MARSHMAN O'NEILL CONSULTING STRUCTURAL & CIVIL ENGINEERS

ANDREW MARSHMAN & ASSOCIATES PTY LTD ABN 86 064 689 694

ANDREW MARSHMAN
BE (CIV) MIE Aust CPEng NER APEC Engineer Int PE (Aust)

CRAIG O'NEILL
BE MIE Aust CPEng NER

35A MAIN STREET MERIMBULA NSW
PO BOX 768 MERIMBULA NSW 2548
PHONE (02) 6495 1670

CUTTAGEE BRIDGE – MR 272

OPTIONS INVESTIGATION REPORT

for

BEGA VALLEY SHIRE COUNCIL

27 May 2021

Prepared by:

MARSHMAN O'NEILL ENGINEERS

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EXECUTIVE SUMMARY

This report has been written to formally consolidate the Cuttagee Bridge replacement options engineering investigation performed by this office in mid-2020 for Bega Valley Shire Council. The investigation outcome was produced in the Cuttagee Lake Bridge Replacement plan Preliminary Design Issue (12.08.2020) AJ20022.06 Sheets C1.1, C2.1, C3.1, C3.2, C3.3 prepared by this office and issued as a Preliminary Issue - Not For Construction.

1. INTRODUCTION

In accordance with Bega Valley Shire Council (BVSC) RFQ 50/20 BRIDGES2020 Design commission and namely Section 3.4 Scope of Work Cl 3.4.2 Design Engineering Scope points 2, 3, 5 and 6, we have evaluated the existing Cuttagee Bridge and replacement options. This involved the investigation of the existing bridge, water course and approach roads, the geotechnical and survey information provided, proposed constructability of materials and construction methods, including cost, time and asset life benefits.

We understand that a Heritage, Biodiversity and Aboriginal assessments are being undertaken at present and as such, do not form part of this investigation.

A formal report of our investigation as described above follows.

2. LOCATION DESCRIPTION

Cuttagee Bridge is located within the Bega Valley Shire on MR272 Tathra-Bermagui Road, some 6.9km south from the Bermagui town centre. It crosses Cuttagee estuary at the eastern entrance to the Tasman Sea at the northern end of Cuttagee Beach.

3. STRATEGIC CONTEXT

The Princes Highway traverses inland, away from the coast, for the Bega Valley Shire area located north from Pambula to the northern border with Eurobodalla Shire. MR272 provides an important bitumen sealed alternative access to the Princes Highway in this region, from Tilba (or Cobargo) in the north, to Tathra and Bega; or further south to Merimbula and Pambula via Sapphire Coast Drive and Arthur Kaine Drive. The close ocean proximity of MR272 provides access to the Sapphire Coast for approximately 35% of the 130km coastline of the Bega Valley Shire area. It forms an integral part of the tourist facility of this coastal shire and is marked as a Tourist Road.

MR272 also links through the popular Mimosa Rocks National Park (MRNP). It provides SES/RFS emergency access to an increasing residential rural population and tourist camper patron use of the four MRNP camp sites at Aragunnu, Picnic Point, Middle Lake and Gillards Beach. A summer holiday population swell, combining with increased fire risk during warmer months makes MR272 an essential reliable access to these areas.

Cuttagee Beach is a popular beach location for Bermagui (and district) residents and tourists. MR272 and Cuttagee Bridge provide vehicular access from Bermagui and pedestrian access across Cuttagee estuary mouth.

Refer Figure 1.

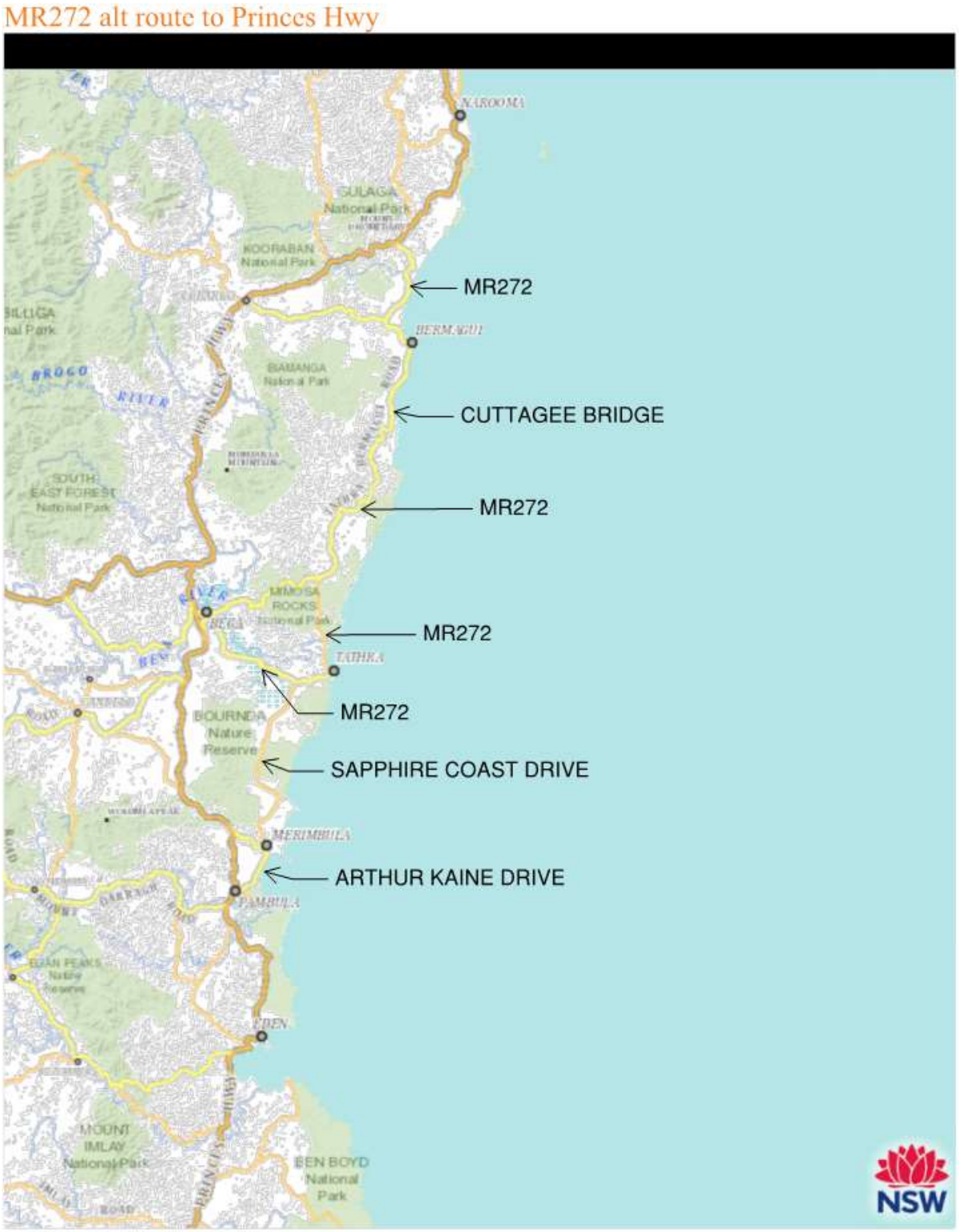

Figure 1 – Cuttagee Bridge Location showing MR272 alternative access to Princes Hwy (NTS)

4. EXISTING BRIDGE DESCRIPTION AND HISTORY

The existing bridge is a single lane, 10 span bridge of approximate length 110m, with timber deck running boards and cross planks. The southern shorter 6 spans are of traditional timber log girder construction supported onto 6 steel and timber piers comprising a combination of driven timber and steel piles. The northern longer 4 spans are of steel girder construction supported onto 3 concrete piers with concrete piles.

The original timber northern spans were replaced with a PWD designed 4 span steel and concrete pier system after this section of timber bridge was washed away during a high seas storm event in the 1970's. The northern approach is flanked by an outcropping headland of exposed bedrock, which also supports the northern abutment. The southern approach is located within the Cuttagee Beach dunal system which also supports the southern abutment via driven friction steel and timber piles. This southern approach and sections of the adjoining roadway (MR272) flanking Cuttagee Beach to the south were also eroded during high seas storm events in the 1970's. The bridge is in various stages of structural condition, with many corroded steel members, rotting timber members and deflecting log girders. The steel girders are severely corroded in places, affecting their original structural integrity. The concrete piers are cracked and spalling. There are many remaining disused and cut off piles within the beach sand beneath the bridge. These are exposed invariably with the ever-changing surface levels of the beach sand bed below the bridge.

The history of the bridge will be included in more detail in a specialist Heritage Report to be prepared by a specialist heritage consultant.

In the 1970's the original Tathra / Bermagui Road was a 2-lane rural road with a mix of gravel and bitumen surfaces; being gravel from Cuttagee to Tanja. The original road in the 1970's included 2 creek river stone lined causeways and traditional timber log girder bridges at Nelson's Creek and Sandy Creek (Tanja) in the south, over Wapengo Creek, Brockelos Creek, Murrah River and Cuttagee Lake in the north. A staged upgrade to 2 lane bituminous seal commenced during the 1990's and was completed in the 2000's. This coincided with a variation to the MR272 route to include from Bega through Tathra (via Bega/Tathra Road) and north to Bermagui (via Bermagui/Tathra Road). During this period, continuous maintenance has been performed on all of these bridges, with major concrete pier and abutment construction at the Murrah River and Brockelos Creek bridges.

5. GEOTECHNICAL ENGINEERING INVESTIGATION SUMMARY

A geotechnical investigation and report has been completed by ACT Geotechnical Engineers P/L (Ref MD/C10638.228 22 April 2020) as commissioned by BVSC. In summary, the report states the site is covered by Cainozoic age Quaternary coastal marine deposits (greater than 10.45m deep - southern abutment) as well as Palaeozoic age Adaminaby Group bedrock weathered siltstone (exposed on the northern abutment).

For a new bridge replacement in the present location, the report recommends that the:

- Northern abutment be founded with concrete spread footings onto the bedrock.
- Southern abutment and intermediate piers be founded through the deep coastal (beach) sand and into a base bedrock (at an unknown depth but greater than 10.45m).
- It should be noted that the investigative drilling on then southern abutment location ceased at 10.45m depth within the sand foundation. Bedrock depths were not determined.

6. CONSIDERATIONS

Considerations of the various options available for the bridge upgrade will include many factors with some listed as follows:

- Biodiversity, Aboriginal and Heritage assessments are to be required by BVSC – indicated to be included within a pending Review of Environmental Factors.
- The available capital works budget and lifetime maintenance budget.
- Combination of heritage, environmental and strategic aspects including coastal location and subsequent construction completion. If the time frame for approvals is too long, the existing bridge will require constant inspection and maintenance to keep servicing as MR272 status.
- Community value / expectations. Cuttagee Beach is a popular beach location for Bermagui residents and tourists. The current bridge provides community vehicular and pedestrian access across Cuttagee estuary mouth at Cuttagee Beach. As such, consideration should be given to dedicated or shared pedestrian and cyclist lanes. At present the bridge is a long, narrow single lane without a separated pedestrian/cyclist corridor. Crossing the present bridge as a pedestrian or push bike cyclist could be considered quite dangerous, when compared with bridges of the modern era with footpaths and kerbs. Cuttagee Bridge is located on a unique road that traverses the Sapphire Coast area linking Tilba/Bermagui to Tathra, then onto Merimbula/Pambula via Sapphire Coast Drive. It is officially marked as a Tourist Route and deservedly so. This section of roadway has beach traverses, coastline, ocean and estuary/lake glimpses, crosses tidal estuaries and floodplains, coastal virgin bushland and water courses whilst travelling through an area of intermittently settled sparse rural population density and the Mimosa Rocks NP. It includes additional significant current timber bridge crossings at the Murrah River, Wapengo Creek and Sandy Creek and gives access to the Mimosa Rocks National Park beaches and associated camping grounds at Aragunnu, Picnic Point, Middle Beach and Gillards Beach. Whilst maintained as a road of state transport significance (MR272 state funding) for existing residents and servicing, it also provides a softer, valuable tourist access to this section of isolated coastline. It must be stated that the flavour of this coastal route as a tourist and resident's route is enhanced by the unique inclusion of the numerous traditional timber bridges of which only 4 remain. If a significant maintenance upgrade of the existing timber bridge is to be provided, consideration should be given to the inclusion of an additional pedestrian / cycle lane perhaps cantilevering off the existing structure.

7. EFFECT OF CHANGING FACTORS

Changing factors over the expected future bridge life are included as follows:

- Climate change and the effects on our environment. This has been widely scientifically studied and publicised. In principle, these effects include an anticipated rise in sea levels of approximately 1m over the next 50 years and include a significant increase in storm (surf and rainfall) activity and severity.
- Population increases and resulting increase in traffic use of MR272. The Urbanista Residential Land Strategy 2040 commissioned by BVSC (adopted May 2020) for Bermagui and surrounds lists current population growth as 25.5% (second highest in the shire behind Tura/Mirador at 26.9%).

8. CONSTRUCTION TYPE & BRIDGE SERVICE REQUIREMENTS

Generally, bridges on MR272 should all comply with the relevant authority requirements and Australian Standards. These include the following:

- Transport for NSW (originally RMS)
- Austroads
- BVSC
- AS5100 Bridge Code.

AS5100 generally describes all standards required for loading and construction type and materials. There is also facility for the bridge owning authority (in this case BVSC) to stipulate some variations to these. Transport for NSW also has some special requirements for roads within NSW.

Bridge construction can include timber, steel, concrete and composite materials.

Loading type should include as a minimum SM1600 (AS5100) for a MR272 type main road. This generally includes a 44 tonne articulated truck loading.

Bridge service life. In many cases, traditional timber log girder bridge construction, in peak structural condition, can perform to SM1600 requirements. However, a characteristic of this type of construction is the difficulty to assess the existing structural members' condition, typically including piping or hollow internal voids within the log girder main load carrying members. Timber (and steel) piers and piles, where located in water or below ground are difficult to assess also. Generally, many timber piles below ground are in a rotting state and steel piles corroding. It is clear the existing bridge is in a structurally compromised state to carry load, especially of SM1600 requirements. To be able to accurately determine the present load carrying capacity of the bridge a comprehensive physical analysis of the structure is required, combined with an engineering structural analysis. On going bridge maintenance is a real and necessary requirement for the service life of timber bridges. Many members are generally replaced rather than repaired. This can involve lengthy delays in service, as the bridge is closed for regular repairs.

A new replacement of the bridge will incur a significant $ cost to the community. To restore the timber bridge to original condition will involve a considerable $ cost also, of which the community should expect value for the $ cost. This should include the significant maintenance costs to maintain a timber bridge in peak SM1600 load carrying condition for the required future design life.

For these cost / benefit reasons, an existing bridge restoration should be expected to have a 1:100 year design life (or in a timber bridge case include maintenance cost for the same period) in accordance with AS5100.1 Cl 6.2.

The relevant authority with jurisdiction over the bridge (in this case BVSC) determines the appropriate bridge waterway requirements in accordance with AS5100.1 Cl 7.1. For storm event and flood load, AS5100.1 Cl 6.5 defines design actions for ultimate action limit state that has a 5% probability of being exceeded; representing an average return interval (ARI) of 2000 years. AS5100.2 Section 15 defines these water loads and Clause 15.1 and 15.2, more specifically define that the bridge should be designed to resist the effects of water flow, tidal and wave action for bridges over estuaries, specifically for a 1:2000 year ARI flood event.

For a marine environment such as this, we recommend non corrodible building materials such as timber, recycled composites or appropriate strength reinforced concrete.

Constructability. The location is served by a high standard 2 lane bitumen sealed access from Bermagui and the Princes Highway at Cobargo suitable for construction material transportation to site.

9. TECHNICAL DESIGN PARAMETERS

Given the strategic importance of MR272, future MR272 AADT traffic loading has been estimated to be in the 1,000-2,000 vehicles per day range. Council to consider if this is suitable.

Design to be in accordance with:

- Transport for NSW (originally RMS)
- Austroads
- BVSC
- AS5100 Bridge Code.

These publications include the following aspects when specifically applied to the Cuttagee Bridge location:

- Loading to be SM1600 in accordance with AS5100 Bridge Design Code as instructed by council.
- BVSC RFQ 50/20 3.2.2 requires a concrete 2 lane, 110m long x 9m width bridge replacement with construction cost estimate listed as $9M. We therefore suggest a 2-lane bridge is required, with lane widths between kerbs, for vehicles, to be 9.0m. This would comprise a 1m shoulder each side + 2x 3.5m lanes (Austroads Part 3 Cl10.2 paragraph 2, as AS5100.2 does not apply due to bridge lengths).
- Design life in accordance with AS5100 to be 100 years for a 1:2000 year storm event.
- Barrier type to be Medium performance requirement (AS5100.1 Cl 10.5.4 for General traffic). Transport for NSW (RMS) type RDO for traffic, cyclists and pedestrians is suggested.
- Guardrail for approaches to be standard RMS W-beam terminals with tapers transitioning to 1 length of Thrie beam guardrail connecting to the bridge barrier – all to RMS standard details.

Cuttagee Bridge alternative construction types have been considered. For a complete replacement we recommend:

- Abutments. Reinforced concrete cast-in-situ boxed cantilevered abutment and wingwalls on either driven prestressed precast or caisson type excavated cast-in-place potted concrete piled foundation to rock with reinforced concrete cast-in-situ pile cap spread footings.
- Piers. Reinforced concrete cast-in-situ piers on either driven prestressed precast or caisson type excavated cast-in-place potted concrete piled foundation to rock with reinforced concrete cast-in-situ pile cap spread footings.
- Girder spans and Deck. Precast prestressed bridge girders (standard RMS Super-T bridge girders) to maximum span to suit site/length and minimize pier quantity requirement with cast-in-situ reinforced concrete deck topping (wearing slab) and RMS standard approach slabs.
- Cast-in-situ reinforced concrete barrier kerbs (as described above).

It is recommended that bridge deck level, location and alignment be suggested only in concept and then be the subject of a detailed coastal storm hazard analysis and report by a separate specialist qualified engineering consultancy experienced in coastal hazard analysis and management, taking into consideration the future aspects of sea level rise and climate change for the proposed bridge design life.

10. PROPOSED BRIDGE OPTIONS

The proposed bridge options have been defined as follows:

- Leave 'as per existing'.
- Retain existing and maintain correctly with an adequately planned and funded continued bridge maintenance program.
- Structurally upgrade existing bridge as traffic bridge only to adequate load carrying capacity for Main Road status and keep as existing single lane.
- Structurally upgrade existing bridge as traffic bridge only to adequate load carrying capacity for Main Road status and duplicate to two lanes.
- Upgrade existing bridge as pedestrian bridge only.
- Replace bridge on same alignment.
- Replace bridge on different alignment.
- Combination of the above such as replace bridge on different alignment and keep existing bridge as pedestrian only with required initial maintenance upgrade and continued maintenance program.

11. ALTERNATIVE ALIGNMENT OPTIONS

MR 272 within the bridge vicinity is bounded by varying landscape and legal features as follows:

- East: Tasman Sea and associated coastline.
- West: Cuttagee Lake and private land holding.
- North: Private land holding.
- South: Private land holding.

2 alternative bridge locations have been considered. Refer Figure 2.

Alt Bridge Location

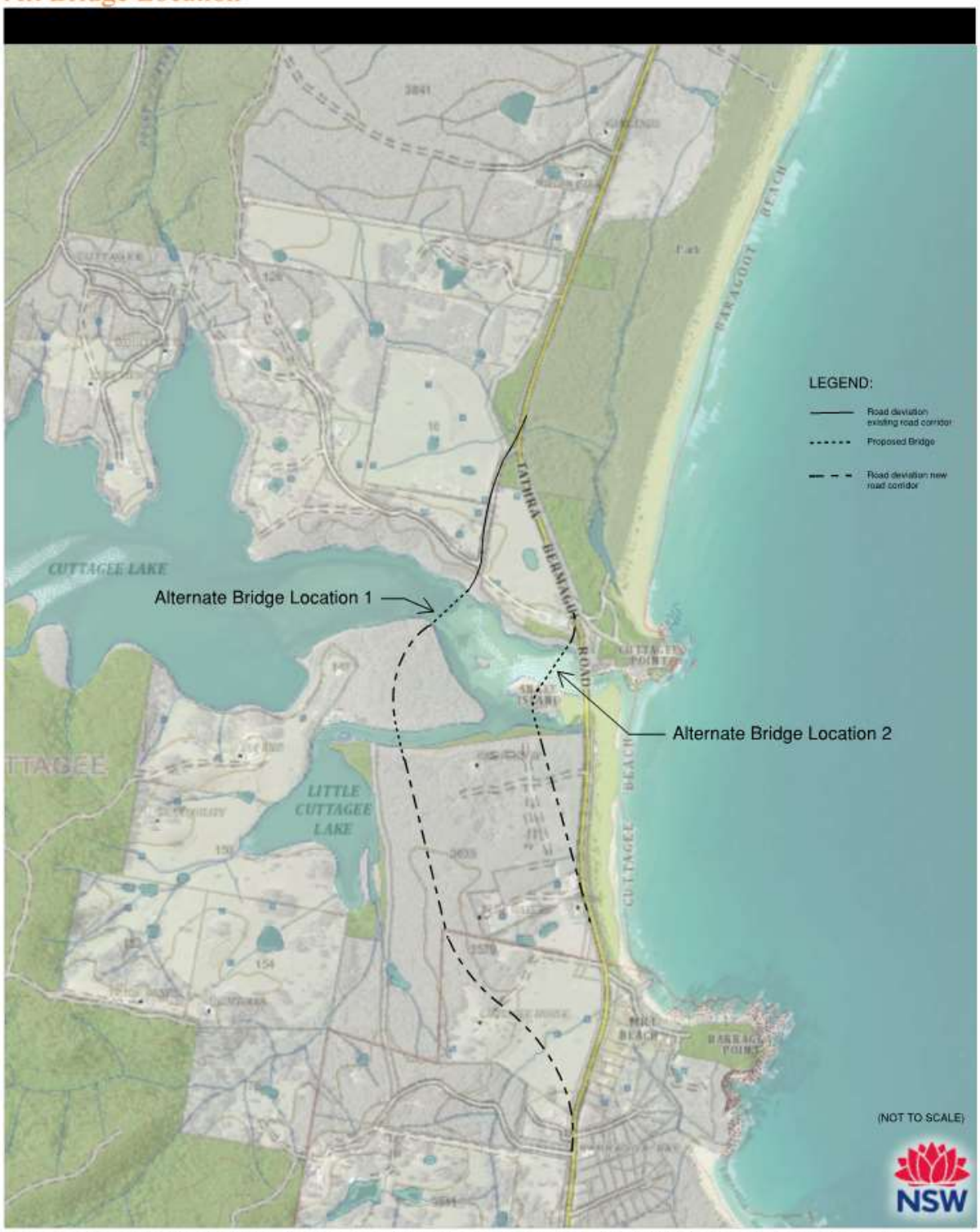

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Figure 2 – Cuttagee Bridge replacement options.

Alternatives have details listed as follows:

Alternative 1:

- Northern Road deviation (existing road corridor) 600m
- Bridge 1 Length 230m
- Central Road deviation (or possible bridge elevation) 250m
- Bridge 2 Length 100m
- Southern Road deviation (new corridor required) 1300m
- TOTAL BRIDGE LENGTH 330m
- TOTAL ROAD APPROACH LENGTH 2150m

Alternative 2:

- Northern Road deviation (existing road corridor) 200m
- Bridge Length 320m
- Southern Road deviation (new corridor required) 450m
- TOTAL BRIDGE LENGTH 320m
- TOTAL ROAD APPROACH LENGTH 650m

Alternative 1 could be a higher speed deviation posted up to 80km/hr. Alternative 2 contains sharper approach curves and would be a lower speed deviation posted at ~60 km/hr.

Alternative 1 does relocate the existing roadway away from the storm wave erosion zone of Cuttagee Beach. Alternative 2 only partially achieves this.

The proposed present replacement of the existing bridge would involve less approach works (approx. 200m) and an anticipated bridge length of 116m. However, the risk of wave erosion would remain for the southern existing approach road traverse behind Cuttagee Beach.

Construction cost estimation is beyond the scope of this initial investigation and report and will be required by qualified and experienced Quantity Surveyors. However, comparative construction costs could be viewed as follows:

- Replace existing bridge 100% (@116m) and approach 100% (@200m).
- Alternative 1 Bridge 284% and approach 1075% + 1550 lineal metres private land acquisition corridor.
- Alternative 2 Bridge 276% and approach 325% + 450 lineal metres private land acquisition corridor.

To replace the existing bridge in the same location and alignment is the most cost-effective option for all new bridge replacements. However, to align immediately parallel to the existing bridge to allow the existing bridge to remain in service until the replacement bridge is completed (or at least one single lane of the 2 lanes proposed) would be a significant advantage.

12. RECOMMENDATIONS

Based on our past 30 years professional engineering experience working with the maintenance of timber bridges and the design and construction of new bridges, we recommend with consideration to a longer-term economic value relative to design life requirements, a preliminary design be put forward for:

- A 2-lane concrete bridge replacement, with immediately parallel alignment, staged in construction, to maintain the existing bridge single lane in service until (partial) commissioning of the new structure.

We recommend that this be provided as a Concept Issue engineering plan format, showing alignment, cross-section and staged construction, to enable QS cost estimation, future cost/benefit analysis, and a community and professional consultation process.

It is recommended that bridge deck level and location be suggested only in concept and then be the subject of a detailed coastal storm hazard analysis and report by a separate specialist qualified engineering consultancy experienced in coastal hazard analysis and management, taking into consideration the future aspects of sea level rise and climate change for the proposed bridge design life.

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