

M1 PACIFIC MOTORWAY – VARSITY LAKES TO TUGUN (VL2T) 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 – Varsity Lakes to Tugun Project (VL2T) 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 Q4 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 – Varsity Lakes to Tugun (VL2T) 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	\$960 million	\$1,017 million
Incremental ongoing cost ²	\$173 million	\$181 million
Net Present Value (NPV)	\$446 million	\$419 million
Benefit cost ratio (BCR)	1.74	1.67

¹ Nominal capital cost estimates are undiscounted and have been rounded to the nearest million.

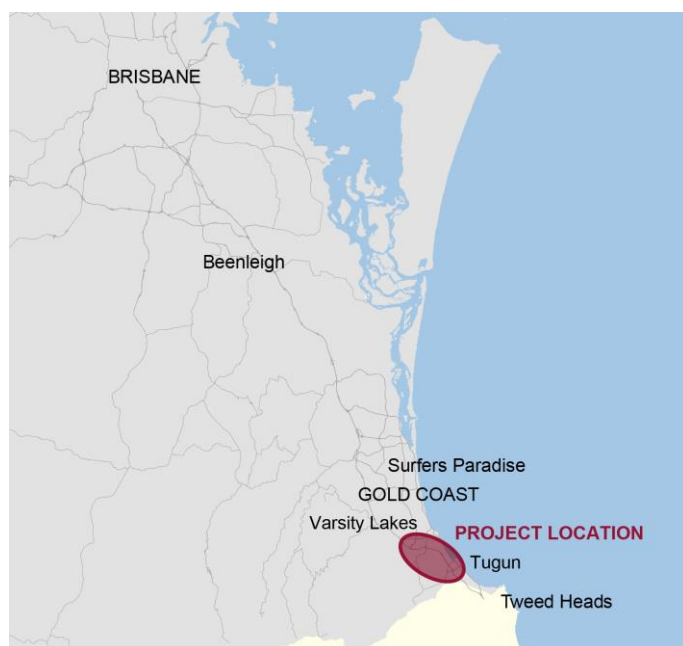
² Nominal ongoing operating and maintenance costs, undiscounted dollars and rounded to the nearest million.



2 Proposal overview

The M1 Pacific Motorway is the key road link between Queensland and NSW. It is also the primary regional road connecting Brisbane and the Gold Coast. It caters for long-distance travellers, local residents, commuters, commercial vehicles, freight, buses, tour operators and international and domestic tourists.

The Australian and Queensland Governments have been progressively upgrading the motorway and work is now underway on widening the section between Nerang and Tugun from four to six lanes. Construction is complete between Nerang and Mudgeeraba, works are underway from Mudgeeraba to Varsity Lakes and planning for the Varsity Lakes to Tugun section is being undertaken through the VL2T Project.



The detailed business case for the VL2T 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 VL2T 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 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 VL2T Project.



3 Approach

A cost benefit analysis (CBA) was undertaken as part of the detailed business case to establish the economic case for the VL2T Project. The 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. In this way, all costs and benefits are measured and compared in 'present value' terms.

The economic costs of delivering and maintaining the reference project (capital and operating costs) have been included in the CBA. All costs were estimated incremental to the base case and are expressed in real June 2018 dollars. In keeping with the application of real effects only, project costs include only real price escalation.

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 information on a specific topic was unclear, other documents sourced from Australian and international literature were considered.

4 Base case

Between Varsity Lakes Interchange (Exit 85) and Tugun Interchange (Exit 95), the M1 is four lanes (two lanes in each direction) with a posted speed limit of 100km/h. It passes through a highly developed urban area and includes six interchanges and numerous other large structures both under and over the motorway.

Should the VL2T Project not proceed, significant works will still be required for the motorway to remain operational. The pavement must be fully replaced, including concrete median barriers, and additional geotechnical works are needed to strengthen embankments. The detailed business case assumed that these works would be delivered in four stages between July 2020 and December 2027.

Pressure on the M1 Pacific Motorway will intensify as South East Queensland continues to grow and regional employment becomes more centralised. Approximately 400,000 extra jobs are projected for Brisbane City by 2041 and about 170,000 for the Gold Coast. More workers will be commuting to these economic hubs from surrounding local government areas, and despite upgrades to the public transport network, many of these trips will be on the M1.



Traffic modelling shows the base case will be unable to cope with forecast traffic flows, exacerbating congestion and heightening safety risks for both freight and commuter traffic. The two largest congestion points on the motorway (Palm Beach Avenue in the morning and Bermuda Street in the evening) will remain the same in 2026 as in 2016. However, queues begin earlier, dissipate later and affect longer portions of the motorway, as regional population and employment growth increase traffic demand.

By 2026, morning peak-hour congestion lasts until 11 am instead of 9 am and trips through the 10-kilometre stretch take 15 minutes longer than in 2016. By 2041, peak-hour is not expected to end until 1pm and trips take twice as long as in 2016.

5 Reference project

The key features of the reference project include:

- six lanes full construction of the M1 between Varsity Lakes and Tugun, including auxiliary lanes between the majority of interchanges
- overall improved geometric alignments, sight distances and ramp lengths
- motorway realignment of tight horizontal curves between Burleigh and Tallebudgera
- upgrade of Varsity Lakes, Burleigh, Tallebudgera and Palm Beach interchanges, including replacement of the Reedy Creek flyover and a new flyover at Bermuda Street
- relocation of Sarawak Avenue exit ramp through the provision of a southbound collector road between Palm Beach Avenue and Sarawak Avenue
- new bridge overpass at Nineteenth Avenue to accommodate future heavy rail requirements
- entry ramp upgrades between Nerang and Tugun to provide improved ramp storage for ramp metering
- managed motorways between Nerang and Tugun including ramp metering, variable speed limit (VSL) and variable message signs
- new service road between Tallebudgera and Palm Beach interchanges including a crossing of Tallebudgera Creek and a connection to Tsipura Drive
- cycle facilities at interchanges and along service roads to improve cycle connectivity
- two fauna crossings.

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

ASSUMPTION	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	June 2018	Latest ABS price index data was June 2018. Parameters in earlier price years were inflated to June 2018 dollars based on the Consumer Price Index or change in Average Weekly Earnings, where appropriate.
Construction period	June 2019—December 2023 (benefits accruing from July 2024)	TMR
Appraisal period	June 2018—June 2054	Infrastructure Australia (2018), ATAP – T2 (2016) Commences in FY2017–18 and extends to 30 years from the opening date of the reference project
Residual value	Assumed to be zero for reference project and base case	Reference project contains bridge infrastructure that would have a useful life longer than the appraisal period. However, the inclusion of a residual value assumes that the bridge is entirely rehabilitated (or new) following construction. As the VL2T Project is focused on road widening, some bridges included in reference project will have a lesser remaining asset life, resulting in a lower residual value. It has therefore conservatively been assumed that reference project has no residual value, as information around the proportion of fully rehabilitated versus partially rehabilitated bridges is unavailable
Demand annualisation factor	350 (car); 312 (LGV); 302 (HGV); 285.6 (PT passenger) Sensitivity tests were also conducted for 260, 290 and 330.	TMR TARS Classified Traffic Counts – 2013 to 2016 and ATAP – M1 (2018)

7 Demand forecasts

Transport modelling has been undertaken to understand how the reference project will affect travel 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. For the reference project, allowing for changes in route choice only (i.e. the fixed trip matrix) would overstate the benefits by holding constant several behavioural responses that tend to reduce travel-time savings (e.g. people choosing to travel further, adding to road congestion). In contrast, the variable trip matrix understates benefits because it assumes substantial behavioural responses will occur immediately after the reference project opens.



To capture changes in behavioural response for the reference project over time, the CBA relies upon benefits associated with a ‘blended’ scenario, which assumes a transition from the fixed trip matrix to the variable trip matrix over a 10-year period, commencing from the first year after the reference project opens.

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. In keeping with the application of real effects only, project costs include only real price escalation. Economic capital costs including planning, design, construction and client and construction contingencies have been used as the central case for the economic assessment (Table 2). Costs incurred before the start of the appraisal period (sunk costs) are excluded.

Table 2 Project capital cost estimate

CAPITAL COSTS ¹ (\$ JUNE 2018, MILLIONS, UNDISCOUNTED)							
	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24	TOTAL (UNDISCOUNTED)
P50	61.2	119.8	214.9	236.4	186.1	65.5	883.9
P90	61.2	119.8	214.9	236.4	186.1	114.9	933.3

¹ As used in the economic analysis, cashflow allows for P50 risk to be spread during the scoping, development and delivery phases and then the difference between P50 and P90 risk quantum in the year after delivery.

Operating and maintenance costs include all labour, machinery and materials for routine, periodic and rehabilitation maintenance required to maintain and preserve the reference project. Ongoing operating and maintenance costs have been included from the first full year of operations (immediately after construction finishes) to the end of the evaluation period of 30 years.

Quantified operating costs for this economic assessment are structural maintenance and rehabilitation costs relative to the base case. Annual lighting and delineation costs have been conservatively assumed to remain the same between the Base Case and reference project. The incremental cost of other maintenance items (e.g. corridor management—environment and road safety, intelligent transport systems (ITS) and traffic operations) have been assumed to not vary significantly between the base case and reference project.

Operating costs for the reference project, relative to the base case, are summarised in 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
Routine maintenance	0.9	33.1
Rehabilitation	0.6	22.5
ITS operating costs	0.7	27.8
Total	2.2	83.4



9 Project benefits

The primary focus of the reference project is improving direct transport outcomes for users of the network. This focus is reflected in the project objective of a transport corridor that improves travel times, reliability and safety and optimises efficiency. Alongside these primary outcomes and associated benefits, the reference project is also expected to generate a number of non-user benefits. Targeted and monetised benefits are:

- direct benefits to users—travel time savings, reduced vehicle operating costs and improvements in travel time reliability and safety for private vehicle users, commercial vehicles and public transport passengers as well as improvements in public transport amenity
- benefits to South East Queensland—improvements to externalities
- benefits to government—increases in government revenue (i.e. excise and GST on fuel, and farebox revenue)
- wider economic benefits—economic gains that arise from relaxing some of the assumptions in conventional CBA, such as that all markets are perfectly competitive. Wider economic benefits estimate the impact on markets and economic sectors beyond the direct user impacts and ‘external’ impacts conventionally measured in CBA.

Benefits for the reference project are summarised in in Table 4.

Table 4 Project benefits

ECONOMIC BENEFITS (\$ JUNE 2018 MILLIONS, REAL, PRESENT VALUES DISCOUNTED AT 7%)	(\$ M)
Road user benefits	1,076.2
Public Transport user benefits	41.9
Changes in Government revenue	-12.3
Unperceived impacts of changes in user behaviour	-61.7
Externalities	4.3
Total	1,048.4
Travel time reliability	82.3
Wider economic benefits (excluded from BCR Results)	74.8

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 (\$ JUNE 2018 MILLIONS ¹ , REAL, PRESENT VALUES DISCOUNTED AT 7%)	REFERENCE PROJECT (\$M)	% OF TOTAL
PROJECT COSTS (P90 ESTIMATES)	629.0	100%
Project costs	615.4	98%
Operating and maintenance costs	13.6	2%
TOTAL PROJECT BENEFITS	1,048.4	100%
User benefits (consumer surplus)	1,118.0	107%
Car users	927.4	88%
Travel time savings personal	613.3	58%
Travel time savings business	120.2	11%
Fuel consumption benefits	193.9	18%
Light goods vehicles	43.8	4%
Travel time savings	35.1	3%
Fuel consumption benefits	8.7	1%
Heavy goods vehicles	105.0	10%
Travel time savings	78.7	8%
Fuel consumption benefits	26.2	2%
Public transport user benefits	41.9	4%
Trip time savings personal ²	33.3	3%
Trip time savings business ²	12.3	1%
Station amenity improvements Personal	-1.3	0%
Station amenity improvements Business	-2.5	0%
Savings in public transport fares	0.1	0%
Consumer surplus as reflected in	-12.3	-1%
Additional government revenue from excise and GST on fuel	-12.1	-1%
Additional public transport fare revenue collected	-0.2	0%
Unperceived impacts of changes in user behaviour	-61.7	-6%
Changes in vehicle operating costs (excl. fuel) car	-70.6	-7%
Changes in vehicle operating costs (excl. fuel) LGV	-1.3	0%
Changes in vehicle operating costs (excl. fuel) HGV	12.0	1%
Crash cost savings	-1.7	0%
Externalities	4.3	0%
Reduced emissions	4.3	0%
Benefit cost ratio	1.67	
Net present value	\$419M	
Internal rate of return	11.8%	



CBA RESULTS (\$ JUNE 2018 MILLIONS ¹ , REAL, PRESENT VALUES DISCOUNTED AT 7%)	REFERENCE PROJECT (\$M)	% OF TOTAL
First year rate of return	9.7%	
Productivity benefits	\$413M	
BENEFITS EXCLUDED FROM BCR RESULTS	157.1	100%
Travel time reliability	82.3	52%
Travel time reliability improvements car	74.4	47%
Travel time reliability improvements LGV	3.4	2%
Travel time reliability improvements HGV	4.5	3%
Wider economic benefits	74.8	48%
WEB1 Agglomeration economies	57.1	36%
WEB 2 Output change in imperfectly competitive markets	14.4	9%
WEB 3 Tax revenues from labour market impacts	3.3	2%

(1) Results estimated incremental to the base case, discounted over the period appraisal period (June 2018 to September 2054). Benefits held constant post last modelled year (2041).

(2) 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 2.6 when a four per cent discount rate is used and declines to 1.1 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 11.8 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	BCR
Reference project	1.67
DISCOUNT RATE	
4%	2.6
10%	1.1
PROJECT COST	
P50 costs	1.7
+20% costs	1.4
-20% costs	2.1
PROJECT BENEFITS	
+20% benefits	2.0



SENSITIVITY TEST	BCR
- 20% benefits	1.3
BEST CASE SCENARIO	
+20% benefits and -20% costs	2.5
WORST CASE SCENARIO	
-20% benefits and +20% costs	1.1
ANNUALISATION FACTOR	
Road user annualisation factor of 260	1.3
Road user annualisation factor of 290	1.4
Road user annualisation factor of 330	1.6
ADDITIONAL BENEFITS	
Including wider economic benefits and reliability benefits	1.9

12 Other considerations

Assumed proposal completion times

Assuming design activities can commence in January 2019, construction on the VL2T Project could be completed by December 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 all 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)	\$413 million
Wider economic benefits	\$74.8 million