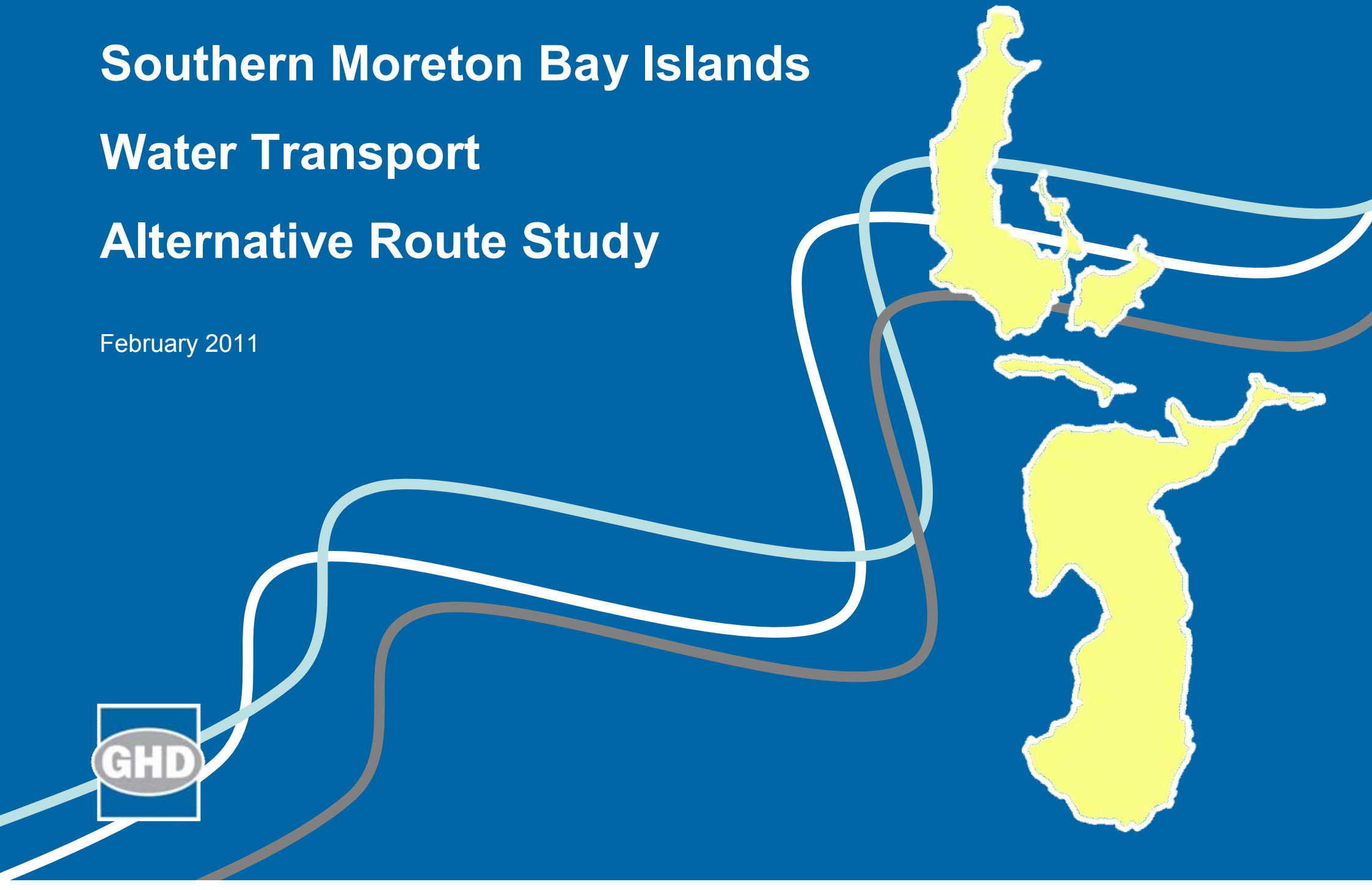
Appendix F
Water Transport Alternative Route Study

Southern Moreton Bay Islands Water Transport Alternative Route Study

February 2011



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1. Introduction

1.1 The project

GHD was commissioned by Redland City Council to provide an independent assessment of the feasibility of additional access routes to the Southern Moreton Bay Islands including:

- Alternative and/or additional vehicle barge routes
- Alternative and/or additional water taxi routes
- A bridge from the southern end of Russell Island to the mainland

The project:

- Reviewed background information and previous assessments of alternative routes
- Identified environmental constraints including marine park zoning, sea grass distribution and habitat areas.
- Identified locational constraints including:
  - Land tenure and availability
  - Access to the existing transport networks and upgrade requirements
  - Water depth, access channels and dredging requirements
  - Wind direction/shelter/exposure/tidal flows
- Identified operational constraints including:
  - Travel time and costs
  - Impact on other services/operators
  - Landside requirements
- Prepared and compared indicative cost estimates for barge and water taxi alternatives and a potential bridge for cost comparison purposes

Figure 1 Study area

1.2 Study area

The Southern Moreton Bay Islands (SMBI) are situated in the southern end of the Moreton Bay Marine Park (refer to Figure 1). They are rich in environmental and cultural resources and offer an idyllic quiet lifestyle on the doorstep of Australia's third largest and fastest growing metropolitan area.

Russell, Karragarra, Lamb and Macleay (including Perulpa) Islands were incorporated into Redland City Council on 12 May 1973. In the 1960s and early 1970s, much of the collective island land was subdivided into small allotments. Since then, Redland City Council has restricted further subdivisions and rationalised planning so that the significant environmental and cultural values of the islands and surrounding Moreton Bay are preserved. From a connectivity perspective, the islands are serviced from Weinam Creek Marina, Redland Bay, on the mainland by passenger ferry and vehicle barge.

1.3 Study need

1.3.1 Capacity constraints at Weinam Creek

Demand for car parking at Weinam Creek is arguably the most contentious issue affecting the Southern Moreton Bay Islands.

The *Redland Bay Centre and Foreshore Master Plan* notes: "Future demand for car park spaces in the Weinam Creek Ferry Terminal car parking area will continue to increase in an unsustainable way, if trends are not arrested or changes influenced by policy decisions. This position is unsustainable and will place unacceptable demands on public foreshore land in the locality."

1.3.2 Travel cost

One of the concerns raised most frequently by island residents is the cost of accessing the mainland. As at 4 October 2010, the return barge fare for island residents for a (standard vehicle) was $87.00.

The isolated nature of the islands means that residents are reliant on the use of either a passenger ferry or vehicular barge, and are thus at the mercy of operator pricing arrangements.

Increased use of vehicular barges has the potential to reduce parking demand at Weinam Creek by allowing those island residents who require the use of a private vehicle on the mainland to store their vehicle at their private property on the island rather than on the mainland. However, anecdotal evidence currently suggests that the cost of vehicle barge journeys means some residents prefer to maintain two vehicles, one on the mainland and one on the island, compounding parking problems.

Reduced barge costs also have the potential to reduce the cost of goods and services on the islands by reducing the cost of transport and delivery.

1.3.3 Safety and emergency access

The residents of the Southern Moreton Bay Islands are currently reliant on a single access point to the mainland at Weinam Creek. Discussions with Maritime Safety Queensland have suggested that the provision of appropriate infrastructure to cater to emergency and evacuation requirements should be considered in the design and rationalization of transport infrastructure. The recent upgrades to Dunwich terminal on North Stradbroke Island were largely driven by emergency evacuation requirements.

1.4 Mainland destinations

In many cases, the barge and passenger ferry terminal at Weinam Creek does not provide the most appropriate mainland landing point for onward journeys using public transport.

Table 1 provides a summary of travel survey results undertaken on the Southern Moreton Bay Islands in recent years such as:

- The 2003 SMBI Travel Survey
- The 2009 SMBI Travel Survey
- The 2010 Barge Intercept Survey (barge passengers only)

The majority of mainland destinations are located within Redland City Council, followed by Brisbane City Council. This suggests that outside of Redland City Council, the majority of trips to the mainland are in a northbound direction and could benefit from reduced travel times resulting from an additional barge route from Macleay Island to a more northern mainland landing point.

Table 1 Mainland destinations by Local Government Area

	2003[1]	2009[1]	2010[2]
Redland City Council	43%	42%	30%
Brisbane City Council	24%	37%	30%
Gold Coast City Council	5%	6%	9%
Logan City Council	4%	7%	6%
Other	3%	8%	25%
Total	79%[3]	100%	100%

[1] Southern Moreton Bay Islands Travel Survey Report, April 2009

[2] Barge Intercept Survey, RCC, 2010

[3] Total as shown in 2009 Southern Moreton Bay islands Travel Survey Report, RCC

1.5 Study assumptions

The assessment of potential barge and passenger ferry landing points and the proposed Russell Island Bridge was based on the following key assumptions:

- Historic and existing environmental conditions including bathymetric surveys provided by Maritime Safety Queensland and the level of highest astronomical tide (HAT). The report does not consider the potential impacts of climate change including sea level rise and tidal inundation.
- A bathymetric depth of -1m LAT (lowest astronomical tide) was selected as the minimum depth required for the operation of barge services. -1m LAT was chosen on the basis that a tide of this depth is reached infrequently.
- Due to a lack of data, the assessment does not consider the requirements for dredging; a major constraint that requires detailed investigation.
- Population and settlement patterns are generally as assumed in the Southern Moreton Bay Islands Planning and Land Use Study (2002) and Redland City Council's *Issue Paper – Population and Dwelling Profile – Southern Moreton Bay Islands.*
- The recommendations made in this report are exclusive of detailed environmental assessment. Any further investigation must include detailed environmental investigations including the hydrodynamic modelling and impact on sediment movement.
- The existing barge type and configuration has been used as the basis for the study. The current flat bottom barges are considered most suitable for the Southern Moreton Bay Islands due to the limited depth and enforced speed restrictions which aim to reduce potential environmental impacts. The exception was the consideration for a cable driven barge from southern Russell Island.
- The purchase and operational cost of additional barge vessels have not been included in the cost as there is insufficient information to make an assumption on barge costs. For example, whether the vessel would be purchased second hand or purpose built.
- The existing infrastructure for the barge service is adequate for efficient operation. Proposed new infrastructure has been modelled upon that existing on the islands and mainland. Constructing a terminal style facility similar to that at Weinam Creek is outside the scope of this study.
- Installation of additional navigation aids is outside the scope of this study.
- The recommendations provided in this report are void of any detailed geotechnical data or recent topographic and bathymetric survey data. Therefore, the viability and configurations of the concepts provided would need to be reviewed following completion of these detailed investigations.
- The recommendations and cost estimates provided in this report are based on high level analysis of the requirements for infrastructure upgrades within the vicinity of potential landing points only. Further investigations must consider capacity impacts and upgrade requirements on wider transport networks and the impact on travel behaviour both on the islands and the mainland.
- Additional traffic associated with the construction of the proposed facilities, may place strain on the existing barge/road network. A traffic assessment has not been completed nor has the cost of additional maintenance to the existing road network been considered as this is outside the scope of the study.

2. Existing situation

2.1 Terminal facilities

All existing vehicular barge and passenger ferries depart from the Redland Bay Marina at Weinam Creek, Redland Bay. Redland Bay Marina is located approximately 50 minutes driving time south of Brisbane CBD and approximately 55 minutes north of Nerang on the Gold Coast. The marina is also accessible by a number of TransLink bus services to Brisbane, Garden City, Loganholme and Victoria Point.

2.2 Vehicular barge

Stradbroke Ferries is currently the sole operator providing vehicular barge services to the Southern Moreton Bay Islands. The company operates four vessels as detailed in Table 2. Services travel in a clockwise direction from Weinam Creek to Karragarra, Macleay, Lamb and Russell Island.

Barge services in Queensland are not subject to regulation from the Department of Transport and Main Roads. A standard return journey costs $105. Discounted fares are available for island residents ($87).

The substantial cost means that it is often cheaper for residents to maintain two vehicles – one on the islands and one on the mainland – than to travel via barge on a regular basis. This was highlighted in the *2010 SMBI Travel Survey* conducted by SocialData which showed that 37% of trips included a passenger ferry journey, whilst only 3.1% of trips included a vehicular barge journey.

The Redland City Council *2010 Barge Survey* highlighted that 32% of vehicles travelling on the barge were for government or commercial purposes.

Table 2 Barge vessel details

	Lakarma	Moreton Escape	Bay Islander	Stradbroke Venture
Length (m)	38.77	36.77	33.99	54.41
Beam (m)	8.84	11.32	9.45	10.97
Draft[1] (m)	1.2	1.3	0.9	1.2
Capacity	22	18	16	32

Source: www.stradbrokeferries.com.au, accessed 24.06.10

1 Laden Fore Draft

2.3 Passenger ferry

Bay Islands Transit (BIT), formerly Bay Islands Taxi Service has a fleet of four 60 foot catamarans serving the Bay Islands. Their new larger vessels can now accommodate up to 150 passengers (previously up to 120 passengers) and are wheelchair accessible and bicycle friendly.

Services travel in both a clockwise (via Karragarra Island) and anti-clockwise (via Russell Island) direction to the four islands.

BIT has an unexclusive, fare regulated contract with the Department of Transport and Main Roads. The contract allows for an annual review of fares based on major operating costs – fuel, wages etc – but excluding capital expenditure.

As previously mentioned, passenger ferry is the most popular water transport mode to access the mainland.

Table 3 Existing services (one way)

	Vehicular barge	Passenger ferry
Journey time (Russell Island) (Macleay Island)	 65 mins 40 mins	 20 mins 18 mins
Journey cost (standard)	$50.50	$7.70
Services / weekday	14	38
Operating hours	05:30 – 18:30	04:20 – 00:10

* Valid at 24 June 2010

3. Overarching considerations

Appropriate landing sites for potential future landing points were selected based a wide variety of considerations including:

- Landside access
- Potential demand
- Water depth and access
- Environmental constraints

At this pre-feasibility stage, potential landing points have been assessed based on a high level desktop analysis. Any further investigations into future vehicular barge and water taxi routes and a potential Russell Island Bridge must include detailed investigations into the environmental, social and economic impacts.

3.1 Landside considerations

3.1.1 Existing infrastructure

Locations with existing maritime infrastructure are likely to be those with appropriate water depth, access to navigable water, road access etc. Additional water-based transport may also have less environmental impact in those areas with existing infrastructure than those in relatively untouched environments.

However, the Department of Transport and Main Roads discourage the dual use of maritime infrastructure for public and private use for safety reasons. Whilst this may be the department's preference, legislation relevant to coastal development (such as the Draft Queensland Coastal Plan) has preference for protecting undeveloped coastal areas and catering for demand for maritime services and maritime development as follows:

- Existing infrastructure utilised to the greatest extent possible
- Marine development provided within designated maritime development areas
- Marine development facilities provided in areas adjoining maritime areas
- New marine facilities provided outside of designated areas (preferable in degraded areas) where there is an overriding need in the public interest

3.1.2 Land tenure, zoning and ownership

Those sites within an existing road reserve or under Council ownership are preferred. Impact on Environmental Protection areas, Conservation Areas and Open Space areas designated under the Redlands Planning Scheme should be avoided where possible. Vacant sites that are in private ownership will also be considered.

3.1.3 Landside access

There are three key considerations for landside access:

- **Road access:** existing vehicular access to minimize the need for road works and clearing, proximity to arterial routes and destination points, impact on existing transport networks and upgrade requirements
- **Proximity to public transport:** existing and potential bus services, proximity to rail heads (on the mainland)
- **Passenger amenity:** passenger facilities, proximity to commercial facilities, aesthetic and safety considerations

3.1.4 Infrastructure requirements

Vehicular barge

The general arrangement of the landside infrastructure has been modelled on the existing facilities on the islands, including:

- **Barge Ramp:** The barge ramp will be constructed of durable concrete planks. The ramp will provide all tide access.
- **Waiting Area:** An area to queue before travelling on the barge. An area to turn vehicles and reverse onto the barges will also need to be provided.
- **Breasting Piles:** Piles driven either side of the ramp will be required to guide the barges to the ramp while also assisting the barge to hold steady while at the ramp.

Additional infrastructure that is required at the alternative barge ramp locations to provide all tide access is a causeway to link the barge ramp with the waiting area. This is preferred over the alternative to dredging which has more potential

for environmental impacts and would represent an ongoing maintenance cost. Causeways have not been needed at existing barge ramp locations as access to deep water has not been an issue.

Additional navigation aids are also likely to be required, however the positioning, number of aids and cost associated with the installation of the navigation aids has not been reviewed as part of this study.

Passenger ferry

Similarly to the vehicular barge, the infrastructure required for the passenger ferry terminal has been modelled on the existing facilities on the islands, including:

- **Floating terminal:** A floating pontoon held in place by piles and attached to the shoreline by a piled walkway structure will be required. The terminal will need to be located in sufficient water depth to allow the ferry all tide access.
- **Car Park:** A car park sufficient for the current population as well as space to expand for future population growth will be required at the ferry terminals.
- **Breasting Piles:** Piles driven either side of the pontoon will be required for the ferry to moor against while at the terminal.

Similarly to the vehicle barges, additional navigation aids are likely to be required.

3.1.5 Land reclamation

The requirement for reclamation of land below highest astronomical tide (HAT) at terminal locations is critical to the assessment of any development in the study area. Reclamation of tidal waters can result in significant degradation of coastal resources and as such should be avoided.

The State Coastal Management Plan (Policy 2.1.9) notes that land below the highest astronomical tide may be reclaimed where:

(c) it is for coastal-dependent land uses or other 'areas of state significance (social and economic)' and there is a demonstrated net benefit for the state or a region;

(e) it is necessary for the development of a public or private facility and there is public support and a demonstrated public benefit from the proposal;

For (c) and (e) above, it needs to be demonstrated that there are no alternative sites available that do not require reclamation.

This sentiment is reiterated in the Draft Queensland Coastal Plan which states:

SO3 – 16 Reclamation of land below HAT only occurs within maritime areas unless it is:

(a) necessary for maintaining physical coastal processes including maintaining intensively managed foreshores; or

(b) within an existing artificial waterway; or

(c) necessary for the establishment of government supported transport infrastructure and there are no alternative sites available that do not require reclamation.

3.2 Water depth and access channels

Existing vehicular barges and passenger ferries on average have a laden draft of 1.2 metres and 1.6 metres respectively. An under keel clearance of approximately 1 metre is preferred when under way, therefore the minimum depth required in the access channels to provide all tide access is -2.2 metre LAT and -2.6 metre LAT for the vehicular barge and passenger ferries respectively.

The waters of southern Moreton Bay are generally characteristic of a relatively shallow sandy seabed with highly mobile sand banks. Muddy tidal flats extending out from low-lying islands which are densely vegetated with mangroves indicate that there is little erosion caused by wave and wind action.

The removal of material below the high water mark can have significant impacts on the coast, ranging from effects on water quality, aquatic fauna and flora to sediment supply. Consequently, the Department of Environment and Resource Management seeks to avoid developmental dredging in the Moreton Bay Marine Park.

Developmental dredging of a navigation channel or boat harbour is classified as major works under the *Marine Parks (Moreton Bay) Zoning Plan 2008* and cannot be carried out without a permit. Maintenance dredging (for navigational purposes) may be carried out without permission after giving notice.

3.3 Environmental constraints

The following environmental legislation applies to development within the study area:

- T he *Draft Queensland Coastal Plan 2010* will replace the *State Coastal Management Plan 2002,* until such time the existing legislation will remain in force. It seeks to provide policy direction and guidance on managing coastal land in Queensland in line with the Coastal Act.
- *South East Queensland Regional Coastal Management Plan 2006* provides specific regional direction on coastal management outcomes in support of the State Coastal Plan.
- *Marine Parks (Moreton Bay) Zoning Plan 2008* which seeks to manage different activities in the marine park by separating potentially conflicting uses, while maintaining the park's unique biodiversity. The Marine Park Zoning Plan overrides the South East Queensland Coastal Plan
- T he *Redlands Planning Scheme* describes the land use intent in the local government area. The Conservation Zone Sub-area CN1 identifies land with environmental values and/or
- T he *Vegetation Management Act (VMA)* including the requirements of Regional Vegetation management Code for SEQ
- T he *Environmental Protection and Biodiversity Conservation Act (EPBC)* requires that any proposal within Moreton Bay be referred to the Ferderal Minister for the Department of the Environment, Water, Heritage and the Arts regarding impact on a matter of National Environmental Significance.
- T he *Ramsar Convention* is an intergovernmental treaty that provides a framework for the conservation and wise use of wetlands and their resources

The Moreton Bay Marine Park covers the entirety of the Southern Moreton Bay Islands study area. Its waters provide for environmentally significant fish, turtle and dugong habitats and its shorelines and riparian zones provide habitat for significant coastal wetlands a shorebird habitats.

A summary of applicable environmental regulations and policy requirements is provided on the next page. These regulations apply unless it can be demonstrated there is an overriding need in the public interest and that no other suitable sites are available:

- Development must not adversely impact on areas of high ecological significance including:
  - Coastal wetlands
  - Endangered regional ecosystems
  - Protected areas (State land) declared under the *Nature Conservation Act 1992*
  - Declared fish habitat area
  - Seagrass (including turtle and dugong feeding habitat)
  - Rocky reefs
  - Reefs (including coral)
  - Wetlands (significant and coastal)
  - Shore bird habitat (including internationally significant migratory bird roosts)
- Development must allow the natural effect of coastal processes to continue including hydrological flows, tidal or natural currents or drainage patterns and sediment flows.
- Protection of undeveloped tidal waterways from maritime infrastructure
- Reclamation of land below HAT only occurs within *maritime development areas*
- In the Moreton Bay Marine Park, major works may only be designated in general use or habitat protections zones

As can be seen in Figure 2 and Figure 3 significant environmental habitats limit the potential for additional maritime infrastructure in the Southern Moreton Bay Islands study area. However, there is potential for development approval if it can be demonstrated that there is an overriding need in the public interest. According to the *Draft Queensland Coastal Plan* (Sec A2.1), to demonstrate overriding need in the public interest, the applicant must establish:

- *"The overall social, economic and environmental benefits of the development outweigh:*
  - *Any detrimental effect upon the natural values of the site and adjacent areas; and*
  - *Conflicts with the policy outcome of this draft; and*
- *The development cannot be located elsewhere to avoid conflicting with the policy outcome of this draft policy."*

The approvals process for any new bridge, barge or ferry route, and associated infrastructure is discussed in Section 3.5.

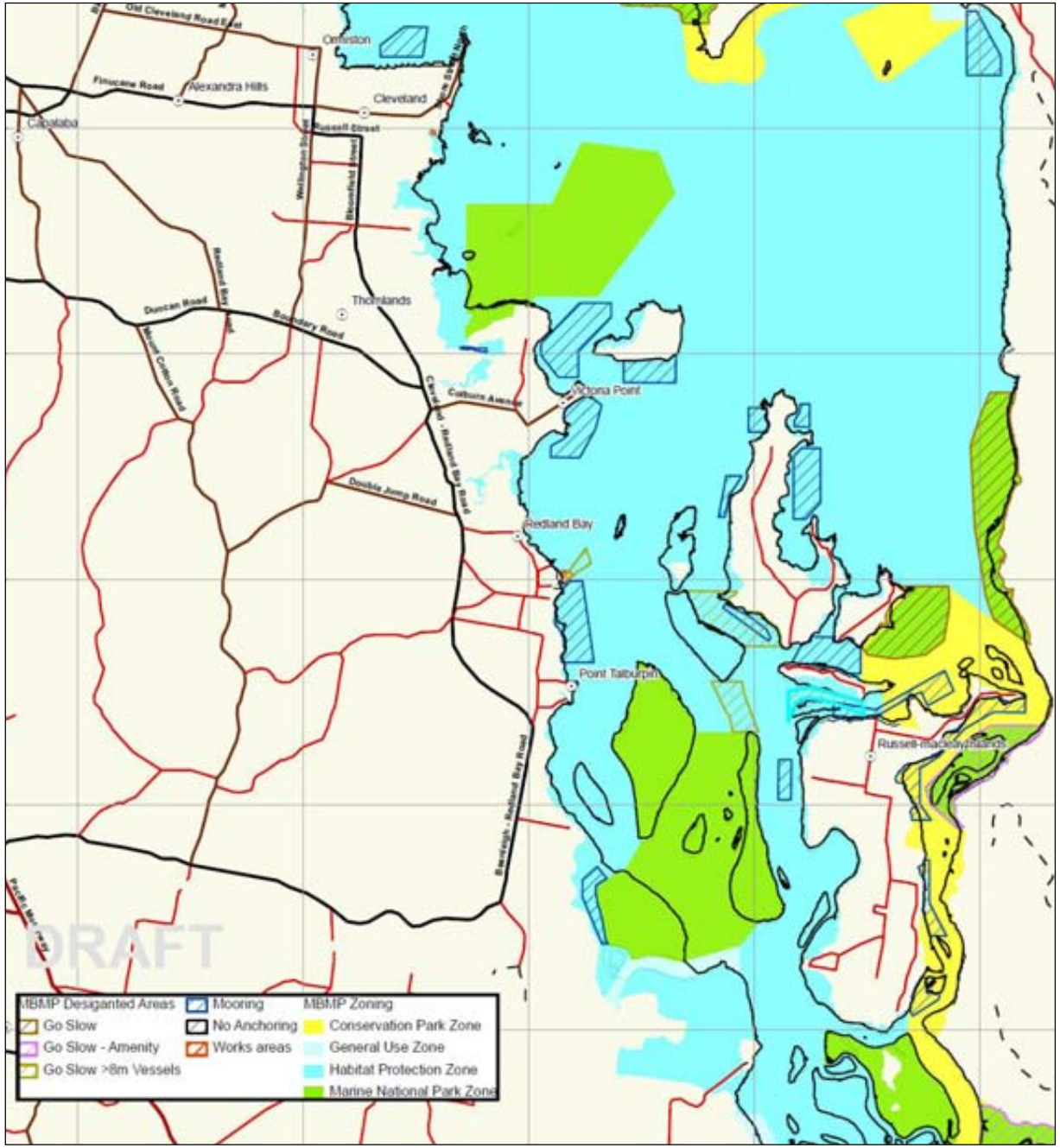
3.4 Operational considerations

3.4.1 Wind direction / shelter

Review of the 9am and 3pm wind roses prepared by the Bureau of Meteorology for Redlands indicate the prevailing wind direction in the morning is South East, coupled with significant contributions from the South West and North West quadrants. South East winds remain the prevailing wind direction in the afternoon, however winds from the North West quadrant provide the only other significant contribution in the afternoon.

Given the prevailing south-east wind direction all potential landing sites on the west side of Russell and Macleay Islands are relatively protected. Most of these sites, however, are exposed to the northerly and westerly winds.

Figure 2 Environmental constraints



3.4.2 Travel speed

Maritime Safety Queensland applies a speed limit of **40 knots** on smooth water limits on all Queensland Waterways (unless otherwise prescribed) (MSQ website, 22 Sept 2010). The South Brisbane smooth water limit extends from Cleveland Point on the mainland to Amity Point, North Stradbroke Island and south to the Gold Coast Seaway.

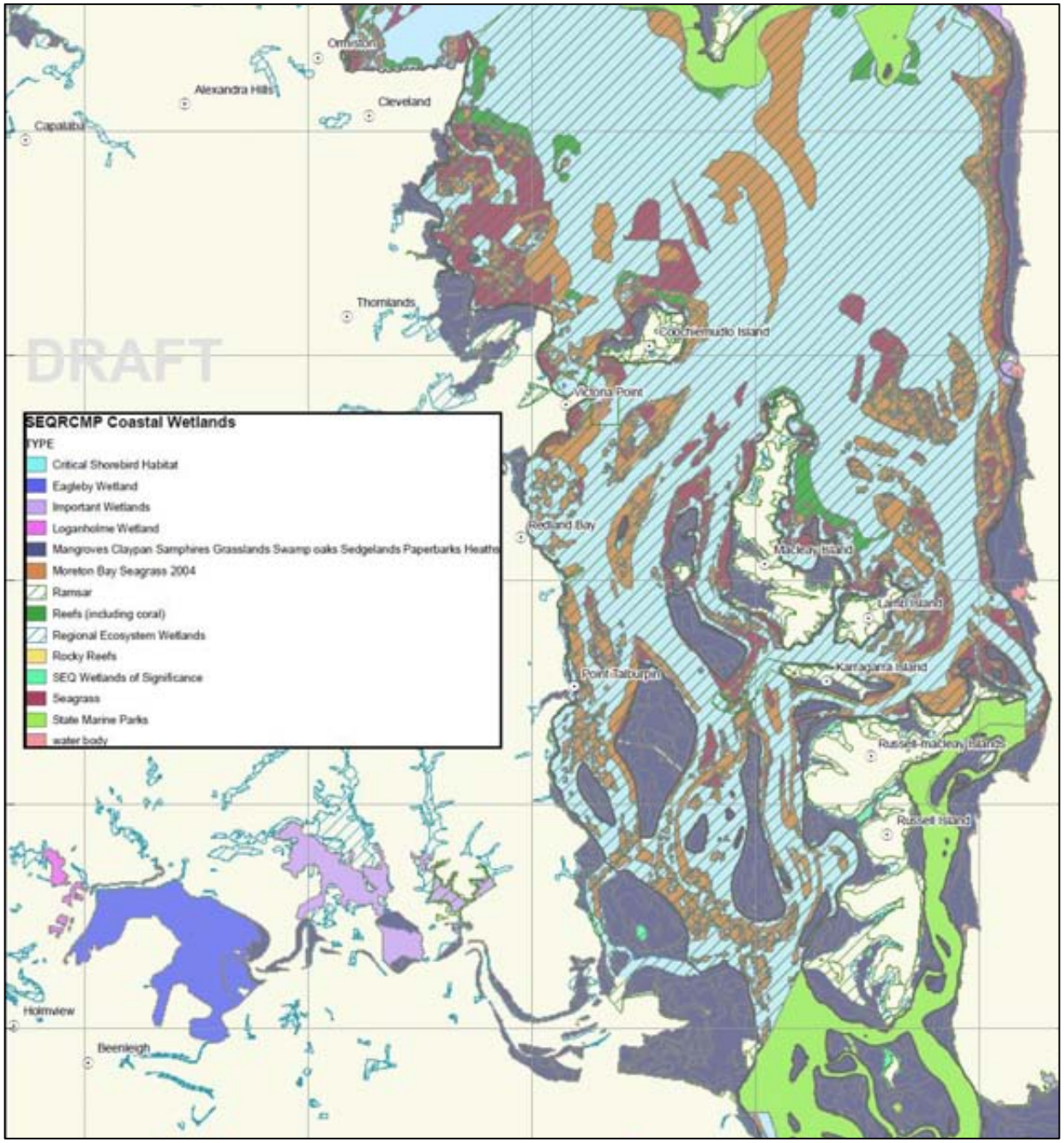
A further restriction to **six knots** is applied:

- Within 30 metres of boats anchored, moored to the shore or aground, a jetty, wharf, pontoon or boat ramp
- Within 30m of people in the water
- Within 50m of people in the water when operating a personal watercraft
- In boat harbours and marinas

In addition, the Department of Environment and Resource Management applies the following restrictions in designated areas to help manage specific environmental issues (Marine Park (Moreton Bay) Zoning Plan, 2008):

- **Go Slow Areas for Turtles and Dugongs**: all vessels must travel off-the-plane in displacement mode, and in a way that minimises the change of a turtle or dugong being struck
- **Go Slow Areas for Turtles and Dugongs (vessels >8m)**: vessels over 8m are restricted to 10 knots or less in the following areas:
  - GSB01 – Weinam Creek
  - GSB02 – Garden Island
  - GSB03 – Karragarra Channel
  - GSB04 – Krummel Passage

Figure 3 Marine Park zones



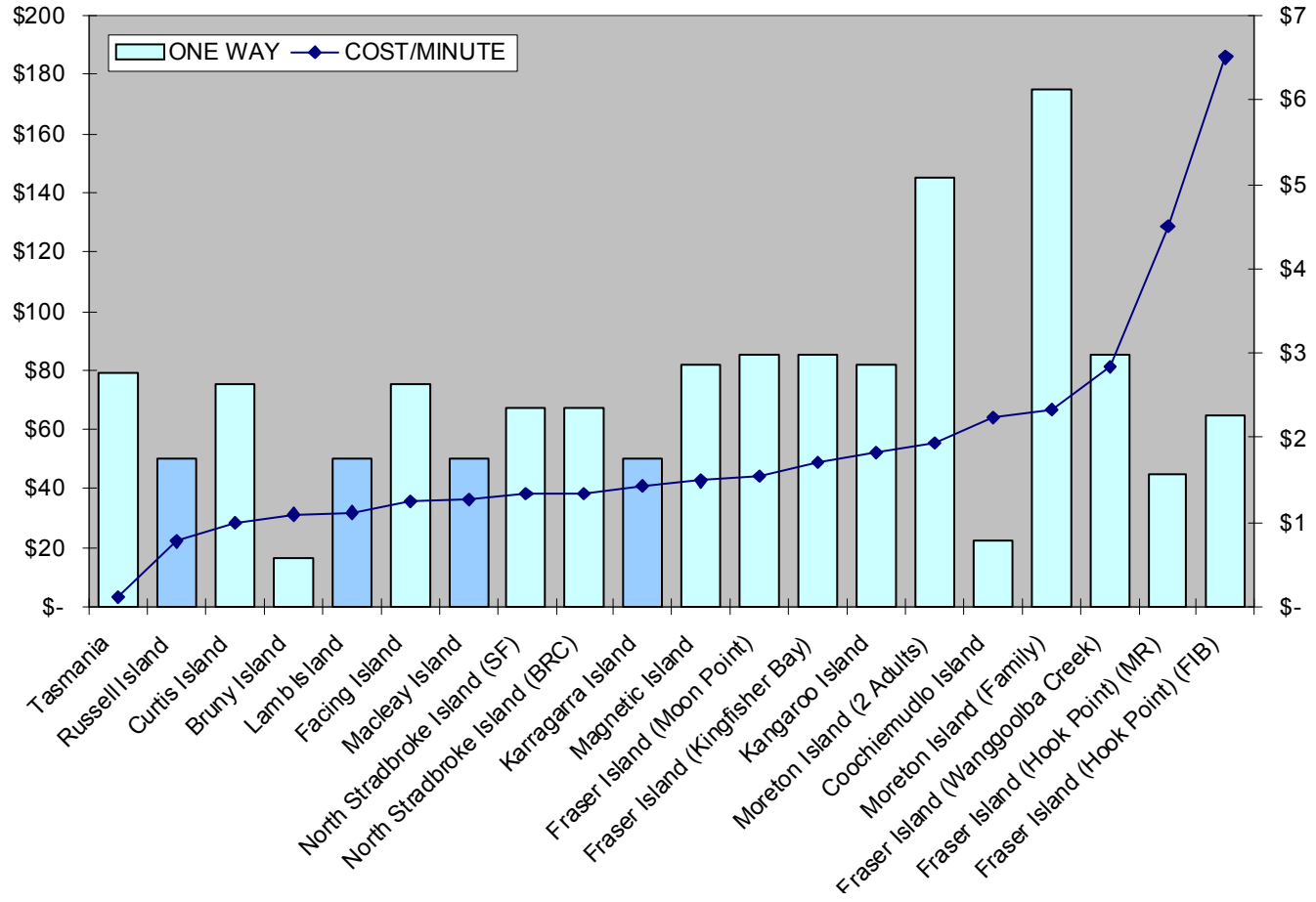
However, permission may be granted for vessels to operate in the area at a speed of more than 10 knots.

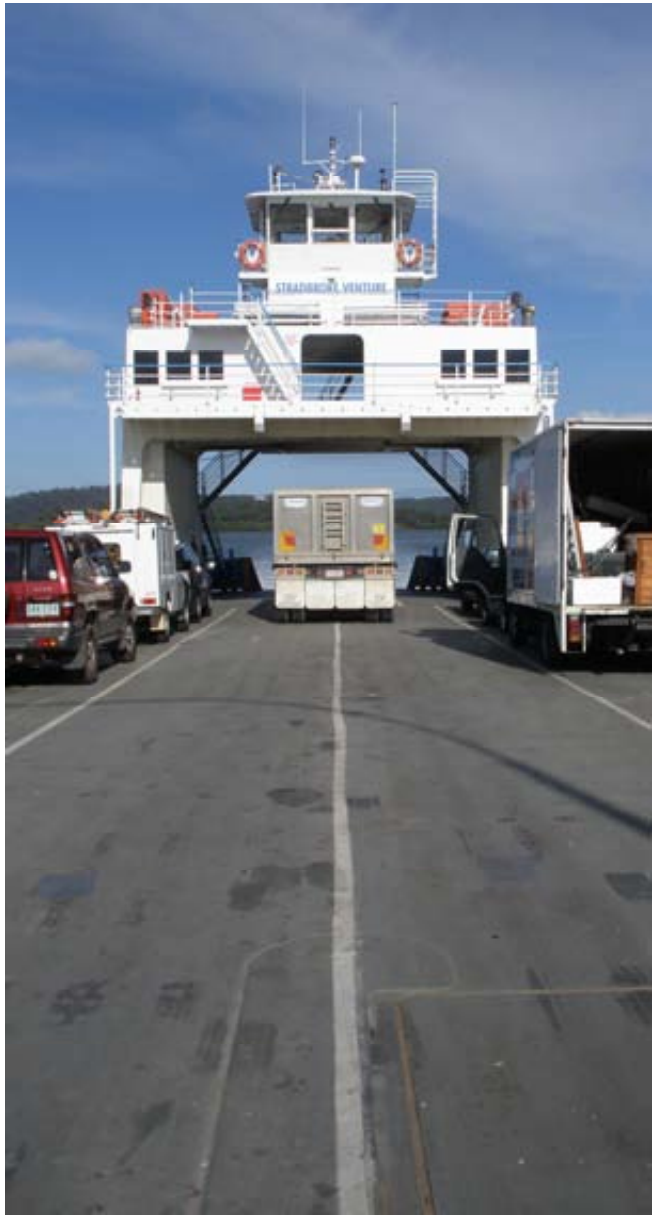
- **Go Slow Areas for Natural Values**: all vessels must travel off-the-plane or in displacement mode

3.4.3 Travel time and cost

There is a common belief that shorter travel distances will reduce time on the water, thus reducing the cost per journey. The high cost of fares is cited as one of the reasons for low barge usage and consequent parking of a second vehicle at the Weinam Creek terminal by residents. It follows that reduced fare costs will make barge travel a more attractive mode choice for residents and reduce parking demand at Weinam Creek. However, a comparison of barge fares on the east coast of Australia shows that there is no direct correlation between journey time and cost (Figure 4).

Figure 4 Comparison of vehicular barge fares in Australia





3.5 Environmental approvals process

Any potential new barge routes will only be progressed by a private operator as Redland City Council does not operate barge services

Council advised that the operator of any new barge service will be responsible for the construction and operation of any new infrastructure as well as obtaining all the required statutory approvals, which will include the following:

- Resource entitlement to any State land on which the infrastructure is located. This may involve first applying for tenure over the State land involved.
- Allocation of quarry material or a dredge management plan for any dredging and disposal of dredge spoil to above high water mark under the Coastal Protection and Management Act 1995.
- Approval to conduct environmentally relevant activities (ERA) under the Environmental Protection Act 1997.
- Permits under the Marine Parks Act 2004 for works and operations in the Moreton Bay Marine Park.
- Development approval for tidal works under the Sustainable Planning Act 2009 (SPA)

The development approval under SPA will be for prescribed tidal works for which the Redland City Council will be the Assessment Manager and the following agencies will have a Concurrence role:

- Department of Environment and Resource Management (DERM) in relation to coastal management and consistency with the policies of the State Coastal Management Plan, Draft Queensland Coastal Plan and South-east Regional Coastal management Plan;
- Fisheries Queensland (part of the Department of Employment, Economic Development and Innovation (DEEDI)) in relation to effects on fisheries values and in particular the need for a permit to damage or destroy marine plants; and
- Maritime Safety Queensland (MSQ) in relation to maritime safety.

Key issues in the approval process include:

- The effect of the infrastructure located below high water mark on coastal processes and the adjacent coastline
- The extent of reclamation areas over tidal lands. Reclamation works need to be kept to the minimum area necessary to service the maritime infrastructure
- The extent of dredging works. Dredging needs to be kept to a minimum and the expected level of future maintenance dredging needs to be identified
- Disposal of dredge spoil. Land based disposal is the preferred option as are limited opportunities to dispose of dredge material in the marine park
- Fuelling requirements
- Public benefits of the proposal
- Long term maintenance arrangements. The measures that are in place to ensure that there is an identified entity responsible for on-going maintenance.

4. Potential new landing points

4.1 Approach to assessment

Potential sites for alternative vehicular barge and passenger landing points on Macleay Island, Russell Island and the mainland were selected based on sites identified in previous studies and reports and a brief desktop analysis of vacant sites with access to navigable water and road corridors. These are shown in Figure 5.

The suitability of each site was initially assessed based on:

- Land zoning, tenure and availability
- Shelter from prevailing wind and waves
- Access to navigable water without dredging
- Conflicts with use of other marine infrastructure (e.g. recreation boat ramps and moorings)
- Extent of environmental constraints

The outcomes of the Stage 1 assessment are summarised in this section. The full evaluation matrix is presented in Appendix A and summarised in Table 4 at the end of this section.

Sites recommended for further investigation were then assessed in Stage 2 (Section 5) based on:

- Potential to accommodate required infrastructure at landing points
- Causeway length required to access deep water
- Approximate route distance to mainland
- Road upgrade requirements
- Access to public transport and town centres
- Further environmental considerations

Figure 5 Location of potential new landing points

4.2 Macleay Island

Outside of Redland Bay Centre, the key mainland desire routes from the Southern Moreton Bay Islands are either north to Victoria Point, Cleveland and onward to Brisbane City or south to Beenleigh and the Gold Coast.

Macleay Island is the northern most island in SMBI meaning that the desire line to achieve shorter barge routes and overall journey time is northbound. Consequently, the preferred location for new barge and ferry landing facilities is along the north and north-western foreshore.

Consistent with the SMBI enclave, Macleay Island is characterized by extensive shallow foreshores. The northern tip of the island suffers from exposure to northerly winds and there are a series of coral enclaves. However, the islands formation has resulted in a series of rocky outcrops that may provide opportunities for future landing points.

Eight sites were initially identified for investigation as to their potential to accommodate vessel landing infrastructure:

- Eagle Street – Perrebinpa Point
- Karrawarra Street
- Wharf Street – known as Thompson's Point
- Orana Street / Kalara Street
- Attunga Street – Dalpura Point
- Dalpura Street – at the existing boat ramp
- Beelong Street – Pat's Park
- Cross Street – known as Parson's Point

Figure 6 Location of potential new landing points on Macleay Island

4.2.1 Eagle Street (Perrebinpa Point)

Eagle Street is located approximately one third of the way up Macleay Island at Perrebinpa Point. It abuts the Main Channel east of Garden Island.

The Eagle Street road reserve provides direct access to the foreshore, however, is currently uncleared. Any development of this site would require significant clearing of remnant vegetation, as well as impact on mangrove areas of State biodiversity significance.

The location provides a sheltered landing point protected by surrounding sandbanks. There are tidal flats fronting the site which would require a causeway or dredging (140m to --1m LAT) to ensure all-tide access. Main Channel in this location has also been identified as an important area of seagrass habitat, therefore, any impact on the marine floor should be avoided.

There is an established residential community which would be exposed to amenity impacts associated with increased vehicular traffic. There may also be some requirements for property acquisition at the junction of Eagle Street and Western Road.

Furthermore, Eagle Street's location towards the south of Macleay Island is not expected to demonstrate any significant travel time savings to northern mainland landing points. Subsequently, Eagle Street will not be carried forward for further investigation.

4.2.2 Karrawarra Street

Karrawarra Street is located approximately half way down Macleay Island. It abuts the Main Channel north of Garden Island.

The Karrawarra Street road reserve provides direct access to the Macleay Island Foreshore. The road reserve is abutted to the north by undeveloped SMBI residential and to the south by designated conservation land.

Mangrove habitat of State biodiversity significance extends approximately 100m from the foreshore. Any development in this location would require significant disturbance to this important environmental habitat.

Thomson's Point provides protection from northerly wind and waves. Access to navigable water can be provided, however, would require a significant causeway from the shoreline. MSQ bathymetry notes a distance of 245m from the shoreline to 1m HAT.

Although Karrawarra Street achieved the highest score for Macleay Island under the Stage 1 assessment (along with Dalpura Street), the causeway requirements and minimal reduction in travel time associated with the sites southern location has deemed this site unsuitable for further investigation.

4.2.3 Wharf Street (Thompson's Point)

Wharf Street is located to the north of Karrawarra Street at the northern end of the Main Channel.

The Wharf Street road reserve extends to the foreshore and is bound by conservation land to the south.

Compared to other proposed sites, Wharf Street provides good shelter from prevailing north and south easterly winds and has better access to deep water (approximately 141m to -1m LAT).

The area has been largely cleared of mangroves, however, there are seagrass beds and dugongs are known to frequent this relatively quiet channel.

The conservation area on Thompson's Point contains threatened remnant vegetation which would be disturbed by any transport infrastructure development. A 'Kanaka' wharf present in this location also has cultural heritage significance. The wharf was built in 1865 and is believed to be the first structure built in Australia using Kanaka labour.

The Wharf Street location has been deemed unsuitable for further investigation based on the impact on sites of cultural and environmental significance.

4.2.4 Orana Street / Kalara Street

Orana Street and Kalara Street are located approximately one third of the way south of the northern tip of Macleay Island.

Both streets have road reservations extending to the foreshore. The area is zoned SMBI residential with a sporting facility to the south of Kalara Street.

The location provides good shelter with sand banks off Dalpura Point providing protection to the north.

The area is largely cleared of mangroves and there is no coral evident. However, the large tidal flats in this location are bird feeding and roosting grounds of international significance. Access to navigable water in this location would require a significant causeway y from the shoreline – the -1m LAT contour is estimated to be 340m from the shoreline.

This location has not been recommended for further investigation based on disturbance to significant environmental habitats and minimal travel time reductions.

4.2.5 Attunga Street

Attunga Street is located on Dalpura Point approximately one quarter of the way south of the northern tip of Macleay Island, just south of the Dalpura Street boat ramp.

The location is zones SMBI residential. Although the proposed location is vacant freehold there are established residential properties adjacent.

The site is currently uncleared and would require disturbance to remnant mainland vegetation and approximately 40m of mangroves.

The location is exposed to north-easterly winds. Although this location provides improved access to navigable water compared to other location on Macleay Island, it would still require the construction of a causeway of approximately 160m to -1m LAT.

This location has not been recommended for further investigation based on impact to private properties and disturbance to significant habitats.

4.2.6 Dalpura Street

Dalpura Street is located approximately one quarter of the way south of the northern tip of Macleay Island.

The Dalpura Street road reservation provides direct access to the foreshore. It currently accommodates a public car park this minimizing property impact.

A recently built boat ramp and designated staging area is a popular recreational facility for residents. It is Department of Transport and Main Roads policy to separate recreational and commercial boat ramps for safety reasons.

The large number of boat moorings in the sheltered bay in front of Dalpura Street is likely to impede navigation.

The foreshore immediately adjacent to the north provides one of only a few sandy beaches in the Southern Moreton Bay Islands and is a popular spot for families.

The location is exposed to north-easterly winds. Access to navigable water would require the construction of a significant causeway. Distance to -1m LAT is estimated to be 230m.

Although Dalpura Street achieves the highest score, the location has not been recommended for further investigation based on impact to important recreational facilities and causeway requirements.

4.2.7 Beelong Street (Pat's Park)

Beelong Street is located on the northern foreshore of Macleay Island.

The Coondooroopa Drive road reserve provides direct access to the foreshore. Mangroves have been cleared in this location to create an informal boat launching facility on the rocky shelf.

Deep water access is quite close compared to other locations on Macleay Island (146m to -1m LAT). However, any formalization of boat launching facilities would require significant additional clearing of mangroves.

The area is one of few rocky foreshores on the island and has extensive areas of coral. It also provides a popular public park and swimming area.

The site is extremely exposed with no protection from northerly winds.

This location has not been recommended for further investigation based on exposure to prevailing weather, impact on mangrove and coral habitats and impact on the public recreation area.

4.2.8 Cross Street

Cross Street is located just south of the north-west Peninsula of Macleay Island.

The Cross Street Road reservation provides direct access to the foreshore with the potential to accommodate landing facilities. The road reservation is bound to the north by vacant land designated for conservation and to the south by land with mixed conservation / SMBI residential designation. Survey markers indicating the width of the road reservation at the foreshore are shown in the middle photograph at right.

The road reservation to the west of Coondooroopa Drive is uncleared and contains significant remnant vegetation. The road reserve to the east of Coondooroopa Drive has been closed and currently constitutes a grassed open space area. Discussions with Council officers suggest that this corridor suffers from drainage issues.

The area directly in front of Cross Street has been largely cleared of mangroves, however, there would be some disturbance to mangroves abutting the site to the north. There is also a coral enclave in the vicinity of Parson's Point.

This location provides a partly sheltered site that is exposed to northerly wind. Access to navigable water is available but would require the construction of a significant causeway. -1m LAT is estimated to be approximately 225m from the shoreline.

Although Cross Street has environmental constraints and will require an extensive causeway to access navigable water it is deemed the most appropriate location to carry forward for further investigation based on it's northern location and road reserve access to the HAT mark.

4.3 Russell Island

Russell Island is the largest and southern most island in SMBI. The south-western corner of Russell Island is the closest to the mainland from any of the Southern Moreton Bay Islands.

A potential barge route alignment is from Russell Island to Little Rocky Point, thus facilitating movement southbound to Beenleigh and the Gold Coast, or from Russell Island to the northern bank of the Logan River to access southern Redland Bay.

The western foreshore of Russell Island is characterized by muddy tidal flats and extensive mangrove communities. As a result, there are few suitable locations for marine infrastructure.

Two sites were identified for their potential to accommodate vessel landing infrastructure:

- Channel Street / Jackson Street
- Rocky Point

Figure 7 Location of potential new landing points on Russell Island

4.3.1 Channel Street / Jackson Road

Channel Street and Jackson Street are located approximately one third of the way south from the northern shore of Russell Island facing Main Channel. A road reserve provides direct access to the foreshore at both sites with SMBI residential, open space and conservation land adjacent.

Any development in this location would require significant disturbance to mangrove habitat and tidal flats extending approximately 310m to -1m LAT.

Channel Street and Jackson Road are not recommended for further investigation.

4.3.2 Rocky Point

Rocky Point is located on the far south-eastern corner of Russell Island.

The site is designated as Open Space with SMBI Residential adjacent to the north and Conservation land to the south. The site is currently undeveloped apart from an Energex electricity easement.

There is no existing marine infrastructure; however, the site is used as a popular park and fishing area with picnic tables and fish cleaning facilities.

There is no significant mangrove vegetation; however, the tidal flats in this location have been listed under RAMSAR and State Biodiversity Significance.

Rocky Point is partly sheltered. Adequate water depth is relatively close to the shoreline. Note that Maritime Safety Queensland bathymetry shows 240m to the -1m LAT however, there is a channel within closer distance.

Rocky Point offers the most suitable location on Russell Island for further investigation. It is the most southerly point providing a shorter distance to the mainland. Although it will require significant causeway construction, it offers the shortest distance to navigable water (excluding Jock Kennedy Park on the northern foreshore).

4.4 Mainland

The potential mainland landing points considered extend from Raby Bay, Cleveland in the north to Woongoolba, Gold Coast City Council in the south.

Twelve sites were identified for their potential to accommodate vessel landing infrastructure on the mainland:

- William Street, Cleveland
- Orana Esplanade, Point Halloran
- Dundas Street, Ormiston
- Thompson Street, Victoria Point
- Masters Avenue, Victoria Point
- Toondah Harbour, Cleveland
- Raby Bay Boat Harbour, Cleveland
- Point Talburpin
- Little Rocky Point (south), Woongoolba
- Little Rocky Point (north), Woongoolba
- Rocky Passage Road, Redland Bay
- Zipf's Road, Redland Bay

Figure 8 Location of potential landing points on the mainland

4.4.1 William Street (Volunteer Marine Rescue), Cleveland

The William Street (Volunteer Marine Rescue) site is located on the northern side of Cleveland Point.

The site is currently designated as community purposes and is used by the Volunteer Marine Rescue. The site is surrounded by Foreshore Park and is a popular recreational boat launching facility. Consequently, the area may experience some marine and landside congestion, particularly at the weekends.

The area is clear of mangroves and is provided with maintenance dredging to provide all tide access.

This location should be carried forward to Stage 2 as a possible location for passenger ferry facilities.

4.4.2 Orana Esplanade, Point Halloran

Point Halloran is located to the north of Victoria Point.

Point Halloran is an established residential community with an extensive foreshore park.

The area is largely cleared of mangroves; however, the tidal foreshore falls under RAMSAR designation. There is approximately 135m to the -1m LAT.

The sheltered bay is a popular boat mooring area that is likely to significantly impede navigation.

This location has not been recommended for further investigation based on the water depth and impact on public parklands, residential areas and boat moorings.

4.4.3 Dundas Street, Ormiston

The Dundas Street site is located on the Ormiston side of Endeavour Canal, fronting the north-east corner of Raby Bay.

The site is currently designated open space and is clear of mangroves and remnant vegetation.

It provides good access to deep water and is free of marine infrastructure.

This location should be carried forward to Stage 2 as a possible location for passenger ferry facilities.

4.4.4 Thompson Street, Victoria Point

Thompson Street is located to the south of Victoria Point. It provides a popular recreational reserve and is one of a few sandy beaches in the Redlands.

There is an extensive tidal shelf extending 615m to the -1m LAT mark. For this reason, and for impact on popular recreational amenities, this location should not be carried forward for further investigation.

4.4.5 Zipf's Road, Redland Bay

Zipf's Road is located south of Scenic Road in southern Redland Bay. The site has limited access to navigable water as it is surrounded by tidal flats which dry at low tide and is unsuitable for further investigation.

4.4.6 Masters Avenue, Victoria Point

Masters Avenue, Victoria Point, is the existing vehicular barge and passenger ferry terminal to Coochiemudlo Island.

The area is designated open space and is cleared of mangroves. Subsequently, significant environment and property impacts are not expected.

Any introduction of additional marine transport services is likely to conflict with the existing commercial and recreational facilities in this location.

The existing Coochiemudlo Barge service is currently limited during low spring tides. The existing channel may require ongoing dredging and would need to be deepened for larger capacity vessels.

This location is not expected to experience significant environmental or private property impacts. Maintenance of a navigable channel is required for the Coochiemudlo services. Although Masters Avenue does not score highly under the Stage 1 assessment, the locations should be carried forward based on its northern location and minimal environmental impacts.

4.4.7 Toondah Harbour, Cleveland

Toondah Harbour, Cleveland, is the existing vehicular barge and passenger ferry terminal to Stradbroke Island.

The area is a designated marine facility area and has mixed tenure. Although the site has been cleared of mangroves there may be some impacts on the Cassim Island world heritage bird rookery. Any introduction of additional marine transport services is likely to conflict with the existing commercial and recreational facilities in this location.

Maintenance dredging is required to maintain access to the existing terminal, however, the channel has capacity limitations.

This location is not expected to experience significant environmental or private property impacts. Maintenance of a navigable channel is already required for the North Stradbroke services. Existing capacity constraints resulting from North Stradbroke Island barge services mean that this location should be carried forward for further investigation for passenger ferries only.

4.4.8 Raby Bay Boat Harbour, Cleveland

The Raby Bay Boat Harbour site is located adjacent to Cleveland Railway Station in parkland on the corner of Shore Street West and Harbourview Court. The open space in this location offers one of the most important recreational grounds and scenic vistas in Cleveland Centre.

The site is located at the far end of Endeavour Canal, and consequently offers good shelter from prevailing winds and access to navigable water.

This section of Endeavour Canal functions as a busy recreational boating harbour resulting in potential conflict with both motoring and moored recreation and tourist vessels in the canal.

The Raby Bay Boat Harbour site is not recommended for further investigation based on potential conflict with the busy boating harbour and impact on significant open space.

4.4.9 Point Talburpin

Point Talburpin in located to the south of Redland Bay. There is a road reservation to the foreshore and is surrounded by urban residential and open space.

The site has poor access to navigable water as it is surrounded by tidal flats exposed at low tide. This site should not be carried forward for further investigation.

4.4.10 Little Rocky Point (south), Woongoolba

Little Rocky Point is located south of the Logan River in Gold Coast City Council.

The site is a de-facto island of high land surrounded by mangroves. It currently accommodates farming land and a public park and is joined to the mainland by a long causeway structure.

The site has good access to adequate water depth (approximately 65m to 1m HAT) and partly sheltered.

Although any development in this location would have significant impact on important tidal mangrove habitats, this option should be carried forward for further investigation based on it's proximity to Russell Island and good water depth.

4.4.11 Little Rocky Point (north), Woongoolba

The northern causeway option is located to the north of Little Rocky Point. The proposed landing point is the location of the current Energex easement across to Russell Island. It provides the most direct access between the island and mainland.

This location is below high water mark in a significant mangrove habitat of State environmental significance. A track has already been passed through this area for maintenance of the electricity pylons which may reduce some disturbance.

The bathymetry in this location is very shallow with a tidal area of 420m to the -1m LAT line. A significant causeway would be required either bridge or barge option in this location.

This site will be carried forward for further investigation as it has been put forward as a potential location for a barge landing point and as the mainland connection for the Russell Island Bridge. It is expected that environmental impacts will rule out either option however further investigations are required.

4.4.12 Rocky Passage Road, Redland Bay

Rocky Passage Road is located in the south of Redland Bay on the Logan River.

The site is designated conservation and environmental protection and accommodates an existing freehold residential dwelling.

The site is well sheltered however may be of concern during times of flood. There is good access to navigable water relatively close to the shoreline.

Any development in this site would require clearing of significant remnant vegetation and mangroves and state biodiversity significance. However, the site should be carried forward for further investigation based on good access to navigable water, location within Redland Shire and proximity to Russell Island.

4.5 Recommended sites for further investigation

22 sites were assessed for their suitability for marine transport infrastructure based on:

- Land zoning, tenure and availability
- Shelter from prevailing wind and waves
- Access to navigable water without dredging
- Conflicts with use of other marine infrastructure (e.g. recreation boat ramps and moorings)
- Extent of environmental constraints

The full multi-criteria analysis is presented in Appendix A and summarised in Table 4.

The following ratings have been applied:

- 1 – meets criteria (no cost or approval blockages)
- 2 – partially meets criteria (with some costs and standard approvals)
- 3 – may be possible to achieve criteria (but likely to have significant cost and complex approval requirements)
- 4 – unlikely to be able to meet criteria (costs and approvals likely to be prohibitive)

Note: The lowest score equates to the highest achievement.

Table 4 demonstrates that of the remaining sites on Russell Island, Macleay Island, and the mainland that haven't already been developed, there are no sites that demonstrate high suitability for new marine infrastructure. The development of additional marine facilities at those few sites that are not subject to significant environmental constraints would result in conflict with existing recreational and commercial facilities. Extensive causeway constructions and maintenance or capital dredging would be required at the majority of sites.

Notwithstanding these constraints, seven sites were recommended for further investigation:

- **Cross Street, Macleay Island** based on its northern location and road reserve access to the HAT mark
- **Rocky Point, Russell Island** based on the sites proximity to the mainland
- **Masters Avenue, Victoria Point** based on the site's proximity and minimal environmental impacts
- **Toondah Harbour, Cleveland** for passenger ferry services only based on the sites proximity to Cleveland Centre and existing vehicular barge capacity constraints
- **Little Rocky Point (south), Woongoolba** based on the sites proximity to Russell Island
- **Little Rocky Point (north), Woongoolba** for cable barge services only based on the sites proximity to Russell Island and environmental impacts
- **Rocky Passage Road, Redland Bay** based on the sites proximity to Russell Island and location within Redland City Council

Rocky Point, Macleay Island, and Little Rocky Point, Woongoolba will also be considered for a potential vehicular bridge.

Table 4 Summary of potential new landing site evaluation matrix

	Land use		Waterside access		Existing facilities	Environmental Constraints	Distance	Score	Suitable
	Zone	Land availability	Shelter	Navigable water					
Eagle Street	2	2	1	2	1	4	3	15	X
Karrawarra Street	2	2	1	3	1	3	2	14	X
Wharf Street	2	3	1	2	1	4	2	15	X
Orana Street / Kalara Street	2	3	1	4	1	2	2	15	X
Attunga Street	3	3	2	2	1	2	2	15	X
Dalpura Street	1	1	2	3	4	2	2	15	X
Beelong Street	2	3	3	2	3	3	2	18	X
Cross Street	3	2	2	3	1	3	1	15	✓
Jackson Road / Channel Street	2	1	2	3	1	3	3	15	X
Rocky Point	2	1	2	2	1	2	1	11	✓
William Street	2	2	1	1	4	2	3	15	X
Orana Esplanade	3	2	3	3	3	2	3	19	X
Dundas Street	2	2	2	1	3	2	3	15	X
Thompson Street	2	3	1	4	3	2	3	18	X
Masters Avenue	2	2	3	3	4	1	1	16	✓
Toondah Harbour	1	1	1	3	2	3	3	14	✓
Raby Bay Boat Harbour	2	2	1	1	4	1	3	14	X
Point Talburpin	2	2	2	3	2	2	3	16	X
Little Rocky Point (south)	3	2	2	1	1	3	1	13	✓
Little Rocky Point (north)	3	2	2	3	1	3	1	15	✓
Rocky Passage Road	3	2	1	1	1	3	2	13	✓
Zipf's Road	2	2	1	2	2	3	3	15	X

5. Potential new vehicular barge routes

5.1 General approach to vehicular barge route assessment

Seven sites were recommended for further investigation following an initial assessment of site suitability for landing infrastructure. Those sites were then further investigated based on:

- Potential to accommodate required infrastructure at landing points
- Causeway length required to access deep water and geotechnical suitability
- Approximate route distance to mainland
- Access to the existing road network and road upgrade requirements
- Access to public transport and town centres
- Preliminary cost estimates for landing point infrastructure and road upgrade requirements (Summarised in Table 5)
- Further environmental considerations

The potential vehicular barge routes described in Section 5 and shown in Figure 9 have been selected based on the shortest possible route between Macleay Island and the mainland following a northern desire route, and Russell Island and the mainland following a southern desire route. A discussion on each route includes:

- Bac kground
- Potential advantages and disadvantages
- Operational considerations
- Infrastructure requirements and capital cost estimates

Figure 9 Potential vehicular barge routes

5.2 Concept design and costing assumptions for vehicular barge infrastructure

Figure 10 shows a typical cross section through the causeway and a long section through the barge ramp. This typical design was then applied at all locations with amendments to causeway and ramp length as required. The exception to this is at Victoria Point where the general arrangement is slightly different.

Marine infrastructure has been costed from the cadastral boundary seaward. Road upgrade requirements are costed from the cadastral boundary landward.

The general requirements for vehicular barge landing facilities include:

- Causeway and ramp to a depth of -1m LAT
- Vehicle queuing areas
- Mooring piles

Redland City Council have requested that all road upgrades in the vicinity of proposed barge and passenger ferry landing points, and the proposed Russell Island bridge meet the following requirements:

- 2 lanes of 4.0m each
- 2.7m 'contraflow' bike path with a 0.3m buffer
- 1.5m footpath

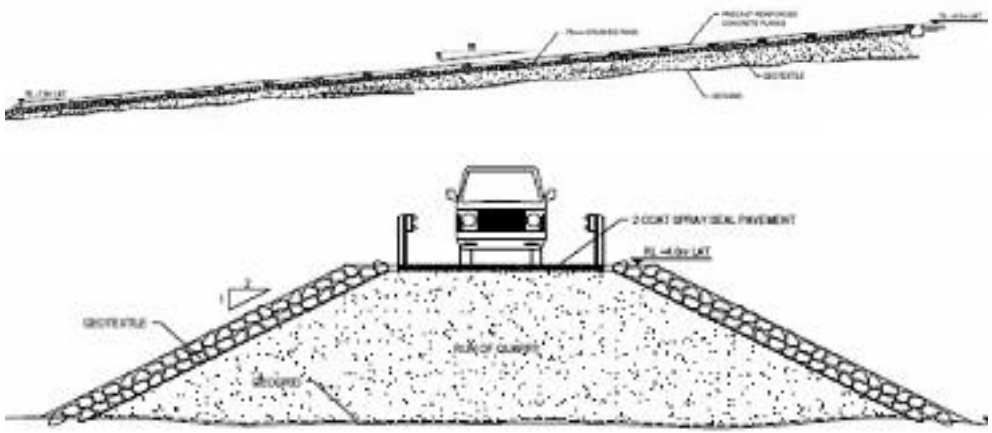
Preliminary cost estimates for landing point infrastructure and road upgrade requirements have been completed at a high level only. All infrastructure requirements and costings noted in this report must be revised when detailed information becomes available including (but not limited to) geotechnical surveys, environmental impact studies, travel impact assessments, hydrographic surveys and hydrological models.

Indicative drawings of marine and road infrastructure requirements at each site are presented in Appendix B. Comparative cost estimates by site are presented in Appendix C.

Table 5 Summary of comparative cost estimates for vehicular barge routes

Description of work	Cross Street	Rocky Point via Bangalow Street	Little Rocky Point	Rocky Passage Road	Victoria Point
Preliminaries	$ 251,000	$ 216,500	$ 200,500	$ 224,000	$ 174,000
Causeway	$ 1,397,393	$ 69,349	$ 20,768	$ 44,859	n.a.
Ramp	$ 1,053,898	$ 862,332	$ 814,302	$ 836,957	$ 941,940
Roadworks	$ 1,230,711	$ 2,360,648	$ 5,722,999	$ 1,413,109	n.a.
Contingency (20%)	$ 786,600	$ 701,766	$ 1,351,714	$ 503,785	$ 223,188
Total (excl GST)	$ 4,719,602	$ 4,210,594	$ 8,110,282	$ 3,022,709	$ 1,339,127

Figure 10 Typical long and cross sections of barge landing facilities



5.3 Cross Street (Macleay Island) to Masters Avenue (Victoria Point)

Table 6 Comparative cost estimate of Cross Street to Victoria Point infrastructure requirements

Cross Street	**$ 4.72M**
160m causeway + 55m ramp	$ 2.45M
Road upgrades: • Construction of Cross Street (270m) from Kate Street to barge landing point. The 11m formation has been allowed for despite the existing road corridor being 10m wide. Land resumption has not been included in the estimated cost. • Upgrade of the drainage at the Coondooroopa Dr and Cross St intersection	$ 1.23M
Preliminaries and contingency	$ 1.04M
Masters Avenue	**$ 1.34M**
50m ramp	$ 0.94M
Road upgrades • Assume surrounding roads currently sufficient as accommodate barge service to Coochiemudlo Island	$ NA
Preliminaries and contingency	$ 0.40M
Total	**$ 6.06M**

5.3.1 Route description

The Cross Street to Masters Avenue route runs between Macleay Island and Victoria Point.

Following a 2m LAT bathymetry, the route distance is estimated to be 4.841km.

5.3.2 Background

The authors are unaware of any vehicular barge or water transport service operating from Cross Street. Nor is there any evidence of previous boat launching facilities from this location.

Masters Avenue is currently used as the vehicular barge and passenger ferry terminal for services to Coochiemudlo Island.

On the 14 September 2010, a presentation was made to Redland City Council by a number of residents for a Cross Street to Victoria Point barge route. To date, further investigation on this route have not been progressed.

5.3.3 Potential advantages and disadvantages

The potential advantages of this route would be as follows:

- Reduced on-water travel time and potential to reduce overall journey time for north-bound travel
- More direct access to Victoria Point town centre
- Potential to provide Macleay to Victoria Point direct bus service
- Road reservation to foreshore
- No conflict with existing public facilities or moorings
- Offers the least expensive of the four vehicular barge options

The potential disadvantages of the route are as follows:

- Limited deep water access is available which would require initial and ongoing maintenance dredging
- Exposure to northerly winds during journey impacts on journey experience
- Impact on adjacent conservation lands, and significant marine and intertidal environments
- Traffic management issues at Victoria Point
- Drainage issues at Cross Street
- Patronage leakage from existing barge services and commercial businesses at the southern tip of Macleay Island
- Congestion with Coochiemudlo services
- Significant infrastructure cost
- Additional foreshore developments will increase impacts on the riparian environment

5.3.4 Operational considerations

The channel to the Coochiemudlo Barge terminal at Victoria Point was dredged by Port of Brisbane in the mid 1990's. Since then, the channel depth appears to have remained relatively stable, with the turning basin and entrance channel still clearly evident from aerial photography. Hydrographic surveys undertaken in June 2001 indicate the depth in the area to be between -0.9m LAT and -

0.7m LAT meaning that initial dredging may be required, however, ongoing maintenance dredging should be minimal.

Journey quality could be negatively impacted by exposure to northerly winds along this route.

5.3.5 Infrastructure requirements and capital cost estimates

The total estimated capital cost for landing point infrastructure to support a new barge route between Cross Street and Masters Avenue is $6.06 million as detailed in Table 6. This figure is exclusive of the cost for property resumptions, maintenance or capital dredging, the purchase of any vessels required or wider transport network upgrades.

The Cross Street road reserve is uncleared to the west of Coondooroopa Drive and has been reinstated as open space area to the east. This section of the road reserve from Kate Street to the shoreline currently forms an overland drainage route. The construction of a sealed road in this location must include significant stormwater drainage works.

The road reserve is 10m wide. The construction of an 11m road corridor, as requested by RCC, will require property resumptions. These have not been included in cost estimates.

The Cross Street site provides good access to navigable water, however, a significant causeway is required between the shoreline and -1m LAT.

The existing barge terminal at Masters Avenue will need to be expanded with an additional 50m barge ramp to accommodate services.

The boat ramp shown in Drawing SK014 in Appendix B does not reach the -1m LAT contour. The Coochiemudlo Island barge service operates in this location and as such is deemed suitable for operation. As previously noted, a hydrographic survey undertaken in June 2001 indicates the depth in the area is between -0.9m LAT and -0.7m LAT. The existing barge service does experience some difficulties during spring tides. As such, some capital dredging may be required at this location. Dredging costs have not been included in the cost estimates provided. If the project proceeds into either a feasibility study or detailed design than a detailed hydrographic survey of the area is recommended to confirm if dredging is required.

The need to relocate public boat ramp facilities has not been considered.

It has been assumed that no road upgrades will be required at Victoria Point.

5.4 Rocky Point (Russell Island) to Rocky Passage Road (Redland Bay)

Table 7 Comparative cost estimate of Rocky Point to Rocky Passage Road infrastructure requirements

Rocky Point	**$ 4.21M**
10m causeway + 55m ramp	$ 0.93M
Road upgrades: • Widening of 480m concrete road along Bangalow Street / Yarra Street from 3.5m to 11m • Widening of 375m sealed road from 6m to 11m	$ 2.36M
Preliminaries and contingency	$0.92M
Rocky Passage Road	**$ 3.02M**
5m causeway + 55m ramp	$0.88M
Road upgrades: • 700m of new road from Rocky Passage Road to shoreline	$ 1.41M
Preliminaries and contingency	$ 0.73M
Total	**$ 7.23M**

5.4.1 Route description

The Rocky Point to Rocky Passage Road route runs between the south-eastern corner of Russell Island and Redland Bay, on the Redland City Council side of the Logan River.

The approximate route distance is 5.806km

5.4.2 Background

Rocky Passage Road was identified as a suitable location for a new recreational boat ramp facility in GHD's 2005 report for Redland City Council. Since that time, no public facility has been constructed in this location.

5.4.3 Potential advantages and disadvantages

The potential advantages of this route would be:

- Reduced on-water travel time and potential to reduce overall journey time for south-bound travel
- Jurisdiction advantages as within Redland City Council
- Road reservation to foreshore at Rocky Point and Rocky Passage Road
- No conflict with existing public facilities or moorings
- Offers the least expensive of the four vehicular barge options

The potential disadvantages of this route would be:

- Some increase in mainland journey times for northbound movements
- Increased journey times on Russell Island
- Impact on private land at Rocky Passage Road
- Road upgrade requirements on mainland
- Disturbance to areas of environmental significance
- Patronage leakage from existing barge services and commercial businesses at the southern tip of Macleay Island
- Only caters to Russell Island residents
- The desired route of northbound traffic will increase movements through wildlife habitat areas on the mainland
- Impact on hydrographic and sediment movements

5.4.4 Operational considerations

As shown in Drawing SK002 in Appendix B, the depth of the toe of the ramp proposed at Rocky point does not reach the -1m LAT contour.

The bathymetry supplied by Maritime Safety Queensland only detailed contour information. Actual survey spot heights were not provided, therefore it was unable to be confirmed if the contours are based on "real" data or whether the contouring software package has extrapolated the input data. MSQ Chart MB7 shows depths up to -2.1 m LAT (spot height) at this location. For this study it has been assumed that no dredging will be required at this location. If the project

proceeds into either a feasibility study or detailed design then a detailed hydrographic survey of the area is recommended to confirm if dredging is required or if the causeway/ramp needs to be extended.

5.4.5 Infrastructure requirements and capital cost estimates

The total estimated capital cost for landing point infrastructure to support a new barge route between Rocky Point and Rocky Passage Road is $7.23 million as detailed in Table 7. This figure is exclusive of the cost for property resumptions, maintenance or capital dredging, the purchase of any vessels required or wider transport network upgrades.

The connection from the existing Rocky Passage Road construction through to the barge location requires approximately 700 m of new formation that runs parallel to the existing property owners' access track. An allowance for culverts beneath the proposed access has been made to facilitate the passage of water through what appears to be a drainage channel. Due to the excessive skew of this crossing, the pipe allocation is large.

This section of the road reserve passes through private land and may require some property acquisition which has not been included in cost estimates.

The road width along sealed sections of Rocky Passage Road ranges from six to seven metres with some very dangerous vertical curves.

Additional road upgrades would be required to bring this connecting road up to the 11 metre standard (including bikeway and footpath) required by Redland City Council. These have not been included in cost estimates.

5.5 Rocky Point (Russell Island) to Little Rocky Point (south) (Woongoolba)

Table 8 Comparative cost estimate of Rocky Point to Little Rocky Point infrastructure requirements

Rocky Point	**$ 4.21M**
10m causeway + 55m ramp	$ 0.93M
Road upgrades: • Widening of 480m concrete road along Bangalow Street / Yarra Street from 3.5m to 11m • Widening of 375m sealed road from 6m to 11m	$ 2.36M
Preliminaries and contingency	$0.92M
Little Rocky Point (south)	**$ 8.11M**
10m causeway + 55m ramp	$ 0.84M
Road upgrades • Widening of 2600m of Santa Barbara Road from 4m to 11m width • Widening of unsealed access road from 6m to 11m. Requires a 5m wide by 1m deep causeway for 200m length with turning circle at end	$ 5.72M
Preliminaries and contingency	$ 1.55M
Total	**$ 12.32M**

5.5.1 Route Description

The Rocky Point to Little Rocky Point (south) route runs between Russell Island and Woongoolba. Little Rocky Point is located in the Gold Coast City Council area just south of Logan River.

The route distance from Rocky Point to Little Rocky Point is approximately 2.8km.

5.5.2 Background

In July 1991, the Planning and Environment Committee heard a proposal from the Russell Island Progress Association for a vehicular barge between Rocky Point and Little Rocky Point.

The Department of Transport and Main Roads advice was as follows:

- Provides and shortest route from Russell island to the mainland and therefore assumed lowest cost. However, "having regard to other infrastructure costs…the total overall cost of this alternative may not necessarily be the cheapest option"
- "The cost to the State Government and/or Albert Shire in upgrading the road link to Little Rocky Point would be quite considerable"
- "Russell Island does not have a community of interest with Albert Shire. A link to Albert Shire would not reinforce Russell Island's identity"
- The majority of traffic from the Southern Moreton Bay Islands is to and from Brisbane, Redland Shire and Loganholme; "travel times would therefore be considerably higher than any connection to Redland Shire"
- Recommendation – "That Council not favour the overall planning for the proposal"

5.5.3 Potential advantages and disadvantages

The potential advantages of this route would be:

- Shortest possible route to the mainland
- Reduced on-water travel time and potential to reduce overall journey time for south-bound travel
- Road reservation to foreshore at Rocky Point
- No conflict with existing public facilities or moorings

The potential disadvantages of this route would be:

- Only caters to Russell Island residents
- Unless the new service caused a proportional drop in traffic at the current site (which is believed to be unlikely) there will be an effective increase in traffic and therefore implied pollution.
- The desired route of northbound traffic will increase movements through wildlife habitat areas on the mainland.
- Proposed landing sites are adjacent to environmentally significant areas. Increased vehicle and barge activity has the potential to detrimentally impact natural systems. Two additional foreshore developments will increase impacts on the riparian environment.

- Out of sequence infrastructure upgrades in the range of $12.32 million, the most expensive 'normal barge' option.
- Little Rocky Point is within Gold Coast City Council (GCCC) jurisdiction, therefore RCC unable to contribute funding. Not currently considered by GCCC in its planning.

5.5.4 Operational considerations

As shown in Drawing SK002 in Appendix B, the depth of the toe of the ramp proposed at Rocky point does not reach the -1m LAT contour.

The bathymetry supplied by Maritime Safety Queensland only detailed contour information. Actual survey spot heights were not provided, therefore it was unable to be confirmed if the contours are based on "real" data or whether the contouring software package has extrapolated the input data. MSQ Chart MB7 shows depths up to -2.1 m LAT (spot height) at this location. For this study it has been assumed that no dredging will be required at this location. If the project proceeds into either a feasibility study or detailed design then a detailed hydrographic survey of the area is recommended to confirm if dredging is required or if the causeway/ramp needs to be extended.

5.5.5 Infrastructure requirements and capital cost estimates

The total estimated capital cost for landing point infrastructure to support a new normal barge route between Rocky Point and Little Rocky Point (north) is $12.32 million as detailed in Table 8.

This figure is exclusive of the cost for property resumptions, maintenance or capital dredging, the purchase of any vessels required or wider transport network upgrades.

The proposed landing facility at Little Rocky Point will be located in the vicinity of Cecil Zipf Park.

Little Rocky Point is a de-facto island on high ground in the middle of Moreton Bay Marine Park mangrove habitat. Santa Barbara Road is a causeway-like construction for 2.5 kilometres which only has a 4 metre seal. Consequently, any road upgrades in associated with a barge landing facility at this location will require widening of the causeway with significant disturbance to environmentally significant areas.

Property acquisition will be required for the upgrade of Santa Barbara Road and Holmstead Road which run through private land.

5.6 Rocky Point (Russell Island) to Little Rocky Point (north) – cable barge

Table 9 Comparative cost estimate of Rocky Point to Little Rocky Point (north) – cable barge infrastructure requirements

Rocky Point	**$ 7.25M**
245m causeway to main channel + 55m ramp	$ 3.46M
Road upgrades: • Widening of 480m concrete road along Bangalow Street / Yarra Street from 3.5m to 11m • Widening of 375m sealed road from 6m to 11m	$ 2.36M
Preliminaries and contingency	$1.42M
Little Rocky Point (causeway and cable barge)	**$ 15.21M**
490m causeway + 55m ramp	$ 4.38M
Road upgrades: • Widening of 2600m of Santa Barbara Road from 4m to 11m width • New 1300m causeway from Santa Barbara Road to the shoreline to the east of the Energex electricity easement	$ 8.10M
Preliminaries and contingency	$ 2.74M
Total	**$ 22.51M**

5.6.1 Route description

The second alternative for a barge route between Rocky Point, Russell Island and Little Rocky Point is to provide a causeway following the Energex easement, north of the farmland, to the mangrove boundary.

This would reduce the barge route distance and allow for a direct cable barge operating arrangement.

5.6.2 Potential advantages and disadvantages

The potential advantages of this route would be as follows:

- Potential to reduce journey time further compared to normal barge service to Little Rocky Point (south)
- Potential reduction in fuel costs compared to normal barge
- Road reservation to foreshore at Rocky Point

The potential disadvantages of this route would be as follows:

- Will require additional infrastructure over and above that required for normal barge operation
- Requires significantly longer causeways compared to normal barge
- Impact on hydrographic and sediment movements
- Significant disturbance to adjacent conservation lands and marine and intertidal environments
- Impact on Energex electricity infrastructure
- Patronage leakage from existing barge service and commercial business at northern tip of Russell Island
- Only caters to Russell Island residents
- The desired route of northbound traffic will increase movements through wildlife habitat areas on the mainland
- Proposed landing sites are adjacent to environmentally significant areas. Increased vehicle and barge activity has the potential to detrimentally impact natural systems. Two additional foreshore developments will increase impacts on the riparian environment
- Little Rocky Point is within Gold Coast City Council jurisdiction, therefore RCC unable to contribute funding. Not currently considered by GCCC in its planning.
- Road upgrade requirements on mainland
- Landside requirements for cable barge infrastructure are significantly more expensive when compared to other barge options

5.6.3 Operational considerations

The cable barge option will rely upon a number of cables stretched between the mainland at Little Rocky Point and Russell Island at Rocky Point. A cable barge can only move linearly and will need to be able to load/unload at both the fore and aft of the vessel, similar to a ro-ro barge.

Generally a cable barge will use two guide cables to direct the barge between each shoreline. The cable barge will then commonly either have a third cable used as a drive cable or use one of the guide cables to winch the barge across the

channel. The cables are generally secured on each shoreline by large anchors or anchor system.

During operation the cable barge will lift the equivalent length or weight of cable equal to that of the forces required to propel the barge forward. Therefore, the cable will only be lifted to the surface to the fore and aft of the vessel, the remainder of the time the cable will either rest on the seabed or sag low in the water. The channel can therefore remain open to boat movements, however signs warning deep drafted vessels of the cables should be in place, additionally a restricted area around the barge itself should also exist.

In times of severe weather the cable barge will generally be winched up to the shoreline and anchored down.

5.6.4 Infrastructure requirements and capital cost estimates

The total estimated capital cost for landing point infrastructure to support a cable barge between Rocky Point and Little Rocky Point (north) is $22.51 million as detailed in Table 9. This figure is exclusive of the cost for property resumptions, maintenance or capital dredging, the purchase of any vessels required or wider transport network upgrades.

The earthworks required for a cable barge are massive compared to normal barges for example, cables, anchors etc. These have not been included in the cost estimates thus would represent an additional fee.

Causeway requirements on the Rocky Island side are significantly longer than for a normal barge. In order to facilitate direct cable barge operations a causeway would be required to the main channel. For normal barge operations the vessel can track a northern route, before heading south-west, to avoid the sandbank.

The proposed cable barge facility at Little Rocky Point is located to the south of the Energex easement, north of the farm house.

The construction of a facility in this location will require a 1300 metre causeway from Santa Barbara Road to the shoreline, along the alignment of the existing Energex easement.

Little Rocky Point is a de-facto island on high ground in the middle of Moreton Bay Marine Park mangrove habitat. Santa Barbara Road is a causeway-like construction for 2.5 kilometres which only has a 4 metre seal. Consequently, any road upgrades in associated with a barge landing facility at this location will require widening of the causeway with significant disturbance to environmentally significant areas.

Property acquisition will be required for the upgrade of Santa Barbara Road and the construction of the new causeway to the shoreline.

Negotiations will also be required with the power infrastructure manager to maintain clearance to the power lines.

6. Potential passenger ferry route

6.1 General approach to passenger ferry route assessment

Council requested that GHD investigate the potential for passenger ferry services concurrently with the review of barge infrastructure requirements.

Of the 22 sites assessed for suitability for marine infrastructure, three were further considered for passenger ferry facilities. These were:

- Cross Street, Macleay Island
- Masters Avenue, Victoria Point
- Toondah Harbour, Cleveland

The full Stage 1 multi-criteria assessment is presented in Appendix A.

Passenger ferry terminal infrastructure requirements would include:

- Floating pontoon
- Covered walkway
- P iling
- Widening of causeways to accommodate pedestrian traffic
- 100 bay car park

The cost to build passenger ferry infrastructure would be over and above the cost for vehicular barge ramp infrastructure.

6.2 Background

A water taxi service has previously run from the Southern Moreton Bay Islands to Cleveland. Bay Islands Transit cancelled this service in November 2001 following a dramatic decrease in patronage rendering the service financially unviable.

The 2002 SMBI ILTP declared it likely that a passenger ferry service from SMBI to Cleveland be re-introduced in the near term. The route is considered strategically important as it provides a key connection to the CityTrain network.

6.3 Likely demand

A recent survey conducted by Bay Islands Transit System suggests that there is little community interest in a Cleveland Service. Approximately 500 questionnaires were distributed to ferry travellers, only 132 were returned - of those respondents, only 57.6% would be prepared to travel the extra journey time of 50-75 minutes, and only 25% travelled by train.

6.4 Cross Street (Macleay Island)

Cross Street was considered for the location of passenger ferry facilities as it offered the shorters travelling time to Victoria Point and Cleveland.

However, the additional requirements for passenger ferry infrastructure, including carparking, cannot be accommodated at the Cross Street site. The development of passenger ferry facilities at the northern tip of Macleay Island conflicts with the existing development pattern and would likely result in traffic management and parking issues on surrounding streets.

Furthermore, the development of a new northbound passenger ferry route from Macleay Island to the mainland would likely result in patronage leakage from the existing services with the potential to reduce the profitability of the Weinam Creek service, potentially to the detriment of the remaining SMBI community.

For these reasons, as well as those outlining the limitation of Masters Avenue and Toondah Harbour below, it is not recommended that any additional passenger ferry routes be investigated.

6.5 Masters Avenue (Victoria Point)

Masters Avenue is currently used as the vehicular barge and passenger ferry terminal for services to Coochiemudlo Island. The existing Masters Avenue water transport terminal experiences capacity constraints from existing services and conflict with the recreational boat ramp.

A passenger ferry terminal to Victoria Point has the potential to improve access to Victoria Point Town Centre from Macleay Island, provide a direct connection to existing bus services, reduce on water journey time compared to the existing Brighton Road to Weinam Creek route, and

reduce the overall journey time for north-bound journeys.

However, any additional services to Victoria Point would place additional pressure on the already congested terminal, conflict with the Coochiemudlo services and the recreational boat ramp. Furthermore, the introduction of additional passenger ferry services would require an increase in parking provided at Victoria Point and likely result in traffic management and parking issues in the surrounding neighbourhood.

The channel to the Coochiemudlo Barge terminal at Victoria Point was dredged by Port of Brisbane in the mid 1990's. Since then, the channel depth appears to have remained relatively stable, with the turning basin and entrance channel still clearly evident from aerial photography. Hydrographic surveys undertaken in June 2001 indicate the depth in the area to be between -0.9m LAT and -0.7m LAT meaning that further capital dredging would be required.

For these reasons, the introduction of additional passenger ferry services at Victoria Point is not recommended.

6.6 Toondah Harbour (Cleveland)

Toondah Harbour is currently used as the vehicular barge and passenger ferry terminal for services to North Stradbroke Island and is already extremely constrained.

Maritime Safety Queensland has advised that the Toondah Harbour facility is already at capacity in terms of vessel movements. Consequently, the introduction of any additional water transport services would be dependent on an extensive redevelopment of the harbour facilities and has not been costed in this study

The recent Toondah Harbour masterplanning and redevelopment exercise did not take into account the potential for a passenger ferry service to the Bay Islands, however, Redland City Council has not provided any formal policy on the potential re-introduction of the Southern Moreton Bay Islands to Cleveland route.

7. Russell Island Bridge comparison

7.1 Potential bridge alignment

For a number of years, Council has received ongoing requests from the community to investigate the feasibility of a bridge from the southern tip of Russell Island to the mainland, south of the Logan River.

While there is no support by Council or State Government for a bridge at this time, six bridge options have been assessed (in addition to the proposed barge routes), to prepare a comparison with alternate barge options. This analysis is not intended, nor should be considered, as an assessment of the feasibility of a bridge, but for comparative reasons only.

The proposed alignment would connect Rocky Point on Russell Island to just north of Little Rocky Point at Woongoolba on the mainland (referred to as Little Rocky Point (north) for barge options). The proposed bridge will span a distance of approximately 1.5 kilometres roughly following the alignment of the existing Energex powerline and pylons.

Energex has advised that the powerline has a height of 15m to the high water spring tide (MHWST) and that any structure would need to be approximately 30m from the centreline of the existing span if it is built high enough to be affected. Further, if it is to be built within 30m of the existing span, it will need to be at least 7.5m (preferably 9m) below the vertex of catenary as per the attached drawings. However, Energex would need to be involved in detailed discussions should designs be progressed.

7.2 Potential bridge design

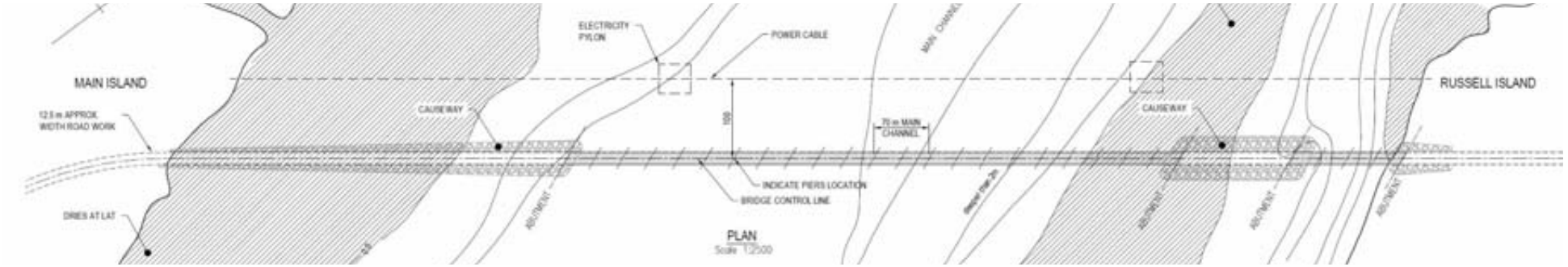
Two options of structure have been reviewed in terms of form of construction:

- Option 1 is using standard T-Roffs at a maximum 35m span
- Option 2 is using a post-tensioned box girder with 60m span to be built either using balanced cantilever method of construction or launched from both sides

For the purpose of the cost estimate it was assumed a balanced cantilever method would be used. Both options have 3 sub-options:

- Sub-option A is causeway to approximate position of Energex pylons from the mainland, then bridge to causeway built on the sand bank adjacent to Russell Island then a smaller bridge crossing over the smaller navigation channel and onto Russell Island
- Sub-option B is a causeway to approximate position of Energex pylons from the mainland, then bridge all the way to Russell Island
- Sub-option C is bridge from the mainland to Russell Island

Figure 11 Option 1a preliminary bridge design



The foundations for Option 1 are assumed to be either driven steel or reinforced concrete cast in place piles, with permanent steel liners; both have an assumed 1.2m diameter

For sub-options A & B it would be necessary to carry out significant ground improvement beneath the causeway sections for 55m before and after the bridge in order to limit differential settlement between the bridge and the causeway. Ground improvement is likely to be controlled modulus columns with geogrid load transfer platform.

7.2.1 Cross-section

As directed by Redland City Council, the bridge layout consists of:

- 2 lanes of 4.0 metres each, no shoulder
- 2.7 metres 'contraflow' bike path with a 0.3 metres buffer and a 1.5 metres footpath
- Total approximate width of 12.5 metres

Preliminary designs for all six options are presented in Appendix D. Cost estimates for construction are presented in Appendix C.

7.3 Bridge assumptions

The bridge cost estimates for Option 1 are based on recent projects using some similar forms of construction but with an allowance for working over water. Using previous projects that we have cost information from gives an average of $5880 to a maximum of $6500 per m2 for a bridge in a similar location with similar form of construction to that proposed for Option 1.

For Option 2, we have used a cost of $10000 per m2 of deck area, based on similar work for concept designs for a bridge to similar island off the east coast of Queensland and a concept option for bridge across the Burnett River in Bundaberg near the port. The cost allows for temporary works, travelling cranes, EIA, safety boats, design costs, likely environmental permits plus increased O/H and Profits for Contractor which is assumed at 40%. It does not allow for any costs for any environmental offset works that may be required as part of the development.

7.4 Environmental impacts

Although the authors acknowledge the potential for significant environmental impacts, these have not been assessed as part of this report. Environmental impacts likely to result from the construction of a bridge include impact on marine and intertidal environments and the potential for introduction of pest species from the mainland and changes to island environmental regimes.

7.5 Potential construction cost

Table 10 provides a summary of comparative cost estimates for all six preliminary bridge designs.

Total approximate cost (excl GST) ranges from approximately $110 million for Option 1A to $235 million for Option 2C.

Table 10 Summary of Russell Island bridge comparative cost estimates

Description of work	Option 1A	Option 1B	Option 1C	Option 2A	Option 2B	Option 2C
Preliminaries	$ 417,000	$ 417,000	$ 417,000	$ 417,000	$ 417,000	$ 417,000
Roadworks	$ 10,456,898	$ 10,456,898	$ 10,456,898	$ 10,456,898	$ 10,456,898	$ 10,456,898
Bridge super-structure	$ 83,400,000	$ 96,200,000	$ 141,410,000	$ 118,440,000	$ 143,820,000	$ 211,500,000
Causeway	$ 9,326,566	$ 9,326,566	$ 9,326,566	$ 9,326,566	$ 9,326,566	$ 9,326,566
Ground improvement	$ 2,100,000	$ 700,000	n.a.	$ 2,100,000	$ 700,000	n.a.
Contingency	$ 4,460,093	$ 4,180,093	$ 4,040,093	$ 4,460,093	$ 4,180,093	$ 4,040,093
Total (excl GST)	$ 110,160,557	$ 121,280,557	$ 165,650,557	$ 145,200,557	$ 168,900,557	$ 235,740,557

8. Economic assessment

8.1 General approach to economic assessment

The economic assessment was based on a minimum demand (trips estimation) method that sought to establish the minimum number of trips necessary to meet the "break even point" for each option; break-even analyses are commonly used for financial evaluations.

Current population and future population forecasts have not been considered as the impact of predicted population growth cannot be assessed without a full demand analysis investigation, which is outside of the scope of this study. Furthermore, the data available was insufficient to complete a demand analysis. The travel surveys did not provide adequate information to establish a link to current population, to understand the current travel demand patterns (e.g. north/south travel, purpose of travel, frequency of travel, barge use per household etc), or to predict how the services might be used in the future.

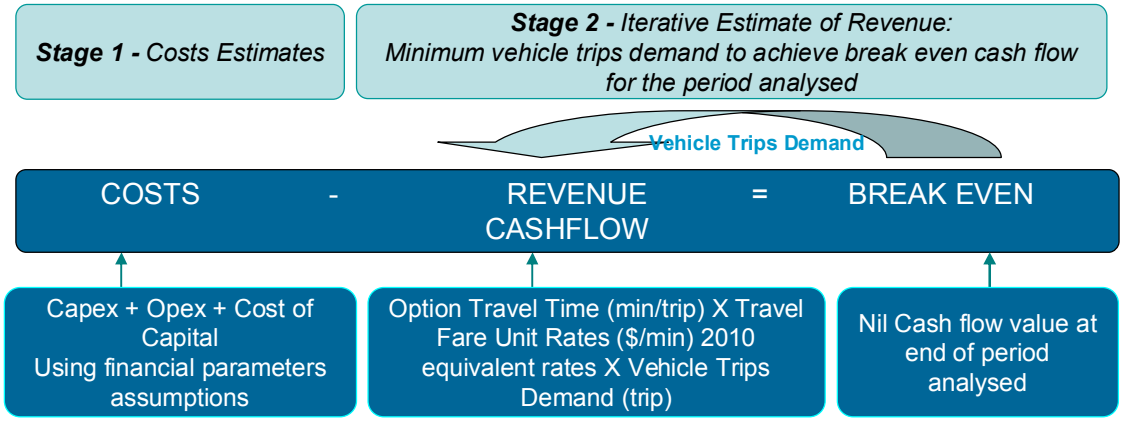
A full analysis of trip demand is outside the scope of this study. For this economic evaluation a "minimum demand estimation" approach was used to provide a high level fare return requirement to reach break even. The existing fare (increased by CPI) has been adopted as the base case, as this provides the only evidence of fees considered acceptable by the public (assuming this achieves a rate of return sufficient for financially viable operation). Whilst the minimum revenue might be achieved with a lower travel fare (and therefore higher trip demand), there is insufficient information available to test the effect of travel fares in trip demands. However, a sensitivity analysis was run on the fare for a maximum and minimum range (+/- 20% of existing fare), thus providing a range of minimum trips required to achieve break even. Details of the sensitivity assessment are outlined in section 8.6.

Figure 12 shows the overall approach schematically.

8.2 Financial model structure

Utilising the data and information available, the number of trips needed to reach the break even point (or zero cash flow) over the 25 year period was calculated. In other words, the number of trips required when revenue minus costs (capex) equals zero in 2035 using the Goal Seek Function in Excel.

Figure 12 Costs estimates and minimum-demand estimation approach



Under these conditions, the Internal Rate of Return (IRR) and the Net Present Value (NPV) were established.

The number of trips were then compared to the actual trips of the existing service and a (qualitative) judgment made as to whether the option may be viable. No assumptions have been made regarding the possibility to generate the trips necessary for a particular option, for example through population growth or change of behaviour of barge users.

Revenue was calculated based on the fare of the existing service correlated with travel time. Alternative fares for new service options were not considered, however, sensitivity assessment on fare ranges have been carried out.

The structure of the financial model has been outlined in more detail in the following pages.

8.2.1 Financial model parameters

The financial assessment was completed through the analysis of cash flow for the proposed options, which included the following model parameters:

- Financial rules relevant to the model (e.g. appropriate depreciation levels and QTC borrowing rates)
- Time profile of the model and life cycle cost estimation setup
- Capital and operational expenditure items, using GHD conceptual estimates of costs
- Minimum demand estimation revenue approach as described below.

8.2.2 Minimum demand estimation

The minimum demand estimation approach estimates the minimum demand in terms of vehicle trips that are required to achieve a break even cash flow for the period analysed. The minimum-demand approach was completed in two stages. Firstly, the most likely total costs for each option were estimated, including capital and operational expenditure, as well as financing cost. Secondly, an iterative function was run to estimate the minimum revenue required to achieve a break even cash flow for the period analysed.

The minimum revenue was estimated as the product of the travel time of each option considered, the travel fare unit rates (using 2010 fares over distance travelled) and the vehicle trip demand. The vehicle trip demand value was iteratively estimated to define the break even cash flow point (i.e. nil cash flow value at the end of the period analysed).

8.3 Economic assumptions

The key model assumptions are as follows:

- A CPI factor of 3.1% is used to estimate 2011 fares and capital expenditure
- No cash flow values associated with interest rates to be earned/payed from short term cash accumulation or overdraft have been included in the model
- No tax liabilities have been included in the model (assumed public ownership)
- A fixed loan amount (equivalent to the capital expenditure) and term (25 year period) has been assumed and an interest rate of 6% (as used by Queensland Treasury for Infrastructure Projects). No allowances have been made for different borrowed amounts or term conditions (e.g. earlier loan repayment)
- All rates are estimated on annual basis
- It is assumed that all options are design and constructed in year 0 (2011)
- Capital Budget decision calculations do not include financing costs (only "free" cash flow generated by the assets)
- Discount rate to calculate NPV 6%
- Operational expenditure at 2% of capital expenditure
- All amounts are exclusive of GST
- No environmental studies and approval costs are included
- Sensitivity on fares with plus and minus 20 % of current fare
- Based on a public sector funding model. Private sector funding would require a higher Internal Rate of Return and therefore higher number of trips to be revenue neutral
- Barge vessel purchasing costs, operational and dredging costs have not been included

8.4 Options analysed

Table 11 details the five options included in the economic assessment. A comparison of options' financial model outcomes was completed, outlining the estimated minimum revenue and trips required to achieve financial viability for each option considered, under the assumptions listed in the previous section.

Table 11 Economic assessment options

Option	Mode	Depart	From	To
Option 1	Regular Barge	Macleay	Cross Street	Victoria Point
Option 2	Regular Barge	Russell	Rocky Point	Little Rocky Point
Option 3	Cable Barge	Russell	Rocky Point	Little Rocky Point
Option 4	Regular Barge	Russell	Rocky Point	Rocky Passage Road
Option 5	Bridge	Russell	Rocky Point	Little Rocky Point

8.5 Options output

Table 12 shows the NPV ranking of each option, the number of trips required for viability and in terms of percentages.

The maximum capacity of the existing service is about 84,000 vehicle trips per year. This is the only data available in terms of trips and possible demand and has consequently been assumed as the proxy for the number of trips necessary to provide a viable service. It has also been assumed that the existing service will remain unchanged and that any proposed new service would need to generate additional trips. This means that each option would need to generate the following additional trips in order to break even:

- Option 1 (Macleay Island to Victoria Point) – over 28,000 additional trips
- Option 2 (Russell Island to Little Rocky Point) – over 78,000 additional trips
- Option 3 (Russell island to Little Rocky Point (cable) – over 530,000 additional trips
- Option 4 (Russell island to Rocky Passage Road) – over 20,000 additional trips
- Option 5 (bridge) – over 6,200,000 additional trips

Table 13 on the following page shows Capex, operating expenditure, loan details, average vehicle trips, Internal Rate of Return (IRR), and Net Present Value (NPV) for each option. NPV is negative for all options, meaning that all options are unviable under the assumptions outline.

Table 12 NPV ranking and number of trips required for financial viability

Option	NPV	NPV Rank	Trips	User Increase (%)
Option 1	-$314,932	1	28,641	34%
Option 2	-$640,438	3	78,095	93%
Option 3	-$1,167,284	4	534,033	635%
Option 4	-$375,986	2	20,294	24%
Option 5	-$5,726,136	5	6,256,973	7443%

Figure 13 Average vehicle trips per year to reach break even (excluding cable barge and bridge options)

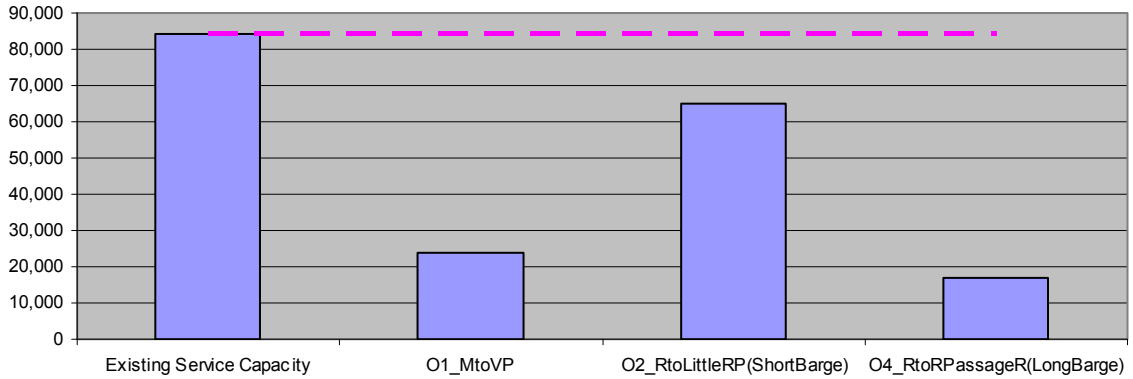


Figure 14 Average vehicle trips per year to reach break even (cable barge and bridge options only)

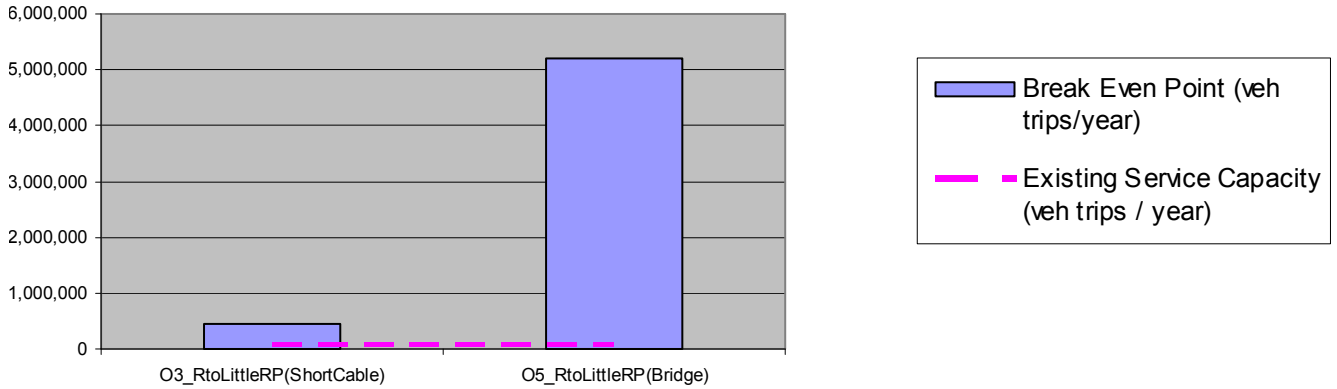


Table 13 Economic assessment summary table

	Option	Existing Service Capacity	Option 1	Option 2	Option 3	Option 4	Option 5
Operating revenue	CPI		3.1%	3.1%	3.1%	3.1%	3.1%
Capital Expenditure	Capex Island		$ 4,865,909	$ 4,341,122	$ 7,469,483	$ 4,341,122	$ 113,575,534
	Capex Mainland		$ 1,380,640	$ 8,361,701	$ 15,683,119	$ 3,116,413	$ 0
	Base Capex		$ 6,246,550	$ 12,702,823	$ 23,152,602	$ 7,457,535	$ 113,575,534
	Capex sensitivity		100%	100%	100%	100%	100%
Operating expenditure (Opex as % of Capex)	Opex Island		2%	2%	2%	2%	2%
	Opex Mainland		2%	2%	2%	2%	2%
	Base Opex (Year 1)		0%	0%	0%	0%	0%
Operating expenditure subtotal	Opex Island		$97,318	$86,822	$149,390	$86,822	$2,271,511
	Opex Mainland		$27,613	$167,234	$313,662	$62,328	$0
	Base Opex (Year 1)		$124,931	$254,056	$463,052	$149,151	$2,271,511
Loan	Loan period (years)		25	25	25	25	25
	Loan Fixed Interest Rate		6%	6%	6%	6%	6%
Break-even rate	Use a break-even (Trips/Year factor)		Yes	Yes	Yes	Yes	Yes
Cashflow	Average Vehicle Trips per year	84,063	23,867	65,080	445,027	16,912	5,214,144
	IRR		5.5%	5.5%	5.5%	5.5%	5.5%
	Payback Period		n/a	n/a	n/a	n/a	n/a
	NPV		-$314,932	-$640,438	-$1,167,284	-$375,986	-$5,726,136
	Net Present Expenditure		$8,153,141	$16,580,017	$30,219,310	$9,733,746	$148,241,402
	Net Present Revenue		-$8,468,073	-$17,220,455	-$31,386,594	-$10,109,733	-$153,967,538
	Revenue Year 1		$472,719	$961,309	$1,752,115	$564,362	$8,595,033

8.6 Sensitivity analysis

One of the main assumptions of the economic assessment is that the existing fare (increased by CPI) is used to generate the trips. However, it is acknowledge that there is a relationship between number of trips and fare. Therefore, a sensitivity analysis has been conducted based on a fare variation of plus and minus 20% of the current fare increased by CPI over time:

- Base case, year 2010 = $0.67/minute for one way trip (based on existing $42 one way fare for residents for a 65 minutes trip)
- +20%, year 2010 = $0.80/minute
- -20%, year 2010 = $0.53/minute

The results of the sensitivity analysis in terms of trips are shown in Table 14.

Table 14 Trips sensitivity analysis of trips required for financial viability of new services

Sensitivity	Base Case		Fare + 20%		Fare - 20%	
Option	Trips	Users Increase (%)	Trips	Users Increase (%)	Trips	Users Increase (%)
Option 1	28,641	34%	23,867	28%	35,801	43%
Option 2	78,095	93%	65,080	77%	97,619	116%
Option 3	534,033	635%	445,027	529%	667,541	794%
Option 4	20,294	24%	16,912	20%	25,368	30%
Option 5	6,256,973	7443%	5,214,144	6203%	7,821,217	9304%

9. Summary and conclusions

9.1 Assessment process

GHD was commissioned by Redland City Council to provide an independent assessment of the feasibility of additional access routes to the Southern Moreton Bay Islands including:

- Alternative and/or additional vehicle barge routes
- Alternative and/or additional water taxi routes
- A bridge from the southern end of Russell Island to the mainland

The project involved:

- A review of background information and previous assessments of alternative routes
- Identification of environmental constraints including marine park zoning, sea grass distribution and coastal habitat areas.
- Identification of locational constraints including:
  - Land tenure and availability
  - Access to the existing transport networks and upgrade requirements
  - Water depth, access channels and dredging requirements
  - Wind direction/shelter/exposure/tidal flows
- Identification of operational constraints including:
  - Travel time and costs
  - Impact on other services/operators
  - Landside requirements
- Preparation of comparative cost estimates for bridge and shortlisted barge and water taxi alternatives
- Feasibility assessment of the proposed routes

22 sites were assessed for their suitability for marine transport infrastructure based on:

- Land zoning, tenure and availability
- Shelter from prevailing wind and waves
- Access to navigable water without dredging
- Conflicts with use of other marine infrastructure (e.g. recreation boat ramps and moorings)
- Extent of environmental constraints

Seven sites were recommended for further investigation:

- Cross Street, Macleay Island
- Rocky Point, Russell island
- Masters Avenue, Victoria Point
- Toondah Harbour, Cleveland
- Little Rocky Point (south), Woongoolba
- Little Rocky Point (north), Woongoolba
- Rocky Passage Road, Redland Bay

Rocky Point, Russell Island, and Little Rocky Point, Woongoolba were also considered for a potential vehicular bridge.

9.2 Vehicular barges

Based on the analysis completed, there were two routes considered suitable for further investigation:

- Cross Street (Macleay Island) to Masters Avenue (Victoria Point)
- Rocky Point (Russell Island) to Rocky Passage Road (Redland Bay)

Significant dredging issues would need to be resolved for either of these routes.

9.2.1 Cross Street (Macleay Island) to Masters Avenue (Victoria Point) – $6.06M

Out of seven sites analysed, Cross Street is the only potential new site for water-transport infrastructure on Macleay Island. High level analysis estimates the cost for a new barge ramp and associated road upgrades at this location to be $4.72 million.

A new barge ramp would be required to be built at Victoria Point to accommodate the additional services at a cost of approximately $1.34 million.

Dredging requirements may be a fatal flaw at Victoria Point, and as a minimum are likely to reduce the size of the barge that could service this route. Small barges may not be able to handle peak morning and evening loads.

The Macleay Island to Victoria Point vehicular barge route would require 28,641 trips annually to pay off the new infrastructure in 25 years based on current trip cost per minute. This is similar to the current total demand between Macleay Island and the mainland (approx 30% of the total existing SMBI vehicular barge service). Consequently, it is highly likely that the introduction of an additional vehicular barge service from Macleay Island to the

mainland would result in significant patronage leakage from the existing service.

9.2.2 Rocky Point (Russell Island) to Rocky Passage Road (Redland Bay) – $7.23M

Rocky Point is the only potential site for additional water-transport infrastructure on Russell Island. A new barge facility and associated road upgrades in this location would cost approximately $4.21 million.

On the mainland, a new barge ramp and 700m extension of Rocky Passage Road is estimated to cost $3.02 million.

Additional considerations not included in the analysis is the poor vertical alignment at Rocky Passage Road which may require significant works to upgrade, and dredging requirements at the mouth of the Logan River.

The Russell Island to southern Redland Bay route would require 20,294 additional trips annually to pay for the marine infrastructure in 25 years. This equates to approximately two thirds of the current annual demand between Russell Island and Weinam Creek and could result in significant patronage leakage from the existing service in the short term.

9.2.3 Rocky Point (Russell Island) Little Rocky Point (south) (Woongoolba) – $12.32M

A new barge facility and associated road upgrades at Rocky Point would cost approximately $4.21 million.

On the mainland, a new barge ramp at Little Rocky Point (south) and significant road upgrades to Santa Barbara Road would be required. This is estimated to cost $8.11 million.

The upgrading of Santa Barbara Road through remnant mangrove vegetation would have significant environmental impacts and require extensive environmental approvals.

A regular vehicular barge from Russell Island to Woongoolba would require 78,822 additional trips annually to pay off the infrastructure within 25 years. This equates to approximately three times the current annual demand between Russell Island and the Mainland.

9.2.4 Rocky Point (Russell Island) Little Rocky Point (north) (Woongoolba) – cable barge ($22.51M)

A cable barge between Rocky Point and Little Rocky Point would require a much higher investment in landing point facilities at both Russell Island and Woongoolba. The causeway at Rocky Point would need to extend past the adjacent sandbank to approximately the alignment of the first Energex pylon (245m compared to 10m for the regular barge) and a 1300m causeway would be required at Woongoolba in addition to upgrades to Santa Barbara Road.

The estimated cost for infrastructure is $7.25 million at Rocky Point and $15.21 million at Little Rocky Point (north).

The proposed cable barge would require 534,033 additional trips annually based on current trip cost per minute.

The proposed causeways at both Rocky Point and Woongoolba will result in significant environmental degradation and there may also be problems associated with the use of the cable barge in the navigation channel.

9.3 Passenger ferries

Three potential locations for additional passenger ferry infrastructure were considered – Cross Street (Macleay Island), Masters Avenue (Victoria Point) and Toondah Harbour (Cleveland).

Passenger ferry terminal infrastructure requirements would include a floating pontoon, covered walkway, piling and carparking.

Based on travel distance and time, the only location considered as having some potential for additional passenger ferry infrastructure on the Southern Moreton Bay Islands is at Cross Street. This means that any additional services would service the Macleay Island population only. However, the additional requirements for carparking cannot be accommodated at the site and a passenger terminal here would likely result in traffic management and parking issues on surrounding streets.

None of the mainland sites were considered suitable for the provision of passenger ferry infrastructure. Facilities at Toondah Harbour would be dependent on an extensive redevelopment of the harbour facilities.

It is noted that a recent survey by Bay Islands Transit System, the existing operator, suggests that there is currently little community interest in an additional northern passenger ferry service.

9.4 Russell Island Bridge

The potential Russell Island Bridge from Rocky Point to Little Rocky Point (north) at Woongoolba is estimated to cost $110.16 million. The estimated cost is based on the cheapest of six indicative designs which would require bridge and causeway construction across navigation channels and result in major environmental implications.

A minimum demand analysis was used to determine the threshold at which point "break-even" would be reached. The proposed bridge would require 6,256,973 trips annually to reach break even or pay off the infrastructure in 25 years. This equates to 17,000 trips per day based on the adopted trip cost ($1.30).

To maximise the demand catchment, additional barge/bridge infrastructure would need to be provided between the Southern Moreton Bay Islands.

Clearly the number of trips required to pay off the proposed bridge infrastructure over the 25 years could be reduced by increasing the total cost per trip (toll).

9.5 Study caveats

In relation to the findings of this preliminary assessment of alternative water transport routes for the SMBI the following should be noted:

- The economic assessment is based public sector financing which requires a lower rate of return than if implemented by the private sector. A rate of return of 5.5% has been considered that addresses cost recovery only. The private sector would be seeking a positive NPV and a rate of return of around 10%.
- Dredging, barge vessel purchase and operational costs have not been able to be included because they are unquantifiable at this stage (and could be significant).
- Environmental assessment processes are expected to be significant and costly. Further, the Southern Moreton Bay Islands' location within the Moreton Bay Marine Park means that it may be difficult to satisfy approval requirements.

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