walker

TOONDAH HARBOUR

APPENDIX 1 - E

ALTERNATE OPTIONS
ASSESSMENT

saunders havill group

Appendix 1-E

Alternate Options Assessment

Assessment of Harbour and Navigation Channel Upgrade Options

1.1. Upgrade Requirements

In order to provide a safe and functional upgrade of the existing harbour and ferry terminal that meets current and future need the following actions would be required at a minimum:

- Expansion of hardstand and car parking areas associated with the ferry precinct;
- A premium transport interchange designed to the Queensland Department of Transport and Main Roads' (DTMR) standards connecting the new ferry terminal with Cleveland CBD and the Cleveland Rail Station by public transport, taxis and private vehicles;
- Construction of new commercial facilities to provide offices and storage for ferry operators;
- Upgraded loading and unloading facilities for vehicle and pedestrian ferries;
- Berths for tourism and charter operators—previously these businesses have been unable to access the harbour due to capacity constraints;
- Dredging to widen and deepen the public navigation channel, the harbour navigation channel, and the turning basin to meet minimum navigational safety standards for a two-way channel, and allow for the future growth of harbour operations; and
- Disposal of the dredge material using a method other than reclamation.

Any on land and over water works at the harbour to meet the above scope would have a similar footprint and impact as the works included in the Toondah Harbour Project. Widening and deepening of the harbour navigation channel and turning basin has been designed in accordance with international and national guidelines and standards for safe navigation, including the PIANC Harbour Approach Channels Design Guidelines and Australian Standard 3962-2001 Guidelines for Design of Marinas, therefore dredging requirements are not likely to change significantly from what has been proposed.

The key difference between the proposed project and any alternatives would therefore be the method of dredging and disposal of material associated with widening and deepening of harbour navigation channel and turning basin, including creation of the reclaimed areas.

It is important to note that the reclamation, marina and urban development are essential components of the Toondah Harbour Project. The Project cannot progress without these components as it would not comply with the Toondah Harbour PDA Development Scheme. The assessment of the alternate option to upgrade of the harbour, dredging and disposal of dredged material is intended to determine feasibility, not provide a detailed analysis of dredge material disposal options.

1.2. Dredged Material Disposal Options

The London Dumping Convention (LDC) and National Assessment Guidelines for Dredging (NAGD) sets out a hierarchy for waste minimisation in relation to disposal of dredge material. Beneficial re-use is favoured over the placement of material as waste, with at sea placement identified as the least favourable outcome for material. In general, the Australian Government does not support disposal of capital dredged material at sea, evidenced by policies such as the Great Barrier Reef (GBR) Marine Park Authority's Dredging and Dredge Spoil Disposal Policy which prohibits disposal of more than 15,000 m^3 of capital sourced material within the GBR Marine Park.

Possible beneficial re-uses of dredge material include beach nourishment, habitat development, levee maintenance and rehabilitation, construction fill, construction material (e.g., brick making) and cover at existing sanitary landfills. However, many of these options are more suitable for dredge material with a higher sand content, compared to dredge material with high fines content like that present at Toondah Harbour. Given the properties of the material to be dredged at Toondah Harbour (fine silts and clays) beneficial reuse is limited to construction fill. Accordingly, the Project proposes beneficial reuse for reclamation, with a direct correlation between the extent of landform and the volume of dredged material.

In their assessment of land-based dredge material and placement options in the GBR region, SKM (2013) concluded that the most feasible option for dredge material would be use of dredge material for construction fill. It was noted that this option would only be suitable if there was a nearby requirement for construction fill, if any ASS had been treated, and if there were no contaminants present at levels of human or environmental health concern.

The Moreton Bay Dredge Material Placement Study (KBR 2006) prepared for the Queensland Office of the Coordinator General evaluated the most suitable options for long term disposal of maintenance dredge material generated from port, harbour and marina dredging in western Moreton Bay. The study concluded that unconfined bay-based marine disposal was the preferred means of disposing of low quality, uncontaminated dredge material. Deeper offshore placement outside of the Bay was also assessed but ranked lower than disposal within Moreton Bay due to logistical and cost implications. Land based placement ranked well below bay and ocean disposal options largely because of social and financial impacts and the engineering and environmental complexity and inefficiency of handling and treatment.

Alternative options for disposal of capital dredged material from Toondah Harbour include:

1. Unconfined ocean disposal within Moreton Bay;
2. Deep-water ocean disposal offshore of the bay islands; and
3. On-land disposal without beneficial re-use.

Conceptual schematics of the three disposal options are shown in *Figure 1*. Dredge material quantity is assumed to be 530,000 m^3, as any design meeting minimum navigational safety requirements would produce a similar material quantity to that proposed for the Project. It is also assumed all dredged material could be disposed of at sea as sediment analysis carried out in accordance with the NAGD found dredged material would not be considered contaminated.

Under all three options, there would be no development to underwrite the costs of disposal, therefore the cost burden would fall on the ratepayer or taxpayer, depending on which level of government assumes responsibility for the harbour upgrade.

1.2.1 Unconfined ocean disposal within Moreton Bay

This option would involve transporting the dredge material to a location within Moreton Bay and releasing the dredged sediment into the water column. Currently, all maintenance dredged material from South East Queensland ports and harbours is disposed of at the Mud Island unconfined ocean disposal site and this is considered the most likely location for unconfined ocean disposal in Moreton Bay. Material would be transported either by barge or within a small Trailer Suction Hopper Dredge (TSHD), similar to what occurs during regular maintenance dredging carried out at Toondah Harbour.

Approvals for the Mud Island unconfined disposal site are held by Maritime Safety Queensland (MSQ) with the Port of Brisbane (PoB) usually consulted prior to third parties being able to utilise the site as it is crucial to the Port's ongoing operations. Both parties were consulted to seek feedback on their response to any application for disposal of more than 500,000 m^3 of capital dredge material. Both indicated they would not support the application as the Mud Island unconfined disposal area's primary use is for the disposal of maintenance dredged material (Attachment 1). While it is an open disposal site there is finite capacity due to the relatively shallow depth in the area.

1.2.2 Deep-water Ocean Disposal

This option would involve transporting the dredge material via barge offshore of Minjerribah (North Stradbroke Island) or Mulgumpin (Moreton Island) and releasing it into the East Australian Ocean Current in water depths of greater than 20 m LAT. This method of disposal would likely have a smaller environmental impact compared to disposal at Mud Island as the sediment would disperse prior to settling and plumes would be expected to be almost undetectable before it reaches any ecological receptors.

The small barge used for loading of dredge material at Toondah Harbour may not be able to withstand wind and currents outside of Moreton Bay, therefore the material may potentially need to be unloaded at a rehandling site and reloaded to a larger barge or hopper for transport offshore. The Port of Brisbane would be the most likely rehandling location for the dredged material. A larger ship would not be able to traverse the narrow channels between Minjerribah (North Stradbroke Island) and Mulgumpin (Moreton Island) therefore would have to travel north of Mulgumpin to dispose of the dredged sediment.

The large steaming times and potential need for rehandling of the material would make this option significantly more expensive than disposal at Mud Island.

1.2.3 Land Disposal

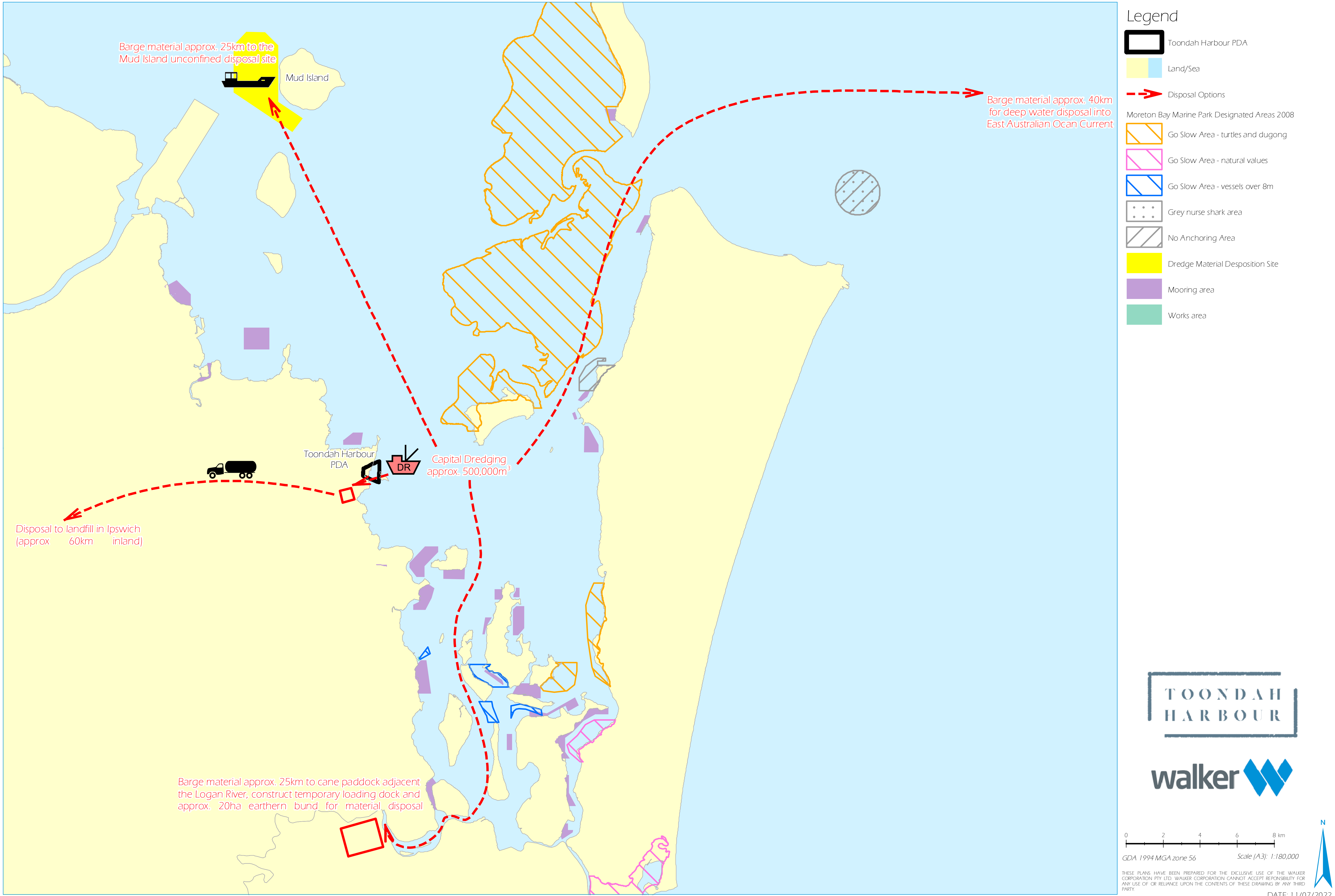
Lack of available land within Cleveland and adjacent suburbs makes disposal on land expensive and logistically difficult. The only available land nearby is the existing dredge spoil pond, which is located adjacent to the boat ramp at Toondah Harbour.

The 0.5 ha pond was utilised for disposal of contaminated material from previous maintenance dredging campaigns and currently contains dredged sediments that would require removal and ultimate disposal offsite. Once emptied the pond has a capacity of approximately 10,000 to 15,000 m^3. Use of this pond for disposal of more than 500,000 m^3 of material would require:

- Dredging using a CSD to transport material onshore via pipeline and pump;
- Temporary storage of dredged material in the pond to remove enough water to make loading and transport via truck feasible;
- Release of tailwater into Moreton Bay as part of the dewatering process;
- Once sufficiently dried loading into an appropriately lined truck for transport through the Cleveland CBD and residential areas to an ultimate disposal location. Investigations carried out as part of the Moreton Bay Dredge Material Placement Study (KBR, 2006) identified disused mine sites near Ipswich as the likely location for ultimate disposal of large volumes of dredge material; and
- Repetition of this process for the entire volume of dredge material.

It would take several weeks to sufficiently dewater material stored in the dredge spoil pond to enable it to be transported via truck meaning a prolonged dredge period of over a year or dredging being carried out intermittently for several years. Assuming use of truck and dog to transport the material, it would take more than 200 truckloads to empty the pond once filled, meaning over 400 truck movements through the ferry terminal, in addition to traffic associated with the ferry and barge operations, for each 10,000 m^3 – 15,0000 m^3 of dredged material. Ultimately up to 30,000 truck movements would be required to remove the total volume of dredged material from capital dredging of the channel and turning basin. Without the proposed upgrades to Middle Street and Shore Street East, which would be unlikely to occur without the Toondah Harbour development, this would result in significant congestion around the harbour area, the Cleveland CBD and local streets.

Figure 1: Alternate Dredge Material Disposal Options Conceptualisation



Layer Source: © State of Queensland Datasets (Department of Resources 2022), Aerial Imagery (Nearmap.com 2020)

DATE: 11/07/2022

If dredged material was to be disposed of on land without rehandling, an area of more than 20 ha would be required to store the material, enclosed by earthen bunds 2 m to 3 m high. The only feasible land parcels large enough to accommodate the volume of material are cane paddocks on the southern banks of the Logan River, approximately 25 km from the dredge area. Given that this area is currently being marketed as future urban, the purchase price would be inflated.

If land could be purchased, material could be transported to the disposal site via barge, requiring construction of a temporary dock near the disposal site. Navigation of laden barges through southern Moreton Bay and down the Logan River for unloading would be extremely difficult and would also be likely to require additional dredging in shallow areas and clearing of mangroves and other intertidal habitat to create the temporary dock. Implementation of this option would be very difficult technically and financially unfeasible as dredging and disposal costs (land purchase, construction of bunds, water management, etc) are likely to exceed $50 million.

Alternatively, the material could be pumped using a pipeline with several booster pumps likely to be required to transport the material over that distance. If a pipeline was utilised it would require clearing of several hectares of mangroves and other intertidal habitat along the Redlands coast. Maximum pumping distances are generally considered to be approximately 11 km before the process becomes too inefficient (Pro Dredge 2014) and therefore it is unlikely for this option to be technically feasible.

1.2.4 Summary

The assessment of all potential dredged material disposal options found onshore disposal is likely to be unfeasible. Therefore, offshore disposal either outside of the Bay Islands or within Moreton Bay at the existing Mud Island unconfined disposal site are the two options that will be considered further.

1.3. Assessment of Feasible Alternate Options

Assessment of the offshore disposal options will include economic feasibility and comparative assessment of environmental impacts. The key difference between the Toondah Harbour Project and an alternative harbour upgrade-only scenario is the creation of the reclamation and future uses of that land compared to disposal of the dredged material into Moreton Bay. Therefore, comparative assessment will focus on this component of the alternate option.

1.3.1 Environmental Comparison

1.3.1.1 Marine Impacts

Impacts resulting from the Toondah Harbour Project, including reclamation, future uses and potential changes to the ecological character of the MBRS are addressed in the Draft EIS.

Loss of intertidal wetland and shorebird foraging habitat from the reclamation would be avoided in the harbour upgrade-only scenario. However, all other impacts would be comparable, including:

- Turbidity plumes from dredging;
- Risk of boat strike during construction, dredging and transporting of dredge material; and
- Risk of boat strike during operations, given that the area will continue to operate as a marine transport hub and the public boat ramp at Emmett Drive would be retained.

While the reclamation will directly impact on wetland habitat, the area of impact is very small when viewed in the context of Moreton Bay and the MBRS. The habitats present are also not considered to be core or of high value to any threatened marine fauna species. While the Project area provides feeding habitat for a small number of threatened and migratory shorebird species, recent studies have shown Moreton Bay contains an abundance of shorebird feeding habitat (more than 100,0000 km^2), therefore impacts to these species will be minimal and environmental offsets are proposed to compensate for the loss of 26 ha of habitat.

The harbour upgrade-only scenario will result in additional turbidity plumes from the unconfined disposal of dredged material at Mud Island, which has the potential to impact on water quality and marine ecology in the area immediately surrounding the disposal site. Potential water quality issues include suspension of fine sediment in the water column, reducing sunlight penetration and blanketing effect associated with settling sediment. This in turn has the potential to impact on benthic communities such as seagrass and coral.

Modelling of turbidity plumes and sediment deposition at the Mud Island unconfined disposal site has been carried out by BMT Australia (Attachment 2). While the disposal site is outside of the MBRS, turbidity plumes would extend beyond the boundaries and potentially impact on seagrass beds to the south of the Port of Brisbane (*Figure 2*). While impacts resulting from the disposal of dredged material from Toondah Harbour at Mud Island would not be expected to be significant, it will add to the ongoing accumulation of dredged sediments, usually fines and mud, in Central Moreton Bay. Annual monitoring carried out by Healthy Land and Water (HLW) has shown a steady increase in water quality in Western and Central Moreton Bay since 2015. One of the key factors credited with this improvement was a significant reduction in mud in these areas, likely due to flushing and resuspension into the deeper parts of the Bay (HLW 2020). The impacts caused to benthic communities as a result of the resuspension are unknown, however the continued placement of dredged material into the Mud Island unconfined disposal site has the potential to undo water quality improvements from the past several years.

1.3.1.2 Terrestrial Impacts

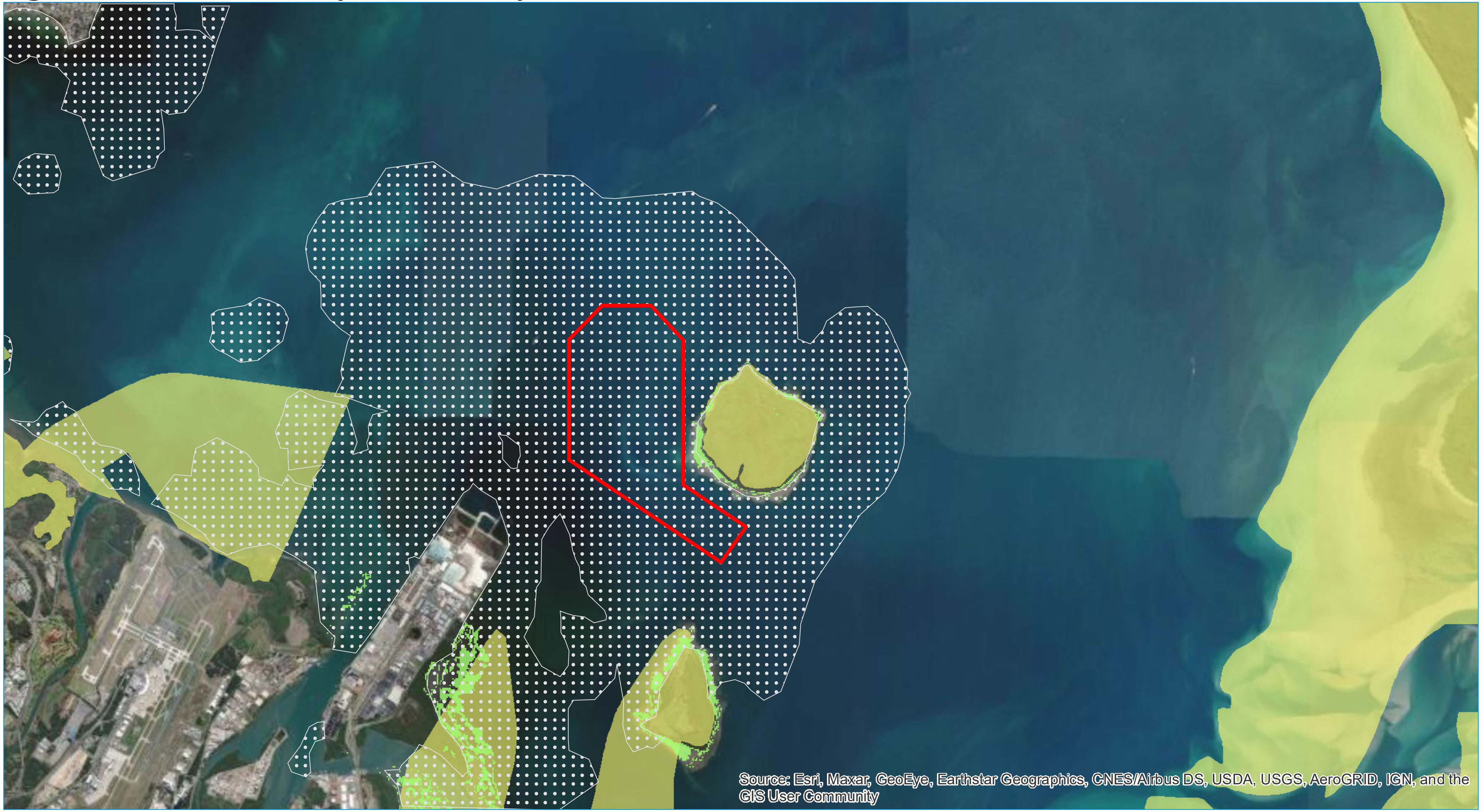
The terrestrial ecology impact assessment carried out for the Toondah Harbour Project identified minimal impacts on terrestrial flora from the Project, as the site is already highly modified. Increased traffic generation was considered the key mechanism for impacts on terrestrial fauna, in particular Koalas.

Traffic generation estimates completed for the Toondah Harbour Project indicate that the ferry terminal and retail space will account for almost half of the ultimate predicted vehicle movements (approximately 9,500 of 20,000) on completion of all development in 15 to 20 years. Approximately 15,000 of the 20,000 vehicles movements would occur along Middle Street with the remaining 5,000 movements to occur along Shore Street East.

In the harbour upgrade-only scenario vehicles would only be able to access the ferry terminal and surrounding retail space via Middle Street. As identified in the cumulative impact assessment (refer to Volume 3 of the EIS), apartment developments outside of the Toondah Harbour PDA are already occurring along Middle Street and this area is likely to become denser in the absence of the residential components of the Toondah Harbour Project. Consequently, vehicle movements along Middle Street in 15 – 20 years is likely to be similar to that of the ultimate development for the Toondah Harbour Project (i.e., 10,000 – 15,000 vehicle movements).

The Toondah Harbour Project includes major upgrades to Middle Street and Shore Street East including koala crossing measures along the interface of Middle Street and GJ Walter Park. This level of mitigation is unlikely to be implemented as part of a harbour upgrade-only scenario, therefore potential impacts to the Cleveland Koala population may actually increase in the absence of the Toondah Harbour Project.

Figure 2: Areas Potentially Impacted by Disposal at Mud Island



Legend

- Mud Island Dredge Material Desposition Site
- Moreton Bay Ramsar site
- Seagrass
- 95th Percentile Turbidity Plume

Toondah Harbour EIS

N

0 1,000 2,000 3,000 4,000 Meters

GDA 1994 MGA zone 56

Scale (A4):1:110,000

Layer Source: © State of Queensland Datasets (Department of Natural Resources, Mines and Energy 2020), Aerial (Nearmap 2020)

DATE 24/03/2021

FILE REF. 9858 E Figure 14 2 Mud Island Potential Impacts L A

1.3.2 Economic Feasibility

An estimate of costs associated with dredging and disposal of material at Mud Island or in deep water offshore of the Bay Islands has been carried out by Haskoning Australia and are included as Attachment 3. For disposal at Mud Island, dredging and disposal costs are expected to be in the order of $40 million, while deep water disposal is likely to cost $60 to $70 million, depending on the dredge equipment utilised. Neither of these costs include upgrade of facilities at the harbour which are expected to cost in the order of $50 million no matter which option is utilised (broad costings included in Attachment 3).

Synergies Economic Consulting has carried out an assessment of the economic feasibility based on the cheapest scenario, disposal at Mud Island (Attachment 4). The assessment found that the 'dredging only' option would have a benefit cost ratio (BCR) of 0.2. The Building Queensland Business Case Development Framework provides guidance on investment decision making for the Queensland Government and states that generally projects need to have a BCR of at least 1 to be accepted and recommended as economically viable. It is noted that these costs do not include the costs of the upgrade of landside ferry and barge facilities at Toondah Harbour (offices, storage, amenities, car parking areas, etc). The BCR would be further reduced if these costs were added.

By comparison the BCR for the Toondah Harbour Project is 1.48 and will have significant economic benefits for the region.

1.4. Summary

The assessment of options to upgrade the harbour and navigation channel found onshore disposal is likely to be unfeasible due to the lack of land near the harbour to store the material or act as a rehandling area. Therefore, offshore disposal either outside of the Bay Islands or within Moreton Bay at the existing Mud Island unconfined disposal site were considered further.

Ocean disposal would avoid impacts associated with the reclamation area, however disposal at Mud Island would impact on water quality in the area and potentially have wider ramifications for water quality in Moreton Bay. Deep ocean disposal would minimise environmental impacts of the dredged material from a dredge plume perspective, however, is considered technically unfeasible.

Neither alternate option for disposal of dredged material would be economically feasible, nor would they meet minimum cost benefit thresholds to be supported by the Queensland Government as a government-funded exercise.

A harbour upgrade-only scenario would also mean forgoing the significant economic and community benefits associated with the Toondah Harbour Project.

References

HLW, 2020, EHMP 2020 Report Card, https://reportcard.hlw.org.au/

KBR, 2006, Moreton Bay Dredge Material Placement Study, Office of the Coordinator General, Brisbane

Pro Dredging (2014). Cairns EIS Land Placement Options Budget. Prepared for Arup and Ports North.

SKM 2013, Improved dredge material management for the Great Barrier Reef Region, Great Barrier Reef Marine Park Authority, Townsville.

Attachment 1:

PORT OF BRISBANE AND MSQ ADVICE LETTERS

PORT of BRISBANE
Here for the future

OUR REF: A3193682
CONTACT: PETER KEYTE
PHONE: 3258 4620

20 September 2021

Attention: Sam Maynard
Saunders Havill Group
9 Thompson Street
Bowen Hills Q4006

Dear Sam

RE: Disposal of Capital Dredge Material from the Toondah Harbour Development

Thank you for your correspondence dated 9 September 2021.I would like to confirm that your understanding of the management of the Mud Island Dredged Material Placement Area (MIDMPA) is correct in that the Department of Transport and Main Roads (DTMR) hold the tidal works permit for dredged material disposal and that Port of Brisbane Pty Ltd (PBPL) are consulted by DTMR prior to approving the disposal of large volumes of dredge material.

In regards to the specific management of dredged material, PBPL subscribes to the key objective of the London Protocl and the Commonwealth Sea Dumping Act that the evaluation of alternatives to ocean disposal and the identification and implementation of measures to avoid ocean disposal should be considered in the first instance. We particularly apply this objective to capital dredged material.

As such, regarding your propsosal, PBPL would support and encourage the beneficial use of any capital dredged material in the first instance prior to considering ocean placement of this material. That may include the use of the dredged material in the contruction of the proposed Toondah Harbour developed or use in other project where the material may be considered a resource. Ocean placement of the capital dredged material should only be considered as a last resort, and as such we do not support placement of the capital material at the MIDMPA.

PBPL would support the placement of smaller volumes of maintenance dredged material at the MIDMPA where beneficial uses cannot be identified, understanding that maintenance dredged material offsers significant barriers to beneficial resue, particularly in regards to sediment particle sizes.

I hope that this advice is adequate to assist you in the review and development of your dredged material handling strategy.

If you have any additional questions in relation to these matters, please feel free to contact me on ☎ (07) 3258 4620.

Yours sincerely

Peter Keyte
Chief Operating Officer

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Sam Maynard

From: Peter G Wood <Peter.G.Wood@msq.qld.gov.au>
Sent: Friday, 25 February 2022 11:02 AM
To: Sam Maynard
Cc: Chris J Voisey
Subject: RE: 9858 Toondah Harbour Project Use of Mud Island

Categories: Archived

Good morning Sam,

TMR co-manages the Mud Island Dredge Material Placement Area (DMPA) with the Port of Brisbane Corporation as a critical resource for the management of uncontaminated maintenance dredging material servicing navigational channels in Moreton Bay and the Brisbane River. Loss of this resource (via it being filled up prematurely) would make navigational maintenance dredging of existing infrastructure cost prohibitive and potentially result in closure of existing marine infrastructure in the Bay.

TMR currently only allows volumes up to 5000m^3 of capital dredged material to be disposed at the Mud Island DMPA. It is not appropriate to put such a large volume of capital material (approx 530,000m^3) in the dredge material area and TMR strongly supports that volume of dredged material from the Toondah Harbour development project going to a land reclamation for a beneficial use.

TMR supports the disposal of future maintenance dredged material from the proposed new marina and internal access channels also being placed on land as proposed.

Maintenance dredging material that is uncontaminated from Fison Channel and the Toondah Harbour basin will continue to be placed at the Mud Island DMPA as per the current arrangement.

Please call me if you have any further queries and I apologise for the delay in responding to your request. Thanks.

Kind regards,

Peter Wood
Manager (Infrastructure Delivery) | Maritime Assets & Infrastructure Unit |
Maritime Safety Queensland | Department of Transport and Main Roads

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Attachment 2:

BMT MUD ISLAND TURBIDITY PLUME MODELLING

Alternative Mud Island Dredge Material Disposal

In the event that dredge material cannot be beneficially reused at Toondah Harbour, a high-level assessment of alternative dredge material disposal options was conducted. The alternative disposal simulations consider potential impacts to the Mud Island Dredged Material Placement Area (DMPA) and immediate surrounds for both dredging campaigns. For the purposes of this assessment Cutter-Suction-Dredge (CSD) operations have been applied as a conservative condition due to the increased projected barge disposal frequency. Inputs for the alternative Mud Island CSD disposal sediment flux boundary conditions are summarised in Table 1.

Table 1   Alternative Dredge Disposal Model Inputs (CSD).

Property	Dredging Stage 1	Dredging Stage 2
Date Disposal Start	29/04/2017	19/06/2017
Date Disposal End	01/08/2017	01/08/2017
Dredging Productivity	250 m^3 in-situ/effective hour	
Dredge Activity	144 hours/week	
Dredge Downtime	25%	
Barge Frequency	14 barges/24 hrs	
Disposal Plume Source Rate	155.0 kg/s	
Disposal Duration	10 minutes	

Dredge disposal sediment fluxes are implemented as an intermittent plume source at randomised locations within the Mud Island DMPA. Central to the dredging activity, disposal is based around a 24-hr daily dredging schedule with no dredging activity imposed on Sundays to formulate a 144 hours/week dredging schedule.

Consistent with the dredge plume analysis presented in the coastal processes technical report, the potential plume effects of dredge material disposal were assessed based on the modelled temporary increases in suspended sediment concentration and sedimentation above natural or ambient levels. The predicted effects of alternative dredge material disposal have been assessed using percentile analysis of depth-averaged turbidity and sediment deposition.

Turbidity

The modelled impacts of the alternative dredge material disposal program on the percentiles of the depth-averaged turbidity are presented for the 50th and 95th percentiles in Figure 1 to Figure 4. Note that turbidity spikes west of the Mud Island DMPA are likely to be numerical artefacts.

The modelled dredged material disposal from the first dredging campaign is shown in Figure 1 and Figure 2. The median turbidity is statistically considered to be representative of typical turbidity impacts over the dredge disposal campaign, whereby turbidity impacts up to 1.50 – 1.75 NTU are modelled beyond the Mud Island DMPA. Turbidity impacts relevant to the Mud Island disposal campaign range from St Helena Island and extend only marginally offshore beyond Mud Island. Acute, 95th percentile turbidity impacts (ambient turbidity exceeded only 5% of the 30 day window period – 1.5 days) demonstrate a larger impact radius than the 50th percentile, with one NTU increases predicted up to approximately 1800 metres from the disposal area. A maximum turbidity impact of 4.5 – 5.0 NTU is modelled within the Mud Island DMPA under the Stage 1 disposal campaign.

Turbidity impacts from disposing of dredge material from the second dredging campaign are presented in Figure 3 and Figure 4. The Stage 2 95th percentile turbidity impacts appear to reduce relative to the impacts from placing the dredge material from the first campaign, both in turbidity differential and the overall impact footprint. While the dredge disposal sediment flux terms and disposal conditions are consistent between the two campaigns, this is reasoned to occur as a result of different maximum windowing periods and potential accrual of the disposed sediment over the longer disposal timeframe of the first campaign. The median impact estimate (presenting "typical" conditions), reflects similar impact conditions to the disposal of dredged material from the first campaign, with a maximum increase within the disposal envelope of 1.50 – 1.75 NTU, and1.25 – 1.50 NTU outside the Mud Island DMPA to be exceeded for 15-days within the 30-day percentile window. The 95th percentile turbidity increase demonstrates a maximum 30-day acute impact of 3.5 – 4.0 NTU within the Mud Island DMPA.

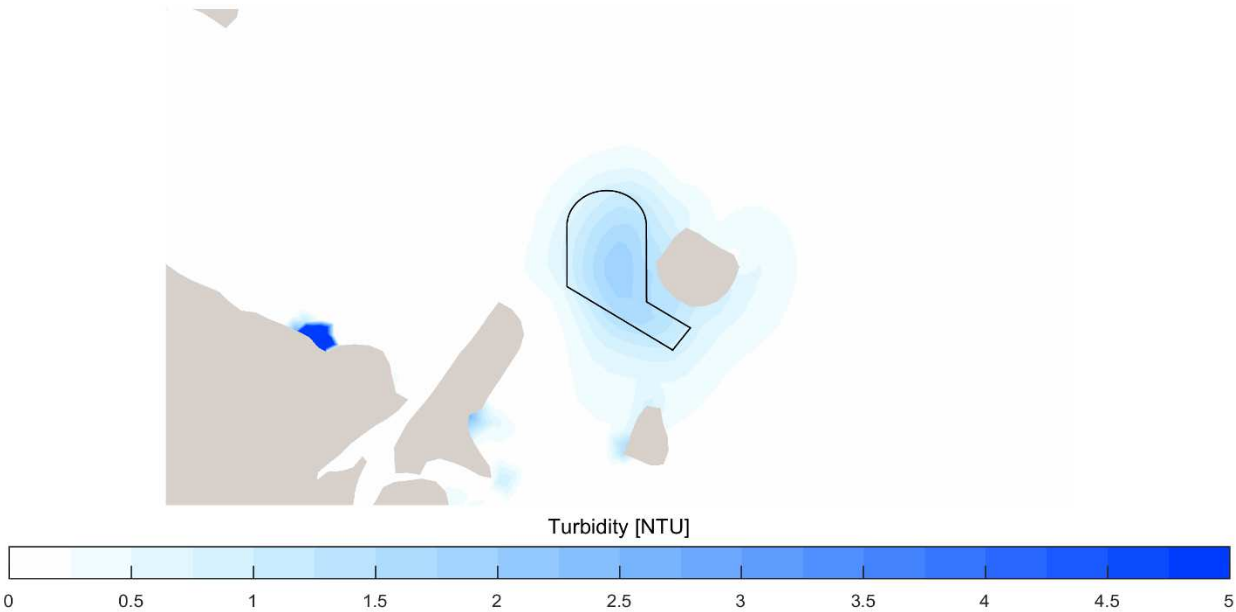


Figure 1 50th Percentile Turbidity Impact. Stage 1 Disposal Mud Island.

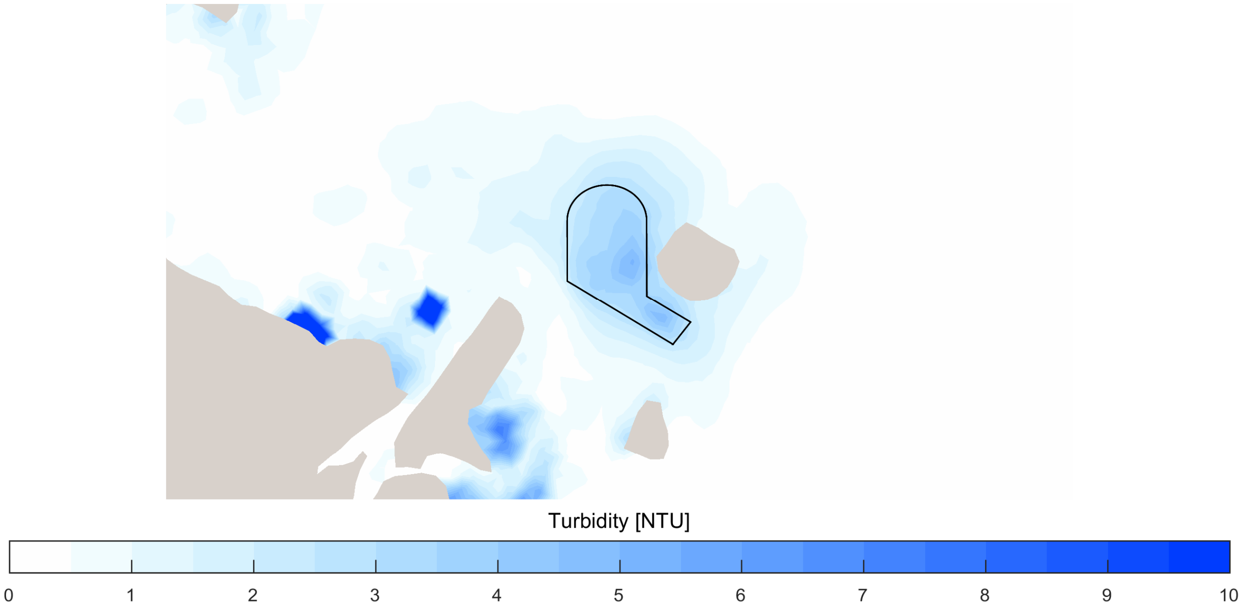


Figure 2 95th Percentile Turbidity Impact. Stage 1 Disposal Mud Island.

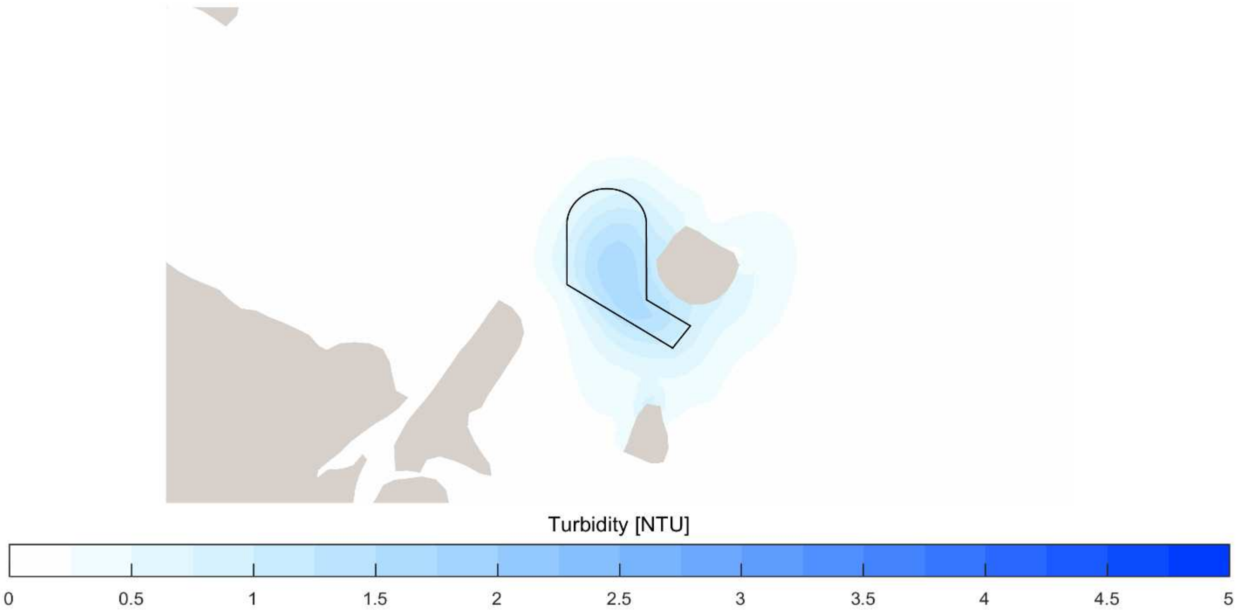


Figure 3 50th Percentile Turbidity Impact. Stage 2 Disposal Mud Island.

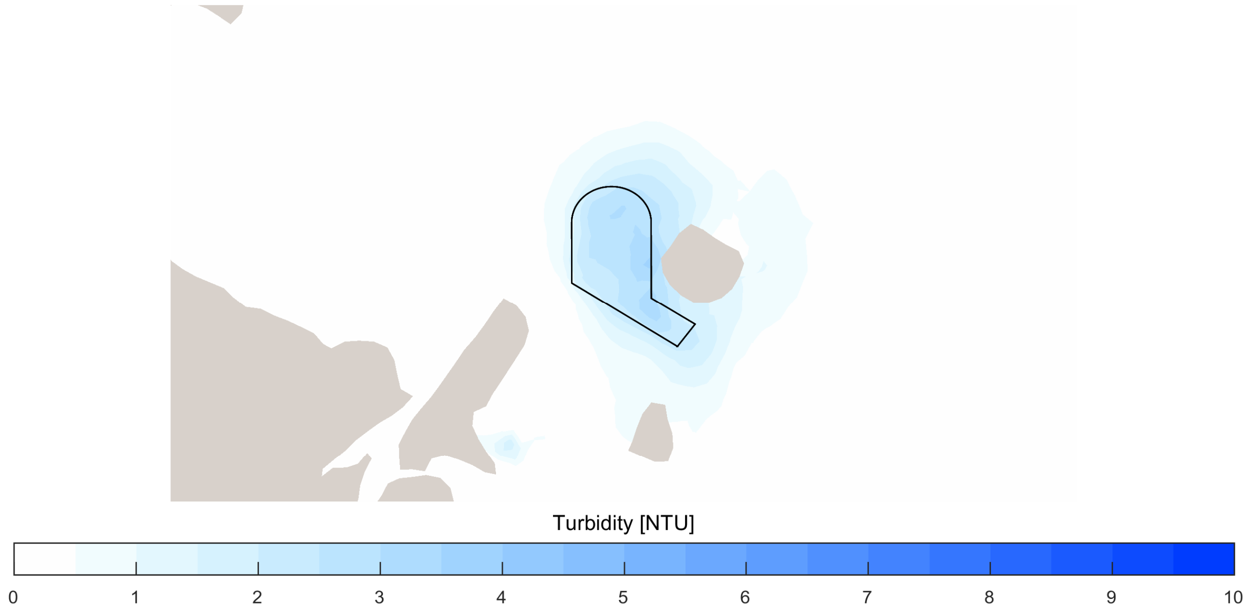


Figure 4 95th Percentile Turbidity Impact. Stage 2 Disposal Mud Island.

Sediment Deposition

Sediment deposition impacts for placement of dredge material at Mud Island are presented in Figure 5 and Figure 6 for both dredging campaigns. Due to the binary nature of dredge disposal there is little deviation of the deposition percentiles, hence the 50th percentile is presented to demonstrate the typical deposition from the respective dredge material disposal programs.

The randomised dredge plume disposal within Mud Island DMPA is evident by the elevated daily deposition rate within the disposal envelope. The first dredging and disposal campaign (which has a longer duration and subsequently, longer material disposal program) demonstrates greater uniformity in dredge sediment deposition within the DMPA relative to the second campaign. Across both dredging campaigns, the deposition rate demonstrates steep transitionary gradients beyond the Mud Island DMPA, with the median deposition rate reducing to less than 200 mg/cm^2/day within approximately 430 metres from the DMPA for the first disposal program. The deposition rate gradient beyond the DMPA for the second disposal program is less acute, generally reducing to 50 – 75 mg/cm^2/day within an equivalent distance.

The lower contour limits (25 mg/cm^2/day) of the first disposal program extend approximately 4300 metres east of the DMPA, 2500 metres to the west, 2400 metres to the south and 3200 metres to the north. The areal extent of the lower contour limits for the second disposal program are notably reduced relative to the first stage, extending 3300 metres beyond the disposal area to the east, 1300 metres to the west, 1800 metres to the south and 2000 metres to the north.

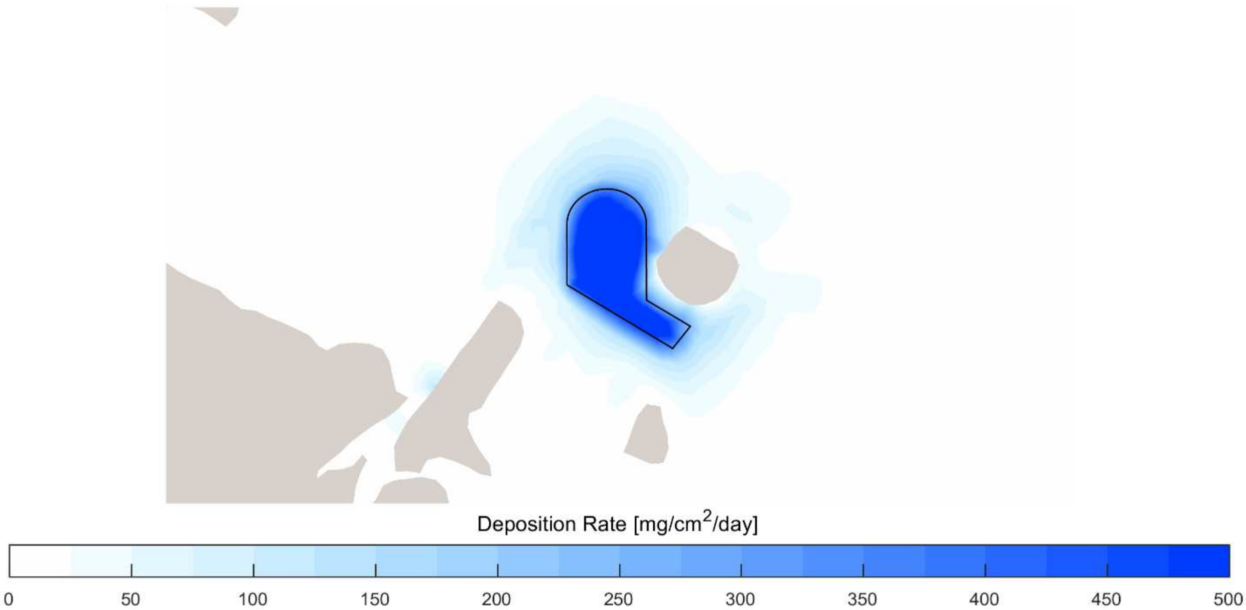


Figure 5 50th Percentile Sediment Deposition Impact. Stage 1 Disposal Mud Island.

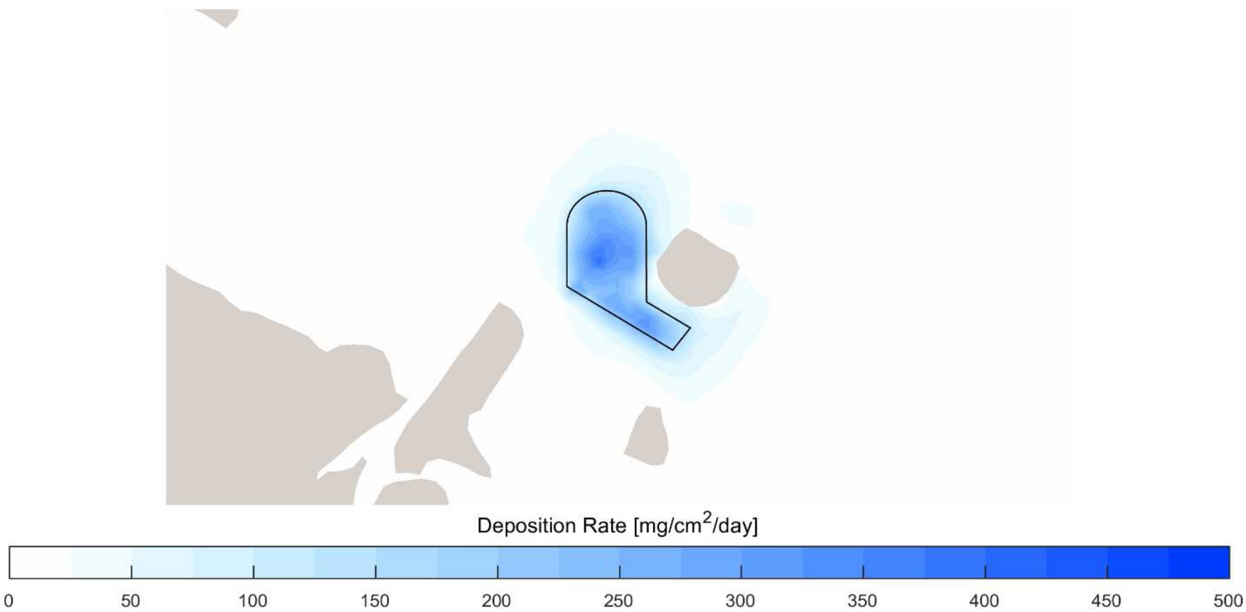


Figure 6 50th Percentile Sediment Deposition Impact. Stage 2 Disposal Mud Island.

Attachment 3:

ESTIMATE OF COST FOR DREDGING OPTIONS AND HARBOUR INFRASTRUCTURE UPGRADES

TOONDAH – INPUTS for MODELLING of PLUMES

Total quantity	530,000m3
Campaign 1	380,000m3
Campaign 2	150,000m3

SOIL INFORMATION (Collected from 2014 + 2020 Soil Reports)

SOIL DISTRIBUTION in SOIL MODEL

Clays	<4 microns	(65%)
Silts	4-75microns	(15%)
Fine Sand	75-110microns	(10%)
Medium-Coarse Sand	110-2000microns	(9.9%)
Gravel	2000-6000microns	(0.1%)

WORK METHODOLOGY

Option 1 – CSD-(350mm) into Barges in deeper water – travel and discharge at MUD ISLAND

Cuttersuction dredging Turning Basin and Channel to design depth of -3mCD+0.25mOD.

Production: 27,500m3/week of 144hrs with 25% down time and 20% concentration.

CSD pumps over approx. 1.75 to 2kms pipeline distance to a single point mooring (SPM) for mooring and loading of either non-propelled (NP-SHB) or self-propelled split hull barges (SP-SHB).

Barges will travel from SPM to Mud Island over 13.5nM to reach disposal area with existing water depth of 5.5-6.5m water depth at low tides.

Opening and discharge of barges will be stationary with backing out of the deposition area.

Equipment: SP-SHB 1,800m3 barge water capacity

Number of Barges 6

Frequency: Loads of spoil disposal (every)

1.75 hrs = 14 barge loads per 24 hour period.

Discharge time per load	10 minutes
Duration of Campaign 1	15 weeks
Duration of Campaign 2	6 weeks

INPUT FOR MODELLING – Losses to the water column

Dredge Site (5% suspension from cutter)

Channel and Turning Basin during dredging works	50kg/m3 insitu
CSD production 250m3 situ/effective hour	3.5kg/sec

Mud Island (30% suspension of barge load)

Barge disposal with 325m3 situ per load	285kg/m3 insitu
Barge disposal per 10minutes discharge time 30% suspension	155kg/sec

WORK METHODOLOGY

Option 2 – BHD (70-140T) into Barges – travel and discharge at MUD ISLAND

BHD dredging Turning Basin and Channel to design depth of -3mCD+0.25mOD.
Production: 20,000m3/week of 144hrs with 30% down time and 85-90% situ/load.
BHD loading of either non-propelled (NP-SHB) or self-propelled split hull barges (SP-SHB).
Barges will travel from dredge site in Channel or Turning Basin to Mud Island over 16.5nM to reach disposal area with existing water depth of 5-6.5m water depth at low tides.
Opening and discharge of barges will be stationary with backing out of the deposition area.

Equipment:

NP-SHB 1,200m3 barge water capacity	
NP-SHB 1,200m3 only (due to draft limitation in channel and part loading at times)	
Number of Barges 3 and 2 suitable tugs (1500HP)	
Frequency: Loads of spoil disposal (every)	6 hrs = 4 barge loads per 24 hour period.
Discharge time per load	10 minutes
Duration of Campaign 1	20 weeks
Duration of Campaign 2	7.5 weeks

INPUT FOR MODELLING – Losses to the water column

Dredge Site (5% suspension from open bucket)

Channel and Turning Basin during dredging works	50kg/m3 insitu
BHD production 200m3 situ/effective hour	3.0kg/sec

Mud Island (15% suspension of barge load)

Barge disposal with 324m3 situ per load	145kg/m3 insitu
Barge disposal per 10minutes discharge time 15% suspension	205kg/sec

WORK METHODOLOGY

Option 3 – CSD-(350mm) pumping into Barges in deeper water – travel and discharge at DEEP WATER OCEAN DISCHARGE LOCATION (>-150mCD)

Cuttersuction dredging Turning Basin and Channel to design depth of -3mCD+0.25mOD.
Production: 27,500m3/week of 144hrs with 25% down time and 20% concentration.
CSD pumps over approx. 1.75 to 2kms pipeline distance to a single point mooring (SPM) for mooring and loading of either non-propelled (NP-SHB) or self-propelled split hull barges (SP-SHB).
Barges will travel from SPM to DEEP OCEAN DISCHARGE (-150mCD) over 47.5nM to reach disposal area beyond the -150mCD contour.
Opening and discharge of barges will be "on the run" at half speed, whilst turning within of the deposition area.

Equipment: SP-SHB 3,700m3 barge water capacity

Number of Barges	8
Frequency: Loads of spoil disposal (every)	3.45 hrs = 7 barge loads per 24 hour period.
Discharge time per load	10 minutes
Duration of Campaign 1	15 weeks
Duration of Campaign 2	6 weeks

INPUT FOR MODELLING – Losses to the water column

Dredge Site (5% suspension from cutter)

Channel and Turning Basin during dredging works	50 kg/m3 insitu
CSD production 250m3 situ/effective hour	3.5 kg/sec

DEEP OCEAN DISCHARGE (30% suspension of barge load)

Barge disposal with 666m3 situ per load	810 kg/m3 insitu
Barge disposal per 10minutes discharge time 30% suspension	900 kg/sec

WORK METHODOLOGY

Option 4 – BHD (70-140T) into Barges – travel and discharge at DEEP WATER OCEAN DISCHARGE LOCATION (-150mCD)

BHD dredging Turning Basin and Channel to design depth of -3mCD+0.25mOD.
Production: 20,000m3/week of 144hrs with 30% down time and 85-90% situ/load.
BHD loading of either non-propelled (NP-SHB) or self-propelled split hull barges (SP-SHB).
Barges will travel from dredge site in Channel or Turning Basin to Mud Island over 49nM to reach disposal area with existing water depth exceeds -150mCD
Opening and discharge of barges will be "on the run" at half speed, whilst turning within of the deposition area.

Equipment:

NP-SHB 1,200m3 barge water capacity
NP-SHB 1,200m3 only (due to draft limitation in channel and part loading at times)
Number of Barges 6 and 5 suitable tugs (1500-2500HP)

Frequency: Loads of spoil disposal (every)	6 hrs = 4 barge loads per 24 hour period.
Discharge time per load	10 minutes
Duration of Campaign 1	20 weeks
Duration of Campaign 2	7.5 weeks

INPUT FOR MODELLING – Losses to the water column

Dredge Site (5% suspension from open bucket)

Channel and Turning Basin during dredging works	50kg/m3 insitu
BHD production 200m3 situ/effective hour	3.0kg/sec

DEEP OCEAN DISCHARGE (65% suspension of barge load)

Barge disposal with 324m3 situ per load	620kg/m3 insitu
Barge disposal per 10minutes discharge time 15% suspension	900kg/sec

ROUGH ORDER OF MAGNITUDE COST LEVELS

Option	Method	Disposal	Rate/m3	Mob	Demob	Quantity	Total Cost
1	CSD	Mud Island	$60.00	$3mio	$2.5mio	530,000m3	$37.3mio
2	BHD	Mud Island	$67.50	$1.5mio	$1.0mio	530,000m3	$38.275mio
3	CSD	Ocean-150m	$105.00	$4.0mio	$2.5mio	530,000m3	$62.15mio
4	BHD	Ocean-150m	$125.00	$3.5mio	$2.5mio	530,000m3	$72.25mio

TOONDAH – FISON CHANNEL – REALIGNMENT AND DEEPENING

OPTION - ONSHORE DISPOSAL - BHD/BARGES/MIXING/TRUCK TRANSPORT/TIPPING ONSHORE

DETAILS:

TOTAL VOLUMES TO DESIGN INCLUDING OVERDREDGING

Volumes:	530,000m3 in-situ 712,500m3 bulked
DISPOSAL LOCATION	Ipswich, Qld – One way journey 60 kms

DAY SHIFT ONLY

Working hours	72 hrs/wk
Effective hours	64.8 hrs/wk

DREDGING RATE TO BE MATCHED BY BARGE DISCHARGE RATES (2x 30T long arm excavators)

BHD (100-200T) WITH BARGES

Weekly Production BHD and 2 or 3 barges	
	10,612 m3/wk
Duration	67.15 weeks

REHANDLING OVER TEMPORARY WHARF AT CLEVELAND AND TRUCKING TO IPSWICH

LONG ARM EXCAVATORS ON WHARF TO MIX AND UNLOAD BARGES INTO TRUCKS DIRECT OR HOPPER(S)

Excavator 1	Mixing lime or cement or inorganic polymer Assist in maintaining discharge rate
Excavator 2	Unload barges into trucks or hopper
Sealed truck details	15m3 bulked material
Truck cycles per week	707
Nos trucks required	50
Trucks leaving loading dock	5 minutes intervals
Truck arriving at loading dock	5 minutes intervals
Av truck-speed on road	30 kms/hr

ROM ESTIMATE

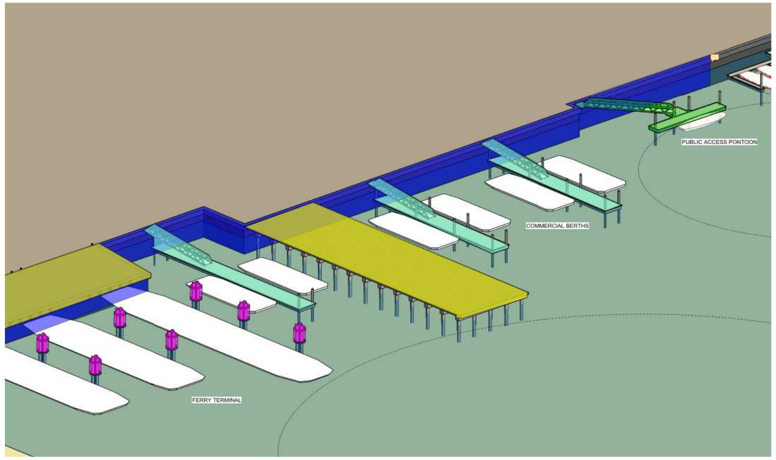
Table 1 Summary of ROM Estimate - Option "ONSHORE DISPOSAL"

Methodology	***Volumes***	***Rate/m3***	***Cost***
	Dredging and Trucking		
BHD with barges including unloading.	530,000 m3 (in-situ)	$60.00	$31,800,000
Treatment with lime for very soft and soft dredged materials only.	310,000m3 (in situ)	$7.50	$2,325,000
Transport Cleveland>Ipswich No tipping fees included.	700,000m3 (bulked)	$57.50	$40,250,000
Handling tipped material at Ipswich with dozer or loader	700,000m3	$2.50	$1,750,000
Total for Operations - Dredging and trucking			***$76,125,000***
	Establishments/Disestablishments		
BHD+ Barges ex QLD or NSW	1x	Lump sum	$1,400,000
Temporary wharf - barge berths (Berth depth -4.5mCD)	1x	Lump sum	$1,500,000
Dry earth moving equipment	1x	Lump sum	$100,000
Lime/cement handling on wharf (Avoid dust)	1x	Lumpsum	$250,000
Total for Mobilisation and demobilisation			***$3,250,000***
Grand Total	**530,000m3**	**$149,75**	**$79,375,000**

Stage 3 4 Completion Estimate

Printed 18/07/2022

Item	Description		Amount
	Marine Structures Public Facility	$	31,321,794.20
	RISK	$	9,264,358.84
	OPPORTUNITY	$	-
	NET	$	40,586,153.04
Item	Description		Amount
1.0	**FLOATING STRUCTURES**	**$**	**11,730,000.00**
	Floating Structure #1	$	3,135,000.00
	Floating Structure #2	$	3,135,000.00
	Floating Structure #3	$	1,500,000.00
	Floating Structure #4	$	3,960,000.00
2.0	**FIXED STRCUTURES**	**$**	**9,766,594.20**
	FIXED STRCUTURE 1 - Car Ferry Ramp	$	611,594.20
	FIXED STRCUTURE 2 - Pontoon / Commercial Strucutre	$	9,020,000.00
	FIXED STRCUTURE 3 - Car Ferry Poles	$	135,000.00
3.0	**LANDWALL STRUCUTRE**	**$**	**9,825,200.00**
	Sheet Piles, Anchor & Tieback	$	9,744,000.00
	Capping Beam	$	81,200.00
4.0	**RISK**	**$**	**9,264,358.84**
	Geotech Risk - will drive design for foundaitons of strucutres.	$	3,000,000.00
	Market Risk - Inflation / Supply / Demand - 20% of current value	$	6,264,358.84
3.0	**Land Components**	**$**	**17,656,224.00**
	Demo	$	3,139,000.00
	Fill and Landform	$	3,000,000.00
	Car Park	$	3,000,000.00
	Port Park	$	2,876,000.00
	Entry Road	$	230,400.00
	Vehicle loading concrete	$	538,120.00
	terminal building	$	1,930,000.00
	design fees	$	2,942,704.00



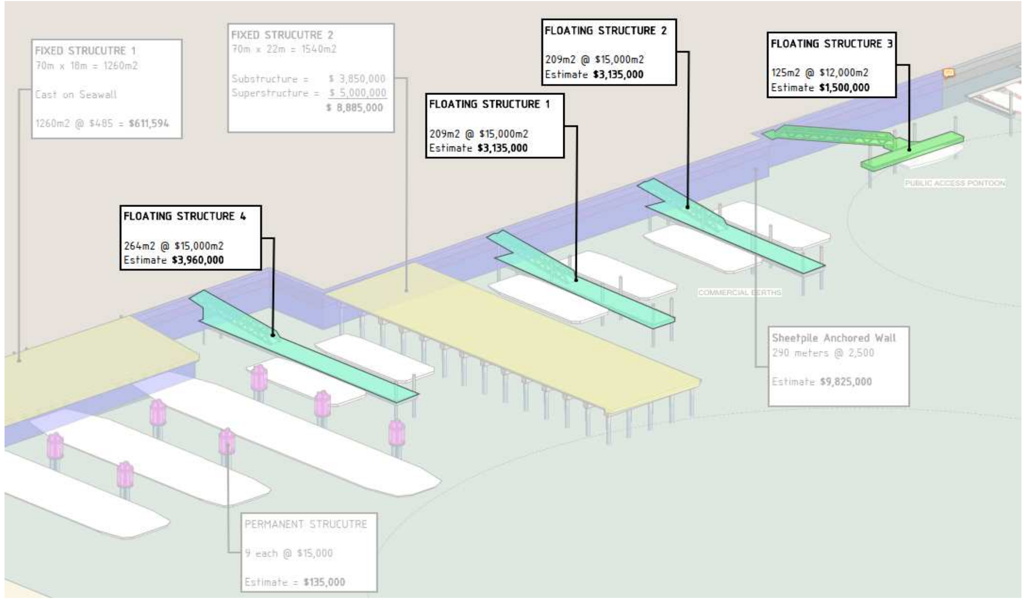
$	31,321,794.20
$	17,656,224.00
$	**48,978,018.20**

Stage 3 4 Completion Estimate

Printed 18/07/2022

FLOATING STRUCTURES $ 11,730,000.00

Item	Description	Quantity	Unit	Rate	Amount
1.0	**Engineering Volumes & Productions**				
	Estimate rates are based on similar strucutres built under a design and construct regeime by *The Jetty Specialist* . Rates have been pro-ratad on the similar scope items designed and built as shown on their website. https://tjsmarine.com.au/commercial/marinas/				
	Figures and Quantities				
	Floating Structure #1	209.0	m2	15,000.0	$ 3,135,000.00
	Floating Structure #2	209.0	m2	15,000.0	$ 3,135,000.00
	Floating Structure #3	125.0	m2	12,000.0	$ 1,500,000.00
	Floating Structure #4	264.0	m2	15,000.0	$ 3,960,000.00



Stage 3 4 Completion Estimate

Printed 18/07/2022

Land components $ 19,971,128.00

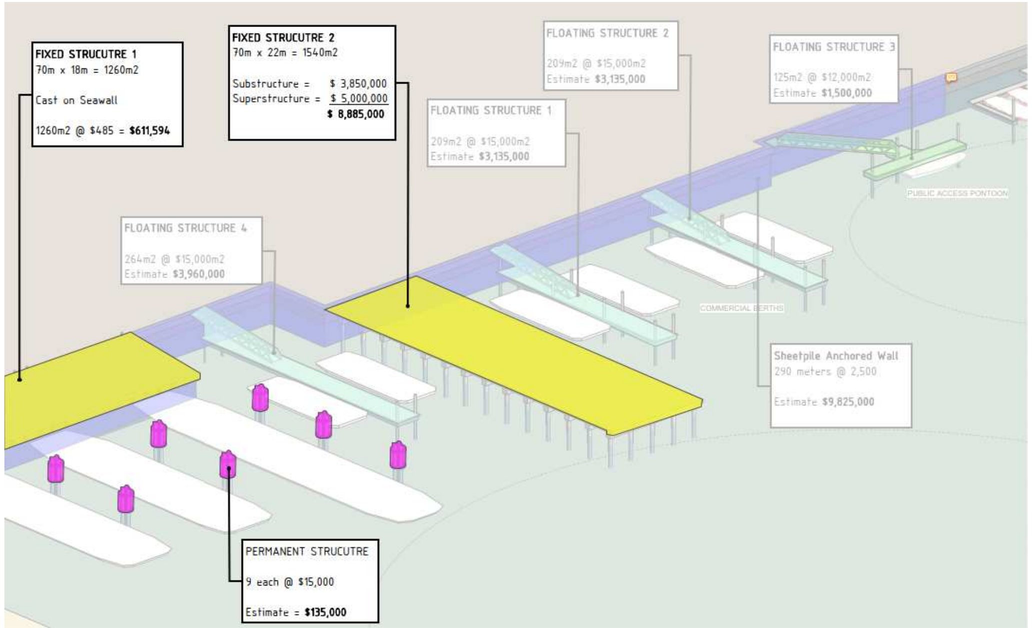
Item	Description	Quantity	Unit	Rate	Amount
1.0	**Demolition**				**3,139,000.00**
	31390m2	31,390.0		**100.00**	
2.0	**Fill and landform**				**$ 3,000,000.00**
	Fill (cart and place from north)				
	From Burchills May 2018 costings				
	Structural containment				
3.0	**Carpark**	18,110.0	**sqm**	**$ 60.00**	**$ 3,000,000.00**
	Lighting				
	Drainage				
	CCTV				
	Landscape (2%)	362.2			
4.0	**Port Park**	5,752.0	**sqm**	**$ 500.00**	**$ 2,876,000.00**
4.0	**Entry Road**	128.0	**lm**	**$ 1,800.00**	**$ 230,400.00**
5.0	**Vehicle loading- concrete**	4,892.0		**$ 110.00**	**$ 538,120.00**
6.0	**Terminal Bulding**	965.0	**2,000.00**		**$ 1,930,000.00**
7.0	**Design fees**				**2,942,704.00**
7.0	**Contingency**				**2,314,904.00**

Stage 3 4 Completion Estimate

Printed 18/07/2022

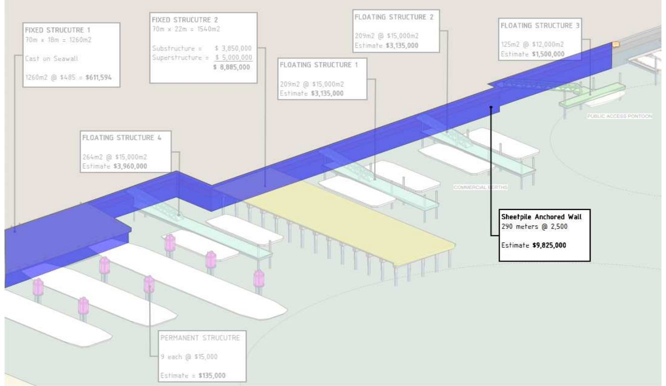
FIXED STRCUTURES **$ 9,631,594.20**

Item	Description	Quantity	Unit	Rate	Amount
1.0	**Engineering Volumes & Productions**				
	FIXED STRCUTURE 1 - Car Ferry Ramp				$ 611,594.20
	70m x 18m	1,260.0	m2	**485.39**	
2.0	**Design Fee (incl Geotech)**				
3.0	**Construct Fee - Structural Element Only [substructure]**				**$ 611,594.20**
	Main Structure				
	Assume Precast Slab on driven precast piles - Based on Sheetpile Wall	-	m2	$ -	$ -
	Slab / Ramp	1,260.0	m2	$ 350.00	$ 441,000.00
	Piles at rear to support slab	6.0	ea	$ 11,765.70	$ 70,594.20
	Supply & Install Pre-Stressed Pile Build				
	Supply	18.0	m	$ 451.70	
	Transport	1.0	ea	$ 3,000.00	
	Handle & Pitch	1.0	ea	$ 5,200.00	
	Driving Piles	18.0	m	$ 114.00	
	Stripping & Scabbling	1.0	ea	$ 1,500.00	
	Dynamic Testing	1.0	ea	$ 1,500.00	
	Handrail and Miscellaneous Items				
	Allow sum to provide fall protection and tie backs etc.	1.0	LS	$ 100,000.00	$ 100,000.00
	FIXED STRCUTURE 2 - Pontoon / Commercial Strucutre				$ 9,020,000.00
	70m x 22m	1,540.0	m2		
2.0	**Design Fee (incl Geotech)**				**$ 35,000.00**
	Design Fee	1.0	LS	$ 35,000.00	$ 35,000.00
3.0	**Construct Fee - Structural Element Only [substructure]**				**$ 3,850,000.00**
	Assume Precast Slab on driven precast piles	1,540.0	m2	$ 2,500.00	$ 3,850,000.00
4.0	**Design and Construct - Superstructure**				**$ 5,000,000.00**
	Design & Construct	1.0	LS	$ 5,000,000.00	$ 5,000,000.00
	FIXED STRCUTURE 3 - Car Ferry Poles				$ 135,000.00
		9.0	ea	$ 15,000.00	$ 135,000.00

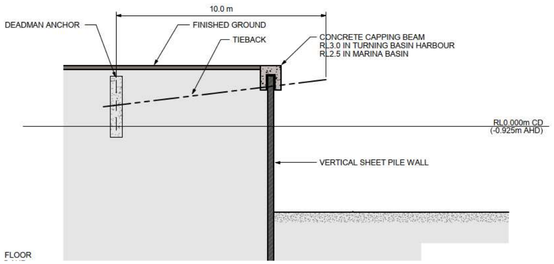


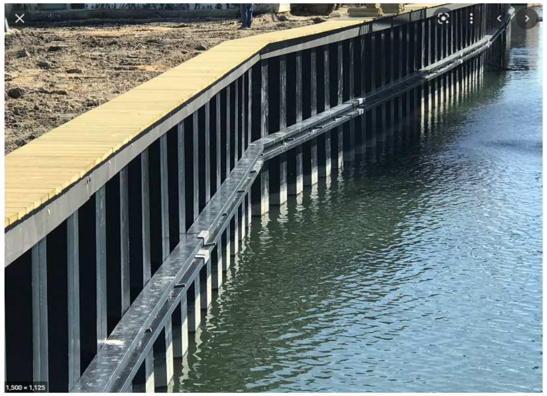
LANDWALL STRUCUTRE $ **9,825,200.00**

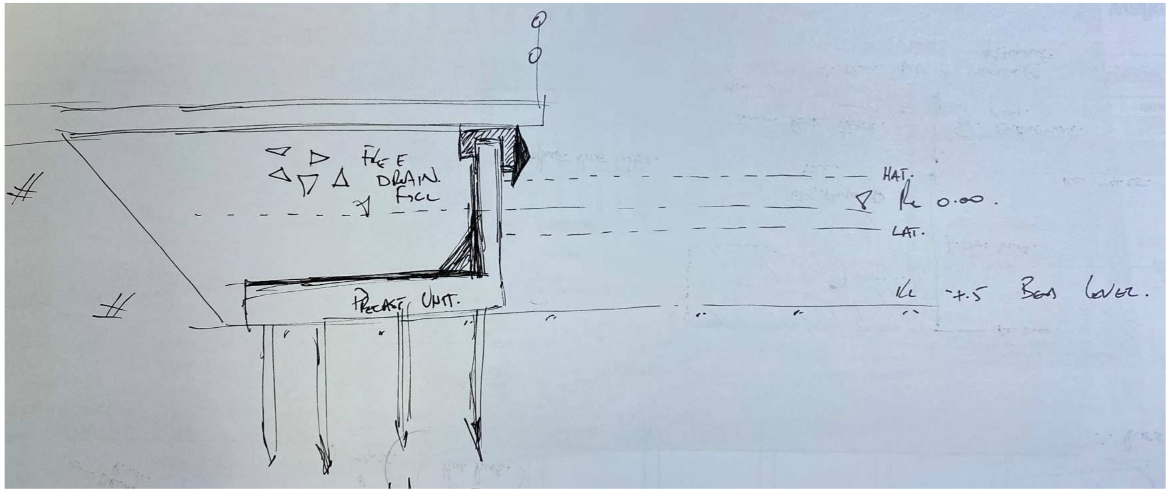
Item	Description	Quantity	Unit	Rate	Amount
1.0	**Engineering Volumes & Productions**				
	Sheet Pile Wall				
	Scaled from PA2060-RHD-00-DR-W-SK10 [B]	290.0	m		
	Harbour Floor	- 4.3	m	**AHD**	
	Sheet Pile Length	12.0	m		
	Area Sheet Piles - Driven	3,480.0	m2		
2.1	**Sheet Piles, Anchor & Tieback**				**$ 9,744,000.00**
	Supply, Design & Install - sheet pile wall	3,480.0	m2	$ 2,800.00	$ 9,744,000.00
	Rate assumed using design/supply/install rates from previous DTMR project. Have allowed for 20mm thick steel sheet piles. Further design investigation required as concrete strucutre will be needed for this. Steel sheet piles will not meet duarbility requirements				
2.1	**Capping Beam**				**$ 81,200.00**
	Precast Capping Beam	290.0	m	$ 280.00	$ 81,200.00



$ 6,500,000.00		
532.00		
$ 12,218.05	Kingsford Smith Drive	1 x 30m x 8m 1 x 20m x 8m
$ 3,100,000.00		
133.00		
$ 23,308.27	Stradbroke Island	25m x 9m
$ 15,000.00	Service Berth	







Attachment 4:

SYNERGIES ECONOMIC FEASIBILITY ASSESSMENT

Synergies
ECONOMIC CONSULTING

Memorandum

To:	Sam Maynard
From:	Daniel Culpitt
Subject:	**Economic feasibility of alternative options to the Toondah Harbour Development Project**
Date:	February 2021

Context

The EIS Guidelines for the Toondah Harbour Development require consideration of any feasible alternatives to the project, as follows:[1]

> Any feasible alternatives to the action to the extent reasonably practicable, including:
>
> (a) if relevant, the alternative of taking no action;
>
> (b) a comparative description of the impacts of each alternative on the MNES protected by controlling provisions of Part 3 of the EPBC Act for the action; and
>
> (c) sufficient detail to make clear why any alternative is preferred to another.
>
> Short, medium and long-term advantages and disadvantages of the options should be discussed.

The following sections detail the analysis of the two feasible alternatives – 'do nothing' and a 'dredging only' option, whereby the project is limited to the dredging of the Fison Channel and swing basin.

[1] Guidelines for the Preparation of a Draft Environment Impact Statement. Environment Protection and Biodiversity Conservation Act 1999. Toondah Harbour Development, Queensland (EPBC 2018/8225). Walker Group Holdings Pty Limited.

Synergies ECONOMIC CONSULTING

Consideration of feasible alternatives

'Do nothing'

As noted above, it is firstly necessary to consider the alternative option of taking no action. This option (i.e. 'do nothing') has been implicitly considered in the economic analysis, as the Toondah Harbour development project has been assessed against the base case, in this case being the 'do nothing'.

The economic analysis found that the economic benefits derived from the project, being the economic value of the land created by the development and the benefit derived from increased tourism visitations to the Redland City Council and Minjerribah were sufficient to overcome the costs of the development, including the capital and operating and maintenance costs, and the costs associated with the adverse environmental impacts of the development.

Dredging only

The only other feasible alternative to the development project is to conduct dredging to alleviate capacity constraints in the Fison Channel and swing basin. This would enable larger and more frequent vessels to call at the mainland ferry terminal, thereby alleviating the constraint on tourist visitations to Minjerribah.

Economic benefits

While the benefits attributable to the development (i.e. residential, commercial and retail development and marina and other facilities) cannot be attributed to this alternative, it is reasonable to attribute the economic benefit derived from the increased tourist visitations and expenditure to Minjerribah to this option.[2] As per the economic analysis of the Toondah Harbour Development Project, the Present Value of these benefits is estimated at $9.1 million, calculated over a 30-year evaluation period.

Economic costs

The economic cost of this alternative option would be limited to the cost of dredging the Fison Channel and swing basin, and the additional maintenance dredging costs associated with the larger channel and basin. It is assumed the dredging costs under this option would be reflective of the dredging costs estimated for the Toondah Harbour

[2] On the basis that this alternative option will alleviate the constraint on the frequency and capacity of ferry services operating between Minjerribah and the mainland, hence enabling the continuation of the recent growth trends in terms of tourist visitations and expenditure on Minjerribah.

Development Project, which are estimated at $43.6 million (all to be incurred in 2021). There is also additional maintenance dredging of $1.8 million in PV terms,[3] resulting in a total cost estimate of $45.4 million (PV terms).

Results

Based on the economic benefits and costs as discussed above, the Net Present Value of the 'dredging only' alternative is estimated at ($36.3 million) with a Benefit Cost Ratio of 0.2. This indicates this alternative option is not economically feasible and compares to the results as reported in the cost-benefit analysis of the Toondah Harbour Development Project of a Net Present Value of $412.6 million and Benefit Cost Ratio of 1.48.

It is noted that these costs do not include the upgrade of on land facilities at Toondah Harbour (offices, car parks, etc). These works are projected to be approximately $20 million for the current proposal but would likely be minimised under a 'dredge only' scenario. The Benefit Cost Ratio would be further reduced if these costs were added.

The dredging costs assume the cheapest disposal option is utilised, unconfined offshore disposal at Mud Island. If this outcome couldn't be achieved dredging costs would increase significantly.

[3] The difference between the maintenance dredging costs under the base case and project options in the economic analysis of the Toondah Harbour Development Project.