7 ECONOMIC ANALYSIS

CHAPTER SUMMARY AND CONCLUSIONS:

- A detailed economic analysis was undertaken for TEARC which comprised of a Cost Benefit Analysis (CBA), which measured the incremental direct benefits associated with the TEARC Project against a base ('without' project) case.
- The CBA for TEARC produced a benefit cost ratio (BCR) of 0.16 with a corresponding net present value (NPV) of negative $226.3 million using a 7 per cent real discount rate.
- Sensitivity testing of the CBA concluded that under the tests, the BCR remained below 1. Across all tests, the BCR ranged between 0.11 (10% real discount rate) to 0.26 (4% real discount rate).
- In addition to sensitivity testing, two alternative demand scenarios were modelled to estimate the impact on TEARC of different assumptions of minerals demand and Port of Townsville (PoT) trade growth. The low demand scenario lowered the BCR to 0.14, while the high demand scenario further reduced the BCR to 0.12 due to the reduction in road user benefits.
- The outcomes of the CBA need to be considered in the context of the non-monetised benefits outlined in this Detailed Business Case.

7.1 Introduction

The purpose of this section is to outline the economic impacts of TEARC. The economic analysis comprises a detailed cost-benefit analysis (CBA).

The economic analysis considers TEARC from a community perspective and identifies the costs and benefits which are both internal and external to the rail operator including government organisations, private sector enterprises, individuals and the environment. Some of these effects (such as time savings, noise and air quality effects) are not directly quantified in market based monetary terms. An economic analysis differs from a financial analysis, as the latter focuses on revenue flows, capital and operating costs for key stakeholders, and it does not include externalities or private (user) benefits such as time savings.

7.2 Approach

CBA is an economic analysis tool, based upon the principles of welfare economics, which is used to assess whether any given project should proceed by comparing the costs of the project to its benefits.

A number of sources and guidelines were referenced to develop the CBA, including:

- Australian Transport Assessment and Planning Guidelines (ATAP), Transport and Infrastructure Council (2016), Commonwealth Department of Infrastructure and Regional Development.
- Assessment Framework: Initiative and Project Prioritisation Process, Infrastructure Australia (IA) (2016).
- Guide to Project Analysis Part 4: Project Analysis Data, Austroads (2012).
- BTE 1999, Competitive Neutrality between Road and Rail, Working Paper 40, Table II.1. (data from Columns G and H, sources and derivations of data detailed in notes to table).
- DTMR 2014, Queensland Level Crossing Safety Strategy 2012-2021.
- Australian Office of the National Rail Safety Regulator 2016, Rail Safety Report 2015-2016.

In addition, the CBA was undertaken in accordance with the requirements of the Building Queensland Cost-Benefit Analysis Guide: Supporting Business Case Development (April 2016).

7.3 Methodology and Assumptions

The CBA framework is based on an annual discounted cash flow model with an analysis period of 30 years from the finalisation of capital investment (as per the BQ guidelines).

The CBA was undertaken for TEARC through the following steps:

- Definition of the 'base case' (i.e. do-minimum, without the project) against which '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).
- Estimation of future freight demand.
- Development of rail operational modelling for the base and project cases.
- Development of traffic modelling for the base and project cases.
- Quantification of the costs and benefits over the analysis period.
- Estimation of the NPV and BCR using discounted cash flow techniques.
- Testing the sensitivity of CBA results to changes in the underlying assumptions and different scenarios.

The key parameters and assumptions used in the analysis are summarised in Table 7.1.

Table 7.1 Key CBA Parameters and Assumptions

ITEM	PARAMETER/ASSUMPTION
Discount rate	The discount rate adopted in the analysis is 7% per annum (real) and is used to calculate present values. Sensitivity tests are undertaken at discount rates of 4% and 10%. These values are in accordance with guidance from Building Queensland. The economic discount rate differs from the discount rate used in the financial analysis. The economic discount rate represents the time value of money while the discount rate in the financial analysis represents the cost of borrowing.
Price year and inflation	All costs and benefits in the economic analysis are presented in 2017 real constant prices (i.e. excludes inflation). This differs from the financial analysis that is undertaken in nominal terms to show actual funding requirements.
Analysis period	An analysis period of 30 years from the end of the capital investment is adopted as per the BQ guidelines to represent the 'economic' life of the asset. The first year of benefits is measured from 2022, being the year of anticipated operations commencement. Therefore, the project benefits are measured from 2022 to 2052.
Modelled periods	The freight demand forecast is undertaken on an annual basis. However, the rail operations modelling is undertaken for 2017, 2022, 2027, 2032, 2037, 2042 and 2047 while the road traffic modelling 2022 and 2027. The interpolation of benefits is based on the demand forecast profile.
Perspective of analysis	The economic analysis considers TEARC from a Queensland community (social) perspective and considers the costs and benefits that are both internal and external to the rail operator, including government organisations, individuals and the environment. While the perspective of the analysis is for Queensland, several of the economic parameters used in the analysis represent an Australian value (e.g. the value of time used in the travel time savings).

ITEM	PARAMETER/ASSUMPTION
Base case	The base case is defined as the do-minimum case (Townsville without the project, i.e. the rail and road network without TEARC). Therefore, in the base case freight trains would continue to access the Port of Townsville (PoT) via the existing North Coast Line. Likewise, the road network would continue to experience delays at level crossings. The Base Case scope includes the rail infrastructure from the Sun Metals Branch Line, via the North Coast Line to the Jetty Branch and associated road infrastructure. The Base Case excludes the Mt Isa Line to Townsville, the North Coast Line south of the Sun Metals Branch Line and north of the Jetty Branch. It also excludes the Port of Townsville to the port boundary. The base case excludes any unfunded projects in the future network. It includes ongoing maintenance costs.
Project case	The project case is defined as Townsville with TEARC. The project case excludes any unfunded projects in the future network. The project case involves the full project scope (Reference Design). In the project case the majority of freight trains will use the TEARC alignment (sugar trains would continue to use the existing North Coast Line alignment). Road users would experience benefits due to the reduction in delays at level crossings. (refer to Chapter 5)
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, value of life and externality parameters.
Real prices	Real price escalation was applied to the value of time and other benefits at a rate 0.75% per annum (excluding rail operating cost savings). Capital costs were escalated in real prices while ongoing costs were assumed to increase at the rate of inflation (i.e. no real increase).
Risk and uncertainty (P50 versus P90 confidence levels)	All benefits and costs in the CBA are forecasts of the future and are subject to risk and uncertainty. Sensitivity analysis is a simple approach to exploring the level of risk in CBAs. More sophisticated approaches involve assigning probability distributions to risky or uncertain variables and using computer simulations (e.g. Monte Carlo methods). In accordance with the national guidelines, the CBA results are tested at the P50 and P90 confidence level for costs. The P50 costs are used in the reporting of the main CBA results. According to the Bureau of Infrastructure, Transport and Regional Economics (BITRE) (2014)[30], the CBA results used for decision making are the 'expected values', that is, the means of the probability distributions for the NPV and BCR. These are obtained by ensuring that all the individual cost and benefit estimates going into the CBA are expected values. For investment costs, the P50 value or median will equal the mean or expected value if the probability distribution is symmetrical. If the distribution is reasonably symmetrical, the P50 value can be used as an approximation of the mean for the central scenario for a CBA.

7.4 Costs

7.4.1 Capital Costs

The outturn capital costs of TEARC were provided by the TEARC Cost and Risk Advisor. The breakdown of these costs is detailed in Table 7.2.

Risk adjustments have been included (based on detailed risk modelling), which equates the construction cost estimate to P50 and P90 equivalents. The total cost is estimated to be $368.7m in nominal 2017 prices using P50 allowance for risk. Further information on project costs and risk adjustments is included in Chapter 6 and Chapter 8.

[30] Refer to page 12 of the BITRE (2014) for more detail.

Table 7.2 Nominal Capital Costs Summary

	NOMINAL COST ($ MILLION)
Total P50 risk adjusted project costs	368.7
Total P90 risk-adjusted project costs	391.7

An adjustment was made to the project costs in order to convert the outturn cost estimates to real economic costs for use in the economic analysis. The adjustment removes the general increase in prices and reflects only real escalation increases over time (e.g. increases in labour costs over and above the general increase in prices, i.e. the Consumer Price Index (CPI).

Table 7.3 details the escalation factors used in the cost estimate. To convert the nominal cost estimate into a real (escalated) cost estimate, the CPI component of the nominal escalation is removed.

Table 7.3 Escalation Rates

ESCALATION FACTORS	RATES (NOMINAL) USED IN CONSTRUCTION COST	RATES (REAL)
2018	4.65%	2.15%
2019	2.69%	0.19%
2020	3.14%	0.64%
2021	2.79%	0.29%
2022	3.03%	0.53%

CPI escalation is based on the mid-point of the inflation rate of two to three percent targeted by the Reserve Bank of Australia (RBA) and is consistent with the assumed escalation rate by economic advisor for the TEARC DBC[31].

The capital cost escalation profile is provided by the cost and risk advisor, in accordance with Department of Transport and Main Roads (TMR) guidance, which adopts the Department of Infrastructure and Regional Development (DIRD) Project Cost Breakdown (PCB) for Federally Funded project policy.

Based on the adjustment for nominal to real escalation, the economic capital cost for TEARC is $336.1m (undiscounted) and $261.2m (discounted at seven %). These resulting economic costs are summarised in Table 7.4.

Table 7.4 P50 Economic Capital Cost

COST COMPONENT	CAPITAL COST ESTIMATE[32] ($ MILLION, P50, 7% DISCOUNT RATE)
Total P50 risk adjusted costs (financial)	368.7
Removal of nominal escalation	-43.2
Inclusion of real escalation (project cost escalation above CPI)	10.5
Total economic capital costs (undiscounted)	336.1
Total economic capital costs (discounted)	261.2

[31] Note: a sensitivity test of this assumption was undertaken which did not change the project's BCR.

[32] Contains rounding.

7.4.2 Ongoing Costs

The ongoing cost estimates are 'incremental' (i.e. cost difference between the base and project case). The ongoing costs include:

- Rail costs:
  a. Fixed ongoing rail maintenance costs (and minor capital replacement)
  b. Variable ongoing rail maintenance costs
- Road costs:
  c. Fixed ongoing road maintenance costs (including minor capital replacement).

Fixed ongoing rail costs were estimated and the results show that the TEARC will increase the fixed routine maintenance cost due to requirement to maintain the existing North Coast Line and the TEARC alignment (i.e. maintenance of 2 rail lines in the project case compared to 1 rail line in the base case). However, the TEARC will reduce the number of Gross Tonne Kilometres (GTK) running over the rail lines. This will lower the ongoing costs associated for variable (or demand) based maintenance. Variable maintenance costs were estimated using the Queensland Competition Authority (QCA) reference tariff incremental maintenance charge of $1.77 per 1,000 GTK.

Ongoing costs were assumed to increase at the rate of inflation (i.e. 2.5% per annum as per the RBA target for inflation[33]). In addition to the rail costs, there are addition maintenance costs required to maintain the re-alignment of Abbot Street at Cluden including the grade separation and also the Racecourse Road realignment and road bridge over Stuart Creek.

A summary of the increment ongoing costs used in the cost benefit analysis is shown in Table 7.5.

Table 7.5 Incremental Ongoing Costs

ONGOING COSTS	TOTAL (UNDISCOUNTED) $M	PRESENT VALUE $M
Rail	15.6	4.4
Road	13.5	3.8
Total incremental ongoing costs	29.0	8.2

7.5 Benefits

The monetised, quantifiable economic benefits of TEARC included in the CBA can be divided into three broad categories:

- Rail freight benefits: this benefit includes changes in the cost of freight transportation on rail and other external benefits such as rail crashes and negative externalities.
- Road user benefits: this benefit includes changes in the cost of travel for road user on the local south Townsville road network due to reduction in delays from freight trains (e.g. at level crossings).

A summary of the benefits included in the CBA are shown in Table 7.6. The residual value of the project at the end of the analysis period is also included as a project benefit.

[33] Note: a sensitivity test of this assumption was undertaken which did not change the BCR of the project.

Table 7.6 Benefits included in the CBA

BENEFITS	DESCRIPTION
RAIL FREIGHT	
Private benefits (producer surplus)	Reduced train operating costs
External benefits	Reduced likelihood of rail crashes (and crashes at level crossings) Reduced externalities
ROAD USERS	
Private benefits (consumer surplus)	Reduced travel times (reduction in delays caused from level crossings) Reduced vehicle operating costs
External benefits	Reduced likelihood of crashes Reduced externalities
OTHER	
Residual value	Remaining value of TEARC at the end of the analysis period

The economic benefits to TEARC were quantified based on the results of rail operations modelling and road traffic modelling undertaken. The modelling found that the proposed changes to rail operations provided by TEARC would provide the following benefits:

- TEARC will allow all shunting operations originated at Stuart Yard or Partington Yard to travel via the TEARC route, significantly decreasing the number of shunts via the city centre to the port.
- The PoT will have fully symmetrical access to its facilities from two entry points – the existing Jetty Branch and new one provided by TEARC. This will add flexibility and redundancy in daily rail operations.
- TEARC will decrease heavy rail traffic through Townsville while still allowing to route trains via Abbott and the Jetty Branch. In the longer term, only sugar trains would require access to the port infrastructure via Abbot and the Jetty Branch, with all rail traffic originating on the Mount Isa line routed to the port via TEARC.
- TEARC will help reduce train cycle times, queueing and rail network delays when under heavy load, and help facilitate port expansion infrastructure development without increasing heavy rail traffic through the city.

7.5.1 Rail Benefits

The CBA included three main rail freight benefits, including reduced:

- train operating costs
- likelihood of rail crashes (and crashes at level crossings)
- negative externalities arising from TEARC.

The rail benefits were quantified using the parameter values shown in Table 7.7.

The study estimates that the average train operating cost is 2.5 cents per net tonne kilometre (NTK). This is based on the outputs from the rail operating cost model.

Also, a number of external costs and benefits are expected to accrue from the project. These costs do not have market values and so must be valued at a “shadow price”. Standard values for these shadow prices have been calculated and are accepted within the field of transport economics. Values for key externality parameters have been derived from publications by the BTE (1999), ATC (2006) and DTMR (2014).

Rail crashes were valued at 0.049 cents per NTK ($2017) as provided by BTE (1999). Crash costs at level crossings were estimated using historical information of crash types from the National Rail Safety Regulator and crash costs from ATAP (2016). The average level crossing crash cost is $844,112 and the open level crossing crash cost is 0.24 per million train kilometres.

Table 7.7 Rail Parameter Values ($2017)

RAIL PARAMETER VALUES	VARIABLES	SOURCE
Rail operating costs		
Operating cost (average for all trains)	2.5 cents / ntk	Rail operating cost model
Rail crashes		
Rail crashes (rail only crashes)	0.049 cents / ntk	BTE (1999)
Level crossing crash rate	0.24 /m train-km	DTMR (2014)
Average level crossing crash cost	$844,112	Calculated
Externalities		
Air pollution	0.22 cents / ntk	ATC (2006)
Greenhouse/climate change	0.02 cents / ntk	ATC (2006)
Noise	0.09 cents / ntk	ATC (2006)
Water	0.007 cents / ntk	ATC (2006)
Nature and landscape	0.05 cents / ntk	ATC (2006)
Total externality cost	0.40 cents / ntk	Calculated

The total rail demand for TEARC incorporates both the minerals (concentrates and fertilises/phosphate) and other freight demand forecast. In the economic analysis, no generated demand is assumed, consequently, the estimates of total rail freight tonnes are assumed to be equal in the base case and project case. The introduction of TEARC was estimated to reduce the number of “train kilometres” required to transport the forecast rail traffic demand.

Table 7.8 details the results of the rail operations. The reduction in NTKs will lower overall rail freight transport costs, reduce the likelihood of a crashes and reduce the level of emissions from trains.

Table 7.8 Rail Freight Demand and Million Net Tonne Kilometres (mNTK)

CASE	2022	2027	2032	2037	2042	2047
Rail demand (mtpa)	6.3	5.8	6.9	6.9	5.9	5.7
Base case (mNTK)	89.5	84.0	97.3	96.8	82.0	78.6
Project case (mNTK)	86.3	81.3	94.3	94.0	80.1	76.6
Savings in mNTK	**3.2**	**2.7**	**3.0**	**2.9**	**2.0**	**2.0**

Rail benefits were calculated using the change in NTKs per annum multiplied by the relevant parameter unit rate (i.e. change in NTKs between the base and project case multiplied by $/ntk). The estimated rail benefits provide by TEARC over the 30-year analysis period are shown in Table 7.9. Overall, given the modest change in NTKs provide by the project the expected rail benefits are $0.8m using a 7% discount rate.

Table 7.9 Rail Freight Demand and Million Net Tonne Kilometres (mNTK)

RAIL FREIGHT BENEFITS	TOTAL (UNDISCOUNTED)	PRESENT VALUE $M
Rail operating cost savings	2.1	0.7
Rail safety benefits	0.2	0.0
Externalities	0.3	0.1
Total	2.7	0.8

- Rail Time Savings

The rail operations modelling included an assessment of the travel times for trains in the base and project case. However, it was found that the time savings provided by TEARC were insignificant with respect to the overall travel time of trains, for instance from Mt Isa. For example, the average travel time saving in 2022 was estimated to be around 16 minutes per train that is insignificant when the majority of trains originating from the North-West Minerals Province have a travel time of around 24 hours. Therefore, potential labour cost savings from the travel time improvements were excluded.

The majority of freight products are non-time sensitive and are therefore unlikely to derive any tangible impact for customers. Therefore, the value of freight travel timesavings was not included in the CBA based on advice from the Peer Reviewer. However, a sensitivity test was included to test this assumption.

7.5.2 Road Users Benefits

TEARC is expected to improve road conditions by diverting the majority of trains accessing the PoT away from the city centre. A traffic model was developed to evaluate the impact of TEARC on the local road network and also for trucks within the Port. The main benefit provided by TEARC is the reduction in delays at level crossings on Abbott Street.

A summary of the expected travel timesavings per trip traffic modelling was undertaken for both the low season and high season (sugar season) of rail traffic. During the 2027 high season, the forecast average travel time savings per trip was 34 seconds for cars and 57 seconds for heavy vehicles. The daily traffic modelling results were annualised using a factor of 130 for the high season and 120 for the low season (250 days in total).

On average, the number of trips are forecast to increase at a rate of 1.1-1.3% for cars and 3.5-4.1% (outside the port) for heavy vehicles.

The results show that due to rail traffic using TEARC, there are less delays at the existing level crossing on Abbot Street.

Overall there is a reduction in vehicle kilometres travelled (VKTs) due to re-routing of traffic (i.e. less diversion around level crossings to avoid delays).

The economic benefits to road users are valued using the parameter values shown in Table 7.10.

The road parameter values are sourced from ATAP (2016), Austroads (2008) and TfNSW (2011).

Table 7.10 Road Parameter Values ($2017)

ROAD PARAMETER VALUES	VARIABLES	SOURCE
Value of time ($/hour)		
Car – Private	$25.8/hr	ATAP (2016)
Car – Business	$73.3/hr	ATAP (2016)
Medium Commercial Vehicle	$40.5/hr	ATAP (2016)
Heavy Commercial Vehicle	$86.7/hr	ATAP (2016)
Vehicle operating costs		
All vehicles	Variable based on operating speed	VOC model from TfNSW
Crashes		
Fatal ($m)	8.3	ATAP (2016)
Serious ($m)	0.5	ATAP (2016)
Minor ($m)	0.03	ATAP (2016)
PDO ($m)	0.01	ATAP (2016)
Externalities		
Air pollution	Cars: 1.4 cents/vkt MCV: $0.9/1000 tonne-km HCV: $0.1/1000 tonne-km	Austroads (2012)
Greenhouse	Cars: 2.2 cents/vkt MCV: $0.5/1000 tonne-km HCV: $0.1/1000 tonne-km	Austroads (2012)
Noise	Cars: 0.5 cents/vkt MCV: $0.1/1000 tonne-km HCV: $0.02/1000 tonne-km	Austroads (2012)
Water	Cars: 0.2 cents/vkt MCV: $0.1/1000 tonne-km HCV: $0.02/1000 tonne-km	Austroads (2012)
Nature and landscape	Cars: 0.3 cents/vkt MCV: $0.1/1000 tonne-km HCV: $0.02/1000 tonne-km	Austroads (2012)

Table 7.11 details the expected benefits to road users based on the travel time and distance savings from the traffic modelling and the unit parameter values described in Table 7.10.

Overall, the benefits to road users from TEARC is $25.9m over the analysis period using a 7% discount rate. Travel timesavings to cars make up the majority of benefits (53%) while travel time savings to commercial freight vehicles (medium and heavy commercial vehicles) make up 12% of the road user benefits. Due to the reduction in VKTs there are also small crash and externality benefits.

Table 7.11 Road User Benefits ($m) – 7% Discount Rate

ROAD USER BENEFITS	TOTAL (UNDISCOUNTED)	PRESENT VALUE $M
Travel time savings		
Car – Private	23.7	12.0
Car – Business	3.5	1.8
Medium Commercial Vehicle	2.8	1.4
Heavy Commercial Vehicle	6.5	3.1
Heavy Commercial Vehicle (inside the port)	0.04	0.02
Vehicle operating costs		
Car – Private	6.4	3.1
Car – Business	0.6	0.3
Medium Commercial Vehicle	1.0	0.5
Heavy Commercial Vehicle	2.6	1.2
Heavy Commercial Vehicle (inside the port)	0.004	0.002
Other		
Crash savings	2.5	1.2
Externalities	2.8	1.3
Total		
Total road user benefits	**52.5**	**25.9**

7.5.3 Residual Value

TEARC has been assigned a residual life, as key components of the investment have economic lives that extend beyond the analysis period. This allows the salvage value of the infrastructure at the end of its life to be calculated. If TEARC was hypothetically disassembled at the end of the 30-year analysis period, there may be some remaining value to the resource. Further, it accounts for asset lives that exceed beyond the 30-year analysis period. The residual value is derived from the application of the formula below:

- Residual value = Capital Cost * [(Economic life – Analysis period) / Economic life]

The residual value of the infrastructure components is $134.9m in undiscounted terms. This equates to approximately 62% of the initial cost for these items ($134.9m / $ 217.3m = 62%). Therefore, to allocate a residual value to the project risks, a factor of 62% of the initial cost for these items has been applied.

The residual value of $225.7m is then added into the final year of the analysis as a benefit (not a 'negative' cost). The results are shown in Table 7.12. The residual value is $16.3m at the 7% discount rate.

Table 7.12 Residual Value

USER BENEFITS	ECONOMIC LIFE	COST $M	RESIDUAL VALUE $M
Design	100	17.1	12.0
Rail		139.3	75.9
Road		60.9	47.0
Sub-total		217.3	134.9
Risk			
P50 Proportion			39.2
P90 Proportion			51.6
Total			
Residual value – P50			174.1
Residual value – P90			186.4

7.6 Cost Benefit Analysis Results

The results of the CBA for TEARC are presented in Table 7.13.

The majority of costs for the project relate to the capital costs while the ongoing costs add 3% to the total costs. There are modest benefits to rail freight provided by the improved rail operations that enables the majority of trains to divert to the PoT via TEARC. A notable outcome of the CBA is the size of road user benefits (54%, comprising travel time and vehicle operating cost savings) compared to rail freight benefits. Also, the residual value makes up a significant proportion of the benefits equating to $16.3m or 38% of the total benefits.

The BCR for the project is 0.16 at the 7% discount rate. This indicates that costs outweigh the benefits by a factor of more than 5. Therefore, the TEARC Project does not generate sufficient benefits to cover its costs.

Table 7.13 CBA Results – 7% Discount Rate

CBA RESULTS	TOTAL (UNDISCOUNTED)	PRESENT VALUE $M	% OF TOTAL
Costs (P50)			
Capital Costs	336.1	261.2	97%
Operating and Maintenance Costs	29.0	8.2	3%
Total	**365.1**	**269.5**	**100%**
Benefits			
Rail freight			
Rail operating cost savings	2.1	0.7	2%
Rail safety benefits	0.2	0.1	0%
Externalities	0.3	0.1	0%
Road users			
Travel time savings	36.5	18.2	42%
Vehicle operating cost savings	10.6	5.1	12%
Safety benefits	2.5	1.2	3%
Externalities	2.8	1.3	3%
Residual value	**174.1**	**16.3**	**38%**
Total	**229.3**	**43.1**	**100%**
BCR		**0.16**	
NPV ($m)		**-226.3**	
NPV/I		**-0.87**	
IRR		**-1.86%**	

7.7 Sensitivity Testing

The CBA results are based on the best estimates of costs and benefits. However, it is common for this type of analysis that there will be some level of uncertainty in the accuracy of the estimates and assumptions adopted. Consequently, the robustness of the economic analysis results was assessed through a series of sensitivity tests.

The results of the sensitivity analyses are shown in Table 7.14.

The sensitivity testing shows that under all of sensitivity tests, the economic analysis results remain negative. This includes a best-case sensitivity test using a discount rate of 4% that returns a BCR of 0.26. Likewise, where costs are lower by 20% and benefits are higher by 20%, which returns a BCR of 0.24.

Two deferral tests were also undertaken including a 5-year and 10-year deferral. Both tests improved the NPV of the project, mainly due to the discounting effect on the capital costs that occur further out in the future when compared to the central case. A 10-year deferral improved the NPV from -$226.3 million to - $112.2 million . This indicates that deferral should be considered as it improves the NPV. Deferral would also enable the demand forecast to be revisited in the future.

Table 7.14 CBA Results Sensitivity Tests

	SENSITIVITY TEST	BCR	NPV ($M)
	Main case (scenario 1)	**0.16**	**-226.3**
1	Discount rate 4%	0.26	-223.6
2	Discount rate 10%	0.11	-214.8
3	P90 costs	0.15	-241.6
4	Project Costs +20%	0.13	-280.2
5	Project Costs -20%	0.20	-172.5
6	Project Benefits +20%	0.19	-217.7
7	Project Benefits -20%	0.13	-235.0
8	Project Costs +20%, Project Benefits -20%	0.11	-288.9
9	Project Costs -20%, Project Benefits +20%	0.24	-163.8
10	No real price increase in costs/benefits	0.16	-220.0
11	5-year deferral	0.16	-156.7
12	10-year deferral	0.15	-112.2
13	Higher rail operating costs (6c/NTK)	0.16	-225.3
14	Residual value = 0	0.10	-242.6

A sensitivity test was undertaken on the estimated rail operating costs of 2.5 cents/NTK. The value of 2.5 cents/NTK was based on the economic advisor's freight operating cost model. This value is on the lower end of the range of costs, based on the distance travelled by trains from Mt Isa to Townsville. Therefore, a test was undertaken using a higher unit cost. Assuming that rail-operating costs are higher, 6 cents/NTK, the benefits of the project would marginally increase, thereby improving the NPV[34]. However, the BCR remained unchanged. Given the nature of the project, this assumption is not material to the outcome of the results.

A sensitivity test was also undertaken on the approach to the residual value calculation. The CBA adopted a straight-line depreciation method to estimate the residual value that is the preferred approach from the ATAP (2016) guidelines and also Infrastructure Australia. However, given the low benefits estimated for TEARC, the depreciated cost approach may overstate the residual value of the asset. As such, it could be assumed that the residual value of the project is zero. The results of the sensitivity test, assuming a residual value of zero, reduced the BCR from 0.16 to 0.10.

7.7.1 Future Scenarios Not Tested

There are other future scenarios that could not be included in the Reference Project. The Port Master Plan should ultimately allow all rail traffic to utilise TEARC and hence the removal of the Jetty Branch, when the full urban amenity can be realised. The removal of the Jetty Branch does form part of the Reference Project as the Port Master Plan has not been developed to a level of detail that could support this DBC.

[34] A higher rate of 6 cents/NTK was selected to determine the sensitivity of the results if rail operating costs were double the main case i.e. to determine the importance of this variable. As rail operating costs are not provided by operators, such as Aurizon, it was important to ensure that the main estimate of rail operating costs was robust and did not materially impact the results.

The increased urban amenity and further reduction in road delays has not been analysed because the additional costs for the PoT to relocate the existing unloading facilities for sugar and Glencore and any other changes required to operations is unable to be costed at this time.

In addition, if the demand on the Mt Isa line were to significantly increase and the requirement for 1,400m long trains was justifiable than this would also provide additional benefit at a cost to support the TEARC DBC. The Mt Isa line is not part of the Reference Project because the demand forecast does not justify moving to 1,400m trains.

Table 7.15 summarises these non-quantified benefits and costs.

Table 7.15 Future Scenarios Not Tested

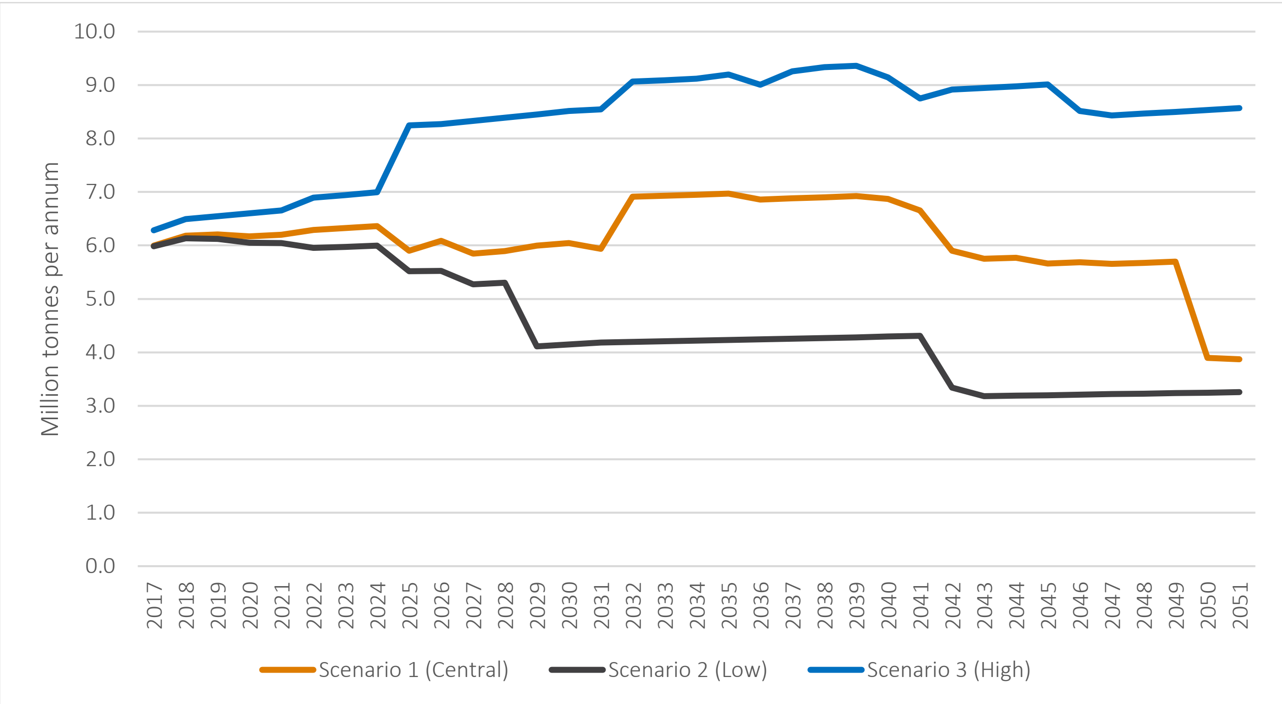
	DESCRIPTION	BENEFITS	COSTS
1	Removal of the Jetty Branch	▪ Road benefits ▪ Urban amenity	▪ Rail modifications ▪ PoT unloading relocation
2	1,400m long trains	▪ Improved train operations and lower total rail freight transport costs	▪ Mt Isa line passing loops ▪ PoT rail modifications

7.8 Scenario Testing

In addition to the sensitivity testing, 2 alternative demand scenarios were modelled to estimate the impact on the TEARC Project from different assumptions of minerals demand and PoT trade growth.

Figure 7.1 details the low and high alternative demand scenarios.

Figure 7.1 Total Rail Demand Forecast under Each Scenario (mpta)



The results of the scenario testing are shown in Table 7.16.

Under all scenarios, the BCR for the TEARC Project remains significantly below 1. The low demand scenario reduces the BCR from 0.16 to 0.14.

An interesting result is that while the high demand scenario increases the rail freight benefits, it results in a lowering of the road user benefits. The main reason is that the high scenario results in a high number of trains using the existing North Coast Line and Jetty Branch alignment in project case when compared to the central case, thereby lowering the road user benefits.

Table 7.16 CBA Results Scenario Tests

CBA RESULTS	SCENARIO 1 (CENTRAL)	SCENARIO 2 (LOW)	SCENARIO 3 (HIGH)
Costs (P50)			
Capital Costs	261.2	261.2	261.2
Operating and Maintenance Costs	8.2	8.3	8.2
Total	**269.5**	**269.5**	**269.4**
Benefits			
Rail freight			
Rail operating cost savings	0.7	0.6	1.3
Rail safety benefits	0.1	0.0	0.1
Externalities	0.1	0.1	0.2
Road users			
Travel time savings	18.2	12.9	10.3
Vehicle operating cost savings	5.1	4.9	2.8
Safety benefits	1.2	1.0	0.7
Externalities	1.3	1.4	1.4
Residual value	**16.3**	**16.3**	**16.3**
Total	**43.1**	**37.3**	**33.1**
BCR	**0.16**	**0.14**	**0.12**
NPV ($m)	**-226.3**	**-232.2**	**-236.3**
NPV/I	**-0.87**	**-0.89**	**-0.90**
FYRR	**-1.86%**	**-1.86%**	**-1.86%**

7.9 Productivity Gains

Consistent with the requirements of s14(2) of the Building Queensland Act 2015 (Qld), the DBC identifies the productivity gains that are anticipated from TEARC. Reduced transport costs, including reduced travel time and vehicle operating costs, result in a reduction in costs of doing business, lowering the costs of production and increasing the efficiency of business interactions.

Table 7.17 details the productivity gains of TEARC from the CBA.

The work and business-related productivity gains amount to $9.0m over the 30-year analysis period. This accounts for 21% of the total economic benefits of TEARC.

Table 7.17 Productivity Gains – 7% Discount Rate

PRODUCTIVITY GAINS	$ MILLION
Rail operating cost savings	0.7
Commercial vehicle travel time savings	6.3
Commercial vehicle operating cost savings	2.0
Total	9.0
Proportion of total benefits	**21%**

7.10 Jobs Supported during the Project

The Project supports direct Full-Time Equivalent (FTE) jobs during planning and delivery. The direct employment supported can be estimated by applying Queensland Treasury supplied ratios of FTE direct jobs supported per $1 million capital outlay. The methodology applied is set out below:

JOBS SUPPORTED DURING THE PROJECT	
Project Timeline	2018 – 2022: 5 years
Queensland Treasury estimated FTE Direct jobs per $1million of capital	2.7 (utilised the 2020-21 projection value from Queensland Treasury Guidance material (May 2017)
Capital Cost (less Land Acquisition, Plant, Equipment, Software)	$383m
Estimated number of jobs supported per annum	Average of 207 direct FTE jobs supported for five years

7.11 Quality Assurance Review

The CIE was engaged to undertake an independent peer review of the economic modelling for TEARC during the DBC phase. The peer review scope included a review of the CBA methodology, freight demand working papers and detailed Economic Analysis Report.

Overall, the independent peer review concluded that the approach to 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 in the final analysis.

7.12 Conclusion

Table 7.18 details the outcomes of the CBA.

A detailed economic CBA was undertaken for TEARC that measured the incremental direct benefits associated with TEARC against a base ('without' project) case. The CBA considered several scenarios to validate the results of the central case, along with sensitivity analysis designed to test any uncertainty in the parameters utilised in the analysis.

The detailed CBA for TEARC produced a BCR of 0.16 with a corresponding NPV of -$226.3m over 30 years.

The sensitivity testing of the CBA concluded that under all of tests, the BCR remained below 1. In addition to the sensitivity testing, two alternative demand scenarios were modelled to estimate the impact on TEARC from different assumptions of minerals demand and trade growth through the PoT. Under all scenarios, the BCR remained below 1.

TEARC returns a BCR of 0.16 that indicates that the monetised costs outweigh the monetised benefits for the projects. Therefore, it is likely that there are alternative investments that could be undertaken in the local region that would further improve economic conditions above the monetised benefits of TEARC.

Table 7.18 CBA Results

CBA RESULTS	4%	7%	10%
P50 costs			
BCR	0.26	0.16	0.11
NPV	-223.6	-226.3	-214.8
P90 costs			
BCR	0.25	0.15	0.10
NPV	-240.9	-241.6	-228.4

There are other future scenarios that could not be included in the Reference Project nor quantified at this time. The Port Master Plan should ultimately allow all rail traffic to utilise TEARC and hence the removal of the Jetty Branch, when the full urban amenity can be realised.

The increased urban amenity and further reduction in road delays has not been analysed because the additional costs for the PoT to relocate the existing unloading facilities for sugar and Glencore and any other changes required to operations is unable to be costed.

In addition, if the demand on the Mt Isa line were to significantly increase and the requirement for 1,400m long trains was justifiable than this would also provide additional benefit at a cost to support the TEARC DBC.