BUILDING QUEENSLAND

BEERBURRUM TO NAMBOUR RAIL UPGRADE DETAILED BUSINESS CASE 2016

COST BENEFIT ANALYSIS SUMMARY

D17/5182

Purpose of this document	This document provides an overview of the economic analysis for the Beerburrum to Nambour Rail Upgrade Detailed Business Case 2016. 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 2016. 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	Beerburrum to Nambour Rail Upgrade Project (B2N project)	
Location	The 39-kilometre section of the North Coast rail line between Beerburrum and Nambour stations, to the north of Brisbane in South East Queensland.	
Proposal owner	Department of Transport and Main Roads	
Proposed delivery agency	Queensland Rail	
Capital cost[1] (P90)	$784 million (nominal)	$706 million (real)
Incremental ongoing cost[2] (P90)	$243 million (nominal)	$123 million (real)
Discount rate	7%	
Net present value (NPV)	$262 million (P50 costs)	$207 million (P90 costs)
Benefit cost ratio (BCR)	1.48 (P50)	1.35 (P90)

[1] Capital cost estimates are nominal, undiscounted 2016 and rounded to the nearest million.
[2] Ongoing operating and maintenance costs, undiscounted.

2 Proposal overview

The North Coast rail line is approximately 1,680 kilometres in length, spanning from Brisbane (within the South East Queensland passenger rail network) to Cairns in Far North Queensland. It forms part of the Australian Government's National Land Transport Network. The North Coast line caters for a mix of passenger transport and essential freight movements including high speed passenger tilt trains, containerised freight services and cattle trains.

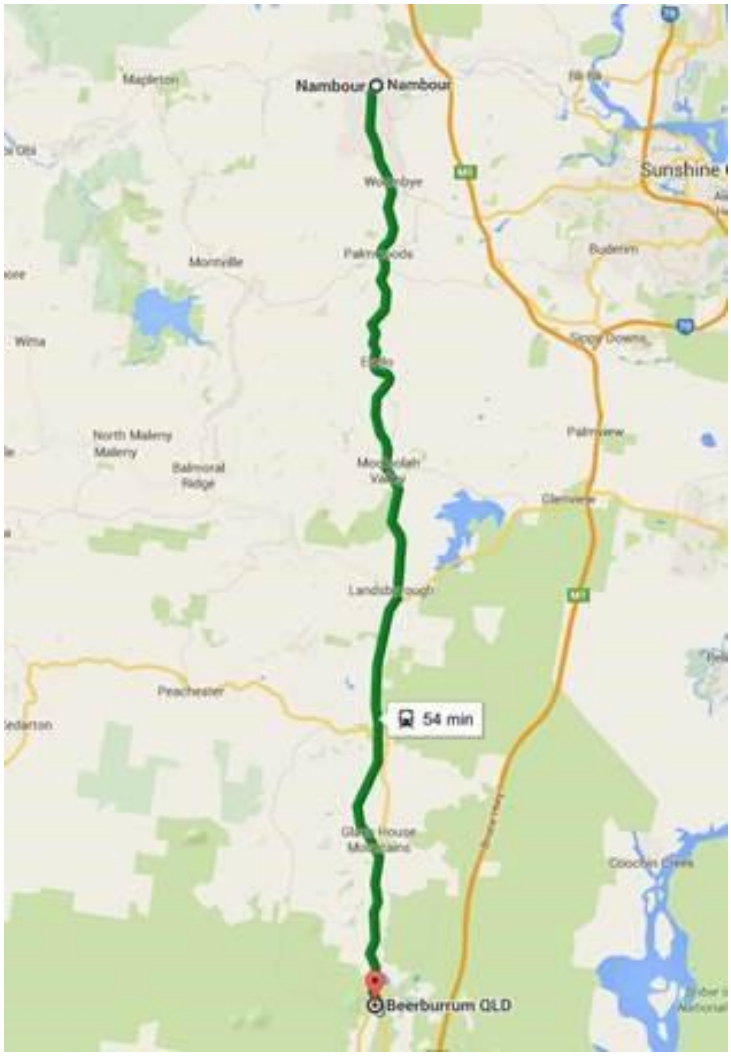
A number of studies over the last 15 years have determined that the ability of the North Coast line to effectively meet current and future passenger and freight transport demand is hindered by constraints in the 39-kilometre bi-directional segment of the North Coast line between Beerburrum and Nambour. The current infrastructure restricts operating speeds due to poor horizontal and vertical track alignment and the presence of numerous level crossings. The lack of functional crossing loops also restricts the ability to pass a freight train with another train between Beerburrum and Nambour.

Significant conflicts currently exist between freight and passenger services on the shared Beerburrum to Nambour corridor resulting in disruptions, service unreliability and increased travel times. Freight services are generally constrained to operating in off-peak periods due to an effective curfew, resulting in decreased commercial path availability to freight operators. The combination of these factors increase the operational and maintenance costs of the line and decrease the competitiveness of rail as a reliable and efficient mode of transport for freight and passenger movements.

The Beerburrum to Nambour Rail Upgrade Detailed Business Case (B2N project) evaluated proposed upgrades to address the reliability, safety and capacity of the North Coast line between Beerburrum and Nambour, as shown in Figure 1. The upgrades include rail duplication between Beerburrum and Landsborough and other infrastructure upgrades, such as station upgrades and additional passing loops between Landsborough and Nambour.

The B2N project contributes to the objectives of the Australian Infrastructure Plan, including greater productivity and connectivity, through the capacity improvements generated by the rail duplication and improved operational efficiency from the construction of additional platforms and passing loops. The project is identified as a near-term (within five years) 'priority initiative' on Infrastructure Australia's Infrastructure Priority List as well as the State Infrastructure Plan (2016). Building Queensland's Infrastructure Pipeline Report (December 2016) recognised it as a priority for investment consideration.

Figure 1. B2N project location



The B2N project is a critical part of a strategic plan to improve the overall efficiency of the North Coast line. There are a number of projects being undertaken by other areas within the Queensland Government, in line with the priorities identified in the Department of Transport and Main Road's Moving Freight Strategy (2013). Duplication of the Beerburrum to Nambour section of the North Coast line is explicitly mentioned in this strategy as a key transport investment priority and is expected to contribute to achieving the objective of expanding the use of rail freight through improving the efficiency, availability and capacity of the freight paths on the North Coast line.

3 Approach

The development of the cost benefit analysis involved the following steps:

- definition of the B2N project's 'base case' (i.e. without the project) against which the B2N project's 'project case' (i.e. with the project) is compared
- identification of the costs and benefits that are expected in moving from the base case to the project case
- identification of the core parameters of the analysis (e.g. time scale, base year for prices to calculate present dollar values, discount rate)
- development of rail operational modelling for the base and project cases
- development of transport modelling for the base and project cases
- development of freight forecasts for the base and project cases
- quantification of the costs and benefits over the analysis period
- estimation of the NPV, BCR and internal rate of return (IRR) using discounted cash flow techniques
- testing the sensitivity of cost benefit analysis results to changes in the underlying assumptions and different scenarios.

The key inputs to the cost benefit analysis include:

- transport modelling (public transport and road user benefits)
- rail operational modelling (rail reliability benefits and rail capacity)
- freight demand modelling (freight market benefits)
- cost estimation (capital and ongoing P50 cost estimates).

4 Base case

The base case is the benchmark against which the reference project[3] is assessed. The base case was modelled on a whole-of-life basis and includes all expected impacts, costs and benefits of the situation that would exist without the project. The B2N project base case includes:

- The rail corridor between Beerburrum and Nambour which is currently a single track with a number of passing loops along the corridor at stations only

[3] In the context of an economic analysis, a reference project represents an indicative investment proposal which addresses the identified service need. While the reference project may be subject to change during the detailed design process, it provides a reference point to assess the potential costs and benefits of the infrastructure proposal.

- A number of level crossings exist in the corridor including those at Barrs Road and Caloundra Street, Landsborough
- Mooloolah, Eudlo, Palmwoods and Woombye stations have single platforms
- Limited park and ride facilities are available at Beerburrum (20), Landsborough (300), Palmwoods (20) and Nambour (200) stations
- The corridor supports commuter, long distance and freight services with passenger services for the base case as follows:

SERVICE	2021	2026	2036
Gympie North	1	1	1
Nambour	4	5	5
Landsborough	0	0	0
Caboolture	12	15	15

- Delays to both passenger and freight services are significant and capacity for passenger services in the peak periods is limited to three trains per hour in the peak direction. Travel times between Caboolture and service end point have been modelled as follows:

SERVICE	NAMBOUR	GYMPIE
Up – Peak	55.4	123
Up – Off peak	69.7	
Up – contra-peak	56	
Down – peak	56.2	123.2
Down – off peak	69.8	
Down – contra-peak	78	

- The current freight capacity of the North Coast Line between Beerburrum and Nambour is 88 paths (44 each way) per week. Approximately 80 paths are currently used. It is assumed that once the current capacity of the rail network is reached (circa 2023), excess freight will be transported by road
- Due to conflicts with freight movements, outside the peak periods a number of passenger services are delivered as RailBus services with significantly longer journey times
- Transport modelling established the following public and private transport trips for the base case

	2021	2026	2036
Public transport	817,055	919,055	1,198,187
Car – driver	8,465,032	9,225,894	10,774,522
Car – passenger	3,237,325	3,522,606	4,019,527

The base case includes projects which have been fully or partially funded and costs to maintain the existing level of service but excludes any unfunded projects in the future network.

The base case (and reference project) includes the European Train Control System (ETCS)—Inner City and the 'Fairer Fares' package.

5 Reference project

The reference project includes the duplication of the North Coast line between Beerburrum and Landsborough and a range of other infrastructure improvements between Landsborough and Nambour to enhance the benefits of the duplication, including:

- full rail duplication (i.e. two new tracks) of the section between Beerburrum and Glass House Mountains within the protected corridor on an improved alignment
- duplication of the section between Glass House Mountains and Landsborough primarily within the existing rail corridor
- road realignments to accommodate the new rail corridor and track infrastructure
- new structures (rail bridges, road bridges, drainage structures and retaining walls) to accommodate the new track infrastructure
- replacing the Barrs Road level crossing in Glass House Mountains with a new connection to Coonowrin Road in Glass House Mountains
- replacing the Caloundra Street level crossing in Landsborough with a road over rail solution.
- In addition to these infrastructure upgrades, the reference project also includes upgrades to a range of supporting infrastructure including:
- expansion of park and ride facilities at Beerburrum, Landsborough, Palmwoods and Nambour stations to meet the 2036 passenger demand projections
- replacement of the temporary single platforms at stations with permanent dual platforms connected by lifts and overbridges (Mooloolah, Eudlo, Palmwoods and Woombye)
- extension of passing loops at Eudlo and Woombye to improve train operations.

The reference project also includes ongoing operating and maintenance costs required to maintain the new infrastructure.

The reference project excludes any unfunded projects in the future network.

6 Methodology

A cost benefit analysis was undertaken as part of the detailed business case to test the project's economic viability. Road user travel patterns and the generalised cost of public transport movements were provided by the B2N project's transport demand modelling advisor utilising the SEQ Strategic Transport Model, Multi Modal version (SEQSTM-MM). Queensland Rail provided further information on rail operations and reliability.

The benefits are estimated in incremental terms (i.e. project case versus base case). The benefits of the B2N project are mainly derived from the travel time savings and increase in rail services between Beerburrum and Nambour which benefits existing rail users and creates a mode shift (e.g. some road users switch to public transport, and when this occurs, there is a flow on benefit to remaining road users who benefit through reduced road congestion).

The majority of road user benefits accrue to 'remaining' road users through a reduction in congestion on the road network, as existing road users switch to public transport. Public transport users benefit through an increase in the number of services offered at peak times and through a reduction in travel times. These user

benefits are measured as 'generalised' costs and reflect savings in access time, wait time and in-vehicle time for rail passengers.

Table 1 provides a summary of the key analytical parameters underpinning the cost benefit analysis.

Table 1 Key cost benefit analysis parameters

PARAMETER	VALUE	SOURCE
Discount rate	A 7% discount rate is used for the central case with sensitivity tests conducted at 4% and 10%	Infrastructure Australia Business Case Assessment Template 2016
Price year	2016	n/a
Evaluation period	50 years from the end of the capital investment (i.e. first year following the construction period). The first year of measured benefits is from 2022, being the year of anticipated operations commencement	Australian Transport Assessment and Planning Guidelines
Indexation	CPI 2.5% Capital cost escalation 0.5% real Operating cost escalation 0.25% real Lifecycle cost escalation 0.25% real	B2N project's cost and risk advisor
Unit costs and parameter values	Adapted from the Australian Transport Assessment and Planning Guidelines and other sources, such as Austroads (where Queensland specific values are not available, the Transport for New South Wales guidelines were also used). The unit parameters include the value of time (i.e. $/hr), vehicle operating costs, value of life and externality parameters	
Modelled periods	The modelling undertaken to support the cost benefit analysis relies on outputs from a transport model. The modelled years from the transport model are 2021, 2026 and 2036	South East Queensland Strategic Transport Multi-Modal Model (SEQSTM-MM)
Annualisation SEQ transport network Freight—train Freight—road	Days per year 251 (public transport and road users) 320 300	

7 Demand forecasts

Demand forecasts form a fundamental component of any economic analysis as the majority of economic benefits are derived based on the number of users. One of the primary drivers for the B2N project is the inability of the existing infrastructure to cater for existing and forecast demand in freight and passenger rail movements.

Freight demand

The North Coast line forms an important link in the National Land Transport Network. Growth in demand for Queensland products and commodities coupled with population growth in and around the regional areas of Cairns, Townsville, Mackay and Rockhampton, will result in continued growth in freight demand.

A freight forecast has been developed as part of the detailed business case process based on current Queensland Rail data and forecast changes in population and economic growth (e.g. gross state product [GSP]). A summary of the assumed population and economic growth rates are presented in Table 2 and Table 3.

Table 2 Forecast population growth[4]

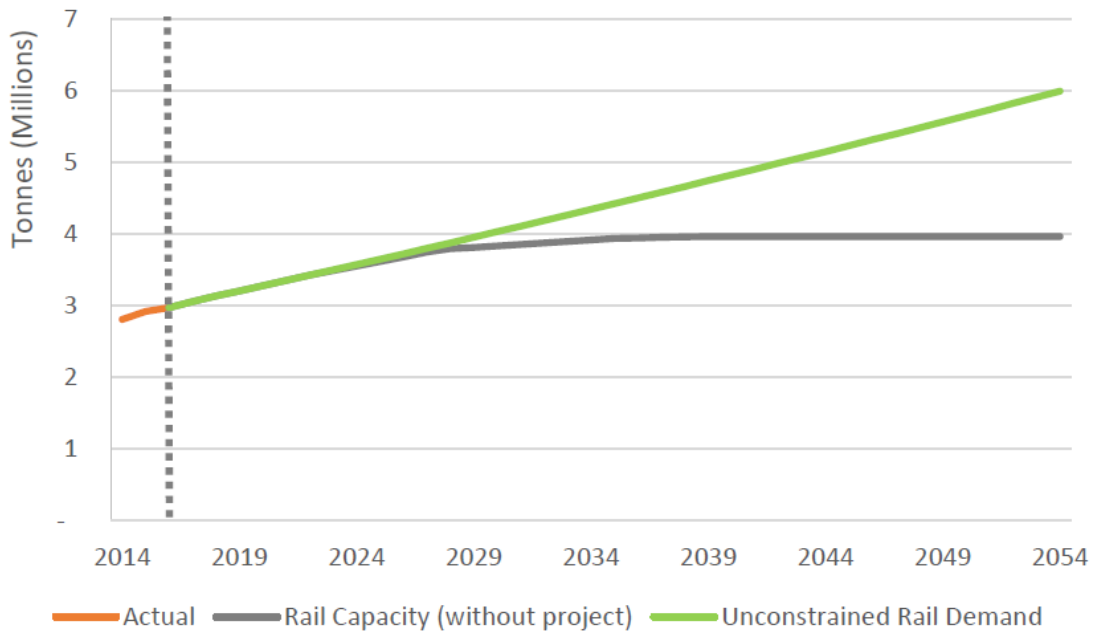
DESTINATION	COMPOUND ANNUAL POPULATION GROWTH RATE % (2015–2036)
Rockhampton	1.9
Mackay	2.0
Townsville	1.9
Cairns	1.6

Table 3 Forecast Queensland economic growth[5]

FUTURE YEARS	FORECAST NOMINAL GSP GROWTH RATE %
2017	4.5
2018	3.8
2019	3.3
2020–2073	2.3 (average)

Based on forecast growth assumptions detailed above, demand modelling[6] was undertaken to determine when the existing infrastructure would meet capacity constraints assuming a continuation of the existing modal share between road and rail. Analysis summarised in Figure 2 found that based on the forecast demand, additional capacity would be required by 2023 to meet supply freight chain requirements. The demand analysis implies that by 2023 rail demand will exceed capacity resulting in additional freight needing to travel by road. This would increase congestion on the Bruce Highway and increase the likelihood of road safety incidents. It is estimated that without the B2N project there would be an additional 497 truck trips each week on the Bruce Highway by 2036.

Figure 2. Forecast capacity and demand (million tonnes per annum)



[4] Queensland Statistician Office, Queensland Government Population Projections, 2015
[5] Queensland Treasury, Mid-Year Fiscal and Economic Review 2015–16, 2015
[6] The demand analysis is based on the SEQSTM-MM transport model which was developed and is owned by the Department of Transport and Main Roads.

Passenger demand

The population of South East Queensland is forecast to grow by over 1.6 million between 2014 and 2036 with a growth rate of 2.1 per cent per annum to 2026 and then 1.9 per cent per annum to 2036. The population of the Sunshine Coast region is expected to grow by 186,000 between now and 2036, with most of the growth being accommodated in new development areas.

It is anticipated that employment on the Sunshine Coast will grow more slowly than population, while in the Brisbane City Council area the opposite is expected. This is anticipated to result in more rail passengers travelling between the Sunshine Coast and Brisbane for work during peak periods.

Based on these factors, transport modelling has indicated that without constraints, passenger demand on the Beerburrum to Nambour section of the rail line would grow by approximately 3–4 per cent per annum on a compounding basis. The modelling found that additional passenger services would be required during the peak periods by 2021.

8 Profile of capital, operating/maintenance costs

Estimated capital costs for the B2N project are detailed in Table 4. The costs include elements such as design, enabling works, road works, station works, rail corridor works and project delivery costs.

In addition to capital costs, incremental train and bus operating costs were also identified and estimated at $243 million (P90, nominal). The incremental increase in operating and maintenance costs can be attributed to the fact the B2N project will allow more frequent services that will in turn require additional feeder bus services, bringing passengers to and from Sunshine Coast destinations.

Table 4 B2N project capital cost estimate

ITEMS	CAPITAL COST ($ MILLION, NOMINAL, ROUNDED)
Final out-turn cost (P90)	784

9 Project benefits

For the B2N project, all material benefits have been quantified in either the cost benefit analysis or the wider economic impact assessment. The identified benefits are not contingent upon capital investment in other areas of the rail and road network and can be solely attributed to the B2N project.

The construction of the B2N project will improve connectivity between the Sunshine Coast and Brisbane and facilitate access to more frequent, efficient and reliable rail services at a number of stations between Nambour and Caboolture, while also supporting significant future population growth in the region through increased capacity on the transport network. Benefits of the B2N project are detailed in Table 5.

The benefits can be divided in three broad categories:

- Transport system: These include changes in the cost (perceived or real) of travel for public transport users and private vehicle users.

Rail operational modelling determined that delivery of the reference project will result in the doubling of rail passengers carried from north of Caboolture inbound to Brisbane during the morning peak period.

Benefits from the project will begin to accrue in year one of operation (2022), as the new infrastructure and public transport routes are used, freeing up capacity on roads and decreasing journey times for all transport network users. Benefits for rail users increase in line with forecast passenger growth to 2056.

- **Freight**: This benefit category captures the impacts of increasing capacity for the freight rail network.

The B2N project is expected to almost double the freight path capacity between Beerburrum and Nambour. No additional capital investment is required on the North Coast line to accommodate this almost doubled number of paths. That is, with the B2N project in place, the forecasted demand for freight can be realised through effective operational planning, particularly as freight trains depart/arrive outside peak hours.

Freight services currently pass through the B2N project area to destinations to the north (including major areas such as Rockhampton, Mackay, Townsville and Cairns) and to destinations to the south (including the Port of Brisbane and Acacia Ridge).

Currently, the freight capacity of the North Coast line between Beerburrum and Nambour is 88 paths or trips (44 each way) per week.

- **Other**: Other benefits may include broader flow-on impacts to the local and state economy.

The B2N project involves key positive social impacts including increased employment opportunities during construction, improved accessibility to health care and medical facilities and improved disability access at upgraded stations. For the community, the B2N project will have positive impacts in helping to eliminate some of the issues currently contributing to rail's inability to provide a viable alternative to road-based travel between the Sunshine Coast and Brisbane. While the majority of these benefits have been captured, it is often not possible to capture the full scope and scale of all benefits—for example, the impact of improved health care outcomes associated with improving accessibility to medical facilities.

Table 5 B2N project benefits

BENEFIT RECIPIENT	DESCRIPTION
Transport system	
Public transport users	Doubling of rail passengers from north of Caboolture inbound to Brisbane during the morning peak Improved journey times with an average transit time saving between Nambour and Caboolture of 3 minutes Improved reliability Increased number of services offered at peak times Station improvements including replacement of existing substandard platforms with new dual high level straight platforms, station access points, station facilities and expansion of park and ride capacity
Long distance passengers	Improved journey times—new alignment will allow passenger trains to travel at faster speeds
Road users	Improved journey times through reduction in congestion on the road network, particularly on highly congested sections of the Bruce Highway. These benefits are quantified through: ▪ reduced vehicle operating costs ▪ reduction in the costs associated with crashes ▪ level crossing elimination (cost savings).
Non-users	Change in externalities (e.g. air pollution, greenhouse gas emissions)

BENEFIT RECIPIENT	DESCRIPTION
Freight	
Freight	Reduction in freight transport costs as the B2N project is excepted to almost double the freight path capacity between Beerburrum and Nambour Average reduction in transit times for freight trains of 46 minutes Reduced rail operating costs Avoided vehicle accident (crash costs—i.e. captured through a reduction in freight vehicles on the road as a result of the B2N project) Avoided environmental externalities
Other	
Government	Incremental fare revenue (captured through induced demand attributed to the project) Residual value of the asset Increases in GSP (captured through increased government taxation) Improvements in employment (both during construction and in the long term as a result of productivity increases)

10 Cost benefit analysis results

The results of the cost benefit analysis for the B2N project are presented in Table 6, including the present value of the incremental benefits and costs based on construction and operating costs at P50.

Table 6 B2N project result table

CBA RESULTS	PRESENT VALUE ($MILLION, ROUNDED $2016) @ 7% REAL DISCOUNT RATE	% OF TOTAL
Cost P50		
Capital costs	512	95
Operating and maintenance costs	30	5
TOTAL	**542**	**100**
Public transport		
Reliability	35	4
Station amenity	0.3	0
Long distance	8	1
Farebox	27	3
Road user		
Travel time	267	33
Vehicle operating costs	16	2
Externalities	(3)	0
Crashes	(3)	0
Level crossings	(3)	0
Freight		
Freight transport cost savings	219	27
Reduced rail operating costs (time component)	27	3
Value of freight travel time savings	16	2

CBA RESULTS	PRESENT VALUE ($MILLION, ROUNDED $2016) @ 7% REAL DISCOUNT RATE	% OF TOTAL
Crash costs	34	4
Externalities	28	4
Road decongestion	21	3
Residual value	6	1
TOTAL	**803**	**100**
Benefit cost ratio	1.48	
NPV	262	
Internal rate of return	9.0%	

The B2N project is economically viable as demonstrated by the benefit cost ratio of 1.48, indicating that for every dollar invested the economic return is $1.48. The total incremental economic benefits exceed the costs by $262 million (present value of the appraisal period).

11 Sensitivity analysis

Sensitivity analysis identifies key economic risks within the conducted analysis. It examines how much the results deviate as a consequence from changes in project driver/s, or combinations of drivers. It is recognised that there will always be some level of uncertainty regarding the future, sensitivity testing is a way to assess uncertainty around assumptions. The sensitivity analysis should focus on varying assumptions regarding key benefit and costs drivers i.e. demand forecasts, key benefit parameters, growth rates.

The sensitivity analysis conducted for the B2N project is summarised in Table 7.

Table 7 Sensitivity analysis

SENSITIVITY ANALYSIS	BCR	NPV ($MILLION, ROUNDED)
Main case	1.48	262
Discount rate 4%	2.98	1,276
Discount rate 10%	0.84	(75)
P90 costs	1.35	207
Project costs +20%	1.24	154
Project costs -20%	1.86	370
Project benefits +20%	1.78	423
Project benefits -20%	1.19	101
Project costs +20%, Project benefits -20%	0.99	(7)
Project costs -20%, Project benefits +20%	2.23	531
Demand capping—10 years	0.75	(136)
Demand capping—20 years	1.11	61
No real price increase in costs/benefits	1.31	179
High freight forecast	2.10	593
Low freight forecast	1.06	34
Freight forecast (2015 demographic series)	1.42	226
30-year analysis period	1.10	53

SENSITIVITY ANALYSIS	BCR	NPV ($MILLION, ROUNDED)
30-year analysis period (P90 costs)	1.01	8
Network disruption costs during construction (5%)	1.42	236

12 Other considerations

Assumed project completion times

The implementation of the B2N project is broken into two key phases:

- project development and procurement phase
- construction and contract management phase.

Indicative key milestone dates are presented in Table 8. The economic appraisal was conducted based on these high-level project milestones. The indicative dates are dependent upon confirmation of project approvals and funding.

Table 8 Indicative B2N project milestones

MILESTONES	INDICATIVE DATES
Project development and procurement phase	
Finalise project implementation plan	Q3 2017
Contract award	Q4 2018
Construction	
Commence enabling works	Q2 2019
Construction completion	Q4 2021/ Q1 2022
Operations commencement	Q1 2022

Wider economic impact assessment

The cost benefit analysis focuses on the direct impacts of the infrastructure investment which are measured by applying values for the estimated reduction in travel times and changes in operating costs for users. The economic impact assessment uses the direct benefits quantified in the cost benefit analysis to measure the broader economic flow-on impacts of the B2N project.

It is important to note that not all infrastructure projects will generate these types of benefits; however, given the scale of the B2N project they have been estimated because they were considered to be material.

Table 9 B2N project wider economic impacts

WIDER ECONOMIC IMPACTS	INDICATIVE DATE
Employment—estimated number of jobs per annum	During construction—total 669 jobs (2017–2021)
Productivity gains	The work and business related productivity gains attributed to the B2N project total $308 million over the 50-year evaluation period and comprise productivity benefits to; road users, freight users and public transport users.

Independent economic peer review

An independent peer review of the economic modelling for the B2N project was undertaken as part of the detailed business case review process. The peer review included a review of the cost benefit analysis methodology, freight demand and economic analyses.

Overall, the independent peer review concluded that the approach of the economic analysis was fit for purpose and was undertaken in accordance with the relevant guidelines. Where appropriate, comments from the peer reviewer were incorporated into the final analysis. Following the independent peer review, the detailed business case was subject to the Queensland Treasury Gateway Review process.