TOOWOOMBA TO GLADSTONE (T2G) INLAND RAIL ECONOMIC ANALYSIS

CENTRAL QUEENSLAND REGIONAL ORGANISATION OF COUNCILS
FEBRUARY 2021

aecgroupltd.com

AEC
OUTCOME DRIVEN

DOCUMENT CONTROL

Job ID:	J001901
Job Name:	Inland Rail to Gladstone Port Economic Analysis
Client:	Central Queensland Regional Organisation of Councils
Client Contact:	John Abbott
Project Manager:	Jonathan Pavetto
Email:	jonathan.pavetto@aecgroupltd.com
Telephone:	07 4771 5550
Document Name:	Toowoomba to Gladstone (T2G) Inland Rail FINAL
Last Saved:	19/2/2021 1:24 PM

Version	Date	Reviewed	Approved
DRAFT v1.0	01/12/20	JP	ARP
DRAFT v2.0	19/01/21	JP	ARP
DRAFT v3.0	10/02/21	JP	JP
DRAFT v4.0	17/02/21	JP	JP
FINAL	19/02/21	JP	JP

FOREWORD

Inland Rail is Australia's largest freight infrastructure project, which when fully developed is proposed to provide a standard gauge rail link between Melbourne and Brisbane. A key driver of the project is to deliver freight transport efficiency savings, in particular for intercapital freight and freight for import/ export.

While the vision for Inland Rail is to provide port-to-port connectivity to fully realise these freight efficiency improvements, designs for Inland Rail do not include a defined connection to the ports of Melbourne or Brisbane (for example, Inland Rail has been designed to terminate at Acacia Ridge in Brisbane, or even further afield at Bromelton in Scenic Rim).

The Inland Rail project was initially estimated to cost $5 Billion. Construction commenced with an estimated cost of $10 billion. With recently announced cost overruns announced, the project is now estimated to cost at least $15 Billion. There is however significant risk of further cost overruns as the entire Queensland route is further evaluated and defined, particularly with the route through the Toowoomba range.

The key challenges in delivering Inland Rail to the Port of Brisbane is the significant geographical and urban constraints with the descent from Toowoomba Range, crossing the Lockyer Valley flood plain, connecting to the interstate rail line through the Teviot Range and the required rail link between Acacia Ridge and the Port of Brisbane. These key challenges represent the rail line from Gowrie to the Port of Brisbane, which costs 50% of the total costs to deliver Inland Rail while only covering 8% of the distance (this is in consideration of the coal to Brisbane which includes track from Miles to Wandoan and Toowoomba/Oakey Miles).

The Acacia Ridge site where Inland Rail is designed to terminate in Brisbane is land locked and is without room to expand now, or in the future. No allowance for the required substantial upgrade of the road network has been included in the current configuration of the project costs.

It has been proposed to spend an additional $2.8 billion to connect Inland Rail to the Port of Brisbane and to avoid both road and commuter rail congestion between Acacia Ridge and the Port of Brisbane. This cost has not been included in ARTC's recent cost estimate upgrade.

Planning for connecting Inland Rail to Brisbane was also undertaken prior to the completion of the second Toowoomba Range crossing, which has considerably improved road freight efficiency between Toowoomba and greater Brisbane. Neither the configuration of Inland Rail nor the business case were revisited following the construction of the second Toowoomba Range crossing, which has changed the economics of completing Inland Rail between Toowoomba and Acacia Ridge.

This report considers a reconfiguration of Inland Rail to extend from Toowoomba to the Port of Gladstone. The analysis identifies this proposal can:

1) Reduce the cost of Inland Rail to ARTC (and the Federal Government) by at least $3.0 billion if the decision is made to terminate the Inland Rail in Toowoomba.
2) Deliver the benefits of a port connection at least three years earlier than a connection to the Port of Brisbane.
3) Allow Gladstone to become the fourth major container port for the east coast of Australia, which can deliver productivity benefits for import/ export freight.
4) Eliminate the substantial community angst and congestion issues in Brisbane by redirecting most coal freight to the Port of Gladstone, and reduce container freight on Brisbane roads by up to 5 million containers a year.
5) Unlock the significant latent resource developments in the Surat Basin.

John Abbott

Deputy Chair, Regional Development Australia – Central and Western Queensland

EXECUTIVE SUMMARY

BACKGROUND

Inland Rail is Australia's largest freight infrastructure project, proposed to connect Melbourne to Brisbane via a new inland route. Although the proposed network has significant benefits, it does not come without the challenges associated with delivering linear infrastructure, most notably the section of rail between Toowoomba and Brisbane and particularly connecting the Port of Brisbane. The constraints across the Toowoomba to Brisbane connection add considerable cost and delivery risk to the project, accounting for 50% of the total cost to deliver Inland Rail from Melbourne to Brisbane (for just 10% of the distance). The sea freight constraints associated with the Port of Brisbane also limit the freight efficiency benefits of the whole Inland rail Project.

Inland Rail is currently designed to terminate at Acacia Ridge, in metro Brisbane, south west of the Port of Brisbane. An additional $2.8 billion investment is required to complete the vision to connect Inland Rail to the Port of Brisbane and to avoid considerable road congestion between Acacia Ridge and the Port of Brisbane.

Planning for connecting Inland Rail to Brisbane was also undertaken prior to the completion of the second Toowoomba Range crossing, which has considerably improved road freight efficiency between Toowoomba and greater Brisbane.

There is potential to reconfigure Inland Rail to extend beyond Toowoomba to connect Gladstone Port. This alternative route can reduce the cost of Inland Rail to the Australian Rail Track Corporation (ARTC) (and the Federal Government) by $4.8 billion and has the potential to deliver considerable freight productivity benefits to all import/ export Inland Rail freight, while unlocking additional resource developments in the Surat Basin.

For example, unloading containers in Gladstone, then railing them to destinations (including southern capitals) rather than being shipped to other ports, would provide considerable savings in sea freight time and cost. It is anticipated that this would comprise the largest component of non-coal freight demand along the inland route between Toowoomba and Gladstone.

Figure ES.1. Inland Rail Route

Source: AEC, based on ARTC 2015 and AECOM 2017

Previous analysis by AECOM (2017) has explored the costs and benefits of extending a link from the Inland Rail alignment to Gladstone Port, which concluded such a link would be unviable. However, this report has a number of critical shortcomings, which include:

- The report assumes containerised freight uses of the rail line would only consist of existing freight between Brisbane and Gladstone. No freight traveling along Inland Rail for import/ export would utilise Gladstone Port, nor potential freight to/ from west of Miles.
- Coal demand was based on a risk-related assessment. This approach had a number of flaws, namely that coal all demand would cease from 2050, which is a departure from the ARTC business case. It also did not assume new projects would be developed as existing projects wound down, which is unlikely to be the case (particularly if rail infrastructure is available).
- In evaluating the economic benefit per tonne of freight using the Gladstone route, the aggregate discounted freight efficiency value divided by the average annual tonnes of freight from the ARTC (2015) business case, was applied to an estimate of the average annual tonnes of freight along the Gladstone route. This approach is inappropriate as the change in freight costs delivered by the Gladstone rail line will differ from those delivered by Inland Rail between Brisbane and Melbourne.
- In valuing the induced coal benefits, a transport efficiency measure was used. This is not an appropriate approach to evaluating the benefit delivered through the Inland Rail connection as it will undercount the benefits significantly; producer margins should be used as without the Gladstone Inland Rail line it is unlikely these projects would be developed.
- AECOM also assumes that coal over 460km would not be transported to Gladstone, and that mines beyond this distance would have a preference to transport coal to the Port of Brisbane. However, being a capital city centre there are freight constraints for the development of Inland Rail to the Port of Brisbane as an increase in capacity would generate additional freight traffic through dense urban areas. The congestion, efficiency and environmental issues that may arise with the development of Inland Rail to the Port of Brisbane may make it more attractive for the mines greater than 460km away to send coal to Gladstone rather than Brisbane.

PURPOSE

This report was developed to examine and assess the full range of benefits and costs and associated potential economic desirability of investing in a dedicated inland freight rail line between Toowoomba to the Port of Gladstone. Importantly, the extension of Inland Rail to the Port of Gladstone has been compared on a like-for-like basis, as far as data permits, to the extension of Inland Rail to the Port of Brisbane.

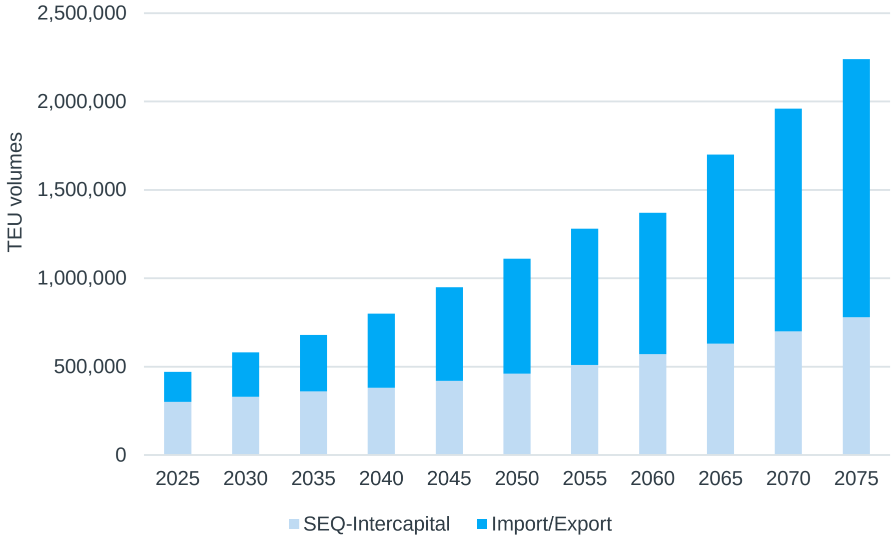
KEY FINDINGS

Freight Demand

Globally, containerised trade has been growing rapidly and has proven to be a dominant form of transporting cargo in international shipping due to the lower cost of transporting goods. Since 1980, containerised trade volumes have increased by 8.1% on average per annum, while overall seaborne trade has increased by an average of 2.8% per annum (HustonKemp, 2019).

The freight task (volume and distance of freight to be transported) is expected to continue to grow rapidly in the medium to longer term on the back of relative strength in Australia's resources and agriculture sectors, and the Federal Government's efforts to revive manufacturing and value adding in minerals and food and fibre processing in regional Australia. An increasing component of this freight task is import/export related as Australia's trade relationships continue to develop. Figure ES.2 shows the growth in containerised freight (Twenty-foot Equivalent Units (TEUs)) expected with Inland Rail.

Figure ES.2. Inland Rail Containerised Freight Volumes, Forecast Growth TEUs.



Note: Initial estimated calculated on metric tonnes. 1 TEU assumed to be 10 metric tonnes
Source: AEC, ARTC (2015).

Further, the development of infrastructure for containerised freight can unlock additional resource development. In the Surat Basin in Southern Queensland, there are eight mines currently identified for potential future production, which together can produce up to 60 million tonnes of saleable coal for export. All of these mines require favourable global economic conditions a rail connection to the Port of Gladstone to be realised.

Port Capacity

A growing national import/ export freight task requires matched capacity in Australia's container ports. Australia's east coast container ports are expected to reach capacity between 2032 and 2052, with further capital works being required to support continued container growth. Meeting the increased demand, while maintaining international competitiveness in the freight supply chain will invariably be complicated by use conflicts surrounding increased population growth in capital cities, increased traffic congestion and high cost of new infrastructure and land resumption around the existing container ports of Brisbane, Sydney and Melbourne.

An alternative to Brisbane, Sydney and Melbourne is Gladstone Port, currently Queensland's largest multi-commodity port (although traditionally perceived as a wet and dry-bulk port for resources export). Gladstone Port provides an alternative 4^{th} major container port on the east coast of Australia as it has a naturally deep harbour that currently services the largest dry bulk cargo ships in the world (Capesize, with a draft of 18.3m), has room to expand container berths at Port Central and additional berths able to be developed at Fisherman's Landing. Unlike Australia's existing container ports, Gladstone Port is adjoined by an additional 27,000ha of medium-high impact developable land in the Gladstone State Development Area, which can be developed to support wholesale trade and other freight related industry.

Gladstone Port also has available capacity in its coal export terminals (both WICET and RG Tanna) to support an additional 30 mt of coal export per year. Importantly, through the development of the Inland Rail link to Gladstone Port, coal and containerised freight can be redirected away from urban greater Brisbane to Gladstone for export.

Freight Efficiency

Developing Gladstone Port as Australia's 4^{th} major container port on the east coast of Australia also provides freight efficiency advantages to Australia's freight task. The ability to develop to accommodate larger container ships than both Brisbane and Melbourne, as well as its relative proximity to Australia's export markets (namely, East Asia) provides freight efficiency savings for all container freight that is imported to and exported from Australia.

Cost Benefit Analysis

Inland Rail from Toowoomba to the Port of Gladstone is economically desirable. The development when examined at 4% realises a Benefit Cost Ratio (BCR) of 1.58, highlights that the project will return $1.58 for every $1 cost. This provides a more economically desirable outcome than the development of Inland Rail to the Port of Brisbane, which presents a BCR of 1.01 (see Table ES.1 below).

Table ES.1 Comparison of CBA Outputs

Discount Rate	Inland Rail to Gladstone Port	Inland Rail to the Port of Brisbane	Difference
NPV ($M)			
4%	$4,533	$79	$4,455
7%	-$470	-$3,878	$3,408
10%	-$1,883	-$4,804	$2,920
BCR			
4%	1.58	1.01	0.57
7%	0.92	0.52	0.40
10%	0.62	0.34	0.28

Note: Totals may not sum due to rounding.
Source: AEC.

Economic Impact Assessment

Input-Output modelling was undertaken on the development of Inland Rail from Toowoomba to Gladstone Port. The Inland Rail works examined in this study will provide the necessary freight infrastructure that may unlock significant large-scale mine developments in the Surat Basin with the ability to leverage built capacity in the Port of Gladstone. It will also deliver a significant contestable freight task to justify expenditure on container port upgrades in Gladstone, creating significant efficiency improvements for the region's freight.

Construction

The different construction activities associated with Inland Rail will generate considerable economic benefits within the catchment[1] area analysed. Direct benefits and total impacts (incorporating direct, production induced and household consumption impacts) are outlined in Table ES.2.

Table ES.2. Direct Economic Benefits from Construction Activities

Activity	Output ($M)	GRP ($M)	Wages & Salaries ($M)	FTE Jobs
Inland Rail				
Direct Impacts	$1,490	$681	$328	3,115
Total Impacts	$3,109	$1,513	$734	8,210
Coal Development [A]				
Direct Impacts	$302	$129	$70	513
Total Impacts	$644	$304	$157	1,601
Gladstone Container Port Upgrades				
Direct Impacts	$203	$87	$47	419
Total Impacts	$433	$204	$105	1,151
Summary				
Total Direct Construction Benefits	**$1,995**	**$897**	**$446**	**4,047**
Total Construction Benefits	**$4,186**	**$2,021**	**$997**	**10,962**

Notes:
- A. This reflects the impacts associated with the development of one coal mine. Scenarios examined in this report included development of between three to six mines through to 2032. This does not consider replacement costs of each coal mine.
- Totals may not sum due to rounding.

Source: AEC.

[1] The catchment area is defined in section 7 and incorporates the LGAs along the Toowoomba to Gladstone route.

Ongoing Activity

The operational phase of the Toowoomba to Gladstone section of Inland Rail is estimated to deliver the following economic activity each year[2]:

- $6.5 million contribution to Gross Regional Product (GRP) per annum (including $2.0 million directly).
- 45 Full Time Equivalent (FTE) jobs per annum (including 18 FTE jobs directly), paying a total of $4.1 million in wages and salaries per year (including $2.0 million directly).

Once a steady state of operations is reached from 2032, operational activity associated with the development of additional coal mines, at an assumed 20 million tonnes per annum (MTPA) of production, is estimated to support:

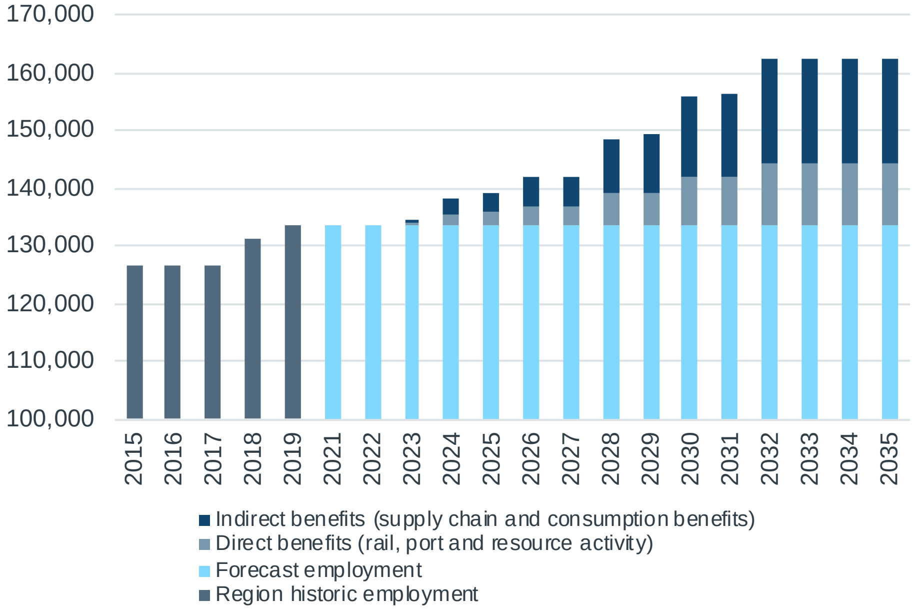
- $1,617.0 million contribution to Gross Regional Product (GRP) per annum (including $851.3 million directly).
- 7,166 Full Time Equivalent (FTE) jobs per annum (including 2,600 FTE jobs directly), paying a total of $833.6 million in wages and salaries per year (including $451.3 million directly).

Combined impact on the regional economy

Accounting for different direct and indirect construction and operating activities occurring simultaneously, the development of Inland Rail is expected to generate an additional 18,300 FTE jobs in the region by 2032. This represents a 21.5% increase in FTE jobs in the region.

The growth in employment is represented in Figure ES.3. Forecast employment has assumed to be static to best represent the benefits delivered by the project.

Figure ES.3. Combined Employment Benefits of Connecting Inland Rail to Port of Gladstone



Source: AEC

[2] This activity represents a 50-year average annual estimate from beginning of operations. Operating activity is initially expected to be below this average level, increasing over time as annual volumes of freight increase.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 BACKGROUND & PURPOSE

Inland Rail is Australia's largest freight infrastructure project, proposed to connect Melbourne to Brisbane via an inland route that enables additional economic activity throughout south eastern Australia. Although the proposed network has its benefits, it does not come without limitations.

The Toowoomba to Brisbane section of Inland rail presents significant challenges for the successful delivery of the Inland Rail. These include the huge engineering and cost challenges with the descent through the Toowoomba Range, crossing the Lockyer Valley flood plain, connecting to the interstate rail line through the Teviot Range and the required rail link between Acacia Ridge and the Port of Brisbane, through densely populated urban areas of metropolitan Brisbane. As the northern terminus of Inland Rail, the Port of Brisbane also has several sea freight constraints which may limit the future productivity benefits of the entire Inland Rail project.

Developing a rail line linking Gladstone to Inland Rail near Toowoomba will provide cost efficiencies for transport of container freight for import/ export at a lower supply chain cost. This is primarily due to closer proximity to key import/ export markets (and thereby reduced sea freight travel distances and time), the immediate ability to utilise larger container ships if required, as well as the avoided cost of building the rail line through mountainous and urban environments. Building the rail line between Toowoomba and Gladstone could also unlock the development of coal mines in the Surat Basin.

AEC Group Pty Ltd (AEC) have been engaged to examine and assess whether this opportunity is economically beneficial.

1.2 APPROACH

To assess the economic desirability of developing and connecting Inland Rail from Toowoomba to the Port of Gladstone a cost benefit analysis was undertaken following a significant literature review to examine freight volumes and forward demand as well as capital and operating costs. The analysis of extending Inland Rail to the Port of Gladstone was then compared to the current development scenario of Inland Rail, adjusting for termination at the Port of Brisbane (instead of Acacia Ridge).

The analysis was supported by an economic impact assessment of the Port of Gladstone option to understand and model the direct and flow on activities unlocked by the extension of rail to the Port of Gladstone resulting from ancillary development. The rail link from Inland rail to Gladstone assumed that the inland rail to South East Queensland terminated in Toowoomba. Options such as the termination for South East Queensland being at other locations such as Ebenezer have not been evaluated.

To the extent possible, data and methodology that was publicly available from ARTC and related entities was used in this analysis.

1.3 REPORT STRUCTURE

The remainder of this report follows the logic of the research and analysis and is structured as follows:

- **Section 2**: outlines the project opportunity, including the current situation regarding the growing demand for freight.
- **Section 3**: outlines the existing and planned port and rail infrastructure at both the Port of Brisbane and Gladstone Port, to support the future growth of Inland Rail.
- **Section 4**: summarises the previous research from ARTC in 2010 and 2015, AECOM in 2015 and DAE in 2018 and highlights both common and contradictory findings.
- **Section 5**: presents the potential demand scenarios for coal and intermodal container and non-coal bulk freight for Inland Rail to the Port of Gladstone.

- **Section 6**: analyses the relative costs and benefits of extending Inland Rail from Toowoomba to the Port of Gladstone.
- **Section 7**: outlines the economic benefits of both the construction and induced benefits of extending Inland Rail to Gladstone Port through Input-Output analysis.

2. THE OPPORTUNITY

2.1 SITUATION ANALYSIS

There are 3 very different freight tasks that potentially will use Inland Rail:

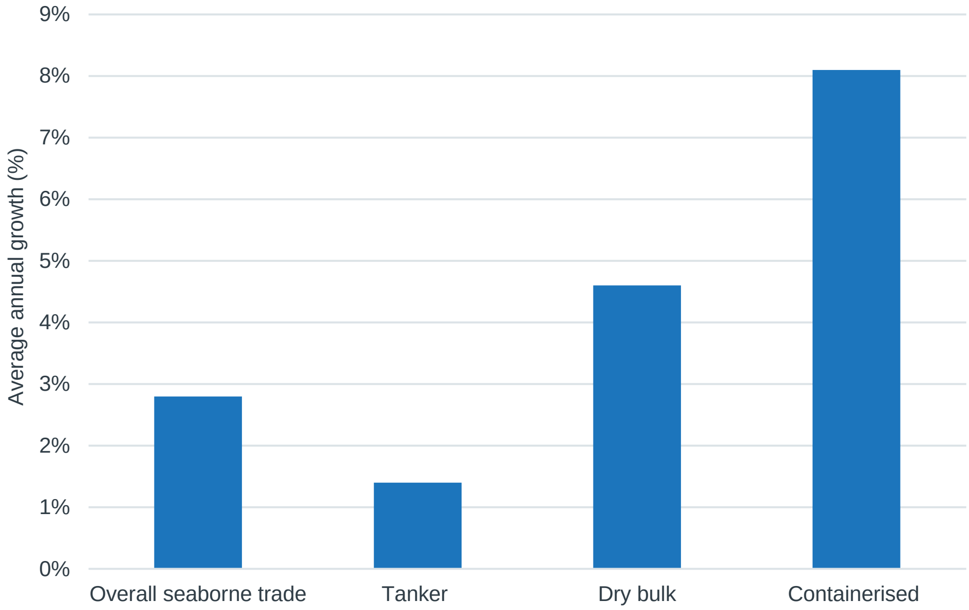
- The Domestic Freight task between cities and regions. Most of this freight currently uses road transport. For the Inland Rail to achieve its business case objectives, this freight task will need to be won from road transport on cost, delivery time, availability and reliability,
- The Import / Export freight task. Currently most of this task is delivered to the major ports of Brisbane, Sydney and Melbourne. A very low proportion of this freight task is transferred to rail, as it is delivered to the receiver by road
- The Coal export task. For example, 25% of the revenue in the Inland rail business case was coal export from the Southern Surat Basin and the West Moreton coal regions.

This section provides an overview of the opportunity that exists for development of an inland rail line between Toowoomba and the Port of Gladstone (T2G Rail Link).

2.1.1 Growing National Freight Task

Globally, containerised trade has been growing rapidly and has proven to be a dominant form of transporting cargo in international shipping due to the lower cost of transporting goods. Figure 2.1 shows that since 1980, containerised trade volumes have increased by 8.1% on average per annum, while overall seaborne trade has increased by an average of 2.8% per annum (HustonKemp, 2019).

Figure 2.1. Growth in Containerised Trade Volumes, Australia (1980-2018)



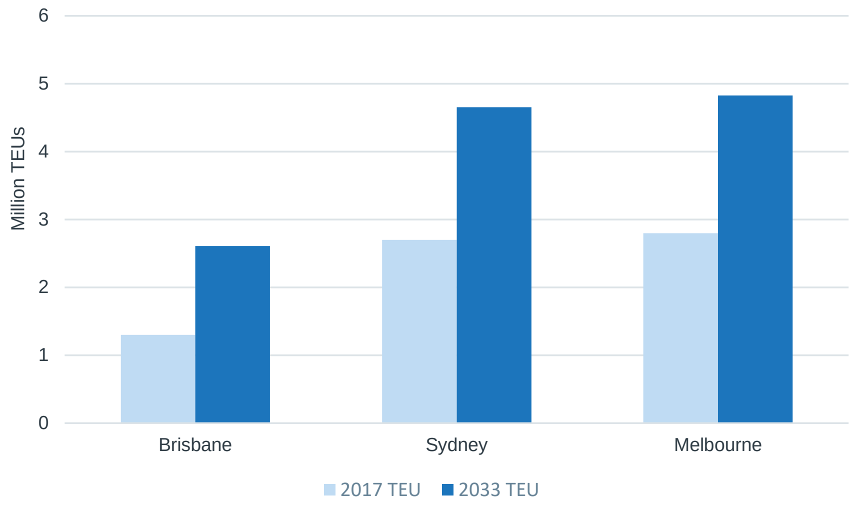
Source: UNCTAD, Review of Maritime Transport 2018 as cited in HustonKemp (2019)

The growth rate of containerisation is expected to reduce over time to be more in line with overall growth in seaborne trade, however, it is still expected to be a dominant form of shipping (HustonKemp, 2019).

Infrastructure Australia (2018) estimates that satisfying Australia's domestic land freight task is one of Australia's biggest infrastructure challenges, with the freight task expecting to grow by 80% from 2011 to 2031. Continued growth in Australia's economy and standard of living depends on the international competitiveness of import and export supply chains. Cost effective freight not only enables economic activity through income generating exports, but also keeps the landed cost of imported industrial inputs and consumer goods down.

On the back of strong population growth over the past two decades, Australia's economy and Import / Export trade has grown strongly, which has placed significant pressure on the freight system to keep pace with demand. The freight task is expected to continue to grow rapidly in the medium to longer term on the back of relative strength in Australia's resources and agriculture sectors, the Federal Government's efforts to revive manufacturing and value adding and on continuing demand for imported consumer goods. This growth, as well as port plans for increased handling capacity are outlined in Figure 2.2.

Figure 2.2. Australian Import and Export Volumes, Forecast Growth (without T2G Rail Link)



Note: HustonKemp (2019) has forecast a growth rate of 100.6% for Brisbane and 72.4% for both Sydney and Melbourne
Source: HustonKemp (2019).

2.1.2 East Coast Port Capacity and Growth Potential

Australia's existing major east coast container ports of Brisbane, Sydney and Melbourne will reach their current theoretical port capacities between 2032 and 2052. Significant further capital expansion works will be required to support the continued growth in container cargo beyond this point (HustonKemp, 2019). Whilst these expansion works are possible at each of these east coast ports an increase in capacity will generate additional freight traffic through dense urban areas and increase road congestion (HustonKemp, 2019) and amenity conflict points with the local community. Any land resumptions for freight corridors to support port growth would also come at a very high cost, if they are possible at all.

Meeting this increased demand, while maintaining international competitiveness in the freight supply chain will invariably be complicated by use conflicts surrounding population growth in capital cities, increased traffic congestion and high cost of new infrastructure around the existing container ports of Brisbane, Sydney and Melbourne.

Urban encroachment provides some unique challenges for Australia's existing major ports. These challenges include:

- Competition for existing land for residential purposes versus land-side expansion and transport corridor extension (particularly problematic in Melbourne and Sydney)
- Environmental concerns and costs associated with land reclamation for expansion of Fisherman's Island into Moreton Bay at the Port of Brisbane
- High costs of residential land resumption for port expansion
- Limited land-side freight connections and poor transport corridor security (for both road and rail)
- Increasing urban traffic congestion
- Environmental/noise concerns from nearby residential areas (particularly for dry bulk freight, such as coal).

To meet this demand, and to induce additional economic activity, major nation-building infrastructure projects such as Inland Rail have been planned and are being delivered. HustonKemp (2019) highlight that the increasing growth in containerised trade will mean current East Coast port capacity will be reached in between 2032 and 2052 with expansion, implying expanded and/or new port facilities may be required.

The Port of Gladstone is arguably the port with the most capacity for expansion on the East coast of Australia with potential to develop from its demonstrated throughput of 124Mtpa to over 300Mtpa. With the connection to the Inland Rail, the Port of Gladstone can enable growth in import/export freight volumes to dominant East Asian markets, without requiring the significant urban disruption and congestion that will occur with port expansion in Brisbane, Sydney, or Melbourne.

2.1.3 Growth in Size of Container Ships

In addition to existing and emerging capacity issues, efficiency gains in sea freight will be limited to capacity of Australia's ports to manage ever-increasing ship sizes (including draft requirements). As outlined in Table 2.1 and Table 2.2, the Port of Brisbane had the capacity to handle ship sizes up to 10,000 TEUs with current channel depth.

The existing Gladstone Auckland Point 4 wharf could be dredged to accommodate ships of 14 m draft. When developed, the new Berths at Auckland Point 5 and 6 could be dredged to accommodate ships to 15.5 m draft.

Table 2.1. Common container Vessel Specifications

Vessel type	Year Commissioned	Capacity (TEUs)	Length (m)	Width (m)	Draft (m)
Handymax	1970	2,500	250	32	10.0
Panamax	1980	3,400	250	32	12.5
Panamax Max	1985	4,500	290	32	12.5
Post Panamax	1988	5,000	285	40	13.0
Post Panamax Plus	2000	8,000	300	43	14.5
New Panamax	2014	12,500	360	49	15.2
Triple E	2013	18,000	400	59	15.5
Ultra Large Container Vessel (ULCV)	2017	21,400	400	59	16.0

Source: marinetraffic (2020), vesseltracking (2020).

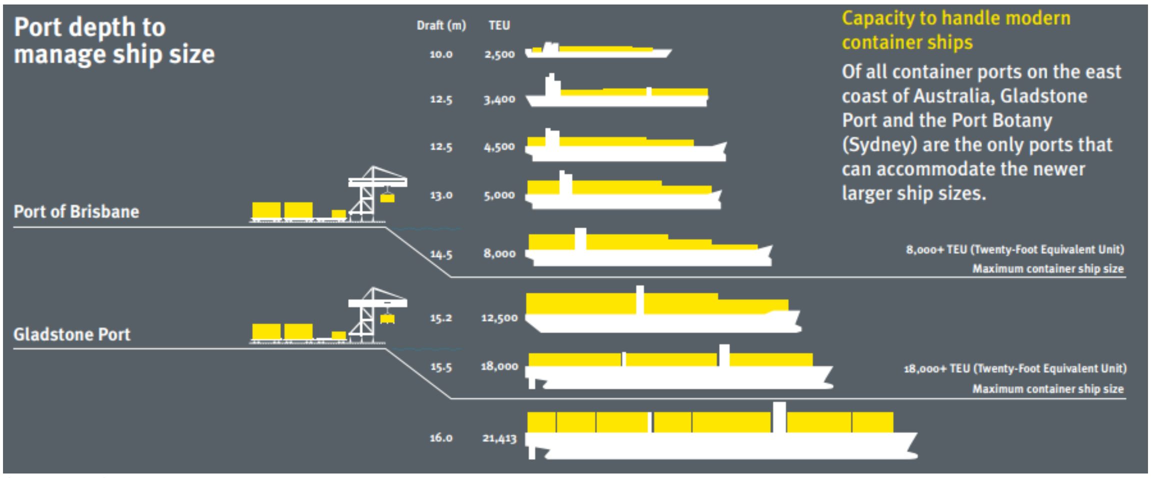
Table 2.2. Australian East-Coast Container Channel Depths

Port	Channel Depth (m)
Townsville	11.8
Gladstone	15.8
Brisbane	15
Newcastle	15.2
Port Botany (Sydney)	16.1
Port Kembla	15.5
Melbourne	14

Note: draft and depth measurements have been identified for access to container berths. Some ports, such as the Port of Gladstone, are complex ports with differential depths for berths based on their operational requirements.
Source: findaport (2020), HustonKemp (2019), Port Authority of New South Wales (2020), PoN (undated, 2019, 2020), PoM (undated) & PoT (undated).

Figure 2.3 is a visual representation of drafts at the Port of Brisbane and the Port of Gladstone and corresponding ship sizes.

Figure 2.3. Port Depth of Gladstone and Brisbane



Source: AEC

2.1.4 Inland Rail

Currently Inland Rail is proposed to connect Melbourne to Brisbane through regional Victoria, western New South Wales, and southern Queensland. The proposed project spans 1,700km with upgrades proposed to 1,100km of existing track and approximately 600km of new track between Melbourne to Brisbane (ARTC, undated). Figure 2.4 below highlights the current proposed Inland Rail network from Toowoomba to the Port of Brisbane.

Figure 2.4. Inland Rail Route

Source: AEC, developed from ARTC (undated).

Inland Rail business case is based on the potential to increase freight transport efficiencies, delivering freight faster to both domestic and international markets. Additional benefits include:

- Spreading the freight task across multiple ports and delaying high-intensity capital expenditure in dense urban centres. However, the business case did not consider ports other than Brisbane, Sydney and Melbourne
- Smaller freight impact on social and environmental factors, decreasing emissions and increasing road safety.
- Reducing road traffic between major centres.

- Improving freight efficiency, costs and travel time.
- Support growing demand for freight in both Australia and internationally.
- Improve regional access to freight networks, increasing their connectivity to domestic and global markets.

Although the current alignment for Inland Rail (terminating in Brisbane) is expected to deliver a number of benefits, the segment between Toowoomba and the Port of Brisbane poses a key challenge in the achieving the objectives of Inland Rail. These include the descent from the Toowoomba Range (requiring 2 new tunnels), crossing the Lockyer Valley Flood Plan, connecting to the interstate rail line through the Teviot Range and overcoming existing rail congestion and bottlenecks between Acacia Ridge and the Port of Brisbane (requiring additional tunnels and dedicated rail freight corridors trough densely populated and environmentally sensitive areas). These challenges combined represent 50% of the total cost to deliver Inland Rail from Melbourne to the Port of Brisbane for just 10% of the total route distance.

2.1.5 Surat Basin Rail Project

The Surat Basin Rail Project is a proposed 210 km rail line that would connect the Moura System near Banana to the Western Railway System near Wandoan. The Surat Basin Rail Project submitted an Environmental Impact Statement (EIS) in 2009 and received approval in 2010. All land required to develop the project is subject to resumption by the Queensland Government under the terms of the *Surat Basin Development Act*.

The Surat Basin Rail Project was proposed to provide the necessary rail infrastructure to unlock the extensive resource despots in the Northern Surat Basin. A number of mines have been proposed in the area around Wandoan. However, without the Surat Basin Rail Project, these mines do not have a route to market. The proposed link to the Port of Gladstone where the export terminals have current installed capacity would substantially increase the likelihood of development of new mines. It is highly likely that much of the coal exported from the Port of Brisbane could be diverted to the Port of Gladstone. This would also have the advantage of eliminating the significant community issue of coal trains passing through the suburbs of Brisbane.

In addition to the “missing southern link” between Banana and Wandoan the inland route between Gladstone and Toowoomba required the reconstruction of the decommissioned narrow-gauge line between Wandoan and Miles. A bypass of the town of Miles has also been planned and included in the cost estimates.

The assessment of a rail line between Toowoomba and Gladstone (AECOM, 2017) included eight known proposed projects located in the area around Wandoan that would use the Surat Basin Rail Project to transport coal to Port of Gladstone if the infrastructure and these coal mines were developed. These include: Bundi, Clifford, Collingwood, Elimatta, Taroom, The Range, Wandoan, and Woori. For each of these coal projects, the distance to the Port of Gladstone via rail would be less than to the Port of Brisbane if the Surat Basin Rail Project is developed. Additionally, the Port of Brisbane currently does not have the export capacity for this volume of coal throughput (for more information on capacity for coal export see section 3.2.2).

With the development of the Surat Basin Rail Project as part of Inland Rail, there is also the opportunity to transport coal from existing mines in the Southern Surat Basin to Gladstone for export, as an alternative to current freight through suburban Brisbane for export via the Port of Brisbane.

2.2 PROJECT OPPORTUNITY

The development of Inland Rail between Melbourne and Toowoomba, as well as the proposed link to Port of Gladstone presents a huge regional development opportunity in Central Queensland. It will create a 4th major container terminal on Australia's East coast to assist in meeting the growing national freight task, while taking advantage of the natural deep water harbour in Gladstone to accommodate the increasing size of freight ships. The rail infrastructure also provides an opportunity to unlock the significant coal resources in the Surat Basin.

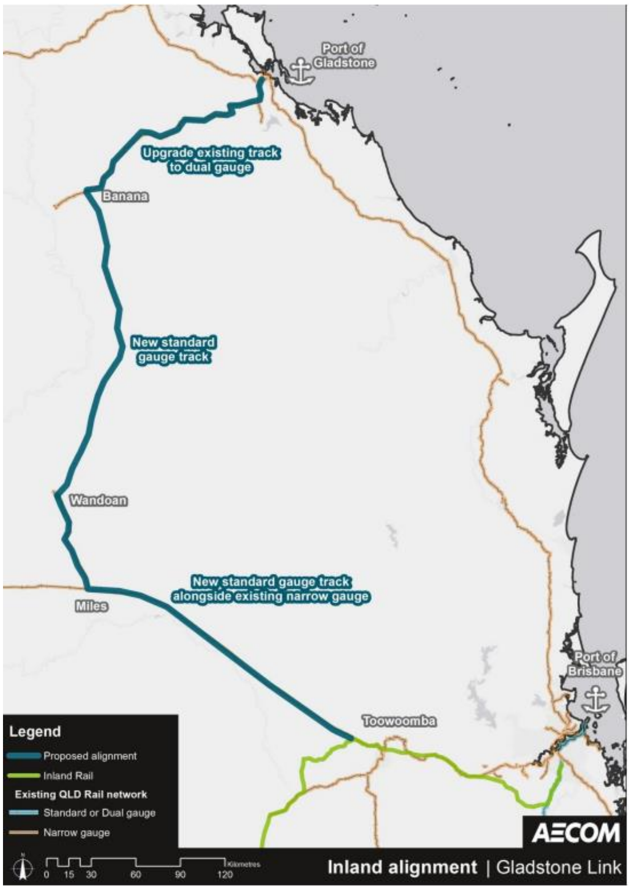
The development of Inland Rail to the Port of Gladstone can provide a number of additional benefits including:

- Potential to unlock several additional mine developments in the Surat Basin.
- Closer proximity to key international markets, reducing travel time at sea and subsequently freight costs.
- Significantly lower construction costs compared to the development of Inland Rail to the Port of Brisbane.

Figure 2.2 below highlights the proposed Inland Rail standard gauge track from Toowoomba to the Port of Gladstone. It should be noted that the figure below is from AECOM (2017) who assumed a new standard gauge track alongside the existing narrow-gauge line would be developed between Gowrie (Toowoomba) and Wandoan, the Surat Basin Rail Project would be dual gauge, and while the Moura System between Banana and Gladstone would be upgraded to dual gauge. This would allow the coal freight task to use the existing narrow gauge coal infrastructure initially, and the non-coal freight to use the standard gauge infrastructure.

The Port of Gladstone, currently Queensland's largest multi-commodity port by tonnage provides a logical and viable alternative 4th major container port on the east coast of Australia. With Inland Rail, Gladstone has the potential to enable growth in import/ export freight volumes to dominant East Asian markets, without requiring the significant urban disruption which will occur from port expansion in Brisbane, Sydney, or Melbourne or adding to congestion in Australia's largest cities.

Figure 2.2. Inland Rail Route – Toowoomba to Gladstone Port



Source: AECOM (2017).

3. PORT & RAIL INFRASTRUCTURE

This section provides an overview of the existing and planned future port and rail infrastructure for both ports in Gladstone and Brisbane.

3.1 THE PORT OF GLADSTONE

The Port of Gladstone is operated by the Gladstone Ports Corporation Limited, which a 100% owned by the Queensland State Government. In 2019-20, GPCL paid $80 million dividend to the Queensland State Government in addition to $70 million in all forms of taxes

Dimensions for container ships have increased substantially over the past two decades and are anticipated to continue to grow, which will place increasing pressure on Australian ports to accommodate large vessels (Drewry, 2017). The Port of Gladstone is one of Australia's natural deep water harbours, allowing for the deepest drafts on Australia's east coast, and is the only port on Australia's east coast capable of meeting market demands up to an including the over 16m draft or Triple E-class container ships (18,000 TEU capacity).

While the Port of Brisbane on the other hand, have the capacity to handle ship sizes up to 10,000 TEUs with current channel depth. Deepening the channel and berths at Port of Brisbane would come at considerable economic and environmental cost.

For more information about port specifications see section 2.1.3.

3.1.1 Port Infrastructure

Current Operations

The Port of Gladstone, located approximately 525 kilometres (km) north of Brisbane, is a vital economic enabler that facilitates the growth and prosperity of both the immediate Gladstone area and of the broader Central Queensland region. The port covers approximately 4,448 hectares of land and is comprised of 20 berths. It is Queensland's largest multi-commodity port, with throughput of 124 Mt in 2018-19. The port is also Queensland's second largest coal export port (behind the Port of Hay Point) as well as the world's fourth largest coal export terminal (by throughput), exporting 72.4 Mt of coal in 2018-19 (TMR, 2019), accounting for approximately 32% of total coal exports from Queensland for the year.

There are currently two coal terminals at the Port of Gladstone:

- The RG Tanna terminal: This terminal is operated by Gladstone Port Corporation and handled 61.0 Mt of coal exports in 2018-19. This was approximately 3.6 Mt more than in 2017-18, but below the peak of 65.0 Mt exported from the terminal in 2013-14. The terminal has four ship berths and three ship loaders, providing an annual capacity of approximately 75 Mtpa. RG Tanna also has a blending facility, which is an added value proposition for export via the Port of Gladstone. Currently there is 14 Mtpa of unallocated capacity.
- The Wiggins Island Coal Export Terminal (WICET): Stage 1 of this terminal opened in April 2015 and is operated by a consortium of Australian and international resource companies. The industry-owned and privately funded delivery model is a first for Queensland. Terminal handling charges are based on a cost recovery basis to assist the competitiveness of the Queensland coal export industry. Approximately 11.4 Mt of coal was exported from WICET in 2018-19, the largest single year volume of coal exported from the terminal to date. WICET is rated to provide annual throughput capacity of 27 Mtpa, and there is currently 16 Mtpa unallocated capacity.

Combined, the RG Tanna terminal and WICET terminal provide annualised coal export capacity of approximately 102 Mtpa. With a combined 72.4 Mt of coal exported from these two terminals in 2018-19, there is significant spare capacity currently available in the Port of Gladstone's coal export infrastructure (approximately 30 Mt).

In addition to the two coal terminals listed above, there are a total of eight main wharf centres at Gladstone Port. The remainder of the facilities include (GPC, undated a):

- Port Central: This facility is made up of five wharves, handling more than 2 Mt of cargo annually.

- Auckland Point 1 was originally developed to export coal and more recently calcite, however it has been repurposed to accommodate clean break bulk/RORO trade and a cruise ship terminal as a prominent feature of the East Shores community project (a parkland area with a number of facilities). (GPC, 2020).
- Auckland Point 2 is a multiuse berth largely utilised to service bulk agriculture exports such as grain with significant silo and road/rail infrastructure connections.
- Auckland Point 3 also is a multiuse berth configured to enable bulk petroleum imports to the adjacent tank farms.
- Auckland Point 4 is a common use berth largely configured to enable containerised trade and break bulk. It is a land backed wharf with a high deck loading making it suitable for heavy project cargo and was extensively used as part of the LNG gas project development. It will be the key site for expansion of containerised trade in Gladstone with the ability to expand into another two adjacent berths nominated as Auckland Point 5&6. The site is ideally located mid port to reduce the potential for vessel delays due to other port movements. In response to inquiries from a major container liner service GPC have invested $3.8 million to install a mooring dolphin enabling the berthing of larger vessels. GPC is now investing approximately $6 million to upgrade the container staging area directly behind the berth, to further lay the foundations for containerised freight for Gladstone.
- The Barney Point Coal Terminal was closed for coal exports in May 2016 following the opening of the WICET. The terminal has now transitioned to a multi use dry bulk export facility and is currently utilised for the calcite that previously was shipped from Auckland Point terminal.

- Fisherman's Landing: This terminal consists of four wharves operated by multiple companies including Rio Tinto and Cement Australia. The terminal handles over 14.5 Mt of cargo each year including bauxite, alumina, caustic soda, liquid ammonia, sulphuric acid and cement products. This facility is adjacent to the Western Basin development which is a large area currently being reclaimed by GPC utilising the dredge spoil material from capital dredging activities. There are significant growth capabilities in this area, particularly given its proximity to the 27,000 Ha State Development Area. It is expected that the site will feature in the ultimate development of containerised freight in Gladstone as part of the Inland Rail scenario.
- South Trees: Consists of two wharves, which are both operated by Queensland Alumina Limited to support one of the largest alumina refineries in Australia which produces approximately 3.95 Mt of smelter grade alumina per year.
- Boyne Wharf: The wharf is operated by Boyne Smelters Limited which is Australia's second largest aluminium smelters.
- Curtis Island: Consists of three wharves all operated by different Liquified Natural Gas (LNG) companies including Australia Pacific LNG, Santos GLNG and Queensland Curtis LNG.

The trade breakdown for each wharf centre located at Gladstone Port for 2017-18 has been included in Appendix A. This breakdown highlights the major commodities handled in each facility and their corresponding tonnage.

Future Operations

The 50 Year Strategic Plan for the Port of Gladstone (GPC, 2012) outlines an aim for the port to develop into a strategic port centre handling 250-300 Mtpa of cargo over the next 40 to 50 years.

In order to accommodate growth in ship movements and provide a safe two-way ship passage at the Port of

Gladstone , Gladstone Ports Corporation Limited has planned for the duplication of the existing Gatcombe and Golding Cutting channels. An Environmental Impact Statement (EIS) for this $760 million project was submitted in November 2019 and received conditional state approval in July 2020. This project requires a full business case prior to commitment and is designed to support expected growth in throughput and ship movements at the Port of Gladstone.

Coal export capacity is also anticipated to grow with WICET being designed to accommodate expansion over multiple stages to a total of approximately 120 Mtpa of long-term export capacity from the existing site when fully developed. Stage 2 expansion, which has approvals in place, would more than double the capacity of WICET to

60 Mtpa. There are also plans for a fifth berth at the RG Tanna terminal, which would add a further 15 Mtpa capacity (GPC, 2012). Considering the Port of Gladstone already has an additional coal capacity of approximately 30 Mt, further expansion works will increase the ports status as a coal export hub and support the development of additional mines in the Surat Basin for years to come. Capacity provided by these future works have not been included in the subsequent analysis in this report.

The Strategic Plan is complimented by a more recent release of a Precinct Outlook for Port Central, outlining a development vision for the facility for containerised freight, intermodal interfaces, and warehousing/ distribution centres. The Precinct Outlook identifies that additional berths can be constructed between Auckland Point and Barney Point (collectively known as Port Central). The facility is ideally located adjacent to a deep channel and close to the mouth of the Port which is suitable for containerised freight and their time critical schedules. With an efficient configuration, Port Central will have capacity of up to 2 Million TEU. Expansion beyond 2 Million TEU towards 5 Million TEU can occur at Fisherman's Landing, on the Western Basin development area which is currently being reclaimed. Figure 3.1 below highlights future expansion plans for container freight.

Figure 3.1. Port Central Future Expansion

Source: GPC (Undated b).

Fisherman's Landing is located adjacent to the Gladstone State Development Area (GSDA). The current terminal has four berths with expansion plans to develop another seven, including a land base of 200 hectares noted in the Strategic Plan. The new berths will have the potential to accommodate vessels up to 15.5 m draft to assist bulk and break-bulk operations (GPC, 2012).

Figure 3.2. Fisherman's Landing Future Expansion

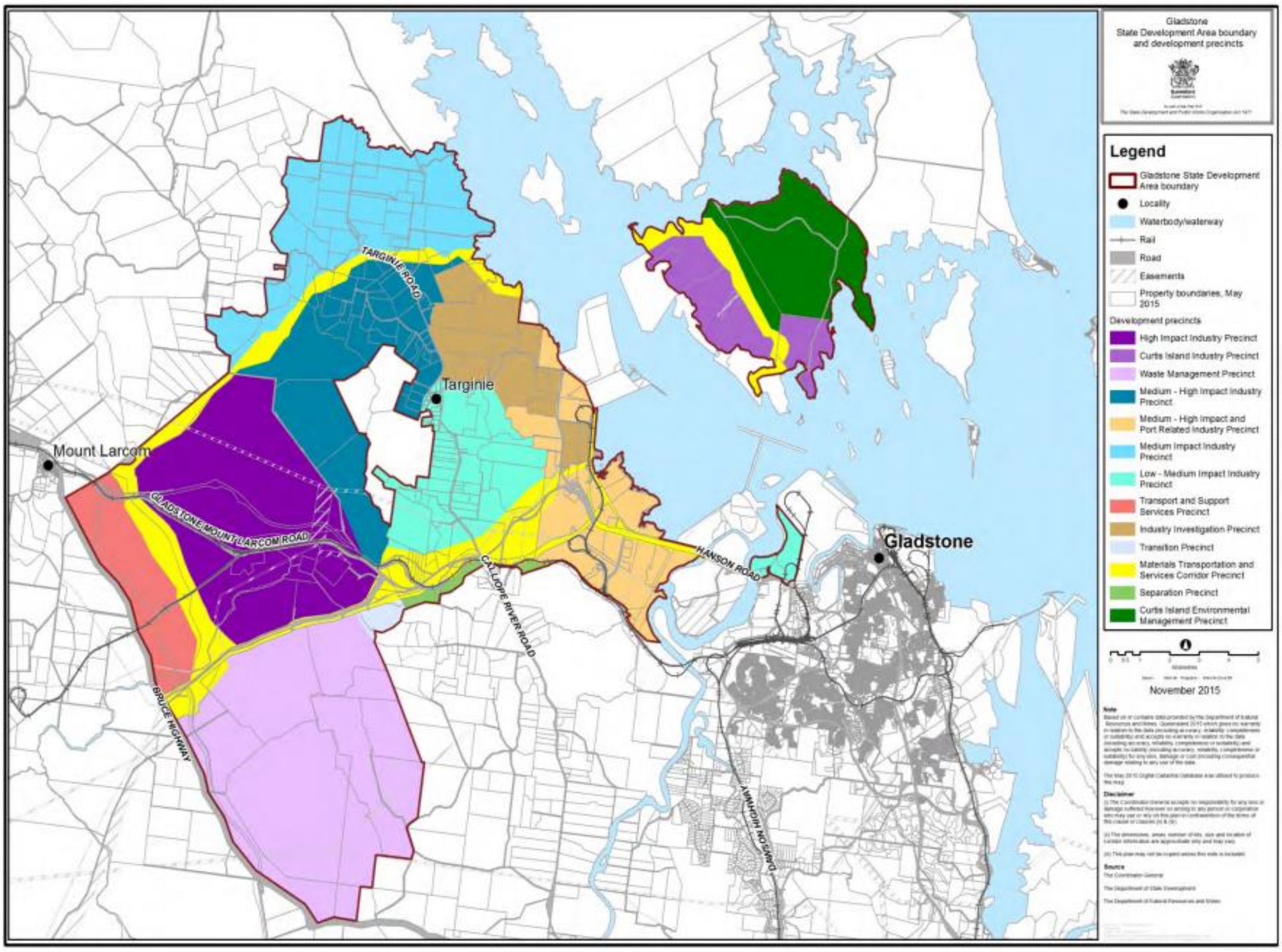
Source: GPC (2012).

Gladstone State Development Area

The GSDA covers a total of 27,194 hectares, of which approximately 1,620 hectares are listed as an environmental management precinct on Curtis Island (see Figure 3.3 below). The GSDA has land available to support land-side expansion of future container freight growth and is currently home to:

- Rio Tinto alumina refinery
- Transpacific Industries waste management and recycling facility
- Orica chemical manufacturing complex
- Australian Pacific LNG
- Queensland Curtis LNG
- Santos Gladstone LNG
- Southern Oil's northern oil refinery
- Queensland Cement.

Figure 3.3. Existing Planning Instruments within the Masterplan Area



Source: Queensland Coordinator General (2015).

3.1.2 Freight Volumes

In 2018-19, Gladstone Port handled a total of 124.0 Mt of throughput (103.1 Mt of exports and 20.9 Mt of imports). Coal exports accounted for majority (58%) of total throughput. LNG has been the second largest throughput volume for the last three years, totalling 17.4% of total throughput in 2018-19.[3]

Container freight in Gladstone accounted for 63,593 tonnes of exports and 2,634 tonnes of imports in 2018-19,[4] accounting for 0.05% of total trade volume through the port. Peak container traffic was 97,271 tonnes in 2015-16.

DAE (2018) identifies a further $560 million in port infrastructure upgrades are required to handle increased container freight, suggesting current capacity is not sufficient to handle increased volumes of container trade.

A detailed history of the Port of Gladstone's freight volumes is included in Appendix A.

3.1.3 Rail Infrastructure

Currently, non-coal rail freight access to the Port of Gladstone is limited to the North Coast Line, a narrow-gauge line that runs along the east coast of Queensland between Nambour and Cairns. The line connects to the South East Queensland rail system at Nambour. The North Coast Line is the principal line for north-south movement of freight by rail and is a shared line between freight and passenger trains, as is the South East Queensland rail

[3] It must be noted that LNG exports commenced in December 2014.

[4] Equivalent to 6,360 import and 260 export TEUs.

system, which constrains capacity for freight movements. Further, recent investments by both the Queensland and Australian Governments have been focused on improving commuter traffic capacity, speed and reliability, with little emphasis of these investments being made on improved rail freight outcomes.

The current commitment by the Federal Government of $390 Million for upgrades on the North Coast line is mainly focused on improvements to commuter services to Nambour and linkages to the Sunshine Coast region. This will have little impact on the efficacy of freight of the North Coast line,

There is currently no access between Gladstone and Toowoomba under an inland alignment. The Moura Coal Rail System is the furthest inland rail line south of Gladstone, terminating near Banana, providing a narrow gauge line servicing a number of mines in the Dawson and Callide Valleys in Central Queensland. The line runs from Moura to Gladstone, where it connects to the two coal export terminals. The Moura System is a single line with passing loops, catering for up to 26.5 tonne total axle limit (TAL) (Aurizon, 2017).

3.2 PORT OF BRISBANE

Located at the mouth of the Brisbane River, Port of Brisbane is managed and developed by the Port of Brisbane Pty Ltd (PBPL) under a 99-year lease from the Queensland Government through Brisbane Port Holdings Pty Ltd.

PBPL is owned by the APH Consortium (formerly known as Q Port Holdings consortium), comprising four of the world’s largest and most experienced infrastructure investors. The members are: Caisse de dépôt et placement du Québec; IFM Investors; QIC Private Capital Pty Ltd on behalf of its managed funds; and Tawreed Investments Ltd, a wholly-owned subsidiary of the Abu Dhabi Investment Authority.

3.2.1 Port Infrastructure

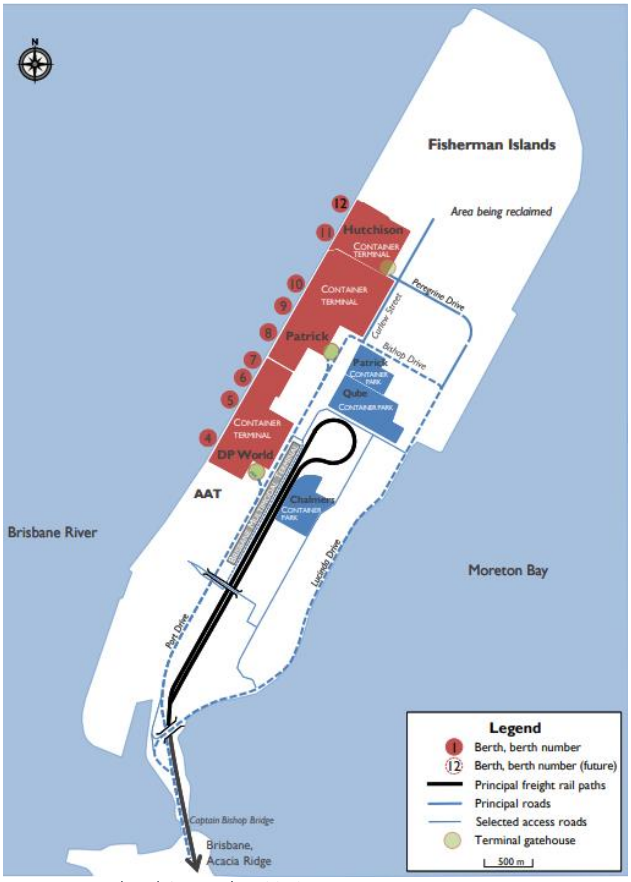
Current Operations

The Port of Brisbane is a multi-commodity port, Queensland’s largest general cargo freight port, and one of Australia’s fastest growing container ports. From 2013-14 to 2018-19, the number of TEUs at the Port of Brisbane increased by approximately 245,000 to reach a total of 1.34 million TEUs (TMR, 2019). This is an average annual growth rate of 4.1%, highlighting the significant growth in containerised cargo over the past five years.

Currently the Port of Brisbane is comprised of eight 300m container berths, equivalent to 2,469 meters of quay line with up to 2,000 TEUs per quay line metre. The current container trade at the port is well below its current capacity of approximately 4.92 TEUs (PoB, 2018). Container movements though the port highlight that currently over 97% of container throughput is transported via road (PoB, 2018)

Figure 3.4 below highlights three container terminals and subsequent organisations, which operate at the port, including Patrick, DP World and Brisbane Container Terminals.

Figure 3.4. Port of Brisbane (Fisherman Island Terminals)



Note: Last updated September 2016
Source: Department of Infrastructure, Transport, Cities and Regional Development (2019).

Coal exports at the Port of Brisbane is significantly lower than is currently handled through the Port of Gladstone . In 2018-19, the Port of Brisbane exported approximately 6.6 million tonnes of coal, which was the largest single commodity export, accounting for approximately 48% of all exports that year (see Appendix B). The port's one coal export terminal has been operated by Queensland Bulk Handling since 1983. The facility has the current capacity to store 909,000 tonnes and handle over 48,000 tonnes per day, with a total capacity of 10 Mtpa (QBH, undated).

Currently, the Port of Brisbane have an additional coal processing capacity of approximately 3.4 Mtpa, however, with the required investment in the existing rail line and new rolling stock, the coal terminal is capable of handling up to 15 Mtpa (PoB, 2018). This means there is considerable spare coal capacity at Port of Brisbane.

Future Operations

The Port of Brisbane Master Plan (PoB, 2018) outlines the port is expecting to grow from approximately 1.35 million twenty-foot equivalent unit (TEU) containers per annum to approximately 4.8 million TEUs by 2048, while also increasing dry bulk freight from 12 million tonnes per annum (Mtpa) to 20 Mtpa over the same period. Projected growth in coal exports is to 19.5 Mtpa (ARTC business case).

Without expansion, the Port of Brisbane is expected to reach capacity by 2052 (HustonKemp, 2019). Currently the Port is largely underutilised with current container trade (1.35 TEUs) being significantly lower than its capacity (4.92 TEUs) (PoB, 2018)).

Table 3.1. Container Growth Targets – TEUs (30-years)

Year	2018	2023	2028	2033	2038	2043	2048
Volume	1.34	1.68	2.14	2.68	3.33	4.01	4.80

Source: PoB (2018).

Although land capacity at the port is significant, AECOM (2017) states that access of rail and road freight through the urban/ metropolitan area as being one of the greatest expansion constraints surround the ports future. The Port of Brisbane does not currently have dedicated transport corridors to manage this freight volume increase.

Also, while Fisherman Island has significant potential to expand and grow capacity with the addition of more berths, considerable dredging of both the Brisbane River and Moreton Bay is required to allow the Port of Brisbane to manage ships larger than 8,500 TEU. Figure 3.5 shows the extent of the dredging to manage container ships of 13,500 TEU requiring at least 15.2 m draft.

Figure 3.5. Dredging Path to Enable Larger Container Ships

Source: PoB (2017).

3.2.2 Freight Volumes

The Port of Brisbane handled a total of 34.0 Mt of throughput in 2018-19, with coal exports being the largest commodity at 19.4% of total throughput. The Port of Brisbane's imports are larger than their exports, with oil (both crude and refined) being the largest imports in 2018-19 (accounting for 25.5% of total throughput).

For the year ending June 2020, container trade accounted for 31% of the total volume of trade, with approximately 5.0 million tonnes imported and approximately 4.7 million tonnes exported.

A detailed overview of the Port of Brisbane's historical freight volumes is included in Appendix B.

3.2.3 Rail Infrastructure

Currently, freight travelling by road or rail in South East Queensland (SEQ) shares infrastructure with passenger rail and urban road transport. The growth in freight via the Port of Brisbane generates cumulative capacity issues on SEQ's road and rail network, as demand for both passenger movements and freight movements on the system increases as population grows. The rail network in Brisbane between the Port of Brisbane and Acacia Ridge (which connects to the East Coast Line to Sydney) does have Standard gauge rail installed, but due to very low freight volumes the standard gauge link has been decommissioned with the remaining rail network in southern Queensland being narrow gauge.

There are limitations regarding tonnage limits and train lengths in SEQ. Rail infrastructure into the Port of Brisbane currently allows for axle load limits of 15.75 tonnes and train lengths of 650 metres (AECOM, 2017), with a maximum of approximately 87 train paths per week allowed for the coal supply chain (ARTC, 2015).

The limitations of the existing infrastructure, as well as requirements to share the network with passenger rail, has resulted in rail accounting for a very small proportion of freight movements in SEQ at less than 2.5%, well below the 20%-30% rail share for many major cities (PoB, 2018). Existing rail infrastructure has limited capacity to handle increased freight loads. This includes the potential to expand coal exports; currently exports of coal from Port of Brisbane is capped at approximately 10-12 Mtpa due to constraints in the existing rail network (AECOM, 2017; PoB, 2018). To increase the network capacity for coal freight the rail infrastructure would need to be upgraded to allow for additional train paths or heavier and/ or longer trains.

ARTC, as part of the business case for the Inland Rail project (ARTC, 2015), included costs associated with providing new and upgraded rail infrastructure (to standard gauge) between Toowoomba and the Port of Brisbane. In total, in 2020 dollar terms, the capital cost for developing this rail infrastructure is estimated to be approximately $5 billion[5] (ARTC, 2015; ARTC, 2010; DAE, 2018), of which over $2.8 billion reflects the cost for developing rail infrastructure between Acacia Ridge and the Port of Brisbane.

Acacia Ridge to the Port of Brisbane proposed Eastern Freight corridor costs approximately $76.75 million per kilometre. This proposal includes 2 tunnels totalling 9.2 km (4.8km and 4.4km)The Toowoomba Range Tunnel component of the Toowoomba to Acacia Ridge line is estimated to cost approximately $149.3 million per kilometre.). For comparison the cross river rail link currently under construction with a 5.9km tunnel of its total 10.2 km length is estimated at $5.9 Billion ($578 million / km).

In addition to these costs, development of this rail infrastructure will require significant investigation, planning, engineering, approval and construction works and negatively impact the timing of developing Inland Rail from Toowoomba to the Port of Brisbane compared to Toowoomba to the Port of Gladstone. It is currently forecast that the connection to the Port of Brisbane could be completed by 2026

[5] Using indexing of 2.5% per annum.

4. SUMMARY OF PREVIOUS INLAND RAIL STUDIES

This section reviews previous research conducted on the Inland Rail and presents key findings and summary of approaches.

4.1 ARTC INLAND RAIL BUSINESS CASE (2010)

In July 2010, ARTC released the Melbourne-Brisbane Inland Rail Alignment Study. The aim of the study was to determine the optimum alignment of a standard gauge route through inland Victoria, New South Wales and Queensland to identify the range of economic benefits and commercial success of the proposal. The analysis was supported by Parsons Brinckerhoff (PB) and PricewaterhouseCoopers (PwC). ACIL Tasman was also engaged to undertake volume and demand analysis in support of the economic review of the project.

The demand analysis showed that the existing coastal rail system would not be able to cope with the increase in the freight task and without investment in Inland Rail, the share of freight on road would considerably increase. By investing in Inland Rail, reliability of freight delivery could increase, terminal-to-terminal freight times could decrease, costs of freight could decrease by up to 33% per tonne and availability to carry more time-sensitive freight could increase, relative to the coastal route.

The economic and financial appraisal of Inland Rail considered a range of benefits including savings in freight travel time and reliability for freight customers, savings in train and road operating costs, an increase in net economic value from induced freight, reduced maintenance, benefits to commuter rail passengers in SEQ and reduced externalities (such as road congestion, noise, water and air pollution and road crash costs).

The residual value of Inland Rail by 2070 was included as an economic benefit.

Terminating Inland Rail at Toowoomba

ARTC did examine a scenario where Inland Rail terminated at Toowoomba, with completing the section to Brisbane (Acacia Ridge) at a later date. The business case found that such an option would defer a significant proportion of the initial capital cost because of the high cost of crossing the Toowoomba range and would involve a longer pick up and delivery by road (approximately 125km or 2-3 hours) from Toowoomba to Brisbane (ARTC 2010).

However, following the construction of the Toowoomba Range Crossing, road transit times have considerably shortened. The ARTC analysis was never updated to reflect this considerable change in operating environment.

Table 4.1 shows the different travel time for a container to various points in SEQ unloaded in both Toowoomba to and Acacia Ridge.

Table 4.1. Present Value of Costs and Benefits in ARTC Inland Rail Business Case by Scenario, 4% and 7% Discount Rates ($M 2014-15)

Destination	Road from Toowoomba	Rail to Acacia Ridge, then Road
Eagle Farm	1hr 50min	2hr 30min
Brendale	2hr 10min	2hr 55min
Helensvale	2hr 10min	2hr 55min

Source: AEC analysis.

ARTC also found that terminating in Toowoomba would negative impact on estimated coal freight demand, resulting in a 60% reduction in below rail revenue.

4.2 ARTC INLAND RAIL BUSINESS CASE (2015)

4.2.1 Summary of Approach and Findings

The business case for the Inland Rail project (ARTC, 2015) outlines the anticipated costs and benefits of delivering a dedicated standard gauge rail freight line between Brisbane and Melbourne, on the basis that exports and imports of freight in southern Queensland associated with the Inland Rail line would use the Port of Brisbane.

The ARTC Inland Rail business case examined two primary scenarios:

- The first scenario includes “complementary investment” upgrading the existing rail lines west of Toowoomba to the Southern Surat and Clarence/ Moreton coal basins (the “Western Line”) to standard gauge (in addition to development of standard gauge rail between Melbourne and Acacia Ridge), to deliver efficiency benefits to rail users west of Toowoomba (in particular coal producers) as a result of increased train lengths. In this scenario, the increase in train lengths also enables increased overall freight capacity for commodities west of Toowoomba, under an assumption of a capacity of 87 train paths per week for coal. Without this complementary investment, the ARTC Inland Rail business case acknowledges that coal freight movements would be considerably lower than included in their assessment of demand.
- The second scenario excludes the above upgrades to the Western Line, resulting in users west of Toowoomba not receiving the efficiency and increased capacity benefits from longer trains, and with coal freight volumes remaining at existing levels.

The above scenarios do not include consideration of providing a dedicated rail freight line between Acacia Ridge and the Port of Brisbane (or alternative capital investment in rail infrastructure to increase capacity), which would be necessary to achieve the projected increase in coal freight volumes from the Surat and Clarence/ Moreton coal basins used in the ARTC Inland Rail business case. The proposed solution for handling and transporting freight from Acacia Ridge to the Port of Brisbane is also not described in the above scenarios, nor the implications for the existing road and rail networks. Extending the rail to the Port of Brisbane would reduce double handling of freight and avoid a significant increase in the road freight task between Acacia Ridge and the Port of Brisbane. Scenarios examining the incremental additional costs and benefits associated with extending the rail line between Acacia Ridge and the Port of Brisbane was examined separately in Chapter 18 of the ARTC Inland Rail business case.

A summary of the total costs and benefits of each scenario presented in ARTC’s Inland Rail Business Case (in present value, 2014-15 dollar terms), as well as the Net Present Value (NPV) and Benefit Cost Ratio (BCR), is provided in Table 4.2 below.

Of note:

- At a 7% discount rate, the Inland Rail project provides a marginal net benefit for the Melbourne to Acacia Ridge scenario including Western Line upgrades but a net cost without the Western Line upgrades. The majority of the additional benefit delivered by the Western Line is delivered by coal freight, highlighting the importance of unlocking the ancillary benefits of coal freight in delivering an economically desirable outcome.
- The additional costs for extending the rail line from Acacia Ridge to the Port of Brisbane is estimated to result in net costs for all scenarios examined at a 7% discount rate.
- At a lower discount rate of 4% all scenarios are estimated to provide a significant net benefit, with BCRs of 2.32 or above for all scenarios. This highlights the high upfront costs of the infrastructure (which receives only a small impact from discounting) versus the long term benefits delivered (which are heavily impacted by discounting).
- Since the announcement of the $4 billion cost over run, and the addition of $5.5 billion additional Government equity into ARTC to cover these cost overruns, the NPVs and BCR will now be considerably over stated

Table 4.2. Present Value of Costs and Benefits in ARTC Inland Rail Business Case by Scenario, 4% and 7% Discount Rates ($M 2014-15)

Scenario/ Impact	4%	7%
Melbourne to Acacia Ridge, Including Western Line Upgrade		
Total Costs ($M)	$8,575	$7,036
Total Benefits ($M)	$22,503	$7,152
Net Present Value ($M)	$13,928	$116
Benefit-Cost Ratio	2.62	1.02
Melbourne to Acacia Ridge, Excluding Western Line Upgrade		
Total Costs ($M)	$8,515	$6,991
Total Benefits ($M)	$21,806	$6,711
Net Present Value ($M)	$13,291	-$280
Benefit-Cost Ratio	2.56	0.96
Melbourne to Port of Brisbane, Including Western Line Upgrade		
Total Costs ($M)	$9,638	$7,588
Total Benefits ($M)	$23,088	$7,255
Net Present Value ($M)	$13,451	-$333
Benefit-Cost Ratio	2.40	0.96
Melbourne to Port of Brisbane, Excluding Western Line Upgrade		
Total Costs ($M)	$9,577	$7,543
Total Benefits ($M)	$22,234	$6,774
Net Present Value ($M)	$12,657	-$769
Benefit-Cost Ratio	2.32	0.90

Source: ARTC (2015).

ARTC also highlights the importance of coal from the Surat Basin to the financial appraisal of the Inland Rail project, where coal freight accounts for 24% of the total expected project revenue (ARTC 2015).

4.2.2 Key Considerations

- Although it is not explicitly stated, it is suggested that ARTC's coal export estimates include existing production as Inland Rail 'is expected to significantly increase coal volumes from the current 8 million tonnes to 19.5 million tonnes' (ARTC 2015, p 126). This indicates that the analysis is not considering additional coal volumes over and above what is already occurring.
- ARTC highlight there will be sufficient port capacity in Brisbane to accommodate forecast coal demand volumes. However, the Port of Brisbane currently has one coal terminal, which has a capacity of supporting 12 Mtpa. It is likely that coal volumes over a total of 12 Mtpa will require upgrades to the existing rail and port network.
- Acacia Ridge to the Port of Brisbane proposed Eastern Freight corridor costs approximately $76.75 million per kilometre. This proposal includes 2 tunnels totalling 9.2 km (4.8km and 4.4km The Toowoomba Range Tunnel component of the Toowoomba to Acacia Ridge line is estimated to cost approximately $149.3 million per kilometre.). For comparison the cross river rail link currently under construction with a 5.9km tunnel of its total 10.2 km length is estimated at $5.9 Billion ($578 million / km).

4.3 AECOM INLAND RAIL GLADSTONE LINK (2017)

4.3.1 Summary of Approach and Findings

AECOM (2017) provided a pre-feasibility and preliminary economic analysis of developing a dedicated freight rail line between Toowoomba and Gladstone. The assessment examined two potential route options:

- A new standard gauge coastal route linking the Port of Gladstone to the Inland Rail project at Acacia Ridge
- A dual gauge/ standard gauge inland route linking the Port of Gladstone to the Inland Rail project near Toowoomba[6].

The assessment examined three main sources of demand for freight movements along the potential new rail line between Brisbane/ Toowoomba and Gladstone:

- Transfer of intermodal container freight from the road network between Brisbane and Gladstone
- Transfer of intermodal container freight from the existing rail network between Brisbane and Gladstone
- Additional coal freight from the northern Surat Basin (inland route only).

Demand from other potential sources was excluded on the assumption that none of this freight was considered likely to transfer to the new rail line. This includes intermodal container from south of Brisbane/ Toowoomba (e.g. freight travelling along the Inland Rail project), rail freight originating from/ destined for north of Gladstone, or agricultural freight from the Darling Downs-Maranoa region.

As development of the coastal route is both a more expensive option by approximately $2 billion than an inland route and does not unlock additional coal freight from the northern Surat Basin, this option was assessed as being considerably less desirable economically than the inland route. As such, the remainder of this summary will focus on the inland route.

For the inland route, coal demand was estimated based on a risk-rated assessment of the likelihood that known proposed coal projects in the northern Surat Basin would proceed, for those projects identified as being likely to use the inland route to the Port of Gladstone (proposed coal projects in the Clarence/ Moreton Basin and east of Miles were assumed to have a preference to export coal through the Port of Brisbane). This risk-adjusted coal demand estimate did not include any consideration for additional future projects to be developed as known projects wound down.

For intermodal container freight, it was optimistically assumed that 48.8% of road freight between Brisbane and Gladstone (i.e. 50% as was assumed for the coastal route less an elasticity factor of 2.4% due to increased transit time using an inland route), and 97.6% of rail freight demand between Brisbane and Gladstone (100% assumed for the coastal route less an elasticity factor of 2.4%) would transfer to inland rail. Intermodal container freight was assumed to grow by 2.5% per annum.

While the assumptions of freight demand transferring from road and rail between Brisbane and Gladstone are likely optimistic, detailed analysis of potential demand was not undertaken and as these estimates don't include any other potential sources of intermodal container freight it is uncertain as to how appropriate these demand projections may be.

Importantly, AECOM's analysis also excluded the potential for freight generated along the Inland Rail corridor (south of Toowoomba) to travel to Gladstone Port. The assumption was that the link to Gladstone was an incremental add on to the network that would have no impact on the Port of Brisbane. The impact of this assumption is a considerable reduction in the benefits associated with the development of the rail link to Gladstone Port.

A summary of the estimated freight demand along the inland route used by AECOM is outlined below.

[6] A third option examining narrow gauge only for the inland route was also outlined in the route options of AECOM's report, however, all analysis of demand, financial analysis and economic impacts was based on a dual gauge option.

Table 4.3. Demand Projections for Inland Route, Mtpa

Freight	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Coal	18.9	24.3	24.3	24.3	24.3	21.9	1.5	-	-	-	-
Intermodal	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.8	0.9
Total	**19.2**	**24.6**	**24.6**	**24.7**	**24.7**	**22.4**	**2.0**	**0.6**	**0.7**	**0.8**	**0.9**

Source: AECOM (2017).

AECOM estimated the cost of developing the dual/ standard gauge inland route to Gladstone at $2.993 billion in 2014-15 dollar terms. The table below provides a breakdown of costs by segment, as well as the total cost at a 4% and 7% discount rate. It should be noted that in developing these cost estimates, AECOM assumed new standard gauge track alongside the existing narrow gauge line would be developed between Gowrie (Toowoomba) and Wandoan, the Surat Basin Rail Project would be standard gauge only, while the Moura System between Banana and Gladstone would be upgraded to dual gauge. It should be noted that the proposal by ATEC Rail Group Pty Ltd for the Surat Basin Rail project, and the re-establishment of the line between Wandoan and Miles would be dual gauge. This link would also include a bypass of the town of Miles.

Table 4.4. Costs for Developing Inland Route, Dual/ Standard Gauge, 2014-15 Dollar Terms

Segment	Distance (km)	Cost ($M)	4% Discount Rate ($M)	7% Discount Rate ($M)
Toowoomba/ Oakey to Miles	198	$840		
Miles to Wandoan	65	$380		
Surat Basin Rail Project (Wandoan to Banana)	215	$1,116		
Banana to Wooderson	129	$334		
Wooderson to Callemondah	32	$86		
Callemondah to Auckland Point	7	$89		
Passing loops	-	$149		
Total	**646**	**$2,993**	**$2,669**	**$2,466**

Source: AECOM (2017).

In valuing the economic benefit per tonne of freight using the inland route, AECOM applied values from the ARTC Inland Rail business case (ARTC, 2015) for coal freight and intermodal container freight. The following table provides a summary of the benefits per average annual tonne used by AECOM based on the ARTC Inland Rail business case.

Table 4.5. Benefits per Average Annual Tonne of Freight, 2014-15 Dollar Terms

Freight Type	4% Discount Rate	7% Discount Rate
Total Benefit – ARTC Inland Rail Business Case ($B)		
Coal	$1.6	$0.6
Intermodal	$15.4	$4.7
Average Annual Freight – ARTC Inland Rail Business Case (Mtpa)		
Coal	19.1	
Intermodal	12.4	
Benefit per Average Annual Tonne of Freight ($)		
Coal	$83.2	$30.6
Intermodal	$1,238.2	$376.1

Source: AECOM (2017).

The approach adopted by AECOM applies the total benefit over 100 years outlined in the ARTC Business Case for coal freight and intermodal container freight between Melbourne and Brisbane, divided by the average annual tonnage of coal/ intermodal container freight over 50 years.

These estimated 100-years of benefit per average annual tonne of freight over 50 years were applied to estimates of average annual tonnes of coal and intermodal container freight using the inland route to Gladstone between 2025 and 2075, based on annual tonnages summarised in Table 4.3 above.

Table 4.6. AECOM Estimated Benefits of Inland Route, 2014-15 Dollar Terms

Freight Type	4% Discount Rate	7% Discount Rate
Average Annual Tonnages of Freight (2025-2075) (Mtpa)		
Coal	13.34	
Intermodal	0.54	
Total Benefit ($M)		
Coal	$1,110.0	$408.1
Intermodal	$666.3	$202.4
Total	**$1,776.3**	**$610.5**

Note: The value reported for Intermodal Benefit in AECOM's report was $369.9 million, however, this is believed to be a typographical error as the total benefit used later in the report uses the correct value of $666.3 million.
Source: AECOM (2017).

The preliminary economic analysis indicates the inland route between Toowoomba and Gladstone is not economic under the scenarios, assumptions and approach used. A summary of the economic analysis results from AECOM's report is provided below.

Table 4.7. AECOM Estimated Net Present Value and Benefit Cost Ratio, Inland Route, 2014-15 Dollar Terms

Impact Measure	4% Discount Rate	7% Discount Rate
Present Value of Costs	$2,669	$2,466
Present Value of Benefits	$1,776	$611
Net Present Value	**-$893**	**-$1,885**
Benefit Cost Ratio	**0.67**	**0.25**

Source: AECOM (2017).

4.3.2 Key Considerations

- The report highlights the constraints of developing and upgrading additional rail infrastructure through the Brisbane metropolitan area. AECOM suggest that there are significant environmental, social and political challenges associated with increasing rail freight capacity in a densely populated area.
- The report does not consider the costs associated with the upgrade of the Port of Brisbane coal handling facilities beyond the current capacity of 12 Mtpa.
- AECOM also does not consider the option of any of the coal that is currently being exported from the Port of Brisbane transferring to the Port of Gladstone. This assumption underwrites the economic and financial viability of he Toowoomba to Port of Brisbane rail link.
- AECOM's analysis assumes the route to Gladstone is an incremental add-on to development of Inland Rail to Acacia Ridge and the Port of Brisbane. Given the significant challenges in developing the connection from Toowoomba to Acacia Ridge (and then to Port of Brisbane), the Toowoomba to Gladstone route can likely be developed and operational many years before the route to Acacia Ridge/ Port of Brisbane, with considerably less cost to the Federal Government via ARTC. If there is consideration for staging, the case can be made to develop the link to Gladstone before Brisbane.

There are a number of issues and limitations in the AECOM analysis regarding the assumptions and approach used that indicates the preliminary analysis may have underestimated some of the key benefits of an inland rail route between Toowoomba and Gladstone. Key issues/ limitations identified are outlined below.

Infrastructure

- The AECOM analysis only examined in detail the demand, costs and benefits for development of a standard/ dual gauge inland route between Toowoomba and Gladstone. However, there is potential for this route to be developed as a narrow gauge only inland route option, and potentially upgrade this to dual gauge at a later date. This would reduce the upfront costs (with the existing Western Line and Moura System already providing narrow gauge infrastructure) while still unlocking the significant coal resources in the northern Surat Basin, and delay investment to dual gauge rail infrastructure to a point in time when demand warrants it. The economics of such an approach will be considerably greater than those presented in AECOM's report.

- A separate assessment of the costs and benefits delivered by the Surat Basin Rail Project (narrow gauge) linking the Moura System to Wandoan was provided in AECOM's report, which outlined considerably greater net present value and benefit cost ratios than the standard gauge line from Toowoomba to Gladstone. However, this analysis excluded a link between Wandoan and Toowoomba, while the benefits are considered to be significantly undervalued as per the issues/ limitations outlined below for coal valuation.
- AECOM report has assumed no agricultural freight would transfer to using the rail line between Toowoomba to Gladstone. Rather, they have assumed existing networks would continue to be used, including a mix of rail and road. It should be noted that the distance from Miles to the Port of Brisbane is only 50 km shorter than to the Port of Gladstone. This would therefore create a competitive tension for this freight task

Coal

- AECOM assumes coal production from the northern Surat Basin will effectively cease beyond 2050. There is no justification provided for this assumption. AECOM have also not included any new mine capacity developed in the longer term to replace the known projects when they wind down. This is a considerable inconsistency, to the ARTC business case for Inland Rail. Both assessments should be considered using a common assumption. Realistically, so long as thermal coal prices and demand supports it, longer term coal mining should also be considered.
- The report assumes that coal over 460km would not be transported to Gladstone, and that mines beyond this distance would have a preference to transport coal to the Port of Brisbane. However, while some of these mines would be closer in distance to the Port of Brisbane (by approximately 60km to 70km), transporting coal to the Port of Gladstone may be a preferred alternative depending on a number of factors such as average rail speeds compared to the existing line to Port of Brisbane (which is impacted by slow speeds and shorter train lengths for the Range Crossing), capacity and congestion constraints on the existing line, and user access fees. Further, the infrastructure costs to increase capacity of both rail and the Port of Brisbane to handle additional mine demand would be significantly greater than the incremental additional freight cost for transporting the coal to Gladstone. The Port of Gladstone has the current installed capacity to handle an additional 30 Mtpa of coal exports without capital expansion.
- The ARTC Inland Rail Business Case (ARTC, 2015) valuation for coal only measures the transport efficiency/ operating cost savings from Inland Rail (and Western Line) infrastructure, it does not include a measure of the producer surplus delivered as a result of mines being developed that would not otherwise occur. However, AECOM has also outlined in their report that most of the future production would not be likely to develop without the inland route to Gladstone. The use of a transport efficiency measure is thereby not an appropriate approach to valuing the benefit delivered by the inland route to Gladstone in terms of coal benefits. Producer margins should be used, which will be considerably greater than the transport efficiency benefits outlined.
- AECOM assumes that the benefits to the coal industry on a per tonne basis 'realised through the Melbourne to Brisbane Inland Rail line are equal to the benefits realised through the Gladstone link' (p. 51). However, this is likely to be a significant understatement of the potential coal benefits that would be realised with the development of Inland Rail from Toowoomba to the Port of Gladstone. The Inland Rail from Toowoomba to Gladstone will likely increase the development prospects of large-scale mines in the Surat Basin.

Intermodal Container Freight

- AECOM estimated approximately 538ktpa of intermodal containerised freight may use the inland route to Gladstone (other than coal), building from around 300ktpa in 2024-25 to around 900ktpa in 2074-75.[7] This:
    - Includes relatively optimistic assumptions regarding the quantum of road and rail freight between Brisbane and Gladstone that would shift to the inland route.

[7] Equivalent to 30,000 TEU in 2024-25 to 90,000 TEU in 2074-75, based on 10 tonnes per TEU.

  - Excludes any attraction of intermodal container freight from Inland Rail south of Toowoomba.
  - Excludes any intermodal container freight that passes Gladstone by rail to/ from Port of Brisbane. There may be potential for some of this freight to transfer to the inland route.
  - Only examined intermodal container freight impacts under a standard gauge scenario. No explanation was provided as to why a narrow gauge throughout option was not examined given the demand projections used are based on freight movement between Brisbane and Gladstone only, where the alternative rail option (North Coast Line) is also narrow gauge.
  - Only examined intermodal container freight between Gladstone and Brisbane.

  While the assumptions used regarding freight between Brisbane and Gladstone transferring to an inland rail route were likely optimistic, the exclusion of other potential avenues for freight will likely under-estimate potential freight volumes such a route may attract.

Agricultural Freight

- AECOM report has assumed no agricultural freight would transfer to using the rail line between Toowoomba to Gladstone. Rather, they have assumed existing networks would continue to be used, including a mix of rail and road. However, there may be potential for agricultural freight, in particular freight from west of Miles, to access a rail route to Gladstone, which would also reduce intensity of infrastructure development in urban areas.

Congestion and Environmental Benefits

- Potential benefits in terms of congestion and environmental considerations from using an inland route to Gladstone compared to existing networks, or potentially diverting some freight from Brisbane to Gladstone, were not included.

4.4 DAE ACACIA RIDGE TO PORT OF BRISBANE LINE (2018)

4.4.1 Summary of Approach and Findings

Deloitte Access Economics (DAE) undertook an assessment of the economic, social and environmental benefits of developing a dedicated freight rail link between Acacia Ridge and the Port of Brisbane, connecting the Port of Brisbane to the proposed Inland Rail terminus in Acacia Ridge (DAE, 2018).

The assessment includes consideration of the transport cost/ efficiency benefits of transferring various levels of projected freight throughput of the Port to be moved by rail instead of road as a result of such a dedicated link, as well as other economic (reduced congestion, road damage, increased reliability), social (reduced accidents, enhanced amenity) and environmental (reduced greenhouse gas emissions and pollution) benefits. Scenarios examined included lifting rail share of freight movements to/ from the Port from less than 2.5% currently to:

- 12%, in line with the share achieved at the Port over a decade previous (this is estimated to deliver approximately 350,000 total TEUs moved by rail by 2035, or 320,000 more than currently moved by rail).
- 20%, approximately in line with that achieved at other Australian east coast capitals (approximately 590,000 total TEUs moved by rail by 2035, or 560,000 more than currently moved by rail).
- 30%, approximately in line with international benchmarks (approximately 880,000 total TEUs moved by rail by 2035, or 850,000 more than currently moved by rail).

Estimates of transport cost/ efficiency benefits were estimated to be between $80 and $220 per TEU, depending on volumes, with an average saving of $130 per TEU used. Values for all other benefits were developed based on guidelines from Transport for New South Wales for valuation per net tonne kilometre for road versus rail applied to the total net tonne kilometres of freight movements in each scenario. A summary of the estimated benefit in 2035 is outlined in the table below.

Table 4.8. Benefits by Scenario by 2035, $M2016-17

Benefit	Scenarios of Rail Share		
	12% Share	20% Share	30% Share
Economic	**$192.9**	**$333.4**	**$509.2**
Freight Savings	$42.9	$74.1	$113.2
Congestion	$73.8	$127.5	$194.7
Road Damage	$58.4	$101.0	$154.2
Indirect Transport Costs	$17.8	$30.8	$47.1
Social	**$35.8**	**$61.9**	**$94.5**
Accident Costs	$33.6	$58.0	$88.6
Urban Separation	$2.2	$3.9	$5.9
Environmental	**$81.4**	**$140.7**	**$214.8**
Air Pollution	$27.0	$46.7	$71.2
Greenhouse Gas Emissions	$27.5	$47.6	$72.6
Noise Pollution	$3.8	$6.6	$10.1
Water Pollution	$9.3	$16.0	$24.5
Nature and Landscape	$13.8	$23.8	$36.4
Total	**$310.1**	**$536.0**	**$818.5**

Source: DAE (2018).

Inland Rail to the Port of Gladstone

In addition to examining the benefits of developing the rail link between Acacia Ridge and Port of Brisbane, DAE also provided some high-level analysis of the costs and potential implications of developing an inland rail route between Toowoomba and Gladstone in Appendix B of their report.

The analysis outlines that developing and upgrading the rail line would cost more than $3 billion for a 26.5 TAL standard gauge line, which is approximately in line with estimates in the AECOM (2017) study. DAE estimate a further $560 million in port infrastructure upgrades are also required to handle increased container freight, with development of this infrastructure (including approvals) estimated to take approximately 5-6 years.

The DAE analysis, which is primarily contextual in nature, presents a range of arguments against the economic merit for a rail line between Toowoomba and Gladstone. These arguments include:

- The current volumes of container freight handled by the Port of Gladstone relative to the Port of Brisbane, and implications in terms of infrastructure and supply chain capability and capacity in Gladstone.
- The cost for developing the required infrastructure (rail and port).
- The cost of transporting goods by road/ the North Coast Line back to Brisbane for any freight that bypasses Brisbane on this route (for freight either distributed in Brisbane or that would then be exported from Port of Brisbane).
- A view that agricultural commodities produced in the Darling Downs-Maranoa region would be unlikely to use a rail line to the Port of Gladstone, preferring to continue to transport goods to the Port of Brisbane.
- A view that coal prices would need to be significantly higher than current levels to encourage investment by coal companies in the northern Surat Basin (noting that in 2017 and 2018 when the DAE report was produced thermal coal prices were averaging above US$90 per tonne).
- A view that a rail line to Gladstone would not alleviate congestion issues in the South East Queensland rail and road networks as it ignored the opportunity to transfer existing or new coal developments to Gladstone for export.

4.4.2 Key Considerations

Key considerations of the report include:

- The report highlights that in the financial year ending 2017, the port of Brisbane handled approximately 30,000 TEUs to and from the port using rail, which equates to 2.5% of total freight.
- The DAE report highlights that the average distance for long distant truck movements is 1,000km (assumed average distance of 500km each way). This distance likely overstates the average distance travelled, impacting (over-valuing) the total net tonne kilometres identified in the report.
- The report indicates that coal is has the most traffic on Inland Rail on a tonne per kilometre basis. The report suggests that coal accounts for approximately 25% of traffic on Inland Rail, of which most is estimated to be sourced from Southern Queensland. There is no consideration of coal freight which is currently shipped from Brisbane changing to be exported from Gladstone.
- The analysis has not considered the likely timeframe issues for developing the link between Toowoomba and Acacia Ridge, and then extending this to Port of Brisbane. The report has assumed the rail link would be operational by 2026, which seems unlikely considering the significant construction and planning works proposed to be undertaken with the Toowoomba Range Tunnel and Acacia Ridge to the Port of Brisbane.
- Additionally, the difficulty of constructing the link between Toowoomba and Acacia Ridge and the considerable community objections to the project are not considered.

Inland Rail to the Port of Gladstone

While it is acknowledged the analysis of the Gladstone route was high level in nature, there are a number of limitations and flaws in the logic of the analysis. These include:

- DAE assumes that for the link to Gladstone to be successful, a large proportion of intercapital freight would need to bypass Brisbane and then need to be transported from Gladstone back to Brisbane. That is, it assumes either:
    - A large proportion of intercapital freight between Melbourne and Brisbane is for distribution in Brisbane, rather than export from the Port of Brisbane. Were this is the case, there would be no need for a line

between Acacia Ridge and the Port of Brisbane as it can be distributed by truck from other centres located elsewhere than the Port of Brisbane, such as Acacia Ridge, Bromelton or Toowoomba..

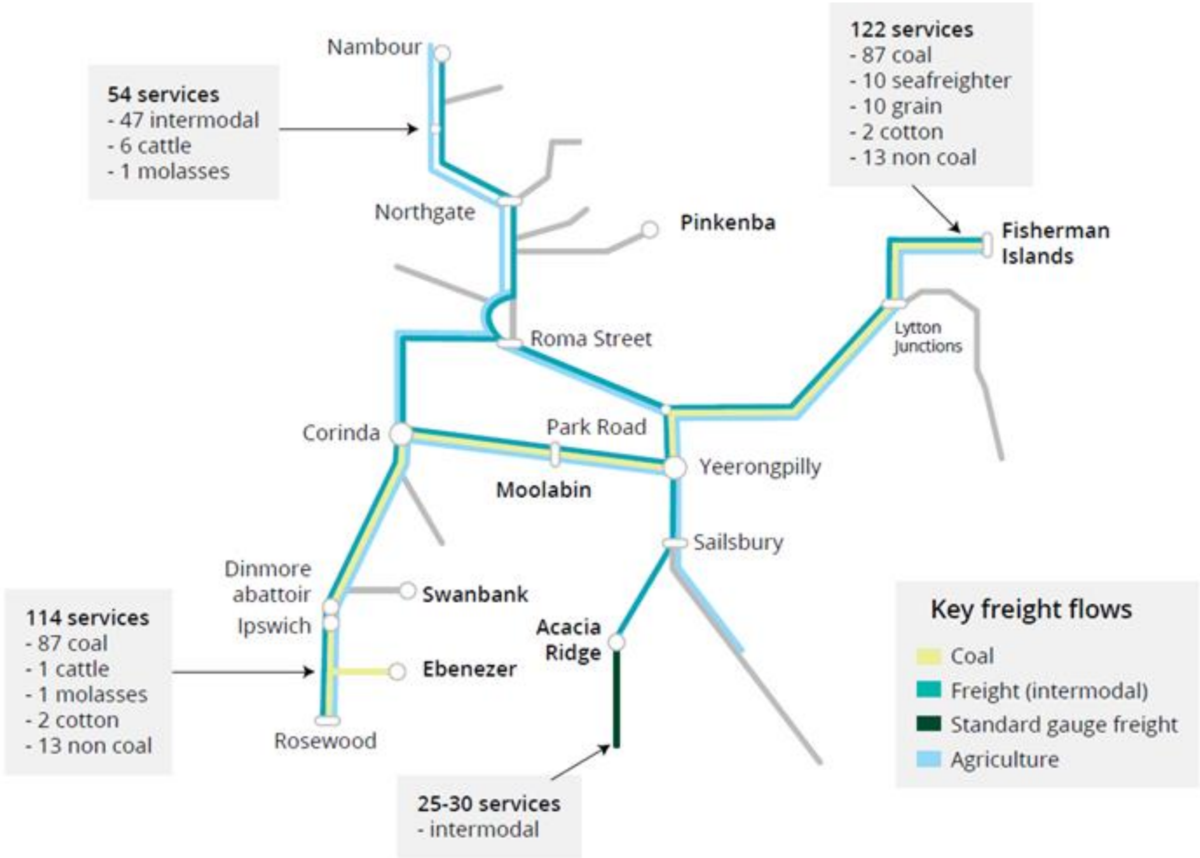
  - There are large volumes of container freight that need to use the Port of Brisbane rather than the Port of Gladstone. This is because this import export freight is destined for or originates from the South East Queensland market. As a result it will be unlikely to use the Inland rail. However, with most export markets located north of Australia, by exporting from the Port of Gladstone there is considerable potential for savings in supply chain cost and time in sea freight costs by using Gladstone

- The report assumes that agricultural freight originating from the Darling Downs-Maranoa would not be likely to use the line to Gladstone. However, agricultural freight produced west of Miles would have minimal difference in time and distance for transporting freight to Brisbane or Gladstone, with the difference in distance from Miles to Brisbane only 50km shorter than Miles to Gladstone. The report argues that the Gladstone line would not assist in alleviating congestion in the South East Queensland transport network. However, this does not take into consideration the implications that such a line could have for taking coal and agricultural freight out of Brisbane, as well as transferring between 1 million and 2 million TEU of the import export freight task from Brisbane to Gladstone. Each of these avenues would assist in alleviating congestion issues by shifting the freight task to another port that bypasses the South East Queensland transport network.
- The report highlights that the Port of Gladstone requires approximately $560 million in container port upgrades to accommodate an increase in intermodal freight. However, it does not state the additional tonnages that the port will be able to handle as a result of the upgrades. For consistency of analysis the report also does not consider the cost of upgrade required at the Port of Brisbane, such as the reclamation of the expansion land on Fisherman’s Island, and the extensive and expensive dredging requirements from the Port to Caloundra

Coal Trains Paths

The DAE report highlights the traffic of coal on the existing Brisbane rail network, which accounts for over 70% of freight services to the Port of Brisbane and 76% of freight services entering the SEQ network from Ipswich. The ‘typical’ daily freight movements are outlined by DAE in Figure 4.1.

Figure 4.1. "Typical" SEQ Freight Movements



Source: DAE (2018).

An opportunity not considered by DAE in its analysis of the Toowoomba to Gladstone link is to utilise the Port of Gladstone for export of all coal from the southern Surat Basin. Doing so would create space for approximately 860,000 TEU of freight in the SEQ rail system, equivalent of 30% of all freight expected to be moved by the Port of Brisbane by 2035. Such a change would enable the deferral of the dedicated rail freight line between Acacia Ridge and the Port of Brisbane.

5. POTENTIAL DEMAND

This section examines potential demand for freight along an inland rail route between Toowoomba and Gladstone. There are three main potential markets of additional freight demand for an inland route between Toowoomba and Gladstone:

- Intermodal container freight, consisting of
  - Domestic inter-capital freight; and
  - Import / export freight landing in Gladstone for distribution to any area along the Inland rail route
- Agricultural freight from the Darling Downs-Maranoa region, in particular freight from west of Miles.
- Coal from proposed coal mines in the Surat Basin. Coal from the Dawson/ Callide Basins will also use the existing Moura System which forms part of this route, but no additional rail infrastructure would be required to support mines in these Basins and as such this demand would not be additional.

These are described in more detail below.

5.1 INTERMODAL CONTAINER AND NON-COAL BULK FREIGHT

There are multiple avenues from which intermodal container and non-coal bulk freight demand may develop. The development of an inland rail route between Toowoomba and Gladstone provides an opportunity to utilise the Port of Gladstone's competitive advantages and become a northern import/ export hub for container freight along the Inland Rail route (including container freight destined for metro Melbourne and Adelaide). This means the Port of Gladstone would become the 4th major Intermodal port on the east coast and be an alternative to the Ports of Brisbane or Melbourne.

For example, unloading containers in Gladstone, then railing them to destinations (including southern capitals) rather than being shipped to other ports, would provide considerable sea freight time savings. It is anticipated that this would comprise the largest component of non-coal freight demand along the inland route between Toowoomba and Gladstone.

These opportunities arise because:

- Using the Port of Gladstone rather than Port of Brisbane (or Sydney or Melbourne) reduces the shipping days from overseas hub ports, as Gladstone is closer to key import/ export markets in East Asia.
- The Port of Gladstone is the only port along the east coast of Australia with the required characteristics (depth of channel, availability of port- and land-side land for growth and to support and unimpeded freight access) to accommodate the largest container freight vessels.
- It would also assist in delaying (and potentially reducing) the need to invest in infrastructure solutions to rail freight between Toowoomba and Port of Brisbane and higher cost container port expansion plans in Brisbane, Sydney and Melbourne.

More information on the value of these benefits have been included in Section 6.3.3.

The following sections consider factors which would influence intermodal container and non-coal bulk freight demand. Based on the information listed below, three scenarios were developed to reflect the level of intermodal freight that might shift from road to rail. It must be noted that these intercapital freight demand projections are a high level evaluation of existing and potential freight which may shift to Inland Rail and three scenarios have been developed for sensitivity testing as it is difficult to quantify intermodal freight prior to operations of Inland Rail.

Inland Rail Projections

Projections of intercapital freight using Inland Rail from ARTC's Inland Rail Business Case (ARTC, 2015) are presented in **Error! Reference source not found.** below, highlighting ARTC's expectations that total intercapital freight is projected to grow from around 4.6 Mt in 2024-25 to approximately 22.4 Mt by 2074-75.

Table 5.1. Demand Projections for Inland Rail, Mtpa, Financial Year Ending June

Freight	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Melbourne to Brisbane	3.2	4.0	4.8	5.7	6.7	7.9	9.1	10.5	12.1	14.0	16.0
Brisbane to Adelaide	0.6	0.7	0.8	1.0	1.2	1.4	1.7	2.0	2.3	2.7	3.1
Brisbane to Perth	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.3	2.6	2.9	3.3
Total	**4.6**	**5.7**	**6.8**	**8.1**	**9.5**	**11.1**	**12.8**	**14.8**	**17.0**	**19.6**	**22.4**

Note: Totals may not sum due to rounding. Freight to Sydney was not included in ARTC's demand assessment.
Source: ARTC (2015).

Based on European Union standards of default weights per TEU container of 12 tonnes per TEU and 2 tonnes per empty TEU (European Commission, 2017), an average of 10 net tonnes per TEU for intercapital freight has been assumed. Based on 10 net tonnes per TEU, approximately 460,000 loaded TEUs would be transported on Inland Rail in 2024-25, increasing to 2.24 million TEUs by 2074-75. Empty TEUs would also need to be transported.

Based on ARTC's demand projections for inter-capital container freight in its 2010 business case, 66% of traffic is expected to travel north to Brisbane (moving North) and 34% of traffic is expected to move south from Brisbane (ARTC, 2010). Table 5.2 combines the forecast freight volumes and the expected north/south split of volume for inter-capital freight.

Table 5.2. Demand Projections for Inland Rail, Mtpa, Financial Year Ending June (North and South)

Freight	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Inland Rail North (Export)											
Melbourne to Brisbane	2.1	2.6	3.1	3.7	4.4	5.2	6.0	6.9	8.0	9.2	10.6
Brisbane to Adelaide	0.4	0.5	0.5	0.6	0.8	0.9	1.1	1.3	1.5	1.8	2.0
Brisbane to Perth	0.6	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.7	1.9	2.2
Total	**3.1**	**3.8**	**4.5**	**5.3**	**6.2**	**7.3**	**8.5**	**9.8**	**11.2**	**12.9**	**14.8**
Inland Rail South (Import)											
Melbourne to Brisbane	1.1	1.4	1.6	1.9	2.3	2.7	3.1	3.6	4.1	4.8	5.4
Brisbane to Adelaide	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.1
Brisbane to Perth	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.1
Total	**1.6**	**1.9**	**2.3**	**2.7**	**3.2**	**3.8**	**4.4**	**5.0**	**5.8**	**6.7**	**7.6**

Note: Totals may not sum due to rounding.
Source: ARTC (2010, 2015).

Some of this intercapital freight would be destined for customers in Brisbane/ South East Queensland, and some would be generated in Brisbane/ South East Queensland and destined for other States. The rest would reflect imports/ exports through the Port of Brisbane that travels to/ from other States. However, there is insufficient information available to understand the exact volumes through the Port of Brisbane.

As an indication of potential volumes of intercapital freight that is imported/ exported through the Port of Brisbane, data from the Port of Brisbane regarding the proportion of container freight that is packed/ unpacked outside of South East Queensland (SEQ) has been used. At the Port of Brisbane, 75% of the containers that are exported are packed within 100km of the port (within SEQ) while 90% of the containers that are imported are unpacked within 100km of the port (PoB, 2018). The remainder, i.e., 25% of exports and 10% of imports, represent freight travelling to/ from outside SEQ. Based on the intercapital freight volumes presented in **Error! Reference source not found.**, and applying the proportion of freight packed/ unpacked in SEQ, the following table provides an indicative estimate of intercapital freight generated/ destined for SEQ.

Table 5.3. Potential SEQ Intercapital Freight Packed/ Unpacked in SEQ, Mtpa

Freight	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Unpacked in SEQ	1.9	2.1	2.3	2.4	2.7	2.9	3.2	3.6	4.0	4.4	4.9
Packed in SEQ	1.1	1.2	1.3	1.4	1.5	1.7	1.9	2.1	2.3	2.5	2.8
Total	**3.0**	**3.3**	**3.6**	**3.8**	**4.2**	**4.6**	**5.1**	**5.7**	**6.3**	**7.0**	**7.8**

Note: Totals may not sum due to rounding.
Source: Pob (2018, 2020), ABS (2020b), QGSO (2020).

The difference in total intercapital freight and intercapital freight packed/ unpacked in SEQ represents an indicative estimate of potential import and export volumes through the Port of Brisbane related to intercapital freight, for which Port of Gladstone may provide an alternative port option for import/ export. This is presented in the table below, however, it must be noted that this only indicates the potential level of intercapital freight that may travel on Inland Rail to the Port of Gladstone. For the purposes of modelling, it has been assumed that intercapital freight figures previously beginning in 2025 are now beginning in 2027, in line with the Inland Rail development timeline.

Table 5.4. Potential Contestable Intercapital Freight, Mtpa (Scenario 2)

	2027	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Export	1.2	1.4	1.9	2.5	3.1	3.9	4.7	5.7	6.7	7.8	9.0
Import	0.5	0.6	0.8	1.1	1.5	1.8	2.2	2.7	3.2	3.8	4.4
Total	**1.7**	**2.0**	**2.7**	**3.6**	**4.6**	**5.7**	**7.0**	**8.4**	**9.9**	**11.6**	**13.4**

Note: Totals may not sum due to rounding.
Source: AEC, ARTC (2010, 2015), Pob (2018, 2020), ABS (2020b), QGSO (2020).

Due to Inland Rail not being constructed or operational at the time of this analysis, it is challenging to quantify the freight volume that will be travelling along the route to the Port of Gladstone. Scenario two is an indicative estimate of demand only highlighting the potential intercapital freight which could travel along the route to Gladstone. However, this is not the only freight that is expected to travel along the route.

As a result, an additional two scenarios of intermodal container volumes for Inland Rail to the Port of Gladstone have been developed for examination in the cost benefit analysis based on the consideration for other avenues of demand, including agricultural freight (see the Scenarios Examined section below for a more detailed description on al scenarios examined in the analysis).

Freight to/ from West of Miles

An inland route between Toowoomba and Gladstone presents opportunities to transfer freight originating from/ destined for areas west of Miles that currently use the Port of Brisbane. This would arise due to:

- Minimal difference in time/ distance for railing freight to Gladstone or Brisbane from Miles.
- Using the Port of Gladstone would provide a time saving in terms of shipping days for most export markets.

The Darling Downs-Maranoa region is one of Australia and Queensland's key agricultural producing regions, with key commodities including broadacre crops such as cotton, wheat, sorghum, chickpeas, barley and corn. The Darling Downs-Maranoa region also produces all of Queensland's apples and pears, as well as a considerable proportion of Queensland's stone fruit.

Broadacre crops in particular provide considerable opportunity for demand for rail, given the high volumes produced. Estimates of production of broadacre commodities in the Darling Downs-Maranoa region have been developed based on a combination of average annual Queensland estimates of production from ABARES (2020) between 2010-11 and 2019-20 and the approximate share of total Queensland production by commodity in the Darling Downs-Maranoa in 2018-19 outlined in the ABS (2020). These estimates are presented in **Error! Reference source not found.** below.

An estimate of the TEU equivalents for broadacre commodities produced are also presented in the table below, based on 26 tonne containers for cotton (approximately equivalent to 1 forty-foot equivalent unit (FEU)) and 25 tonne containers for other crops (approximately equivalent to 1 TEU). This equates to approximately 125,100 loaded TEU equivalent containers. Where all of this product is exported, the total number of TEUs required to be imported and exported would be approximately double that outlined to account for two-way movement of containers to and from the Darling Downs-Maranoa region.

Table 5.5. Tonnes and TEU Equivalents of Agricultural Production, Darling Downs-Maranoa

Commodity	Queensland	Darling Downs-Maranoa		TEU Equivalent	
	Tonnes	Share (%)	Tonnes	26t containers [(a)]	25t containers
Cotton lint	272,000	70%	190,400	14,646	-
Cotton seed	383,000	70%	268,100	20,623	-
Wheat	1,147,000	80%	917,600	-	36,704
Sorghum	1,050,000	80%	840,000	-	33,600
Chickpeas	349,000	55%	192,000	-	7,680
Barley	213,000	85%	181,100	-	7,244
Corn (maize)	148,000	60%	88,800	-	3,552
Other crops	47,000	55%	25,900	-	1,036
Total	**3,609,000**		**2,703,900**	**35,269**	**89,816**

Note: (a) Containers for cotton lint and cotton seed would be forty-foot equivalent units (FEUs), but are expressed in TEUs.
Source: ABARES (2020), ABS (2020).

In addition to the above agricultural commodities, there is also potential for a range of other freight to be attracted, including imports of chemicals, fertilisers and fuel to support the agriculture industry and other industries in the region.

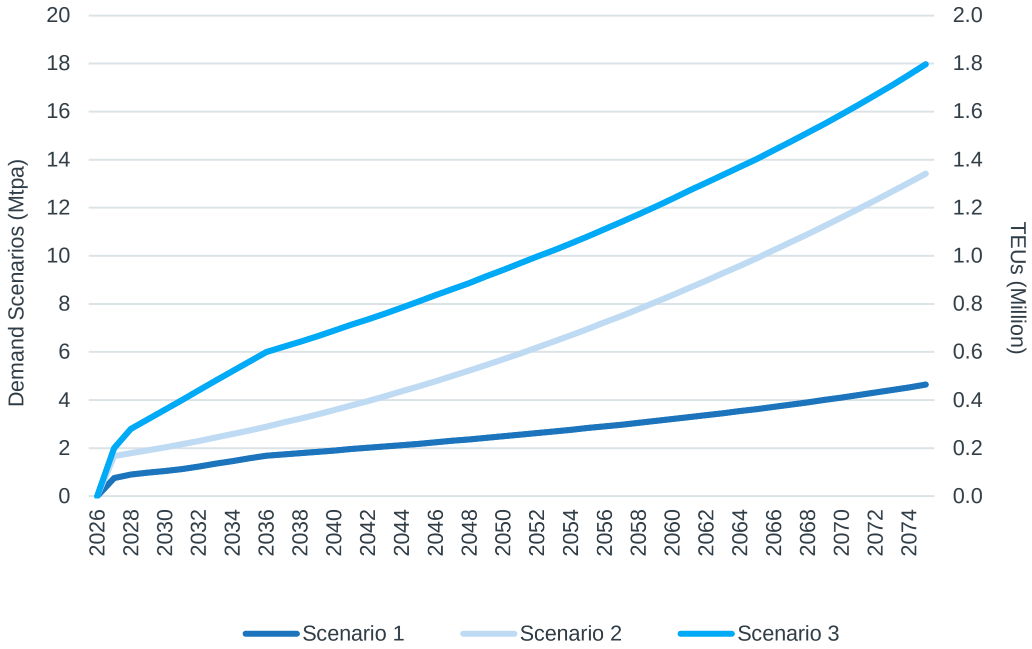
Scenarios Examined

An indicative estimate for scenario two has been provided above. However, as stated, that prior to the development of Inland Rail it is challenging to quantify the full range of freight to be transported by rail to/ from the Port of Gladstone. Three scenarios of intermodal container volumes for Inland Rail that will be likely travelling along the route to the Port of Gladstone. As a result, two alternative scenarios have been developed based on consideration of other avenues of demand and limitations surrounding freight variance once Inland Rail is operational:

- Scenario one: A lower scenario has been developed for sensitivity testing of other potential demand scenarios, where intermodal and non-coal bulk freight is lower than the indicative estimate provided in scenario 2. In 2027, freight volumes are approximately 55% lower than volumes of potential intercapital freight developed in scenario two. Growth rates for the following years are as follows:
  - It has been assumed that the freight volumes increase by 150% every five years for the first 10 years of operation to 2036.
  - From 2037 to 2041 a growth rate of 3% per year has been applied, scaling down to a growth rate of 2.75% from 2042 to 2051.
  - After 2052, a growth rate of 2.5% has been applied per year which is assumed to remain constant for the remainder of the assessment period. This scaling in growth rate highlights a higher demand for freight travelling on Inland Rail at the beginning of operations, providing a rather conservative estimate
- Scenario three: This scenario examines freight volumes which are higher than scenario two, considering the potential for other avenues of demand (i.e., agricultural freight). In 2027, freight volumes are 19% higher than volumes of potential intercapital freight developed in scenario two. Growth rates for the following years are as follows:
  - It has been assumed that the freight volumes increase by 200% for the first five years and then 150% for the following five years until 2036. From 2037 to 2041 a growth rate of 3.5% per year has been applied, decreasing by 0.25 percentage points every five years to reach a growth rate of 2.75% in 2052 which is assumed for the next 10 years.
  - After 2062, a growth rate of 2.5% has been applied per year which is assumed to remain constant for the remainder of the assessment period.

The scenarios presented in Figure 5.1 below extend to 2075, however, modelling in the cost benefit analysis is over 100 years.

Figure 5.1. Potential Demand Scenarios for Gladstone via Inland Rail Mtpa



Source: AEC.

Net Tonne Kilometers

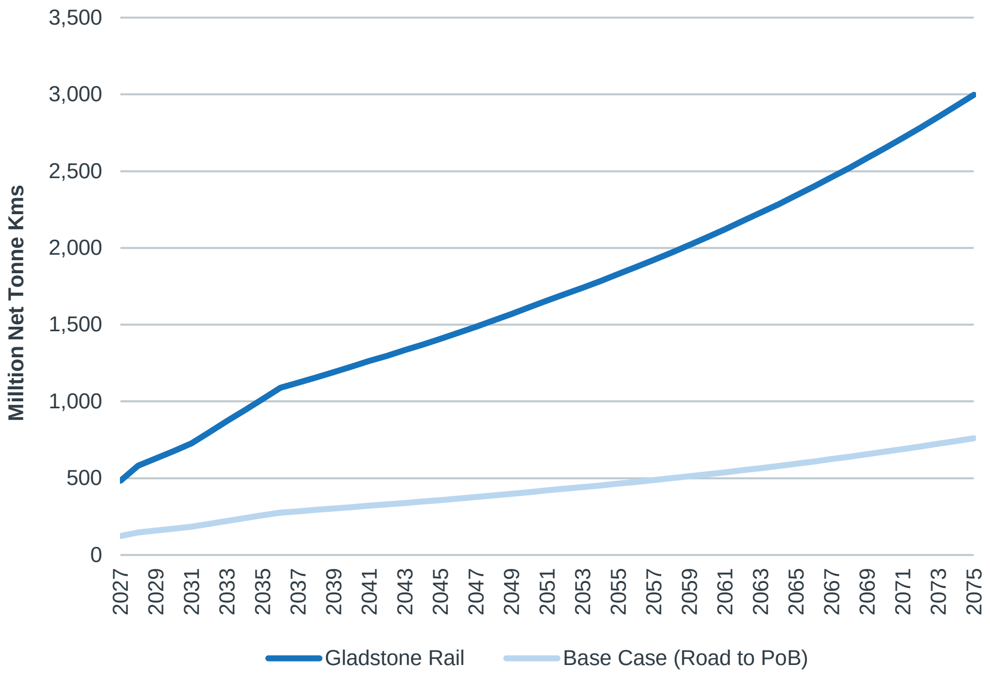
To understand the total net tonne kilometers travelled, the potential demand scenarios for Gladstone via Inland Rail (**Error! Reference source not found.**) were applied to the total distance travelled as displayed in the table below. This was broken down by urban and non-urban components as per the table below.

Table 5.6. Distances Travelled (km)

Route	Urban km	Non-Urban km	Total km
Toowoomba to Port of Gladstone (via rail)	0	646	**646**
Toowoomba to Brisbane Port (via road)	54	110	**164**

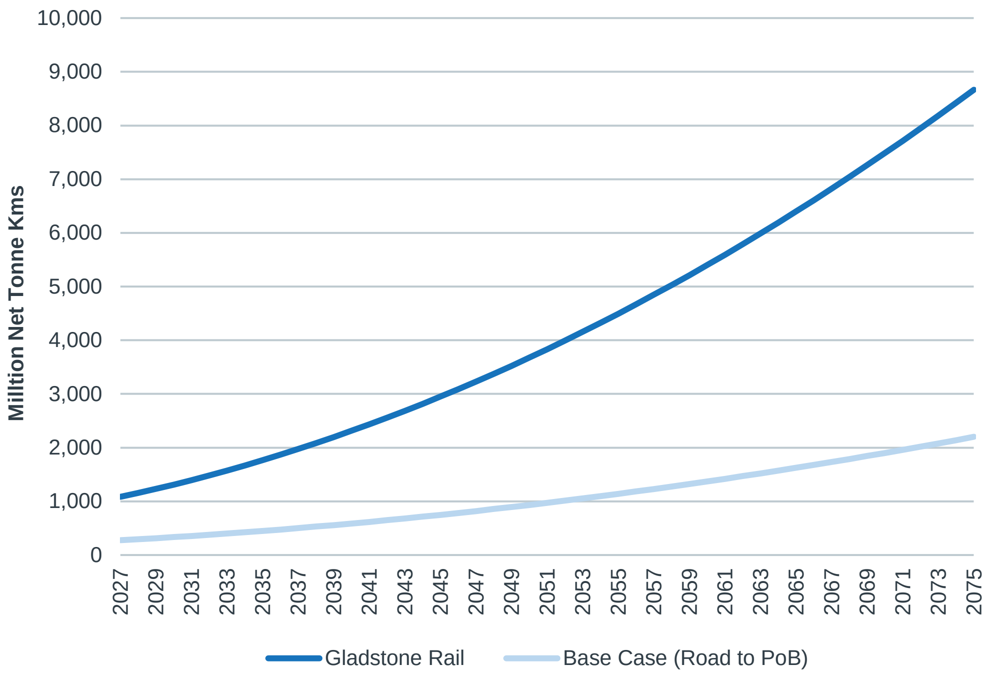
Source: AEC.

Figure 5.2. Million Net Tonne Kms (Scenario 1 & Base Case)



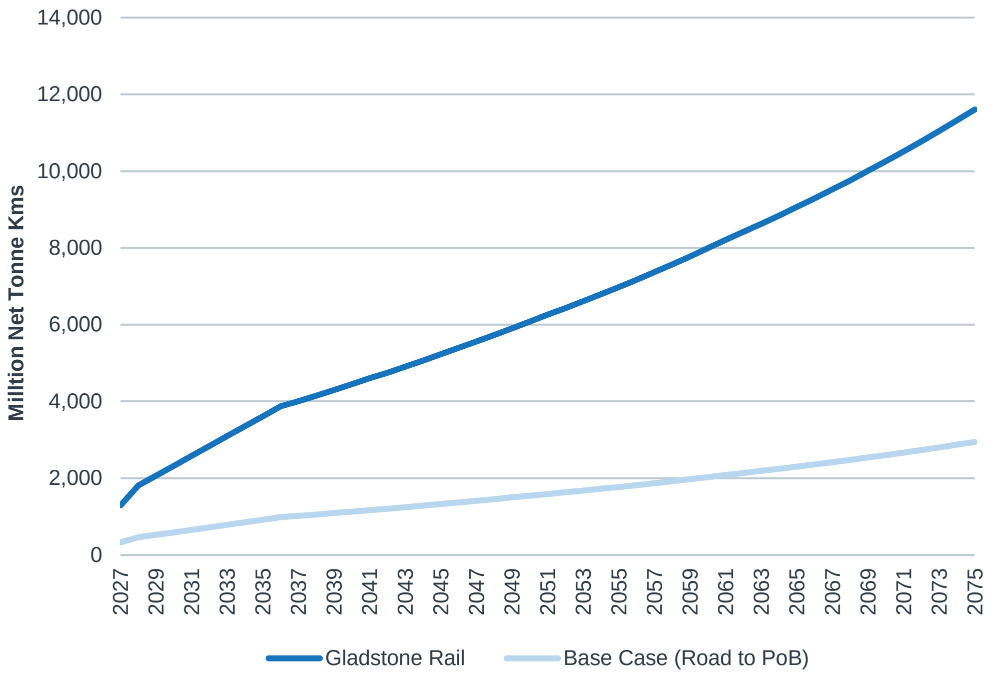
Source: AEC.

Figure 5.3. Million Net Tonne Kms (Scenario 2 & Base Case)



Source: AEC.

Figure 5.4. Million Net Tonne Kms (Scenario 3 & Base Case)



Source: AEC.

5.2 COAL DEMAND

A number of thermal coal projects have been proposed for the northern Surat Basin in the late 2000s and early 2010s as planning and the EIS for the Surat Basin Rail Project was undertaken, completed and approved. Since this time thermal coal prices have fluctuated considerably and generally been depressed relative to the 2000's, which has impacted on the economic case for developing the Surat Basin Rail Project and coal mines in the area.

A review of the AECOM (2017) Inland Rail Gladstone Link Prefeasibility Study indicates that across the eight known proposed projects located around Wandoan, the average saleable coal production is 7.5 Mtpa (see Table 5.7 below). This average production value per annum is highly influenced by the Wandoan Coal Project, which is significantly larger than other proposed projects. For this analysis it has been assumed that a mine the size of the Wandoan project is not likely to occur, and a result, the analysis undertaken considers an average coal production of 5 Mtpa per mine.

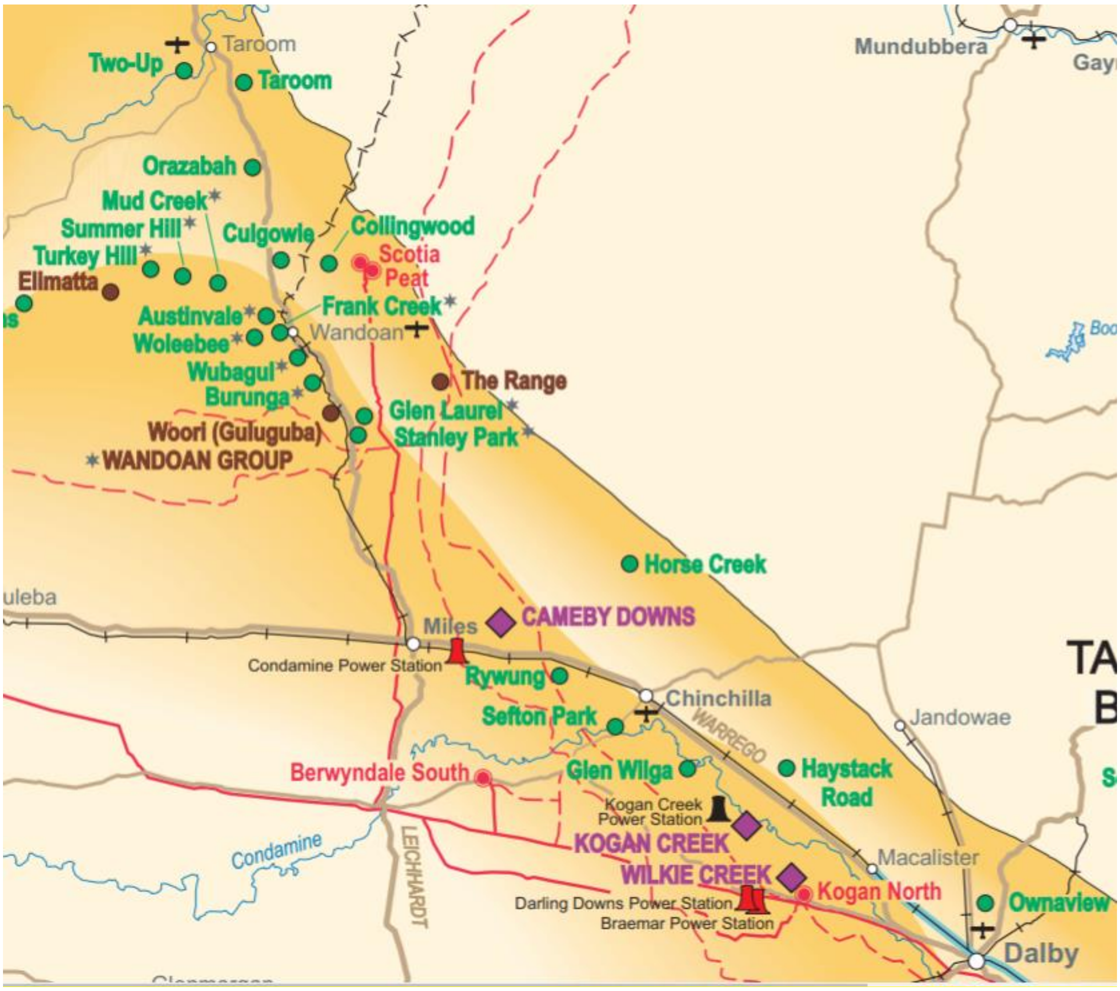
Table 5.7. Saleable Coal Production for Each Project (Mtpa)

Project	Saleable Coal Production (Mtpa)
Bundi	5
Clifford	5
Collingwood	6
Elimatta	5
Taroom	8
The Range	5
Wandoan	22
Woori	4
Total	**60**
Average	**7.5**

Source: AECOM (2017).

The figure below provides and overview of the prospective resource operations in the Surat Basin.

Figure 5.5. Resource Deposits in the Surat Basin



Source: Queensland Government (2020b).

The Port of Gladstone has an annualised coal export capacity of approximately 102 Mtpa through their two coal terminals (RG Tanna terminal and Wiggins Island Coal Export Terminal). In 2018-19, these two terminals exported a combined 72.4 Mt of coal. Capacity over and above what is currently being exported stands at approximately 29.6 Mtpa.

Although AECOM (2017) suggests there is a potential to unlock a total of 60 Mtpa in the area around Wandoan (Table 5.7), the Port of Gladstone's current infrastructure is unable to support this level of coal production. Future coal development beyond the 30Mtpa is possible but would trigger expansion of WICET. AECOM (2017) also undertook a risk-rated projection of mine production based on the likelihood of proposed projects proceeding, which indicated a risk-adjusted demand for rail to Port of Gladstone from coal mines in the northern Surat Basin of approximately 24.3 Mtpa.

Considering the current capacity of the Port of Gladstone and the risk-adjusted demand for rail to the Port of Gladstone (AECOM, 2017), a number of potential coal development scenarios were examined:

- Scenario 1: 15 Mt of coal production per annum.
- Scenario 2: 20 Mt of coal production per annum.
- Scenario 3: 30 Mt of coal production per annum.

Note: the full potential coal production of 60mtpa from the northern Surat basin, as well as the potential coal capacity from the southern Surat basin, has not been incorporated due to the export capacity limitations at the Port of Gladstone. Coal loading capacity at the Port of Gladstone will also be subject to customers' operational requirements.

Table 5.8. Coal Production Scenarios

Scenario	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035 Onwards
Scenario 1	0	0	5	5	10	10	15	15	15	15
Scenario 2	5	5	10	10	15	15	20	20	20	20
Scenario 3	5	10	10	15	20	20	20	25	25	30

Source: AEC.

It should be noted that in order for coal mines to be developed and these levels of production realised, in addition to the rail line to Gladstone being developed, coal prices and prospects would need to be sufficiently high to encourage coal project proponents to invest in developing and operating the mines. A review of anticipated construction costs and operating activity for the proposed mines in the northern Surat Basin was undertaken and it is indicatively estimated that a long term average coal price of above $95 to $100 dollars per tonne may be required to encourage investment[1]. KPMG (2020) forecasts to 2024 (which were developed pre-COVID-19) indicate an average forecast price of approximately $100 per tonne to 2024, which is also approximately in line with the long run average thermal coal price over the past 10 years which has fluctuated between approximately $70/tonne and $160/tonne (KPMG, 2020; IndexMundi, 2020).

Additionally, it must be noted that future prospects for coal mining is subject to a current level of uncertainty depending on different scenarios of future demand. *A Study of Long-Term Global Coal Demand* from the Queensland Treasury (2020) highlights that from 2018 to 2040 global steam coal production demand is projected to grow between -65.1% and 21.3% (under the Stated Policies Scenario (STEPS) which includes 'anticipated effects of announced policies expressed in official targets and plans' (Queensland Treasury, 2020, p.3).

Future demand and production may be impacted by a number of factors including (but not limited to):

- Strategies to reduce carbon emissions, and potential increase in cost pressure placed by a heightened focus on global emissions.
- Introduction of new technology, including renewable energy.
- The opening of new mines over time, and subsequently mine life.
- Global population growth and trade policies.

Australian coal assets are an attractive option for coal production with a highly skilled workforce, and an abundance of opportunities for development. In consideration of the uncertainty surrounding future coal demand and projections, a sensitivity scenario has been modelled without the coal benefits and costs (refer to Table 6.12 for the sensitivity analysis without coal).

6. COST BENEFITS ANALYSIS

This section presents a cost benefit analysis (CBA) for developing the inland route between Toowoomba and Gladstone.

6.1 METHOD AND APPROACH

6.1.1 General Assumptions

The following CBA assesses the present value of benefits and costs of developing the inland route between Toowoomba and Gladstone across a range of scenarios, to understand the public benefit of the Project to the Australian community.

The methodology used in conducting the analysis is outlined in Appendix C. Key considerations for the CBA include:

- Modelling has been undertaken starting from the financial year ending June 2021, with impacts examined to the year ending June 2075, aligning with the timeframes used by AECOM (2017) and ARTC (2015). Consideration has also been given to potential impacts that may extend beyond this timeframe, with rail infrastructure expected to be a very long-term asset (a useful life of 100 years has been assumed).
- A base discount rate of 7% has been used for demonstration purposes (in line with many State and national standards for real discount rates used in economic appraisal of projects), with additional discount rates also examined (4% and 10%). As all values used in the CBA are in real terms, the discount rate does not incorporate inflation (i.e., it is a real discount rate, as opposed to a nominal discount rate).
- All values are expressed in 2020 Australian dollars.

6.1.2 Project Case vs Base Case

The CBA compares the project case to a base case scenario in which assumes the development of Inland Rail to the Port of Gladstone does not proceed. In undertaking the CBA, the following is noted regarding the project case and base case scenarios compared in this assessment.

Project Case

The project case assumes that the development of Inland Rail will proceed from Toowoomba to the Port of Gladstone. The line will be dual gauge, which will allow coal freight to Gladstone to commence prior to the completion of the standard gauge segments. Freight demand for coal and intermodal container freight along the rail route is assumed to be as per the scenarios outlined in section 5, with scenario 2 used in the analysis and alternative scenarios examined in sensitivity. The project case assumes:

- The development of an inland rail route to Gladstone will unlock and facilitate the development of coal mines within the Surat Basin that otherwise would not be developed.
- Aside from the coal volumes produced and transported along the route, all other freight transported to Gladstone along the rail line would represent freight that would otherwise be transported using an alternative route. That is, aside from coal, no additional freight is assumed to be generated by the project, but there would be a shift in how freight is transported. This is likely a conservative assumption as where the development of a rail line to Gladstone improves the cost efficiency for transporting freight this would improve the cost competitiveness of Australian exports and thereby potentially deliver increased demand for Australian goods (with a subsequent lift in domestic production, producer profits and employment).
- In order to facilitate the increase in non-coal freight volumes, additional port capacity in Gladstone would be required. Development costs of $588 Million for increasing port capacity has thereby been included in the project case.

Base Case

The base case assumes the development of Inland Rail to the Port of Gladstone does not proceed. For the base case, it has also been assumed that rail between Toowoomba and Brisbane/ Port of Brisbane does not proceed. That is, the Inland rail terminates in Toowoomba, not Brisbane Acacia Ridge.

In the base case:

- Coal mines in the Surat Basin enabled by the rail line to Gladstone in the project case are assumed to not be developed, and thereby the economic benefit delivered by this activity would be lost to the Queensland economy.
- All non-coal freight that would travel by rail to/ from Gladstone in the project case is assumed to be transported from Toowoomba to the Port of Brisbane via road.
- It is assumed there would be no requirement for additional port capacity at the Port of Brisbane to handle the additional freight volumes traded through the port relative to the project case. This includes no additional coal tonnage beyond the current capacity of the system.

A separate analysis examining the development of rail between Toowoomba and the Port of Brisbane has also been developed and is examined in Appendix E. This analysis has been done for comparison purposes to the project case above.

6.2 COSTS EXAMINED

6.2.1 Construction Costs for Rail Infrastructure

Estimates of construction costs for developing a standard/ dual gauge inland rail route between Toowoomba and Gladstone are presented in AECOM (2017), indicating a total cost of approximately $2.993 billion in 2014-15 dollar terms. Assuming an escalation rate of 2.5% per annum, this equates to a capital cost of approximately $3.387 billion in 2020-dollar terms.

The table below provides a summary of estimated costs by segment. In developing these cost estimates, AECOM assumed new standard gauge track alongside the existing narrow gauge line would be developed between Gowrie (Toowoomba) and Wandoan, the Surat Basin Rail Project would be standard gauge only, while the Moura System between Banana and Gladstone would be upgraded to dual gauge.

For the purposes of this assessment, it is assumed construction costs from Toowoomba to Gladstone Port begin in 2023 and end in 2026.

Table 6.1. Costs for Developing Inland Route, Dual/ Standard Gauge (Gladstone)

Segment	Distance (km)	Cost ($M 2014-15)	Cost ($M 2020)
Toowoomba/ Oakey to Miles	198	$840	$950
Miles to Wandoan	65	$380	$430
Surat Basin Rail Project (Wandoan to Banana)	215	$1,116	$1,263
Banana to Wooderson	129	$334	$378
Wooderson to Callemondah	32	$86	$97
Callemondah to Auckland Point	7	$89	$101
Passing loops	-	$149	$169
Total	**646**	**$2,993**	**$3,387**

Note: 2020 cost estimates are based on an annual escalation rate of 2.5%.
Source: AECOM (2017).

While the CBA has assumed development to standard gauge, it should be noted there is potential for the route to be developed initially as narrow gauge, with variable gauge rolling stock used for freight using the Inland Rail line south of Toowoomba. This could then be upgraded to dual gauge at a later point as freight volumes increase to improve the economics of such an investment. To present a conservative assessment, full costs for development to standard gauge have been included in the CBA. However, potential implications of a lower capital cost alternative is examined in sensitivity.

6.2.2 Development Cost of Additional Port Infrastructure

In order to accommodate any sizeable increase in intermodal container freight, Gladstone Port will require the development of new/ expansion of existing port facilities. This will include intermodal terminals, infrastructure, wharves and wharf facilities. An 'order of magnitude' cost estimate for providing necessary port infrastructure at Gladstone Port was outlined by DAE (2018) at approximately $588 million, excluding channel duplication, which is expected to occur irrespective of inland rail.

For the purposes of modelling, total construction works have been split by year based on assumptions by AEC regarding the most appropriate proportion allocated to each year.

Table 6.2. Additional Port Infrastructure ($M 2020)

Port Infrastructure	2021	2022	2023	2024	2025	2026
Gladstone container facilities	$0	$0	$29	$88	$294	$177

Source: DAE (2018), AEC.

6.2.3 Additional Rail Operating and Maintenance Costs

Estimates of operating costs were developed based on information presented in the following two studies:

- **Surat Basin Rail Project EIS** (Surat Basin Rail, 2009). This report outlines the operating and maintenance costs for the Surat Basin Rail Project, which will encompass a large component of the Toowoomba to Gladstone inland rail route, would be $3 to $4 million per annum in 2009 dollar terms ($3.5 million used). This equates to $0.0163 million per km per annum in 2009-dollar terms, or $0.0214 million per km per annum in 2020 dollar terms using escalation of 2.5% per annum, or approximately $0.00051 per net tonne kilometre based on annual volumes of 42 Mtpa in the EIS.
- **ARTC's Inland Rail Business Case** (ARTC, 2015). This report provides estimates of annual operating costs across the length of the Melbourne to Brisbane route for different volumes of freight. On a per km basis, in 2020 dollar terms (using an escalation rate of 2.5% per annum), annual costs are estimated to range between $0.00289 million per km per annum and $0.001391 million per km per annum, for volumes ranging between 10 million gross tonnes per annum and 100 million gross tonnes per annum.

The above values have been combined to develop an indicative estimate of operating costs per net tonne kilometre of rail line, across different volumes of freight being transported per annum. The table below provides a summary of the operating costs per gross tonne kilometre from the ARTC (2015) report, and the variance was applied to the $0.00051 (or 0.051 cents) per net tonne kilometre at 40 Mtpa from the Surat Basin Rail Project EIS.

Table 6.3. Estimated Operating Costs per Million Tonnes of Freight

Cost	Million Gross Tonnes of Freight									
	10	20	30	40	50	60	70	80	90	100
c/gtkm (ARTC)	0.289	0.199	0.173	0.157	0.148	0.144	0.141	0.144	0.141	0.139
c/ntkm (Used)	0.094	0.064	0.056	0.051	0.048	0.047	0.046	0.047	0.046	0.045

Sources: ARTC, 2015, Surat Basin Rail, 2009, AEC.

These rates were then applied to the net tonne kilometres from Toowoomba to the Port of Gladstone. Operating costs increase each year based on the increasing volume of freight being transported.

6.2.4 Development Costs for Coal Mines

A review of EIS documentation and ASX announcements for the Bundi, Collingwood, Elimatta, Taroom, Range and Wandoan projects was undertaken to identify an average capital cost per Mtpa of product coal for coal mines proposed in the northern Surat Basin. The following table summarises the results of this review, with an average cost of $271.5 million per Mtpa product coal.

This result is highly influenced by the Wandoan Coal Project, which is significantly larger than the other proposed projects and has the highest estimated capital cost per Mtpa of coal. Excluding Wandoan, the average is $190 million per Mtpa of coal. This level of capital cost per Mtpa of coal produced is considerably higher than the estimated costs for other major coal projects recently or currently being assessed under an EIS, such as Olive Downs (~$70 million per Mtpa), Valeria (~$90 million per Mtpa), Winchester South (~$125 million per Mtpa) (Queensland Government, 2020a). It is considered likely, therefore, that the capital cost estimates reflected for the projects in the northern Surat Basin may incorporate some cost items such as sustaining capital that can more appropriately be considered operational expenditure, and overstate the initial construction costs.

For the purposes of this study, a slightly lower average capital cost of $175 million per Mtpa of product coal has been used to reflect that an individual mine of the proposed size of the Wandoan project is unlikely to occur, and that some costs included for the northern Surat Basin projects may better reflect ongoing operating costs.

Table 6.4. Capital Costs per Mtpa ROM

Mine	Coal (Mtpa)	Capital Costs ($M 2020)	Capital Cost per Mtpa Coal ($M 2020)
Bundi	6.5	$1,211.1	$242.2
Collingwood	9	$794.4	$132.4
Elimatta	7.3	$806.9	$161.4
Taroom	8	$1,398.7	$174.8
The Range	6.3	$1,316.3	$263.3
Wandoan	30	$8,320.8	$378.2
Total	**51**	**$13,848.3**	**$271.5**

Note: Capital cost estimates in 2020 dollar values are based on escalation of 2.5% per annum from the year initial estimates were provided for each project.
Sources: MertoCoal (2012), Stanmore Coal (2013), Queensland Government (2012), Sinclair Knoght Merz (2012), Northern Energy Corporation Limited (2009), & Gillespie, T (2017).

Three scenarios of mine development and production were examined (section 5.2). The capital cost estimates per Mtpa outlined in Table 6.4 were applied to the Mtpa of coal mines developed outlined in the three scenarios. In terms of timing of development, it was assumed each mine would take approximately two years to develop, with 33% of costs in the first year and 67% of costs in the second year of construction. These costs are incurred during the two years prior to first coal being produced.

Capital costs are highly dependent on the length of the mine life, however for the purposes of this assessment, it was assumed coal mines will produce an average of 5 Mtpa of product coal and will operate for approximately 25 years. Based on this assumption the average mine is estimated to have a capital cost of $875 million.

6.3 BENEFITS EXAMINED

6.3.1 Coal Producer Margins

Coal producer margins have been included in this analysis to be consistent with the methodology used by ARTC.

A review of ASX announcements for the Range Project and Bundi Project (MetroCoal, 2012 & Stanmore Coal, 2013) indicates operating costs for these projects of approximately $40 to $45 per tonne of product coal in 2011/12 prices, excluding transport costs. This includes mining, processing, and other costs (e.g. marketing, insurance, overheads). Approximately $33 to $38 per tonne in transport costs were also estimated, which were based on conservatively high estimates of user access costs for both the Surat Basin Rail Project and WICET (prior to WICET becoming operational). Since this time WICET has commenced operations with terminal handling charges designed on a cost recovery basis, while both the Range and Bundi Project analyses indicated assumed rail costs were likely higher than would be realised.

A review of other sources has been undertaken to benchmark mining costs, including:

- A coal industry competitiveness assessment by National Energy Resources Australia (NERA, 2016), indicating that the average mining costs in Australia is approximately $50 per tonne (figure is displayed in 2020 dollars and converted from USD by using an average exchange rate between the 2015 and 2016 calendar years). This cost excludes processing costs, however it is assumed to include other costs (e.g. marketing, insurance, overheads). The coal industry competitive assessment (NERA, 2016) also indicates that the average cost of transport for coal mines in Australia is approximately between $20 and $25 per tonne, including $6-$11 in land transport and $15 in sea freight (approximately $5 in port costs and $9.5 in shipping costs). Processing costs of $8.1 per tonne are also estimated.

- An Argus (2020) article highlights that Glencore expects thermal coal costs to be approximately $63 per tonne (this figure is displayed in 2020 dollars and converted from USD using the May 2020 exchange rate). It is assumed that these costs also include other costs (e.g. marketing, insurance, overheads and processing) and likely overstate the actual cost of mining coal.

For the purposes of this assessment, an average operating cost of $80 per tonne of product coal has been assumed, including $60 per tonne for on-site costs (mining, processing, management, administration, etc) and $20 per tonne for transport costs. Of this, approximately $21 per tonne is assumed to reflect labour costs for mining and processing. Revenue from coal is estimated at $100 per tonne, which is approximately in line with KPMG's (2020) forecasts to 2024 and their long run average over the past 10 years.

6.3.2 Benefits to Labour – Coal Mining

While expenditure on employees represents a cost (and is included in the operating costs for coal mining in developing the producer margins in section 6.3.1), employment also represents a social benefit to those employed through a number of avenues, including the provision of incomes (and thereby providing higher standards of living), a sense of identity, self-worth and satisfaction. Employment has also been linked with a number of positive mental and physical health benefits.

Labour benefits are often excluded from CBA. The primary reason for this exclusion is due to the use of "shadow wages"[8] in estimating operating costs, or the use of a highly conservative assumption that the labour would otherwise be employed elsewhere with minimal difference in compensation. However, for simplicity, in this analysis a market wage has been used in estimating operating costs for coal mines/ producer margins and an assumption that labour would otherwise be employed elsewhere with minimal difference in compensation is considered inappropriate where labour would not otherwise be gainfully employed or where a project would result in backfilling of employment positions made available due to transfer of labour to the project with otherwise unemployed or under-employed resources.

The impacts of COVID-19 are having a significant short-term impact on the national and Queensland labour market, and research in both Australia and overseas suggests the economic ramifications of COVID-19 may be felt for decades. It is therefore considered appropriate to consider some of the employment supported by unlocking coal mines as a benefit.

Employment can be valued in terms of the wages and salaries labour receives less income tax and the opportunity cost to these individuals for their time. The opportunity cost is often valued based on the alternative income they would receive, either through alternative employment or through social security payments. For the purposes of this assessment it has been assumed that 25% of the wages and salaries paid to operations staff of the mines unlocked by an inland route between Toowoomba and Gladstone represents a net benefit to these individuals that otherwise would not occur. Estimates of wages and salaries/ employee compensation of $5.44 per tonne of product coal have been used, as per assumptions on operating costs outlined in section 6.3.1.

6.3.3 Intermodal Freight Efficiency Benefits

Transport of containerised import/export freight along the Toowoomba to Gladstone Inland Rail link will result in reduced intermodal freight costs, when compared to the base case of containerised import/export freight being unloaded from an Inland Rail terminus in Toowoomba and transported via road to the Port of Brisbane.

An overview of these freight savings are provided below.

[8] The shadow wage refers to the opportunity cost of labour. Where a shadow wage (rather than market wage) is used in estimating operating costs, the labour benefit is inherently captured in the CBA and should not be measured separately.

Change in Land-Based Freight Costs

The Bureau of Infrastructure and Transport Research Economics (BITRE, 2016) highlights Australian interstate freight costs via rail to total $0.047 per net tonne km while road is estimated to total $0.10 per net tonne km (these figures are displayed in 2020 dollar terms).

Applying the cost of transporting freight to the net tonne kilometres for the project case (rail to the Port of Gladstone) was compared to the base case (road from Toowoomba to the Port of Brisbane) (**Error! Reference source not found.**).

Efficiency Benefit from Reduced Sea Travel Distance

Gladstone Port is approximately 450 km north of the Port of Brisbane by sea and subsequently, 450km closer to Australia's key international container origin/ destination ports north of Australia's east coast (e.g. East Asia). BITRE (2016) highlights Australian interstate freight costs via sea to total $0.035 per net tonne km (this figure is displayed in 2020-dollar terms).

This figure was applied to the total sea km between Brisbane and Gladstone and the volume of freight expected each year to understand the additional efficiency benefit of delivering sea freight to and from the Port of Gladstone, compared to the same volume of freight to the Port of Brisbane.

Freight Efficiency from Using Larger Ships

Veldman (2011) highlights the marginal cost per container when transported by different-sized container ships. This research is principally based on a standard journey between Europe and East Asia (40-day journey time), but it can be applied to the marginal cost of Australia's container freight when adjusted for a comparable journey from Gladstone or Brisbane to East Asia (16-day journey time).

The Port of Gladstone can be developed to have the capacity to account for the largest container ships in operation, up to 21,000 TEUs (see section 2.1.3). However, this analysis does not assume that all container ships to visit the Port of Gladstone will be the largest vessels in operation. An assumed average size of 15,556 TEUs has been used in this analysis. Table 6.5 displays the capacity and 2020 costs for the TEU ship size to visit each port in this analysis.

Brisbane can currently accommodate vessel sizes of between 8,000 and 10,000 TEU full loaded (HustonKemp, 2019). The Port of Gladstone channels and swing basins have the capacity to handle ships up to an including Capesize ships (currently used for resource export), which have similar draft requirements of the Triple-E-sized container ship (18,000 TEU capacity with 15.5m draft). Berth pocket dredging may be required if and when this size vessel is needed for the freight task. However, not all container ships visiting Gladstone are expected to be the largest size, so a lower average has been selected.

Being able to accommodate larger ships, the Port of Gladstone provides operating cost savings per TEU compared to the base case, which assumes that freight will be trucked from Toowoomba to Brisbane and shipped from the Port. This benefit highlights the marginal cost savings of larger ships (i.e. the larger the ships, the lower the operating costs due to economies of scale).

Assuming 10 tonnes per TEU (reference to section), there is a cost saving of approximately $7.0 per tonne for shipping freight to and from the Port of Gladstone compared to the Port of Brisbane. This saving was applied to the total net tonne kilometres assumed to be travelled via inland rail (**Error! Reference source not found.**).

Table 6.5. Operating Cost for each TEU

Port	TEU Size	Cost per TEU ($2020)	Cost per Tonne ($2020)
Port of Gladstone	15,556	$468.88	$46.9
Port of Brisbane	10,000	$539.11	$53.9

Note: Assumed 16 days at sea on average.
Source: Veldman (2011).

Summary

Combined, these factors determine the overall freight savings for container freight. The overall saving per tonne is $9.80 /t.

6.3.4 Social and Environmental Benefits – Land-Based Transport

Transferring container freight to rail between Toowoomba and Gladstone instead of travel to Brisbane via road will deliver a range of social benefits associated with reduced congestion in SEQ's transport network as well as environmental benefits associated with lower pollutant rail transport compared to road. Deloitte Access Economics (DAE, 2018) highlights the costs of road transport compared to rail. The total social/ environmental costs per net tonne km (ntkm) highlighted below in Table 6.6 has been applied to the total urban and rural ntkms (**Error! Reference source not found.** and **Error! Reference source not found.**). This considers the cost savings of freight travelling on rail, compared to the base case where freight is assumed to travel via road from Toowoomba to Brisbane.

Table 6.6. Social and Environmental Costs of Road Compared to Rail

	Urban		Rural	
Impact	**Road (c/ntkm)**	**Rail (c/ntkm)**	**Road (c/ntkm)**	**Rail (c/ntkm)**
Congestion	10.4314	0	0	0
Road damage costs	1.2387	0	1.2387	0.0000
Accident costs	0.7493	0.0375	0.7493	0.0375
Air pollution	0.0254	0.0046	0.0025	0
GHG emissions	0.0063	0.0005	0.0063	0.0005
Noise pollution	0.0047	0.0020	0.0005	0
Water pollution	0.0043	0.0001	0.0017	0.0001
Nature and landscape	0.0005	0.0012	0.0047	0.0012
Urban separation	0.0032	0.0012	0	0
Indirect transport costs - upstream/ downstream	0.0252	0	0.0252	0

Source: DEA (2018).

6.3.5 Environmental Benefits from Larger Ships

An additional benefit of developing Inland Rail to the Port of Gladstone is the environmental benefits from larger container ships. Veldman (2011) highlights the environmental cost per TEU for sea freight from East Asia to both the Port of Gladstone and the Port of Brisbane.

Assuming 10 tonnes per TEU, there is an environmental cost saving of approximately $2.3 per tonne for shipping freight to and from the Port of Gladstone compared to the Port of Brisbane. This saving was applied to the total net tonne kilometres assumed to be travelled via inland rail (**Error! Reference source not found.**).

Table 6.7. Environmental Cost of each TEU

Port	TEU Size	Cost per TEU ($2020)	Cost Per Tonne ($2020)
Gladstone Port	15,556	$127.7	$12.8
Port of Brisbane	10,000	$150.4	$15.0

Note: Assumed 16 days at sea on average.
Source: Veldman (2011).

6.4 CBA RESULTS

Table 6.8 below outlines the Present Value (PV) of the identified costs and benefits associated with the development of Inland Rail from Toowoomba to Gladstone Port, between the financial year ended June 2021 and June 2125, at discount rates of 4%, 7% and 10%. The results are based on scenario 2 for coal and intermodal container and non-coal bulk freight demand outlined in section 5.

In consideration of current low interest rates, as well as the project representing public enabling infrastructure that supports broader business, social, community and environmental outcomes, a discount rate of 4% may be considered the most appropriate discount rate for assessing the net benefit delivered by rail to Gladstone.

The CBA modelling at these levels of freight demand indicates the project is economically desirable at a 4% discount rate with the following results:

- A Net Present Value (NPV) of $4,533 million over the three-year construction period and 100-year operational period with an aggregate PV benefits of approximately $12,378 million compared to an aggregate PV costs of approximately $7,845 million.
- A BCR of 1.58, highlighting that the project is economically desirable under the CBA modelling assumptions, returning $1.58 for every $1 cost.

The cost benefit analysis identifies that at a 4% discount rate the project would be deemed economically desirable with the benefits marginally outweighing the costs. Under the 7% and 10% discount rates however, the project is not deemed economically desirable with a BCR ranging between 0.92 and 0.62.

Table 6.8. Summary of Costs and Benefits, Discount Values, 2021 to 2125 (Financial Year Ended June)

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$128	$56	$32
Coal Development Costs	$4,244	$2,762	$2,091
Total	**$7,845**	**$5,968**	**$4,988**
Benefits			
Coal Producer Margins	$7,459	$3,594	$2,099
Coal Labour Benefit	$2,028	$977	$571
Intermodal Freight Efficiency Benefits	$1,364	$437	$205
Social/Environmental Benefits - Land-Based Transport	$1,212	$388	$182
Environmental Benefits from Larger Ships	$315	$101	$47
Total	**$12,378**	**$5,498**	**$3,105**
Summary			
NPV	**$4,533**	**-$470**	**-$1,883**
BCR	**1.58**	**0.92**	**0.62**

Note:

- Totals presented in the table may not sum due to rounding.
- Outcomes reflect scenario 2 for coal development and intermodal freight (see section 5).

Source: AEC.

No Coal and Intermodal (Scenario 2)

The CBA modelling results below considers the development of Inland Rail from Toowoomba to the Port of Gladstone, without the coal costs and benefits. The results are based on scenario two for intermodal container and non-coal bulk freight demand outlined in section 5. The CBA indicates that the project is not economically desirable at a 4% discount rate with the following results:

- A Net Present Value (NPV) of -$710 million over the three-year construction period and 100 year operational period with an aggregate PV benefits of approximately $2,891 million compared to an aggregate PV costs of approximately $3,601 million.
- A BCR of 0.80, highlighting that the project is not economically desirable under the CBA modelling assumptions, returning $0.80 for every $1 cost.

The cost benefit analysis identifies that across all discount rates the project would not be deemed economically desirable with the costs outweighing the benefits.

Table 6.9. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June)

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$128	$56	$32
Total	**$3,601**	**$3,205**	**$2,897**
Benefits			
Intermodal Freight Efficiency Benefits	$1,364	$437	$205
Social/Environmental Benefits - Land-Based Transport	$1,212	$388	$182
Environmental Benefits from Larger Ships	$315	$101	$47
Total	**$2,891**	**$926**	**$434**
Summary			
NPV	**-$710**	**-$2,279**	**-$2,462**
BCR	**0.80**	**0.29**	**0.15**

Note: Totals may not sum due to rounding.
Source: AEC.

6.5 SENSITIVITY ANALYSIS

6.5.1 Alternative Demand Scenarios

Table 6.10 below highlights the CBA modelling results using different coal and intermodal container and non-bulk freight scenarios at a discount rate of 4%. For both coal and other freight, three different scenarios are presented in sections 5.2 and **Error! Reference source not found.**, providing a total of six different freight scenarios and nine potential combinations of these scenarios. Additionally, a scenario has been developed without coal benefits and costs to each of the three intermodal scenarios. CBA results for each of the scenarios of demand is presented below.

Table 6.10. Alternative Demand Scenarios, 4% Discount Rate

Scenario	NPV	BCR
Coal Scenario 1		
Intermodal Scenario 1	$1,380	1.21
Intermodal Scenario 2	$3,074	1.46
Intermodal Scenario 3	$4,573	1.69
Coal Scenario 2		
Intermodal Scenario 1	$2,841	1.36
Intermodal Scenario 2	$4,533	1.58
Intermodal Scenario 3	$6,030	1.77
Coal Scenario 3		
Intermodal Scenario 1	$3,982	1.45
Intermodal Scenario 2	$5,678	1.65
Intermodal Scenario 3	$7,178	1.81
No Coal		
Intermodal Scenario 1	-$2,402	0.33
Intermodal Scenario 2	-$710	0.80
Intermodal Scenario 3	$787	1.22

Source: AEC.

6.5.2 Testing Benefit/ Cost Parameters for Scenario 2 Demand

Coal and Intermodal (Scenario 2)

Sensitivity analysis in this section has been undertaken using a Monte Carlo analysis (see Appendix C for more details regarding Monte Carlo analysis) across the key assumptions used in the CBA modelling for scenario 2 coal and intermodal freight demand (the base assumptions used are outlined in section 6.2 and 6.3).

Each of the assumptions has been tested in isolation with all other inputs held constant, with the results report in Table 6.11 below in terms of the modelled change in NPV resulting from the variance in the base assumptions at a discount rate of 4%. The final row of Table 6.11 examines each assumption simultaneously to provide a 'combined' or overall sensitivity of the model findings to the assumptions used. Table 6.11 outlines the distribution of NPV allowing for a 10% confidence interval, with the '5%' and '95%' representing a 90% probability that the NPV will be within the range outlined in the table.

The table shows, at a discount rate of 4%, there is a 90% probability the project will provide an NPV of between $1,645.4 million and $7,719.2 million, under demand projections outlined for scenario 2 in section 5. The project outcomes are most sensitive assumptions on coal, including coal development, margins and labour benefits.

Table 6.11. Sensitivity Analysis Summary, Discount Rate 4%

Variable	Net Present Value ($M)	
	5%	95%
Costs		
Construction Costs for Rail Infrastructure	$3,945.6	$5,398.5
Development Cost of Additional Port Infrastructure	$4,444.5	$4,598.9
Additional Rail Operating and Maintenance Costs	$4,491.3	$4,575.7
Coal Development Costs	$3,136.3	$5,929.5
Benefits		
Coal Producer Margins	$2,079.4	$6,986.2
Coal Labour Benefit	$3,865.9	$5,200.2
Intermodal Freight Efficiency Benefits	$4,084.5	$4,981.7
Social/Environmental Benefits - Land-Based Transport	$4,134.8	$4,932.1
Environmental Benefits from Larger Ships	$4,429.7	$4,637.2
Combined	**$1,645.4**	**$7,719.2**

Notes: The percentage distributions used for each variable are provided below:

- Construction Costs for Rail Infrastructure: maximum 30% higher, minimum 50% lower.
- Development Cost of Additional port Infrastructure: maximum 30% higher, minimum 20%.
- Additional Rail Operating and Maintenance Costs: normally distributed with standard deviation of 0.2.
- Coal development costs: normally distributed with standard deviation of 0.2.
- Coal producer margins: normally distributed with standard deviation of 0.2.
- Coal labour benefits: normally distributed with standard deviation of 0.2.
- Intermodal Freight Efficiency Benefits: normally distributed with standard deviation of 0.2.
- Social/environmental benefits – Land-Based Transport: normally distributed with standard deviation of 0.2.
- Environmental Benefits from Larger Ships: normally distributed with standard deviation of 0.2.

Source: AEC.

No Coal and Intermodal (Scenario 2)

A sensitivity analysis has also been tested without the benefits and costs associated with coal mine developments. The results of the sensitivity are listed in Table 6.12 below, highlighting the modelled change in NPV resulting from the variance in the base assumptions at a discount rate of 4%.

The table shows, at a discount rate of 4%, there is a 90% probability the project will provide an NPV of between -$1,548.8 million and $357.1 million, under demand projections outlined for scenario 2 intermodal freight in section 5 (coal benefits and costs have been excluded from this sensitivity analysis).

Table 6.12. Sensitivity Analysis Summary, Discount Rate 4%

Variable	Net Present Value ($M)	
	5%	95%
Costs		
Construction Costs for Rail Infrastructure	-$1,297.4	$155.8
Development Cost of Additional Port Infrastructure	-$798.8	-$644.2
Additional Rail Operating and Maintenance Costs	-$751.9	-$667.5
Benefits		
Intermodal Freight Efficiency Benefits	-$1,158.5	-$261.2
Social/Environmental Benefits - Land-Based Transport	-$1,108.5	-$311.2
Environmental Benefits from Larger Ships	-$813.5	-$606.0
Combined	**-$1,548.8**	**$357.1**

Notes: The percentage distributions used for each variable are provided below:

- Construction Costs for Rail Infrastructure: maximum 30% higher, minimum 50% lower.
- Development Cost of Additional port Infrastructure: maximum 30% higher, minimum 20%.
- Additional Rail Operating and Maintenance Costs: normally distributed with standard deviation of 0.2.
- Intermodal Freight Efficiency Benefits: normally distributed with standard deviation of 0.2.
- Social/environmental benefits – Land-Based Transport: normally distributed with standard deviation of 0.2.
- Environmental Benefits from Larger Ships: normally distributed with standard deviation of 0.2.

Source: AEC.

6.6 COMPARISON OF GLADSTONE AND BRISBANE OPTIONS

For comparison purposes, a scenario examining the benefits and costs associated with extending the Inland Rail line from Toowoomba to the Port of Brisbane has also been examined to provide an indication of the potential net benefit delivered by a standard inland rail route to Gladstone relative to a standard gauge rail route to Port of Brisbane.

Details of the assumptions used in the Port of Brisbane scenario and results of the analysis are presented in Appendix E.

Coal and Intermodal (Scenario 2)

A summary comparison of the CBA results for the two options (the development of Inland Rail to the Port of Gladstone and the development of Inland Rail to the Port of Brisbane) is presented in

Table 6.13 below. As can be seen, the analysis (based on the assumptions used) indicates that the development of Inland Rail to Gladstone Port provides considerably more desirable result than developing Inland Rail from Toowoomba to the Port of Brisbane.

Table 6.13. Comparison of CBA Outputs (Coal & Intermodal Scenario 2)

Discount Rate	Inland Rail to the Port of Gladstone	Inland Rail to the Port of Brisbane	Differential to Port of Brisbane
Total Costs (PV $M)			
4%	$7,845	$9,551	-$1,706
7%	$5,968	$8,157	-$2,189
10%	$4,988	$7,260	-$2,272
Total Benefits (PV $M)			
4%	$12,378	$9,629	$2,749
7%	$5,498	$4,278	$1,220
10%	$3,105	$2,457	$648
NPV ($M)			
4%	$4,533	$78	$4,455
7%	-$470	-$3,878	$3,408
10%	-$1,883	-$4,804	$2,920
BCR			
4%	1.58	1.01	0.57
7%	0.92	0.52	0.40
10%	0.62	0.34	0.28

Note: Totals may not sum due to rounding.
Source: AEC.

No Coal and Intermodal Scenario 2

A summary comparison of the CBA results for the two options (the development of Inland Rail to the Port of Gladstone and the development of Inland Rail to the Port of Brisbane) is presented in Table 6.14 below. This comparison represents the no coal and intermodal scenario two and indicates that the development of Inland Rail to Gladstone Port provides more desirable result than developing Inland Rail from Toowoomba to the Port of Brisbane (even without any benefits and costs derived from coal).

Table 6.14. Comparison of CBA Outputs (No Coal & Intermodal Scenario 2)

	Inland Rail to the Port of Gladstone	Inland Rail to the Port of Brisbane	Differential to Port of Brisbane
Total costs			
PV ($M) - 4%	$3,601	$6,058	-$2,458
PV ($M) - 7%	$3,205	$5,497	-$2,292
PV ($M) - 10%	$2,897	$5,025	-$2,128
Total benefits			
PV ($M) - 4%	$2,891	$4,139	-$1,249
PV ($M) - 7%	$926	$1,494	-$568
PV ($M) - 10%	$434	$751	-$316
NPV			
PV ($M) - 4%	-$710	-$1,918	$1,208
PV ($M) - 7%	-$2,279	-$4,003	$1,724
PV ($M) - 10%	-$2,462	-$4,274	$1,812
BCR			
4%	0.80	0.68	0.12
7%	0.29	0.27	0.02
10%	0.15	0.15	0.00

Note: Totals may not sum due to rounding.
Source: AEC.

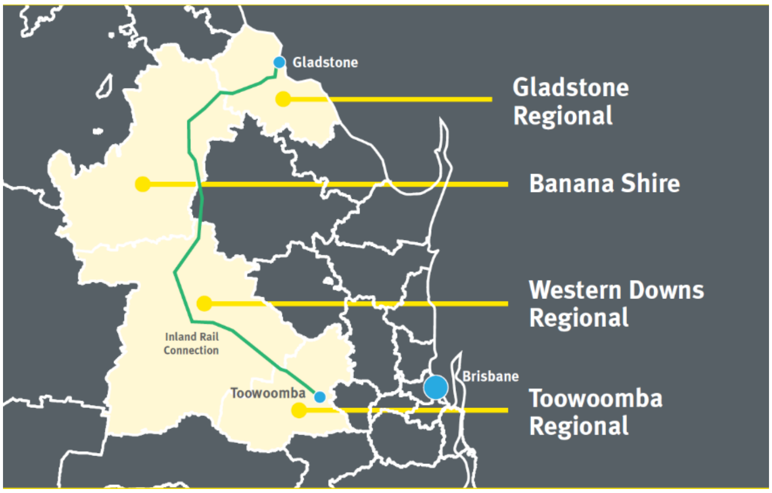
7. ECONOMIC IMPACT ASSESSMENT

Economic modelling in this section examines the economic activity enabled and supported by the construction of the Inland Rail to the Port of Gladstone. Input-Output modelling is used to examine the direct and flow-on[9] activity expected to be supported within the region in which the project is located and will primarily impact and support activity within.

The following local government areas (LGAs) have been included (hereafter referred to as the catchment):

- Gladstone Regional Council
- Banana Shire Council
- Western Downs Regional Council
- Toowoomba Regional Council

Figure 7.1. Analysis Catchment



Source: AEC.

A description of the Input-Output modelling framework used is provided in Appendix F.

Input-output modelling describes economic activity by examining four types of impacts:

- **Output**: Refers to the gross value of goods and services transacted, including the costs of goods and services used in the development and provision of the final product. Output typically overstates the economic impacts as it counts all goods and services used in one stage of production as an input to later stages of production, hence counting their contribution more than once.
- **Gross product**: Refers to the value of output after deducting the cost of goods and services inputs in the production process. Gross product (e.g., Gross Regional Product (GRP)) defines a true net economic contribution and is subsequently the preferred measure for assessing economic impacts.
- **Income**: Measures the level of wages and salaries paid to employees of the industry under consideration and to other industries benefiting from the project.
- **Employment**: Refers to the part-time and full-time employment positions generated by the economic stimulus, both directly and indirectly through flow-on activity, expressed in full time equivalent (FTE) positions[10].

[9] Both production induced (Type I) and consumption induced (Type II) flow-on impacts have been presented in this report. Refer to Appendix A for a description of each type of flow-on impact.

[10] Where one FTE is equivalent to one person working full time for a period of one year.

7.1 CONSTRUCTION PHASE DRIVERS

Inland Rail to the Port of Gladstone

Construction costs for the development are estimated to be $3,387 million as per Table 7.2 below. For a breakdown of construction costs on the Toowoomba to Gladstone line see Table 6.1.

For Input-Output modelling purposes, construction costs were broken down into their respective Input-Output industries. This breakdown was developed based on assumptions by AEC regarding the most appropriate industries for each activity, and the relevant proportion of expenditure to be allocated to each industry.

Table 7.2. Construction Costs by Input-Output Industry

Input-Output Industry	$M
Heavy and Civil Engineering Construction	$1,355
Construction Services	$339
Iron and Steel Manufacturing	$847
Non-Metallic Mineral Mining	$677
Professional, Scientific and Technical Services	$169
Total	**$3,387**

Note: Totals may not sum due to rounding.
Source: MertoCoal (2012), Stanmore Coal (2013), Queensland Government (2012), Sinclair Knoght Merz (2012), Northern Energy Corporation Limited (2009), & Gillespie, T (2017), AECOM (2017) & AEC.

Of the above capital outlay, not all activity will be undertaken within the catchment. In terms of where activity will occur and goods and services are anticipated to be sourced from, the following was assumed:

- 100% of construction activity (construction services and heavy and civil engineering construction) will occur locally, but only 50% of this is assumed to be sourced from businesses and labour inside the region (i.e. 50% of construction will be imported to the region). For businesses/labour sourced from outside the region:
  - Approximately 25% of purchases on goods and services (supply chain related activity) would be spent within the local economy (i.e., 25% of the Type I flow on activity associated with non-local construction companies is assumed to represent additional local activity in the catchment).
  - Approximately 5% of wages and salaries paid to construction-related workers sourced from outside the region would be spent on local goods and services, such as food and beverages (i.e., 5% of the Type II flow on activity associated with non-local workers is assumed to represent additional local activity in the catchment).
- Approximately 80% of the direct expenditure on non-metallic mineral mining will be sourced from local businesses and labour, with the remainder imported.
- Approximately 10% of the direct expenditure on iron and steel manufacturing will be sourced from local businesses and labour, with the remainder imported.
- Approximately 10% of the direct expenditure on professional, scientific and technical services will be sourced from local businesses and labour, with the remainder imported.

It was conservatively assumed that, aside from the on-site construction personnel, non-local suppliers engaged would not undertake any activity within the catchment area as a result of the development.

Coal Development Construction Costs

The project will deliver rail infrastructure that will enable the development of coal mines within the northern Surat Basin, by providing access to port infrastructure in Gladstone for these mines. An overview of the anticipated costs for constructing a coal mine in the northern Surat Basin is presented in section 6.2.3, highlighting a cost of $175 million per Mtpa of product coal the mine will produce. For the purposes of the CBA, and adopted in this impact assessment, it was assumed coal mines will produce an average of 5 Mtpa of product coal and will operate for approximately 25 years. Based on this assumption the average mine is estimated to have a capital cost of $875 million.

For Input-Output modelling purposes, construction costs were broken down into their respective Input-Output industries. This breakdown was developed based on assumptions by AEC regarding the most appropriate industries for each activity, and the relevant proportion of expenditure to be allocated to each industry.

Table 7.3. Construction Costs by Input-Output Industry (Per Mine)

Input-Output Industry	$M
Heavy and Civil Engineering Construction	$438
Non-Residential Building Construction	$44
Construction Services	$88
Professional, Scientific and Technical Services	$44
Specialised and other Machinery and Equipment Manufacturing	$263
Total	**$875**

Note: Totals may not sum due to rounding.
Source: MertoCoal (2012), Stanmore Coal (2013), Queensland Government (2012), Sinclair Knoght Merz (2012), Northern Energy Corporation Limited (2009), Gillespie, T (2017) & AEC.

Of the above capital outlay, not all activity will be undertaken within the catchment. In terms of where activity will occur and goods and services are anticipated to be sourced from, the following was assumed:

- 100% of construction activity (construction services, heavy and civil engineering construction and non-residential building construction) will occur locally, but only 50% of this is assumed to be sourced from businesses and labour inside the region (i.e. 50% of construction will be imported to the region). For businesses/labour sourced from outside the region:
  - Approximately 25% of purchases on goods and services (supply chain related activity) would be spent within the local economy (i.e., 25% of the Type I flow on activity associated with non-local construction companies is assumed to represent additional local activity in the catchment).
  - Approximately 5% of wages and salaries paid to construction-related workers sourced from outside the region would be spent on local goods and services, such as food and beverages (i.e., 5% of the Type II flow on activity associated with non-local workers is assumed to represent additional local activity in the catchment).
- Approximately 10% of the direct expenditure on professional, scientific and technical services will be sourced from local businesses and labour, with the remainder imported.
- Approximately 5% of the direct expenditure on specialised and other machinery and equipment manufacturing will be sourced from local businesses and labour, with the remainder imported.

It was conservatively assumed that, aside from the on-site construction personnel, non-local suppliers engaged would not undertake any activity within the catchment area as a result of the development.

In understanding the impacts from construction of coal mines, it should be recognised that a development timeframe of approximately two years is assumed for a 5 Mtpa mine. The scenario examined in the CBA assumed four coal mines would be developed between 2024 to 2031, to produce a total of 20 Mtpa of coal in the region. Where four mines are developed over this period, the construction costs (and impacts) would be four times that outlined in Table 7.3.

Additionally, as it is assumed that each mine will operate for approximately 25 years, to maintain the 20 Mt of coal per annum beyond this period (as examined in the CBA), new coal mines will need to be developed every 25 years to replace the production of mines as they wind down.

Gladstone Container Port Upgrades

As detailed in section 6.2.2, the Port of Gladstone will require upgrades to support any sizeable increase in intermodal container freight. These construction costs are estimated to total $588 million (DAE, 2018) and for the purposes of this assessment are assumed to take approximately four years to be developed.

For Input-Output modelling purposes, construction costs were broken down into their respective Input-Output industries. This breakdown was developed based on assumptions by AEC regarding the most appropriate industries for each activity, and the relevant proportion of expenditure to be allocated to each industry.

Table 7.4. Construction Costs by Input-Output Industry

Input-Output Industry	$M
Heavy and Civil Engineering Construction	$294
Non-Residential Construction	$29
Construction Services	$59
Specialised and other Machinery and Equipment Manufacturing	$177
Professional, Scientific and Technical Services	$29
Total	**$588**

Source: DAE (2019) & AEC.

Of the above capital outlay, not all activity will be undertaken within the catchment. In terms of where activity will occur and goods and services are anticipated to be sourced from, the following was assumed:

- 100% of construction activity (construction services, heavy and civil engineering construction and non-residential building construction) will occur locally, but only 50% of this is assumed to be sourced from businesses and labour inside the region (i.e., 50% of construction will be imported to the region). For businesses/labour sourced from outside the region:
    - Approximately 25% of purchases on goods and services (supply chain related activity) would be spent within the local economy (i.e., 25% of the Type I flow on activity associated with non-local construction companies is assumed to represent additional local activity in the catchment area).
    - Approximately 5% of wages and salaries paid to construction-related workers sourced from outside the region would be spent on local goods and services, such as food and beverages (i.e., 5% of the Type II flow on activity associated with non-local workers is assumed to represent additional local activity in the catchment area).
- Approximately 10% of the direct expenditure on professional, scientific and technical services will be sourced from local businesses and labour, with the remainder imported.
- Approximately 5% of the direct expenditure on specialised and other machinery and equipment manufacturing will be sourced from local businesses and labour, with the remainder imported.

It was conservatively assumed that, aside from the on-site construction personnel, non-local suppliers engaged would not undertake any activity within the Gladstone LGA as a result of the development.

7.2 OPERATIONS PHASE DRIVERS

Inland Rail to the Port of Gladstone

As outlined in section 6.2.3, operating costs increase each year based on the increasing volume of freight being transported. Estimates of annual operating costs used in this assessment are as per those presented in section 6.2.3 of the CBA, based on annual freight volumes used in the CBA. For the purposes of this assessment a 50-year average annual estimate has been modelled from the beginning of operations in 2026. The average annual operating expenditure over the first 50 years of operation total approximately $6.3 million per annum. It must be noted that this operating cost is only an average and is estimated to be less than this initially and be higher in the latter half of the 50 year period.

To best reflect the economic contribution of the Inland Rail line to the local economy, the modelling has examined the typical level of associated with the above operating costs to estimate the level of direct operating activity, as well as flow-on contribution this level of operating activity would supply. Direct impacts were then adjusted to reflect actual activity of the Inland Rail.

Coal Mine Operations

Estimates of mine operating costs are outlined in section 6.3.1, totalling $80 per tonne, of which $21.75 are estimated to be labour-costs, $20 is estimated to be transport costs, and $38.25 are estimated to be other non-labour operating costs. An assumed long term average thermal coal price of $100 per tonne (AUD) has been used, which is approximately in line with KPMG's (2020) forecasts to 2024 (which were developed pre-COVID-19) and the long run average thermal coal price over the past 10 years which has fluctuated between approximately $70/tonne and $160/tonne (KPMG, 2020; IndexMundi, 2020).

In modelling the economic impacts from coal mine operations, an assumption of 20 Mtpa of coal production being enabled by the project has been used, in line with the assumption used in the CBA. The table below outlines the annual coal revenue and operating costs at this level of production.

Table 7.5. Annual Coal Operating Revenue and Expenditure (20 Mtpa of Coal)

Operating Item	At 20 Mtpa
Revenue	
Coal Revenue	$2,000
Operating Expenditure	
Labour Opex	$451
Non-labour Opex	$1,149
Transport Costs	$400
Other Non-labour Costs	$749
Total Opex	**$1,600**

Source: Angus (2020), (NIERA, 2016), KPMG (2020), AEC.

An estimate of approximately 130 FTE jobs per 1 Mtpa of product coal has been used to estimate employment. This includes mining and processing labour, maintenance as well as other on-site staff. This level of employment has been assumed based on previous AEC experience in the sector.

The above data has been used for the direct impacts of coal mining. For flow-on impacts, to best reflect the economic contribution of coal mining to the regional economy, the modelling has examined the typical level of activity associated with the non-labour operating costs.

7.3 CONSTRUCTION RESULTS

Inland Rail to the Port of Gladstone

In interpreting the result of the economic modelling, it should be recognised that the results refer to the aggregate economic activity supported over the entire construction phase. For the purposes of this analysis, it has been assumed that construction will take approximately four years. To understand the average annual impact during construction, the impacts outlined below should be divided by four.

Construction of Inland Rail to the Port of Gladstone is estimated to directly contribute $1,490.5 million in industry output (i.e. revenues) to local businesses within the catchment. A further $1,618.4 million in industry output is estimated to be supported in the economy through flow-on activity, including $706.6 million in production induced (i.e. supply chain) activity and $911.8 million through household consumption induced activity (i.e. expenditure of households within the local economy as a result of a lift in household incomes).

This level of industry activity is estimated to support the following within the economy:

- A $1,513.1 million contribution to Gross Regional Product (GRP) in the region (including $680.8 million directly).
- 8,210 Full Time Equivalent (FTE) jobs in the region (including 3,115 FTE jobs directly), paying a total of $734.5 million in wages and salaries (including $328.2 million directly).

Table 7.6. Economic Activity Supported by Construction of the Project ($M), Catchment

Impact	Output ($M)	GRP ($M)	Incomes ($M)	Employment (FTEs)
Direct	$1,490.5	$680.8	$328.2	3,115
Production Induced Impacts	$706.6	$318.1	$175.8	1,982
Household Consumption Impacts	$911.8	$514.2	$230.4	3,113
Total	**$3,108.9**	**$1,513.1**	**$734.5**	**8,210**

Note: Figures may not add due to rounding.
Source: AEC.

Coal Development Construction Costs

Modelling of coal mine construction activity has been based on the average activity associated with development of one, 5 Mtpa coal mine, over a two year period, In interpreting the result of the economic modelling, it should be recognised that the results refer to the aggregate economic activity supported over the entire two year construction phase. To understand the average annual impact during construction of a mine, the impacts outlined below should be divided by two.

Construction of a coal mine is estimated to directly contribute $301.9 million in industry output (i.e. revenues) to local businesses within the catchment. A further $342.3 million in industry output is estimated to be supported in the economy through flow-on activity, including $151.4 million in production induced (i.e. supply chain) activity and $190.9 million through household consumption induced activity (i.e. expenditure of households within the local economy as a result of a lift in household incomes).

This level of industry activity is estimated to support the following within the economy:

- A $303.7 million contribution to Gross Regional Product (GRP) in the region (including $129.3 million directly).
- 1,601 Full Time Equivalent (FTE) jobs in the region (including 513 FTE jobs directly), paying a total of $156.8 million in wages and salaries (including $70.5 million directly).

Where 20 Mtpa of coal production is enabled as a result of the project, this would equate to approximately four mines being developed assuming an average mines size of 5 Mtpa. The impacts outlined would thereby be delivered four times as these mines are developed. For the scenario examined in the CBA, construction of the four mines is assumed to occur between 2024 and 2031 (i.e. over an eight-year period), and the average annual construction impact would be approximately half that outlined in the table below (i.e. four mines developed over eight years equals 0.5 of the impact of one mine each year on average).

Table 7.7. Economic Activity Supported by Construction of a 5 Mtpa Mine ($M), Catchment

Impact	Output ($M)	GRP ($M)	Incomes ($M)	Employment (FTEs)
Direct	$301.9	$129.3	$70.5	513
Production Induced Impacts	$151.4	$66.7	$38.1	436
Household Consumption Impacts	$190.9	$107.7	$48.2	652
Total	**$644.2**	**$303.7**	**$156.8**	**1,601**

Note: Figures may not add due to rounding.
Source: AEC.

Gladstone Container Port Upgrades

In interpreting the result of the economic modelling, it should be recognised that the results refer to the aggregate economic activity supported over the entire construction phase. For the purposes of this analysis, it has been assumed that construction will take approximately four years. To understand the average annual impact during construction, the impacts outlined should be divided by four.

Construction of Gladstone container port upgrades is estimated to directly contribute $203.0 million in industry output (i.e. revenues) to local businesses within the catchment. A further $230.2 million in industry output is estimated to be supported in the economy through flow-on activity, including $101.8 million in production induced (i.e. supply chain) activity and $128.4 million through household consumption induced activity (i.e. expenditure of households within the local economy as a result of a lift in household incomes).

This level of industry activity is estimated to support the following within the economy:

- A $204.2 million contribution to Gross Regional Product (GRP) in the region (including $86.9 million directly).
- 1,151 Full Time Equivalent (FTE) jobs in the region (including 419 FTE jobs directly), paying a total of $105.4 million in wages and salaries (including $47.4 million directly).

Table 7.8. Economic Activity Supported by Construction of Port Upgrade ($M), Gladstone LGA

Impact	Output ($M)	GRP ($M)	Incomes ($M)	Employment (FTEs)
Direct	$203.0	$86.9	$47.4	419
Production Induced Impacts	$101.8	$44.9	$25.6	293
Household Consumption Impacts	$128.4	$72.4	$32.4	438
Total	**$433.2**	**$204.2**	**$105.4**	**1,151**

Note: Figures may not add due to rounding.
Source: AEC.

7.4 OPERATIONS RESULTS

Inland Rail to the Port of Gladstone

Modelling of the operational impacts has been undertaken using the modelling drivers outlined in section 7.2. The operational phase of the Inland Rail is estimated to directly support $6.3 million in industry output (i.e. revenues) for local businesses operating within the catchment. A further $9.0 million in industry output is estimated to be supported in the catchment per annum through flow-on activity, including $3.9 million in production induced (i.e. supply chain) activity and $5.1 million through household consumption induced activity (i.e. expenditure of households within the local economy as a result of a lift in household incomes).

This level of industry activity is estimated to support the following within the catchment's economy per year:

- A $6.5 million contribution to Gross Regional Product (GRP) per annum (including $2.0 million directly).
- 45 Full Time Equivalent (FTE) jobs per annum (including 18 FTE jobs directly), paying a total of $4.1 million in wages and salaries per year (including $2.0 million directly).

This activity represents a 50-year average annual estimate from beginning of operations. Operating activity is initially expected to be below this average level, increasing over time as annual volumes of freight increase.

Table 7.9. Economic Activity Supported by Operations of the Rail Line ($M), Annual Average Over 50 Years, Catchment

Impact	Output ($M)	GRP ($M)	Incomes ($M)	Employment (FTEs)
Direct	$6.3	$2.0	$2.0	18
Production Induced Impacts	$3.9	$1.6	$0.8	9
Household Consumption Impacts	$5.1	$2.9	$1.3	17
Total	**$15.3**	**$6.5**	**$4.1**	**45**

Note: Figures may not add due to rounding.
Source: AEC.

Coal Mine Operations

Modelling of the operational impacts from coal mines has been undertaken using the modelling drivers outlined in section 7.2, based on a scenario of 20 Mtpa of coal production being enabled in the northern Surat Basin as a result of the project. The operations of these mines is estimated to directly support $2,000.0 million in industry output (i.e. revenues) for these mining businesses. A further $1,493.8million in industry output is estimated to be supported in the catchment per annum through flow-on activity, including $839.5 million in production induced (i.e.

supply chain) activity and $654.3 million through household consumption induced activity (i.e. expenditure of households within the local economy as a result of a lift in household incomes).

This level of industry activity is estimated to support the following within the catchment's economy per year:

- A $1,617.0 million contribution to Gross Regional Product (GRP) per annum (including $851.3 million directly).
- 7,166 Full Time Equivalent (FTE) jobs per annum (including 2,600 FTE jobs directly), paying a total of $833.6 million in wages and salaries per year (including $451.3 million directly).

This activity represents an average annual estimate at a rate of production of 20 Mtpa.

Table 7.10. Economic Activity Supported by Coal Mine Operations ($M), Per Annum at 20 Mtpa of Coal Production, Catchment

Impact	Output ($M)	GRP ($M)	Incomes ($M)	Employment (FTEs)
Direct	$2,000.0	$851.3	$451.3	2,600
Production Induced Impacts	$839.5	$396.8	$217.0	2,332
Household Consumption Impacts	$654.3	$369.0	$165.4	2,234
Total	**$3,493.8**	**$1,617.0**	**$833.6**	**7,166**

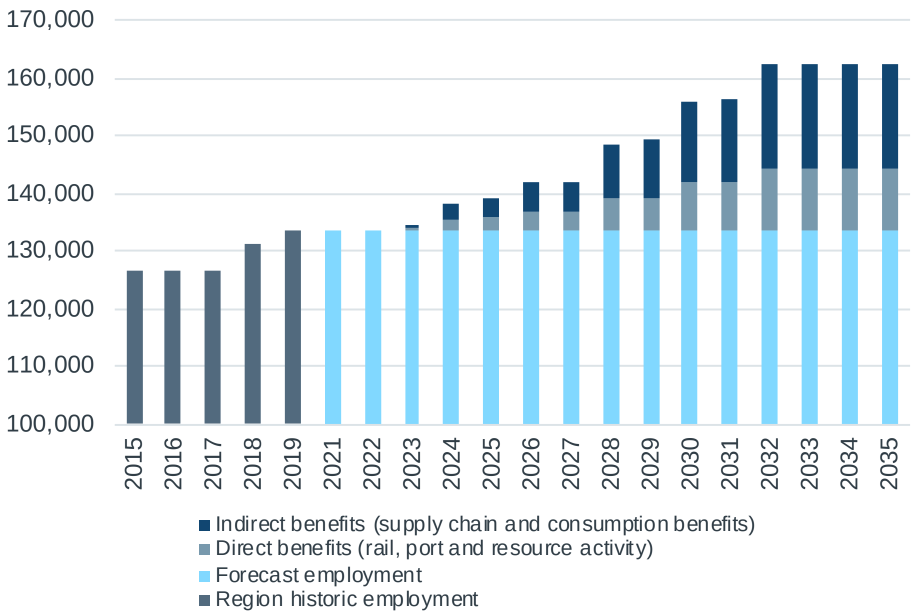
Note: Figures may not add due to rounding.
Source: AEC.

7.5 COMBINED IMPACT ON THE REGIONAL ECONOMY

Accounting for different direct and indirect construction and operating activities occurring simultaneously, the development of Inland Rail is expected to generate an additional 18,300 FTE jobs in the region by 2032. This represents a 21.5% increase in FTE jobs in the region.

The growth in employment is represented in Figure 7.1. Forecast employment has assumed to be static to best represent the benefits delivered by the project.

Figure 7.1. Combined Employment Benefits of Connecting Inland Rail to Port of Gladstone



Source: AEC

REFERENCES

ABARES (2020). *Australian Crop Report, September 2020*. ABARES, Australian Government, Department of Agriculture, Water and the Environment.

ABS (2020a). *Agricultural Commodities, Australia, 2018-19*. Available from: https://www.abs.gov.au/statistics/industry/agriculture/agricultural-commodities-australia/2018-19#data-download. Accessed: 8 October 2020.

ABS (2012). *Census of Population and Housing 2011 – Employment by Place of Work*. Cat. No. 2068.0. Australian Bureau of Statistics, Canberra.

ABS (2017). *Census of Population and Housing 2016*. TableBuilder. Australian Bureau of Statistics, Canberra.

ABS (2020a). *Australian National Accounts: Input-Output Tables – Electronic Publication, 2017-18 tables*. Cat. No. 5209.0.55.001, Australian Bureau of Statistics, Canberra.

ABS (2020b). *Labour Force, Australia, Detailed, Quarterly*. Cat. No. 6291.0.55.003, Australian Bureau of Statistics, Canberra.

ABS (2020c). *Consumer Price Index, Australia*. Cat. No. 6401.0, Australian Bureau of Statistics, Canberra.

ABS (2020d). Regional Population Growth, Australia, 2019. Cat no. 3218.0. Australian Bureau of Statistics, Canberra

AECOM (2017). *Inland Rail Gladstone Link Prefeasibility Study*. Report prepared by AECOM Australia Pty Ltd for the Inland Rail Taskforce, Queensland Government Department of Infrastructure and Regional Development.

ARTC (2017 a). *Initial Advice Statement: Inland Rail – Helidon to Calvert.* Retrieved from http://eisdocs.dsdip.qld.gov.au/Inland%20Rail%20Helidon%20to%20Calvert/IAS/h2c-initial-advice-statement.pdf

ARTC (2017 b). *Initial Advice Statement: Inland Rail – Gowrie to Helidon.* Retrieved from http://eisdocs.dsdip.qld.gov.au/Inland%20Rail%20Helidon%20to%20Calvert/IAS/h2c-initial-advice-statement.pdf

ARTC (2017 c). *Initial Advice Statement: Inland Rail – Calvert to Kagaru.* Retrieved from http://eisdocs.dsdip.qld.gov.au/Inland%20Rail%20Calvert%20to%20Kagaru/IAS/initial-advice-statement.pdf

ARTC (2015). *ARTC 2015 Inland Rail Programme Business Case*. Report prepared by the Australian Rail Track Corporation Limited.

ARTC (2010). *Melbourne-Brisbane Inland Rail Alignment Study*. Report prepared by the Australian Rail Track Corporation Limited.

ARTC (undated). *Inland Rail.* Retrieved from https://inlandrail.artc.com.au/

Argus (2020). *Australian coal heading into loss-making territory.* Retrieved from https://www.argusmedia.com/en/news/2102740-australian-coal-heading-into-lossmaking-territory

Aurizon (2017). *Moura System, Information Pack Version 7.0, March 2017*. Aurizon.

BRITE (2016). *Freight Rates in Australia.* Bureau of Infrastructure and Transport Research Economics. https://www.bitre.gov.au/sites/default/files/documents/asf_2016_17.pdf

DAE (2018). *Establishing the need for the last mile. Making the case for a dedicated freight rail link from Acacia Ridge to the Port of Brisbane*. Report prepared by Deloitte Access Economics Pty Ltd for the Port of Brisbane Pty Ltd.

Department of Infrastructure, Transport, Cities and Regional Development (2019). *Statistical Report: Maritime.* Retrieved from https://www.bitre.gov.au/sites/default/files/publications/water_065.pdf

DoESE (2020). *Small Area Labour Market Data*. Department of Education, Skills and Employment, Canberra.

Drewry (2017). *Container ship fleet forecast and maritime economic assessment*. Prepared by Drewry Maritime Advisors for Infrastructure Victoria.

European Commission (2017). *Draft Guidance Document: The Shipping MRV Regulation – Determination of Cargo Carried*. European Sustainable Shipping Forum Sub-Group on Shipping MRV Monitoring, European Commission. Available from: https://ec.europa.eu/clima/sites/clima/files/docs/0108/20170517_guidance_cargo_en.pdf. Accessed: 8 October 2020.

Findaport (2020). Retrieved from https://www.findaport.com/port-of-townsville#berthing

Gillespie, T. (2017). *Work on $7b Surat Basin project still over a year away.* The Queensland Times.

GPC (2016). *2012 Land Use Plan.* Gladstone Ports Corporation. Retrieved from https://37a60919-af70-449e-a074-269d8ed5cd0e.filesusr.com/ugd/d380da_3f64aa2567d844f2829a2fe943be304c.pdf

GPC (2012). *50 Year Strategic Plan*. Gladstone Ports Corporation.

GPC (undated a). *Gladstone Ports Corporation – Our History.* Retrieved from https://www.gpcl.com.au/our-history

GPC (undated b). *Gladstone Port Corporation 50-year Strategic Vision – Precinct Outlook.* Email received from Gladstone Ports Corporation Limited 11th December 2020.

GPCL (2020). *Trade Statistics.* Retrieved from https://www.gpcl.com.au/trade-statistics

HustonKemp (2019). *Containerised trade trends and implications for Australian ports.* Retrieved from https://www.parliament.nsw.gov.au/lcdocs/other/12148/HoustonKemp-report---Containerised-trade-trends-and-implications-for-Australia-31-Jan-2019.pdf

IndexMundi (2020). *Australian Thermal Coal Prices, Australian Dollars*. Retrieved from: https://www.indexmundi.com/commodities/?commodity=coal-australian&months=120&currency=aud.

Infrastructure Australia (2018). *Australia's growing freight task: Challenges and opportunities*. Retrieved from: https://www.infrastructureaustralia.gov.au/listing/speech/australias-growing-freight-task-challenges-and-opportunities

KPMG (2020). *Coal price and FX market forecasts.* Retrieved from https://home.kpmg/content/dam/kpmg/au/pdf/2020/coal-price-fx-market-forecast-june-july-2020.pdf

MetroCoal (2012). *Positive Results for Bundi Project Scoping Study.* ASX Announcement.

NERA (2016). *Coal Industry Competitiveness Assessment*. National Energy Resources Australia.

Northern Energy Corporation Limited (2009). *Annual Report.*

PoB (2017). *Port of Brisbane Response to the Inquiry into National Freight Supply Chain Priorities*. Retrieved from https://www.infrastructure.gov.au/transport/freight/freight-supply-chain-submissions/Port_of_Brisbane_Pty_Ltd.pdf

PoB (2018). *Port of Brisbane Master Plan 2018-2048*. Port of Brisbane Pty Ltd. Retrieved from POB (2018). *Port of Brisbane Masterplan 2018-2048.* Retrieved from https://www.portbris.com.au/getmedia/8d74ab43-203b-46a1-a7c8-81106b3e8cb0/2019-03-04-PBPL-Master-Plan-2018-2048-FINAL.PDF

PoB (2020). *Port of Brisbane Trade Statistics June Quarter 2020 Container Trade, by Country and Commodity.* Retrieved from https://www.portbris.com.au/Operations-and-Trade/Trade-Development/.

Port Authority of New South Wales (2020). *Berths and Channels.* Retrieved from https://www.portauthoritynsw.com.au/media/4300/berths-and-channels-final-v630-20-october-2020.pdf

PoN (2019). *Port of Newcastle – Port Master Plan 2040.* Retrieved from https://www.portofnewcastle.com.au/wp-content/uploads/2019/10/Port-Master-Plan-2040-for-web.pdf

PoN (undated). *Berth Information.* Retrieved from https://www.portofnewcastle.com.au/wp-content/uploads/2020/05/2020-Berth-information.pdf

PoN (2020). *Newcastle Promulgated Depths at Berths and Channels.* Retrieved from https://www.portauthoritynsw.com.au/media/4298/newcastle-promulgated-depth-notice-issued-14-october-2020.pdf

PoM (undated). *Dock Deepening: Expanding Melbourne's Port Capacity.* Port of Melbourne. Retrieved from https://www.portofmelbourne.com/wp-content/uploads/pcp-fs-dock-deepening.pdf

PoT (undated). *Berth Information.* Port of Townsville. Retrieved from https://s3-ap-southeast-2.amazonaws.com/os-data-2/port-townsville/documents/berth_information_website_final.pdf

QGSO (2020). *Projected populations 2016 to 2041.* Retrieved from https://www.qgso.qld.gov.au/statistics/queensland-regions/regional-tools-statistics/queensland-regional-database

QBH (undated). *About* – Queensland Bulk Handling. Retrieved from http://www.qbh.com.au/content/about

Queensland Coordinator General (2015). *Gladstone State Development Area Development Scheme.* Retrieved from https://www.statedevelopment.qld.gov.au/resources/plan/cg/gladstone/gsda-development-scheme.pdf

Queensland Government (2012). *North Surat – Collingwood Coal Project.* Term of reference for an environmental impact statement.

Queensland Government (2020a). *Coordinated Projects*. Retrieved from http://www.statedevelopment.qld.gov.au/coordinator-general/assessments-and-approvals/coordinated-projects.html.

Queensland Government (2020b). *Queensland Coal Map – Twelfth Edition April 2014.* Retrieved from https://geoscience.data.qld.gov.au/dataset/cr069067/resource/geo-doc1202381-cr069067

Queensland Treasury (2020). *A Study of Long-Term Global Coal Demand.* Retrieved from https://s3.treasury.qld.gov.au/files/A-Study-of-Long-Term-Global-Coal-Demand.pdf

RDACWQ (unpublished). *Capital Cost Estimates, Inland Rail Route Toowoomba to Gladstone*. Unpublished data provided via email by Regional Development Australia – Central West Queensland.

Sinclair Knight Merz (2012). *North Surat – Collingwood Project Initial Advice Statement.*

Stanmore Coal (2013). *Feasibility Study Results for The Range Thermal Coal Project.* ASX Announcement.

Surat Basin Rail (2009). *Surat Basin Rail Project EIS*. Surat Basin Rail.

TMR (2019). *Trade Statistics for Queensland Ports – Throughput statistics for the five years ending 30 June 2019*. Queensland Government Department of Transport and Main Roads.

TMR (2018). *Priority Gladstone Port Master Plan*. Queensland Government Department of Transport and Main Roads. Retrieved from https://www.cabinet.qld.gov.au/documents/2018/Sep/GladMP/Attachments/Plan.PDF

Vessel Tracking (2020). Retrieved from http://www.vesseltracking.net/article/biggest-container-ship

Veldman, S., Glansdorp, C., & Kok, R. (2011). *Economies of size of larger container ships based on internal and external costs.* Retrieved from https://www.researchgate.net/publication/264822993_Economies_of_size_of_large_containerships_based_on_internal_and_external_costs

West, G. R. (1993). *User's Guide, Input-Output Analysis for Practitioners An Interactive Input-Output Software Package Version 7.1*. Department of Economics. University of Queensland, 1993.

WICET (2020). *Access – applying for capacity at WICET*. Wiggins Island Coal Export Terminal. Available from: http://www.wicet.com.au/irm/content/access1.aspx?RID=379&RedirectCount=1. Accessed: 6 October, 2020.

APPENDIX A: GLADSTONE PORT TRADE VOLUMES

Table A. 1. Trade Breakdown for Each Wharf Centre, 2017-18

Wharf Centre	Major Commodities	2017-18 (Tonnes)
RG Tanna Coal Terminal	Coal	57,445,899
Barney Point Terminal	Calcite	104,442
Auckland Point 1	Calcite, Woodchip, General Cargo, Containers	197,397
Auckland Point 2	Grain	162,397
Auckland Point 3	Petroleum, LP Gas, Sulphuric Acid, General Cargo	893,108
Auckland Point 4	Breakbulk, Containers, General Cargo	665,393
Boyne Smelter	Aluminum Alumina Hydrate Petroleum Coke Liquid Pitch	361,974 5,000 186,406 42,633
South Trees East	Alumina Caustic Soda Petroleum Products	2,733,754 1,167,594 146,122
South Trees West	Bauxite	10,041,241
Fisherman's Landing 1 and 2	Bauxite Alumina Caustic Soda Alumina Hydrate	8,712,415 2,900,014 1,018,431 356,150
Fisherman's Landing 4	Cement Products	1,865,926
Fisherman's Landing 5	Liquid Ammonia Caustic Soda Sulphuric Acid	163,094 167,783 17,865
Queensland Curtis LNG	LNG	6,563,769
Australia Pacific LNG	LNG	8,520,986
Santos GLNG	LNG	5,236,655
WICET	Coal	9,713,164
Total Port of Gladstone	-	**119,389,582**

Note: Totals may not sum due to rounding.
Source: GPCL (2018).

Table A.2. Historical Freight Volumes (Tonnes)

Commodity	2014-15	2015-16	2016-17	2017-18	2018-19
Export tonnes					
Coal - RG Tanna	64,395,516	62,553,327	59,754,026	57,445,899	61,014,365
LNG	1,611,103	12,152,537	19,392,449	20,321,380	21,570,655
Coal - Wiggins Island	461,447	7,986,490	9,191,882	9,713,164	11,373,387
Alumina	5,233,323	5,544,568	5,744,470	5,633,768	5,627,229
Cement	1,377,398	1,497,418	1,475,715	1,557,799	1,624,931
Woodchip	0	112,210	45,968	585,205	509,287
Alumina Hydrate	120,493	334,000	269,000	361,150	352,640
Fly Ash	273,168	239,653	229,815	271,909	292,809
Aluminium	408,102	416,547	360,151	361,974	288,129
Calcite	169,420	171,750	166,013	181,905	170,240
Scrap Metal	70,212	38,084	55,544	29,728	74,853
Containers	92,923	82,532	42,455	23,302	63,593
Grain	145,537	89,159	272,008	162,397	51,031
Limestone	46,985	31,999	42,656	34,199	34,048
Ilmenite	6,587	10,880	0	0	26,910
Liquid Pitch	-	-	-	-	3,504

Commodity	2014-15	2015-16	2016-17	2017-18	2018-19
General Cargo	86,766	469,252	560,822	6,521	2,452
Calcined Magnesia	21,915	11,477	10,614	17,954	0
Caustic Soda	0	1,204	0	0	0
Coal - Barney Point	3,707,827	1,629,024	-	0	0
Deadburned Magnesia	30,221	9,001	0	0	0
Electrofused Magnesia	14,163	1,433	0	0	0
Magnetite	0	0	0	0	0
Nickel Ore	50,010	0	0	0	0
Petroleum Coke	0	0	0	0	0
Total Exports	**78,323,116**	**93,382,545**	**97,613,588**	**96,708,254**	**103,080,063**
Import tonnes					
Bauxite	17,128,958	18,792,035	19,096,054	18,753,656	17,397,651
Caustic Soda	2,040,492	2,191,565	2,044,600	2,353,808	1,808,824
Petroleum Products	1,090,860	997,999	937,206	991,899	1,096,728
Liquid Ammonia	178,463	170,235	170,369	163,094	231,698
Petroleum Coke	208,876	196,308	221,533	186,406	165,435
Gypsum	0	59,249	28,898	79,772	79,460
Liquid Pitch	42,584	53,906	44,497	42,633	48,063
General Cargo	34,575	37,320	65,172	43,851	37,291
Grain - Barley	0	0	0	0	36,562
Magnetite	95,998	45,135	42,417	23,638	21,072
Sulphuric Acid	36,484	45,114	17,103	33,332	10,307
Liquefied Petroleum Gas	10,962	8,689	7,787	7,145	7,796
Containers	4,348	2,601	1,589	75	2,634
Cement Gypsum	57,591	0	0	0	0
Cement Clinker	-	-	-	2,019	-
MOF Construction Related Cargo	33,349	-	-	-	-
WICET Channel Utilisation Char	1,548	-	-	-	-
Total Imports	**20,965,088**	**22,600,156**	**22,677,225**	**22,681,328**	**20,943,521**
Total Throughput	**99,288,204**	**115,982,701**	**120,290,813**	**119,389,582**	**124,023,584**

Note: Totals may not sum due to rounding.
Source: GPCL (2020).

APPENDIX B: PORT OF BRISBANE TRADE VOLUMES

Table B.1. Historical Freight Volumes (Tonnes)

Commodity	2014-15	2015-16	2016-17	2017-18	2018-19
Export Tonnes					
Coal	7,247,952	6,753,216	6,931,255	7,229,217	6,590,219
Meat & By-Products	976,448	853,487	734,126	763,914	848,267
Refined Oil	2,997,632	499,341	892,639	611,596	800,669
Iron & Steel	594,011	584,305	662,873	600,535	789,635
Timber	0	153,328	258,718	446,245	552,914
Agricultural Seeds	1,340,260	1,726,640	2,265,919	948,765	435,862
Cotton	382,144	242,113	371,657	444,361	415,309
F.A.K.	318,358	324,326	447,606	436,050	314,266
Paper & Wood Pulp	282,894	303,249	301,746	276,471	275,206
Mining & Energy - Other	177,042	168,230	148,120	273,048	244,965
Woodchip	200,959	138,900	256,319	283,997	218,694
Tallow	226,630	216,774	209,354	221,769	217,496
Mineral Ores & Sands	225,708	186,982	330,374	277,552	206,777
Fertiliser	102,409	109,075	146,136	175,530	191,729
Food - Other	234,122	213,141	202,914	197,814	171,686
Metal Manufactures	149,559	137,701	149,278	125,562	164,891
Fruit & Vegetables	194,137	279,302	360,690	275,924	153,562
Machinery	126,310	127,285	128,859	138,476	129,152
Hides & Skins	150,303	140,307	117,878	124,032	123,661
Building Products	90,568	99,411	106,457	99,749	123,090
Chemicals - Industrial	118,092	114,711	105,595	117,767	100,201
Gas	49,910	876	147,931	115,904	87,740
Beverages	69,486	76,596	78,439	76,178	86,550
Meat - Other	17,770	33,214	26,604	54,266	67,612
Sugar	27,572	127,558	80,729	93,562	64,368
Rubber Manufactures	21,234	20,768	30,275	41,416	52,381
Other	470,283	297,894	247,934	313,228	303,547
Total Exports	**16,791,793**	**13,928,730**	**15,740,425**	**14,762,928**	**13,730,449**
Import Tonnes					
Crude Oil	7,686,124	4,797,476	4,970,535	4,861,724	4,740,500
Refined Oil	2,716,078	2,927,818	3,398,642	3,521,582	3,933,556
Agricultural Seeds	145,462	93,523	53,727	317,171	2,167,270
Cement	1,561,402	1,653,781	1,637,470	1,832,668	1,720,155
Iron & Steel	609,862	588,309	716,614	844,979	740,569
Building Products	584,318	626,028	698,956	738,757	728,002
Machinery	294,022	291,089	354,096	478,067	501,076
Gypsum/Limestone	494,408	517,358	440,955	524,181	478,628
Motor Vehicles	386,406	419,245	423,043	492,301	438,999
F.A.K.	362,300	357,812	530,689	615,671	435,663
Slag	211,602	259,714	230,646	266,992	344,977
Food - Other	270,621	280,788	300,963	293,013	335,973
Fertiliser	336,941	379,278	494,411	410,671	333,945
Household Items	273,253	282,677	289,330	308,530	309,310

Commodity	2014-15	2015-16	2016-17	2017-18	2018-19
Electrical Equipment	203,557	195,108	217,783	302,476	306,810
Timber	327,986	299,451	308,112	337,009	295,723
Chemicals - Industrial	274,169	242,160	273,637	278,290	277,356
Oil Seeds	193,730	198,786	144,134	167,975	259,654
Chemicals - Rural	204,131	216,683	255,394	275,519	256,402
Retail - Other	189,208	195,417	193,237	233,989	243,389
Paper & Wood Pulp	242,429	252,599	210,360	201,775	224,898
Beverages	196,174	186,455	169,464	195,133	206,985
Rubber Manufactures	123,262	125,021	135,456	142,140	152,248
Transport Equipment	106,274	107,906	121,031	127,857	130,709
Gas	59,587	112,218	228,837	169,305	129,893
Other	594,471	614,939	664,415	647,391	614,610
Total Imports	**18,647,777**	**16,221,639**	**17,461,937**	**18,585,166**	**20,307,300**
Total Throughput	**35,439,570**	**30,150,369**	**33,202,362**	**33,348,094**	**34,037,749**

Note: Totals may not sum due to rounding.
Source: TMR (2019).

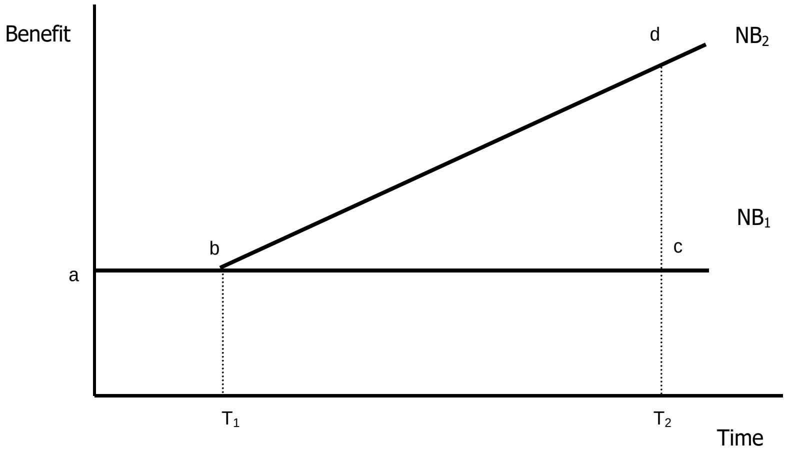
APPENDIX C: COST BENEFIT ANALYSIS METHODOLOGY

STEP 1: DEFINE THE SCOPE AND BOUNDARY

To enable a robust determination of the net benefits of undertaking a given project, it is necessary to specify base case and alternative case scenarios. The base case scenario represents the 'without project' scenario and the alternative or 'with project' scenario examines the impact with the project in place.

The base case (without) scenario is represented by line NB_1 (bc) over time T_1 to T_2 in the figure below. The investment in the project at time T_1 is likely to generate a benefit, which is represented by line NB_2 (bd). Therefore, the net benefit flowing from investment in the project is identified by calculating the area (bcd) between NB_1 and NB_2.

Figure C. 1. With and Without Scenarios



Source: AEC

STEP 2: IDENTIFY COSTS AND BENEFITS

A comprehensive quantitative specification of the benefits and costs included in the evaluation and their various timings is required and includes a clear outline of all major underlying assumptions. These impacts, both positive and negative, are then tabulated and where possible valued in dollar terms.

Some impacts may not be quantifiable. Where this occurs the impacts and their respective magnitudes will be examined qualitatively for consideration in the overall analysis.

Financing costs are not included in a CBA. As a method of project appraisal, CBA examines a project's profitability independently of the terms on which debt finance is arranged. This does not mean, however, that the cost of capital is not considered in CBA, as the capital expenses are included in the year in which the transaction occurs, and the discount rate (discussed below in Step 5) should be selected to provide a good indication of the opportunity cost of funds, as determined by the capital market.

STEP 3: QUANTIFY AND VALUE COSTS AND BENEFITS

CBA attempts to measure the value of all costs and benefits that are expected to result from the activity in economic terms. It includes estimating costs and benefits that are 'unpriced' and not the subject of normal market transactions but which nevertheless entail the use of real resources. These attributes are referred to as 'non-market' goods or impacts. In each of these cases, quantification of the effects in money terms is an important part of the evaluation.

However, projects frequently have non-market impacts that are difficult to quantify. Where the impact does not have a readily identifiable dollar value, proxies and other measures should be developed as these issues represent real costs and benefits.

One commonly used method of approximating values for non-market impacts is 'benefit transfer'. Benefit transfer (BT) means taking already calculated values from previously conducted studies and applying them to different study sites and situations. In light of the significant costs and technical skills needed in using the methodologies outlined in the table above, for many policy makers utilising BT techniques can provide an adequate solution.

Context is extremely important when deciding which values to transfer and from where. Factors such as population, number of households, and regional characteristics should be considered when undertaking benefit transfer. For example, as population density increases over time, individual households may value nearby open space and parks more highly. Other factors to be considered include, depending on the location of the original study, utilising foreign exchange rates, demographic data, and respective inflation rates.

Benefit transfer should only be regarded as an approximation. Transferring values from similar regions with similar markets is important, and results can be misleading if values are transferred between countries that have starkly different economies (for example a benefit transfer from the Solomon Islands to Vancouver would likely have only limited applicability). However, sometimes only an indicative value for environmental assets is all that is required.

STEP 4: TABULATE ANNUAL COSTS AND BENEFITS

All identified and quantified benefits and costs are tabulated to identify where and how often they occur. Tabulation provides an easy method for checking that all the issues and outcomes identified have been addressed and provides a picture of the flow of costs, benefits and their sources.

STEP 5: CALCULATE THE NET BENEFIT IN DOLLAR TERMS

As costs and benefits are specified over time it is necessary to reduce the stream of benefits and costs to present values. The present value concept is based on the time value of money – the idea that a dollar received today is worth more than a dollar to be received in the future. The present value of a cash flow is the equivalent value of the future cashflow should the entire cashflow be received today. The time value of money is determined by the given discount rate to enable the comparison of options by a common measure.

The selection of appropriate discount rates is of particular importance because they apply to much of the decision criteria and consequently the interpretation of results. The higher the discount rate, the less weight or importance is placed on future cash flows.

The choice of discount rates should reflect the weighted average cost of capital (WACC). For this analysis, a base discount rate of 6% has been used to represent the minimum rate of return, in line with Australian Government guidelines. As all values used in the CBA are in real terms, the discount rate does not incorporate inflation (i.e., it is a real discount rate, as opposed to a nominal discount rate).

To assess the sensitivity of the project to the discount rate used, discount rates either side of the base discount rate (6%) have also been examined (4% and 8%).

The formula for determining the present value is:

$$PV = \frac{FV_n}{(1+r)^n}$$

Where:

PV = present value today

FV = future value n periods from now

r = discount rate per period

n = number of periods

Extending this to a series of cash flows the present value is calculated as:

$$PV = \frac{FV_1}{(1+r)^1} + \frac{FV_2}{(1+r)^2} + \cdots + \frac{FV_n}{(1+r)^n}$$

Once the stream of costs and benefits have been reduced to their present values the Net Present Value (NPV) can be calculated as the difference between the present value of benefits and present value of costs. If the present value of benefits is greater than the present value of costs then the option or project would have a net economic benefit.

In addition to the NPV, the internal rate of return (IRR) and benefit-cost ratio (BCR) can provide useful information regarding the attractiveness of a project. The IRR provides an estimate of the discount rate at which the NPV of the project equals zero, i.e., it represents the maximum WACC at which the project would be deemed desirable. However, in terms of whether a project is considered desirable or not, the IRR and BCR will always return the same result as the NPV decision criterion.

STEP 6: SENSITIVITY ANALYSIS

Sensitivity analysis allows for the testing of the key assumptions and the identification of the critical variables within the analysis to gain greater insight into the drivers to the case being examined.

A series of Monte Carlo analyses has been conducted in order to test the sensitivity of the model outputs to changes in key variables. Monte Carlo simulation is a computerised technique that provides decision-makers with a range of possible outcomes and the probabilities they will occur for any choice of action. Monte Carlo simulation works by building models of possible results by substituting a range of values – the probability distribution – for any factor that has inherent uncertainty. It then calculates results over and over, each time using a different set of random values from the probability functions. The outputs from Monte Carlo simulation are distributions of possible outcome values.

During a Monte Carlo simulation, values are sampled at random from the input probability distributions. Each set of samples is called an iteration, and the resulting outcome from that sample is recorded. Monte Carlo simulation does this hundreds or thousands of times, and the result is a probability distribution of possible outcomes. In this way, Monte Carlo simulation provides a comprehensive view of what may happen. It describes what could happen and how likely it is to happen.

APPENDIX D: INLAND RAIL TO GLADSTONE SCENARIO MODELLING

The CBA modelling presented in section 6 is based on a scenario of coal and other freight demand in line with scenario 2 presented in sections 5.2 (coal) and **Error! Reference source not found.** (other freight). This appendix highlights the CBA modelling results using different coal and intermodal container and non-bulk freight scenarios. For both coal and other freight, three different scenarios are presented in sections 5.2 and **Error! Reference source not found.**, providing a total of six different freight scenarios and nine potential combinations of these scenarios. Additionally, a scenario has been developed without coal benefits and costs to each of the three intermodal scenarios.

CBA results for each of the scenarios of demand is presented below.

COAL SCENARIO 1; INTERMODAL SCENARIO 1

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Scenario 1
- Intermodal container and non-bulk freight: Scenario 1.

Table D.1. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June), Coal Demand Scenario 1 and Intermodal Container and Non-Bulk Freight Scenario 1

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$89	$40	$22
Coal Development Costs	$3,055	$1,926	$1,411
Total	**$6,616**	**$5,115**	**$4,298**
Benefits			
Coal Producer Margins	$5,364	$2,506	$1,416
Coal Labour Benefit	$1,458	$681	$385
Intermodal Freight Efficiency Benefits	$553	$196	$98
Social/Environmental Benefits - Land-Based Transport	$492	$174	$87
Environmental Benefits from Larger Ships	$128	$45	$23
Total	**$7,996**	**$3,602**	**$2,010**
Summary			
NPV	**$1,380**	**-$1,513**	**-$2,288**
BCR	**1.21**	**0.70**	**0.47**

Note: Totals may not sum due to rounding.
Source: AEC.

COAL SCENARIO 1; INTERMODAL SCENARIO 2

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Scenario 1
- Intermodal container and non-bulk freight: Scenario 2.

Table D.2. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June), Coal Demand Scenario 1 and Intermodal Container and Non-Bulk Freight Scenario 2

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$112	$49	$27
Coal Development Costs	$3,055	$1,926	$1,411
Total	**$6,640**	**$5,124**	**$4,303**
Benefits			
Coal Producer Margins	$5,364	$2,506	$1,416
Coal Labour Benefit	$1,458	$681	$385
Intermodal Freight Efficiency Benefits	$1,364	$437	$205
Social/Environmental Benefits - Land-Based Transport	$1,212	$388	$182
Environmental Benefits from Larger Ships	$315	$101	$47
Total	**$9,714**	$4,113	$2,236
Summary			
NPV	**$3,074**	**-$1,010**	**-$2,066**
BCR	**1.46**	**0.80**	**0.52**

Note: Totals may not sum due to rounding.
Source: AEC.

COAL SCENARIO 1; INTERMODAL SCENARIO 3

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Scenario 1
- Intermodal container and non-bulk freight: Scenario 3.

Table D.3. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June) , Coal Demand Scenario 1 and Intermodal Container and Non-Bulk Freight Scenario 3

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$133	$56	$31
Coal Development Costs	$3,055	$1,926	$1,411
Total	**$6,660**	**$5,131**	**$4,306**
Benefits			
Coal Producer Margins	$5,364	$2,506	$1,416
Coal Labour Benefit	$1,458	$681	$385
Intermodal Freight Efficiency Benefits	$2,080	$717	$352
Social/Environmental Benefits - Land-Based Transport	$1,849	$637	$313
Environmental Benefits from Larger Ships	$481	$166	$81
Total	**$11,233**	**$4,707**	**$2,548**
Summary			
NPV	**$4,573**	**-$424**	**-$1,758**
BCR	**1.69**	**0.92**	**0.59**

Note: Totals may not sum due to rounding.
Source: AEC.

COAL SCENARIO 2; INTERMODAL SCENARIO 1

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Scenario 2
- Intermodal container and non-bulk freight: Scenario 1.

Table D.4. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June), Coal Demand Scenario 2 and Intermodal Container and Non-Bulk Freight Scenario 1

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$103	$48	$28
Coal Development Costs	$4,244	$2,762	$2,091
Total	**$7,819**	**$5,960**	**$4,984**
Benefits			
Coal Producer Margins	$7,459	$3,594	$2,099
Coal Labour Benefit	$2,028	$977	$571
Intermodal Freight Efficiency Benefits	$553	$196	$98
Social/Environmental Benefits - Land-Based Transport	$492	$174	$87
Environmental Benefits from Larger Ships	$128	$45	$23
Total	**$10,660**	**$4,987**	**$2,879**
Summary			
NPV	**$2,841**	**-$973**	**-$2,105**
BCR	**1.36**	**0.84**	**0.58**

Note: Totals may not sum due to rounding.
Source: AEC.

COAL SCENARIO 2; INTERMODAL SCENARIO 2

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Scenario 2
- Intermodal container and non-bulk freight: Scenario 2.

Table D.5. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June), Coal Demand Scenario 2 and Intermodal Container and Non-Bulk Freight Scenario 2

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$129	$58	$33
Coal Development Costs	$4,244	$2,762	$2,091
Total	**$7,845**	**$5,969**	**$4,989**
Benefits			
Coal Producer Margins	$7,459	$3,594	$2,099
Coal Labour Benefit	$2,028	$977	$571
Intermodal Freight Efficiency Benefits	$1,364	$437	$205
Social/Environmental Benefits - Land-Based Transport	$1,212	$388	$182
Environmental Benefits from Larger Ships	$315	$101	$47
Total	$12,378	$5,498	$3,105
Summary			
NPV	**$4,533**	**-$470**	**-$1,883**
BCR	**1.58**	**0.92**	**0.62**

Note: Totals may not sum due to rounding.
Source: AEC.

COAL SCENARIO 2; INTERMODAL SCENARIO 3

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Scenario 2
- Intermodal container and non-bulk freight: Scenario 3.

Table D.6. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June), Coal Demand Scenario 2 and Intermodal Container and Non-Bulk Freight Scenario 3

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$151	$66	$37
Coal Development Costs	$4,244	$2,762	$2,091
Total	**$7,867**	**$5,977**	**$4,993**
Benefits			
Coal Producer Margins	$7,459	$3,594	$2,099
Coal Labour Benefit	$2,028	$977	$571
Intermodal Freight Efficiency Benefits	$2,080	$717	$352
Social/Environmental Benefits - Land-Based Transport	$1,849	$637	$313
Environmental Benefits from Larger Ships	$481	$166	$81
Total	**$13,897**	**$6,091**	**$3,417**
Summary			
NPV	**$6,030**	**$114**	**-$1,576**
BCR	**1.77**	**1.02**	**0.68**

Note: Totals may not sum due to rounding.
Source: AEC.

COAL SCENARIO 3; INTERMODAL SCENARIO 1

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Scenario 3
- Intermodal container and non-bulk freight: Scenario 1

Table D.7. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June), Coal Demand Scenario 3 and Intermodal Container and Non-Bulk Freight Scenario 1

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$119	$55	$32
Coal Development Costs	$5,185	$3,322	$2,479
Total	**$8,776**	**$6,527**	**$5,375**
Benefits			
Coal Producer Margins	$9,108	$4,323	$2,488
Coal Labour Benefit	$2,476	$1,175	$677
Intermodal Freight Efficiency Benefits	$553	$196	$98
Social/Environmental Benefits - Land-Based Transport	$492	$174	$87
Environmental Benefits from Larger Ships	$128	$45	$23
Total	**$12,758**	**$5,913**	**$3,373**
Summary			
NPV	**$3,982**	**-$614**	**-$2,002**
BCR	**1.45**	**0.91**	**0.63**

Note: Totals may not sum due to rounding.
Source: AEC.

COAL SCENARIO 3; INTERMODAL SCENARIO 2

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Scenario 3
- Intermodal container and non-bulk freight: Scenario 2

Table D.8. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June), Coal Demand Scenario 3 and Intermodal Container and Non-Bulk Freight Scenario 2

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$140	$63	$36
Coal Development Costs	$5,185	$3,322	$2,479
Total	**$8,797**	**$6,535**	**$5,380**
Benefits			
Coal Producer Margins	$9,108	$4,323	$2,488
Coal Labour Benefit	$2,476	$1,175	$677
Intermodal Freight Efficiency Benefits	$1,364	$437	$205
Social/Environmental Benefits - Land-Based Transport	$1,212	$388	$182
Environmental Benefits from Larger Ships	$315	$101	$47
Total	$14,476	$6,424	$3,599
Summary			
NPV	**$5,678**	**-$110**	**-$1,780**
BCR	**1.65**	**0.98**	**0.67**

Note: Totals may not sum due to rounding.
Source: AEC.

COAL SCENARIO 3; INTERMODAL SCENARIO 3

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Scenario 3
- Intermodal container and non-bulk freight: Scenario 3

Table D.9. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June), Coal Demand Scenario 3 and Intermodal Container and Non-Bulk Freight Scenario 3

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$160	$69	$39
Coal Development Costs	$5,185	$3,322	$2,479
Total	**$8,817**	**$6,541**	**$5,383**
Benefits			
Coal Producer Margins	$9,108	$4,323	$2,488
Coal Labour Benefit	$2,476	$1,175	$677
Intermodal Freight Efficiency Benefits	$2,080	$717	$352
Social/Environmental Benefits - Land-Based Transport	$1,849	$637	$313
Environmental Benefits from Larger Ships	$481	$166	$81
Total	**$15,995**	**$7,018**	**$3,912**
Summary			
NPV	**$7,178**	**$477**	**-$1,471**
BCR	**1.81**	**1.07**	**0.73**

Note: Totals may not sum due to rounding.
Source: AEC.

NO COAL SCENARIO; INTERMODAL SCENARIO 1

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Assume that there are no coal benefits or costs (i.e., coal is excluded from this scenario analysis)
- Intermodal container and non-bulk freight: Scenario 1

Table D.10. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June), No Coal Scenario and Intermodal Container and Non-Bulk Freight Scenario 1

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$103	$48	$28
Total	**$3,575**	**$3,197**	**$2,893**
Benefits			
Intermodal Freight Efficiency Benefits	$553	$196	$98
Social/Environmental Benefits - Land-Based Transport	$492	$174	$87
Environmental Benefits from Larger Ships	$128	$45	$23
Total	**$1,173**	**$415**	**$209**
Summary			
NPV	**-$2,402**	**-$2,782**	**-$2,684**
BCR	**0.33**	**0.13**	**0.07**

Note: Totals may not sum due to rounding.
Source: AEC.

NO COAL SCENARIO; INTERMODAL SCENARIO 2

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Assume that there are no coal benefits or costs (i.e., coal is excluded from this scenario analysis)
- Intermodal container and non-bulk freight: Scenario 2

Table D.11. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June), No Coal Scenario and Intermodal Container and Non-Bulk Freight Scenario 2

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$128	$56	$32
Total	**$3,601**	**$3,205**	**$2,897**
Benefits			
Intermodal Freight Efficiency Benefits	$1,364	$437	$205
Social/Environmental Benefits - Land-Based Transport	$1,212	$388	$182
Environmental Benefits from Larger Ships	$315	$101	$47
Total	**$2,891**	**$926**	**$434**
Summary			
NPV	**-$710**	**-$2,279**	**-$2,462**
BCR	**0.80**	**0.29**	**0.15**

Note: Totals may not sum due to rounding.
Source: AEC.

NO COAL SCENARIO; INTERMODAL SCENARIO 3

The table below displays the CBA modelling results of the following scenario assumptions:

- Coal demand: Assume that there are no coal benefits or costs (i.e., coal is excluded from this scenario analysis)
- Intermodal container and non-bulk freight: Scenario 3

Table D.12. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June), No Coal Scenario and Intermodal Container and Non-Bulk Freight Scenario 3

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$2,970	$2,701	$2,464
Development Cost of Additional Port Infrastructure	$502	$448	$401
Additional Rail Operating and Maintenance Costs	$151	$66	$37
Total	**$3,623**	**$3,215**	**$2,902**
Benefits			
Intermodal Freight Efficiency Benefits	$2,080	$717	$352
Social/Environmental Benefits - Land-Based Transport	$1,849	$637	$313
Environmental Benefits from Larger Ships	$481	$166	$81
Total	**$4,410**	**$1,520**	**$747**
Summary			
NPV	**$787**	**-$1,695**	**-$2,155**
BCR	**1.22**	**0.47**	**0.26**

Note: Totals may not sum due to rounding.
Source: AEC.

APPENDIX E: COST BENEFIT ANALYSIS INLAND RAIL TO THE PORT OF BRISBANE

As a point of comparison to the CBA for the inland rail route to Port of Gladstone, a scenario examining the benefits and costs associated with extending the Inland Rail line from Toowoomba to the Port of Brisbane has also been examined to provide an indication of the potential net benefit delivered by a standard inland rail route to Gladstone relative to a standard gauge rail route to Port of Brisbane. This appendix presents the assumptions and parameters used in assessing standard gauge rail from Toowoomba to Port of Brisbane, as well as CBA results.

METHOD AND APPROACH

General Assumptions

The CBA assesses the present value of benefits and costs of developing the inland route between Toowoomba and Brisbane. The overarching methodology used in conducting the analysis is in line with that used for assessing the inland route to Gladstone (see section 6.1).

Project Case vs Base Case

In undertaking the CBA, the following is noted regarding the project case and base case scenarios compared in this assessment.

Project Case

The project case assumed that standard gauge rail linking Inland Rail from Toowoomba to the Port of Brisbane is developed. Of note:

- The basis for the development of rail route, alignment, and capital costs are assumed to be in line with that presented by ARTC (2015), ARTC (2017 a, b & c) and DAE (2018). Estimates of capital and ongoing operating costs are outlined in the Costs Examined section.
- For comparison purposes to the Gladstone route, the same overarching timeframes for development have been assumed, with the line assumed to be operational by 2026. This is considered to be an optimistic assumption as to when such a rail line could be developed in consideration of the key challenges in construction of the Toowoomba Range section, crossing the Lockyer Valley flood plain, connecting to the interstate rail line through the Teviot Range and overcoming existing rail congestion and bottlenecks between Acacia Ridge and the Port of Brisbane (requiring additional tunnels and dedicated rail freight corridors trough densely populated and environmentally sensitive areas).
- The development of the rail line is anticipated to result in an increased share of freight travelling to/ from Brisbane using rail. It has also been assumed that development of the rail line would provide opportunity for a small increase in coal mine investment and production and export through Port of Brisbane. Assumptions regarding the volume of freight attracted along the rail line is presented in the Freight Demand Assumptions section below. This includes consideration of potential coal and other freight demand that may be generated.
- Aside from the additional coal investment and coal freight volumes produced and transported along the route, all other freight transported along the rail line would represent freight that would otherwise be transported using road. That is, aside from coal, no additional freight is assumed to be generated by development of the rail route to Port of Brisbane, but there would be a shift in how freight is transported.
- As this scenario does not involve shifting the port from which goods are traded, no impacts in terms of reduced sea transport have been examined for developing rail to the Port of Brisbane.
- The analysis does not consider any additional infrastructure upgrades to the Port of Brisbane. Upgrades are not required to accommodate additional intermodal container freight, as without expansion, the Port of Brisbane is not expected to reach capacity until 2052 (HustonKemp, 2019). However, coal infrastructure at the

port including investment in the existing rail line and new rolling stock will be required to increase current handling capacity from 10 Mtpa to 15 Mtpa (PoB, 2018).

Base Case

The base case that assumes the development of Inland Rail to the Port of Brisbane does not proceed. In the base case, it is assumed that no additional coal mine investment for transport and export through Port of Brisbane would be enabled, while all intermodal container and non-bulk freight that would travel by rail to/ from Brisbane in the project case is assumed to be transported from Toowoomba to the Port of Brisbane via road.

POTENTIAL DEMAND

Similar to Gladstone, there are two main potential markets of additional freight demand for an inland route between Toowoomba and Brisbane:

- Coal from proposed coal mines in the Surat Basin.
- Intermodal container freight, including inter-capital freight using Inland Rail.

These are described in more detail below.

Coal Demand

As stated in the PoB (2018) Masterplan, there is potential for additional mine development beyond the existing mines which export from the Port of Brisbane (e.g. Cameby Downs and New Acland).

The Cameby Downs mine is located approximately 16 km south-east of Miles, while an additional mine (Columboola) has also been proposed in close proximity to Cameby Downs. Additionally, New Acland which is located an estimated 240 km by rail from the Port of Brisbane has plans to expand their existing operations. It is uncertain whether either of these projects will proceed.

Table E.1. Saleable Coal Production for Each Project (Mtpa)

Project	Saleable Coal Production (Mtpa)
Columboola	5
New Acland Stage 3	7
Total	**12**

Source: AECOM (2017).

The development of Inland Rail to the Port of Brisbane also has the potential to support additional coal mine developments located near Wandoan where rail infrastructure is developed to link these mines to the Western Rail Line (or alternatively where coal is trucked to a rail interface along the existing Western Rail Line). However, the vast majority of these projects are located closer to the Port of Gladstone and transport costs would likely be lower for such operations where a rail line to Gladstone was developed.

The Port of Brisbane currently has an annualised coal export capacity of approximately 10 Mtpa, with one operating coal terminal (QBH) and capacity constraints along the Western Rail Line for transport of coal. The PoB (2018) Masterplan highlights that they are currently 'working with track manager, rail operators and the coal companies to find ways to extract additional freight capacity out of existing rail infrastructure, to achieve at least 15 Mtpa export capacity' (p.35).

In 2018-19, the QBH coal terminal exported approximately 6.6 Mt of coal. Capacity over and above what is currently being exported stands at approximately 3.4 Mtpa.

For the purposes of this analysis, it has been assumed that approximately 5 Mtpa would be exported through the Port of Brisbane without development of rail infrastructure between Toowoomba and the port, and with the rail infrastructure this would increase to 15 Mtpa. That is, the development of the rail infrastructure is assumed to unlock 10 Mtpa of additional coal mine investment and annual production.

Intermodal Container and Non-Coal Bulk Freight

Freight to/ from the Port of Brisbane

DAE (2018) highlights that, currently, only 2.5% of the Port of Brisbane's containerised freight is moved by rail in and out of the port (approximately 30,000 TEUs in 2017). DAE outlines this is considerably below the rail share achieved in the early 2000s (12%) as well as the share of container freight movements for other ports on Australia's east coast (20%) as well as compared to overseas benchmarks (30%).

The Port of Brisbane is projecting significant growth in containerised freight throughput to 2050. The following table summarises Port of Brisbane's projected growth in TEU throughput between 2018 and 2048, showing the number of TEUs through the port is estimated to increase by 358% over the 30 year period. To understand the tonnes of container freight this volume of TEU's corresponds to, the TEU growth targets listed in the table below were multiplied by an average of 10 net tonnes per TEU (based on European Union standards of default weights per TEU container of 12 tonnes per TEU and 2 tonnes per empty TEU (European Commission, 2017)).

Table E.2. Container Growth Targets (30-years), TEUs and Tonnes of Freight

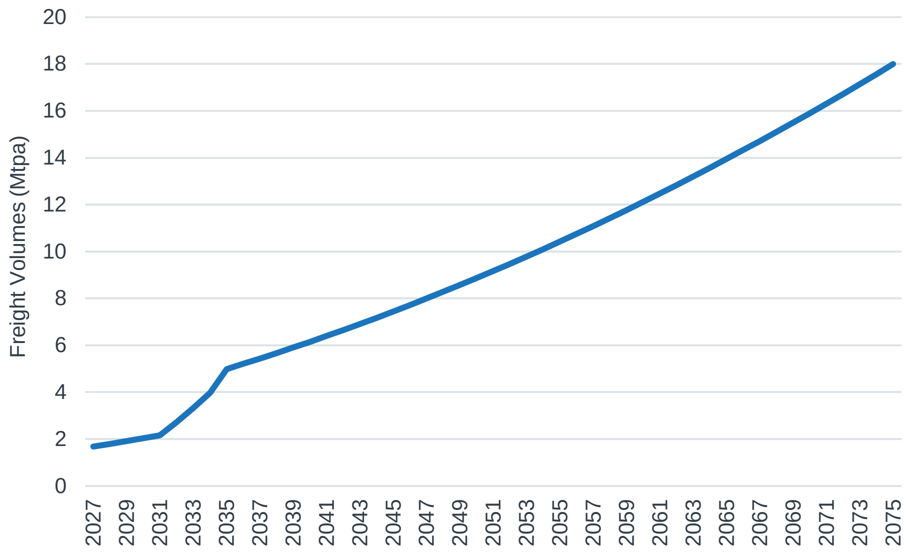
Year	2018	2023	2028	2033	2038	2043	2048
TEUs	1.34	1.68	2.14	2.68	3.33	4.01	4.80

Source: PoB (2018).

Without the development of Inland Rail, it is assumed that the Port of Brisbane's proportion of container freight travelling on rail will remain consistent (at 2.5% of total volumes) over the period of the analysis.

The development of Inland Rail is expected to incentivise other freight onto rail to the Port of Brisbane. By 2035, it is assumed that the port's proportion of freight using rail is expected to grow to 20%, in accordance with DAE's 2018 analysis and the Port of Brisbane's future freight forecasts. It is assumed that the development of Inland rail will accommodate the additional freight volumes over and above what is expected if the development does not proceed. The figure below reflects the greater volume between **Error! Reference source not found.** and the estimated additional freight volumes, considering the 20% growth in rail freight (DAE, 2018).

Figure E.1. Estimated Freight to and from the Port on Inland Rail



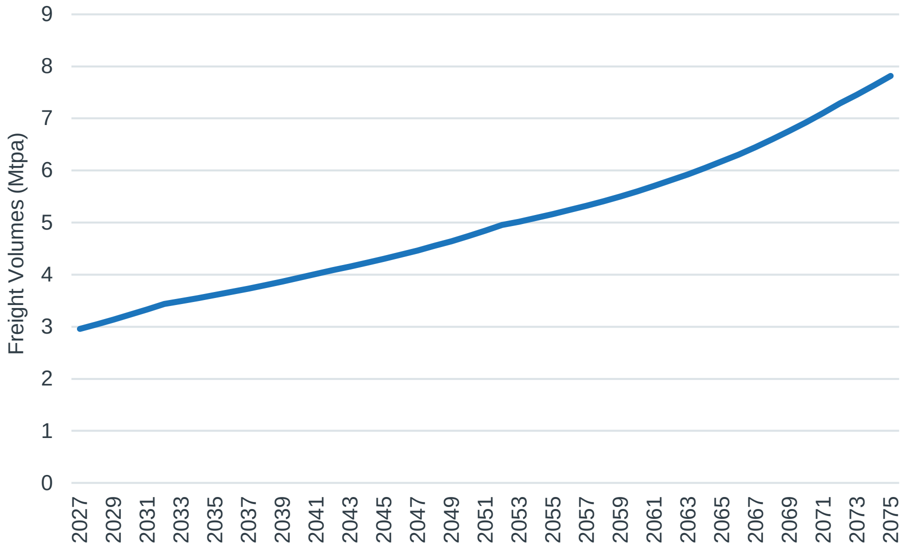
Source: AEC & DAE (2018).

Freight Originating in/ Distributed to Brisbane/ SEQ

The freight volumes outlined above only considers the freight that travels to and from the Port of Brisbane. It does not consider freight that goes to Brisbane/ SEQ on either road or rail for consumption/ distribution in SEQ, or the freight that originates in SEQ and is transported by road or rail to destinations outside SEQ.

With the development of standard gauge rail from Toowoomba to Brisbane, there will be potential for a mode shift in this freight originating in/ destined for SEQ that travels south/ north. In estimating the volume of this freight that may shift from road to rail, projections from ARTC (2015) of intercapital freight was used. An indicative estimate of potential volumes of intercapital freight generated/ destined for SEQ transported along Inland Rail was developed and presented in section **Error! Reference source not found.** (see **Error! Reference source not found.**). This level of intercapital freight generated/ destined for SEQ has been assumed to shift from road to rail and is summarised in the figure below.

Figure E.2. Estimated Freight to and from Brisbane on Inland Rail



Source: AEC.

Net Tonne Kilometers

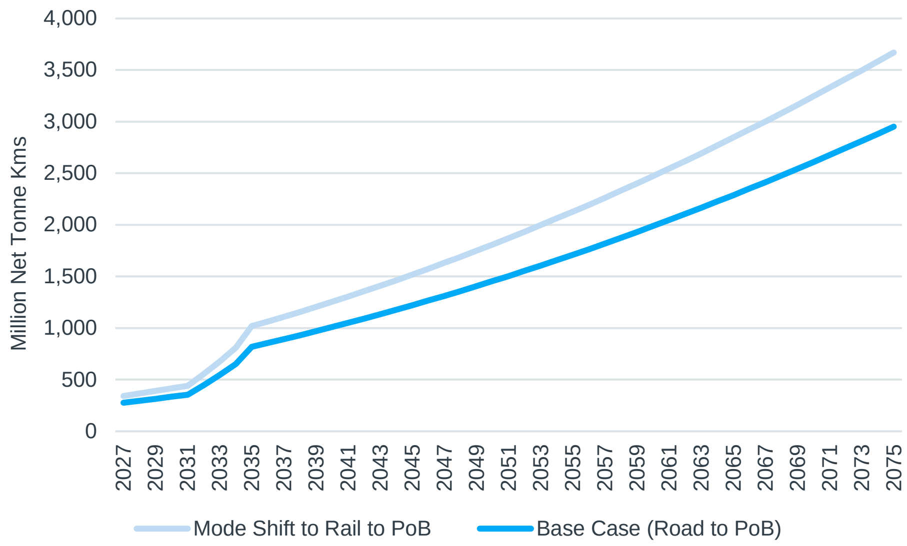
To understand the total net tonne kilometers travelled, the potential demand scenarios for freight to and from the Port of Brisbane via Inland rail (Figure E.1) and freight to and from Brisbane via Inland Rail (Figure E.2) were applied to the total distance travelled as displayed in the table below. This was broken down by urban and non-urban components as per the table below.

Table E.3. Distances Travelled (km)

Route	Urban km	Non-Urban km	Total km
Toowoomba to Acacia Ridge (via rail)	19	110	**129**
Toowoomba to Brisbane Port (via road)	54	110	**164**

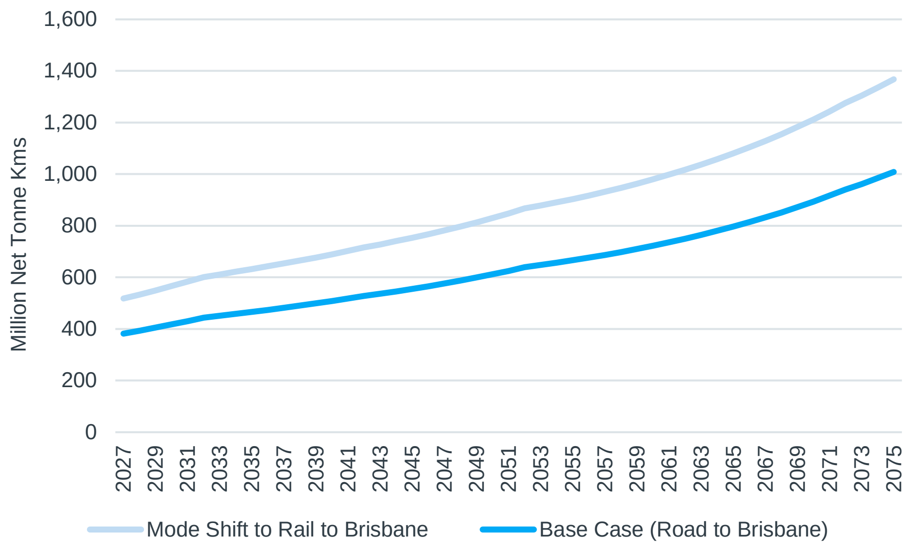
Source: AEC.

Figure E.3. Estimated Import/Export Freight to and from the Port of Brisbane (ntkms)



Source: AEC.

Figure E.4. Estimated Freight to and from Brisbane (ntkms) to be generated from/consumed in South East Queensland



Source: AEC.

COSTS EXAMINED

Construction Costs for Rail Infrastructure

Estimates of construction costs for developing a standard/dual gauge inland rail route between Toowoomba and the Port of Brisbane are presented in ARTC's 2015 and DAE's 2017 reports. Assuming an escalation rate of 2.5% per annum, capital costs are approximately $6.8 billion in 2020-dollar terms.

The table below provides a summary of estimated costs by segment. Acacia Ridge to the Port of Brisbane is a significant cost of the overall Toowoomba to Port of Brisbane route, accounting for approximately 20% of total Inland Rail construction costs.

This analysis also considers that the development of Inland Rail to the Port of Brisbane will result in additional coal developments (see Appendix E – Coal Demand). However, upgrades to the current Western Line System between Miles and Wandoan and Toowoomba/ Oakey to Miles will be required to support additional activity from potential mine developments to the Port of Brisbane, transforming the current system to a new standard gauge track. These upgrades are estimated to cost a total of $1.4 billion in 2020-dollar terms (AECOM, 2017).

For the purposes of this assessment, it is assumed construction costs begin and end the same year as construction of the Toowoomba to Gladstone line. This is an optimistic scenario for the Inland Rail development to the Port of Brisbane as the Toowoomba Range Tunnel, the new rail line through the Teviot Range, traversing the Lockyer Valley flood plain and the Acacia Ridge/ Port of Brisbane line includes significant construction activity and planning requirements.

Table E.4. Costs for Developing Inland Route, Dual/ Standard Gauge (Brisbane)

Rail Line Network	Distance (km)	Cost ($M 2010)	Cost ($M 2020)
Oakey to Toowoomba Range Tunnel	16	$79	$102
Gowrie to Helidon	28	$1,350[2]	$1,454
Helidon to Calvert	47	$1,000[2]	$1,077
Calvert to Kagaru	53	$1,200[2]	$1,292
Kagaru to Acacia Ridge	36	$0	$0
Acacia Ridge to Port of Brisbane	37	$2,510	$2,840
Toowoomba/ Oakey to Miles	198	$840[1]	$950
Miles to Wandoan	65	$380[1]	$430
Total	**480**	**$7,359**	**$8,145**

Note:

- Totals may not sum due to rounding.
- [1] Toowoomba/ Oakey to Mile and Mile to Wandoan are listed in 2014-15 values.
- [2] Listed in 2017 values.
- 2020 cost estimates are based on an annual escalation rate of 2.5%.

Source: DAE (2018), ARTC (2010, 2015, 2017 a, b & c) and AECOM (2017).

For context, Table E.5 shows the comparative costs of developing Inland Rail from Melbourne to Toowoomba, then extending to the Port of Brisbane. As stated, the key challenges in delivering Inland Rail to the Port of Brisbane is the significant geographical and urban constraints with the descent from Toowoomba Range, crossing the Lockyer Valley flood plain, connecting to the interstate rail line through the Teviot Range and the required rail link between Acacia Ridge and the Port of Brisbane. These key challenges represent the rail line from Gowrie to the Port of Brisbane, which costs 50% of the total costs to deliver Inland Rail while only covering 10% of the distance.

Table E.5. Costs for Developing Inland Rail from Melbourne to the Port of Brisbane

Cost estimate	Cost $B
Published cost	$10
Published overrun	$4.4
Total cost Melbourne to Acacia Ridge	$14.4
Published cost of Gowrie to Acacia Ridge	$7.2
% of Gowrie to Acacia Ridge	**50%**

Source: AEC.

Additional Rail Operating and Maintenance Costs

The average operating and maintenance costs per km as listed in Table 6.3 have been applied to the net tonne kilometres listed in Table E.3 and Table E.4. These costs are assumed to occur from 2026 until the end of the analysis period in 2125.

Development Costs for Coal Mines

For the purposes of this assessment, the development costs per mine outlined in section 6.2.4 have been applied to the two estimated mine developments resulting from the construction of Inland Rail to the Port of Brisbane. In terms of timing of development, it was assumed each mine would take approximately two years to develop, with 33% of costs in the first year and 67% of costs in the second year of construction. These costs are incurred during the two years prior to first coal being produced.

Construction costs are assumed to being in 2024 for mine development one and in 2026 for mine development two.

Table E.6. Development Costs for Coal Mines

Coal Mine	2024	2025	2026	2027
Coal Mine 1	$292	$583	$0	$0
Coal Mine 2	$0	$0	$292	$583

Note: It is assumed that coal mines will operate for approximately 25 years, after which additional construction costs will occur for mine replacement.
Source: MertoCoal (2012), Stanmore Coal (2013), Queensland Government (2012), Sinclair Knight Merz (2012), Northern Energy Corporation Limited (2009), Gillespie, T (2017) & AEC.

BENEFITS EXAMINED

Coal Producer Margins

Operating expenditure ($80/t) and revenue estimates ($100/t) per tonne outlined in section 6.3.1 have been applied to the estimated coal production unlocked by the Inland Rail route to the Port of Brisbane. This was applied to the projected volume of additional coal volumes produced outlined in the table below.

Table E.7. Coal Production (Mtpa)

Production	2026	2027	2028 Onwards
Annual Production	5	5	10

Source: AEC.

Benefits to Labour – Coal Mining

The same employee benefit per tonne ($5.44 /t) of product coal outlined in section 6.3.2 has also been applied for operations staff of the mines unlocked with the Inland Rail route to the Port of Brisbane. This was applied to the projected volume of additional coal volumes produced outlined above in Table E.7.

Freight Benefits

Transport of freight to Brisbane will result in a shift from freight being transported by road to Brisbane to by rail to Brisbane. Additionally, the development of Inland Rail to the Port of Brisbane (including the Western Line upgrades) will support freight savings on the current coal transported to the Port via rail.

An overview of these freight savings are provided below.

<u>Non-Coal Freight Efficiency Savings</u>

BITRE (2016) freight costs for rail and road applied above in section 6.3.3 have also been applied to the net tonne km for rail to Brisbane and the Port of Brisbane (project case) and road to Brisbane and the Port of Brisbane (base case). See Figure E.3 and Figure E.4 for net tonne kilometres.

The analysis considers the freight efficiencies of transporting the intermodal container and non-bulk freight by rail instead of road.

Coal Freight Efficiency Benefit

ARTC (2015) indicated a total PV benefit of $1.592 billion (4% discount rate) for coal from 2014-15 to 2074-75 (10 years construction, 50 years of operation). This was based on the transport and efficiency savings and includes the residual value, reflecting an assumed 100-year economic life. The benefit of approximately $3.5 per tonne (undiscounted) was applied to the coal tonnes per annum assumed to be currently handled at the Port of Brisbane (approximately 5 Mtpa).

Social and Environmental Benefits – Land-Based Transport

The social and environment costs of road costs compared to rail as highlighted in Table 6.6 has been applied to the development of Inland Rail to the Port of Brisbane. The total net tonne kilometres as highlighted in Figure E.3 and Figure E.4 has been applied to the total urban and rural net tonne kilometres in Table E.3.

This considers the cost savings of freight travelling on rail to Brisbane, compared to the base case where freight is assumed to travel via road to Brisbane.

Reduced Toowoomba Range Maintenance

The ARTC (2010) report indicated that the development of Inland Rail to the Port of Brisbane will result in avoided ongoing maintenance of the existing Toowoomba range rail crossing, producing a saving of $9.8 million per annum (this figure is displayed in 2020-dollar terms). The maintained costs of Toowoomba Range are significantly high due to the difficult terrain.

CBA RESULTS

Coal and Intermodal Freight

The table below outlines the Present Value (PV) of the identified costs and benefits associated with the development of Inland Rail from Toowoomba to the Port of Brisbane, between the financial year ended June 2021 and June 2075, consideration has also been given to potential impacts that may be extended beyond this timeframe (to 2125), at discount rates of 4%,7% and 10%.

In consideration of current low interest rates, as well as the project representing public enabling infrastructure that supports broader business, social, community and environmental outcomes, a discount rate of 4% may be considered the most appropriate discount rate for assessing the net benefit delivered by rail to Gladstone.

The CBA modelling at these levels of freight demand indicates the project is economically desirable at a 4% discount rate with the following results:

- A Net Present Value (NPV) of $78 million over the three-year construction period and 100 year operational period with an aggregate PV benefits of approximately $9,629 million compared to an aggregate PV costs of approximately $9,551 million.
- A BCR of 1.01, highlighting that the project is economically desirable under the CBA modelling assumptions, returning $1.01 for every $1 cost.

The cost benefit analysis identifies that at a 7% and 10% discount rate the project would not be deemed economically desirable with the costs outweighing the benefits.

Table E.8. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June)

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$7,174	$6,547	$5,992
Additional Rail Operating and Maintenance Costs	$89	$43	$26
Coal Development Costs	$2,288	$1,567	$1,243
Total	**$9,551**	**$8,157**	**$7,260**
Benefits			
Coal Producer Margins	$4,028	$2,039	$1,247
Coal Labour Benefits	$1,095	$554	$339
Freight Efficiency Benefits	$2,132	$817	$430
Social/Environmental Benefits - Land-Based Transport	$2,168	$760	$373
Reduced Toowoomba Range maintenance	$206	$107	$67
Total	**$9,629**	**$4,278**	**$2,457**
Summary			
NPV	**$79**	**-$3,879**	**-$4,804**
BCR	**1.01**	**0.52**	**0.34**

Note: Totals may not sum due to rounding.
Source: AEC.

No Coal and Intermodal Scenario

The CBA modelling results below considers the development of Inland Rail from Toowoomba to the Port of Brisbane, without the coal costs and benefits. At the levels of freight demand highlighted for the Port of Brisbane above, the CBA indicates that the project is not economically desirable at a 4% discount rate with the following results:

- A Net Present Value (NPV) of -$1,919 million over the three-year construction period and 100 year operational period with an aggregate PV benefits of approximately $4,139 million compared to an aggregate PV costs of approximately $6,058 million.
- A BCR of 0.68, highlighting that the project is not economically desirable under the CBA modelling assumptions, returning $0.68 for every $1 cost.

The cost benefit analysis identifies that across all discount rates the project would not be deemed economically desirable with the costs outweighing the benefits.

Table E.9. Summary of Costs and Benefits, Discount Value, 2021 to 2125 (Financial Year Ended June)

Discount rates	PV ($M) - 4% Discount Rate	PV ($M) - 7% Discount Rate	PV ($M) - 10% Discount Rate
Costs			
Construction Costs for Rail Infrastructure	$5,969	$5,455	$4,999
Additional Rail Operating and Maintenance Costs	$89	$43	$26
Total	**$6,058**	**$5,497**	**$5,025**
Benefits			
Freight Efficiency Benefits	$1,765	$627	$311
Social/Environmental Benefits - Land-Based Transport	$2,168	$760	$373
Reduced Toowoomba Range maintenance	$206	$107	$67
Total	**$4,139**	**$1,494**	**$751**
Summary			
NPV	**-$1,919**	**-$4,003**	**-$4,274**
BCR	**0.68**	**0.27**	**0.15**

Note: Totals may not sum due to rounding.
Source: AEC.

APPENDIX F: INPUT-OUTPUT METHODOLOGY

INPUT-OUTPUT MODEL OVERVIEW

Input-Output analysis demonstrates inter-industry relationships in an economy, depicting how the output of one industry is purchased by other industries, households, the government and external parties (i.e. exports), as well as expenditure on other factors of production such as labour, capital and imports. Input-Output analysis shows the direct and indirect (flow-on) effects of one sector on other sectors and the general economy. As such, Input-Output modelling can be used to demonstrate the economic contribution of a sector on the overall economy and how much the economy relies on this sector or to examine a change in final demand of any one sector and the resultant change in activity of its supporting sectors.

The economic contribution can be traced through the economic system via:

- **Initial stimulus (direct) impacts**, which represent the economic activity of the industry directly experiencing the stimulus.
- **Flow-on impacts**, which are disaggregated to:
  - **Production induced effects (type I flow-on)**, which comprise the effects from:
    - Direct expenditure on goods and services by the industry experiencing the stimulus (direct suppliers to the industry), known as the first round or direct requirements effects.[11]
    - The second and subsequent round effects of increased purchases by suppliers in response to increased sales, known as the industry support effects.
  - **Household consumption effects (type II flow-on)**, which represent the consumption induced activity from additional household expenditure on goods and services resulting from additional wages and salaries being paid within the economic system.

These effects can be identified through the examination of four types of impacts:

- **Output**: Refers to the gross value of goods and services transacted, including the costs of goods and services used in the development and provision of the final product. Output typically overstates the economic impacts as it counts all goods and services used in one stage of production as an input to later stages of production, hence counting their contribution more than once.
- **Gross product**: Refers to the value of output after deducting the cost of goods and services inputs in the production process. Gross product (e.g., Gross Regional Product) defines a true net economic contribution and is subsequently the preferred measure for assessing economic impacts.
- **Income**: Measures the level of wages and salaries paid to employees of the industry under consideration and to other industries benefiting from the project.
- **Employment**: Refers to the part-time and full-time employment positions generated by the economic shock, both directly and indirectly through flow-on activity, and is expressed in terms of full time equivalent (FTE) positions.

Input-Output multipliers can be derived from open (Type I) Input-Output models or closed (Type II) models. Open models show the direct effects of spending in a particular industry as well as the indirect or flow-on (industrial support) effects of additional activities undertaken by industries increasing their activity in response to the direct spending.

Closed models re-circulate the labour income earned as a result of the initial spending through other industry and commodity groups to estimate consumption induced effects (or impacts from increased household consumption).

[11] Modelling note: In assessing construction impacts, AEC's modelling approach treats subcontractors in the construction services sector engaged through first round effects as part of the initial stimulus impact rather than as part of the production induced impact.

MODEL DEVELOPMENT

Multipliers used in this assessment are derived from sub-regional transaction tables developed specifically for this project. The process of developing a sub-regional transaction table involves developing regional estimates of gross production and purchasing patterns based on a parent table, in this case, the 2017-18 Australian transaction table (ABS, 2020a).

Estimates of gross production (by industry) in the study areas were developed based on the percent contribution to employment (by place of work) of the study areas to the Australian economy (ABS, 2012; ABS, 2017; ABS, 2020b; DoESSFB, 2020), and applied to Australian gross output identified in the 2017-18 Australian table.

Industry purchasing patterns within the study area were estimated using a process of cross industry location quotients and demand-supply pool production functions as described in West (1993).

Where appropriate, values were rebased from 2017-18 (as used in the Australian national Input-Output transaction tables) to current year values using the Consumer Price Index (ABS, 2020c).

MODELLING ASSUMPTIONS

The key assumptions and limitations of Input-Output analysis include:

- **Lack of supply-side constraints**: The most significant limitation of economic impact analysis using Input-Output multipliers is the implicit assumption that the economy has no supply-side constraints so the supply of each good is perfectly elastic. That is, it is assumed that extra output can be produced in one area without taking resources away from other activities, thus overstating economic impacts. The actual impact is likely to be dependent on the extent to which the economy is operating at or near capacity.
- **Fixed prices**: Constraints on the availability of inputs, such as skilled labour, require prices to act as a rationing device. In assessments using Input-Output multipliers, where factors of production are assumed to be limitless, this rationing response is assumed not to occur. The system is in equilibrium at given prices, and prices are assumed to be unaffected by policy and any crowding out effects are not captured. This is not the case in an economic system subject to external influences.
- **Fixed ratios for intermediate inputs and production (linear production function)**: Economic impact analysis using Input-Output multipliers implicitly assumes that there is a fixed input structure in each industry and fixed ratios for production. That is, the input function is generally assumed linear and homogenous of degree one (which implies constant returns to scale and no substitution between inputs). As such, impact analysis using Input-Output multipliers can be seen to describe average effects, not marginal effects. For example, increased demand for a product is assumed to imply an equal increase in production for that product. In reality, however, it may be more efficient to increase imports or divert some exports to local consumption rather than increasing local production by the full amount. Further, it is assumed each commodity (or group of commodities) is supplied by a single industry or sector of production. This implies there is only one method used to produce each commodity and that each sector has only one primary output.
- **No allowance for economies of scope**: The total effect of carrying on several types of production is the sum of the separate effects. This rules out external economies and diseconomies and is known simply as the “additivity assumption”. This generally does not reflect real world operations.
- **No allowance for purchasers’ marginal responses to change**: Economic impact analysis using multipliers assumes that households consume goods and services in exact proportions to their initial budget shares. For example, the household budget share of some goods might increase as household income increases. This equally applies to industrial consumption of intermediate inputs and factors of production.
- **Absence of budget constraints**: Assessments of economic impacts using multipliers that consider consumption induced effects (type two multipliers) implicitly assume that household and government consumption is not subject to budget constraints.

Despite these limitations, Input-Output techniques provide a solid approach for taking account of the inter-relationships between the various sectors of the economy in the short-term and provide useful insight into the quantum of final demand for goods and services, both directly and indirectly, likely to be generated by a project.

In addition to the general limitations of Input-Output analysis, there are two other factors that need to be considered when assessing the outputs of sub-regional transaction table developed using this approach, namely:

- It is assumed the sub-region has similar technology and demand/ consumption patterns as the parent (Australia) table (e.g. the ratio of employee compensation to employees for each industry is held constant).
- Intra-regional cross-industry purchasing patterns for a given sector vary from the national tables depending on the prominence of the sector in the regional economy compared to its input sectors. Typically, sectors that are more prominent in the region (compared to the national economy) will be assessed as purchasing a higher proportion of imports from input sectors than at the national level, and vice versa.

AFFILIATED OFFICES:

BRISBANE
Level 5, 131 Leichhardt Street
Spring Hill QLD 4000
Australia
T: +61 (0)7 3831 0577

TOWNSVILLE
233 Flinders Street East
Townsville QLD 4810
Australia
T: +61 (0)7 4771 5550

SYDNEY
Level 14, 25 Bligh Street,
Sydney NSW 2000
Australia
T: +61 (0) 2 9283 8400

BANGKOK
2024/129-130 Sukhumvit 50
Prakanong Klongtoey,
Bangkok, Thailand 10260
T: +66 2 107 0189

DARWIN
Level 1, 48-50 Smith Street
Darwin NT 0800
Australia
T: 1300 799 343

MELBOURNE
Level 13, 200 Queen Street
Melbourne VIC 3000
Australia
T: +61 (0)3 8648 6586

PERTH
Level 2, 580 Hay Street
Perth WA 6000
Australia
T: +61 (0) 8 6555 4940

SHANGHAI
Level 35, 1st Building,
700 Liquan Road, Putuo District,
Shanghai, China 200333
T: +8618 516293312

aecgroupltd.com

OUTCOME DRIVEN

AEC

OUTCOME DRIVEN