Project Evaluation Summary
Haughton River Floodplain upgrade project (Bruce Highway)

Proponent Queensland Government
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Contents

1. Summary

Infrastructure Australia has not added the **Haughton River Floodplain upgrade project** (as it is currently specified) to the Infrastructure Priority List.

The Bruce Highway is part of the National Land Transport Network (the National Network) and plays an important role in facilitating freight and passenger vehicle movements along the east coast of Queensland. Currently, transport system connectivity on the National Network in Queensland is affected by the frequency and severity of flood closures for both road and rail. Upgrading the Bruce Highway to improve connectivity between Queensland's coastal cities is a Priority Initiative on the Infrastructure Priority List.

The proposed project aims to upgrade a 13.5-kilometre section of the Bruce Highway which crosses the Haughton River floodplain between Ayr and Townsville. This includes the replacement of a narrow, low-level bridge at the Haughton River, which is particularly susceptible to flooding events that close the highway for extended periods. This project would significantly reduce the frequency and duration of road closures and improve road safety on this section of the Bruce Highway. It would also improve reliability, connectivity, and accessibility.

The proponent's stated net present value (NPV) for the project is -$10.2 million, with a benefit cost ratio (BCR) of 0.97 using a 7% real discount rate and P50 cost estimate. Infrastructure Australia has identified a number of issues with the economic evaluation that, when taken together, overstate the project's expected benefits. While recognising the strategic merit of improving flood resilience and connectivity on the Bruce Highway, Infrastructure Australia considers that the cost of the proposed solution, as it is currently specified, outweighs its benefits.

Infrastructure Australia would welcome the submission of a revised business case for a respecified solution that achieves a better balance between costs and benefits.

2. Strategic context

The Bruce Highway is part of the National Network. The section of the highway which crosses the Haughton River floodplain is situated between Townsville and Ayr. It facilitates agricultural freight movements and supports intra-regional movements for residents to access medical and health care facilities in Townsville. More broadly, the highway supports tourism in North Queensland and is part of an important link for road freight movements to major Queensland ports, including the Port of Townsville.

The Bruce Highway is sometimes affected by severe rainfall events. The proponent's hydraulic modelling indicates that, on average, the Bruce Highway is closed to traffic at the project site for 85 hours each year. Flooding that affects the Bruce Highway often also results in the closure of the North Coast rail line, with land travel between Mackay and Townsville diverted to an inland route that is 400 kilometres longer than the Bruce Highway route. Climate change is expected to increase the severity and frequency of extreme weather events, including floods and cyclones, placing further pressure on the Bruce Highway.

The *Bruce Highway Action Plan* 2012, developed by the Queensland Government, aims to improve the condition of the Bruce Highway through progressive priority upgrades over a 10-year period. The Haughton River Floodplain upgrade project is a 'High Priority' project in the Plan and is included as one of the four flood-immunity projects on the Bowen-Ingham section of the Highway included in the North Queensland Flood Immunity Bridge Package.

The Flood Immunity Bridge Package projects are being developed to achieve the Vision Standards set out in the Bruce Highway Action Plan for the Mackay – Townsville Link, which are:

- Time of Closure in a Q50 rainfall event of no more than 48 hours[1]; and
- Average Annual Time of Closure of no more than 10 hours per year.

In 2013, the Australian and Queensland Governments committed $8.5 billion (federal: $6.7 billion; state: $1.8 billion) over 10 years (2013-14 to 2022-23) to address safety, flood immunity and capacity deficiencies on this nationally significant road corridor. In 2016, the Northern Australia Infrastructure Audit identified improved service standards on the Bruce Highway between Gladstone and Cairns, including for flood protection, as a primary infrastructure gap. The upgrade of the Bruce Highway to improve connectivity between various Queensland coastal cities was included as a Priority Initiative on the Infrastructure Priority List (2016).

The Haughton River Floodplain upgrade project is one of a number of projects that have been investigated under the Australian and Queensland Government funding commitment. However, the project site is in a relatively rural location and carries only modest traffic volumes (approximately 5,050 vehicles per day on average, or 1.8 million vehicles per annum). Traffic estimates indicate that approximately 16 per cent of these vehicles are heavy vehicles.

3. Problem description

The section of the Bruce Highway that crosses the Haughton River has a low level of flood immunity (Q1 – Q2). In practice, this means that the Haughton River crossing is closed due to flooding once every two years on average. In this section, the highway traverses a large, flat floodplain and during high rainfall events, flooding can extend along the highway for up to 5 kilometres south of the Haughton River Bridge and 9 kilometres to the north. Flooding at the project site is characterised by:

- large debris loads, particularly at the Haughton River Bridge and approaches
- multi-peak floods when there is not enough time for the water to subside and debris to be cleared between rainfall events
- high water velocities.

[1] A Q50 rainfall event is one that happens once in every 50 years on average.

The combined effect of these factors is that this section of the Bruce Highway is closed to traffic for long periods of time during large rainfall events[2]. The proponent estimates the Average Annual Time of Submergence (AATOS) to be 85 hours[3]. This section has a Maximum Recorded Time of Closure (MRTOC) of 115 hours (almost 5 days).

When the Bruce Highway is closed due to flooding, the following transport and essential services are affected:

- North Queensland's primary supply chain (for the transport of general freight and produce to southern markets)
- access to essential health services in Townsville for rural communities
- access for tourists and tourism operators
- disaster-relief and efforts after significant natural adverse events.

There are also safety issues on this section of the Bruce Highway. The three existing low-level bridges were constructed more than 50 years ago and are relatively narrow. These bridges do not meet contemporary design standards or community expectations, particularly for the increasing freight task, and for higher-productivity vehicles. The area of the proposed project currently includes two points where cane tramways cross the Bruce Highway at-grade. This creates road safety issues, particularly where drivers such as tourists are not familiar with the route. Between 2008 and 2015, there were 42 recorded crashes on this section of the Bruce Highway, three of which resulted in fatalities and a further 14 of which resulted in serious injury.

4. Proposal

The proposed project is located on the Bruce Highway (Mackay – Cairns link), approximately 30 kilometres north of Ayr and 50 kilometres south of Townsville. The project's scope is to upgrade a 13.5 kilometre section of the Bruce Highway which traverses the Haughton River floodplain.

The proposed project would upgrade ageing bridge, culvert and pavement infrastructure to current standards, so that it can more effectively and safely cater for the current and future freight and passenger tasks, while addressing identified flood resilience and safety deficiencies associated with the current infrastructure configuration. The existing infrastructure includes three narrow, low-level bridges, major culverts, ageing pavements and narrow seal width of 9 metres on most sections, at-grade intersections and two at-grade tramway crossings of the highway.

The proposed upgrade would include 16 new, wider, higher-level bridges (including overpasses across the two at-grade cane tramway crossings), increased road height on approaches, significantly increased extent of major culverts, increased seal width to 11 metres, and new pavements.

The Queensland Government states that the project would provide a range of benefits including:

- Increased resilience to flooding, improved reliability and connectivity on the Bruce Highway
- Improved reliability and efficiency on the Ayr – Townsville section, supporting the local sugar industry and ensuring that transport connectivity is not a barrier to potential economic diversification in the region
- Improved travel times during flood events by reducing the time vehicles have to wait for the highway to reopen
- Vehicle operating cost savings during flood events due to vehicles avoiding diversion via an inland route that is 400 kilometres longer than the Bruce Highway route
- Improved safety as a result of widening the narrow bridges
- Improved ride quality
- Avoiding air transport food and grocery drops to surrounding communities during major flood events
- Avoiding loss of life or property damage associated with attempted vehicle crossings during flood events

[2] High water velocities mean that is not safe to cross even when surface water levels are low. A high level of debris extends closure times as this debris needs to be cleared from the highway before vehicles can safely cross.

[3] The vision standards in the Bruce Highway Action Plan relate to Average Annual Time of Closure (AATOC) as opposed to AATOS. Given the characteristics of flooding in this section, the proponent states that AATOS more accurately reflects actual time of closure, noting that AATOC is an output of a hydrologic model.

- Improved access to essential services such as health and medical facilities.

5. Options identification and assessment

The proponent used multi-criteria analysis to assess a long list of options. The options analysis included a number of hydraulic, overtaking-lane, cane tramway and bridge configuration sub-options. A key factor that underpinned the assessment of options was meeting the vision standard in the Bruce Highway Action Plan to achieve an Average Annual Time of Closure (AATOC) of 10 hours or less per year and to manage afflux issues on surrounding properties. Two short-listed options were taken forward into the Business Case for detailed investigation:

- Option 1A – Two cane tramway overpasses (Hodel Road/Upper Haughton Roads and Shirbourne Road)
- Option 2A – One cane tramway overpass (Hodel Road/Upper Haughton Road).

Options 1A and 2A have the same infrastructure configuration across the 13.5 kilometre project extent. Both options are high cost solutions, as is often the case with projects on large flat floodplains where there is an extensive length of road across a floodplain. The main difference between the two options is their treatment of the existing cane tramway crossing north of the Haughton River Bridge. Option 1A includes an overpass of this crossing while Option 2A saw this crossing remain at-grade on the highway.

A detailed investigation was conducted on the two short-listed options. The assessment considered each option against technical, economic, financial, risk and transport criteria, as well as public interest, whole-of-government issues and legislative issues. The proponent selected Option 1A as the recommended option, based on its capacity to deliver additional safety benefits by removing both cane tramway overpasses. Option 1A was also viewed as more favourable by key stakeholders due to the additional safety benefits and less impacts during construction on cane-harvesting. The cost difference (Option 1A is estimated to cost $12.3 million more than Option 2A) was assessed by the proponent as being a worthwhile additional investment for the reasons outlined above.

6. Economic evaluation

The proponent's stated net present value (NPV) for the project is -$10.2 million, with a benefit cost ratio (BCR) of 0.97 using a 7% real discount rate and P50 cost estimate. The largest (65 per cent) stated benefit of the project is avoided passenger waiting costs, which accrued under the base case as a result of drivers and passengers waiting for the highway to re-open during flood events. Additionally, there are travel time and vehicle operating cost savings from fewer vehicles diverting via the longer inland route, along with crash and safety benefits.

Infrastructure Australia has identified a number of issues with the economic evaluation that, when combined, overstate the reported benefits of this project. The cost estimated for each driver and passenger that chooses to wait during a flooding event is significantly higher than the cost of taking the alternative inland route. The evidence in the business case shows the inland route's costs (including travel time and vehicle operating costs) to be two to three times less than the proponent's estimated cost of waiting, depending on when and where highway users become aware of the closure. Users who are aware of the closure ahead of time and immediately take the inland route incur lower costs than those who only become aware of the closure at the project site and have to turn around before diverting. While the proponent calculated average vehicle wait times using the methodology set out in TMR's Cost Benefit Analysis Manual, the availability of a faster, cheaper alternative route suggests that the estimated value of travel time savings associated with waiting is too high[4]. This assumption results in the benefits being overstated.

The economic evaluation assumes that, for non-freight vehicles, half of the users will choose to wait for the route to re-open, and the other half would divert via the inland route. The proponent has assumed that no users choose to postpone or cancel travel during a flood event. This results in every person incurring either waiting or diversion

[4] Infrastructure Australia acknowledges that the proponent has provided evidence of commuters waiting for long periods during large flood events. However, as outlined in TMR's Cost Benefit Analysis manual, road users may choose to divert via an alternative route if their willingness to pay exceeds their perceived cost of travel (including the cost of their time). In this case, where the nature of flooding means that the road is closed for long periods of time, the methodology to calculate average wait times and then apply full value of time parameters is not appropriate.

costs. During major flood events, it is typical for government officials and emergency service personnel to encourage the community to stay off the roads. Therefore, it is unrealistic to assume that there are no users postponing or cancelling their trips. This is also inconsistent with previous economic evaluations prepared by the proponent. Infrastructure Australia is aware of examples for similar projects where the proponent has assumed that 30 per cent of users choose not to travel during flood events. While there would still be some loss of utility for users who cancel their trips, assuming that no users choose to do so overstates waiting cost benefits.

Lastly, there is insufficient evidence to support the traffic growth rates used in the economic evaluation. Traffic counts at the project site show that the traffic has increased by approximately 1 per cent per annum between 2008 and 2016. This compares to an average annual increase in traffic of 2.5 per cent assumed over the entire 30-year period of the economic evaluation. This also results in the benefits being overstated.

The proponent did not quantify benefits such as improved access to health services and avoided wage losses in the economic evaluation. However, given the issues with the evaluation of benefits outlined above, and the high overall cost of the project, Infrastructure Australia considers that, overall, the cost of the project as it is currently specified outweighs its benefits. Infrastructure Australia would welcome the submission of a revised business case for a respecified solution that achieves a better balance between costs and benefits. For example, a solution that targets a smaller reduction in AATOC, at a level that is higher than 10 hours, might deliver benefits in excess of project costs.

Benefits and costs breakdown

Proponent's stated benefits and costs		**Present value ($m, 2016) @ 7% real discount rate**	**% of total**
Benefits			
Passenger travel time savings		$22.58	6.6%
Freight travel time savings		$2.85	0.8%
Passenger waiting time savings		$221.34	65.1%
Freight waiting time savings		$9.86	2.9%
Vehicle Operating Cost Savings		$25.24	7.4%
Crash Savings		$42.63	12.5%
Environmental (externality) savings		$15.58	4.6%
Total Benefits[1]		**$340.07**	**100%**
Capital costs (P50)		$376.86	
Residual value[2]		-$22.43	
Net operating costs[2,3]		-$4.19	
Total Costs[1]		**$350.23**	**100%**
Core results	**Net benefits - net present value (NPV)[1,4]**	**- $10.16**	n/a
	Benefit–cost ratio (BCR)	**0.97**	n/a

Source: Proponent's Business Case

Notes:

(1) Totals may not sum due to rounding.

(2) Infrastructure Australia recommends that the residual value and operating cost savings be included as benefits. This methodological difference would have a negligible impact on the BCR.

(3) Operating costs savings accrue from savings in periodic maintenance and rehabilitation by replacing the existing ageing infrastructure.

(4) The net present value is calculated as the present value of total benefits less the present value of total costs.

Capital costs and funding

Total capital cost (nominal, undiscounted)	$466.3 million
Proponent's proposed Australian Government funding contribution	$373.1 million
Other funding (source / amount / cash flow) (nominal, undiscounted)	$93.2 million (Queensland Government)

7. Deliverability

The proponent assessed the potential to attract private funding and concluded that it was highly unlikely that there would be scope for enhanced value for money through the use of a privately financed model. There are no opportunities for tolling under current policy on the Bruce Highway, and traffic volumes would not be sufficient to generate adequate revenue. It is therefore proposed that the project be funded by the Australian and Queensland Governments.

The proponent assessed three possible delivery models:

1. Design and then Construct – using a Transport Infrastructure Contract – Construct Only.
2. Design and Construct (D&C) model using an Early Contractor Involvement (ECI) contract.
3. Alliance contract.

The proponent's preferred delivery model is a D&C model using an ECI contract. This delivery model is preferred for the following reasons:

- Aligns with recent and current approaches to major project delivery, which has underpinned increased maturity for ECI contracts for the proponent and industry
- Well suited to a project such as this where there is a well-defined project footprint and scope, sufficient site information and a reference design to enable a contractor to appropriately price the project
- Provides the greatest potential for acceleration of the project's construction start date
- Provides greater potential for design and construction innovation compared to other models for this project
- The collaborative approach embedded within the delivery model reduces the risk of under-design (achieving contractor savings at the expense of quality) and large cost variations.

The contract will be managed by the proponent who has experience delivering similar major projects under this delivery model including the Port of Brisbane Motorway and Ipswich Motorway (Rocklea to Darra Stage 1) projects. The proponent has successfully delivered similar highway upgrades across other large, flat floodplains on the Bruce Highway. The most recent example of a project of similar scale and complexity is the 15 kilometre Corduroy Creek to Tully High project. The project was completed ahead of time and within budget.

There are five matters of national environmental significance within the project area. During the Business Case phase, the proponent undertook a self-assessment using the *Matters of National Significance: Significant impact Guidelines* to determine whether the project would have a significant impact on any of the five protected matters under the Environment Protection and Biodiversity Conservation Act. The proponent's self-assessment concluded that the Environment Protection and Biodiversity Conservation Act would not be triggered. Environmental matters will continue to be monitored and mitigated including through clear specifications in the D&C tender documents.