BUILDING QUEENSLAND

BRUCE HIGHWAY—MAROOCHYDORE INTERCHANGE PROJECT DETAILED BUSINESS CASE 2018

BUSINESS CASE/COST BENEFIT ANALYSIS SUMMARY

D19/1383

Purpose of this document	This document provides an overview of the Bruce Highway—Maroochydore Interchange Project Detailed Business Case. The primary objective of this document is to outline the economic analysis undertaken and the key outcomes.
Status	This summary was prepared based on the contents of the detailed business case presented to the Building Queensland Board in May 2018. The information presented may be subject to change as the proposal progresses through future stages of development, delivery and operations.

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1 Summary information

Project name	Bruce Highway—Maroochydore Interchange Project	
Location	South East Queensland	
Proposal owner	Queensland Department of Transport and Main Roads	
Proposed delivery agency	Queensland Department of Transport and Main Roads	
P90 cost estimates	Nominal[1]	Present value[2]
Capital cost	$301 million	$239 million
Incremental ongoing cost	$39 million	$1 million
Net present value		$529 million
Benefit cost ratio		3.2

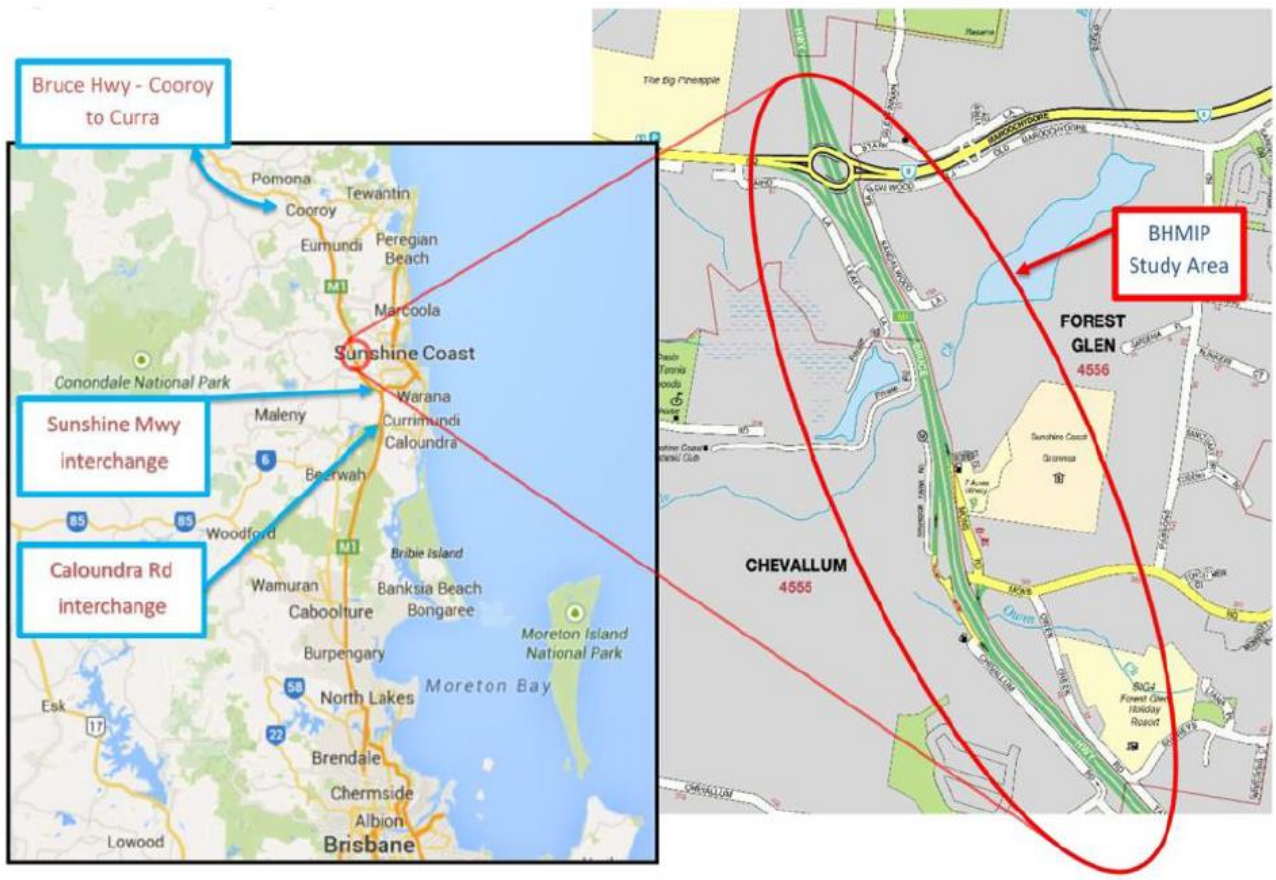
[1] Financial.
[2] Discounted at 7 per cent.

2 Proposal overview

The Bruce Highway is a national highway serving as the major north-south transport route between Brisbane and Cairns. The Bruce Highway's primary function is to safely and efficiently cater for major regional and inter-regional traffic (both freight and general traffic). The Queensland Government is progressively upgrading the highway and its interchanges and intersections to meet Australian standards. The Bruce Highway Action Plan (BHAP), developed in 2012, is guiding this work. This engineering-based plan was developed to address critical safety, flood immunity and capacity issues through a suite of projects over a 10-year period.

BHAP prioritised upgrading the highway between Brisbane and Gympie through various projects. Currently, the highway comprises six lanes extending north from Dohles Rocks Road to Caboolture, and four lanes between Caboolture and Gympie. BHAP nominated the Maroochydore Road Interchange Upgrade—Stage 1 as a high priority 1 project (to be undertaken within four years). Stage 2, the upgrade of the Mons Road Interchange, was allocated a high priority 3 project for delivery beyond the 10-year BHAP. These two projects are combined into the preferred project referred to as the Bruce Highway Maroochydore Interchange Project (BHMIP). The extent of the BHMIP study area is shown in Figure 1.

Figure 1: BHMIP study area



3 Service need

The main drivers for BHMIP are traffic congestion and safety issues. Congestion, poor sight-distances at interchanges and the close spacing of ramps between interchanges contribute to these issues. Both the Maroochydore Road and Mons Road interchanges currently operate at level of service (LOS) F during peak periods. Community consultation and stakeholder engagement has informed BHMIP. Community members expressed concern about congestion, high crash rates, access difficulties and lack of walking and cycling infrastructure.

The Maroochydore Road interchange is struggling to cope with peak demand, with southbound exit ramp queues extending back to the Bruce Highway, resulting in delays and safety implications. The Maroochydore Road interchange operates at a LOS F during the AM peak period (greater than 50 seconds average delay for a particular movement), with queues in excess of 1,500 metres on the eastbound approach to the roundabout. Without intervention, the LOS will decline, and congestion will last longer. Congestion on the eastbound approach to the Maroochydore roundabout has increased in duration from around 30 minutes in 2013 to 60 minutes in 2017. Queues on the southbound exit ramp to the roundabout are also increasing (approximately 200 metres), which adversely impacts speeds and safety on the Bruce Highway.

Safety and capacity issues at the Maroochydore Road interchange are intertwined with the Mons Road interchange 420 metres (from extremities) to the south, requiring an assessment of this interchange. The Mons Road interchange operates at a LOS F and has insufficient storage for maximum peak periods queues, spilling back and blocking both signalised intersections.

Deficiencies contributing to safety issues include the following:

- The southbound exit ramp from the Bruce Highway to Maroochydore Road has sight-distance deficiency, making it difficult for drivers to judge a safe entry gap into the roundabout's circulating traffic. The deficiency is the result of closely spaced ramp terminal intersections (unsignalised), uphill ramp geometry, narrow two-lane bridges on curve and solid concrete bridge parapets at driver height.
- The Bruce Highway's northbound exit onto the Maroochydore Road interchange has a sight-distance deficiency, caused by the combination of existing design elements referred to above.
- The southbound entry ramp onto the Bruce Highway at Maroochydore Road experiences a high number of off-road (on curve) crashes, largely attributable to poor approach geometry. The Maroochydore Road approaches the overpass roundabout at an acute angle, and a reverse curve connects the approach to the roundabout. Of the three approach lanes, one lane exits onto the southbound entry ramp and two lanes go through to Nambour and the Bruce Highway northbound.
- The Bruce Highway's northbound entry ramp typically experiences angle and rear-end crashes. Traffic heading either north onto the highway or towards Maroochydore weaves on the roundabout, while traffic from Nambour endures a poor observation angle. Combined with the high traffic volumes and small entry gaps, the existing situation leads to a high number of angle crashes.
- Congestion at the Maroochydore Road interchange blocks traffic lanes, reducing highway safety and transport efficiency.
- The existing three-way, signal-controlled intersection at Mons Road east has an exit-only leg for the Bruce Highway southbound on-ramp. There are two lanes on the northern, western and eastern approaches. A review of the existing intersection revealed that the traffic signal lantern arrangements did not have the required number of primary lanterns to provide full coverage and appropriate redundancy for approaching vehicles (as per Austroads Guidelines), which is exacerbating safety issues. This appears to

contribute to the angle crash cluster on the eastern approach. In addition, the current lane configuration leads to risk taking, further increasing its crash potential.

- Ramps between the interchanges are closely spaced. The distance between entry and exit ramps is about 50 per cent of that required by current standards and results in merging and weaving conflicts.

4 Options assessment

A two-stage multi-criteria analysis (MCA) assessment process undertaken during the options analysis stage identified a preferred option, which was refined during the detailed business case preliminary design. The first MCA considered the study area broken into three separate areas. Four options, based on strengths and weaknesses, were short-listed from this process and developed further. The four options recommended by the first MCA were considered and as these were developed, two further options were added:

- a Parclo A4/closed diamond with eastern service road only
- a signalised roundabout interchange at Maroochydore Road and service roads on both sides of the Bruce Highway, offering a lower cost alternative.

The second MCA demonstrated the performance of the latter added option in terms of preferred criteria of traffic efficiency, familiarity, constructability, future flexibility and cost. Subsequent investigations proved this option to be the best and therefore was the preferred option taken into the detailed business case.

This option forms the reference project:

- a signalised roundabout with a new, wider northern bridge at Maroochydore Road
- one-way western service road and combination one-way/two-way eastern service road connecting Mons Road interchange to Maroochydore Road interchange
- removal of the Mons Road interchange north facing ramps
- relocation of the Mons Road interchange northbound off-ramp
- widening of the Mons Road underpass.

5 Base case

The base case consists of the existing road network and interchange arrangements at the Maroochydore Road and Mons Road interchanges and ongoing maintenance.

In modelling future years, the speed limit on the Bruce Highway has been reduced from 110km/h to 100km/h for safety reasons associated with the substandard weaving section between the interchanges and on-ramp merging operations. Traffic signal configurations at Mons Road interchange have also been optimised to serve future year traffic characteristics.

Traffic modelling shows that the base case has significant congestion and queuing at the Maroochydore Road interchange and is currently operating at LOS F during the AM peak period and LOS E during the PM peak period. The modelling also found that congestion and queuing will worsen in future years without intervention.

The Mons Road interchange, which operates at LOS F in both the AM and PM peak periods, will show an initial improvement in future years due to the optimisation of traffic signal operations and because increasing congestion will see some traffic demand held back at Maroochydore Road interchange. Traffic performance is shown to improve to LOS D in both AM and PM in 2021, before decreasing to LOS E in 2031 and LOS F in 2041.

6 Reference project

The reference project includes:

- at the Maroochydore Road intersection, constructing a four-lane, west-east bridge with a shared user path over the Bruce Highway, reconfiguration and signalisation of ramp intersections and ramp upgrades
- removing north-facing ramps at Mons Road interchange
- constructing two-way service roads on both sides of the highway between interchanges
- upgrading drainage under the Bruce Highway to manage afflux created by the service roads across the Eudlo Creek flood plain and to facilitate Q100 flood immunity for the future upgrade of the highway
- extending Owen Creek Road between Mons Road and the Sunshine Coast Grammar School
- widening the Mons Road underpass
- relocating the Mons Road northbound exit ramp to Chevallum Road and upgrading the exit ramp/Chevallum Road intersection
- extending the Mons Road southbound entry ramp.

7 Economic methodology

Traffic modelling outputs were used as inputs for the economic analysis. Generated traffic modelling outputs for car, light commercial vehicles and heavy commercial vehicles included numbers of trips, vehicle kilometres travelled (VKT), vehicle hours travelled, average speeds and average trip length. Following the application of parameter values to calculate benefits and account for real increases, the benefit and cost streams were discounted to present day values to calculate key economic indicators. Externalities are calculated from the application of parameter values to VKT applied to demand forecasts over the evaluation period. These externalities may be negative, for example where there is a net incremental reduction in modelled network VKT.

Table 1 shows key input data used in the calculation of the cost benefit analysis.

Table 1: Cost benefit analysis inputs

PARAMETER	VALUE	SOURCE
Discount rate	A seven per cent real discount rate is used for the central case with sensitivity tests conducted at four per cent and 10 per cent	Infrastructure Australia Assessment Framework, March 2018
Price year	2017	Cost estimate
Evaluation period	30 years from the end of capital investment First year of measured benefits is 2023 (first full year of benefits)	ATAP (Category 4, section 2.4)
Temporal treatment of benefits and costs	Demand model outputs have been provided for 2021, 2031 and 2041 Linear interpolation has been undertaken to estimate benefits between these years, while benefits have been held constant at 2041 levels for the remainder of the appraisal period	TMR Traffic modelling and KPMG Economic Appraisal, April 2018

PARAMETER	VALUE	SOURCE
Indexation	Unit costs and parameter values indexed to the price year by the Consumer Price Index (including subcategories as appropriate), Average Weekly Earnings and Producer Price Index	ABS
Annualisation	264.4 days with volume expansion factors applied during holiday periods	TMR traffic modelling report and analysis of permanent traffic count data

8 Demand forecasts

Detailed traffic modelling has been undertaken to assess demand over the road network under the base case and the project case scenarios to inform the economic assessment and quantify the benefits associated with BHMIP.

Traffic modelling for BHMIP followed a three-tiered process, using different models:

1. The Sunshine Coast Integrated Multi-Modal Model was used to model trip generation, distribution and mode choice, taking into account future development patterns and population forecasts.
2. The mesoscopic regional Sunshine Coast VISUM (SC-VISUM) models were used for traffic assignment, incorporating assumed future network changes and utilising both link and turn delay for network impedance.
3. Study area microscopic VISSIM models developed utilising demands calculated from the assigned traffic volumes in the SC-VISUM models were used to provide a detailed assessment of intersection and network operation.

The detailed VISSIM modelled the network for the following peak periods:

- two-hour AM peak period: 7–9 am (6:45–7 am warm-up period)
- four-hour PM peak period: 2–6 pm (1:45–2 pm warm-up period).

The PM peak periods were extended to operate over a four-hour analysis period (accounting for the earlier peak period than the regular 4–6 pm peak). This is influenced by schools located within and adjacent to the study area. It was considered imperative to extend the PM peak period to ensure peak loading condition was being assessed. It should be noted that it has been assumed there will be no material benefits from BHMIP outside of these modelled peak periods.

9 Cost benefit analysis results

Key results of the economic analysis are shown in Table 2, and include estimated travel time savings, vehicle operating costs, crash benefit and externalities. The estimated residual value is also shown.

Table 2: P90 cost benefit analysis results summary—central case at 7% discount rate

PROJECT BENEFITS	TOTAL $M	PRESENT VALUE ($M, ROUNDED)
Value of time	2,307	643
Light vehicle—private	960	266
Light vehicle—business	1,166	327
Heavy vehicle	181	50

PROJECT BENEFITS	TOTAL $M	PRESENT VALUE ($M, ROUNDED)
Vehicle operating costs	394	117
Light vehicle—private	131	39
Light vehicle—business	111	33
Heavy vehicle	152	45
Externalities	-1.6	-0.4
Crash	26	8
Residual value	17	1.8
TOTAL	2,744	769
Capital costs	286	239
Ongoing (incremental to base case)	4.5	1.2
TOTAL costs		240
Net present value		529
Benefit cost ratio		3.2

Subject to rounding

10 Sensitivity analysis

Sensitivity analysis identifies key economic risks within the conducted analysis. It examines how much the results deviate consequently from changes in key project driver/s, or combinations of drivers. The sensitivity analysis for the project is summarised in Table 3.

Table 3: Sensitivity tests

SENSITIVITY TEST	BENEFIT COST RATIO	NET PRESENT VALUE ($M)
Central case	3.2	529
Costs at P50	3.4	541
Discount rate four per cent	4.9	1,006
Discount rate 10 per cent	2.2	274
Capital costs +20%	2.7	287
Capital costs -20%	4.0	577
Total benefits +20%	3.9	683
Total benefits -20%	2.6	375
Benefits -20%, costs +20%	2.1	327

11 Wider economic impacts

The proposed project is expected to support an average of 153 full-time equivalent (FTE) during the capital expenditure period. Productivity benefits of $455 million accrue from travel time and vehicle operating cost savings for light vehicle use for business purposes and heavy vehicle/freight movements.

12 Project implementation

The procurement options analysis assessed the following forms of delivery contract:

- transport infrastructure contract—construct only (TIC—CO)
- design and construct, including with early contractor involvement
- competitive alliance contracting.

A value-for-money assessment of public private partnership options was undertaken. It concluded that a traditional delivery model would be appropriate, and that the reference project would be best delivered using a TIC–CO delivery model.