BUILDING QUEENSLAND

M1 PACIFIC MOTORWAY – EIGHT MILE PLAINS TO DAISY HILL (EMP2DH) DETAILED BUSINESS CASE 2018

BUSINESS CASE/COST BENEFIT ANALYSIS SUMMARY

Purpose of this document	This document provides an overview of the economic analysis for the M1 Pacific Motorway—Eight Mile Plains to Daisy Hill 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 Q3 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

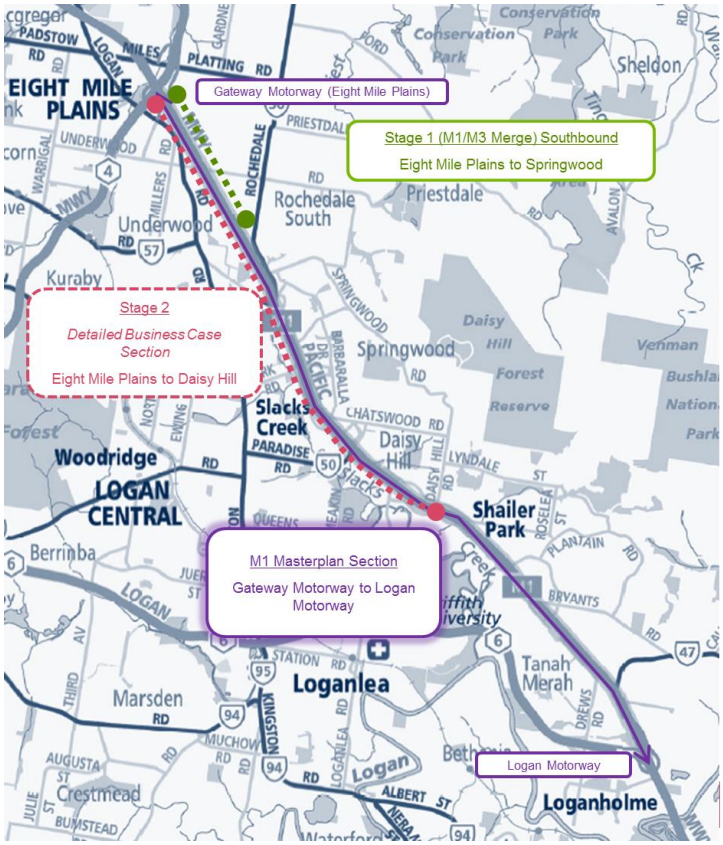
Project name	M1 Pacific Motorway—Eight Mile Plains to Daisy Hill (EMP2DH) Project	
Location	South-East Queensland	
Proposal owner	Queensland Department of Transport and Main Roads	
Proposed delivery agency	Queensland Department of Transport and Main Roads	
Discount rate	7%	
	P50	P90
Project costs[1]	$713 million	$747 million
Incremental ongoing cost[2]	$501 million	$550 million
Net Present Value (NPV)	$173 million	$151 million
Benefit cost ratio (BCR)	1.34	1.28

[1] Nominal capital cost estimates are undiscounted and have been rounded to the nearest million.
[2] Nominal ongoing operating and maintenance costs, undiscounted dollars and rounded to the nearest million.

2 Proposal overview

The M1 Pacific Motorway is the primary road transport route connecting New South Wales and the Gold Coast and Logan cities with metropolitan Brisbane. It caters for long-distance travellers, local residents, commuters, commercial vehicles, buses, tour operators and international and domestic tourists. Congestion already slows traffic and compromises motorists' safety and future population and economic growth will further degrade the motorway's performance. The Australian and Queensland governments are progressively upgrading the motorway, and work is now underway on widening the section between Eight Mile Plains and the Logan Motorway.

The route between Eight Mile Plains, where the Gateway Motorway merges with the Pacific Motorway, and the Logan Motorway is one of the motorway's busiest sections. The M1 Masterplan is guiding the upgrade and widening of this 16-kilometre section through three stages. Following completion of a strategic assessment of service requirement for the full M1 Masterplan corridor in 2016, a preliminary evaluation was undertaken for Stage 2 of works through the EMP2DH Project (completed in August 2017), which recommended the development of a detailed business case.



The detailed business case for the EMP2DH Project was developed in accordance with Building Queensland's Business Case Development Framework (BCDF) and the Queensland Government's Project Assessment Framework.

The project owner of the EMP2DH Project is the Department of Transport and Main Roads (TMR). Development of the detailed business case was led by Building Queensland, supported by TMR. A Project Steering Committee (PSC) consisting of representatives from TMR, Building Queensland and the Australian Government Department of Infrastructure, Regional Development and Cities provided strategic advice and direction to the EMP2DH Project.

3 Approach

A cost benefit analysis (CBA) was undertaken as part of the detailed business case to establish the economic case for the EMP2DH Project. CBA seeks to estimate the net economic benefits to affected parties by measuring the overall change in welfare caused by the proposal. CBA involves identifying and, where possible, quantifying relevant economic costs and benefits attributable to a project incrementally from the base case.

Costs and benefits associated with the reference project are spread over several decades. Timing differences are accounted for by discounting values incurred after the base year (people prefer to receive benefits sooner rather than later). In this way, all costs and benefits are measured and compared in 'present value' terms.

All historic costs, including base case capital costs, have been expressed in real March 2018 dollars through application of the appropriate price index, where relevant. Capital costs for the reference project and associated residual values, however, were provided in real June 2018 dollars.

The CBA followed Infrastructure Australia's Assessment Framework (2018) and drew on the following state and national guidelines for guidance:

- Building Queensland, BCDF Cost Benefit Analysis Guide, Supplementary Guidance, Release 2, December 2016
- Australian Transport Assessment and Planning (ATAP)
  - T2 Cost Benefit Analysis (August 2016)
  - PV2 Road Parameter Values (August 2016)
- TMR, Cost-benefit Analysis Manual—Road projects, First Edition, published February 2011.

The above guidelines were generally applied in the order listed. For more detailed guidance, or where guidance on a specific topic was unclear, other guidance documents sourced from Australian and international literature were considered.

4 Base case

The base case represents the future network without the EMP2DH Project. It includes background assumptions on population and employment growth, non-project transport network improvements and economic factors that are held constant between the base case and reference project.

With a capital cost estimate of $31.62 million ($ June 2017), the base case includes the following investments, considered the minimum remedial intervention necessary to maintain flow along the M1 should the EMP2DH Project not proceed:

- a new northbound Interchange 27 (at Loganholme) to replace Interchanges 26 (Nujooloo Road) and 28 (Bryants Road), to provide necessary ramp geometry and storage capacity for ramp metering
- implementation of managed motorways technology for ramp metering at the northbound on-ramps at Interchange 34 (City Road), Interchange 30 (Beenleigh–Redland Bay Road) and a new Interchange 27.

Under the 2036 base case, the M1 experiences growing traffic demand, driven by changing land use. High population growth in Brisbane, Logan and the Gold Coast (an additional 950,000 people by 2041), and along the M1 itself (Coomera, Pimpama, Helensvale, Rochedale–Burbank and Upper Mount Gravatt will collectively account for more than 145,000 new residents by 2041), combined with highly centralised employment growth will generate high demand for work trips using the M1.

An additional 25,000 daily trips are forecast south of the Gateway merge by 2036, which will further drive traffic congestion along the M1 within the project area, despite the completion of the Pacific Motorway M1–M3 Gateway Merge Project.

As a result of external influences, and despite the implementation of minimum remedial intervention, daily average travel speeds in a northbound direction from the Logan River and Gateway Motorway on the M1 are forecast to decline from 70km/h to 58km/h under the 2036 base case. In the reverse southbound direction, speeds are forecast to decline from 82km/h to 69km/h. Peak traffic will extend longer, with congestion projected to delay traffic on the M1 from 5:00 am to 11:15 am and from 2:15pm to 7:30 pm.

While implementing ramp metering in the base case (do minimum) is sufficient to achieve a 20km/h traffic flow along the M1 in congested periods and to avoid standstill traffic, an assessment of modelled performance of the base case in 2036 shows increasing demand, longer travel times and an extension of the length of peak congestion periods along the M1.

5 Reference project

The key features of the reference project include:

- 8.5 kilometres of northbound motorway widening, incorporating:
  - five lanes between the Paradise Road on-ramp and the Logan Road off-ramp (widening of the existing carriageway)
  - four lanes between the Logan Road off-ramp and Lexington Road on-ramp (offline construction)
  - five lanes between the Lexington Road on-ramp and the Gateway Motorway off-ramp (utilising the existing carriageway north of Rochedale Road)
  - merging to three lanes north of the Gateway Motorway off-ramp
  - construction of the Paradise Road/Loganlea Road collector district road, including a grade-separated crossing of Paradise Road and a signalised intersection at Paradise Road
  - construction of the Lexington Road on-ramp, including a grade-separated crossing of Springwood Road
  - closure of the T3 Logan Road northbound on-ramp
  - closure of the Sports Drive on-ramp to be replaced with the Lexington Road on-ramp
  - managed motorway features for the extent of the works, as well as ramp metering at the Lexington Road on-ramp and Paradise Road/Loganlea Road on-ramp
  - modifications to the western service road from Judds Court to Carlyle Street to provide four lanes and an on-road cycle track.
- 1.1 kilometres of southbound motorway widening, incorporating:
  - southbound motorway generally utilises the existing northbound carriageway
  - M1 southbound lane arrangement includes extension of the four lanes from Rochedale Road off-ramp to Springwood Road overpass, merging into the existing three lanes at the Logan Road overpass.

6 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 number of trips, vehicle kilometres travelled, 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, including net present value (NPV), benefit cost ratio (BCR), internal rate of return, and first year rate of return. The CBA was completed using the assumptions shown in Table 1.

Table 1 Cost benefit analysis assumptions

ITEM	ADOPTED ASSUMPTION	SOURCE AND COMMENTS
Real discount rate	Seven per cent (real) as central case Four per cent and 10 per cent (real) as sensitivity tests	Infrastructure Australia (2018) and BCDF
Base price year	March 2018	Latest ABS price index data was March 2018 Parameters in earlier price years have been inflated to March 2018 dollars based on the Brisbane Consumer Price Index and Queensland Wage Price Index, where appropriate however project cost estimates were provided in June 2018 present values.
Construction period	January 2020 – mid June 2023	TMR
Appraisal period	June 2018 to December 2051	Infrastructure Australia (2018), ATAP – T2 (2016) Commences in FY2018–19 and extends to 30 years from the opening date of the assessed project option with the earliest opening date.
Residual value	Applied at the end of the appraisal period Based on assumed infrastructure life of: ▪ bridge infrastructure (concrete): 120 years ▪ road infrastructure: 30 years	Infrastructure Australia (2018), TMR Transport for NSW (TfNSW) (2016) ATAP – T2 (2016)
Annualisation factor	357 (car); 310 (LGV); 291 (HGV); 300 (public transport passenger). Sensitivity tests were also conducted for 260, 290 and 330.	TMR TARS Classified Traffic Counts (Site reference 131796 – M1 at Paradise Road) – 2013 to 2016 TfNSW (2016)

7 Demand forecasts

Transport modelling has been undertaken to understand how the reference project will affect traveller behaviours and outcomes and provided the evidence base for quantifying benefits. Two models were used:

- Zenith Strategic Model for M1—a strategic model used to represent area-wide, multimodal travel
- Zenith Dynamic Traffic Assessment Model—a corridor-level dynamic traffic assignment model used to represent vehicle queuing in more detail.

Two behavioural response scenarios were modelled—a fixed trip matrix which only allows for changes in route choice in both models, and a variable trip matrix via the strategic model which allows for changes in route, mode and destination.

In the short term the fixed trip matrix is a reasonable assumption, but over the longer-term the variable matrix is a considered more realistic. To capture the changes in behavioural response for the reference project over time, the CBA relies upon benefits associated with a 'blended' scenario.

8 Profile of capital, operating/maintenance costs

The economic costs of delivering and maintaining the reference project (capital and operating costs) are included in the CBA. All costs have been estimated incremental to the base case and are expressed in real June 2018 dollars (Table 2).

Table 2 Project capital cost estimate

CAPITAL COSTS ($ JUNE 2018, MILLIONS, UNDISCOUNTED)							
	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24	TOTAL (UNDISCOUNTED)
P50	18.9	110.6	174.4	189.3	127.2	6.6	627.0
P90	19.6	114.6	182.7	197.0	135.3	7.9	657.1

Operating and maintenance costs incremental to the base case include additional bus operating expenditure, reduced road and structural maintenance (including the busway extension) and reduced intelligent transport systems operating costs. The incremental cost of other maintenance items (such as corridor management—environment, road safety and traffic operations) were investigated; however, these were not found to change significantly between the base case and reference project.

Annual lighting and delineation costs have been conservatively assumed to remain the same between the base case and reference project. However, it is likely the reference project will experience reduced annual lighting and delineation maintenance costs during the beginning of its lifetime as these components will be replaced during construction. It is noted though that the impact of this annual saving in operating costs on the reference project is expected to be small. Operating and maintenance costs are summarised in Table 3.

Table 3 Operating and maintenance costs

OPERATING AND MAINTENANCE COSTS INCREMENTAL TO BASE CASE ($ MARCH 2018 MILLIONS, UNDISCOUNTED)		
	AVERAGE ANNUAL EXPENDITURE (UNDISCOUNTED)	TOTAL EXPENDITURE | 30 YEAR APPRAISAL PERIOD
Bus operating expenditure	5.4	182.2
Road and structural maintenance	-0.3	-29.8
ITS operating costs	-0.4	-12.9
Total	**4.7**	**139.5**

Reduced operating and maintenance costs for the reference project are due to the time-profile of operating expenditure. These were excluded from maintenance costs in line with an assumed zero residual value at the end of its useful life. The overall reduction in ITS operating costs is due to a lack of ramp metering and variable speed limits between Nujooloo Road exit and the Logan Motorway/M1 Motorway merge in the reference project. Ramp metering and variable speed limits are present in the base case.

9 Project benefits

The primary focus of M1 upgrade options is improving direct transport outcomes for users of the network. The EMP2DH Project is also expected to generate a number of indirect benefits. The benefits that have been quantified and valued in monetary terms are summarised as follows and further in Table 4:

- direct benefits to users—a net reduction in congestion costs and improvements in travel time reliability for private vehicle users, commercial vehicles and public transport passengers as well as improvements in public transport and active transport amenity
- benefits to government—increases in government revenue paid by transport system users
- broader benefits to South East Queensland—community benefits from reduced crash costs
- wider economic benefits—economic gains in markets and economic sectors beyond the direct user impacts and 'external' impacts conventionally measured in CBA
- Additionally, residual values of assets have been recognised in the last year of the appraisal period to represent the unused portion of assets that have lives greater than the appraisal period.

Table 4 Project benefits

ECONOMIC BENEFITS ($ MARCH 2018 MILLIONS, REAL, PRESENT VALUES DISCOUNTED AT 7%)	($ M)
Road user benefits	550.2
Public transport user benefits	108.4
User benefits reflected in changes in government revenue	24.0
Externalities	-11.7
Other benefits	3.7
Residual value of assets	7.5
Total	**682.0**
Travel time reliability	28.3
Wider economic benefits (excluded from BCR Results)	14.4

10 Cost benefit analysis results

The results of the cost benefit analysis for the reference project are presented in Table 5. Monetised costs and benefits were discounted to present value terms using a real discount rate of 7 per cent per annum.

Table 5 Project result table

CBA RESULTS ($ MARCH 2018 MILLIONS[1], REAL, PRESENT VALUES DISCOUNTED AT 7%)[2]	REFERENCE PROJECT ($M)	% OF TOTAL
PROJECT COSTS (P90 ESTIMATES)	**530.9**	**100%**
Project costs[2]	491.9	93%
Operating and maintenance costs | infrastructure	-13.8	-3%
Operating and maintenance costs | bus fleet	52.9	10%
TOTAL PROJECT BENEFITS	**682.0**	**100%**
Residual value of assets[2]	**7.5**	1%
Car Drivers and Passengers	**428.9**	**63%**
Travel time savings | personal	317.8	47%
Travel time savings | business	80.1	12%
Fuel consumption	87.0	13%
VOC excluding fuel	-55.9	-8%
Light Goods Vehicles	**37.3**	**5%**
Travel time savings	37.0	5%
Fuel consumption	5.2	1%
VOC excluding fuel	-4.9	-1%
Heavy Goods Vehicles	**84.0**	**12%**
Travel time savings	70.7	10%
Fuel consumption	10.0	1%
VOC excluding fuel	3.3	0%
Public Transport User Benefits	**108.4**	**16%**
Trip time savings | personal[3]	21.3	3%
Trip time savings | business[3]	0.0	0%
Station amenity benefits | personal	80.7	12%
Station amenity benefits | business	5.0	1%
Fare benefits	1.4	0%
User Benefits Reflected in Changes in Government Revenue	**24.0**	**4%**
Excise and GST on fuel	8.2	1%
Fare collected	15.8	2%
Externalities (emissions)	**-11.7**	**-2%**
Crash cost savings	**3.7**	**1%**

CBA RESULTS ($ MARCH 2018 MILLIONS[1], REAL, PRESENT VALUES DISCOUNTED AT 7%)[2]	REFERENCE PROJECT ($M)	% OF TOTAL
Benefit cost ratio	**1.28**	
Net present value	**$151M**	
Internal rate of return	9.3%	
First year rate of return	4.2%	
Productivity benefits	**$239M**	
BENEFITS EXCLUDED FROM BCR RESULTS	**42.7**	**100%**
Travel time reliability	**28.3**	**66%**
Car drivers and users	19.7	46%
Light goods vehicles	1.4	3%
Heavy goods vehicles	2.3	5%
Public transport users	4.9	11%
Wider economic benefits	**14.4**	**34%**
WEB1 | Agglomeration economies	8.9	21%
WEB2 | Output change in imperfectly competitive markets	4.2	10%
WEB3 | Tax revenues from labour market impacts	1.2	3%

(1) Excluding Project Case capital costs and associated residual values that are in $ June 2018 millions (base case capital costs are in $ March 2018 millions).
(2) Results estimated incremental to the base case, discounted over the period appraisal period (June 2018 - December 2051). Benefits held constant post last modelled year (2041).
(3) Includes car and walk access, waiting and transfer time savings.

11 Sensitivity analysis

CBA results are based on best estimates of costs and benefits. The robustness of the economic analysis results was assessed through a series of sensitivity tests, including all of those suggested by Infrastructure Australia's Assessment Framework (2018) plus others considered relevant. Under the discount rate sensitivity tests, the BCR increases to 1.9 when a four per cent discount rate is used and declines to 0.9 at a 10 per cent discount rate.

The internal rate of return is the minimum discount rate at which the initiative is viable in economic terms. The observed internal rate of return of 9.3 per cent indicates the reference project will return a positive NPV for all discount rates below this rate. The sensitivity analysis for the reference project is summarised in Table 6.

Table 6 Sensitivity analysis

SENSITIVITY TEST	REFERENCE PROJECT	
	BCR	% CHANGE
REFERENCE PROJECT	**1.28**	
Discount rate 4%	1.9	51%
Discount rate 10%	0.9	-31%
P50 Project costs	1.3	4%
P90 Project costs + 20%	1.1	-17%
P90 Project costs - 20%	1.6	25%
Project benefits + 20%	1.5	20%
Project benefits - 20%	1.0	-20%
P90 Project costs -20%, project benefits + 20%	1.9	50%
P90 Project costs +20%, project benefits - 20%	0.9	-33%
Inclusion of travel time reliability benefits	1.3	4%
Inclusion of real price escalation	1.2	-3%
Annualisation factor of 260	1.0	-19%
Annualisation factor of 290	1.1	-12%
Annualisation factor of 330	1.2	-3%

12 Other considerations

Assumed proposal completion times

Assuming the reference project was approved for procurement in September 2018, development and procurement activities including land acquisitions, approvals and design development for early works would take place through to January 2020 when construction begins. Construction on the main works would begin mid-2021, with all construction expected to be completed by mid-2023.

Wider economic impact assessment

Wider economic benefits reflect economic gains that arise from relaxing some of the assumptions in conventional CBA, such as that all markets are perfectly competitive. Wider economic benefits complement

the direct user impacts (and externality benefits) measured elsewhere in CBA. Three main categories of wider economic benefits are relevant to transport initiatives:

- Agglomeration economies (WEB1)
- Output change in imperfectly competitive markets (WEB2)
- Tax revenues from labour supply impacts (WEB3)

Under Infrastructure Australia's Assessment Framework (2018), and consistent with local and international guidance, wider economic benefits are not included in the central case BCR calculation. These results are summarised in Table 7.

Table 7 Wider project economic impacts

WIDER ECONOMIC IMPACT	CBA RESULTS
Productivity gains (GSP)	$239 million
Wider economic benefits	$14.4 million