DOUGLAS SHIRE COUNCIL

Diggers Bridge Replacement, Mowbray River

Options Analysis Report

Prepared for:

Douglas Shire Council

Trinity Engineering and Consulting

design | consult | manage

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DOCUMENT CONTROL SHEET

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1. Executive Summary

The aim of the Options Analysis was to determine the preferred crossing type for the Diggers Bridge replacement. The Options Analysis considered the site constrains and different criteria including crossing types, crossing widths, costs, alignment constraints, traffic requirements, topographic features, flooding immunity levels, design loads, vegetation removal to identify the preferred scenario based on these inputs.

This report advises on the process, inputs, outcomes and is intended as a record of the outcomes of this phase of the analysis.

Fourteen options were considered ranging from Refurbishing the Existing Bridge; full replacement on the same footprint; through to different crossing alignments. The original fourteen options were shortlisted to six replacement options for a more detailed options assessment. The six shortlisted options examined opportunities to improve traffic safety by realigning either the crossing, or by realigning the approach roads.

The detailed option assessment determined that two options stood out from the rest. These are;

Option 1 (Single Lane Box Culvert Structure with shared path and modification to approach road alignments) this option provides the appropriate level of service for traffic and pedestrians with minimal costs. Because it would be constructed on the same alignment as the existing bridge, environmental impacts and disturbance are considered to be minimised.

This option is expected to be the optimum outcome in this regard.

Option 6 (Two Lane Box Culvert Structure, with modifications to the approach road alignments, to the west from the existing road with the existing bridge maintained) was considered as the next preferred option as the existing bridge may be kept in service for pedestrians/cyclist and community uses. This would remove the potential pedestrian/cycle user conflict from the bridge.

Option 6 acknowledges that the bridge has reached its useful life as a Road Bridge, however, it may have benefit and further life if the road traffic use is removed.

Council considers there is significant community benefit in keeping the existing bridge for pedestrian/cycle uses. Once costing is known, Council Officers can determine the additional project costs for relocated the crossing to the west, maintaining the existing bridge for pedestrians and whether it is beneficial/feasible to seek further funding over and above Option 1 and 6.

Key elements to be further explored for Option 6 include;

- Additional vegetation clearing;
- Acceptance of the new crossing disturbance by the relevant authorities;
- Additional road length; and
- Additional impact on farming use currently occurring on road reserve.

2. Introduction

Diggers Bridge is located in the Mowbray Valley to the Southwest of Port Douglas and west of the Captain Cook Highway. This area consists of sugar cane farming, rural residential properties, an operating quarry, and the Flames of the Forest Restaurant. Council has advised that organised recreational mountain bikes events utilise Diggers Bridge several times a year. The main access to the Mowbray Valley during flooding events is via Mowbray River Road. The proposed crossing replacement will ensure Mowbray River Quarry can provide raw materials to the surrounding areas via the new crossing.

Diggers Bridge current configuration is a timber bridge located on Mowbray River Road consisting of a one lane carriageway and has a 20-tonne load limit applied. A recent level two structural inspection was undertaken by Forcecor Infrastructure Consultants to determine the condition of the bridge. The inspection determined the bridge is in overall poor condition and severe cracking is evident in majority of the piles. Inspection report attached in Appendix E. The overall length of the bridge is 47m and it is Council's desire to replace the bridge with a similar structure that serves the community, local farmers and quarry.

2.1 Purpose and Objectives

Trinity Engineering and Consulting was commissioned by Douglas Shire Council to provide the designed design and documentation for the Diggers Bridge Replacement project. This report is for the Options Assessment phase of the project.

The Option Assessment phase considers the available crossing types, having regard to designed crossing width, costs, alignment constraints, traffic requirements, topographic features, flooding immunity levels, design loads and vegetation. It includes options analysis, risk assessments, wants vs needs assessment etc.

The purpose of this report is to provide the additional commentary on the process and outcomes that are not readily conveyed through the use of plans and spreadsheet tools only. This report is intended as a record of the outcomes of this analysis and for ease of future reference. It includes meeting minutes, Options Analysis and concept plans of three alignment options.

The Options Analysis included discussions with Council Officers and two project meetings were held to discuss the project status, inputs and constraints. Copies of the meeting minutes can be found in **Appendix A**.

This report is to be read in conjunction with the Options Analysis (spreadsheet tool) provided in **Appendix B**.

Figure 1 - Locality Plan

3. Site Constraints

The following constraints were identified for Mowbray River Crossing as part in the constraints analysis undertaken:

Site Constraints	
Geotechnical	Completing construction of the crossing will require geotechnical investigation in order to establish the ground conditions, to determine the footings required.
Environment	The site is surrounded by trees and vegetation which the local community has grown accustomed too. Community consultation/advice will need to be managed if removal of trees is required.
Sight Distance	Current sight distance for traffic approaching the bridge is not safe and does not meet the minimum distances for safe stopping distance. All options need to address this safety issue.
Cultural Heritage	The current bridge is not affected by cultural heritage listing however, it is noted that the site was formerly the location of the original Diggers Bridge. Preliminary Cultural Heritage advice shown in **Appendix D**.
Native Title	The area around Diggers Bridge has been identified within the Native Title Area by Yirrganydji (Irukandji) People #2.
Flood Immunity	Crossing currently does not have the flood immunity recommended by FNQROC and Queensland Urban Drainage Manual (10% AEP flood event). Note approach roads have similar flooding immunity issues.
Loading	Mowbray River Quarry currently uses the crossing, with heavy equipment and materials transported over the crossing. Design loading to TMR standards is recommended for all options.
Bank Stability	There is a potential that the removal of vegetation and a change in crossing alignment could de-stabilise the bank causing additional works to be completed.

Table 1 – Site Constraints

These constraints form the inputs to the options assessment process with some directly influencing all options, (for example; provision for greater sight distance).

3.1 Approval Management Plan (Preliminary)

Council's briefing document nominated the requirement for an Approvals Management plan to be compiled to identify the required approvals and agreements for the proposed infrastructure upgrade. The plan is to detail requirements in terms of approval procedures, timeframes for the identified upgrade option(s), and stakeholders to be approached.

The implementation of the Approvals Management Plan is to include:

- Preparation of submission(s) on behalf of Council to respective authorities detailing the project, the impact, and the requirements of Council;
- Facilitate communication with respective stakeholders;
- Maintaining records of communications, submissions, and feedback during the process; and
- Obtain required approvals (including planning approvals) for the construction and ongoing operation of the infrastructure.

At this phase of the project (pre-detailed site survey and geotechnical investigations) it is not possible to identify conclusively all the aspects of the proposed new crossing that will require specific statutory approvals. This is primarily because the final alignment and width of the crossing, and the associated corridor impacts are still to be determined

The recommendations of this report include advancing more than one crossing alternative for further consideration and refinement at the preliminary design phase of the project. Therefore, adoption of the preferred solution will be part of the approval management plan as the options being considered include varying impacts and may have different approvals required.

Desktop assessments of environmental considerations, and native title and cultural heritage considerations have been undertaken which included:

- Site visit with Council Officers to identify possible construction and alignment constraints;
- Searches to identify possible constraints with vegetation, private property, cultural heritage, services, and easements.

Appendix D reports the preliminary findings.

A summary of the currently identified approvals typically associated with construction of this nature is listed in Table 2 below.

Potential Approvals	
River Protection Permits	May not be required, as work is being completed on behalf of a Local Council.
Cultural Heritage	Not affected by Cultural Heritage listing
Flora and Fauna	A flora and fauna expert may be required to determine whether any plants or animals are protected within the area. Propose to review following further refinement of preferred option after detailed survey. May be able to be covered in applications to be lodged with Council.
Declared Fish Habitat	Diggers Bridge is not located within the declared fish habitat area.
Native Title	Current within the Yirrganydji (Irukandji) People #2 Native Title Area. Discussions recommended with the representative of the Yirrganydji (Irukandji) People #2.
Vegetation Clearing	If clearing more than 5,000 square metres approval is required from the state. May be able to be covered in applications to be lodged with Council.
Operational Works	Operational Works application is required to be lodged with Councils planning department.
Water Barrier Works	Forms (IDAS 27) required to be submitted with Operational Works Application which will be referred to the State. Barrier will be required for construction.
Taking or interfering with water in a watercourse	Submitted with Operational Works Application and will be referred to the State.

Table 2: Potential Approvals

Implementation of Approvals Management Plan will be required as the subsequent stages of the project proceed with tasks including;

- Prepare and lodge formal applications for relevant statutory approvals, including Operational Works Application;
- Manage assessment process and liaise with relevant agencies/authorities and client to resolve any issues; and
- Review final approval documentation and provide recommendations to client.

3.2 Input Considerations

At the project start up meeting with Douglas Shire Council, known issues and crossing replacement options were discussed.

Council advised the preferred type of crossing proposed was expected to be either a complete replacement with a bridge or culvert alternative. Bridges are generally considered to be more expensive to construct and are often associated with higher engineering and whole of life costs.

Whilst a deck replacement option was considered, the lack of confidence in the remaining bridge elements as identified in structural inspection report was a significant impediment for this option.

The current road alignment along the northern approach does not appear to be contained within the road reserve. It appears to be slightly south of the road reserve and encroaching into the drainage reserve. Currently most of the above road reserve is under cane cultivation. No lease easement or temporary road closure was identified over the road reserve. It is recommended Douglas Shire Council consult with the farmer regarding current farming usage within the road reserve and the potential new road alignment.

From an engineering perspective, there are minimal construction impediments for the realignment of the northern crossing approach to within the road reserve.

The realignment of the northern approach is to provide vehicles with satisfactory sight distance to safely use the crossing. Quarry trucks currently utilise the crossing for delivery purposes. Sight distance was determined using Austroads design standards recommendation for trucks. Utilising Austroads Part 3 (Geometric Deign) documentation, Table 5.6 was considered the applicable criteria which nominates 50 metres stopping distance for a truck operating at 40 kilometres an hour and 70 meters for 50 kilometres an hour.

For the single lane bridge options, the stopping distance will need to be provided prior to the transition zone from two lanes down to the single lane.

The transition taper location was determined using Transport and Main Roads: ‘Traffic Control Devices for General Use’ documentation, which nominates a 20-30 metre requirement from the start of the crossing (Figure 3-A: ‘Controlled approach to one lane crossings). The start of the taper determines the placement of a ‘giveway’ or ‘no overtaking on bridge’ sign. Noting the pre-existing constraints on both sides of the crossing, the concepts adopt the 20m minimum distance recommended.

Based on this 20m transition plus the minimum stopping distance, the assessment adopts 70m from the start of the crossing as the closest point that the vehicles (trucks) need to be able to see across the bridge and determine if any vehicle conflicts exist. Sight distance requirement for the single lane crossing is therefore the length of the crossing plus 70 metres which includes both the taper and the minimum truck stopping distance (40 kilometre an hour assumed).

The southern approach carriageway is contained within the road reserve and a section of the balance road reserve is leased to the neighbouring farm property. Council identified the verge on the south-east portion of this road is used to store cane bins and would prefer that it is not altered.

The alignment assessments give consideration to the above road inputs.

The alternative to realigning the road is to realign the northern end of the crossing. This will result in a longer crossing and has cost implications. Also, as discussed previously, the realignment of the bridge may cause bank stability issues due to the expected need for removal of large rainforest trees located along the bank. The removal of these trees is not desirable as additional costs for bank repair may be required. Council advised that the community is unlikely to be in favour of the removal of these trees.

Council Officers confirmed that the new crossing replacement at a minimum is to have a single trafficable lane with shared path on one side. Additional options including dual lanes has been considered and costed to confirm feasibility and/or funding requirements.

A further option was identified for consideration resulting from Council’s review of the initial issue of the Options Analysis report. This option (Option 6) is to preserve the existing timber bridge for public uses and pedestrian/cycle use with a separate alignment for the road traffic crossing.

4. Options Assessment

4.1 Preliminary

The initial options assessment considered thirteen options with a further option added for consideration after Council's review of the initial issue of the report. The decision criteria for these options are the following:

Criteria	Options Selected
Crossing Type	Repair Current Bridge Culvert
Crossing Alignment	Current Skewed
	Move Crossing
Crossing Width	Single Lane (4.2m) Single Lane & path (6.5m) Dual Lanes (7.5m) Dual Lanes & path (10m)
Flood Immunity (Crossing level)	Maintain Current Level Higher Lower
Design Load	Current T44 SM1600
Road Alignment	Minimal change Modified
Vegetation Removal	Minor Major

Table 3 - Design Criteria

Full details of fourteen options can be found in Appendix B. The options initially considered range from Refurbish Existing Bridge to constructing a new Dual Lane crossing. The further option was added for a dual lane crossing and retaining the existing crossing for community uses.

The options were assessed based on the risks during and after construction. These risks included costs, safety, construction timeframe, resources, cultural, environmental and engineering. Each risk was assigned a low, medium, or high chance of occurring associated with them.

An indication of the order of costs associated with each of the fourteen options was provided with the Preliminary Options Assessment. Indications of Costs were based on establishing a base case value and then reporting the relative costs of options against this base value. The base case was for the single lane culvert structure with no path; "Base Case X". All other options will have a multiplication factor associated with the cost increase in comparison to the base number.

This preliminary risk assessment has some subjectivity and has inputs based on the judgement of the person completing the assessment. The preliminary assessment is used as a tool to rank options relative to each other and assists to determine appropriate options to further investigate. Further investigations include a further Risk Matrix and a Wants Decision Matrix.

Six options were identified for further investigation.

5. Detailed Option Assessment

The six options that will be further investigated can be described as follows:

Option 1 - Single Lane Box Culvert Structure with shared path, and realigned approach road.
- Order of Costs $1,900,000 (Link Slab)
  $2,700,000 (Box Culverts)

Option 2 - Single Lane Box Culvert Structure with shared path, skewed crossing alignment.
- Order of Costs $2,500,000 (Link Slab)
  $3,900,000 (Box Culverts)

Option 3 - Single Lane Box Culvert Structure with shared path, skewed crossing alignment and modified approach road alignments.
- Order of Costs $2,700,000 (Link Slab)
  $4,100,000 (Box Culverts)

Option 4 - Single lane box culverts structure with higher flood immunity, with Shared Path, modified approach road alignments.
- Order of Costs $2,500,000 (Link Slab)
  $3,300,000 (Box Culverts)

Option 5 - Dual Lane Box Culvert Structure, modified approach road alignments.
- Order of Costs $2,100,000 (Link Slab)
  $3,000,000 (Box Culverts)

Option 6 - Dual Lane Box Culvert Structure, modify approach road alignment, crossing moved to the west and existing bridge maintained
- Order of Costs $2,000,000 (Link Slab)
  $2,700,000 (Box Culverts)

It is noted that the options identified to progress the detailed options assessment phase were all culvert only options (no bridges). Completion of the initial phase of the Options Analysis concluded that the high costs, resources, and engineering associated with bridge construction ruled out further investigations for the bridge option.

A conventional prestressed concrete bridge with approach road modifications (as required for all options) had an order of cost of $3,700,000. It is noted that a bridge at this location offers the same level of service as a culvert but with higher costs with no significant benefits identified.

The two key variables for the remaining options are:

1. Realignment of the road approach; and
2. Realignment of the crossing.

Two sketches were prepared to provide further details to Council Officers and stakeholders.

SKETCH 1073-1 shows the option for the realignment of the northern approach road and SKETCH 1073-2 shows the option for the skewed crossing realignment (with minor approach modification) to allow for better sight distance from the approach road. The addition of SKETCH 1073-5 has been included to show the possible new crossing location to the west of the existing bridge and associated modifications/realignment of the approach roads.

Further details regarding these options are discussed in Section 5.

5.1 Wants Decision Matrix

A Wants Decision Matrix was completed for the project. This involves scoring each option to determine which would provide the most benefit for the community and Council. The detailed option assessment involved scoring each option based off the following criteria:

- Value for money;
- Ensure integrity of the economically import link of Crossing to Douglas Shire Council;
- Maximise opportunities for local business (through construction);

- Minimise capital costs (Low CAPEX);
- Minimise ongoing maintenance costs (Low OPEX);
- Maximise the use of local materials;
- Minimise adverse social impacts;
- Minimise political impacts;
- Minimise adverse environmental impacts – Vegetation;
- Minimise adverse environmental impacts – Waterway;
- Minimise cultural heritage environmental impacts – Preservation of Heritage of original Diggers Bridge Crossing site;
- Minimise construction risk;
- Maximise Funding Opportunity;
- Consider stakeholder requirements.

Each option was scored out of 0, 3, 5, 7 and 10, 0 being the worse result. The scores selected are based off the judgement of each participant completing the ratings and hence there is some subjectivity in the process. However, the purpose of the analysis is to seek to narrow the options down to identify an appropriate solution having regard to the identified selection criteria. Whilst subjectivity can influence the outcome, it tends to be a "levelling out" due to the "relative" scoring and the number of criteria assessed against.

5.2 Risk Assessment

A more in-depth risk assessment was completed on the six selected options to assess the threat and consequence in the short and long term. The consequence range varies from insignificant to major for each of the project risks.

The following projects risks were assessed to determine the likelihood they would occur:

Project Risk	**Effect/Consequence**
Harm to People (Safety / Health)	Exposure to health risk
Environmental Impact	Environmental Harm
Business Interruption / Material Damage & Other Consequential Losses	Disruption to operations, causing a loss of operation profit or assets
Legal & Regulatory	Legal issues that could occur
Schedule / Timeline	Delays in project completion
Cost / Budget	Increase in overall project budget
Quality of Deliverables	Impact on quality of deliverables
Impact on Reputation / Social / Community	Public awareness or concern

Table 4 - Project Risks

The risk rating varies from Low (1-5) to Medium (6-12), to Significant (13-20) to High (21-25) which determines when a mitigation strategy to eliminate the risk should be devised. Full details of the risk analysis are shown in **Appendix B**.

6. Selected Options

6.1 Option 1

Option 1 is a Single Lane Culvert Structure with shared path; realignment of the northern approach road and minor modification of the southern approach. Option 1 was selected as it provided the appropriate level of service for traffic and pedestrians with minimal costs.

Details of this option include:

- Crossing Width – Single Lane (4.2m minimum) & Shared Path (total width 6.4m);
- Crossing Type – Culvert;
- Flood Immunity – Existing (constrained by southern approach road levels);
- Vegetation Removal – Minor clearing of banks;
- Crossing Alignment – No change;
- Road Alignment – Extend northern approach road to achieve sight distance;
- Design load – SM1600;

The design methodology for this option sought to maintain the existing major vegetation (the rainforest trees) and undertake road works to provide adequate traffic safety to residents that use the crossing.

Realignment is proposed on the northern approach to improve the geometry and sight distance for oncoming traffic, allowing time to see traffic approaching the bridge and give way as necessary. This provides additional safety for vehicles and pedestrians on the crossing. Minor modifications are proposed on the southern approach to better define the “hold storage” for give way zone.

The location of the northern road realignment requires cane farming uses within the road reserve to be removed.

Council requested the single lane width be increased to 4.2m to allow for larger vehicles using the crossing. All single lane options have been adjusted to reflect this requirement.

Constraints and opportunities for this option are summarised in the table below.

Constraints	**Opportunities**
Relies on removal of existing cane cultivation along in the road reserve	Minimum vegetation removal required
Reliant on Geotechnical results	Additional sight distance for vehicles
	Speed limited by north approach road, due to curvature

Table 5 - Option 1 Constraints and Opportunities

The final results assessment of the risk matrix determined an overall risk of 15(S). Per section 4.2, a rating of 13-20 is a significant overall risk. This rating is due to major consequence if an accident occurs during construction. Mitigations measures would include following the appropriate Work Place Health and Safety plan.

Option 1 scored the highest in regards to the Decision Matrix and is considered to provide the most value for money option for the community and Council with the least unknowns.

6.2 Option 2

Option 2 is a Single Lane Box Culvert Structure with shared path and has a skewed crossing alignment with minor modifications to the approaches. Option 2 was selected to determine whether a change in crossing alignment (increased skew) was a viable option.

Details of this option include:

- Crossing Width – Single Lane (4.2m minimum) & Shared Path (total width 6.4m);
- Crossing Type – Culvert;
- Flood Immunity – Existing;
- Vegetation Removal – Major clearing of banks;
- Crossing Alignment – Moved to the east;

- Road Alignment – Minimal change.
- Design load – SM1600;

Skewing the crossing alignment gives the opportunity to achieve compliant traffic sight distance for the crossing with less approach road realigning. Sight distance may not be improved as much as extending the northern approach road and is still reliant on the removal of significant vegetation along the top of the banks. Removal of two large rainforest trees, one on each bank to the east of the existing bridge is considered necessary to realign the crossing.

Removing these rainforest trees may introduce the risk of destabilising the banks, and may require reinstatement/stabilisation measure (costs unknown at this stage). As discussed previously, Council Officers believe the surrounding community would not be in favour of the removal of the major vegetation.

Constraints and opportunities for this option are summarised in the table below.

Constraints	Opportunities
Reliant on the removal of vegetation along the top of the banks. (two large trees)	Will assist to achieve a smoother road alignment and better sight distance (reduce length of road realignment)
Reliant on Geotechnical results	
Vegetation removal may destabilise banks	

Table 6 - Option 2 Constraints and Opportunities

The final results assessment of the risk matrix determined an overall risk of 20(S). As previously identified, a rating of 13-20 is a significant overall risk. This is due to identified construction risk per Option 1 and additional project risk of impact on the community when the trees are removed. In addition to Option 1 measures further mitigations measures could include speaking to local stakeholders regarding the construction and managing the potential negative perceptions of tree loss by highlighting the positive benefits the project will make to the surrounding community.

Based on the scores given in the Decision Matrix, Option 2 scored fourth due adverse impact to environment and increased construction risk.

6.3 Option 3

Option 3 is a Single Lane Box Culvert Structure with a shared path and has both an increased skewed crossing alignment and more significant modifications of northern approach road alignments. This option combines both options 1 and 2 to provide additional safety for vehicles and pedestrians.

Details of this option include:

- Crossing Width – Single Lane (4.2m minimum) & Shared Path (total width 6.4m);
- Crossing Type – Culvert;
- Flood Immunity – Existing;
- Vegetation Removal – Major clearing of banks;
- Crossing Alignment – Moved to the east;
- Road Alignment – Extend northern approach road.
- Design load – SM1600;

The combination of Option 1 and 2, realigning both the northern approach road and the crossing for a greater increase in sight distance. The road and crossing will have a straighter alignment than what was previously proposed, which may increase the approach speed environment in the vicinity of the crossing.

Essentially, this option gives priority to the horizontal geometry for road traffic.

Constraints and opportunities for this option are summarised in the table below.

Constraints	Opportunities
Relies on removal of existing cane cultivation along in the road reserve	Additional sight distance for vehicles
Reliant on the removal of vegetation along the top of the banks	Less requirement for speed control (Higher speed environment)
Reliant on Geotechnical results	smoother road and crossing alignment
Vegetation removal may destabilise banks	
Overhead power may limit the realignment of the road approaches on this crossing orientation	

Table 7 - Option 3 Constraints and Opportunities

The final results assessment of the risk matrix determined an overall risk of 21(H). The rating for this option is in the High (21-25) overall risk. The high risk is due to previously identified risk elements in Options 1, 2 and the possibility the project budget will be significantly higher due to realigning the road and crossing and the risks associated with two areas with unknown surface conditions. Additional Mitigation measures for this option could include confirming bank stability with additional geotechnical investigations and power pole location relative to proposed crossing alignment.

Option 3 scored fifth in the Decision Matrix due adverse impact to environment, increased construction risk and capital costs.

6.4 Option 4

Option 4 is for a Single Lane Box Culvert structure with a shared path and provides for higher flood immunity. External roadworks would be required to realign the northern approach road alignment and for increasing the flood immunity of the crossing above what is currently provided. No realignment of the crossing is proposed with this option; hence it is essentially Option 1 but with raised crossing and road heights.

Details of this option include:

- Crossing Width – Single Lane (4.2m minimum) & Shared Path (total width 6.4m);
- Crossing Type – Culvert;
- Flood Immunity – Higher Immunity;
- Vegetation Removal – Minor clearing of banks;
- Crossing Alignment – No change;
- Road Alignment – Extend northern approach road to achieve sight distance;
- Design load – SM1600.

Increasing the flood immunity of the crossing alone would be of limited benefit, as the approach roads will be inundated and local traffic will be unable to access the crossing. A more detailed flood analysis will be required to be completed on the Mowbray River to further assess raising the surrounding roads and crossing to gain greater immunity.

The additional analysis would need to determine impacts from such changes on surrounding properties upstream and downstream. Currently the Mowbray river floods into farmland, this provides addition surface area for the water to encroach. If the road height was to be increased, the water would be restricted to a smaller area and flood heights would be expected to increase, which may cause a worsening of conditions on the upstream properties. This may lead to other issues.

The expected complexity (and hence costs) associated with completing the upgrades required (and completing the required flood modelling) are considered too high to make this a viable option.

Constraints and opportunities for this option are summarised in the table below.

Constraints	Opportunities
Reliant on flood model to determine the amount of earthworks required.	Increase immunity to roads and crossings
Changes in waterway may cause increase in upstream flood level and possible impacts to property owners.	Additional sight distance for vehicles
Reliant on Geotechnical results	Speed limited by north approach road, due to curvature

Table 8 - Option 4 Constraints and Opportunities

The final results assessment of the risk matrix determined an overall risk of 21(H). The rating for this option is in the High (21-25) overall risk (Compared with Option 1 risk rating). This is due to the factors identified for options 1 plus the additional likely possibility the overall project budget and timeline would be significantly increased based on additional work required to provide higher flood immunity in accordance to QUDM and FNQROC. In addition to the mitigation measures for the earlier Option 1, the mitigation measures for project budget risk could include examining the high-risk sections of the project and determining whether these works can be staged to reduce the costs and time needed for construction.

Option 4 scored last (sixth) in the Decision Matrix due adverse impact to environment, increased construction risk, value for money, maintenance and capital costs.

6.5 Option 5

Option 5 considers the use of a dual lane crossing with modifications of approach road alignments and no path. This option is essentially Option 1 with a wider crossing structure to accommodate two lane traffic.

Details of this option include:

- Crossing Width – Dual Lane (Width 7.5m);
- Crossing Type – Culvert;
- Flood Immunity – Existing;
- Vegetation Removal – Minor clearing of banks;
- Crossing Alignment – No change;
- Road Alignment – Extend northern approach road to achieve sight distance.
- Design load – SM1600;

The increased width to facilitate two-way vehicular traffic increases the crossing width from 5.5m to 7.5m. Due to the absence of a dedicated cycleway/walkway, removal of the path was to reduce the width of the crossing and provide cost savings. Vehicles on the crossing will be required to give way to multi-modal traffic (pedestrians/bicycles) as is the case for the approach roads and balance of Mowbray River Road.

It is considered some realignment will still be required on the northern approach to improve the geometry and sight distance for oncoming traffic, allowing time for traffic to see any pedestrians and give way as necessary. This provides additional safety for vehicles and pedestrians on the crossing.

Constraints and opportunities for this option are summarised in the table below.

Constraints	Opportunities
Relies on removal existing cane cultivation in the road reserve	Caters to future traffic, no giveway required
No shared path, traffic to giveway to pedestrians/cyclist on bridge (but with dual lanes to enable this to occur)	Less requirement for speed control (Higher speed environment)
Vegetation removal along top of banks may be required	Additional sight distance for vehicles

Table 9 - Option 5 Constraints and Opportunities

The final results assessment of the risk matrix determined an overall risk of 15(S). Similar to Option 1 the rating for this option is in the significant (15-20) overall risk. Similar to Option 1 this is due to major consequence if an accident occurs during construction. Mitigations could measures include following the appropriate Work Place Health and Safety plan.

Option 5 scored third in the Decision Matrix, due to the higher capital costs and potential increase in vegetation removal when compared with Option 1.

6.6 Option 6

Option 6 is an additional option adopting a two-lane crossing to the west from the current bridge and maintaining the existing bridge for pedestrians/community uses. This option requires significant realignment of the northern approach and realignment of the southern approach.

Details of this option include:

- Crossing Width – Two Lane (Width 7.5m);
- Crossing Type – Culvert;
- Flood Immunity – Existing;
- Vegetation Removal –Clearing for new alignment on both banks;
- Crossing Alignment –Moved to the west;
- Road Alignment – New road construction required for northern approach road, modifications and realignment required for southern approach; and
- Design load – SM1600.

Option 6 has been considered following further discussion with Council Officers and feedback from Council's internal consultation process.

Option 6 As noted above, it involves realignment of the crossing to the west from the existing bridge and proposes to retain the existing timber bridge as a pedestrian cycleway bridge.

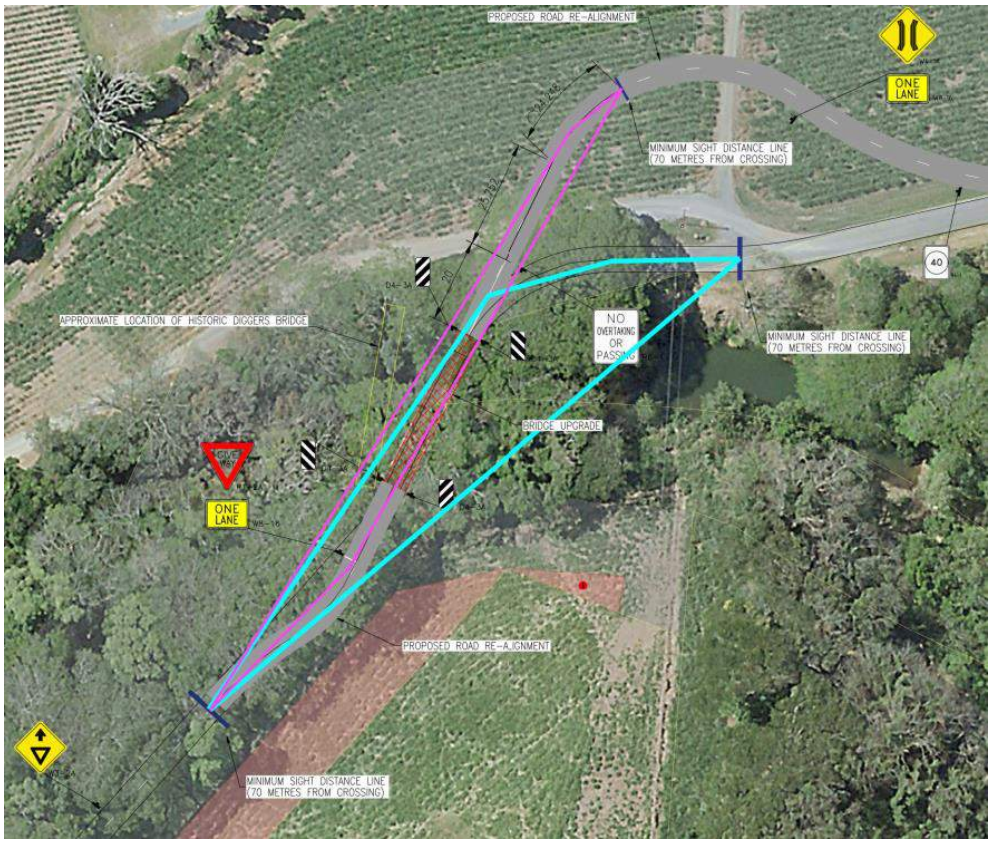
This option requires additional clearing and has greater road construction and road geometry constraints (bends). However, as the existing bridge would be kept in service for pedestrians it would remove the pedestrian/cycle user conflict from the bridge.

The other positive construction benefit is the opportunity to reduce the skew of the crossing. Reducing the skew has benefits for the length and width of the crossing and as a result of the reduced culvert staggering required will enable a wider usable carriageway for the road users for a given number of culvert crown units. Initial assessment of this concept has identified that a similar number of culvert units could accommodate a two-lane road as the skew could be reduced significantly (assumed to around 10 degrees on initial assessment).

Note that until detailed survey is available and all constraints identified the final location and skew cannot be further refined. The presence of large trees and the value attributed to individual trees will need to be confirmed and plotted on the plans to progress the assessment of this option.

The road geometry will be more constrained in this option with additional bends and a greater length of road to be constructed. However, the ability to achieve a wider useable carriageway for the similar number of culvert units does afford the option to eliminate the one lane bridge. Provision of two lane crossing changes the sight distance parameters significantly. Normal stopping sight distance will still need to be achieved as for normal road use, (that is, sight to hazard with sufficient distance to stop before hazard).

However, that the sight distance will be much less restrictive than the current criteria for the one lane option; (that is, sight distance currently proposed is well beyond the stopping point; sight across full extent of bridge with that sight distance available at a point sufficiently along the road to enable vehicles (trucks) to stop 20m clear of the bridge). As a result, the sight distance criteria for the single lane bridge option is more than double that for normal safe stopping distance on a two-lane road. The image below shows the greater sight distance required for the single lane bridge option.



The attached SKETCH-1073-5 shows the possible alignment of the crossing and the modifications/realignment of the approach roads. Further assessment of the location of trees, and the actual location of the top of bank will be required to refine this option further.

If the creek width is the same, a 10-degree skew crossing compared to a 30-degree crossing will result in about 12% reduction in the crossing length (measured along the road centreline). Once the survey confirms the crossing profile it is proposed to verify the lengths of the respective crossing options.

Constraints and opportunities for this option are summarised in the table below.

Constraints	Opportunities
Relies on removal existing cane cultivation in the road reserve	Caters to future road and pedestrian/cycle traffic, no giveway required
Repairs may be required to make existing bridge safe for pedestrians	Reduced requirement for sight distance for vehicles and greater distance achievable.
Vegetation removal along top of banks will be required to both sides of river.	No pedestrian/cycle user conflict

Constraints	Opportunities
	Speed limited by north approach road, due to curvature
	Existing bridge maintained for the community

Table 10 - Option 6 Constraints and Opportunities

The final results assessment of the risk matrix determined an overall risk of 15(S). Similar to Option 1 and Option 5, the rating for this option is in the significant (15-20) overall risk. As for Option 1 and Option 5, this is primarily due to major consequence if an accident occurs during construction. Mitigation measures would include following the appropriate Work Place Health and Safety plan.

Option 6 scored second in the Decision Matrix, due to the expected higher capital costs with additional road construction and greater uncertainty of impacts including increased vegetation removal when compared with Option 1. Though the costs are expected to be slightly higher than Option 1, it provides the highest safety for both pedestrians and vehicles that use the crossing.

Given the potential community benefit and ability to merge construction impacts to road users, it is recommended that Option 6 also be assessed further in the preliminary design phase. Detailed survey in particular will assist to confirm the vegetation impacts and verify crossing length and skew.

7. Summary and Conclusions

The aim of the Options Analysis was to consider the available crossing types, crossing widths, costs, alignment constraints, traffic requirements, topographic features, flooding immunity levels, design loads and vegetation removal and identify the preferred scenario based on these inputs.

This report advises on the process, inputs and outcomes and is intended as a record of the outcomes of this phase of the analysis.

Fourteen options were considered ranging from Refurbish Existing Bridge to constructing a new Dual Lane crossing to the west of the existing bridge.

The assessment undertaken concludes that the six initial options were all culvert options. This was primarily due to cost advantages for a culvert crossing (approximately 50% compared to prestressed concrete bridge) and lack of significant constraints at this location for culvert construction. The six selected replacement options examined opportunities to improve traffic safety by realigning either the crossing, or the approaches.

For traffic safety (sight distance); realignment of either the approaches or the crossing, was identified as a requirement. Through the options analysis process and particularly the risk matrix, the realignment of the road approaches was determined to have the lowest overall project risk rating.

The two options proposed for further assessment at preliminary design phase are:

- Option 1- Single Lane Box Culvert Structure with shared path, and realignment of northern approach road; and
- Option 6 – Two Lane Box Culvert Structure west from the existing bridge with existing bridge maintained for pedestrians/cyclists/community uses; realignment of both approach roads will be required with significant additional road construction required on northern side.

8. Recommendation

Per the summary and conclusions section, this analysis identified that Option 1 and Option 6 are the preferred options to progress through to the preliminary design phase.

Both options can provide the minimum levels of service to traffic and pedestrians.

Option 6 has the potential to provide greater community benefit but will have greater impacts and will likely trigger more approvals management. Accordingly, the potential constraints on this option are higher but it does appear to offer a superior overall outcome.

Further refinement of the two options with the benefit of survey is expected to assist to determine the preferred option.

It is recommended that:

- Council adopt these options for further assessment in preliminary design; and
- Council accept this report and use the findings to seek community feedback on the two options identified.

APPENDIX A: Meeting Minutes

Trinity Engineering and Consulting
design | consult | manage

					Meeting #:	001
Meeting Purpose:	Diggers Creek Bridge – Options Assessment and Workshop	***Meeting Time:***	8-12	PM	***Meeting Date:***	16/11/2016
Attendees:	Paul Steele (PS), Rudd Rankine (RR), Daniel Reitano (DR) – Trinity Engineering and Consulting (TEC) Michael Matthews (MM), Michael Kriedemann (MK), Benjamin Armbrust (BA), Kim Armbrust (KA), Thomas Donnelly (TD) – Douglas Shire Council (DSC)					
Circulation:	All					
Apologies:	Andrew Armstrong (AA), Gaye Scott (GS)					

#	Agenda / Issues:	Decision / Action:	Action by:	Additional Comments
1	Project Team	Project Engineers – Andrew Armstrong, Daniel Reitano		
		Senior Engineers – Paul Steele, Rudd Rankine		
2	Method of Communication (first contact)	TEC Contact – Paul Steele Council Contact – Michael Matthews		
3	Project Background	Diggers Creek Bridge replacement		
4	Project Timing (Options Analysis)	Week 3 – 2nd December		
5	Known Issues and Constraints	Alignment - Adjust road or realign bridge - Moving alignment can cause bank stability issues - Evidence of accidents on the northern side bend, approximately 350 metres from crossing		
		Sight distance/Traffic - North side approach to be lengthened; - Sketches showing recommended option; - Sugar cane bin storage south side of crossing; - Limit speed; - Confirm posted signs.	TEC TEC TEC	
		Geotechnical Issues - Bank stability - Potentially unstable if rainforest trees east of the bridge are removed.		

		Other - New deck is expected to be thinner (hydraulically important); - DSC to confirm likely funding body and whether assistance is required.	DSC	
6	Council Information	Existing Services – As Constructed Drawings - Telstra pit located in verge on south approach, behind barrier; - LiDAR information provided; - As-Cons of services if available to be provided	DSC	
7	Local Constraints	Vegetation - Removal of rainforest trees not recommended; - Community complaints will be expected.		
		Private Property - Cane land inside road reserve; - Correspond with community engagement officer.	DSC/ TEC	
		Cultural Heritage - Perception that the current Diggers bridge is the original; - No known cultural heritage sites in area; - TEC to include clause in tender documentation regarding unknown cultural heritage sites	TEC	
		Services - DBYD; - Internal discussions with DSC regarding water main upgrades that may be required with these works.	TEC DSC	
		Easements - Southern approach Land Lease easement.		
8	Bridge Replacement Options	Single Lane - Share path recommended; - Path along the western side.		
		Dual Lanes - Not recommended; - Higher costs. - To be confirmed in Option analysis		

		Realignment - Discussed at point 5.		
		Bridge - Expensive, not recommended. - To be confirmed in option analysis		
		Box culverts - Recommended replacement option.		
		Bridge height - Height varies from 2.5-3.5m, to be confirmed with site survey; - Change in crossing height does not appear to be feasible, to be confirmed with option analysis.	TEC	
		Other - Removal of rainforest trees may pose a problem.		
9	**Other Discussions**	- Bridge condition rating 4; - 8m to first pier on bridge (TEC consider minimal hydraulic capacity in first span); - Option bridge/deck replacement; - Fisheries waved fees for previous projects, as that project was funded by State Government. Sub-consultants - Local consultants recommended (survey/geotechnical). Options for Stakeholders - Statements of support for options/funding; - Expectation of level of service from stakeholders (i.e. quarry load limit). Council would like to review draft Option Assessment, TEC to forward.	TEC DSC TEC	

Meeting Closure Time:	10am

APPENDIX B: Options Analysis

Diggers Bridge, Mowbray River		
Participants		
Name	**Position**	**Company**
Rudd Rankine	Senior Civil/ Geotechnical Engineer	Trinity Engineering and Consulting Pty Ltd
Paul Steele	Senior Civil Engineer	Trinity Engineering and Consulting Pty Ltd
Andrew Armstrong	Project Engineer	Trinity Engineering and Consulting Pty Ltd
Daniel Reitano	Project Engineer	Trinity Engineering and Consulting Pty Ltd

Trinity Engineering and Consulting

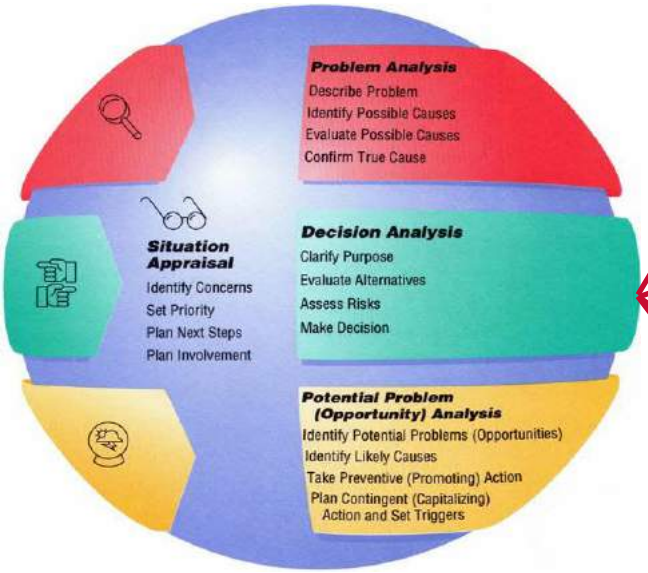
Diggers Bridge, Mowbray River

Kepner Tregoe Problem Solving & Decision Making

Kepner Tregoe Decision Analysis

A systematic process for making choice

To balance benefits and risk



Clarify Purpose
- State the decision
- Develop objectives
- Classify objectives into MUSTS and WANTS
- Weigh the WANTS

Evaluate Alternatives
- Generate alternatives
- Screen alternatives through the MUSTS
- Compare alternatives against the WANTS

Assess Risks
- Identify adverse consequences

Make Decision
- Make the best balanced choice

Diggers Bridge, Mowbray River

Expectations

What do we want to achieve?

What are the expected achievements from using this tool
Determine best option for providing safe and serviceable access across Mowbray River, giving due consideration to current and future requirements and stakeholder input.

Diggers Bridge, Mowbray River
State the Decision

Ask:

What do we need to decide?
What is the appropriate decision level?
Do we have the correct people in the room to make the decision???

List what we want to decide on
Crossing Type (Bridge / Culvert)
Crossing Alignment (Current or modified)
Crossing Width & Configuration (Number of lanes and for vehicles and or pedestrians/ bikes etc.)
Define appropriate immunity level for crossing
Define appropriate design load requirement for crossing
Determine if any approach / road alignment modifications are required or justified
Determine likely extent of vegetation removal

Statement describing intended result of the decision:

Write a concise statement of the decision required
To determine the best option to provide safe and serviceable access across the Mowbray River at Diggers Bridge Crossing site..

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Project Name:

Diggers Bridge, Mowbray River
Develop Objectives and Classify into MUSTS and WANTS
Objectives (Selection Criteria)

MUST

Provide safe access across Mowbray River Crossing
Provide serviceable access across Mowbray River Crossing
Cater for current and future needs (loadings and capacity)

WANTS

Value for Money
Ensure integrity of the economically important link of Crossing to DSC (Quarry, Tourism facilities, Community Facilities - Bump Track)
Maximise opportunities for local business (through construction & operational phases)
Minimise capital costs (Low CAPEX)
Minimise ongoing maintenance costs (Low OPEX)
Maximise the use of local resources
Minimise adverse social impacts
Minimise political impacts
Minimise adverse environmental impacts - Vegetation
Minimise adverse environmental impacts - Waterway
Minimise cultural heritage environmental impacts - Preservation of Heritage of original Diggers Bridge Crossing site.
Minimise construction risk
Maximise Funding Opportunity
Consider stakeholder requirements

Trinity Engineering and Consulting

Project Name:

Diggers Bridge, Mowbray River

GENERATE OPTIONS AND ASSESS RELATIVE RISK FOR HIGH ORDER CONSIDERATIONS

PRELIMINARY OPTIONS ASSESSMENT

Decision Criteria

Crossing Type	Repair Current	Condition assessment (Poor) Structural inadequacies. Certification of existing structure not possible. Repair costs are expected to be greater than replacement costs due to age and state of existing crossing.
	Bridge	Bridge replacement, associated with higher construction costs (more specialised construction techniques) and ongoing inspection and operational costs.
	Culvert	Culvert crossing : Cheaper and simpler construction and ongoing maintenance costs - when compared to bridge
	Recommendation	**Consider alternative culvert structure in lieu of new bridge structure**
Crossing Alignment	Current	Replace the existing crossing with another at the same location as the current bridge structure.
	Skewed	Realign the bridge northern side of the crossing east, reducing the approach/exit angle and improving sight distance. Major vegetation removal (raintrees) will be required. Re-alignment of the bridge to the west of the existing alignment would shorten the bridge length (and potentially reduce cost) however, would also require significant vegetation removal, and may impact/ encroach on the original alignment of "Diggers" crossing - which is socially sensitive .
	Move Crossing	Construct the new crossing to the west of the existing bridge, maintaining the bridge for pedestrian purposes
	Recommendation	**Cost recommendation - Maintain Current.** **Safety Recommendation - Move crossing west, allowing existing bridge to be used for pedestrians.**
Crossing Width	Single Lane (4.2m)	Inadequate safety pedestrian safety for current level of moderate - high use of non-vehicular transport associated with the crossing.
	Single Lane & path (6.5m)	Current design, giveway required traffic conditions support a One Lane vehicle crossing and separate shared path
	Dual Lanes (7.5m)	Higher costs, pedestrians will require to share the bridge with vehicles, tendency will be for vehicles to use both lanes increasing risk to cyclists and pedestrians. Signage will be required to manage ("No passing or overtaking on the Bridge" or "Give way")
	Dual Lanes & path (9.5m)	Higher costs. Safest crossing, additional clearing of vegetation may be required. Geometry (and capacity) of the crossing is well in excess of the network servicing the bridge and is expected to be so for the full design life of the crossing.
	Recommendation	**Single Lane & path (6.5m)**
Flood Immunity (Crossing level)	Maintain Current Level	Current immunity of the crossing level is approximately a 2 year ARI event
	Higher	Higher immunity for the crossing will require the surrounding roads to be increased in height, doing this will restrict the overland and flooding flow and will likely cause a "worsening" of flooding on upstream properties. Expected legal and compensation claims. Limited additional benefit expected by raising the crossing if the surrounding roads connecting to the crossing are not at the same or greater immunity level.
	Lower	Lower immunity provides a lower level of service and will cause the crossing to flood more often. Not recommended
	Recommendation	**Maintain current Flood immunity level for new Crossing**
Design Load	Current	Load limit of 20 tonnes
	T44	Current design standard loading for Council Controlled Bridges
	SM1600	Current design standard loading for State Controlled Bridges (Higher Load Rating)
	Recommendation	**SM1600: Loading type was selected instead of Load Type T44, as it provides higher load rating support for the quarry vehicles (mobile crushing plant - which will be required for any road reconstruction works in DSC - LGA (i.e. A strategically high value / important infrastructure /material source for DSC). The price difference between each load type is approximately than 5%-15%**
Road Alignment	Current	Keep the current road alignment - which has deficiencies in sight distance(s), horizontal geometry and safety
	Modify	Modify the Northern approach into the crossing to extend into the existing farm land (within Council's road reserve), and then increased the radius (reduce the curvature) of the approach to align with the crossing of the bridge. This will increase the sight distance and safety for traffic from the Northern side. On the Southern side - provide give way signage and linemarking to vehicles heading North-East, Increased the pavement width at this point to provide greater passing opportunities and safety for vehicles passing stationary vehicles.
	Recommendation	**Modify the approaches to the crossing to improve sight distances, safety and passing opportunities.**
Vegetation Removal	Minor	Minor clearing or vegetation removal. Required as a consequence of modifications to the road approaches or to improve sight distance(s)
	Major	Removal of the rainforest trees located on the eastern side of the crossing. Tree removal may destabilise the bank and require rock armouring or protection, with associated increase in costs. It is expected that there would be significant resistance from social, and environmental groups as well as the surrounding community (and high value property owners) who have become accustomed to the existing level of service and amenity. There are political and reputational risks associated with removal of the large rainforest trees in particular
	Recommendation	**Minor - reducing the removal of major vegetation**

Cost Estimates will be based off a single lane culvert structure with no path (Option 3) as base case X. All other options will have a multiplication factor associated with the cost increase in comparison to the base number (Preliminary Option 3 - Single lane, no path).

Trinity Engineering and Consulting

Project Name:

Diggers Bridge, Mowbray River

GENERATE OPTIONS AND ASSESS RELATIVE RISK FOR HIGH ORDER CONSIDERATIONS

PRELIMINARY OPTIONS ASSESSMENT

Preliminary Options Assessment

	Options	Option Criteria Breakdown							Risks							Order of Costs	Conclusion	Comments
		Design Load	Crossing Width	Crossing Type	Flood Immunity	Vegetation Removal	Crossing Alignment	Road Alignment	Costs	Safety	Construction Timeframe	Resources	Cultural	Environmental	Engineering			
1	Do Nothing	Current	Single Lane & path	Current	Current	Minor	Current	Current	L	H	L	L	L	L	H	$0	Out	Inadequate safety (Civil): current sight distances on approaches are not compliant; Inadequate safety (Structural): Bridge assessment report notes that all existing sub-structure elements (piers) are currently cracked; current dimensions of bridge girders are compromised - no certification of the substructure possible Serviceability: Current levels of serviceability do not meet current design standards (Bridge Code: AS 5100) Costs: Expected increase of inspection, maintenance and rehabilitation costs with existing structure Design of Life of bridge: Bridge requires replacement - (very short term - noted as one of the top four bridges in the worst condition in DSC) Current Needs: (Capacity): Satisfactory Future Needs : Does not adequately cater for increased traffic volumes or loadings for the design life of the bridge (i.e. will not meet future requirements) --- DO NOT CONSIDER FURTHER ---
2	Refurbish existing bridge deck - Sub-structure (piers) to remain	Current	Single Lane & path	Repair Current	Current	Minor	Current	Current	M	H	M	M	L	L	H	0.6X	Out	Inadequate safety (Civil): current sight distances on approaches not compliant, Inadequate safety (Structural): Bridge assessment report notes that all existing sub-structure elements (piers) are currently cracked; current dimensions of bridge girders are compromised - no certification of the substructure possible Serviceability: Current levels of serviceability do not meet current design standards (Bridge Code: AS 5100) Costs: Expected increase of inspection, maintenance and rehabilitation costs with existing structure Design of Life of bridge: (Only Design life of bridge deck would be extended withe replacement of Bridge deck: Substructure will still require replacement - (very short term - noted as one of the top four bridges in the worst condition in DSC) Current Needs: (Capacity): Satisfactory Future Needs : Does not adequately cater for increased traffic volumes or loadings for the design life of the bridge (i.e. will not meet future requirements) --- DO NOT CONSIDER FURTHER ---
3	Single Lane Box Culvert Structure - No Path	SM1600	Single Lane	Culvert	Current	Major	Current	Current	L	H	M	M	L	H	M	X (Estimated as approximately $1,000,000)	Out	Lowest Cost Inadequate safety (Civil): current sight distances on approaches not compliant, Safety (Structural): Complies : To be designed and constructed to current standards Serviceability: (Deflection) Complies : To be designed and constructed to current standards Current Needs: (Capacity): Satisfactory Future Needs: Does not adequately cater for multi-modal traffic (pedestrians/ bicycles) for the design life of the bridge (i.e. will not meet current or future legislative requirements) --- DO NOT CONSIDER FURTHER ---
4	New single lane bridge structure, with shared path	SM1600	Single Lane & path	Bridge	Current	Minor	Current	Current	H	L	H	H	M	M	H	2.5X	Out	High Costs with little benefit Inadequate safety (Civil): current sight distances on approaches not compliant, Safety (Structural): Complies. To be designed and constructed to current standards Serviceability: (Deflection) Complies: To be designed and constructed to current standards Current Needs: (Capacity): Satisfactory Future Needs : Does not adequately cater for increased traffic volumes or loadings for the design life of the bridge (i.e. will not meet future requirements) --- DO NOT CONSIDER ANY FURTHER ---
4	Single Lane Box Culvert Structure with shared path, Current Alignment - remove trees/ vegetation for sight lines	SM1600	Single Lane & path	Culvert	Current	Major	Current	Current	L	H	M	M	L	H	M	1.4X	Out	Low Cost Inadequate safety (Civil): Current sight distances on approaches not compliant, Removal of large mature trees and reduction of speed limits for bridge crossing may provide sight distance requirements, but geometric constraints on North-Eastern End remain, Critical and ongoing maintenance obligations created with the removal of the mature trees. Potential bank destabilisation due to removal of tree/root system. Armouring of bank to protect against scour may be required. Safety (Structural): Complies. To be designed and constructed to current standards Serviceability: (Deflection) Complies. To be designed and constructed to current standards Current Needs: (Capacity): Satisfactory Future Needs : Adequately caters for multi-modal traffic (pedestrians/ bicycles) for the design life of the bridge High Risks associated with Safety (Ongoing vegetation management), Bank Stability and Erosion Issues, Social and Political Impacts (Vegetation removal) --- DO NOT CONSIDER ANY FURTHER ---
5	Single Lane Box Culvert Structure with shared path, modification of approach road alignments	SM1600	Single Lane & path	Culvert	Current	Minor	Current	Extend	M	L	M	M	L	M	M	1.5X	Investigate	Moderate Cost Safety (Civil): current sight distances on approaches not compliant, modifications to the alignment of the approaches may improve the geometry and safety of the road and crossing, while also obviating the removal of vegetation due to maintenance of existing crossing alignment. Safety (Structural): Complies : To be designed and constructed to current standards Serviceability: (Deflection) Complies : To be designed and constructed to current standards Current Needs: (Capacity): Satisfactory Future Needs : Adequately caters for multi-modal traffic (pedestrians/ bicycles) for the design life of the bridge --- DETAILED OPTION ASSESSMENT RECOMMENDED ---

Trinity Engineering and Consulting

Project Name:

Diggers Bridge, Mowbray River

GENERATE OPTIONS AND ASSESS RELATIVE RISK FOR HIGH ORDER CONSIDERATIONS

PRELIMINARY OPTIONS ASSESSMENT

		Option Criteria Breakdown							Risks									
	Options	Design Load	Crossing Width	Crossing Type	Flood Immunity	Vegetation Removal	Crossing Alignment	Road Alignment	Costs	Safety	Construction Timeframe	Resources	Cultural	Environmental	Engineering	Cost Estimate	Conclusion	Comments
6	Single Lane Box Culvert Structure with shared path, skewed crossing alignment	SM1600	Single Lane & path	Culvert	Current	Major	Skewed	Current	M	M	M	M	M	H	M	1.6X	Investigate	Significant Benefits : As per Option 6 ; although Increased Risks over Option 6 : Includes (environmental, social, political, reputational) associated with the re-alignment of the crossing structure. In particular the removal of the mature raintrees and potential bank instability are considered high risk options. --- DETAILED OPTION ASSESSMENT RECOMMENDED ---
7	Single Lane Box Culvert Structure with shared path, change crossing alignment and modify approach road alignments	SM1600	Single Lane & path	Culvert	Current	Major	Current	Extend	M	L	M	M	M	H	M	1.8X	Investigate	Significant Benefits : As per Option 6, although modifying the road approaches are expected to improve the safety and serviceability. Increased Risks over Option 6 : Includes (environmental, social, political, reputational) associated with the re-alignment of the crossing structure. In particular the removal of the mature raintrees and potential bank instability are considered high risk options. --- DETAILED OPTION ASSESSMENT RECOMMENDED ---
8	Single lane box culverts structure with higher flood immunity, with Shared Path, modify approach road alignments	SM1600	Single Lane & path	Culvert	Higher	Minor	Current	Extend	H	M	M	M	M	M	M	2.0X	Investigate	As per Option 8, however increased immunity level of the bridges and approaches is expected to restrict overland flow and flooding - causing a "worsening" of conditions / impacts on the upstream properties. This may lead to unacceptable litigation and compensation risks. --- DETAILED OPTION ASSESSMENT RECOMMENDED ---
9	Dual Lane Box Culvert Structure	SM1600	Dual Lanes	Culvert	Current	Minor	Current	Current	H	H	M	M	L	M	M	1.7X	Out	Higher Cost Inadequate safety (Civil): current sight distances on approaches not compliant. Safety (Structural): Complies: To be designed and constructed to current standards. Serviceability: (Deflection) Complies: To be designed and constructed to current standards. Current Needs: (Capacity): Satisfactory. Future Needs : Adequately caters for multi-modal traffic (pedestrians/ bicycles) however - the non-vehicular traffic will be required to share the bridge with vehicles. The tendency will be for vehicles to use both lanes increasing risk to non-vehicles (pedestrians/ bikes) at higher speeds due to the favourable (wider) crossing geometry --- DO NOT CONSIDER ANY FURTHER ---
10	Dual Lane Box Culvert Structure, skewed crossing alignment	SM1600	Dual Lanes	Culvert	Current	Major	Skewed	Current	H	M	M	M	M	H	M	1.9X	Out	As per Item 10, but on an alternative alignment (which is expected to be more expensive (+40% or more), has increased levels of environmental, social and community concerns, as well as elevated political and reputational risk) --- DO NOT CONSIDER ANY FURTHER ---
11	Dual Lane Box Culvert Structure, modify approach road alignments	SM1600	Dual Lanes	Culvert	Current	Minor	Current	Extend	H	M	M	M	L	M	M	2.0X	Investigate	Safe & Serviceable Design Higher Cost Option Risks - Similar to Item 10 - which excludes the identified risks of changing the crossing alignment (environmental, community, social, political, reputational) This is likely to be the solution for this section of the network in its "ultimate" configuration. This may be considered appropriate into the future, when the traffic network servicing the link is upgraded to the same capacity / level of service. This is not expected to occur until after the design life of the current structure. Due to reduced risk profile - may consider this option in the detailed options assessment for comparison. --- DETAILED OPTION ASSESSMENT RECOMMENDED ---
12	Dual Lane Box Culvert Structure, with shared path, skewed crossing alignment	SM1600	Dual Lanes & path	Culvert	Current	Major	Skewed	Current	H	M	M	M	M	H	M	2.2X	Out	Safe & Serviceable Design Higher Cost Option Risks - Similar to Item 11 - which are mostly associated with the re-alignment of the crossing. The proposed geometry of the crossing is likely the solution for the "ultimate" configuration. This may be considered appropriate into the future, when the traffic network servicing the link is upgraded to the same capacity / level of service. This is not expected to occur until after the design life of the current structure. On this basis this option is not considered a cost effective or appropriate solution. --- DO NOT CONSIDER ANY FURTHER ---
13	Dual Lane Box Culvert Structure, modify approach road alignment, crossing moved to the west and existing bridge maintained	SM1600	Single Lane (4.2m)	Culvert	Current	Minor	Move Crossing	Modify	H	L	M	M	M	M	M	1.9X	Investigate	High Cost Safety (Civil): High safety, maintaining existing bridge for pedestrians requirements. Dual lane crossing, no giveway required Safety (Structural): Complies : To be designed and constructed to current standards Serviceability: (Deflection) Complies : To be designed and constructed to current standards Current Needs: (Capacity): Satisfactory Future Needs : Caters for multi-modal traffic (pedestrians/ bicycles) for the design life of the bridge --- DETAILED OPTION ASSESSMENT RECOMMENDED ---

Trinity Engineering and Consulting

Project Name:

Diggers Bridge, Mowbray River

How important is the ROW compared to the COLUMN?

↑↑ Much More Important
↑ More Important
↔ Equally Important
↓ Less Important
↓↓ Much Less Important

WANTS Decision Matrix

WANTS (to compare against)

WANTS (How important are these compared to the columns?)

		1	2	3	4	5	6	7	8	9	10	11	12	13
		Value for Money	Ensure integrity of the economically important link of Crossing to DSC (Quarry, Tourism facilities, Community Facilities - Bump Track)	Maximise opportunities for local business (through construction & operational phases)	Minimise capital costs (Low CAPEX)	Minimise ongoing maintenance costs (Low OPEX)	Maximise the use of local resources	Minimise adverse social impacts	Minimise political impacts	Minimise adverse environmental impacts - Vegetation	Minimise adverse environmental impacts - Waterway	Minimise cultural heritage environmental impacts - Preservation of Heritage of original Diggers Bridge Crossing site.	Minimise construction risk	Maximise Funding Opportunity
1	Value for Money	↔	↓	↔	↑	↑	↑↑	↑	↑	↑	↑	↑	↑	↔
2	Ensure integrity of the economically important link of Crossing to DSC (Quarry, Tourism facilities, Community Facilities - Bump Track)	↑	↔	↑	↑↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
3	Maximise opportunities for local business (through construction & operational phases)	↔	↓	↔	↓	↔	↓	↓	↑	↓	↓	↓	↓	↓
4	Minimise capital costs (Low CAPEX)	↓	↓↓	↑	↔	↓	↑	↔	↓	↓	↓	↓	↓	↓
5	Minimise ongoing maintenance costs (Low OPEX)	↓	↓	↔	↑	↔	↑	↑	↑	↔	↓	↑	↔	↓
6	Maximise the use of local resources	↓↓	↓	↑	↓	↓	↔	↓	↔	↔	↔	↔	↓	↓
7	Minimise adverse social impacts	↓	↓	↑	↔	↓	↑	↔	↔	↔	↔	↔	↓	↓
8	Minimise political impacts	↓	↓	↓	↑	↓	↔	↔	↔	↔	↔	↔	↓	↓
9	Minimise adverse environmental impacts - Vegetation	↓	↓	↑	↑	↔	↔	↔	↔	↔	↔	↔	↓	↓
10	Minimise adverse environmental impacts - Waterway	↓	↓	↑	↑	↑	↔	↔	↔	↔	↔	↔	↓	↓
11	Minimise cultural heritage environmental impacts - Preservation of Heritage of original Diggers Bridge Crossing site.	↓	↓	↑	↑	↓	↔	↔	↔	↔	↔	↔	↓	↓
12	Minimise construction risk	↓	↓	↑	↑	↔	↑	↑	↑	↑	↑	↑	↔	↓
13	Maximise Funding Opportunity	↔	↓	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↔

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Project Name:

Diggers Bridge, Mowbray River
Detailed Options Assessment
What are the available options?

List up to 5 Options Comment if required.

Option 1 - Single Lane Box Culvert Structure with shared path, modification of approach road alignments
Option 2 - Single Lane Box Culvert Structure with shared path, skewed crossing alignment
Option 3 - Single Lane Box Culvert Structure with shared path, change crossing alignment and modify approach road alignments
Option 4 - Single lane box culverts structure with higher flood immunity, with Shared Path, modify approach road alignments
Option 5 - Dual Lane Box Culvert Structure, modify approach road alignments
Option 6 - Dual Lane Box Culvert Structure, modify approach road alignment, crossing moved to the west and existing bridge maintained

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Project Name:

Diggers Bridge, Mowbray River

WANTS Scoring by Participants

As a group or individually, score each WANT in comparison to the Alternatives.
Low to High, only available scores are: 0, 3, 5, 7, 10

		Participant Name	Rudd Rankine						Daniel Reitano					
		Alternative	Option 1 - Single Lane Box Culvert Structure with shared path, modification of approach road alignments	Option 2 - Single Lane Box Culvert Structure with shared path, skewed crossing alignment	Option 3 - Single Lane Box Culvert Structure with shared path, change crossing alignment and modify approach road alignments	Option 4 - Single lane box culverts structure with higher flood immunity, with Shared Path, modify approach road alignments	Option 5 - Dual Lane Box Culvert Structure, modify approach road alignments	Option 6 - Dual Lane Box Culvert Structure, modify approach road alignment, crossing moved to the west and existing bridge maintained	Option 1 - Single Lane Box Culvert Structure with shared path, modification of approach road alignments	Option 2 - Single Lane Box Culvert Structure with shared path, skewed crossing alignment	Option 3 - Single Lane Box Culvert Structure with shared path, change crossing alignment and modify approach road alignments	Option 4 - Single lane box culverts structure with higher flood immunity, with Shared Path, modify approach road alignments	Option 5 - Dual Lane Box Culvert Structure, modify approach road alignments	Option 6 - Dual Lane Box Culvert Structure, modify approach road alignment, crossing moved to the west and existing bridge maintained
WANTS (How important are these compared to the columns?)	1	Value for Money	10	7	5	3	5	7	10	7	5	3	7	7
	2	Ensure integrity of the economically important link of Crossing to DSC (Quarry, Tourism facilities, Community Facilities - Bump Track)	7	7	7	7	7	10	7	7	7	7	10	10
	3	Maximise opportunities for local business (through construction & operational phases)	7	5	5	5	7	7	7	5	7	10	7	7
	4	Minimise capital costs (Low CAPEX)	10	5	3	3	3	7	10	7	3	0	5	5
	5	Minimise ongoing maintenance costs (Low OPEX)	7	5	5	3	5	5	5	5	5	5	5	5
	6	Maximise the use of local resources	5	5	5	5	5	5	5	5	7	10	5	5
	7	Minimise adverse social impacts	7	5	5	5	7	10	7	3	0	3	5	10
	8	Minimise political impacts	7	5	7	5	5	7	7	5	5	3	7	7
	9	Minimise adverse environmental impacts - Vegetation	7	3	3	3	7	5	7	3	3	5	5	5
	10	Minimise adverse environmental impacts - Waterway	5	5	5	5	5	5	5	5	5	5	5	5
	11	Minimise cultural heritage environmental impacts - Preservation of Heritage of original Diggers Bridge Crossing site.	7	5	5	5	7	7	5	5	5	5	5	5
	12	Minimise construction risk	7	5	5	7	7	7	7	5	3	3	7	5
	13	Maximise Funding Opportunity	10	5	5	3	7	7	7	5	5	3	7	7
	14	Consider stakeholder requirements	5	5	5	5	5	7	7	3	3	3	7	7
	15													
	16													

Diggers Bridge, Mowbray River

WANTS Scoring by Participants

As a group or individually, score each WANT in comparison to the Alternatives.
Low to High, only available scores are: 0, 3, 5, 7, 10

		Average					
		Option 1 - Single Lane Box Culvert Structure with shared path, modification of approach road alignments	Option 2 - Single Lane Box Culvert Structure with shared path, skewed crossing alignment	Option 3 - Single Lane Box Culvert Structure with shared path, change crossing alignment and modify approach road alignments	Option 4 - Single lane box culverts structure with higher flood immunity, with Shared Path, modify approach road alignments	Option 5 - Dual Lane Box Culvert Structure, modify approach road alignments	Option 6 - Dual Lane Box Culvert Structure, modify approach road alignment, crossing moved to the west and existing bridge maintained
	1	10.0	7.0	5.0	3.0	6.0	7.0
	2	7.0	7.0	7.0	7.0	8.5	10.0
	3	7.0	5.0	6.0	7.5	7.0	7.0
	4	10.0	6.0	3.0	1.5	4.0	6.0
	5	6.0	5.0	5.0	4.0	5.0	5.0
	6	5.0	5.0	6.0	7.5	5.0	5.0
	7	7.0	4.0	2.5	4.0	6.0	10.0
	8	7.0	5.0	6.0	4.0	6.0	7.0
	9	7.0	3.0	3.0	4.0	6.0	5.0
	10	5.0	5.0	5.0	5.0	5.0	5.0
	11	6.0	5.0	5.0	5.0	6.0	6.0
	12	7.0	5.0	4.0	5.0	7.0	6.0
	13	8.5	5.0	5.0	3.0	7.0	7.0
	14	6.0	4.0	4.0	4.0	6.0	7.0
	15						
	16						

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Project Name:

Diggers Bridge, Mowbray River

Assess Risks

To understand the risk of chosing an alternative:

Develop adverse consequences
What could go wrong, in both the short and long term?
Are we close to any MUST limit?
What are the disadvantages with this alternative?
Is any information vague or uncertain? What are the implications?

Assess the Threat
How likely is adverse consequence? (probability)
What impact will this adverse consequence have? (seriousness)

Operations and Project Risk Matrices		Hazard Effect / Consequence (Where an event has more than one 'Loss Type', choose the 'Consequence' with the highest rating)				
Loss Type (Additional 'Loss Types' may exist for an event; identify & rate accordingly)		**1 Insignificant**	**2 Minor**	**3 Moderate**	**4 High**	**5 Major**
Harm to People (Safety / Health)		First aid case / Exposure to minor health risk	Medical treatment case / Exposure to major health risk	Lost time injury / Reversible impact on health	Single fatality or loss of quality of life / Irreversible impact on health	Multiple fatalities / Impact on health ultimately fatal
Environmental Impact		Minimal environmental harm – L1 incident	Material environmental harm – L2 incident remediable short term	Serious environmental harm – L2 incident remediable within LOM	Major environmental harm – L2 incident remediable post LOM	Extreme environmental harm – L3 incident irreversible
Business Interruption / Material Damage & Other Consequential Losses		No disruption to operation - 5% loss of budgeted operating profit	Brief disruption to operation - 10% loss of budgeted operating profit / listed assets	Partial shutdown - 15% loss of budgeted operating profit / listed assets	Partial loss of operation - 20% loss of budgeted operating profit / listed assets	Substantial or total loss of operation - 25% of loss budgeted operating profit / listed assets
Legal & Regulatory		Low level legal issue	Minor legal issue; non compliance and breaches of the law	Serious breach of law; investigation / report to authority, prosecution and / or moderate penalty	Major breach of the law; considerable prosecution and penalties	Very considerable penalties & prosecutions. Multiple law suits & jail terms
Schedule / Timeline		Less than 1% impact on overall project timeline	May result in overall project timeline overrun equal to or more than 1% and less than 5%	May result in overall project timeline overrun equal to or more than 5% and less than 20%	May result in overall project timeline overrun equal to or more than 20% and less than 50%	May result in overall project timeline overrun of 50% or more
Cost / Budget		Less than 1% impact on overall project budget	May result in overall project budget overrun equal to or more than 1% and less than 5%	May result in overall project budget overrun equal to or more than 5% and less than 20%	May result in overall project budget overrun equal to or more than 20% and less than 50%	May result in overall project budget overrun of 50% or more
Quality of Deliverables		No significant impact on quality of deliverables	Quality issues that can be addressed prior to handover	Quality issues that can be addressed during initial use	Quality issues that require significant intervention / Steering Comm intervention	Quality issues that require significant intervention to achieve performance
Impact on Reputation / Social / Community		Slight impact - public awareness may exist but no public concern	Limited impact - local public concern	Considerable impact - regional public concern	National impact - national public concern	International impact - international public attention
Likelihood		**Risk Rating**				
5 (Almost Certain)	The unwanted event has occurred frequently;occurs in order of one or more times per year & is likely to reoccur within 1 year 90% and higher probability of occurring	**11 (M)**	**16 (S)**	**20 (S)**	**23 (H)**	**25 (H)**
4 (Likely)	The unwanted event has occurred infrequently;occurs in order of less than once per year & is likely to reoccur within 5 years Between 60% and 90% of occurring	**7 (M)**	**12 (M)**	**17 (S)**	**21 (H)**	**24 (H)**
3 (Possible)	The unwanted event has happened in the business at some time; or could happen within 10 years Between 30% and 60% of occurring	**4 (L)**	**8 (M)**	**13 (S)**	**18 (S)**	**22 (H)**
2 (Unlikely)	The unwanted event has happened in the business at some time; or could happen within 20 years Between 1% and 30% of occurring	**2 (L)**	**5 (L)**	**9 (M)**	**14 (S)**	**19 (S)**
1 (Rare)	The unwanted event has never been known to occur in the business; or it is highly unlikely that it will occur within 20 years Less than 1% of occurring	**1 (L)**	**3 (L)**	**6 (M)**	**10 (M)**	**15 (S)**

Risk Rating	Risk Level	Guidelines for Risk Matrix
21 to 25	**(H) – High**	A high risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised immediately.
13 to 20	**(S) – Significant**	A significant risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as soon as possible.
6 to 12	**(M) – Medium**	A moderate risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as part of the normal management process.
1 to 5	**(L) – Low**	A low risk exists that management's objectives may not be achieved. Monitor risk, no further mitigation required.

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Diggers Bridge, Mowbray River

Assessment of Risks

Option 1 **Option 1 - Single Lane Box Culvert Structure with shared path, modification of approach road alignments**			
Risk	**Consequence**	**Likelihood**	**Rating**
Harm to People (Safety / Health)	5 (Major)	1 (Rare)	15 (S)
Environmental Impact	2 (Minor)	2 (Unlikely)	5 (L)
Damage & Other Consequential	3 (Moderate)	2 (Unlikely)	9 (M)
Legal & Regulatory	2 (Minor)	1 (Rare)	3 (L)
Schedule / Timeline	4 (High)	2 (Unlikely)	14 (S)
Cost / Budget	4 (High)	2 (Unlikely)	14 (S)
Quality of Deliverables	4 (High)	2 (Unlikely)	14 (S)
Impact on Reputation / Social / Community	3 (Moderate)	2 (Unlikely)	9 (M)
Overall Risk			15 (S)
What are the positives?			
Simple design & construction			
Existing availability of local resources (plant, materials, labour)			
Opportunity for local employment and training opportunities			
Majority of existing vegetation able to be maintained			
Additional sight distance for approaching traffic			

Option 2 **Option 2 - Single Lane Box Culvert Structure with shared path, skewed crossing alignment**			
Risk	**Consequence**	**Likelihood**	**Rating**
Harm to People (Safety / Health)	5 (Major)	1 (Rare)	15 (S)
Environmental Impact	2 (Minor)	5 (Almost Certain)	16 (S)
Damage & Other Consequential	3 (Moderate)	1 (Rare)	6 (M)
Legal & Regulatory	2 (Minor)	2 (Unlikely)	5 (L)
Schedule / Timeline	4 (High)	2 (Unlikely)	14 (S)
Cost / Budget	4 (High)	3 (Possible)	18 (S)
Quality of Deliverables	4 (High)	3 (Possible)	18 (S)
Impact on Reputation / Social / Community	3 (Moderate)	5 (Almost Certain)	20 (S)
Overall Risk			20 (S)
What are the positives?			
Simple design & construction			
Existing availability of local resources (plant, materials, labour)			
Opportunity for local employment and training opportunities			
Straighter road alignment			

Option 3 **Option 3 - Single Lane Box Culvert Structure with shared path, change crossing alignment and modify approach road alignments**			
Risk	**Consequence**	**Likelihood**	**Rating**
Harm to People (Safety / Health)	5 (Major)	1 (Rare)	15 (S)
Environmental Impact	2 (Minor)	4 (Likely)	12 (M)
Damage & Other Consequential	3 (Moderate)	1 (Rare)	6 (M)
Legal & Regulatory	2 (Minor)	2 (Unlikely)	5 (L)
Schedule / Timeline	4 (High)	3 (Possible)	18 (S)
Cost / Budget	4 (High)	4 (Likely)	21 (H)
Quality of Deliverables	4 (High)	3 (Possible)	18 (S)
Impact on Reputation / Social / Community	3 (Moderate)	3 (Possible)	13 (S)
Overall Risk			21 (H)
What are the positives?			
Simple design & construction			
Existing availability of local resources (plant, materials, labour)			
Opportunity for local employment and training opportunities			
Additional sight distance for approaching traffic			
Straighter road alignment			

Diggers Bridge, Mowbray River

Assessment of Risks

Option 4 **Option 4 - Single lane box culverts structure with higher flood immunity, with Shared Path, modify approach road alignments**			
Risk	**Consequence**	**Likelihood**	**Rating**
Harm to People (Safety / Health)	5 (Major)	1 (Rare)	15 (S)
Environmental Impact	2 (Minor)	4 (Likely)	12 (M)
Business Interruption / Material Damage & Other Consequential Losses	3 (Moderate)	1 (Rare)	6 (M)
Legal & Regulatory	2 (Minor)	3 (Possible)	8 (M)
Schedule / Timeline	4 (High)	4 (Likely)	21 (H)
Cost / Budget	4 (High)	4 (Likely)	21 (H)
Quality of Deliverables	4 (High)	3 (Possible)	18 (S)
Impact on Reputation / Social / Community	3 (Moderate)	3 (Possible)	13 (S)
Overall Risk			21 (H)
What are the positives?			
Existing availability of local resources (plant, materials, labour)			
Opportunity for local employment and training opportunities			
Additional sight distance for approaching traffic			
Higher flood immunity at the crossing			

Option 5 **Option 5 - Dual Lane Box Culvert Structure, modify approach road alignments**			
Risk	**Consequence**	**Likelihood**	**Rating**
Harm to People (Safety / Health)	5 (Major)	1 (Rare)	15 (S)
Environmental Impact	2 (Minor)	3 (Possible)	8 (M)
Business Interruption / Material Damage & Other Consequential Losses	3 (Moderate)	2 (Unlikely)	9 (M)
Legal & Regulatory	2 (Minor)	2 (Unlikely)	5 (L)
Schedule / Timeline	4 (High)	2 (Unlikely)	14 (S)
Cost / Budget	4 (High)	2 (Unlikely)	14 (S)
Quality of Deliverables	4 (High)	2 (Unlikely)	14 (S)
Impact on Reputation / Social / Community	3 (Moderate)	3 (Possible)	13 (S)
Overall Risk			15 (S)
What are the positives?			
Existing availability of local resources (plant, materials, labour)			
Opportunity for local employment and training opportunities			
Cater for increase in traffic			
Additional sight distance for approaching traffic			
Higher speed environment			

Option 6 **Dual Lane Box Culvert Structure, modify approach road alignment, crossing moved to the west and existing bridge maintained**			
Risk	**Consequence**	**Likelihood**	**Rating**
Harm to People (Safety / Health)	5 (Major)	1 (Rare)	15 (S)
Environmental Impact	2 (Minor)	3 (Possible)	8 (M)
Business Interruption / Material Damage & Other Consequential Losses	3 (Moderate)	2 (Unlikely)	9 (M)
Legal & Regulatory	2 (Minor)	2 (Unlikely)	5 (L)
Schedule / Timeline	4 (High)	2 (Unlikely)	14 (S)
Cost / Budget	4 (High)	2 (Unlikely)	14 (S)
Quality of Deliverables	4 (High)	2 (Unlikely)	14 (S)
Impact on Reputation / Social / Community	3 (Moderate)	2 (Unlikely)	9 (M)
Overall Risk			15 (S)
What are the positives?			
Existing availability of local resources (plant, materials, labour)			
Opportunity for local employment and training opportunities			
Cater for increase in traffic			
Additional sight distance for approaching traffic			
Higher speed environment			

Trinity Engineering and Consulting

Project Name:

Diggers Bridge, Mowbray River

Decision Matrix

		Option												Comments
		1		2		3		4		5		6		
		Option 1 - Single Lane Box Culvert Structure with shared path, modification of approach road alignments		Option 2 - Single Lane Box Culvert Structure with shared path, skewed crossing alignment		Option 3 - Single Lane Box Culvert Structure with shared path, change crossing alignment and modify approach road alignments		Option 4 - Single lane box culverts structure with higher flood immunity, with Shared Path, modify approach road alignments		Option 5 - Dual Lane Box Culvert Structure, modify approach road alignments		Option 6 - Dual Lane Box Culvert Structure, modify approach road alignment, crossing moved to the west and existing bridge maintained		
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
MUSTS (Does this alternative meet MUST)	Provide safe access across Mowbray River Crossing	✓		✓		✓		✓		✓		✓		All options currently meet this requirement Option 2 - is contingent on Management of Vegetation on each approach
	Provide serviceable access across Mowbray River Crossing	✓		✓		✓		✓		✓		✓		All options currently meet this requirement
	Cater for current and future needs (loadings and capacity)	✓		✓		✓		✓		✓		✓		Option 5 Dual Lane caters for greater future growth

		Weight	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Comments
WANTS (How do the Alternatives compare against each Want?)	Value for Money	9.3	10.0	92.6	7.0	64.8	5.0	46.3	3.0	27.8	6.0	55.5	7.0	64.8	Option 1 - Provides the most affordable option
	Ensure integrity of the economically important link of Crossing to DSC (Quarry, Tourism facilities, Community Facilities - Bump Track)	10.0	7.0	70.0	7.0	70.0	7.0	70.0	7.0	70.0	8.5	85.0	10.0	100.0	
	Maximise opportunities for local business (through construction & operational phases)	6.0	7.0	42.1	5.0	30.1	6.0	36.1	7.5	45.1	7.0	42.1	7.0	42.1	
	Minimise capital costs (Low CAPEX)	5.9	10.0	59.2	6.0	35.5	3.0	17.8	1.5	8.9	4.0	23.7	6.0	35.5	
	Minimise ongoing maintenance costs (Low OPEX)	7.7	6.0	46.1	5.0	38.4	5.0	38.4	4.0	30.7	5.0	38.4	5.0	38.4	
	Maximise the use of local resources	6.1	5.0	30.5	5.0	30.5	6.0	36.6	7.5	45.8	5.0	30.5	5.0	30.5	
	Minimise adverse social impacts	6.9	7.0	48.6	4.0	27.8	2.5	17.3	4.0	27.8	6.0	41.6	10.0	69.4	
	Minimise political impacts	6.6	7.0	46.0	5.0	32.8	6.0	39.4	4.0	26.3	6.0	39.4	7.0	46.0	
	Minimise adverse environmental impacts - Vegetation	7.1	7.0	49.9	3.0	21.4	3.0	21.4	4.0	28.5	6.0	42.7	5.0	35.6	
	Minimise adverse environmental impacts - Waterway	7.3	5.0	36.5	5.0	36.5	5.0	36.5	5.0	36.5	5.0	36.5	5.0	36.5	
	Minimise cultural heritage environmental impacts - Preservation of Heritage of original Diggers Bridge Crossing site.	6.9	6.0	41.6	5.0	34.7	5.0	34.7	5.0	34.7	6.0	41.6	6.0	41.6	
	Minimise construction risk	8.4	7.0	59.0	5.0	42.1	4.0	33.7	5.0	42.1	7.0	59.0	6.0	50.5	
	Maximise Funding Opportunity	9.2	8.5	77.9	5.0	45.8	5.0	45.8	3.0	27.5	7.0	64.2	7.0	64.2	
	Consider stakeholder requirements	7.5	6.0	45.0	4.0	30.0	4.0	30.0	4.0	30.0	6.0	45.0	7.0	52.5	
	Included Totals			**744.8**		540.4		504.0		481.6		645.2		707.6	
	Excluded Totals														

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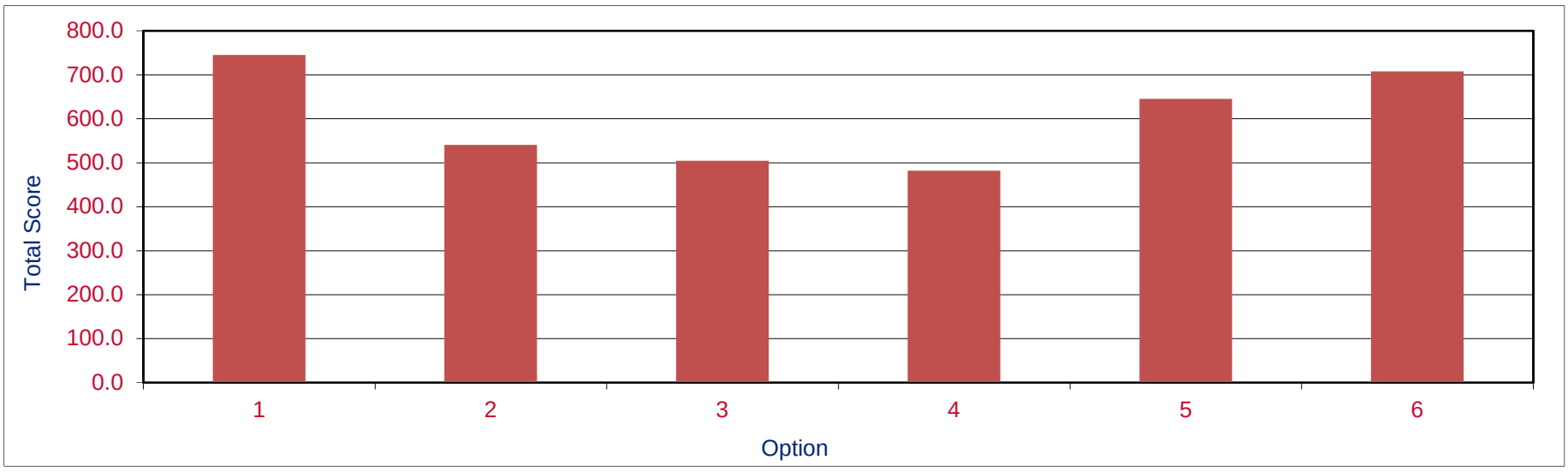
Diggers Bridge, Mowbray River

Decision & Risk Matrix Results

Options

1. Option 1 - Single Lane Box Culvert Structure with shared path, modification of approach road alignments
2. Option 2 - Single Lane Box Culvert Structure with shared path, skewed crossing alignment
3. Option 3 - Single Lane Box Culvert Structure with shared path, change crossing alignment and modify approach road alignments
4. Option 4 - Single lane box culverts structure with higher flood immunity, with Shared Path, modify approach road alignments
5. Option 5 - Dual Lane Box Culvert Structure, modify approach road alignments
6. Option 6 - Dual Lane Box Culvert Structure, modify approach road alignment, crossing moved to the west and existing bridge maintained



Risk:	15 (S)	20 (S)	21 (H)	21 (H)	15 (S)	15 (S)

	1 Insignificant	2 Minor	3 Moderate	4 High	5 Major
5 (Almost Certain)	11 (M)	16 (S)	20 (S)	23 (H)	25 (H)
4 (Likely)	7 (M)	12 (M)	17 (S)	21 (H)	24 (H)
3 (Possible)	4 (L)	8 (M)	13 (S)	18 (S)	22 (H)
2 (Unlikely)	2 (L)	5 (L)	9 (M)	14 (S)	19 (S)
1 (Rare)	1 (L)	3 (L)	6 (M)	10 (M)	15 (S)

Trinity Engineering and Consulting

Project Name:

Diggers Bridge, Mowbray River

Decision Analysis Summary

State the Decision

To determine the best option to provide safe and serviceable access across the Mowbray River at Diggers Bridge Crossing site..

Objectives

MUSTS

Provide safe access across Mowbray River Crossing
Provide serviceable access across Mowbray River Crossing
Cater for current and future needs (loadings and capacity)

WANTS

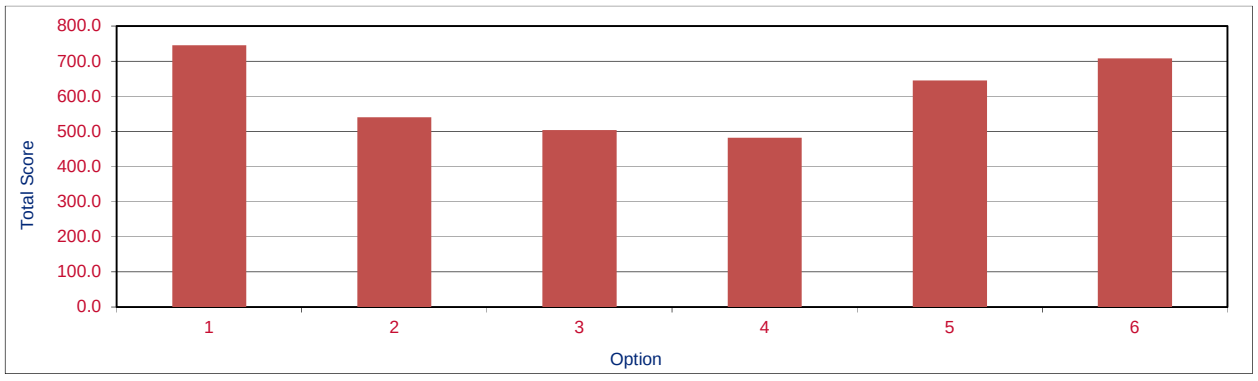
Value for Money
Ensure integrity of the economically important link of Crossing to DSC (Quarry, Tourism facilities, Community Facilities - Bump Track)
Maximise opportunities for local business (through construction & operational phases)
Minimise capital costs (Low CAPEX)
Minimise ongoing maintenance costs (Low OPEX)
Maximise the use of local resources
Minimise adverse social impacts
Minimise political impacts

From the First Pass options Assessment - the following Alternatives were considered in detail.

Alternatives

1	Option 1 - Single Lane Box Culvert Structure with shared path, modification of approach road alignments
	Alternative 1 met all MUSTS
2	Option 2 - Single Lane Box Culvert Structure with shared path, skewed crossing alignment
	Alternative 2 met all MUSTS
3	Option 3 - Single Lane Box Culvert Structure with shared path, change crossing alignment and modify approach road alignments
	Alternative 3 met all MUSTS
4	Option 4 - Single lane box culverts structure with higher flood immunity, with Shared Path, modify approach road alignments
	Alternative 4 met all MUSTS
5	Option 5 - Dual Lane Box Culvert Structure, modify approach road alignments
	Alternative 5 met all MUSTS
6	Option 6 - Dual Lane Box Culvert Structure, modify approach road alignment, crossing moved to the west and existing bridge maintained
	Alternative 6 met all MUSTS

Decision Matrix and Risk Results



Risk	15 (S)	20 (S)	21 (H)	21 (H)	15 (S)	15 (S)

Decision

Option 1 - Single Lane Box Culvert, with Shared path, extend road north
Option 6 - Dual Lane Box Culvert Structure, modify approach road alignment, crossing moved to the west and existing bridge maintained

Recommendation in regards to decision

Undertake Concept Design on RCBC designs & Costings to rationalise choice for concept designs.
Provide an indicative cost estimate for alternative bridge construction options for comparison, and to provide a basis for a change of scope form to the funding body
Seek Community consultation regarding the preferred option(s)
Seek Council's Endorsement for a preferred option(s), and undertake detailed design on the preferred option(s).
Undertaken documentation and procurement for the preferred option.
Tender Assessment & Report to be provided to Council for endorsement
Construct preferred alternative.

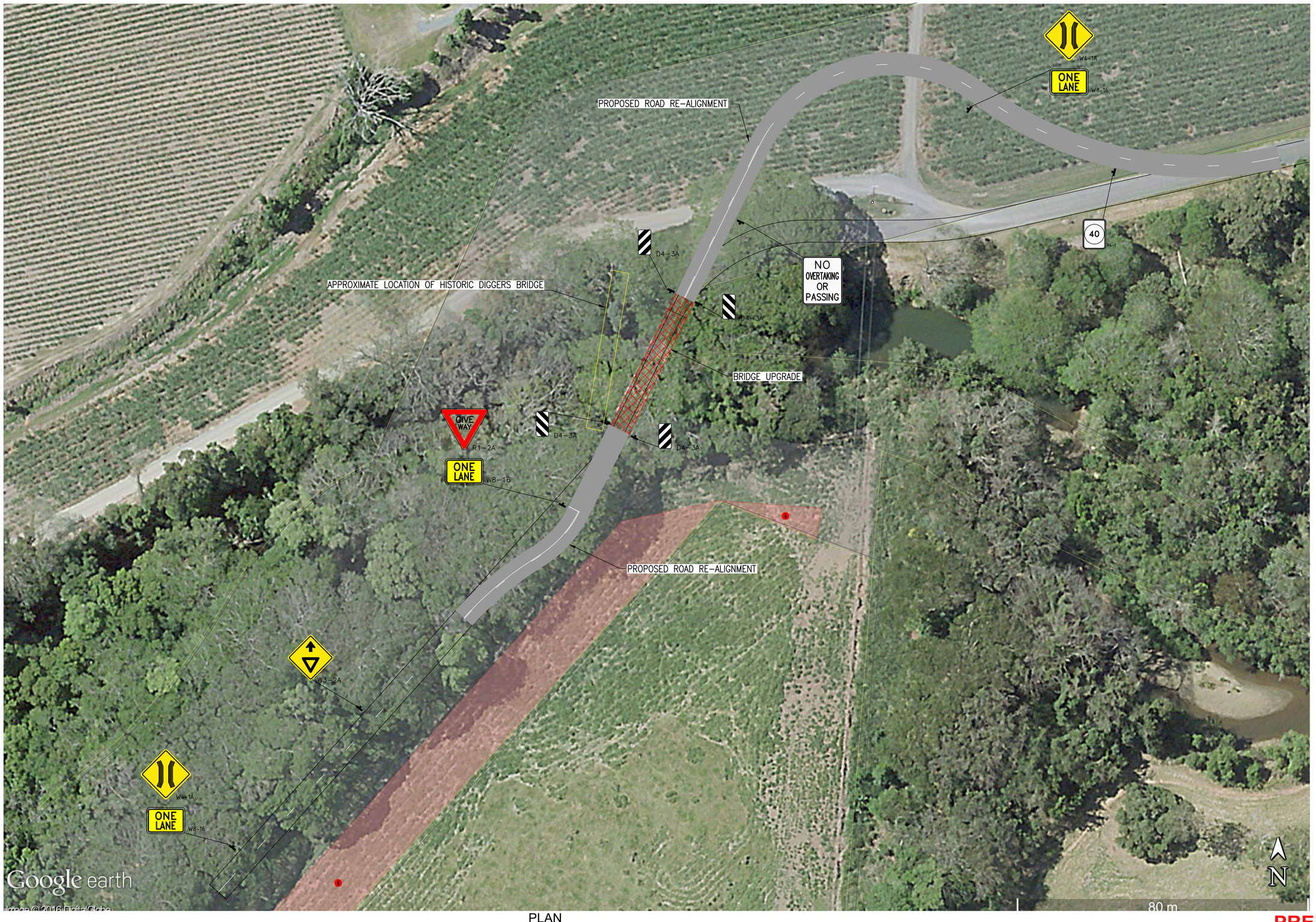
Considerations for decision

Harm to People (Safety / Health)
Environmental Impact
Business Interruption / Material Damage & Other Consequential Losses
Legal & Regulatory
Schedule / Timeline
Cost / Budget
Quality of Deliverables
Impact on Reputation / Social / Community

Enhancement for chosen alternative

Option 1 - Culvert Solutions appear to be the most appropriate solution for Mowbray River Crossing
Option 1 - appear to be the best value for money solution
Both (Option 1 and 6) provide a reasonably simple construction alternative that may be sourced using local contractors, plant, materials and equipment. This consequentially provides additional employment and training opportunities for local contractors.
Quality can be controlled by using pre-cast concrete slabs and culverts.
Logistical Issues minimised (can be transported by conventional means - road train), split into more manageable portions (vs.
Timing - Simpler construction method may speed up the delivery of the crossing and delivery of the project.
Option 6 - provides best safety alternative

APPENDIX C: Concept Sketches



PLAN
SCALE 1:500

PRELIMINARY ONLY

0 5 10 15 20 25m
SCALE 1:500 (A1 SIZE)

Trinity Engineering and Consulting

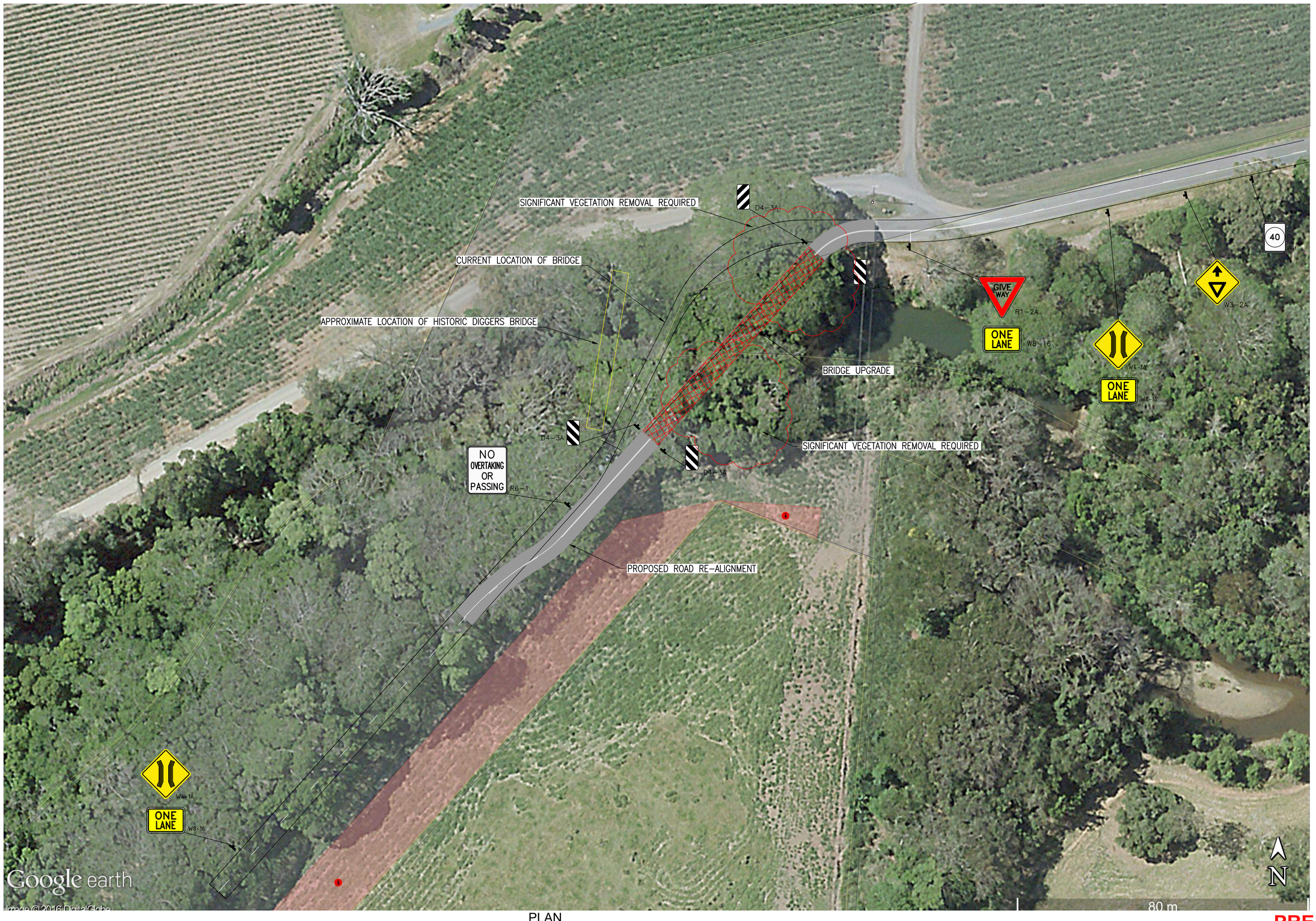
Trinity Engineering and Consulting Pty Ltd
Ph. (07) 4040 7111
www.trinityengineering.com.au

Level 1, 10 Grafton Street | PO Box 7963
Cairns QLD 4870
Email admin@trinityengineering.com.au

Client	DOUGLAS SHIRE COUNCIL
Project	DIGGERS BRIDGE UPGRADE
Title	PROPOSED BRIDGE & ROADWORKS - OPTION 1

JOB No.	Scale (A1 size)	Date	Drawing No.	Revision
1073	1:500	25 NOVEMBER 2016	SKETCH 1073-1	B

Printed: 16 December 2016, 2:31 PM
File: T:\1073 Diggers Bridge\Drawings\ 1073-SKETCH-001(B).dwg
External References: TEC-TITLE-SKETCH-A1_a.dwg



N

PLAN
SCALE 1:500

0 5 10 15 20 25m
SCALE 1:500 (A1 SIZE)

Trinity Engineering and Consulting

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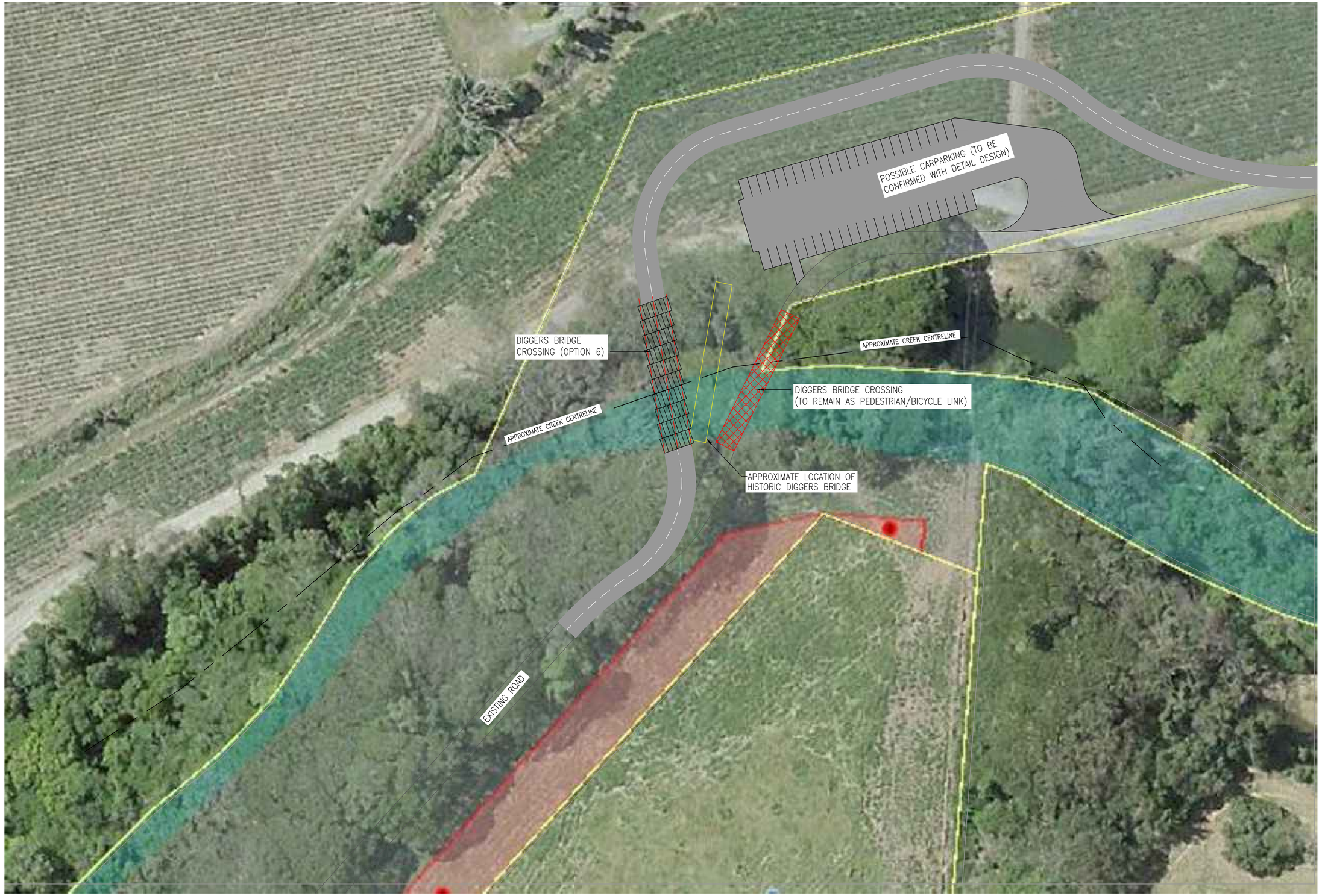
PRELIMINARY ONLY

Client	DOUGLAS SHIRE COUNCIL
Project	DIGGERS BRIDGE UPGRADE
Title	PROPOSED BRIDGE & ROADWORKS - OPTION 2

JOB No.	Scale (A1 size)	Date	Drawing No.	Revision
1073	1:500	25 NOVEMBER 2016	SKETCH 1073-2	B

Printed: 16 December 2016, 2:34 PM File: T:\1073 Diggers Bridge\Drawings\ 1073-SKETCH-002(B).dwg

External References: TEC-TITLE-SKETCH-A1_a.dwg



PLAN
SCALE 1:500

PRELIMINARY ONLY

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Client: **DOUGLAS SHIRE COUNCIL**

Project: **DIGGERS BRIDGE UPGRADE**

Title: **PROPOSED BRIDGE AND ROADWORKS - OPTION 6**

JOB No.	Scale (A1 size)	Date	Drawing No.	Revision
1073	1:500	15 DECEMBER 2016	SKETCH 1073-5	A

Printed: 15 December 2016, 12:52 PM
File: T:\1073 Diggers Bridge\Drawings\ 1073-SKETCH-005(A).dwg

External References: TEC-TITLE-SKETCH-A1_a.dwg

APPENDIX D: Approval Management Plan

Preliminary Approvals Management Plan

1.0 Introduction

There are existing constraints and operational issues associated with the existing Diggers Bridge Crossing of The Mowbray River. Condition assessment has identified that the bridge is in poor condition and Council Officers consider that it has reached the end of it useable life as a road bridge.

The Douglas Shire Council therefore wishes to replace the bridge with a vehicle crossing capable of meeting the needs of the community.

Detailed design including an option assessment phase has been commissioned by Council relating to the above matters.

It is considered that a number of statutory approvals will be required to approve the construction, use and possibly ongoing maintenance of the proposed new crossing.

2.0 Approvals required

At this phase of the project (pre-detailed site survey and geotechnical investigations) it is not possible to identify conclusively and in detail all the aspects of the proposed new crossing that will require specific statutory approvals. This is primarily because the final alignment and width of the crossing, and the associated corridor impacts are still to be finally determined.

However, noting the high environmental value of the project's location, a Preliminary Approvals Assessment was completed identifying:

- Possible statutory approval requirements;
- Possible land tenure and acquisition requirements;
- Possible Native Title and cultural heritage requirements;
- Potential approvals issues and recommendations to address;
- Undertake an evaluation of land options and landholder impacts

A summary of potential approvals is shown in the table below with some of the initial reviews and findings included as Appendix D1:

Approvals	
River Protection Permits	Not required, as work is being completed on behalf of a Local Council.
Cultural Heritage	Not affected by Cultural Heritage listing
Flora and Fauna	A flora and fauna expert may be required to determine whether any plants or animals are protected within the area.
Declared Fish Habitat	Diggers Bridge is not located within the declared fish habitat area.
Native Title	Current within the Yirrganydji (Irukandji) People #2 Native Title Area. Discussions required with the representative of the Yirrganydji (Irukandji) People #2.
Vegetation Clearing	If clearing more than 5,000 square metres approval is required from the state. May be required to be lodged with the Local Council.
Operational Works	Operational Works application is required to be lodged.
Water Barrier Works	Forms (IDAS 27) required to be submitted with Operational Works Application which will be referred to the State
Taking or interfering with water in a watercourse	Submitted with Operational Works Application and will be referred to the State.

Appendix D: Table 1

3.0 Approval Requirements

Based on the above information the preliminary approval review indicates that:

1. An Operational Works approval for vegetation clearing is not likely to be required from the State, provided clearing is less than 5,000sq m, and only consists of regrowth vegetation;
2. An Indigenous Land Use Agreement (ILUA) may be required from the Native Title holders subject to land requirements/alignment considerations;
3. A Riverine Protection Permit/s are not required, as work is being done by or on behalf a local government (reference Riverine Protection Permit Exemption Requirements Guideline, DNRM);
4. An Operational Works Approval is required from Council, and will be referred to the State for:
   (a) Taking or interfering with water in a watercourse;
   (b) Waterway barrier works;
5. An Operational Works application for vegetation clearing may be required to be obtained from Council, however, may be lodged as part of the overall "works" application if required.

It is recommended a local expert on flora and fauna examine the site to determine whether protected species have migrated to the site.

Based on this preliminary assessment the current approvals can be progressed included obtaining an Indigenous Land Use Agreement and engaged a local flora and fauna expert to examine the site.

4.0 Approvals Management

It is considered that there are three main steps to managing the approvals process.

Step 1 is to identify the likely statutory approvals that will be required to construct, operate and maintain the new road link/Diggers Bridge Crosisng.

Step 2 is to identify the relevant provisions that will be used by decision makers to assess the required applications.

Step 3 is to recommend strategies that Council can take to ensure that its objective is met to secure the Statutory Approvals required with conditions that are acceptable.

5.0 Applications

5.1 Content

To enable the assessment by the respective authorities, the following minimum information is expected to be required to accompany applications

- Plans that clearly specify the land that is the subject of the upgrade.
- Plans that outline the nature of the proposed work, ie the crossing and associated works/roads;
- An assessment of effects on the local environment:
  - identifying the nature, scale and extent of the positive effects of the new crossing;
  - identifying the nature, scale and extent of the adverse effects of the crossing;
  - identifying proposed mitigation to avoid, remedy or mitigate the adverse effects identified above.
- Demonstration that there has been adequate consideration of alternatives for the crossing;
- Advice of the extent of consistency the crossing and Mowbray River Road link for the continued community benefit and use of the Mowbray valley area and how this fits with Council and State Government mapping/planning, (context to existing crossing);
- Matters raised in community consultation or by Council during the assessment process;
- Assessment against the specific provisions of the assessing authority.
- Review of previous relevant reports to identify how the project need was identified, (for example bridge condition assessments that identify the issues with the existing);.
- Subject to clearing requirements, obtain advices on trees removed and their value and potential for offset planting or similar within the project;
- Identifying through consultation with the community and stakeholders the perceived community benefit of the project.

- Recommended action to facilitate assessments by identified authorities includes:
  - Pre-lodgement discussions of the background and scope of the project with Officers from relevant Authorities, and what the assessment criteria/scope is for the authority.
  - Proposed approval conditions discussed through liaison with the authorities

6.0 Indicative process, timeframe and contacts

The indicative process and timeframe that is anticipated is as follows:

Process	**Timeframe**
Option development and scoping	Dec 2016
Further community consultation	Dec 2016/Jan 2017
Preliminary Design Inputs	First quarter 2017
Council approval of preferred option	First quarter 2017
Preparation of draft applications for statutory approvals.	First quarter 2017
Ongoing consultation with affected parties	second quarter 2017
Review and finalisation of statutory approvals	Second quarter 2017
Finalise design (including requirements from approvals)	Second quarter 2017

Communication in relation to this Management Plan should be directed to:

Trinity Engineering and Consulting Pty Ltd
Attention: Mr Paul Steele
Project Manager

Appendix D1 Initial Findings

It is understood at this preliminary stage that:

(a) The site proposed for bridge replacement is subject to tidal influence and is subject to flooding.

(b) An inspection of the subject site around Diggers Bridge saw no known marine plants present.

(c) The site is a road reserve, shown on planning scheme mapping as “un-zoned”.

(d) The site is not mapped as being at risk for protected plants (protected plants flora survey) or habitat for wildlife (fish/wildlife habitat). However regulated vegetation is seen within the site;

(e) The Coastal Management District extends to the eastern portion of the area in question;

(f) Storm surge and sea level rise mapping affects the area;

(g) There are matters of state environmental significance (waterways and vegetation) mapped in the area;

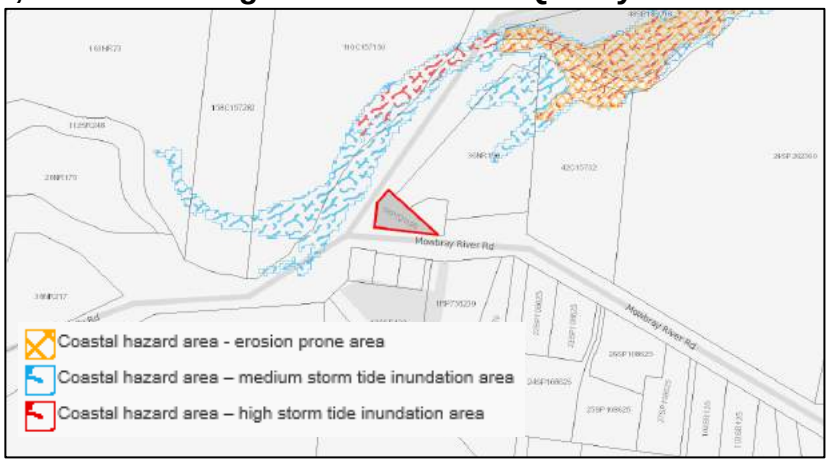
(h) It is not known if there are protected plants in the location proposed for work;

(i) The site is not heritage listed;

(j) The site is currently within the Yirrganydji (Irukandji) People #2 Native Title Area.

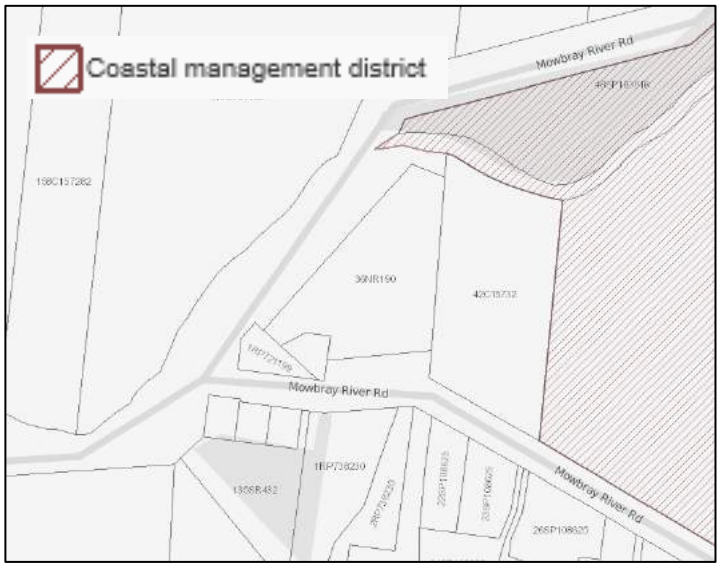
(k) Environmental Protection and Biodiversity Conservation (EPBC) search was shown there was no Natural Environmental Significant at the site location. However, it is noticed there are endangered flora and fauna within 1 kilometre of the site.

Government mapping information was used to assist in the preliminary stage of the approval assessment to determine what conflicts may be present around the Diggers Bridge site. Associated figures relating to the above points are shown below.



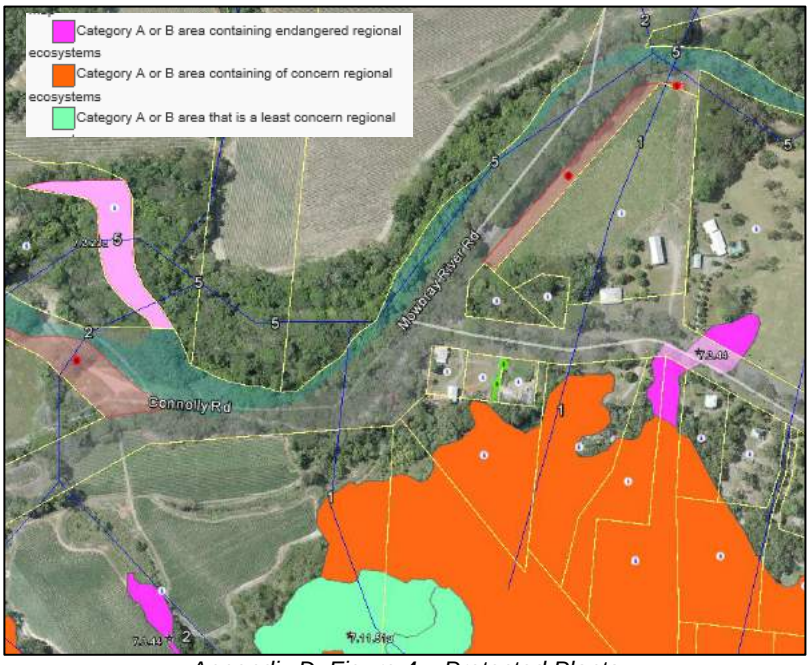
Appendix D: Figure 1 – Coastal Hazard Areas

Appendix D: Figure 2 - Flood Hazard Area

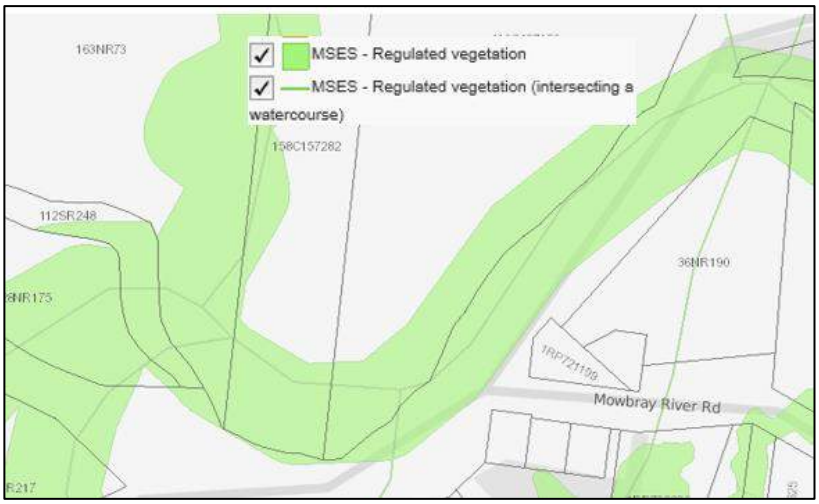


Appendix D: Figure 3 - Coastal Management District

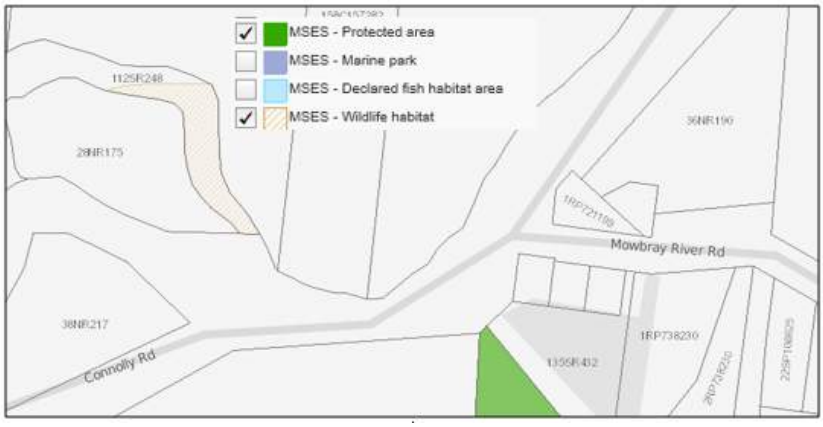
Flora and Fauna



Appendix D: Figure 4 – Protected Plants

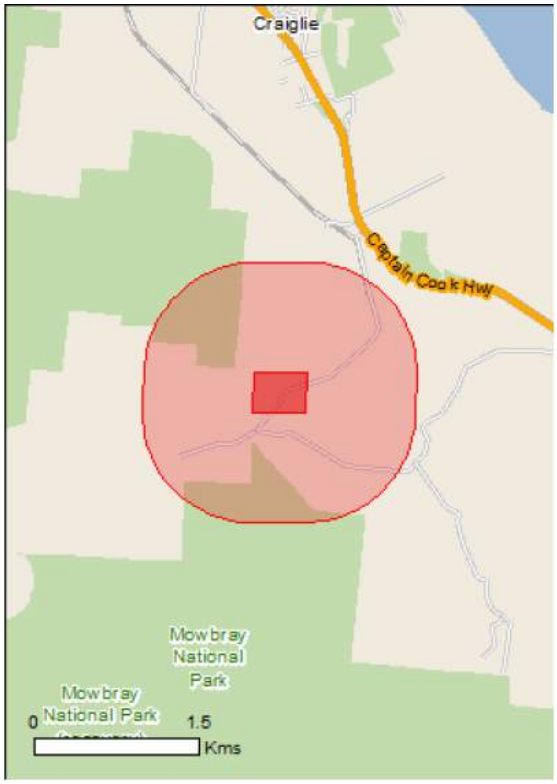


Appendix D: Figure 5 – Regulated Vegetation

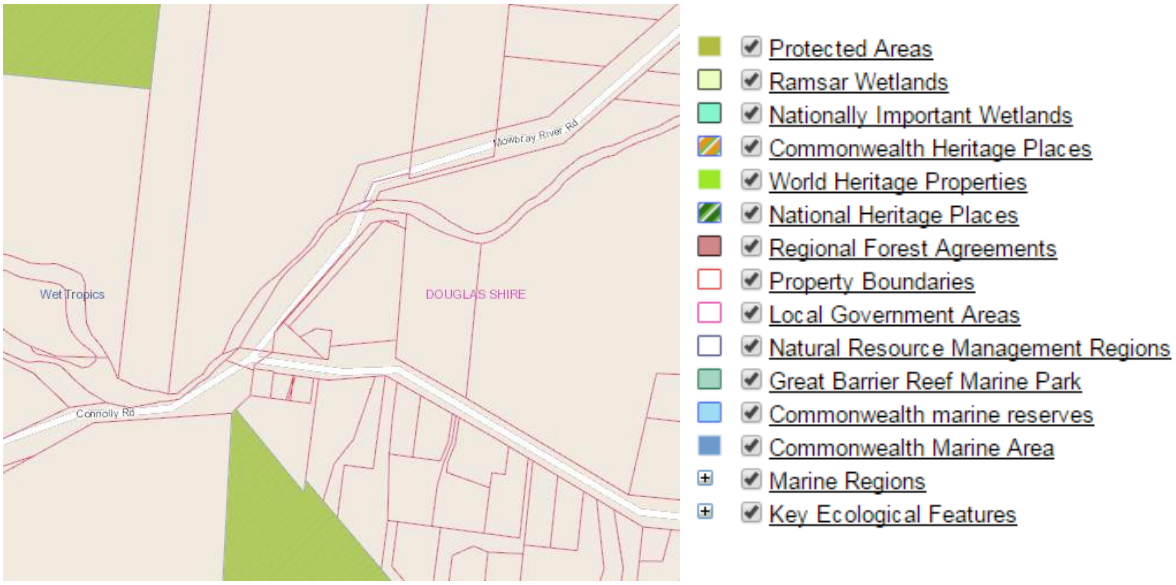


Appendix D: Figure 6 – Protected Habitats

Environmental Protection and Biodiversity Conservation



Appendix D: Figure 7 – EPBC Overview



Appendix D: Figure 8 – EPBC Diggers Bridge Site

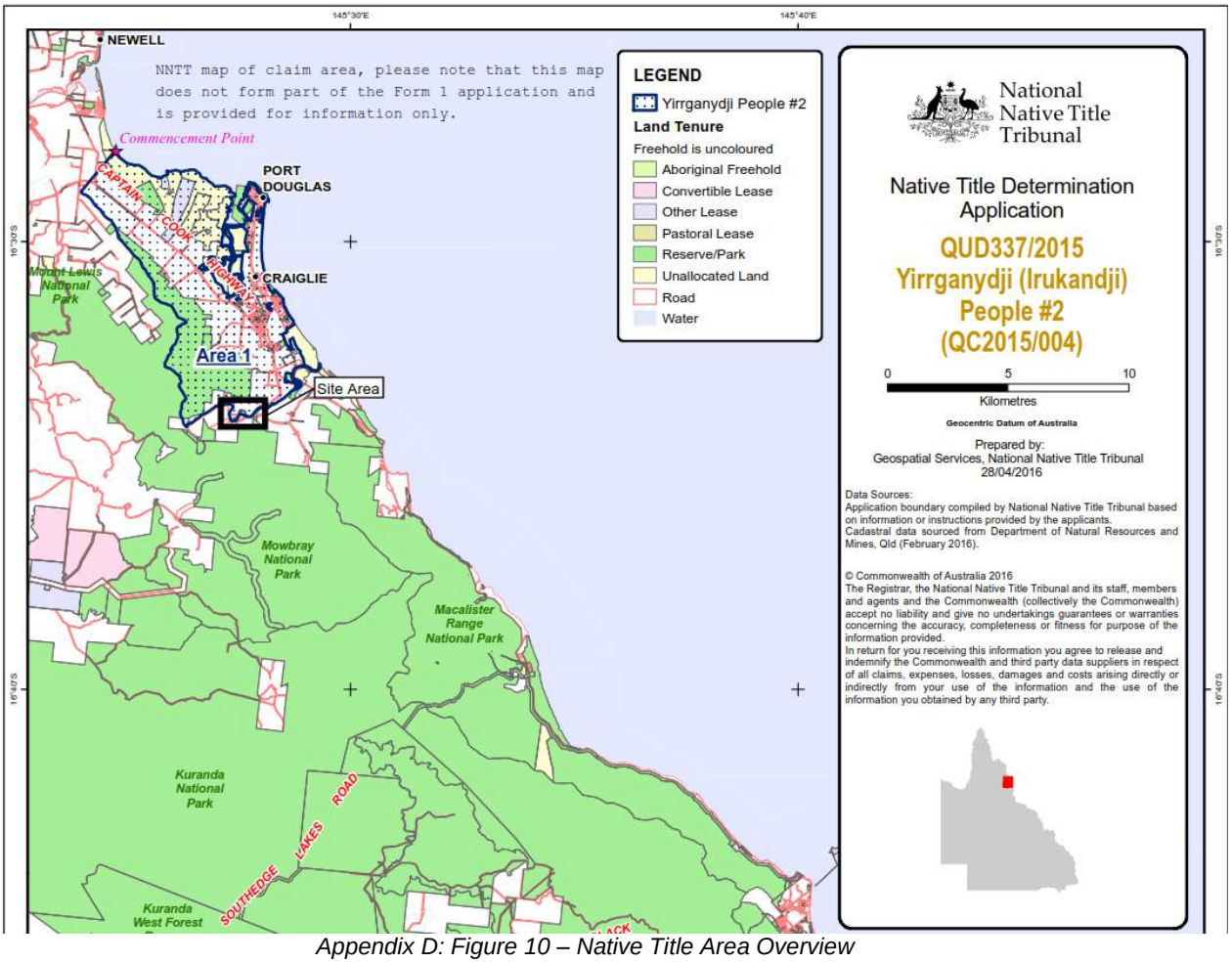
Cultural Heritage

Mowbray

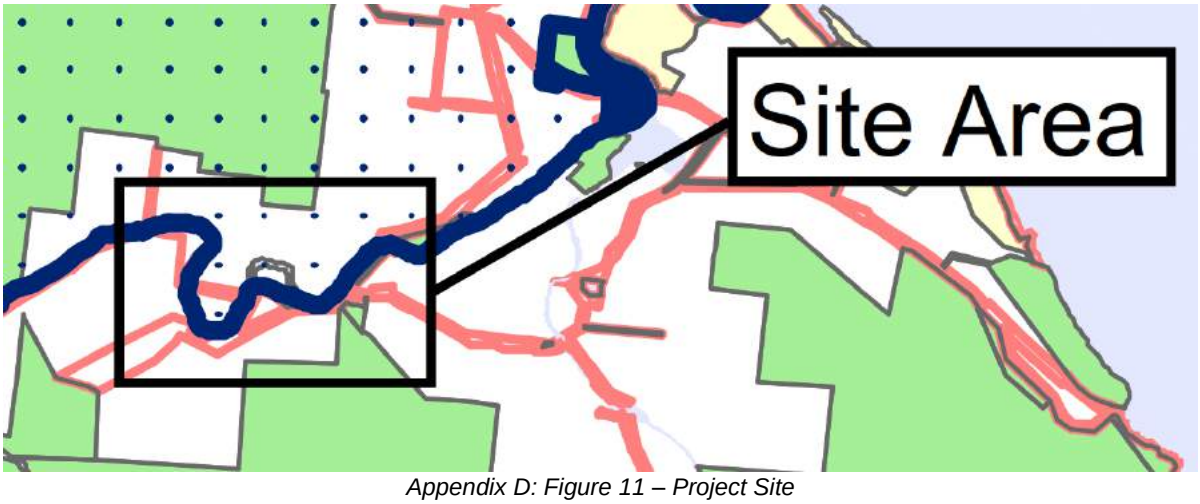
Map Ref	Place of significance	Property description
25	Bump Track	Lot 1 on USL8615 Off Connolly Road
26	Mullavey's Hotel	Lot 97 on SR124 Connolly Road

Appendix D: Figure 9 – Cultural Heritage

Native Title



Appendix D: Figure 10 – Native Title Area Overview



Appendix D: Figure 11 – Project Site

APPENDIX E: Level 2 Structural Inspection

Level Two Structure Inspection Report

B2/1

Structure ID:	8002	Bridge Name:	Diggers Bridge
Crossing:	Mowbray River	Road Number:	
Structure Type:	Bridge	Road Name:	Mowbray River Road
Construction Type:	Girder	Owner:	Douglas Shire Council
Construction Material:	Timber	District:	Mowbray
Inspector:	Mark de Hayr	Local Authority:	DSC
Latitude:	-16.561936	Longitude:	145.465859
Inspection Date:	1/02/2016	Max Height (M)	1.5
Next Inspection Date:	1/02/2017	Width (M)	7.8
Total Length (M)	46.8	Bearing - AP1-AP2	North
Carriageway	One way road	Load Limit	20t
Footway	None	Status	Active
Chainage (Km)	1.970	From	To

Inspection Level 2 ☑ Level 3 ☐ Programmed ☑ Exceptional ☐ Underwater ☐

Inspection Comments:

Six Span, Signle Lane Timber Girder Style Bridge over the Mowbray River on the Mowbray River Road. Approach 1 is from the southern approach to the bridge.Approach Two is Giveway controlled. Inspected at high tide. Crocodiles are present in the waterway. A 20T load limit has been applied to this structure. While inspecting the bridge a number of large tipper trucks were seen going back and forth over the bridge. When loaded these vehicles would be exceeding the recommended load limit. A considerable amount of movement and flexing of the structural components could be seen when the trucks were going over the bridge.

Piers are on 30degree skew angle.

Overall Condition State

ModificationName	CS 1	CS 2	CS 3	CS 4	Comments
Original	☐	☐	☐	☑	Bridge is in Poor Condition

Defect Comments:

Bridge is in Overall Poor Condition. Excessive snipes have been cut into the ends of the girders and corbels is primary reason of OCS4 rating. Moderate internal 'piping' found in a number of corbels and girders. Timber deck planks are loose, and need fixings tightened or replaced. Severe cracks in all concrete piles on the piers.

FORCECOR INFRASTRUCTURE CONSULTANTS

The Deck Wearing Surface if noted as being overly wide for a signle Span Bridge at 7.8m wide. Kerbs and or entire structure should be narrowed to deter vehicles from two way traffic.

Inventory Report

B2/2

Modification	Group	Component	Standard Number	Exposure Class	Quantity	Unit	CS 1	CS 2	CS 3	CS 4	Mtce Required	Comments
O	AP1	GR	72S	2	2	Each		2			☐	W Beam Guardrail is in Fair Condition
O	AP1	AP	70O	2	1	Each	0	1	0	0	☐	Bitumen Wearing Surface is in Fair Condition - Approach Includes 20T Load Limit Signage [See Photo] - DSCN4149.JPG, DSCN4150.JPG, DSCN4151.JPG
O	S1	K	3T	2	18	Lin m		18			☐	Timber Kerb is in Fair Condition
O	S1	D	20T	2	64	m2		64			☐	Transverse Deck Planks are in Fair condition - 7.6m wide between kerb [See Photo] - DSCN4152.JPG
O	S2	K	3T	2	14	Lin m		14			☐	Timber Kerb is in Fair Condition
O	S2	D	20T	2	58	m2		58			☐	Transverse Deck Planks are in Fair condition - 7.6m wide between kerb
O	S3	K	3T	2	16	Lin m		16			☐	Timber Kerb is in Fair Condition
O	S3	D	20T	2	62	m2		62			☐	Transverse Deck Planks are in Fair condition - 7.6m wide between kerb
O	S4	K	3T	2	16	Lin m		16			☐	Timber Kerb is in Fair Condition
O	S4	D	20T	2	59	m2		59			☐	Transverse Deck Planks are in Fair condition - 7.6m wide between kerb
O	S5	K	3T	2	14	Lin m		14			☐	Timber Kerb is in Fair Condition
O	S5	D	20T	2	58	m2		58			☐	Transverse Deck Planks are in Fair condition - 7.6m wide between kerb
O	S6	K	3T	2	16	Lin m		16			☐	Timber Kerb is in Fair Condition
O	S6	D	20T	2	64	m2		64			☐	Transverse Deck Planks are in Fair condition - 7.6m wide between kerb
O	AP2	GR	72S	2	2	Each		2			☐	W Beam Guardrail is in Fair Condition
O	AP2	AP	70O	2	1	Each		1			☐	Bitumen Wearing Surface is in Fair Condition - Approach Includes 20T Load Limit Signage and Give Way Control sign [See Photo] - DSCN4154.JPG, DSCN4155.JPG, DSCN4156.JPG
O	A1	H	54C	2	1	Each		1			☐	Cast In situ Headstock is in Fair condition
O	A1	P	56C	2	3	Each		3			☐	Cast in Situ Piles are Buried
O	S1	G	22T	2	5	Each	0	0	2	3	☐	G1 is in CS3 due to drilling and CS4 from Snipping the rest are in CS 2 from drilling and 2 & 4 are in CS4 due to Sniping. G1,2,3,&5 have 20-30% surface rot [See Photo] - DSCN4157.JPG, DSCN4158.JPG, DSCN4159.JPG, DSCN4161.JPG
O	P1	COR	27T	2	5	Each		2		3	☐	All Corbels are in CS2 by Drilling - Corbel 2,3,4 are in CS4 due to over sniping

O	P1	H	54C	2	1	Each		1			☐	Cast in Situ Concrete Headstock is in fair condition [See Photo] - DSCN4160.JPG, DSCN4165.JPG
O	P1	P	56C	2	3	Each		0		3	☐	Moderate to Severe Vertical Cracking in All Piles [See Photo] - DSCN4162.JPG, DSCN4163.JPG, DSCN4164.JPG
O	S2	G	22T	2	5	Each		2		3	☐	Girders 1,2,4,5 are in CS2 by Drilling and G3 is in CS3. G1,3,4 are in CS4 due to sniping. G5 is new as in fair condition. G3 is splitting at E1 at the notch. G4 has 30% loss of Sapwood due to rot
O	P2	COR	27T	2	5	Each				5	☐	Corbel 1,3,4,5 are in CS2 due to drilling but CS4 due to Sniping. Corbel 2 is in CS4 due to Piping
O	P2	H	54C	2	1	Each		1			☐	Cast in Situ Concrete Headstock is in fair condition [See Photo] - DSCN4166.JPG, DSCN4169.JPG
O	P2	P	56C	2	3	Each			3		☐	Moderate to Severe Vertical Cracking in All Piles [See Photo] - DSCN4167.JPG, DSCN4168.JPG
O	S3	G	22T	2	5	Each				5	☐	All Girder are in CS2 due to drilling and CS4 due to Sniping. G4 has a 20% loss of sapwood due to rot. [See Photo] - DSCN4173.JPG, DSCN4176.JPG, DSCN4191.JPG
O	P3	COR	27T	2	5	Each			1	4	☐	Corbel1 is in CS4 due to Piping and is badly crushed/rotted, Corbel 2,3,4 are in CS4 due to sniping. Corbel5 is in CS3 due to sniping. [See Photo] - DSCN4171.JPG, DSCN4172.JPG, DSCN4177.JPG, DSCN4180.JPG
O	P3	H	54C	2	1	Each		1	0		☐	Cast in Situ Concrete Headstock is in fair condition [See Photo] - DSCN4170.JPG, DSCN4178.JPG
O	P3	P	56C	2	3	Each			3		☐	Moderate to Severe Vertical Cracking in All Piles [See Photo] - DSCN4179.JPG
O	S4	G	22T	2	5	Each				5	☐	All Girder are in CS2 due to drilling and CS4 due to Sniping. G3 has severe vertical split at E1 over Pier, G5 has active termites [See Photo] - DSCN4153.JPG, DSCN4174.JPG, DSCN4175.JPG
O	P4	COR	27T	2	5	Each				5	☐	All Corbels are in CS2 due to Drilling and CS4 due to sniping. Corbel 4 has 80mm dia pipe at E1. Corbel5 has severe splitting.
O	P4	H	54C	2	1	Each		1			☐	Cast in Situ Concrete Headstock is in fair condition [See Photo] - DSCN4181.JPG, DSCN4182.JPG
O	P4	P	56C	2	3	Each			3		☐	Moderate to Severe Vertical Cracking in All Piles
O	S5	G	22T	2	5	Each				5	☐	G5 is in CS3 due to drilling, G1-4 are in CS2 by drilling. All are in CS4 due to sniping [See Photo] - DSCN4184.JPG, DSCN4192.JPG
O	P5	COR	27T	2	5	Each				5	☐	All Corbels are in CS2 due to Drilling and CS4 due to sniping. Corbel 4 has 80mm dia pipe at E1. Corbel5 has severe splitting.
O	P5	H	54C	2	1	Each		1			☐	Cast in Situ Concrete Headstock is in fair condition [See Photo] - DSCN4183.JPG, DSCN4186.JPG
O	P5	P	56C	2	3	Each			3		☐	Moderate to Severe Vertical Cracking in All Piles
O	S6	G	22T	2	5	Each				5	☐	All Girder are in CS2 due to drilling and CS4 due to Sniping. G5 has heavy Splting and White Rot [See Photo] - DSCN4185.JPG, DSCN4188.JPG

O	A2	H	54C	2	1	Each		1			☐	Cast in Situ Concrete Headstock is in fair condition [See Photo] - DSCN4187.JPG
O	A2	P	56C	2	3	Each		3			☐	Piles are buried

Defective Components Report

B2/3

Modification	Group	Component	Standard Number	Exposure Class	Condition State 3	Condition State 4	Defect Description	Monitor	Level 3 Inspection	Other
O	S1	G	22T	2	2	3	Replace Girders 1-5	☐	☐	☑
O	P1	CO	27T	2		3	Apply anti split treatment to Corbels 2,3,4	☐	☐	☑
O	P1	P	56C	2		3	Repair Cracking in Piles to improve durability	☐	☐	☑
O	S2	G	22T	2		3	Replace Girders 1-4	☐	☐	☑
O	P2	CO	27T	2		5	Replace Corbel 2, apply anti split treatment in Corbels 1,3,4,5	☐	☐	☑
O	P2	P	56C	2	3		Repair Cracking in Piles to improve durability	☐	☐	☑
O	S3	G	22T	2		5	Replace G4 and apply anti split treatment to G1,2,3,5	☐	☐	☑
O	P3	CO	27T	2	1	4	Replace Corbel1 and apply anti split treatment to Corbel 2-5	☐	☐	☑
O	P3	P	56C	2	3		Repair Cracking in Piles to improve durability	☐	☐	☑
O	S4	G	22T	2		5	Replace G3 & 5, apply anti snipe treatment in G1,2,4	☐	☐	☑
O	P4	CO	27T	2		5	Replace Corbel5, apply anti split treatment in Corbel 1-4	☐	☐	☑
O	P4	P	56C	2	3		Repair Cracking in Piles to improve durability	☐	☐	☑
O	S5	G	22T	2		5	Replace G5 apply anti Snipe treatment to G1-4	☐	☐	☑
O	P5	CO	27T	2		5	Replace Corbel 4&5, apply anti split treatment to Corbel 1-3	☐	☐	☑
O	P5	P	56C	2	3		Repair Cracking in Piles to improve durability	☐	☐	☑
O	S6	G	22T	2		5	Replace G5 apply anti Snipe treatment to G1-4	☐	☐	☑

Standard Procedure Exceptions Report

B2/4

Modification	Group	Component	Standard Number	Exposure Class	Undefined Component	Component Not Inspected	Less than 25% Comp Inspected	Other	Comments *Description *Photographic reference *Reason component not inspected *Any other exceptions
O	A1	P	56C	2	☐	☐	☑	☐	component buried
O	A2	P	56C	2	☐	☐	☑	☐	component buried

Photographs and Sketches Record List

B2/6

Reference	Modification	Group	Component	Description *Deck Surface (full width and alignment) *Side View (waterway, spans, piers, etc) *Underside (deck and pier construction) *Deficient Component and Major Defects *Undefined Elements
DSCN4150.JP	O	AP1	AP	Approach One
DSCN4151.JP	O	AP1	AP	Approach one
DSCN4149.JP	O	AP1	AP	Detail of 20T load limit in Approach One
DSCN4152.JP	O	S1	D	General view of deck from approach one
DSCN4154.JP	O	AP2	AP	Detail of 20T load limit in Approach Two
DSCN4155.JP	O	AP2	AP	Approach Two
DSCN4156.JP	O	AP2	AP	Abutment One
DSCN4159.JP	O	S1	G	Detail of Over Sniping in Span One G5
DSCN4161.JP	O	S1	G	Detail of White Rot in Span One G2
DSCN4158.JP	O	S1	G	Detail of 50mm deep Split in Span One Girder One LHS
DSCN4157.JP	O	S1	G	Detail of "over Sniping in Span One Girder One End One
DSCN4165.JP	O	P1	H	Pier One Face Two
DSCN4160.JP	O	P1	H	Pier One Face One
DSCN4162.JP	O	P1	P	Detail of Severe cracking and spalling in Pier One Pile One Face One
DSCN4163.JP	O	P1	P	Detail of Severe cracking and spalling in Pier One Pile One Face Two
DSCN4164.JP	O	P1	P	Detail of severe cracking in Pier One Piles 1&2 face two
DSCN4169.JP	O	P2	H	Pier Two Face Two
DSCN4166.JP	O	P2	H	Pier Two Face One
DSCN4168.JP	O	P2	P	Detail of Severe cracking in Pier Two Pile 2&3 Face One
DSCN4167.JP	O	P2	P	Detail of Severe cracking in Pier Two Pile One Face One
DSCN4173.JP	O	S3	G	Detail of Splitting at Snipe in Girder Three Span three end two
DSCN4176.JP	O	S3	G	Detail of Splitting at Snipe in Girder Four Span three end two
DSCN4191.JP	O	S3	G	Detail of 50mm split in top of Girder Two in Span Three End Two
DSCN4180.JP	O	P3	COR	Detail of Severe Splitting in Pier Three Corbel One End Two
DSCN4171.JP	O	P3	COR	Detail of Severe Splitting in Pier Three Corbel One End One
DSCN4172.JP	O	P3	COR	Detail of Severe Splitting in Pier Three Corbel One Middle
DSCN4177.JP	O	P3	COR	Detail of severe splitting in Pier Three Corbel Four End One
DSCN4178.JP	O	P3	H	Pier Three Face Two
DSCN4170.JP	O	P3	H	Pier Three face One
DSCN4179.JP	O	P3	P	Detail of severe cracking in Pier three Pile Three face Two
DSCN4174.JP	O	S4	G	Detail of Severe split (>150mm) in Span Four Girder Three End One
DSCN4175.JP	O	S4	G	Detail of Severe split (>50mm) in Span Four Girder Two End One
DSCN4153.JP	O	S4	G	Detail of 150mm wide split in Span Four Girder Three End One
DSCN4181.JP	O	P4	H	Pier Four Face One
DSCN4182.JP	O	P4	H	Pier Four Face Two

DSCN4184.JP	O	S5	G	Detail of 30-40mm loss of section in Span Five Girder 2&3 due to surface rot
DSCN4192.JP	O	S5	G	Detail of 50mm split in top of Girder Two in Span Five End Two
DSCN4183.JP	O	P5	H	Pier Five Face One
DSCN4186.JP	O	P5	H	Pier Five Face Two
DSCN4185.JP	O	S6	G	Span Six Girder One
DSCN4188.JP	O	S6	G	Detail of Severe rot in Span Six Girder Five End Two RHS
DSCN4187.JP	O	A2	H	Abutment Two

Photographs and Sketches Record

Modification:	Group:	Standard Number:	Component:
O	AP1	70O	AP
ID: DSCN4150.JPG		Inspection Date	1/02/2016

Description:

Approach One

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	AP1	70O	AP
ID: DSCN4151.JPG		Inspection Date	1/02/2016

Description:

Approach one

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	AP1	70O	AP
ID: DSCN4149.JPG		Inspection Date	1/02/2016

Description:

Detail of 20T load limit in Approach One

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	S1	20T	D
ID: DSCN4152.JPG		Inspection Date	1/02/2016

Description:

General view of deck from approach one

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	AP2	70O	AP
ID: DSCN4154.JPG		Inspection Date	1/02/2016

Description:

Detail of 20T load limit in Approach Two

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	AP2	70O	AP
ID: DSCN4155.JPG		Inspection Date	1/02/2016

Description:

Approach Two

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	AP2	70O	AP
ID: DSCN4156.JPG		Inspection Date	1/02/2016

Description:

Abutment One

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	S1	22T	G
ID: DSCN4159.JPG		Inspection Date	1/02/2016

Description:

Detail of Over Sniping in Span One G5

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	S1	22T	G
ID: DSCN4161.JPG		Inspection Date	1/02/2016

Description:

Detail of White Rot in Span One G2

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	S1	22T	G
ID: DSCN4158.JPG		Inspection Date	1/02/2016

Description:

Detail of 50mm deep Split in Span One Girder One LHS

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	S1	22T	G
ID: DSCN4157.JPG		Inspection Date	1/02/2016

Description:

Detail of "over Sniping in Span One Girder One End One

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	P1	54C	H
ID: DSCN4165.JPG		Inspection Date	1/02/2016

Description:

Pier One Face Two

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	P1	54C	H
ID: DSCN4160.JPG		Inspection Date	1/02/2016
Description:			
Pier One Face One			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P1	56C	P
ID: DSCN4162.JPG		Inspection Date	1/02/2016
Description:			
Detail of Severe cracking and spalling in Pier One Pile One Face One			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P1	56C	P
ID: DSCN4163.JPG		Inspection Date	1/02/2016
Description:			
Detail of Severe cracking and spalling in Pier One Pile One Face Two			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P1	56C	P
ID: DSCN4164.JPG		Inspection Date	1/02/2016
Description:			
Detail of severe cracking in Pier One Piles 1&2 face two			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P2	54C	H
ID: DSCN4169.JPG		Inspection Date	1/02/2016
Description:			
Pier Two Face Two			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P2	54C	H
ID: DSCN4166.JPG		Inspection Date	1/02/2016
Description:			
Pier Two Face One			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P2	56C	P
ID: DSCN4168.JPG		Inspection Date	1/02/2016
Description:			
Detail of Severe cracking in Pier Two Pile 2&3 Face One			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P2	56C	P
ID: DSCN4167.JPG		Inspection Date	1/02/2016
Description:			
Detail of Severe cracking in Pier Two Pile One Face One			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	S3	22T	G
ID: DSCN4173.JPG		Inspection Date	1/02/2016
Description:			
Detail of Splitting at Snipe in Girder Three Span three end two			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	S3	22T	G
ID: DSCN4176.JPG		Inspection Date	1/02/2016
Description:			
Detail of Splitting at Snipe in Girder Four Span three end two			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	S3	22T	G
ID: DSCN4191.JPG		Inspection Date	1/02/2016
Description:			
Detail of 50mm split in top of Girder Two in Span Three End Two			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P3	27T	COR
ID: DSCN4180.JPG		Inspection Date	1/02/2016
Description:			
Detail of Severe Splitting in Pier Three Corbel One End Two			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P3	27T	COR
ID: DSCN4171.JPG		Inspection Date	1/02/2016

Description:

Detail of Severe Splitting in Pier Three Corbel One End One

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	P3	27T	COR
ID: DSCN4172.JPG		Inspection Date	1/02/2016

Description:

Detail of Severe Splitting in Pier Three Corbel One Middle

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	P3	27T	COR
ID: DSCN4177.JPG		Inspection Date	1/02/2016

Description:

Detail of severe splitting in Pier Three Corbel Four End One

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	P3	54C	H
ID: DSCN4178.JPG		Inspection Date	1/02/2016

Description:

Pier Three Face Two

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	P3	54C	H
ID: DSCN4170.JPG		Inspection Date	1/02/2016
Description:			
Pier Three face One			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P3	56C	P
ID: DSCN4179.JPG		Inspection Date	1/02/2016
Description:			
Detail of severe cracking in Pier three Pile Three face Two			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	S4	22T	G
ID: DSCN4174.JPG		Inspection Date	1/02/2016
Description:			
Detail of Severe split (>150mm) in Span Four Girder Three End One			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	S4	22T	G
ID: DSCN4175.JPG		Inspection Date	1/02/2016
Description:			
Detail of Severe split (>50mm) in Span Four Girder Two End One			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	S4	22T	G
ID: DSCN4153.JPG		Inspection Date	1/02/2016
Description:			
Detail of 150mm wide split in Span Four Girder Three End One			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P4	54C	H
ID: DSCN4181.JPG		Inspection Date	1/02/2016
Description:			
Pier Four Face One			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	P4	54C	H
ID: DSCN4182.JPG		Inspection Date	1/02/2016
Description:			
Pier Four Face Two			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	S5	22T	G
ID: DSCN4184.JPG		Inspection Date	1/02/2016
Description:			
Detail of 30-40mm loss of section in Span Five Girder 2&3 due to surface rot			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	S5	22T	G
ID: DSCN4192.JPG		Inspection Date	1/02/2016

Description:

Detail of 50mm split in top of Girder Two in Span Five End Two

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	P5	54C	H
ID: DSCN4183.JPG		Inspection Date	1/02/2016

Description:

Pier Five Face One

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	P5	54C	H
ID: DSCN4186.JPG		Inspection Date	1/02/2016

Description:

Pier Five Face Two

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	S6	22T	G
ID: DSCN4185.JPG		Inspection Date	1/02/2016

Description:

Span Six Girder One

Reference:	Sketch:

Modification:	Group:	Standard Number:	Component:
O	S6	22T	G
ID: DSCN4188.JPG		Inspection Date	1/02/2016
Description:			
Detail of Severe rot in Span Six Girder Five End Two RHS			
Reference:		Sketch:	

Modification:	Group:	Standard Number:	Component:
O	A2	54C	H
ID: DSCN4187.JPG		Inspection Date	1/02/2016
Description:			
Abutment Two			
Reference:		Sketch: