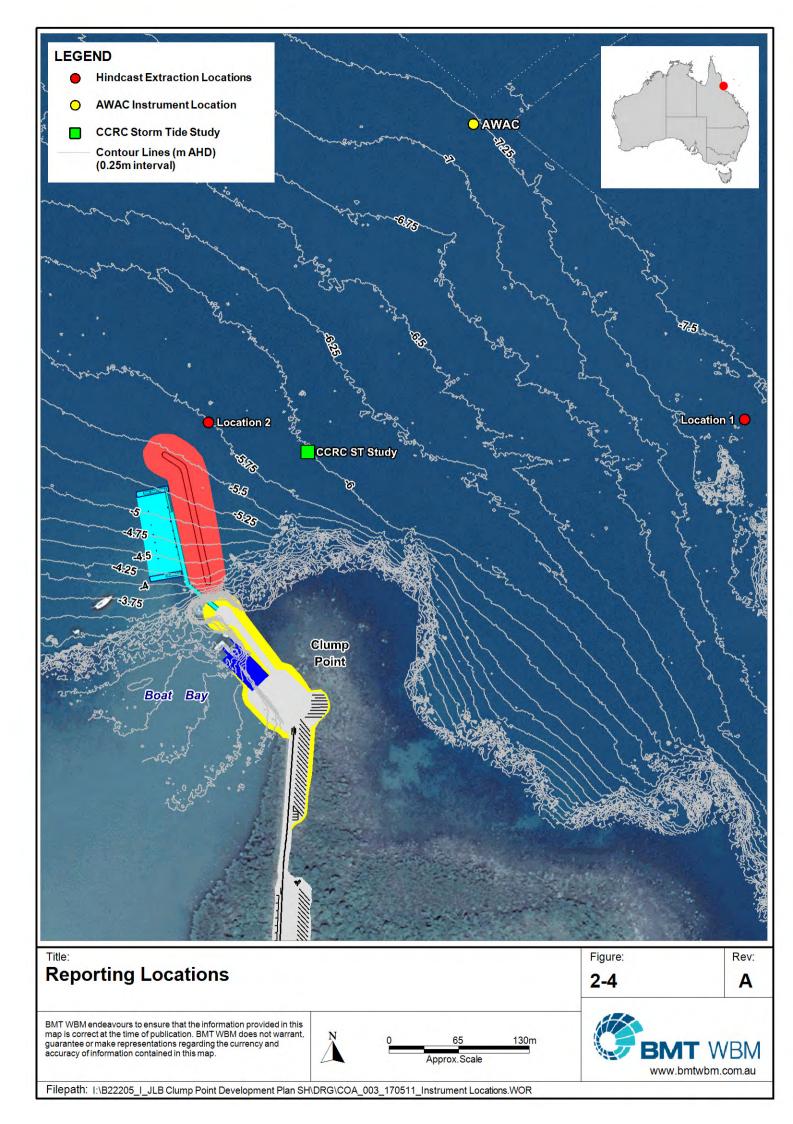


Figure 2-3 Wind Rose, Lucinda AWS 2006-2017 (patched with CFSRv2).



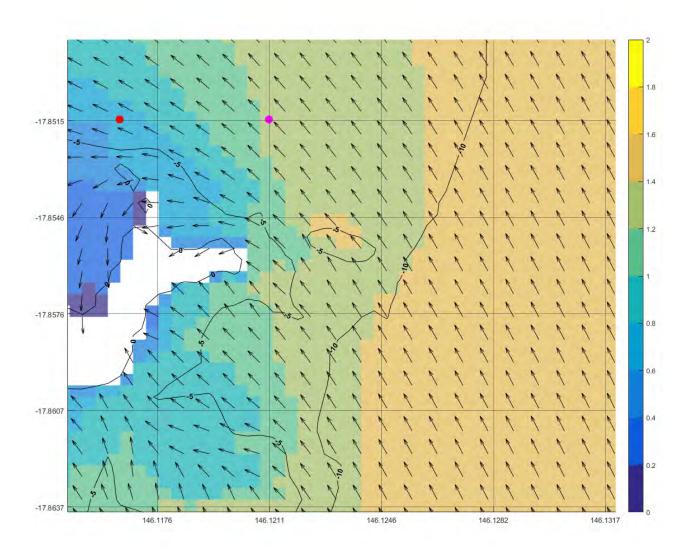


Figure 2-5 Modelled Wave Field During 20-25 knot SE wind Conditions. Data reporting locations are shown. Location 1 (magenta). Location 2 (red).

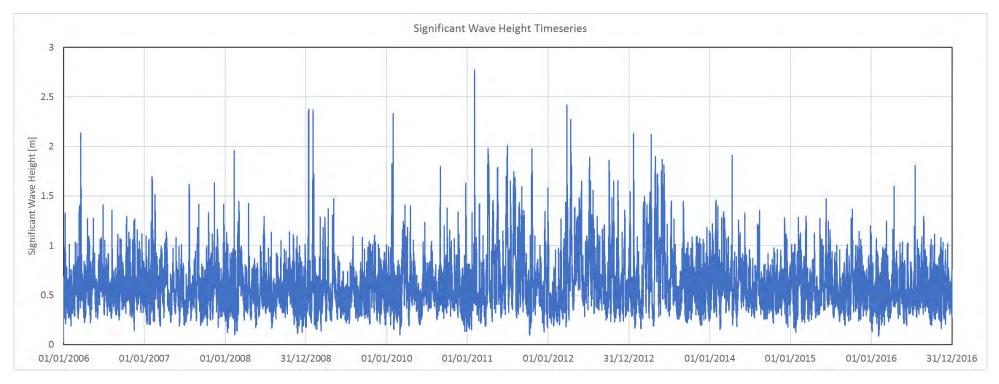


Figure 2-6 Hindcast Significant Wave Height Timeseries at Location 1.

3 Design Wave Statistics

3.1 Ambient Conditions

The wave climate at Location 1 (500 m east of the proposed breakwater) is dominated by waves from the ESE sector (see Figure 3-1a and Table A-1). Due to sheltering and wave refraction the wave climate at Location 2 (adjacent the proposed breakwater) is dominated by waves from the E sector (see Figure 3-1b and Table A-2).

At Location 1 the median significant wave height is 0.55 m, with 52% of waves from the 90-120 sector. The 95th percentile significant wave height, which represents the level exceeded for 18.25 days (438 hours) a year, is 1.06 m.

At Location 2 the median significant wave height is 0.45 m, with 51% of waves from the 90-120 sector. The 95th percentile significant wave height is 0.84 m.

As shown in Table A-3 and Table A-4, typical low energy wave conditions exhibit a broad range of peak wave periods from 2 to 18s, which reflects the combined influence of wind acting on fetches within the GBR lagoon and a small amount of swell penetration from the Coral Sea. For higher wave heights (Hs>0.75m) the peak period is usually in the range from 4 to 9s.

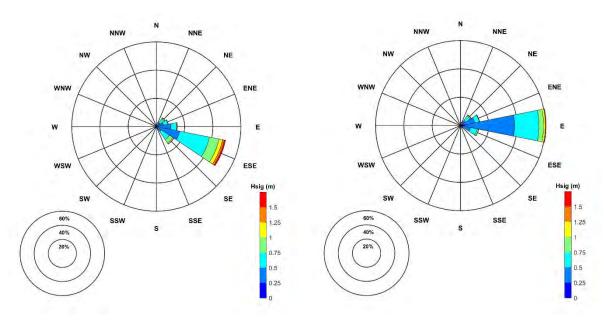


Figure 3-1 Wave Roses. Location 1 (left), Location 2 (right).

3.2 Design Conditions

3.2.1 Event Selection

A Peak Over Threshold (POT) approach was used to select independent peak wave height peak conditions from the continuous hindcast dataset. Peak significant wave heights greater than a threshold (in the range 1.2–1.4 m) were selected for extreme value analysis. A period of 5 days between peaks was adopted to ensure independence of events. The top 10 largest wave heights from the 11 year hindcast are summarised in Table 3-1 (for Location 1). Five of the top 10 peak wave heights can be attributed to tropical cyclone events, and the largest hindcast wave height was due to TC Yasi in February 2011.

Table 3-1 Top 10 Largest Hindcast Wave Heights (Location 1)

Rank	Date	Event Name	Peak Hs (m)
1	03/02/2011	TC Yasi	2.77
2	26/03/2012		2.42
3	13/01/2009		2.38
4	01/02/2009	TC Ellie	2.37
5	30/01/2010	TC Olga	2.33
6	12/04/2012		2.27
7	19/03/2006	TC Larry	2.14
8	22/01/2013	TC Oswald	2.13
9	11/04/2013		2.12
10	01/07/2011		2.01

3.2.2 Hindcast Extreme Value Analysis

In order to derive significant wave heights corresponding to the design recurrence intervals relevant to the Project, Extreme Value Analysis (EVA) was performed on the POT sample of independent peak wave heights (Coles, 2001). Generalised Pareto distributions were fitted to the POT exceedances using a Maximum Likelihood estimator fitting technique. Distributions were fitted to population samples representing all hindcast wave height peaks ("All Data") and only non-tropical cyclone event wave height peaks ("Non-TC Data"). The EVA return level plots showing the distribution fit to the hindcast data is shown Appendix A. The best-estimate significant wave heights for the 1, 10, 50, 100 and 200-year Average Recurrence Intervals at both hindcast reporting locations is summarised in Table 3-2.

Table 3-2 Design Significant Wave Heights (m) from Hindcast Assessment

Average Recurrence Interval (years)	Location 1 Significant Wave Height (All Data)	Location 1 Significant Wave Height (Non-TC Data)	Location 2 Significant Wave Height (All Data)	Location 2 Significant Wave Height (Non-TC Data)
1	1.96	1.81	1.64	1.47
10	2.63	2.38	2.37	2.01
50	3.05	2.76	2.88	2.39
100	3.22	2.92	3.10	2.55
200	3.39	3.08	3.32	2.72

3.2.3 CCRC Storm Tide Study

Storm tide and significant wave heights have been extracted from the CCRC Storm Tide Study (BMT WBM, 2015). Note that the location of the results presented here differs from the Clump Point extraction point summarised in the CCRC report.

The CCRC study derived tropical cyclone storm tide levels and wave heights up to a 1 in 10,000 year ARI, using a monte carlo simulation approach. Non-tropical cyclone storm tide levels were also derived based on an analysis of measured water level time history from the Clump Point storm tide gauge (located on Perry Harvey jetty and maintained by DSITI). The storm tide levels reported here are the

maximum of the non-cyclonic and cyclonic estimates, and are dominated by the latter up to the 200 year ARI. An allowance for Sea Level Rise has not been included in the reported storm tide levels.

The design water levels and significant wave heights from the CCRC Storm Tide Study are summarised in Table 3-3. The significant wave heights reported below are only for cyclone events and are generally comparable with the wave heights derived from the hindcast simulation and reported in Table 3-2.

Table 3-3 Design Water Levels and Significant Wave Heights from CCRC Storm Tide Study (BMT WBM, 2015)

Average Recurrence Interval (years)	Storm Tide Level ¹ (m AHD)	Significant Wave Height (m)
50	2.25	3.14
100	2.31	3.19
200	2.37	3.23

¹ Current climate storm tide level taken as maximum of Cyclonic and Noncyclonic design levels. Does not include future Sea Level Rise.

3.2.4 Directional Distribution

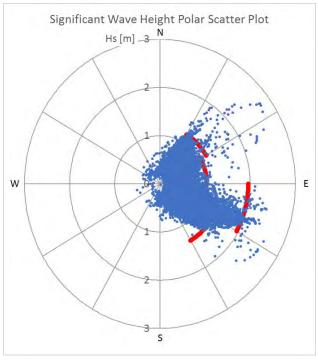
The significant wave height directional distribution from the hindcast simulation is shown in Figure 3-2. Significant wave heights greater than 2 m may occur at Location 1 along with directions anywhere from NE through to SE sectors. The most frequent direction for extreme waves at Location 1 is ESE. However, it should be noted that the largest modelled wave heights occurred during TC Yasi and were from the NE shortly after the system made landfall.

Due to the orientation of the bathymetric contours, waves from the SE sector tend to have refracted to be from the E sector at Location 2. Waves from the NE sector do not refract substantially between Location 1 and 2.

AS3962 Guidelines for Design of Marinas Table 4.2 uses a 1 in 1 year design wave event to assess the quality of mooring conditions. A directional analysis of the 1 year ARI design wave has been undertaken using the hindcast simulation dataset, and is summarised in Table 3-4.

Table 3-4 1 year ARI Design Significant Wave Height (m) Across Directional Sectors

Directional Sector (deg True)	Location 1 Significant Wave Height	Location 2 Significant Wave Height
Omni	1.96	1.64
30-60	1.18	1.24
60-90	1.04	1.41
90-120	1.96	1.64
120-150	1.36	-



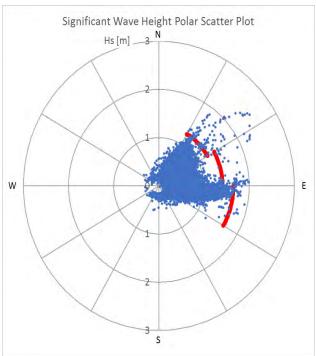


Figure 3-2 Significant Wave Height Scatter Plot.

Red Lines are the 1- Year ARI Wave Height Estimates.

Location 1 (top), Location 2 (bottom).

3.2.5 Wave Period

A scatter plot of wave period versus significant wave height is shown in Figure 3-3. Using this output as a guide it is suggested that a wave steepness of around 1 in 45 would be a reasonable (upper bound) estimate of peak wave period for design conditions greater than or equal to the 1 year ARI. This corresponds to wave periods of 7.5, 9.4 and 9.9 s for the 1, 50 and 200 year ARIs respectively.

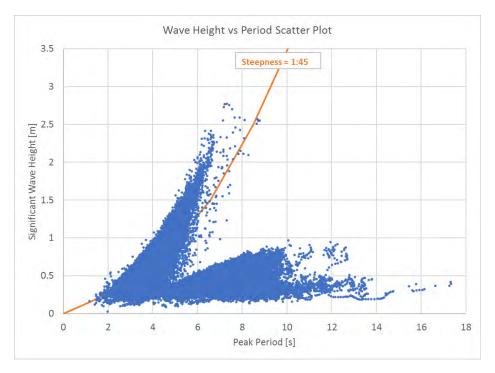


Figure 3-3 Wave Height vs Period Scatter Plot (Location 1)

3.2.6 Concurrent Water Levels

Analysis of water levels measured at the DSITI Clump Point storm tide gauge indicates that a Mean High Water Spring (MHWS) level of 1.04 m AHD is an appropriate design water level to be used concurrently with a 1 year ARI wave condition. This conclusion is based on there being approximately 10 days in the 11 year hindcast where wave heights exceeded the 1 year ARI level and concurrent water levels exceeded MHWS.

For the 50 and 200 year ARI design conditions, it would be appropriately conservative to use the storm tide levels in Table 3-3 concurrent with the corresponding design wave heights.

It should be noted that the design water levels reported here do not include a future Sea Level Rise allowance. An appropriate allowance should be selected and applied in the basis of design for the Project.

4 Summary

The recommended design conditions for design of the Clump Point offshore breakwater are summarised in Table 4-1 below.

Table 4-1 Clump Point Breakwater Design Condition Summary

Average Recurrence Interval (years)	Water Level ² (m AHD)	Significant Wave Height (m)	Peak Wave Period (s)
1	1.04	1.6–2.0 ³	7.5
50	2.25	3.1	9.4
200	2.37	3.4	9.9

² Does not include future Sea Level Rise allowance.

5 Qualifications

BMT WBM Pty Ltd has prepared this document for the Queensland Department of State Development and specifically to provide design wave estimates for the next design stage of the Clump Point Boating Facilities Upgrade project.

Our analysis and overall approach has been specifically designed for the requirements of the next design stage of the Clump Point Boating Facilities Upgrade project, and may not be applicable beyond this scope.

BMT WBM has relied on the following information supplied by others:

- Bathymetric data from multiple sources;
- Wind data from the Commonwealth Bureau of Meteorology;
- Global wave model data sourced from NOAA;
- · Clump Point storm tide gauge data supplied by DSITI; and
- Clump Point Boating Facilities Upgrade project concept layout as shown in DSD (2017).

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³ Lower number is wave height estimate at the structure, higher number is 500m east of structure. See Table 3-4 for directional distribution of 1 year ARI wave conditions.

6 References

Aurecon (2014a), *Mission Beach Safe Boating Infrastructure Project: Planning Report*, prepared for Department of State Development, Infrastructure and Planning, ref: 238465-002

Aurecon (2014b), Mission Beach Safe Boating Infrastructure Project: Detailed Design Report, Appendix G in Mission Beach Safe Boating Infrastructure Project: Planning Report (Aurecon, 2014a)

BMT WBM (2015), Cassowary Coast Regional Council Coastal Hazards Assessment: Storm Tide Inundation, prepared for Cassowary Coast Regional Council.

Coles, Stuart (2001), An Introduction to Statistical Modelling of Extreme Values, Spring Series in Statistics, 2001d

Delft University of Technology (2016), SWAN Scientific and Technical Documentation, version 41.10. http://swanmodel.sourceforge.net/online doc/swantech/swantech.html

DSD (2017), Clump Point Boating Facilities Upgrade - Development Plan, February 2017 (Draft).

BMT WBM (2016a), Clump Point Boat Ramp Development Plan – Coastal Process Modelling Study, prepared for Department of State Development.

BMT WBM (2016b), Clump Point Boat Ramp Development Plan – Coastal Process Modelling Study, prepared for Department of State Development.

Appendix A Design Wave Analysis

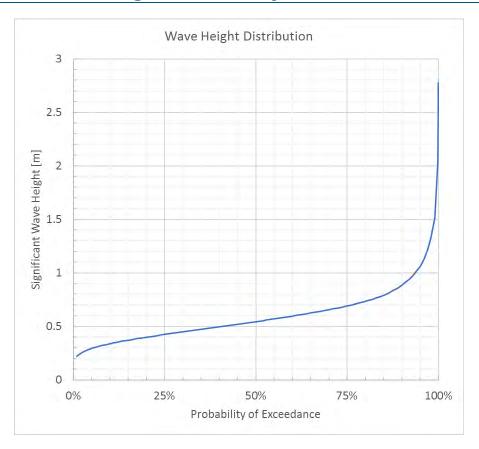


Figure A-1 Significant Wave Height Distribution (Location 1).

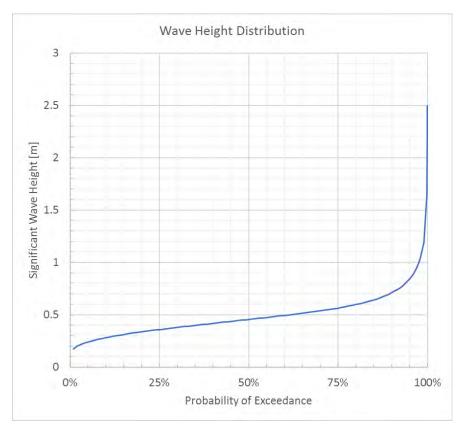


Figure A-2 Significant Wave Height Distribution (Location 2).

Table A-1 Percentage Occurrence of Wave Height and Direction Conditions (Location 1)

Hs [m]	Wave Di	Nave Direction [deg]											
	0-30	30-60	60-90	90-120	120-150	150-180	180-210	210-240	240-270	270-300	300-330	330-360	Total
0-0.25	0.034%	0.270%	0.589%	0.672%	0.374%	0.049%	0.024%	0.003%	0.003%	0.008%	0.004%	0.016%	2.05%
0.25-0.5	0.601%	3.770%	7.701%	20.226%	5.770%	0.594%	0.053%	0.006%	0.004%	0.006%	0.027%	0.030%	38.79%
0.5-0.75	0.967%	4.585%	3.816%	20.848%	10.555%	0.109%	0.003%		0.001%		0.001%	0.005%	40.89%
0.75-1	0.265%	1.075%	0.343%	6.035%	4.246%	0.005%							11.97%
1-1.25	0.029%	0.213%	0.036%	2.184%	1.274%								3.74%
1.25-1.5	0.004%	0.055%	0.002%	1.123%	0.352%								1.54%
1.5-1.75		0.016%	0.010%	0.539%	0.069%								0.63%
1.75-2		0.015%	0.002%	0.264%	0.006%								0.29%
2-2.25		0.005%	0.002%	0.057%	0.006%								0.07%
2.25-2.5		0.003%	0.005%	0.015%	0.004%								0.03%
2.5-2.75		0.003%	0.001%	0.001%	0.005%								0.01%
2.75-3		0.003%											0.00%
Grand Total	1.90%	10.01%	12.51%	51.96%	22.66%	0.76%	0.08%	0.01%	0.01%	0.01%	0.03%	0.05%	100.00%

 Table A-2
 Percentage Occurrence of Wave Height and Direction Conditions (Location 2)

Hs [m]	Wave Dire	Vave Direction [deg]											
	0-30	30-60	60-90	90-120	120-150	150-180	180-210	210-240	240-270	270-300	300-330	330-360	Total
0-0.25	0.074%	0.756%	3.407%	1.514%	0.211%	0.068%	0.032%	0.020%		0.006%	0.037%	0.037%	6.16%
0.25-0.5	0.514%	5.008%	24.129%	25.123%	0.752%	0.034%	0.014%	0.008%	0.004%	0.006%	0.010%	0.018%	55.62%
0.5-0.75	0.631%	5.027%	6.008%	18.573%	0.047%		0.001%					0.002%	30.29%
0.75-1	0.113%	1.027%	0.473%	4.014%									5.63%
1-1.25	0.005%	0.171%	0.084%	1.303%	0.001%								1.57%
1.25-1.5	0.001%	0.049%	0.039%	0.454%									0.54%
1.5-1.75		0.017%	0.024%	0.086%									0.13%
1.75-2		0.012%	0.018%	0.017%									0.05%
2-2.25		0.004%	0.003%										0.01%
2.25-2.5		0.008%	0.002%										0.01%
2.5-2.75													0.00%
2.75-3													0.00%
Grand Total	1.34%	12.08%	34.19%	51.09%	1.01%	0.10%	0.05%	0.03%	0.00%	0.01%	0.05%	0.06%	100.00%

 Table A-3
 Percentage Occurrence of Wave Height and Period Conditions (Location 1)

Hs [m]	Peak Peri	Peak Period [s]										
	<2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	Total		
0-0.25	0.050%	0.646%	0.472%	0.423%	0.359%	0.057%	0.031%	0.008%		2.05%		
0.25-0.5	0.041%	14.187%	3.832%	15.576%	4.467%	0.540%	0.125%	0.013%	0.006%	38.79%		
0.5-0.75		23.255%	6.611%	6.259%	4.681%	0.073%	0.012%			40.89%		
0.75-1		2.002%	9.598%	0.012%	0.301%	0.039%	0.018%			11.97%		
1-1.25			3.720%	0.017%						3.74%		
1.25-1.5			1.513%	0.024%						1.54%		
1.5-1.75			0.525%	0.110%						0.63%		
1.75-2			0.041%	0.246%						0.29%		
2-2.25			0.003%	0.065%	0.002%					0.07%		
2.25-2.5				0.026%	0.001%					0.03%		
2.5-2.75				0.005%	0.005%					0.01%		
2.75-3				0.003%						0.00%		
Grand Total	0.09%	40.09%	26.31%	22.77%	9.82%	0.71%	0.19%	0.02%	0.01%	100.00%		

 Table A-4
 Percentage Occurrence of Wave Height and Period Conditions (Location 2)

Hs [m]	Peak Per	iod [s]								Grand
	<2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	Total
0-0.25	0.070%	0.953%	1.789%	1.861%	1.118%	0.274%	0.074%	0.020%	0.003%	6.16%
0.25-0.5	0.019%	14.392%	6.225%	25.371%	8.620%	0.777%	0.199%	0.010%	0.008%	55.62%
0.5-0.75		10.830%	9.170%	4.371%	5.642%	0.226%	0.051%			30.29%
0.75-1		0.287%	5.203%	0.098%	0.023%	0.007%	0.009%			5.63%
1-1.25		0.001%	1.472%	0.091%	0.001%					1.57%
1.25-1.5			0.249%	0.291%	0.003%					0.54%
1.5-1.75			0.020%	0.102%	0.005%					0.13%
1.75-2			0.005%	0.035%	0.006%					0.05%
2-2.25				0.007%						0.01%
2.25-2.5				0.010%						0.01%
2.5-2.75										0.00%
2.75-3										0.00%
Grand Total	0.09%	26.46%	24.13%	32.24%	15.42%	1.28%	0.33%	0.03%	0.01%	100.00%

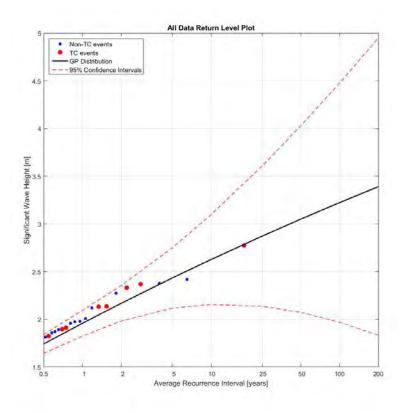


Figure A-3 Return Level Plot for All Hindcast Data (Location 1)

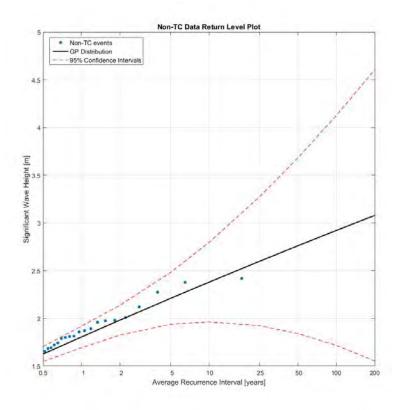


Figure A-4 Return Level Plot for Non-Tropical Cyclone Data (Location 1)

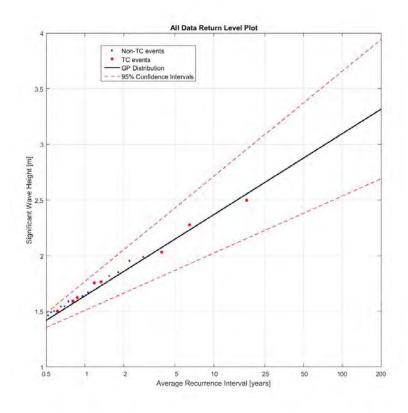


Figure A-5 Return Level Plot for All Hindcast Data (Location 2)

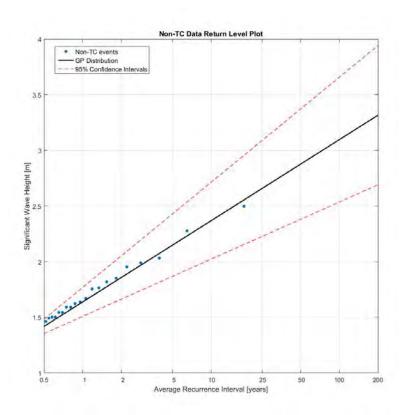
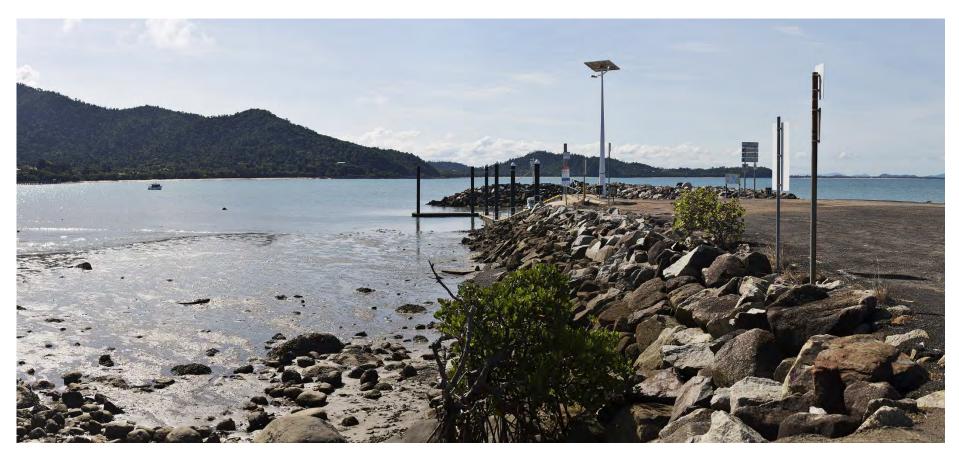


Figure A-6 Return Level Plot for Non-Tropical Cyclone Data (Location 2)

Appendix J- Visual Amenity images



Existing View - Clump Point Lower Carpark



Post Development View – Clump Point Lower Carpark

