BRUCE HIGHWAY—CAIRNS SOUTHERN ACCESS CORRIDOR STAGE 3—EDMONTON TO GORDONVALE DETAILED BUSINESS CASE 2017

COST BENEFIT ANALYSIS SUMMARY

D18/2397

Purpose of this document	This document provides an overview of the economic analysis for the Bruce Highway—Cairns Southern Access Corridor Stage 3—Edmonton to Gordonvale Detailed Business Case. The objective of this document is to outline the economic analysis and the key outcomes.
Background	This summary was prepared based on the contents of the detailed business case presented to the Building Queensland Board in Q4 2017. 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[1]

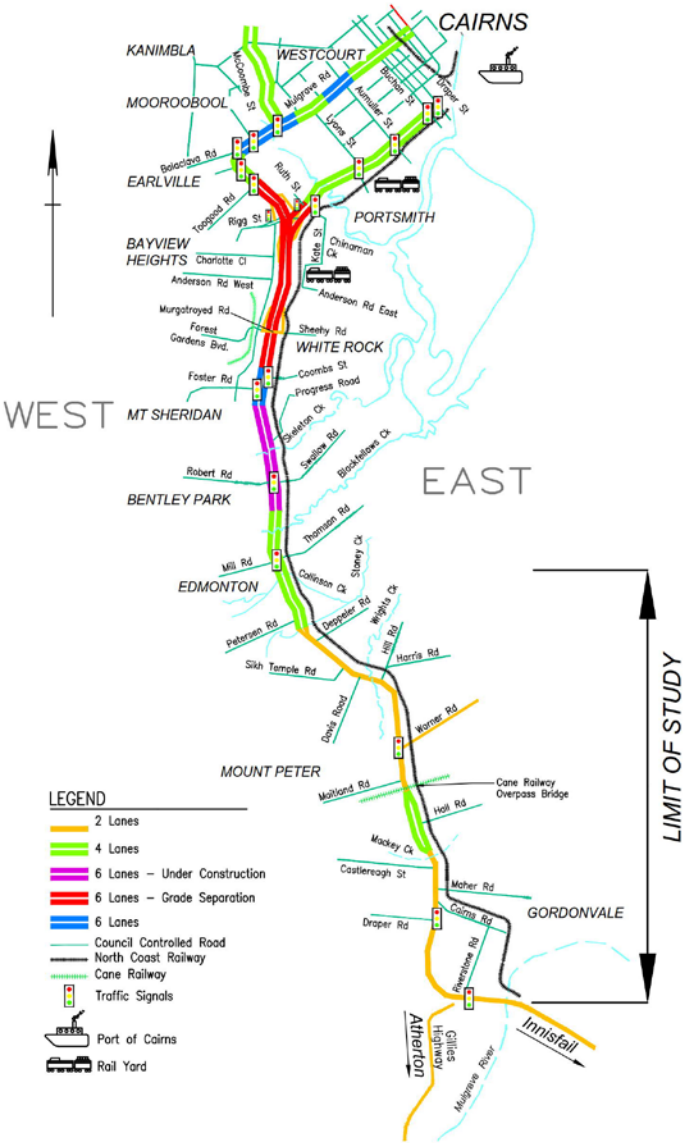
Project name	Bruce Highway—Cairns Southern Access Corridor Stage 3—Edmonton to Gordonvale	
Proposal owner	Department of Transport and Main Roads	
Proposed delivery agency	Department of Transport and Main Roads	
	P50	**P90**
Capital cost of proposal[2]	$470 million	$500 million
Incremental ongoing costs of proposal[3]	$13 million	$15 million
Discount rate	7%	
Net present value (NPV)	$41.7 million	$19.6 million
Benefit cost ratio (BCR)	1.13	1.06

[1] Rounding is used throughout this document in tables and reporting.
[2] Capital cost estimates are nominal, undiscounted 2017 dollars.
[3] Incremental ongoing costs estimates are provided for the 30-year evaluation period.

2 Proposal overview

The Bruce Highway—Cairns Southern Access Corridor Stage 3—Edmonton to Gordonvale project seeks to address traffic congestion and safety issues by adding capacity and optimising corridor efficiency. The proposed project includes four-laning of the Bruce Highway between Edmonton and Gordonvale, rationalisation of property accesses and removal of intersections for safety reasons, provision for signalised intersections, rail realignment and removal of seven rail crossings. The project area is shown in Figure 1.

Figure 1 Project area



3 Approach

A cost benefit analysis was undertaken to assess the economic viability of the Edmonton to Gordonvale project as part of the detailed business case. The cost benefit analysis has been based on guidance from the Building Queensland Cost Benefit Analysis Guide: Supplementary Guidance Release 2 December 2016, and conforms to the following sector guidelines:

- Australian Transport Assessment and Planning (ATAP) Framework (2016)
- Austroads' Guide to Road Safety Part 8 (2015)
- Austroads' Guide to Project Evaluation Part 4 (2012)
- DTMR's Cost-Benefit Analysis Manual, Road Projects (2011).

Economic viability is measured on the magnitude of benefits, including road user and impacts on the wider community, compared to investment costs borne by the road operator. The net project impacts are measured by comparing project benefits to capital investment and operational expenditures.

4 Methodology

In conducting the cost benefit analysis, the following steps were undertaken:

- comparison between the defined base case and project case
- forecasting of traffic demand, using a strategic transport model
- estimation of project impacts, using micro-simulation modelling to develop estimate vehicle fleet delay times, average speeds, vehicle kilometres travelled (VKT) and vehicle hours travelled (VHT)
- application of parameter values to estimate key project impacts, including:
  – travel time savings
  – vehicle operating costs
  – externalities.
- comparison between actual vehicle crashes and expected crash reductions in the project case
- comparison of project benefits with cost estimates
- calculation of key economic indicators
- sensitivity testing of results.

4.1 Analytical parameters

Key analytical parameters underpinning the cost benefit analysis are outlined in Table 1.

Table 1 Key analytical parameters

PARAMETER	VALUE
Discount rate	7% (central case) with sensitivity testing at 4% and 10%.
Price year and inflation	All costs and benefits in the economic analysis are presented in 2017 real prices.
Analysis period	An analysis period of 30 years from the end of the capital investment is adopted as per the ATAP guidelines to represent the 'economic' life of the asset. The first year of benefits is measured from 2023. Therefore, the project benefits are measured from 2023 to 2052.
Modelled periods	The modelled years from the transport model are 2021 and 2036. A compound annual growth rate (CAGR) formula was used for interpolation between the modelled years based on advice from the traffic modelling team. Benefits were held constant post-2036 based (i.e. flatlined).
Base case	The base case is defined as predicted investments required to continue current conditions, along with any committed projects. Routine maintenance: $0.35 million annually. Periodic main carriageway maintenance: $9.5 million every 5 years. Periodic service road maintenance of $0.4 million every 8 years. It also includes various low-cost modifications to the road seeking to maintain safety and congestion levels as demand increases, such as intersection treatments.
Reference project	Excludes any unfunded projects in the future network.
Unit costs and parameter values	Adopted from ATAP and other sources such as Austroads. The unit parameters include the value of time (i.e. $/hour), vehicle operating costs and externality parameters, inflated to present day values.

4.2 Inputs and outputs

The key inputs provided by the traffic modelling included road user travel patterns, service level and delay estimates. The Cairns Strategic Transport Model (CSTM) was used for traffic demand estimation and forecasting for input into detailed microsimulation modelling using Advanced Interactive Microscopic Simulator for Urban and Non-urban Networks (AIMSUN).

Generated outputs of the traffic modelling included vehicle kilometres hours (VKT), vehicle hours travelled (VHT), and average vehicle speeds. Traffic demand estimates and traffic modelling outputs were used as inputs into the economic modelling to calculate estimated project benefits. Benefits were estimated and calculated in incremental terms (i.e. comparing the difference between the base and project cases).

4.3 Benefits and costs

Key project benefits are expected to accrue from:

- increases in mean speeds during the AM and PM peak periods, resulting in improved travel times
- increased capacity of existing asset allowing for enhanced levels of service
- reductions in crash costs.

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, including net present value (NPV), benefit cost ratio (BCR), internal rate of return (IRR) and first year rate of return (FYRR).

The costs incorporated in the cost benefit analysis are based on the capital and ongoing maintenance costs generated from the cost estimation report. Adjustments have been made to these costs for inclusion of real cost changes only.

The costs and benefits considered in the analysis are outlined in Table 2.

Table 2 Costs and benefits included in analysis

COSTS	BENEFITS
▪ Capital cost ▪ Whole-of-life cost ▪ Externalities	▪ Travel time cost (TTC) savings ▪ Vehicle operating cost (VOC) savings ▪ Improved safety (reduced crashes)

Key inputs to the cost benefit analysis include:

- transport report (traffic modelling)
- cost estimate report
- crash report.

5 Base case

The base case describes the existing network arrangements and the expected scenario in the future should the Edmonton to Gordonvale project not proceed and is reflective of expected levels of service. The base case for the Edmonton to Gordonvale project includes the retention of a two-lane rural standard roadway, with 900 metres of dual lane, currently serving as an overtaking lane. To cope with expected traffic growth and performance, particularly of intersections, the base case modelling scenario includes several upgrades:

- an upgrade of the Draper Road intersection to include four stand-up lanes on the highway
- an upgrade of the Maitland Road intersection to include four stand-up lanes on the highway
- movement of the merge at Petersen Road southward.

Additionally, in conjunction with the expected upgrades, several intersections would be upgraded from priority to signalised intersections as part of base case ongoing works. Such upgrades are reflective of the need for safety-related upgrades.

In the base case scenario, traffic modelling indicates that traffic on the Bruce Highway is forecast to increase:

- at Stoney Creek from 21,800 vehicles per day in 2016 to 27,400 vehicles per day at 2021 and 42,900 vehicles per day by 2036
- at Meringa from 19,300 vehicles per day in 2016 to 24,300 vehicles per day at 2021 and 33,100 vehicles per day by 2036.

Existing traffic congestion on the road network would intensify as the region experiences on-going local development within the Edmonton, Gordonvale and Mount Peter areas, as well as wider regional growth. The upgrades to signalise existing priority intersections are expected to provide improved safety for minor traffic movements crossing the Bruce Highway. The upgrades to Draper Road, Maitland Road and Peterson

Road do not however provide additional capacity to the highway and, as such, are inadequate to address traffic congestion throughout the network.

The traffic modelling indicates that, should the current two-lane highway remain in place by 2036, the Petersen Road, Maitland Road, Warner Road and Draper Road intersections are expected to become constraints to through traffic movement on the Bruce Highway, with excessive delays and queuing throughout the full extent of the study area.

Due to the congestion issues displayed by the modelling, the base case is not considered to be an acceptable solution for the Bruce Highway between Edmonton and Gordonvale.

6 Reference project

The reference project will upgrade the Bruce Highway to four lanes between Edmonton and Gordonvale. Key features of the upgrade include:

- 16.4 kilometres of new two-lane carriageway (9.4 kilometres northbound and 7 kilometres southbound)
- 4.7 kilometres of relocated (new) Queensland Rail line with flood immunity increased to Q100
- removal of 21 direct property accesses from the highway
- removal of ten intersections from the highway (six completely removed, four left in or left out)
- two upgraded signalised intersections (Draper Road and Riverstone Road)
- two new signalised intersections (Petersen Road and the Bruce Highway, and Petersen Road and the proposed new service road)
- one grade separated intersection (Maitland Road)
- improvement in the flood immunity of the highway from Q2 to Q50
- removal of seven at grade crossings of the Queensland Rail line
- construction of an off-road cycle path.

7 Demand forecasts

CSTM was used to inform the traffic demand estimation for detailed micro-simulation modelling using AIMSUN. The most recent update to the CSTM in 2015-16 includes:

- 2014 Cairns Region Household Travel Survey
- 2014 Cairns Region Visitor Travel Survey
- 2014 Land use and demographics
- Latest traffic count data.

AIMSUN micro-simulation modelling used the AM and PM weekday peak periods to assess operation, inform design of the network and intersection arrangements, as well as to assess potential benefits of upgrade options.

In lieu of adjusting the CSTM demographic assumptions, the lower population forecast by Queensland Government Statistician's Office (QGSO) for Mount Peter was accounted for by adjusting traffic demand in the AIMSUN micro-simulation modelling. The QGSO population forecast for the Mount Peter area is 90 per cent of the population forecast provided by the CSTM. As there is a correlation between population and traffic generation the AIMSUN models for 2021 and 2036 have been adjusted to achieve 90 per cent of the 2021–36 traffic demand for all trips with an origin or destination within Mount Peter.

Traffic modelling was conducted for the corridor, with and without the project, for AM and PM peak periods for the following scenarios:

- 2016 (existing)
- 2021 (post construction)
- 2036 (representing the 20-year design horizon).

Table 3 compares network performance during peak periods, using 2021 and 2036 modelled years.

Table 3 Weekday travel times on the Bruce Highway during peak periods (minutes:seconds)

PEAK PERIOD	TRAVEL DIRECTION	2021		2036	
		BASE CASE	REFERENCE PROJECT	BASE CASE	REFERENCE PROJECT
AM	Northbound	09:31	06:48	52:47	06:49
	Southbound	09:26	07:15	09:38	07:08
PM	Northbound	10:08	07:07	21:25	07:26
	Southbound	11:32	07:01	18:41	07:10

The traffic modelling results show that the reference project performs significantly better than the base case, with the gap in performance widening over time. In 2036, the total travel time (for the same number of trips in a 24-hour period) is 14,615 hours for the base case, whereas it is 6,216 hours under the reference project. The reference project is forecast to provide a saving of 8,399 hours per day at 2036 compared to the base case.

8 Project costs

Table 4 provides the capital investment profile for the cost benefit analysis.

Table 4 P90 capital expenditure ($m)[4]

2018	2019	2020	2021	2022	2023
$11.7	$72.9	$129.1	$123.9	$115.0	$4.3

Calculated maintenance costs for the base and project cases are shown in Table 5.

[4] A small residual value for the bridge asset has been calculated using straight-line depreciation and asset life of 100 years.

Table 5 Maintenance costs

	BASE CASE		PROJECT CASE	
Treatment	Cost	Occurrence	Cost	Occurrence
Routine highway carriageway maintenance	$161,872	Annual	$227,950	Annual
Periodic highway carriageway maintenance	$9,570,124	Every 5 years	$16,388,295	Every 10 years
Routine intersection maintenance	$185,000	Annual	$100,000	Annual
Routine service road maintenance	$6,280	Annual	$67,320	Annual
Periodic service road maintenance	$432,535	Every 8 years	$4,636,665	Every 8 years

9 Project benefits

Expected project benefits include:

- reduced congestion from increased capacity
- enhanced levels of service leading to decreased travel times through the corridor
- more efficient operation of intersections due to rationalisation, reductions in congestion, and signalisation
- reduced crashes.

9.1 Monetisable benefits

Estimated project benefits were monetised using the estimated demand and accepted parameter values, using the sources shown in Table 6, and inflated to present day values using consumer price indexing.

Table 6 Cost benefit analysis benefits estimation

TRAVEL COST	COMPONENTS OF UNIT COST	METHOD OF ESTIMATION
Travel time costs	▪ Value of occupant time ▪ Value of freight time	Travel time unit cost × VHT
Vehicle operating costs (VOCs)	▪ Fuel and oil ▪ Tyre wear ▪ Repair and maintenance ▪ Depreciation and interest	VOC unit cost × VKT
Crash costs	▪ Fatality ▪ Serious Injury ▪ Slight injury ▪ Property damage only	Crash rate per VKT × Average Crash Cost × VKT
Externalities	▪ Air pollution ▪ Greenhouse gas emissions ▪ Noise ▪ Water ▪ Nature and landscape ▪ Upstream and downstream costs	Externalities unit cost × VKT

9.2 Non-monetisable benefits

The social impact evaluation identified three non-monetisable impacts. Of these, two were assessed as a material and positive social impacts. These impacts were:

- **Access to services and facilities**—Upgrade will increase reliable access to services and facilities in the local area and in the Cairns CBD.
- **Improved access to new growth areas in the south through new local roads**—The expected growth south of Cairns (Mount Peter) will place additional pressure on the road network. The project will provide improved access for new residents and the community through provision of new local roads.

10 Cost benefit analysis results

A 30-year evaluation period of benefit streams against construction and operating costs was analysed. Costs and monetised benefits were discounted to present value terms using a real discount rate of seven per cent for the central case. Cost benefit analysis results are presented in Table 7. All costs and benefits are presented in $2017 (real).

Table 7 Cost benefit analysis results

COST BENEFIT ANALYSIS RESULTS	TOTAL (UNDISCOUNTED $M)	PRESENT VALUE (DISCOUNTED $M)
Capital costs (P90)	456.9	359.4
Maintenance costs	-4.3	-7.6
Total costs	**452.6**	**351.8**
Travel time saving benefit	1,387.1	328.5
Private cars	1,113.5	263.3
Commercial cars	166.4	39.3
Light commercial vehicles	72.7	17.5
Medium commercial vehicles	21.8	5.3
Heavy commercial	12.8	3.1
Vehicle operating cost saving benefit	35.6	6.8
Private cars	34.2	6.9
Commercial cars	3.1	0.7
Light commercial vehicles	-0.4	-0.3
Medium commercial vehicles	-0.9	-0.3
Heavy commercial vehicles	-0.4	-0.2
Crash cost saving benefit	137.3	38.1
Environmental impact	-6.5	-2.1
Total benefits	**1,553.5**	**371.4**
NPV ($m)		**19.6**
BCR		**1.06**
IRR		**7.4%**
FYRR		**2.8%**

Headline economic indicators show P50 results as a net present value of $42 million and a benefit cost ratio of 1.13:1 at a discount rate of seven per cent. P90 results indicate a net present value of $19.6 million, and benefit cost ratio of 1.06:1, at a discount rate of seven per cent.

The effect of different discount rates on P90 results is shown in Table 8.

Table 8 P90 results, discount rate changes

DISCOUNT RATE	4%	10%
Net present value ($m)	256.7	-95.6
BCR	1.7	0.7

11 Sensitivity analysis

The robustness of results was further assessed through a series of sensitivity tests. Table 9 shows the results of the sensitivity analysis.

Table 9 Sensitivity analysis

SENSITIVITY TEST	BCR	NPV ($M)
Capital costs +20%	0.88	-52.3
Capital costs -20%	1.33	91.4
Benefits +20%	1.27	93.8
Benefits -20%	0.84	-54.7
Travel time saving benefit -20%	0.87	-46.1
Travel time saving benefit +20%	1.24	85.3
Project costs +20%, Project benefits -20%	0.70	-126.6
Project costs -20%, Project benefits +20%	1.59	165.7

Several other sensitivity tests were conducted, including changes to maintenance costs, vehicle operating costs, crash costs, environmental externalities, car occupancy rates, annualisation factor, and bridge residual value calculation. None of these additional tests proved significant.

12 Other considerations

12.1 Wider economic impact assessment

It is estimated that the project will support an average of 340 full-time equivalent jobs over the construction period. Productivity benefits in the form of freight travel time savings were calculated at $65 million.

12.2 Independent economic peer review

An independent peer review of the cost benefit analysis was undertaken to confirm the veracity of results, application of correct industry standards, source documentation, internal consistency, and confirmation of the methodology underpinning the calculation of project benefits. Further, the peer review sought to assure that key inputs were correct and appropriately incorporated into the economic modelling, assure the soundness of the adopted methodology, adequacy and consistency of documentation, scope and depth of analysis, treatment of key risks and uncertainties, assumptions and results.