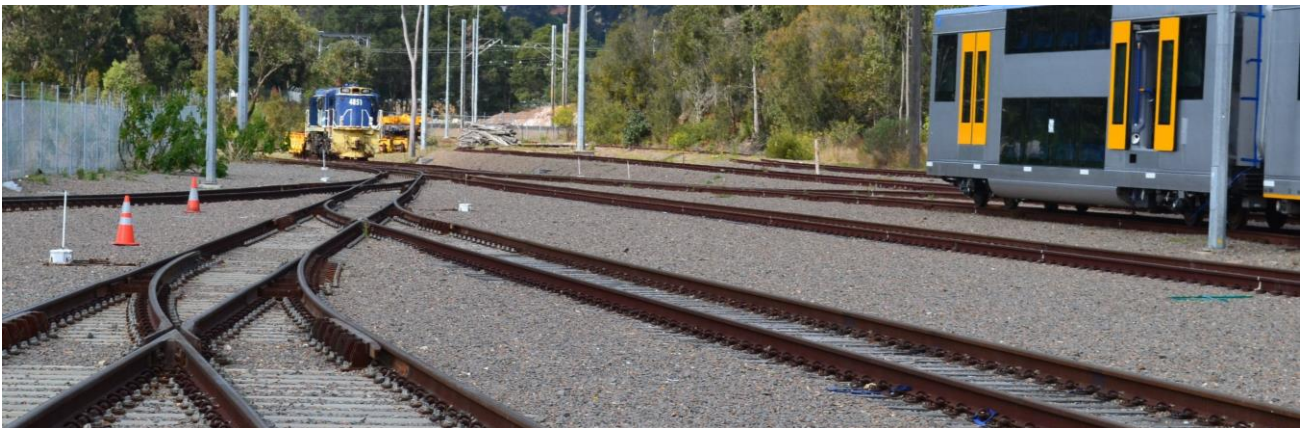


# Upgrading rail connectivity between Illawarra and Sydney

Directed research: Identification of measures to improve speed and reliability of rail connectivity between the Illawarra and Sydney



2 August 2017



**smart**  
infrastructure facility



UNIVERSITY  
OF WOLLONGONG  
AUSTRALIA

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# Glossary

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ABS	Australian Bureau of Statistics
ARTC	Australian Rail Track Corporation
BAU	Business as Usual
BCR	Benefit Cost Ratio
CBA	Cost Benefit Appraisal
CEGEM	Cadence Economics General Equilibrium Model
CGE	Computable General Equilibrium
EIA	Economic Impact Analysis
ETCS	European Train Control System
ETCS2	European Train Control System Level 2
GDP	Gross Domestic Product
GRP	Gross Regional Product
IBC	Illawarra First/Illawarra Business Chamber
IA	Infrastructure Australia
INSW	Infrastructure NSW
LGA	Local Government Area
Mtpa	Million tonnes per annum
NPV	Net Present Value
PwC	PricewaterhouseCoopers
RailNet	SMART's in-house rail timetable optimisation model
ROA	Rest of Australia
ROW	Rest of the World
SMART	Simulation Modelling Analysis Research Teaching
STN	Sydney Trains Network
SWIRL	South West Illawarra Rail Link
TEU	Twenty-Foot Equivalent Unit (a standard-size shipping container)
TfNSW	Transport for NSW
WEB	Wider Economic Benefit
WEI	Wider Economic Impact

# 1. Executive Summary

The Illawarra Business Chamber (Illawarra First) commissioned the SMART Infrastructure Facility UOW (SMART) to investigate options to improve the speed and reliability of passenger and freight rail transport services between the Illawarra and Sydney (Terms of Reference at Appendix A).

The Illawarra region, despite its geographic proximity to Australia's largest city, has historically suffered from relatively higher unemployment, particularly youth unemployment, in part due to poor transport connectivity to Sydney and a lack of industrial diversification. Traditionally a large employer of mining, mining services, steelmaking and port services, the Illawarra economy has often struggled to maintain healthy growth and low unemployment during mining downturns. Improving rail transport connectivity to Sydney can assist in providing labour market diversification and improve workforce participation.

The potential economic and social benefits of improved connections between the Illawarra and Western Sydney have been highlighted in several recent studies, including the Greater Sydney Commission in its Draft South West District Plan (2016). The Commission cited the objectives established by Transport for NSW in relation to improving north-south transport connectivity in south western Sydney, including: *“improved public transport and freight connectivity to Port Kembla and the Illawarra”* (p.50). A 2014 report by PwC for the Illawarra Business Chamber found that: *“Accessing jobs and trading opportunities in Sydney already costs Illawarra residents and businesses around half a billion dollars a year. Without action, the time and out of pocket costs are expected to increase to at least \$690 million per annum by 2031”* (p.iii).

The significant population and economic growth forecasts for Western Sydney will be further supported by the decision to build Sydney's second airport at Badgerys Creek. In summary, the arguments to better connect the Illawarra to Sydney via the south west are strong and, in our view, will become even stronger over the next two decades.

Australian public policy in recent years has identified the need to focus on regional development as the nation wrestles with the high costs of addressing major liveability issues in our large cities such as traffic congestion, pollution, the availability of public space and housing affordability pressures. This focus has also been driven by a sharp slowdown in regional growth following the end of the mining boom in 2012.

A sensible lower cost approach to regional development would be to first develop Australia's satellite regions that are immediately proximate to Sydney, Melbourne and Brisbane. Such regions include the Illawarra, Ballarat and the Sunshine Coast. For example, in the 1990s the Pacific Highway between Brisbane and the Gold Coast was significantly upgraded and the Brisbane rail network now extends into the heart of the Gold Coast. As a result, there is practically no difference in the respective unemployment rates, and thousands of commuters travel between the two cities each day for work, study or leisure. Similarly, better transport connectivity between the Illawarra and Sydney (particularly Western Sydney) has the potential to open up jobs, education, housing and leisure opportunities for the over two million residents of the Illawarra and Western Sydney.

## **THE ISSUE**

The main rail line between the Illawarra and Sydney is the South Coast Line. The South Coast Line runs from Bomaderry (near Nowra) to Waterfall at the southern edge of the Sydney Trains Network. The South Coast Line continues through to Central station and terminates at Bondi Junction.

According to the current Sydney Trains timetable, it takes 87 minutes to travel the 82 km line (ie 56 km/h average speed) between Wollongong and Central station in Sydney during the weekday morning peak. To reach Parramatta station at the geographic centre of Sydney, the journey from Wollongong (via Redfern) takes a further 27 minutes at best. On average, the total commute times between Wollongong and stations in south west Sydney, such as Liverpool (125 minutes), Leppington (130 minutes) and Campbelltown (131 minutes), are all over two hours. Many rail commuters find it more convenient to opt for an extreme form of ‘park and ride’, driving the roughly 40 kms along the M1 (Princes Motorway) and parking at Waterfall, Heathcote or Sutherland stations before utilising the Sydney Trains Network.

This lengthy commute for workers, students and day-trippers reduces economic and social opportunities for both Illawarra and Sydney residents in terms of accessing a wider range of jobs, business, trade, education, leisure and housing choices.

The South Coast Line is shared between passenger and freight services, with significant freight movement between Port Kembla and Sydney (up to 23 slots per day). Thermal coal is transported by rail to Port Kembla (for export) from the coalfields in the Sydney Basin and imported container freight is sent from Port Kembla into Sydney. It has been previously estimated that the South Coast line will hit capacity in the mid-to late-2020s (ACIL Tasman, 2011).

## **THE OPTIONS**

SMART was tasked with first examining whether it was possible to improve the efficiency of the South Coast Line and at what cost.

In theory, rail commute times can be reduced by: (i) shortening the distance travelled (via line straightening, reducing steep gradients, and tunnelling), (ii) increasing train speeds safely (which often requires line straightening and/or investment in new signalling technology), or (iii) investing in line duplication to reduce bottlenecks and congestion. Often, a combination of these measures is required to make a significant difference to commuting times.

Reducing passenger commute times on the South Coast Line is severely challenged by the geological conditions of the Illawarra escarpment and the consequent engineering challenges. SMART’s high-level cost benefit analysis indicates that, in order to achieve a reduction in commute times between Wollongong and Central stations, an investment in the order of \$2 billion is required. This high cost is driven by the fact that the South Coast Line is built on the Illawarra escarpment and significant line straightening by way of tunnelling is necessary to improve commute times. Previous work on infrastructure cost drivers by SMART indicates that tunnelling costs would be in the order of \$150 million per kilometre. In other words, up to 13 kms of tunnelling could cost up to \$2 billion.

Given the likely costs and operational impact of investing in, and completing significant improvements to deliver greater efficiency on the South Coast Line, SMART investigated the potential for an additional passenger and freight line between the Illawarra and Sydney, by completing and electrifying the 35 km Maldon-Dombarton line, which was partially built in the

mid-1980s. The rail link would connect the Main South Line (at Maldon) and the Moss Vale-Unanderra dedicated freight line at Dombarton. The 7 km rail link from Dombarton along the Moss Vale-Unanderra Line to the junction with the South Coast Line would require electrification. In sum, the South West Illawarra Rail Link (SWIRL) would comprise:

- the completion and electrification of the proposed 35 km Maldon-Dombarton rail line;
- a dual passenger/freight track (except for the two main bridges and the 4 km tunnel) with electrification; and
- electrification of the 7 km section of the Moss Vale-Unanderra Line.

Our central estimate for the total cost of constructing the SWIRL as specified above is **\$1,689 million** in 2016-17 dollars.

In SMART's view, the SWIRL could meet the transport connectivity objectives set by TfNSW at a lower cost and provide many economic and social benefits for residents of the Illawarra and Western Sydney. For instance, the SWIRL and the South Coast Line operating together would increase total passenger and freight rail network capacity and open up jobs, business, trade, education, leisure and housing opportunities for both regions. A new line would also reduce the cost of congestion, short-term closures (for upgrades) or a consequence of a catastrophic geological failure on the South Coast Line.

Shutting the South Coast Line in the event of a significant rock fall/landslide on the Illawarra escarpment would severely disrupt the region's economy, preventing coal exports and container imports as well as forcing rail commuters onto already congested roads in peak times. The availability of a second passenger and freight line between Sydney and the Illawarra would greatly reduce these costs.

Finally, the 'two-lines' option could reduce the Illawarra's traditionally higher average rate of unemployment by better connecting the region to Australia's largest and deepest labour market. By way of example, the difference between the long-term average rates of unemployment (over the period 1998-2016) between the much better connected Brisbane (5.6%) and Gold Coast (5.9%) regions is 0.3%, whereas the difference between Greater Sydney (4.9%) and the Illawarra (7.1%) is 2.2%.

The following schematic illustrates the main findings of our study.

## The South West Illawarra Rail Link (SWIRL)



Benefit Cost Ratio 1.13  
 (7%, 50 years)



\$1 invested in the SWIRL would provide a return to the Illawarra of \$1.84



Over 1,100 additional permanent jobs in the Illawarra



\$2.6 Billion Gross Regional Product in the Illawarra

SWIRL (New Line)  
 SWIRL (Electrification of Existing Line)

Current Rail Network  
 Badgerys Creek Airport



**With SWIRL**  
 (estimated time)

WOLLONGONG ↔ CAMPBELLTOWN  
 60 minutes

WOLLONGONG ↔ LEPPINGTON  
 91 minutes

WOLLONGONG ↔ LIVERPOOL  
 91 minutes



**Without SWIRL**  
 (via South Coast Line average peak times)

WOLLONGONG ↔ CAMPBELLTOWN  
 131 minutes

WOLLONGONG ↔ LEPPINGTON  
 130 minutes

WOLLONGONG ↔ LIVERPOOL  
 125 minutes



## KEY FINDINGS

There are substantial net economic benefits that could accrue, in particular to the Illawarra and south west Sydney regions, from constructing the \$1.7 billion SWIRL. We have estimated a benefit-cost ratio (BCR) for a passenger-freight SWIRL to be between 1.02 and 1.24, with our central estimate at the standard 7% discount rate over 50 years being **1.13**. At a 4% discount rate over 50 years, which is the standard lower-bound estimate but in our view a more appropriate measure in the post-GFC world, our BCR central estimate is **1.56**.

It is important to note that whilst we recommend a discount rate of 4%, a standard rate of 7% is typically applied by Infrastructure Australia and Infrastructure NSW. This is further outlined in Appendix E.

SMART has also estimated the economic impact on the Illawarra region of constructing the SWIRL. Our detailed economic modelling identifies the benefit to the Illawarra region would be \$2.6 billion (in NPV terms at the standard 7%) and over 1,100 permanent additional jobs (in FTE terms). This indicates the return to the Illawarra would be **\$1.84 for each \$1 invested in the SWIRL**.

There are many potential benefits deriving from constructing the SWIRL, including:

- Improved transport connectivity to the industrial heartland of south west Sydney, including the proposed Sydney second airport at Badgerys Creek. The SWIRL would provide a faster route for rail commuters to stations in western and south west Sydney such as Liverpool, Leppington and Campbelltown.
- Provision of infrastructure to accommodate potential increases in coal and other freight moving between Port Kembla and Sydney, and the Lithgow coalfields and Port Kembla (thus largely bypassing the Sydney Trains Network).
- Augmentation of the capacity of Port Kembla by providing the capacity for more freight by rail.
- Reduced passenger and freight congestion on the South Coast Line by providing an alternative entry point into the Sydney Trains Network.
- Improved transport connectivity between the Illawarra, Sydney's second airport at Badgerys Creek and the Moorebank intermodal terminal.
- Capacity to reduce heavy truck traffic congestion on Mt Ousley and other roads near Port Kembla (by taking some freight off trucks).
- Additional incentive for investment in the Illawarra to counter the impacts of the mining downturn.
- Indirect benefits such as reduced noise and pollution in urban areas in Wollongong and southern Sydney.
- Essential infrastructure to minimise costs of a major upgrade or disruption to the South Coast Line, for instance as a result of landslides or rock falls, by providing an alternative route into Sydney.

Constructing the SWIRL to better connect the Illawarra with Sydney (and in particular south west Sydney) aligns with the Strategic Priorities of Infrastructure Australia and the Australian Government's National Infrastructure Plan.

For instance, Infrastructure Australia seeks to identify projects that:

- Expand Australia's productive capacity (SP1)
- Increase Australia's productivity (SP2)
- Diversify Australia's economic capabilities (SP3)

The addition of the SWIRL to the existing South Coast Line will significantly enhance freight capacity through Port Kembla. Directing thermal coal exports from the coalfields in the Sydney Basin to Port Kembla via the more efficient SWIRL will increase productivity, as found by ACIL Tasman (2011). Further to this, improving passenger and freight rail connectivity between the Illawarra and Western Sydney will diversify Australia's economic capabilities by enhancing jobs, education, business, trade and leisure opportunities.

The Australian Government, in the 2017-18 Budget, documented a clear commitment to regional economic development with the following key initiatives:

- \$5.3 billion in a new Commonwealth-owned company, WSA Co., to develop Western Sydney Airport with works planned to commence in 2018 and generate around 20,000 direct and indirect jobs in Western Sydney by the early 2030s;
- An additional \$8.4 billion equity investment in the Australian Rail Track Corporation to deliver Melbourne to Brisbane Inland Rail;
- A \$10 billion National Rail Program to fund priority regional and urban rail investments, with funding to be provided over 10 years. The Australian Government "stands willing to deliver ready and proven rail projects across the nation that better connect our cities and grow the economy. This initiative provides \$20 million, within the next twelve months for the development of up to three business cases for infrastructure projects that may deliver faster rail connections between major cities and major regional centres" (BP1, p.1-11); and
- More than \$533 million in new funding to infrastructure and community projects to improve the "resilience, connectedness and adaptability of our regions, including a \$472 million Regional Growth Fund", (Australian Government 2017-18 Budget Papers, BP1, p.3-11).

## **KEY RECOMMENDATIONS**

With the above in mind, SMART recommends that:

- The NSW Government make a submission under the National Rail Program to secure funding to develop a detailed business case for the construction of the SWIRL and the upgrade of the South Coast Line.
- Infrastructure Australia and the Australian Government prioritise their consideration of the SWIRL given the significant potential economic benefits on offer and at a lower cost against alternative options to improve rail transport connectivity in the Illawarra.
- In addition to constructing the SWIRL, TfNSW, Infrastructure Australia and the Australian Government consider (and make financial allocation for) further cost-effective incremental infrastructure improvements to the South Coast Line.
- TfNSW fast track the rollout of the ETCS2 onto the Sydney Trains Network, which should improve the efficiency, safety and reliability of the South Coast Line.

## 2. Introduction

Illawarra First has commissioned the SMART Infrastructure Facility to investigate options to improve the speed and reliability of passenger and freight rail transport services between the Illawarra and Sydney (Terms of Reference at Appendix A).

### 2.1 ABOUT THIS STUDY

SMART has undertaken this study in five phases.

In the first phase, we gathered expert opinion by hosting a stakeholder's workshop on 2 February 2017, attended by NSW government and industry representatives. We also undertook follow up meetings with TfNSW and NSW Ports as well as a number of individuals (Appendix C).

In the second phase, we considered options to improve speed and reliability on the South Coast Line. We analysed the current Sydney Trains timetable and used our in-house model RailNet (Appendix B) to try to better optimise passenger and freight rail transport between the Illawarra and Sydney.

In the third phase of the study we undertook a cost benefit appraisal (CBA) of additional investments to improve the efficiency of the South Coast Line.

In phase four, we undertook a high-level CBA of constructing the South West Illawarra Rail Link (SWIRL) as both a passenger and freight line, which incorporates the partly completed Maldon-Dombarton line.

Finally, in phase five, we undertook an economic impact analysis of the SWIRL to understand the impacts of the project on regional growth and jobs. For this analysis we applied a best-practice computable general equilibrium (CGE) model of the Illawarra and Sydney economies in order to understand the impact of the additional capital expenditure as well as an expansion in the rail network and labour supply. The preliminary findings of this analysis were tested with key stakeholders, including experts in freight and logistics operations.

### 2.2 A NOTE ON ECONOMIC EVALUATION METHODOLOGY

Economic performance can be measured in many ways and there is no one measure that captures all of the factors affecting the wellbeing of individuals, households, businesses or communities. One common indicator of economic performance is GDP, which measures the production or income or spending generated in a country (or region) in a given year. Other economic measures include employment growth, the unemployment (or underemployment) rate, the price level, private and public investment, wages growth, agricultural or industrial production and so on. Social measures of performance might include rates of homelessness, suicide, hospital admission rates or waiting times, domestic violence, community and sports participation, educational attainment and so on. Generally, GDP (and particularly GDP per capita) is considered the best approximation for individual and community wellbeing (or 'living standards') because it is positively correlated to most other economic and social indicators.

Cost benefit appraisal (CBA) is considered the foremost economic project evaluation technique, particularly for publicly funded infrastructure projects. Done well, CBA is rigorous, objective, comparable and transparent. CBA attempts to quantify in a comparable framework all of the private and community costs and benefits associated with a project. Annual estimates of benefits and costs are discounted using a commonly accepted social discount rate to a common year. In this

way, the net benefits of projects (in dollar terms) planned across different time periods can be compared. Benefit cost ratios can also be reliably compared.

Measuring economic performance and evaluating infrastructure projects are two different things. The economic performance lens is broad, generally at the national, state or regional level. The project evaluation lens is narrow, generally at the local level.

A weakness of CBA, however, is that the evaluation framework is not well aligned to the breadth of government policy objectives in relation to major infrastructure projects. While governments usually seek to get value of money in their (taxpayer-funded) infrastructure investments, governments also pursue strategic economic and social objectives such as regional economic development, or addressing high regional unemployment rates or other types of social disadvantage.

To the extent that governments have these other policy objectives in mind, regional economic impact analysis and a ‘dashboard approach’ that takes into account non-financial wellbeing factors can be useful tools to inform project selection *ex ante*, or evaluate the benefits of public infrastructure projects *ex post*.

Economic impact analysis (EIA) is a credible and widely used economic evaluation method, particularly for the purposes of identifying a projects’ impacts in terms of additional value-added (GRP, GSP, GDP) and jobs created. Economic impact analysis measures ‘benefits’ in terms of our national accounting framework, which is based on the concept of value added to avoid double-counting economic activity. However, the weakness of this approach is that it does not necessarily tell us whether a project is a good idea or not, it just measures the projects impact. It does not specifically account for the initial investment as a ‘cost’ as part of the evaluation framework and it does not generally compare projects (other than the BAU or ‘do nothing’ case).

That said, EIA closely aligns with government policy objectives, such as economic growth and jobs growth. An emerging trend in project evaluation techniques, particularly in the United Kingdom, is for a broader economic appraisal framework to be applied that includes so-called wider economic impacts. This form of evaluation is, in our view, better suited to the consideration of public infrastructure projects with mixed policy objectives such as in relation to improving transport connectivity between the Illawarra and Sydney.

The Australian Transport Assessment and Planning (ATAP) guidelines to an extent follow the lead set by the WebTAG framework used by the UK Department for Transport. The WebTAG guidance, in addition to a CBA, includes a framework for the consideration of wider economic impacts (WEIs), and also recommends including an economic narrative with all project appraisals.

Recent changes to the WEI Guidance in the UK support the application of a broader economic evaluation lens to projects such as the SWIRL. The main changes to the 2016 WEI Guidance were:

- A requirement for scheme promoters to produce a context-specific economic narrative, explaining how their investment will impact the economy and achieve the stated economic objectives.
- Greater clarity on the relationship between the welfare appraisal (cost-benefit analysis) and economic metrics, such as GVA, GDP and employment.
- A stronger focus on additionality and displacement in the analysis and reporting of economic impacts, to provide more clarity about the extent to which impacts are additional at the national level, or redistributed.

- Greater flexibility to use new modelling and valuation approaches to supplement standard appraisal methods.
- The integration of regeneration impacts into the assessment of wider economic impacts (regeneration impacts have, until now, been separately assessed).
- More clarity about how the analysis of WEIs will be used to inform value for money assessments.

### 2.3 ABOUT THE AUTHORS

The SMART Infrastructure Facility and Cadence Economics have undertaken this study jointly. Cadence Economics provided the CGE capability to estimate the economic impacts of the SWIRL on the Illawarra region.

**Joe Branigan** is a Senior Research Fellow at the SMART Infrastructure Facility UOW where he leads the Infrastructure Economics Research Group. Joe has managed this project and is the lead author of this report.

Joe has extensive expertise in infrastructure economics and finance, cost benefit appraisal and economic impact analysis and is also an Associate with Cadence Economics. Joe is a leading public policy economist with 20 years' experience in the public sector, academia and private sector consulting. He is a former regulator at the Queensland Competition Authority (QCA) and former economic advisor to the American Ambassador to Australia. Early in his career, Joe worked at the Productivity Commission and then Federal Treasury.

**Dr Fariba Ramezani** is an economist with expertise in cost benefit analysis, economic impact analysis and quantitative economic modelling. Fariba has developed economic models of the Illawarra region for a number of large projects undertaken at SMART. In this study, Fariba undertook the high-level cost benefit appraisal of the rail options identified. She also undertook the economic impact analysis of the preferred option in collaboration with Cadence Economics.

**Dr Johan Barthélemy** is a mathematician and computer scientist specialising in agent-based simulation modelling. During his PhD, he developed the foundations of a parallelized micro-simulation platform for population and mobility behaviour and applied it to the Belgian context. Johan ran the RailNet modelling simulations for the South Coast Line.

**Dr Bob Scealy** is a Director of Cadence Economics. He is mathematician and computer scientist by training and one of Australia's leading computable general equilibrium modelers. For this project, Bob (with Fariba) set up the model structure and provided quality assurance on the development of the scenarios.

**Andrew McCusker** is the Director of the Rail Logistics Program at SMART and provided advice on rail connectivity options. Andrew has had a long career in the rail industry, working with Hong Kong MTR Corporation for 24 years and serving five years as Operations Director. He supported the NSW Government in developing a rail strategy for Sydney and NSW and is appointed to a number of committees concerned with the strategy and execution of rail futures in NSW.

Andrew is a Director of MTM, the Melbourne Metro, and chairs a board safety committee for the shareholders (MTR, UGL and John Holland).

## **2.4 REPORT OUTLINE**

The remainder of our report is set out as follows:

- Section 3 describes the characteristics of the South Coast Line in terms of capacity and passenger and freight demand.
- Section 4 describes the main options for improving rail transport connectivity between Sydney and the Illawarra.
- Section 5 presents our high-level cost benefit appraisal of each option.
- Section 6 reports the results of our economic impact analysis of undertaking our preferred option on the Illawarra and Sydney economies.
- Section 7 discusses potential funding options for the SWIRL.
- Section 8 provides our key conclusions and recommendations.

## **2.5 ACKNOWLEDGEMENTS**

The contribution of Chris Lamont, Katherine Baker and Ross Bain from the Illawarra Business Chamber/Illawarra First in the preparation of this report is acknowledged.

The contribution of Pascal Perez, Tania Brown and Tim Davies from SMART in the preparation of this report is also acknowledged.

### 3. Characteristics of Rail Transport in the Illawarra

This section discusses the issues around rail transport in the Illawarra Region:

- Section 3.1 provides an overview of the Illawarra Region;
- Section 3.2 describes the South Coast Line which connects the region to Sydney;
- Section 3.3 describes passenger demand for rail services in the region;
- Section 3.4 describes the demand for freight rail services arising from the operations at Port Kembla; and
- Section 3.5 describes the options for improving services on the Illawarra rail network.

#### 3.1 CHARACTERISTICS OF THE ILLAWARRA REGION

The Illawarra region is geographically defined as the narrow strip of land between the Illawarra escarpment and the Pacific Ocean located between 40-200 km south of Sydney's CBD and comprising the local government areas (LGAs) of Shellharbour, Wollongong, Kiama, Shoalhaven and Wingecarribee. The population of the Illawarra is just over 300,000 (2017 estimate). By train, Nowra in the south of the Illawarra is about 2¾ hours from Sydney and Waterfall in the north of the Illawarra is around 45 minutes from Sydney's CBD.

The region is the third most densely populated in NSW after Sydney and Newcastle. In terms of transport infrastructure, the Illawarra region is supported by two main rail lines (being the South Coast Line and the Moss Vale-Unanderra Line), the Princes Highway, local motorways, and local roads. The main airport used for passenger and freight is Sydney (domestic and international). Port Kembla is a significant Australian seaport serving the Illawarra, Sydney and greater NSW.

Because of its proximate location to Sydney, which is Australia's largest and deepest labour market (comprising close to 4 million jobs), about 20,000 people commute daily between the Illawarra and Sydney to work, study or visit for leisure (2011 Census). Most (about 15,000) travel from the Illawarra to Sydney. We estimate that, in 2017, about 12,000 people travel by car and 3,000 by rail.

The main rail line is the South Coast Line from Bondi Junction through Central Station to Port Kembla or Bomaderry station near Nowra in the Shoalhaven. This line has been recognised by the Australian Government as a key strategic passenger rail corridor (DIRD 2017, p.15). The line is publicly owned through RailCorp, a NSW State Owned Corporation (SOC). In recent years, the efficiency of the South Coast Line has been impacted by increased congestion with passenger and freight trains competing for scarce slots. In addition, because of the physical topography of the Illawarra escarpment, significant improvements to the South Coast Line are likely to come at a very high cost.

PricewaterhouseCoopers (PwC) completed a study of Illawarra transport connectivity for Illawarra Business Chamber in 2014. PwC found:

*“Our assessment of the Illawarra's connectivity reveals strengths and weaknesses. While the region is served by a reasonably comprehensive road and rail network, the low speeds on those networks are a major weakness. The scores for road user speed are consistently low across all external trip origins and destinations. This has a significant negative impact on the economic productivity of the region given that private trips account for a large proportion of the transport task. In particular, the connectivity performance between Sydney and Wollongong is mixed. Road and rail network coverage is strong, with scores of 4 and 5, respectively. Public transport speed*

*and quality are average with scores between 3 and 4. However, road user speed is particularly poor, with a score of 1. The analysis also highlights a particular weakness in the Illawarra's freight connectivity, particularly to Sydney's west and south west.*" (PwC 2014, p.iv, emphasis added).

**Table 3-1: PwC analysis of Illawarra transport connectivity**

Connectivity attribute	External				Internal			Total
	Wollongong ⇄ Sutherland	Wollongong ⇄ Ingleburn	Wollongong ⇄ Sydney CBD	⇄ Shellharbour ⇄ Sydney CBD	Wollongong ⇄ Shellharbour	Wollongong ⇄ Nowra	Wollongong ⇄ Bowral	
Road coverage	4.1	3.0	4.0	3.9	4.0	3.3	3.8	3.7
Rail coverage	5.0		5.0	3.0	3.0	1.0	1.0	3.0
Freight rail coverage		1.0						1.0
<b>Network Coverage</b>	<b>4.6</b>	<b>2.0</b>	<b>4.5</b>	<b>3.5</b>	<b>3.5</b>	<b>2.2</b>	<b>2.4</b>	<b>2.6</b>
Road speed (passenger)	2.0	1.0	1.0	1.0	2.0	3.0	2.0	1.7
Road speed (freight)		2.0						2.0
Public transport speed	3.0		3.0	2.0	3.0	4.0	2.0	2.8
Public transport quality	4.3		4.3	3.0	2.8	2.0	2.5	3.1
<b>Service Quality</b>	<b>3.1</b>	<b>1.5</b>	<b>2.8</b>	<b>2.0</b>	<b>2.6</b>	<b>3.0</b>	<b>2.2</b>	<b>2.2</b>
<b>Weighted Scores</b>	<b>2.9</b>	<b>1.8</b>	<b>2.7</b>	<b>2.1</b>	<b>2.4</b>	<b>2.1</b>	<b>1.8</b>	<b>2.4</b>

Source: PwC analysis and estimates

Figure 3-1 shows the use of the line by both freight and passenger trains at Tempe Station, which is on the South Coast Line in the heart of the Sydney Trains Network. The congestion affects reliability and often causes delays or cancellations. Our modelling has shown that there are very few additional passenger or freight 'slots' available on the South Coast Line without significant (and in our view prohibitive) additional infrastructure investment, including expensive tunnelling.



**Figure 3-1: South Coast Line is shared by both passenger and freight trains**



Source: NSW Freight and Ports Strategy (2013).

### **3.2 DESCRIPTION OF SOUTH COAST LINE**

Taken as a whole (from Bomaderry to Bondi Junction – approximately 160 kms), the South Coast Line currently includes 49 stops. South of Wollongong, the track is predominately single line and diesel trains are used between Kiama and Bomaderry for both passenger and freight services. The line is dual track north of Wollongong apart from the Clifton Tunnel (1km) between Scarborough and Coalcliff. The stations covered by the South Coast Line include 18 stops between Bomaderry and Wollongong (including the spur line to Port Kembla), 17 stops between Wollongong and Waterfall, 9 stops between Waterfall and Central and 5 stops between Central to Bondi Junction.

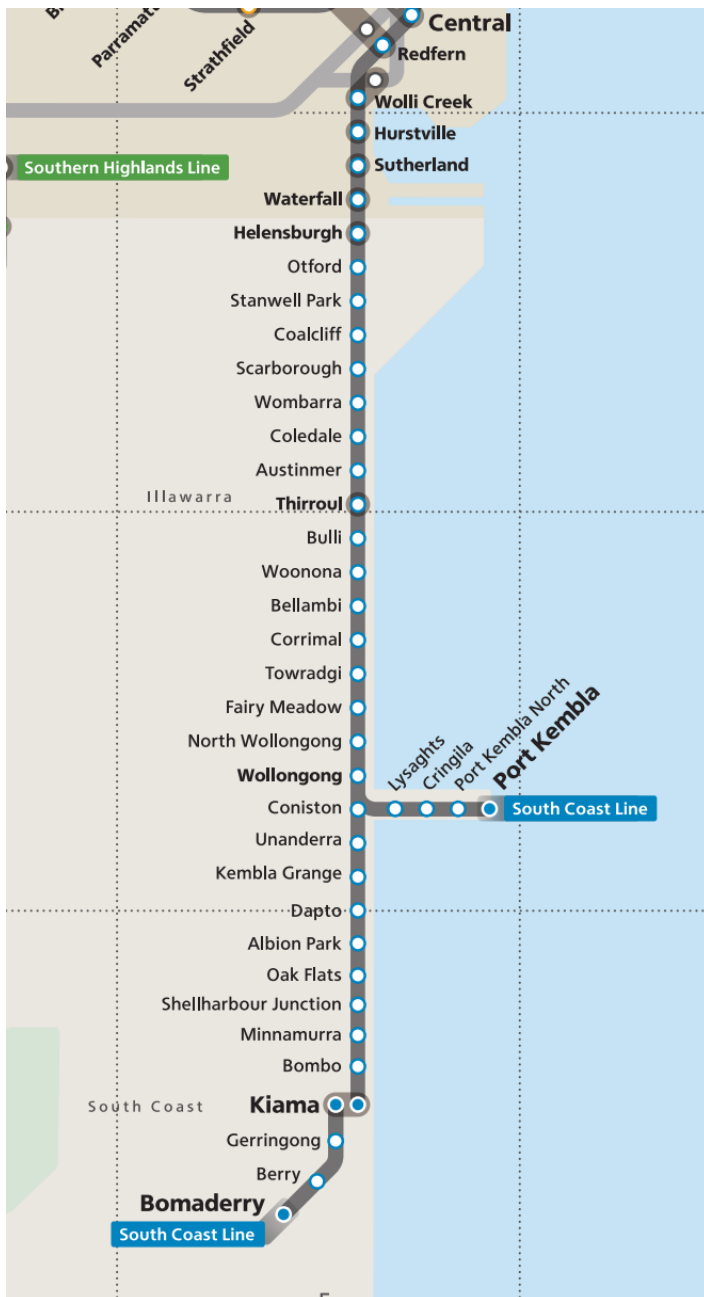
#### **3.2.1 Getting from the Illawarra to different parts of Sydney**

The average peak commute times from Wollongong station to key stations in the Sydney Trains Network are as follows:

- Wollongong-Central – 87 minutes
- Wollongong-Parramatta – 118 minutes
- Wollongong-Liverpool – 125 minutes
- Wollongong-Leppington – 130 minutes
- Wollongong-Campbelltown – 131 minutes

Figure 3-2 shows the stops on the South Coast Line between Central and Bomaderry stations.

**Figure 3-2: South Coast Line Network**



Source: [www.sydneytrains.info](http://www.sydneytrains.info).

### **3.3 PASSENGER SUPPLY AND DEMAND ON THE SOUTH COAST LINE**

During weekdays, there are 28 passenger services travelling from the Illawarra to Sydney (with 27 services from Sydney to the Illawarra). The service covers roughly a 20-hour period from 2.30am to 12.30am. Most of these services are ‘limited stop’ (8 stops at: North Wollongong, Thirroul, Helensburgh, Sutherland, Hurstville, Wollli Creek, Redfern and Central). At best, the commute time between Wollongong station and Central station is 87 minutes, but the journey can take up to 104 minutes.

In addition to passenger trains, the South Coast Line services freight trains connecting Port Kembla to Sydney and regional NSW. Currently, there are 116 freight paths on the South Coast line per week (weekdays), which means that there are about 23 freight paths per day on average. Most of these paths are overnight, which do not impede existing passenger services.

The South Coast Line passes through the Illawarra escarpment, which consists of moderate to steep slopes with many intermediate benches and cliff lines. Several landslides and large rock falls have occurred in different locations throughout the escarpment and this obviously increases the risk of line closure. In fact, the Grand Pacific Drive and Sea Cliff Bridge were constructed in 2005 to avoid the costs of dangerous rock falls that regularly closed Lawrence Hargrave Drive.

Considering that, on average, 78 trips per day are made via the South Coast Line (consisting of 28 passenger trains from Wollongong to Central, 27 passenger trains from Central to Wollongong and 23 freight trains), any closure of the line would have a significant impact on the regional economy, commuters and freight movements.

SMART has estimated the cost of a 1 in 100 year failure of the South Coast Line. We have assumed the cost of repairing the line to be \$1.5 billion. Hence, the expected value of the capital cost in any single year is \$15 million. The NPV (at 7%) over 50 years is \$207 million. It is highly uncertain how long the South Coast Line would be closed but our central estimate is 3 months. To be conservative in our modelling, we have not included an estimate of lost freight productivity and the welfare losses resulting from the disruption to passenger services.

### **3.3.1 Passenger demand projections**

In terms of assessing the potential future demand profile of the South Coast Line, we analysed a number of data sources, including:

- 2011 Census data on travel to work (being the most recent data available); and
- TfNSW Open Data Hub (includes Opal Card data).

The 2011 Census data indicated that 1,978 people travelled from Wollongong to Sydney by train each day to work. Around three-quarters of these commuters detrain in Sydney's CBD, inner-south or Sutherland. The remaining one-quarter of these commuters travel further into Sydney's north and west.

Only a very small number (114 commuters) travelled by train from Sydney to Wollongong for work. Most of these commuters (56%) are travelling from Sydney's western and south western suburbs, with about 30% travelling from Sydney's inner-south and the Sutherland Shire.

The population of the Illawarra increased from 272,703 in 2005 to 303,590 in 2016, 1.1% per year. This period corresponded to Australia's mining boom when Australia had the highest rate of population growth in the OECD. Looking ahead, it would be reasonable to assume that, based on 'sea change' migratory patterns and historic growth rates, the future population growth in the Illawarra would be in the order of 1.1% per year. However, according to the NSW Department of Planning & Environment (2016), the population of the Illawarra is projected to grow by just 0.89 per cent per annum between 2016 and 2021, moderating to 0.81 per annum to 2026.

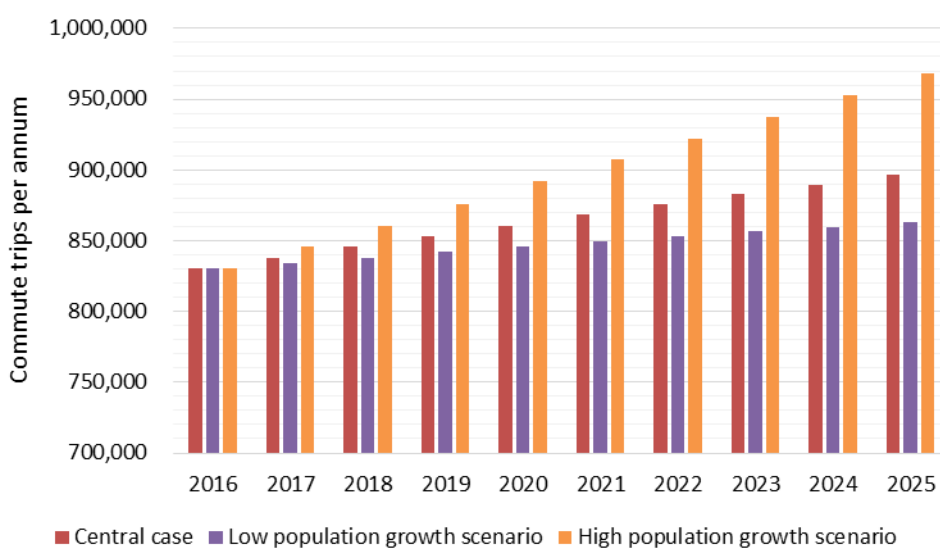
Assuming 200 return trip commutes per person per annum, and applying the above annual population growth forecasts, the annual number of commute trips made by South Coast Line will increase from almost 840,000 in 2017 to between 902,000 (at 0.89%) and 917,000 (at 1.1%) in 2025, depending on which population growth rate is applied.

The population-based projections of passenger rail demand assume, among other things, there is a direct relationship between forecast population growth and the demand for rail services, there are no feedback effects (for instance, better train services may encourage more people to commute by train), and existing work and commuting patterns continue to hold. To illustrate the range of possible outcomes, we have therefore applied two sensitivities:

- the first sensitivity assumes the demand for rail services grows at a lower rate, corresponding to half the population growth rate projected by the NSW Department of Planning & Environment; and
- the second sensitivity takes account of the potential for high demand growth that the Opal data appears to suggest, and assumes the demand for rail services grows rapidly, corresponding to twice the population growth rate projected by the NSW Department of Planning & Environment.

The results indicate if the population growth rate in the Illawarra is only half of what was projected, the annual number of commutes would increase to around 863,000 by 2025. Population growth based on recent experience (of 1.1% growth per year) would increase the annual number of commutes to almost 970,000. Figure 3-3 displays the results of the sensitivity analysis.

**Figure 3-3: Sensitivity Analysis: Forecast demand for the South Coast Line, by population growth assumption**



Source: SMART forecast based on NSW Department of Planning & Environment (2016) and Opal Card data.

### 3.3.2 Passenger travelling patterns

The above analysis (based on the data from TfNSW Open Data Hub) illustrates projected demand for passenger travel on the entire South Coast Line. To obtain a more detailed view of the demand for different segments of the line, especially Wollongong-Central, we used Opal card data provided by TfNSW for Monday, 28 March 2016, which was a typical weekday, not during a school holiday period and with normal weather.

The data revealed that 25,741 people travelled between Bomaderry and Central. We can categorise the demand of the line based on stations into three routes as follows:

- Bomaderry-Coniston: The Opal card data shows that 1,815 people board the train at stations between Bomaderry and Coniston (inclusive). We found that 26% of these people detrain within this segment, 45% travel further north and detrain between Wollongong and Waterfall, and 29% travel into the Sydney Trains Network, between Heathcote and Central Stations.
- Wollongong-Waterfall: We found that 3,374 commuters start their journey from a station between Wollongong and Waterfall (inclusive). Of these commuters, 40% detrain within this segment, while 47% commute through to the Sydney Trains Network and 13% travel south detraining between Coniston and Bomaderry stations.
- Heathcote-Central: 20,552 of people travel from a station between Heathcote and Central from which 88% travelled to another station in the Sydney network, and only 9% and 3% respectively travelled south to Wollongong-Helensburgh and Bomaderry-Coniston respectively.

We then excluded the number of commuters between Heathcote and Central (which is a part of Sydney Trains Network) in order to find the demand for the Illawarra segment. This elimination decreases the demand of the segment to 7,591 trips per day from which 4,685 trips (equivalent to 62 per cent) commute to/from Wollongong and Central. Applying the central population growth projections referred to above and without any significant improvements to the current rail transport network, demand between Wollongong and Central is projected to increase from 4,685 trips per day in 2016 to 5,099 trips per day by 2025.

Table 3-2 below summarises our demand forecasts for different line segments.

**Table 3-2: The Current and Future Demand of Passenger Train on the South Coast Line**

SEGMENT	DEMAND (TRIPS PER DAY)		
	2016	2021	2025
Bomaderry-Central	25,741	26,912	28,018
Southern Stations (Coniston-Bomaderry)	2,906	3,038	3,163
Wollongong-Central	22,835	23,874	24,855
Demand between Bomaderry and Central (Excluding Heathcote-Central)	7,591	7,936	8,263
Demand between Wollongong and Central (Excluding Heathcote-Central)	4,685	4,898	5,099

Source: SMART forecasts based on Census (2011) and Opal Card data.

### **3.4 FREIGHT DEMAND ON THE SOUTH COAST LINE**

Port Kembla is the most significant bulk goods port in southern NSW. It accommodates NSW's largest grain handling facility and is the second largest coal export port in NSW. Port Kembla's main dry bulk trades are grain, coal, coke, cement clinker, and steel making raw materials, but also include other dry bulk products include fertiliser, copper concentrate, soda ash and gypsum. Dry bulk trade at Port Kembla is forecast to grow from 20.3 million tonnes in 2015 to 30 million tonnes per year by 2045.

The Australian Infrastructure Audit 2015 identified that Port Kembla would face capacity constraints in the absence of any rail network improvements (Infrastructure Australia 2017).

There are two freight lines in the Illawarra that connect Port Kembla to several markets in Sydney and in regional NSW: the South Coast Line and the Moss Vale-Unanderra Line, managed by the NSW Government and ARTC respectively. Figure 3-4 shows the freight paths, rail and road, to or from Port Kembla. Currently, 60-65% of freight moving to and from Port Kembla is transported by rail on either the South Coast Line or the Moss Vale-Unanderra Line. As noted above, operations on both lines are impacted by passenger rail services in the region, resulting in disruptions to freight scheduling as passenger trains are given priority. Growing train patronage on the Sydney rail network will reduce the number of 'train paths' available for freight rail. The capacity of the network is also limited by geographical constraints in and out of the Illawarra which restrict train lengths, operating speeds and, in some cases, the type of cargo that can be transported by rail (Infrastructure Australia 2017).

**Figure 3-4: Port Kembla Rail Network**



Source: NSW Ports (2015).

The main type of freight moving to or from Port Kembla via South Coast Line is coal, but other types of bulk freight include grain, copper concentrates, limestone, kaolin and cement, plus import and export containers. The movement of freight to or from Port Kembla by rail has a direct impact not only on the Illawarra, but also on the Sydney rail network given the volumes of grain and coal that transit through Sydney from western NSW. Likewise, the domestic steel produced by BlueScope is mostly transported interstate and intrastate starting the journey on the South Coast Line.

Based on the latest available data, the freight volume on the South Coast Line was 9,566 kilotonnes in 2011 and is estimated will double over the next 20 years (NSW Freight and Ports Strategy, 2013). However, it is expected there will be no spare capacity on the line from 2030 (based on ACIL Tasman's demand forecast). In order to derive a detailed demand analysis, and since coal is the main type of freight, we have categorised all freight on the line to two groups of coal, and other

container freight, and overview the contribution of each of these two groups to total freight demand. Table 3-3 displays the estimation of the current and future demand of all types of freight and coal on the South Coast Line.

**Table 3-3: Estimated and Forecast of Freight Volumes (kilotonnes) on the South Coast Line**

<b>FREIGHT DEMAND</b>	<b>2011</b>	<b>2031</b>	<b>2011-31 CHANGE</b>
Total Demand of the South Coast Line	9,566	19,602	104.91%
Coal	14.3	31.33	119.09%

Source: NSW Freight and Ports Strategy, 2013.

As freight shares the South Coast Line with passenger trains, freight traffic is not allowed to use the line during the peak commuting hours. Also, the rail line is basically set up for passenger trains, which makes it difficult to secure longer train paths for freight trains. In addition to these limitations, the expected growth in the passenger demand and the introduction of the southern Sydney rapid trains project will provide further boundaries for freight, especially more difficulties for freight train paths availability. Meeting the future demand of freight will require efficient solutions to manage these limitations. Currently, there are two potential solutions, these include: upgrading the Moss Vale-Unanderra Line; and constructing the SWIRL. Before providing the details of these two solutions, we briefly review the key characteristics of the freight demand on the South Coast Line.

### **3.4.1 Coal**

About half of the freight volume on the South Coast Line is coal that mainly comes from mines near Lithgow and the Port Kembla hinterland. Some of the Lithgow coal is used for power stations and the rest moves to Port Kembla on the Sydney freight network and the South Coast Line. About half of the hinterland coal is exported through Port Kembla while the other half is sold to the steel, coke, cement and other industries.

The relevant mines include Tahmoor and Appin/West Cliff (Bulli Seam), both near Maldon. Glencore had initially slated Tahmoor for closure in 2018, however given recent increases in coking coal prices, Tahmoor remains open and Glencore has announced that it is for sale. The current nominal coal capacity of Port Kembla is around 17-18 million tonne per annum (Mtpa) while 14.3 Mtpa of it is used. The Port Kembla Coal Terminal is upgrading its capacity to 25.5 Mtpa.

Congestion on the Illawarra and Sydney Trains Network (including the South Coast Line) and the limitation of train paths on the Sydney Trains Network available to coal services is an ongoing concern to this industry in NSW. For example, there is only one path for coal freight trains to travel from the Western and Southern Coalfields to Port Kembla and that is the Sydney Trains Network. The limitation of coal freight could be addressed by moving coal freight to the SWIRL.

### **3.4.2 Bulk goods and general cargo**

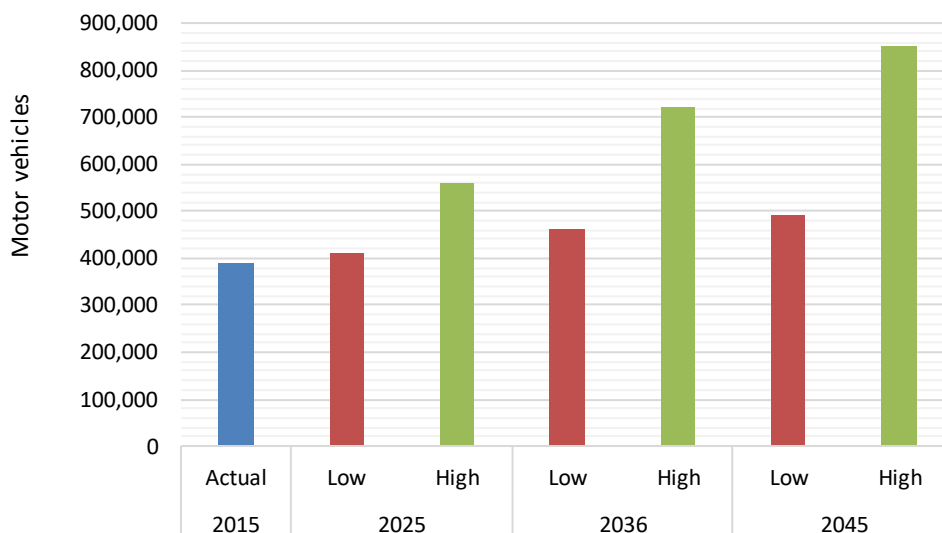
There are many other products transported to or from Port Kembla. Port Kembla is the main port for motor vehicle imports in NSW (and Australia), the leading port for steel and is a main export port for minerals and grain.

Currently, approximately 400,000 vehicles are imported through Port Kembla. Volumes of vehicle imports are forecast to grow to between 540,000 and 850,000 vehicles per year by 2045. These vehicles are transported by trucks to avoid the costs of double handling (to get cars to car yards in



Sydney). The end of car manufacturing in Australia in 2017 is expected to drive an increase in car imports through Port Kembla.

**Figure 3-5: Port Kembla - Motor vehicle forecast (financial years)**



Source: NSW Ports 2015.

Grain exported via Port Kembla comes from regional NSW. Currently, the grain export through Port Kembla is at around 1.0-1.5 Mtpa in a typical year, and is forecast to at least remain equivalent with the long-term historic yearly average of 1.3 million tonnes. Grain is mostly transferred to Port Kembla through the Moss Vale-Unanderra Line. Due to the port facilities and the convenience of the Moss Vale-Unanderra line, the grain industry considers Port Kembla an efficient grain exporting port. In drought conditions, the export of grain is insignificant while in good years up to 70% of the crop is exported, which is difficult for the existing rail line to handle, especially in peak months. The regular domestic grain service is approximately 0.5 Mtpa of grain from Manildra, Narrandera and Gunnedah to Manildra's starch plant at Bomaderry, which are moved by six services per week on the South Coast Line (ACIL Tasman, 2011).

### 3.4.3 Port Kembla infrastructure and rail

Responsibility for maintenance and upgrading of infrastructure at Port Kembla is shared between NSW Ports and the operators of the facilities. Port Kembla has the right to develop a container and multi-purpose facility at Port Kembla's Outer Harbour, which may include new wharves, berths and terminal facilities for NSW's second container terminal. Stage 1A of the development, which provides seven hectares of additional port land on which a cement grinding and storage facility was constructed and is largely completed, while the design of the new wharf structure which will adjoin this reclaimed land to the east is also being progressed.

A container terminal facility capable of handling at least three million standard shipping containers (TEUs) with both road and rail access are essential for a viable facility. Rail solutions to accommodate further freight rail demands include upgrades to the Moss Vale-Unanderra Line and constructing the Maldon-Dombarton freight line (NSW Ports 2015).

### **3.5 ILLAWARRA RAIL OPTIONS**

As noted above, very few additional passenger or freight ‘slots’ are available on the South Coast Line without significant additional infrastructure investment. Two alternative rail options have been identified – the Moss Vale-Unanderra Line and the SWIRL.

#### **3.5.1 Moss Vale-Unanderra Line**

The Moss Vale-Unanderra Line connects Port Kembla to the Sydney Trains Network via Moss Vale (which is on the Main South Line) and Unanderra (near Port Kembla). The line is used for bulk freight such as grain, limestone from southern New South Wales and coal from Tahmoor. Connecting Port Kembla to Sydney, the Moss Vale-Unanderra Line is an alternative to the South Coast Line for freight. Assuming no network delays and a clear path, the Moss Vale route takes 75 minutes longer than the South Coast Line due to a longer distance to Sydney (the route is approximately 100 kilometres longer) and the steeper downhill gradient in the loaded direction which requires a slow descent.

While the Moss Vale-Unanderra Line currently has spare capacity and can accommodate additional freight movements, the steep gradient of the line deters further upgrades to expand capacity.

#### **3.5.2 SWIRL**

In 2010, the Australian Government commissioned a feasibility study of a potential rail link between Maldon (south west of Sydney, on the Main South Line) and Dombarton (near Port Kembla, on the Moss Vale-Unanderra Line). It was envisaged that the line would provide a more direct rail link between the port and south west Sydney and the coal mines in the Lithgow area.

Originally, this rail line was considered during the construction of the Port Kembla coal loader in 1979. In October 1982, the project received concept approval from the NSW Government and construction was commenced during the mid-1980s. The project was cancelled in 1988.

As the activity and operations of Port Kembla have increased, it is clear that SWIRL could unlock further potential of the port of Port Kembla and maximise rail transport of bulk products. The construction of the line would free up capacity for commuter needs on the South Coast Line, while providing a more direct rail connection to the Sydney metropolitan freight network. The SWIRL is therefore essential for the efficient movement of containers between Port Kembla and the growth areas of Western Sydney.

### **3.6 SUMMING UP**

Passenger rail services between the Illawarra and the metropolitan hub of Sydney currently rely solely on the South Coast Line. Commuting times between the Illawarra and Sydney are slow, constrained by the steep and winding journey through the Illawarra escarpment and the congestion on the Sydney Trains Network. In recent years, the efficiency of the South Coast Line has also been impacted by increased congestion with passenger and freight trains competing for scarce slots. Given current freight projections out of Port Kembla, the demand for freight services is expected to double over the next 20 years (ACIL Tasman, 2011). At the same time, the expected growth in passenger demand is expected to limit the scope for expanding freight services.

Very few additional passenger or freight ‘slots’ are available on the South Coast Line without significant additional and very costly infrastructure investment. The most promising alternative rail option identified is the proposed SWIRL, discussed further in the following sections.

## 4. Options to Improve Rail Connectivity

Section 3 described the rail transport links in the Illawarra and identified important demographic, geographical, geotechnical and demand characteristics of the South Coast Line. We found the adequacy of the line deteriorates quickly when modest growth in passenger and freight demand is projected.

In this section, we consider several options to improve the performance of the South Coast Line and, more generally, improve rail connectivity between the Illawarra and Sydney:

- Sections 4.1 through to 4.3 review various options to improve services on the South Coast Line; and
- Section 4.4 considers the option of commissioning a new rail line to avoid the Illawarra escarpment and connect the Illawarra to Western Sydney, the fastest growing economy in Australia.

The options outlined below have been informed by several discussions with key stakeholders. We have undertaken extensive consultations and used detailed modelling, RailNet model (Appendix C) as well as financial and economic modelling (Appendix D) to develop proposed options and recommendations.

### **4.1 OPTION 1 – INCREASE THE FREQUENCY OF PASSENGER TRAINS**

The first option we considered was adding passenger train slots into the current Sydney Trains timetable, without making any other changes. In other words, we tested whether the South Coast Line is operating at full capacity under current conditions.

Based on the latest available passenger and freight timetables, we found the number of additional slots that can reasonably be accommodated would be minimal, likely six additional slots between Wollongong and Central stations in the morning and two additional slots between Central and Wollongong stations in the afternoon. Outside of peak hours, additional passenger slots were generally scarce, other than in the early hours of the morning when passenger demand would be close to zero.

The potential benefit to commuters from the (modelled) additional passenger trains at peak times would be marginal. These additional trains, like the current trains, would still take 87-104 minutes to travel between Wollongong and Central stations. Therefore, the only benefit to passengers would relate to a marginal increase in train frequency, which would provide a reduced waiting time and slightly greater passenger convenience.

We also considered increasing the frequency of passenger trains by introducing a high frequency shuttle service operating between Bomaderry and Wollongong and Wollongong and Waterfall, stopping at all stations.

Under this configuration, we found six additional slots for shuttle services between Bomaderry and Wollongong stations. Of these, two additional services are in the morning peak (6am to 9am). We found eight additional slots for shuttle services between Wollongong and Bomaderry stations. Of these, three additional services are in the afternoon peak (4pm to 7pm).

We found 24 additional slots for shuttle services between Wollongong and Waterfall stations. Of these new services, seven additional services are in the morning peak. We also found 25

additional slots for shuttle services between Waterfall and Wollongong stations. Of these new services, nine additional services are in the afternoon peak.

We also considered more 8-carriage train services to increase capacity on the South Coast Line.

Although these options would not reduce the travel time between the Illawarra and Sydney, it would provide a benefit of increased reliability and convenience for rail commuters. This, in turn, could provide a longer-run benefit as the increased frequency of services could lead to an increase in demand, which would justify more infrastructure investment on the South Coast Line.

#### **4.2 OPTION 2 – INCREASE THE SPEED OF PASSENGER TRAINS**

Our terms of reference focussed on improving the passenger commute time between the Illawarra and Sydney, which is currently, at best, 87 minutes between Wollongong and Central stations. Our objective was to evaluate under what conditions it may be possible to travel the 82 kilometres (by track) between Wollongong and Central stations in 60 minutes.

To support faster trains, we considered the following indicative infrastructure works:

- additional duplication (beyond the current works) around Helensburgh to allow for an express service between Wollongong and Central Stations;
- line straightening (requiring tunnelling) between Scarborough and Stanwell Park; and
- line straightening (requiring tunnelling) between Helensburgh and Waterfall.

With these significant infrastructure upgrades, we found it may be possible to shorten the passenger commute time by, at most, some 15-20 minutes each way. One factor to note is, without bypassing the Illawarra escarpment the steepness of the gradient remains an unavoidable constraint to increasing speeds. Another limiting factor is almost half of the journey between the Illawarra and Sydney is on the congested Sydney Trains Network. It would, therefore, require significant timetable or infrastructure modifications to the South Coast Line (between Waterfall and Central stations) to clear the line to allow for an express service to run on the line.

In summary, we found, short of completely rebuilding the South Coast Line and severely interrupting the timetable on the Sydney Trains Network (to free up the South Coast Line), it is not possible to achieve the 60-minute passenger commute goal.

#### **4.3 OPTION 3 – INTRODUCE MORE ADVANCED SIGNALLING TECHNOLOGY**

Given the constraints around increasing the frequency and speed of passenger trains, we considered whether introducing more advanced signalling technology would enable trains to safely run closer together or faster. This would, in theory, allow for faster commute times through the Sydney Trains Network but would be of less value on the South Coast Line.

We examined the potential impacts of introducing the European Train Control System (ETCS) onto the South Coast Line (that is, from Bomaderry to Bondi Junction stations). Obviously, the introduction of the ETCS onto the South Coast Line would be in conjunction with a more general rollout of the technology across the Sydney Trains Network. We understand TfNSW is considering such a rollout although, as at the 2017-18 State Budget, no funding decision has been made.

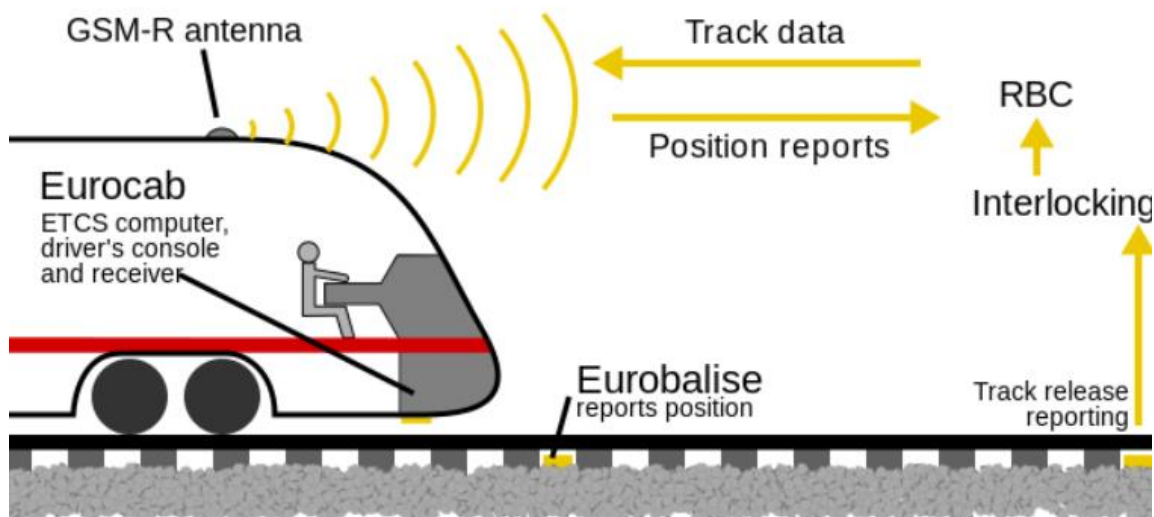
ETCS is a “signalling, control and train protection system” that designed to improve safety and reliability on Europe’s railways. There are four different levels of ETCS, namely: Levels 0, 1, 2 and 3 whereby each level is more technologically sophisticated.

Level 0 relates to situations in which an ETCS-fitted vehicle is used on a non-ETCS route. In this case, the train equipment monitors the speed of the train while the train driver checks the trackside signals. Level 1 is a cab signalling system in which the cab system continuously displays the permitted speed and the line profile ahead to the driver. The trackside signals are also collected by a system called ‘Eurobalise’, which reports the position of the train to rail track coordinators.

The ETCS Level 2 (ETCS2) is a digital radio-based system where most of the signalling system is displayed in the drivers cabin. A central coordinator monitors train movements in real time and provides ‘movement authority’ based on information about the location of other trains in the network, speed and route data. The Eurobalises act as passive positioning beacons or ‘electronic milestones’. Between two positioning beacons, the train determines its position via sensors (axle transducers, accelerometer and radar). The positioning beacons are used in this case as reference points for correcting distance measurement errors.

A schematic of ETCS Level 2 is displayed in Figure 4-1 below.

**Figure 4-1: Schematic of ETCS Level 2**



Source: [http://www.wikiwand.com/en/European\\_Train\\_Control\\_System#/Level\\_0](http://www.wikiwand.com/en/European_Train_Control_System#/Level_0)

With ETCS Level 3, fixed signalling is no longer required as train spacing is determined by the on-board signalling system. The train route is no longer cleared in fixed track sections but rather by ensuring headway between trains (in terms of time, not distance). Level 3 is currently undergoing testing and further development.

The Queensland Government has approved the introduction of ETCS Level 2 on the Brisbane rail network (for \$600 million), which it expects will reduce the spacing between trains from an average of 3 minutes to 2½ minutes. Specifically, the ETCS2 will be rolled out on the central part of the Brisbane rail network (between Milton and Northgate stations and covering all the stations in Brisbane’s CBD – Roma Street, Central and Fortitude Valley stations). The CBA undertaken by Building Queensland (the equivalent body to INSW) found a strong benefit-cost ratio (BCR) of 2.9.

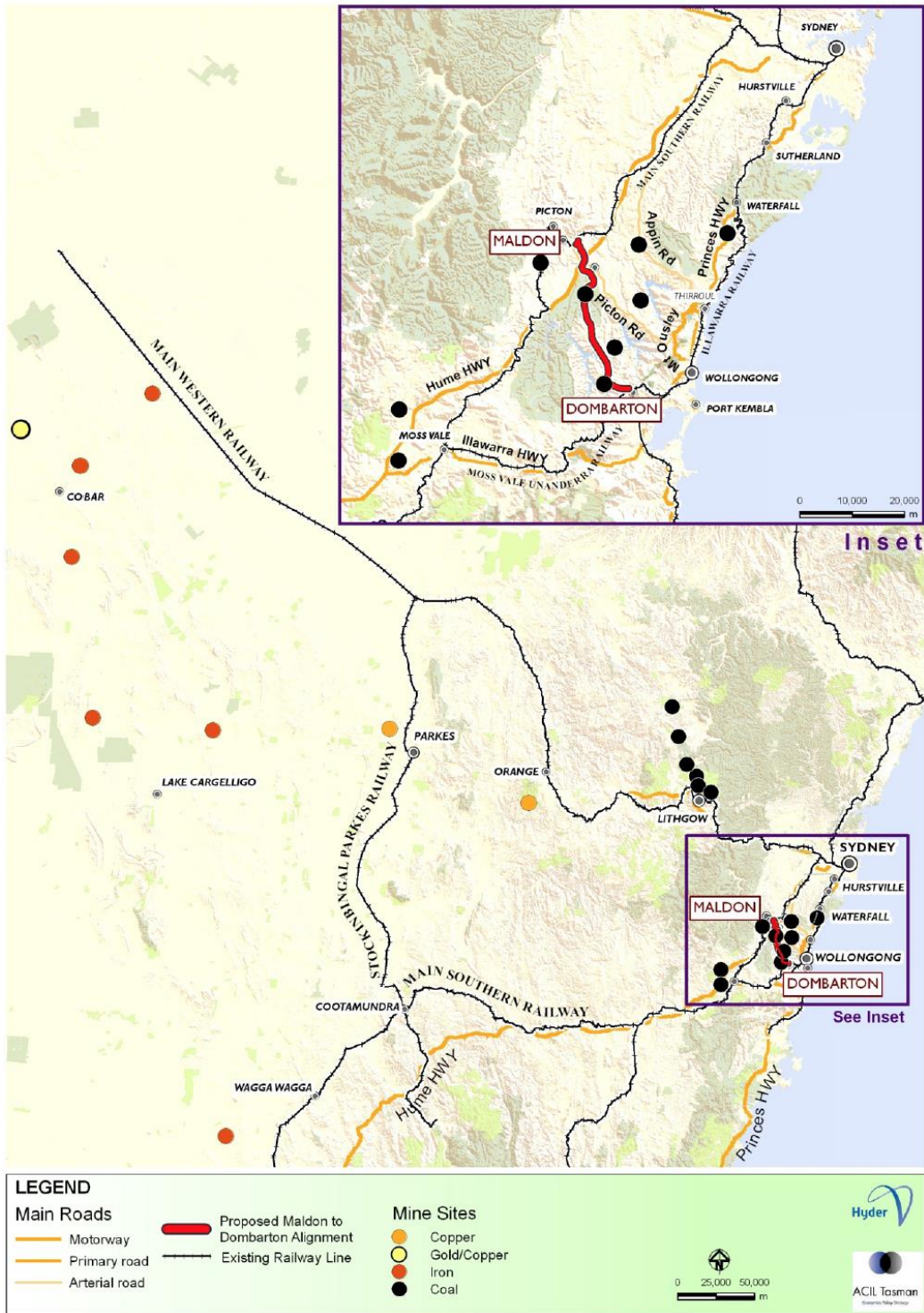
#### **4.4 OPTION 4 – BUILD A NEW LINE TO BYPASS THE ILLAWARRA ESCARPMENT**

Given the binding constraints on the South Coast Line, we considered building an additional line to expand passenger and freight capacity, improve performance and reduce the potential costs of the South Coast Line failing (either by way of geotechnical failure or reaching peak capacity).

We reviewed expanding capacity on the Moss Vale-Unanderra Line but rejected that option based on limited potential expansion of freight capacity and the steep gradient of the line preventing certain types of heavy freight utilising the line.

We also considered construction of the SWIRL, which is already partially built (Figure 4-2). The SWIRL is a more direct route into the industrial heartland of south west Sydney, including the proposed Sydney second airport at Badgerys Creek. The SWIRL would provide a faster route for rail commuters to stations in western and south west Sydney, such as Liverpool, Leppington and Campbelltown.

**Figure 4-2: SWIRL connection between Maldon and Dombarton**



Source: ACIL Tasman Feasibility Study (2011).

There have been numerous studies looking at the potential benefits of the Maldon-Dombarton rail line. The following are reasons generally given for why completion of the line would be desirable:

- to accommodate potential increases in coal and other freight moving between Port Kembla and Sydney, and the Lithgow coal fields and Port Kembla (thus largely bypassing the Sydney Trains Network);
- to augment the capacity of Port Botany by bringing more freight through Port Kembla;
- to address increasing passenger and freight congestion on the South Coast Line by providing an alternative entry point into the Sydney Trains Network;
- to enable upgrading of the South Coast Line to occur without relying on alternative transport options;
- to connect the Illawarra with opportunities and services related to Sydney's second airport at Badgers Creek and the Moorebank intermodal terminal;
- to reduce heavy truck traffic congestion on Mt Ousley and other roads near Port Kembla (by taking some freight off trucks);
- to encourage investment in the Illawarra to counter the impacts of the mining downturn and loss of the steelmaking industry; and
- indirect benefits such as reduced noise and pollution in urban areas in Wollongong and southern Sydney.

#### **4.5 SUMMING UP**

We considered a number of alternative passenger and freight rail options to improve the connectivity for passenger and freight transport in the Illawarra region and metropolitan Sydney and beyond, respectively:

- Option 1 – increasing the frequency of passenger trains on the South Coast Line – would offer only minimal improvements since the number of additional slots that can reasonably be accommodated would be small;
- Option 2 – increasing the speed of passenger trains on the South Coast Line –requires a significant infrastructure investment to yield time savings of around 30-40 minutes for a return trip between Wollongong and Sydney Central stations;
- Option 3 – introducing more advanced signalling technology on the South Coast Line – would offer improvements in safety, but only limited time savings; and
- Option 4 – building a new line to bypass the Illawarra escarpment – is unlikely to be feasible for the Moss Vale-Unanderra Line, but is assessed as feasible for the SWIRL.



## 5. Cost Benefit Appraisal

In the previous section, we identified four options to improve rail transport connectivity between the Illawarra and Sydney. The first three options related to improving the performance of the South Coast Line, while the fourth option considered constructing the SWIRL.

In this section, we undertake two high-level cost benefit appraisals in relation to upgrading the South Coast Line and constructing the SWIRL as both a passenger and freight service.

### 5.1 OPTIONS CONSIDERED

The South Coast Line upgrade (covering options 1-3 considered in the previous section) are summarised below:

- track straightening requiring tunnelling, estimated in this study to be up to 13 kms at various points between Scarborough and Waterfall stations;
- introduction of the ETCS2 on the Sydney Trains Network, including the South Coast Line (here we estimate the incremental cost of the ETCS2 on the South Coast Line);
- timetable changes to allow for an express service to run between Wollongong and Central stations; and
- track duplication improvements, although north of Wollongong station the South Coast Line is dual track apart from the Clifton Tunnel (1km).

The expected benefits of the South Coast Line upgrade are as follows:

- to reduce the passenger commute time by up to 20 minutes each way between Wollongong and Central stations;
- reduce freight commute times by up to 15 minutes each way between Wollongong and Central stations;
- improve road transport times as a result of fewer cars and trucks using the roads; and
- reduce car-related pollution, accidents and congestion.

The SWIRL option (covering Option 4 in the previous section), involves completing the Maldon-Dombarton rail line and making the line a predominantly dual passenger/freight track with electrification. The SWIRL would provide a direct passenger and freight connection between Wollongong and south west Sydney.

The expected benefits of constructing the SWIRL are as follows:

- improved freight productivity;
- reduced passenger commute times between Wollongong and some of the main south west Sydney stations (estimated to be between 35-70 minutes);
- reduced road congestion between Wollongong and Sydney;
- expand the labour supply and demand in both regions; and
- increased jobs and employment opportunities, improved access to education business, trade, housing and tourism choices for both Sydney and the Illawarra.

## 5.2 METHODOLOGY

A standard method for evaluating large public infrastructure projects is by undertaking a cost benefit appraisal (CBA). A CBA involves the estimation of the economic costs and benefits of a particular project. Economic costs and benefits are different from financial costs and benefits in the sense that economic measurements are broader and try to capture all of the costs and benefits of a project that would accrue to society as a whole, including the financial aspects.

In terms of costs, while the financial costs of a project can be simply identified as the contract prices for construction and ongoing operation, economic costs are defined as the true 'resource cost' of the project and does not include the contractors' margin for profit and risk, which is simply a transfer of economic surplus from the consumer (or taxpayer) to the contractor. Further, costs not directly compensated such as noise and air pollution (during construction) or loss of environmental amenity, are also included as economic costs.

In terms of benefits, financial benefits can be summarised as the future revenue stream from the project such as passenger and freight charges. Economic benefits are broader and include benefits to society, such as reduced commuting times, reduced transport costs, greater access to jobs, and avoided accidents and congestion.

Generally, these economic costs and benefits accrue over a number of years and, therefore, it is important to analyse the net impacts (in dollar terms) using a common base year.

Usually, a project is compared to a 'do nothing' or 'business as usual' case, and/or alternative projects. It is important to keep in mind that a dollar spent on one project is a dollar that cannot be spent on another project; this is the concept of opportunity cost.

The results of the analysis can be measured as a ratio of benefits to costs (BCR) or in dollar terms as a net benefit (or net cost).

The breakeven point for the BCR is 1, in that a BCR between 0 and 1 represents a net cost, while a BCR above 1 represents a net benefit. A positive dollar value (in net present value NPV terms) represents a benefit, while a negative dollar amount represents a cost.

The NPV of benefits is the discounted value of the net benefit stream. It is obtained by discounting the stream of net benefits back to its value in the chosen base period, in this case 2017-18.

The general NPV formula can be represented by:

$$NPV = \sum_{(t=0 \text{ to } n)} Bt - Ct / (1 + r)^t, \text{ where:}$$

Bt is the benefits from project in period t, Ct is the expenditure on the project in period t, r is the economic discount rate (generally set at 7%), n is the number of years the benefits and costs from projects are accrued.

The ROI calculates the net return on an investment, relative to the costs invested, and is expressed as a percentage.

The general ROI formula is represented by:

$$ROI = \{[NPVB - NPVC] / NPVC\} \times 100, \text{ where:}$$

NPVB is the NPV of the benefits and NPVC is the NPV of the costs.

### 5.3 RESOURCE COSTS

The economic costs of the South Coast Line upgrade and the SWIRL can be categorised as described in Table 5-1. A comprehensive costing of these options requires a detailed engineering assessment, which is beyond the scope of this report. The cost estimates described in the following sections have been derived from a number of sources, including discussions with industry experts, and are therefore indicative in nature, recognising that the costs of infrastructure projects tend to be highly bespoke and site-specific.

An important point to note is that the definition of resource costs does not include contractors' margins, which is simply a transfer of wealth from the consumer to the producer. We use ACIL Tasman's estimate of contractors' margin of 10% in our assessment of both South Coast Line and SWIRL costs.

**Table 5-1: Categorisation of resource costs**

TYPE OF COST	SOUTH COAST LINE	SWIRL
Infrastructure costs	Rail line duplication	Line completion
	Rail line straightening	Electrification
	Additional train sets	Additional train sets
	New signalling technology	New signalling technology
	Labour	Labour
	Disruption costs	Disruption costs
	Environmental costs	Environmental costs
Operating costs	Running costs such as electricity and labour costs	Running costs such as diesel, electricity and labour costs
	Maintenance costs	Maintenance costs
	Depreciation	Depreciation

Source: SMART analysis.

#### 5.3.1 South Coast Line upgrade

##### 5.3.1.1 COSTS

SMART identified a number of infrastructure upgrades that could improve passenger commute times between the Illawarra and Sydney. These upgrades relate to line duplication (to reduce peak congestion), line straightening and signalling technology upgrades (to reduce commute times).

Line straightening would require an estimated 13 kms of tunnelling work to be undertaken on the South Coast Line. Rail tunnelling is generally considered to be an extremely expensive undertaking, as highlighted in the Productivity Commission's 2014 inquiry into the cost drivers of infrastructure in Australia. For instance, the Productivity Commission cites estimates of tunnelling costs for specific rail routes of:

- \$208.2 million per route-kilometre for the Epping-Chatswood Line;
- \$125.1 million per route-kilometre for the Sydney Airport Line; and
- \$136.2 million per route kilometre for the underground sections of the Perth-Mandurah Line.

Taking the approximate mid-point of these estimates, we assume the cost of tunnelling for the South Coast Line to be \$150 million per route-kilometre, or around \$2 billion for 13 kms of tunnelling (range: \$125 million to \$200 million per route-kilometre).

The cost of duplicating rail tracks is variable. To develop approximate cost estimates, we have again drawn on information from the Productivity Commission 2014 enquiry, an analysis by Martin (2012), as well as internal analysis undertaken by SMART for various Australian transport authorities (2016):

- the Productivity Commission cites costs for duplicating existing railway tracks of around \$60 million per route-kilometre for the Cronulla Line, and around \$85 million per route-kilometre for the Richmond Line;
- Martin (2012) cites duplication costs for a number of rail projects ranging from \$4.1 million per route-kilometre for the Ormeau – Coomera Line to \$68.3 million per route-kilometre for the Quakers Hill – Schofields line; and
- two confidential case studies reviewed by SMART as part of its Infrastructure Cost Drivers Study (2016) indicate that, depending on the type of environment, the costs of track duplication may range between \$10 million and \$40 million per route-kilometre.

On this basis, the cost of track duplication for the South Coast Line can be expected to lie between a lower range cost estimate of \$5 million per duplicated route per kilometre and high range cost estimate of \$85 million per duplicate route-kilometre. Again, taking an approximate mid-point of these estimates provides a cost of \$40 million in today's dollars per route-kilometre.

However, because of the limited benefit for track duplication between Wollongong and Waterfall stations, we have not pursued this option further.

In addition, we have not pursued costing the introduction of the ETCS2 system onto the South Coast Line because, essentially, a rollout across the Sydney Trains Network would be required to reduce congestion on the South Coast Line between Waterfall and Central stations.

Table 5-2 accordingly summarises our 'best estimate' of key cost components of upgrading the South Coast Line:

- the central estimate of the costs of the necessary upgrades for the South Coast Line is around \$1.95 billion; noting that
- on the basis of the range of outcomes observed in practice, these costs could range from \$1.35 billion in the most optimistic case to \$2.85 billion in a high-cost scenario.

**Table 5-2: Costs of infrastructure upgrades to South Coast Line**

	SECTIONS OF TRACK AFFECTED (INDICATIVE)	CENTRAL COST ESTIMATE (LOW/HIGH ESTIMATE) \$ MILLION PER ROUTE-KILOMETRE	TOTAL COST (CENTRAL ESTIMATE)	TOTAL COST LOW / HIGH ESTIMATE
Line straightening on South Coast Line (via tunnelling)	13 kilometres	\$150 million (\$125 / \$200 million)	\$1.950 billion	\$1.35 billion / \$2.850 billion
Total costs			<b>\$1.950 billion</b>	\$1.35 billion / \$2.850 billion

Source: Martin (2012), PC (2014) and SMART analysis.

### 5.3.1.2 BENEFITS

We modelled a number of expected benefits flowing from the South Coast Line upgrade. The main private benefit is the predicted travel time savings for existing commuters and new commuters who switch from road transport to train transport. Social benefits include reduced pollution, reduced accidents and congestion on the roads as car commuters switch to trains.

In terms of assessing private benefits, we first analysed the value of saving up to 30 minutes in commuting time twice a day (i.e. up to 60 minutes per day) for approximately 3,000 commuters who use the South Coast Line service.

We estimated annual travel time savings to be just under \$12 million based on assuming the opportunity cost of a working commuter's time to be \$16.65 per hour (which is essentially 50% of the average hourly wage rate in NSW in 2016-17).

In our central case scenario, we assumed an additional 6,000 commuters would switch to the passenger train service from cars, saving 15 minutes in travel time each way. This amounts to a further (just under) \$12 million per year in private commuter travel time savings. Moving cars off the road would result in improved travel times on roads as well as reduced externalities such as pollution, accidents and congestion. We have estimated this impact to be \$21 million per year. There would also be an improvement in freight efficiency, which we estimate to be \$10 million per year in our central case estimate. Our freight efficiency estimate aligns with previous detailed work undertaken by ACIL Tasman (2011).

In total, we estimated an annual benefit of about \$55 million, which translates to \$732.9 million in NPV terms (at the standard 7% social discount rate over 50 years). At a 4% discount rate, the total benefit is \$1,181 million (50 years)<sup>1</sup>.

As discussed above, we estimated total costs for materially upgrading the South Coast Line to reduce commuter times to be \$2 billion, which is just over \$1.543 billion in NPV terms (at 7%, over 50 years) or \$1,677 million (at 4% over 50 years).

<sup>1</sup> While we apply the 7% discount rate to maintain comparability across projects, in our view in the post-GFC world a 4% social discount rate is more applicable. See Appendix E for more details.

This cost figure of \$1.5 billion (at 7%) is simply the discounted value of the estimated \$1.95 billion South Coast Line infrastructure investment. Because the investment is spread over four years, the discounted value in today's dollars is less. Also, in the CBA framework, we ignore the profit component of the investment as this represents a transfer between the consumer and producer of the infrastructure service. We therefore discount the original estimate of \$1.95 billion by 10% (\$1.77 billion), which is the same approach used by ACIL Tasman in its study.

At the standard 7% social discount rate, our central case BCR is 0.48, with a low case estimate of 0.35 and a high case estimate of 0.63. At a 4% discount rate, which in our view is more appropriate in this current post-GFC environment, our central case BCR is 0.69, with a range of 0.51 (low) and 0.90 (high) (Table 5-3).

**Table 5-3: CBA of the South Coast Line**

DESCRIPTION (ANNUAL SAVINGS)	LOW ESTIMATE \$ MILLIONS	CENTRAL ESTIMATE \$ MILLIONS	HIGH ESTIMATE \$ MILLIONS
Travel time savings (existing commuters)	11.988	11.988	11.988
Travel time savings (new commuters)	5.994	11.988	17.982
Reduced pollution/accidents/congestion	12.000	17.500	23.000
Improved freight efficiency	9.500	12.475	17.500
Total private and social benefits (Annual)	39.482	53.951	70.470
Total private and social benefits (NPV, 7%, 50 years)	544.881	744.564	972.539
Total private and social costs (NPV, 7%, 50 years) (Central estimate)	1,542.893	1,542.893	1,542.893
<b>BCR (7%, 50 years)</b>	<b>0.35</b>	<b>0.48</b>	<b>0.63</b>
<b>BCR (4%, 50 years)</b>	<b>0.51</b>	<b>0.69</b>	<b>0.90</b>

Source: SMART estimates of individual benefits are based on annual savings.

### 5.3.2 South West Illawarra Rail Link

The 42 km electrified SWIRL would comprise a 35 km link between Maldon (near Picton in south west Sydney) on the main South Coast Line and Dombarton (at the foothills of the Illawarra plateau), located on the Moss Vale-Unanderra Line. The 7 km distance from Dombarton to the south of Unanderra station, on the South Coast Line, would need to be electrified. Based on the proposed Hyder engineering specifications, the line from Dombarton would track northwest and negotiate the Illawarra escarpment, climbing at a 1-in-30 gradient through a 4 km-long tunnel (ACIL Tasman, 2011). An electrified passenger service on this gradient (at 1:30 maximum or an angle of 3.3%) is feasible.

With these additions, the SWIRL would be a predominantly dual track line except for the two major bridges and the 4 km tunnel where the line would be a single track as per the Hyder specifications. This would pose some constraint on capacity but this constraint would not be considered limiting in the short to medium-term in our view.

The original estimate of the full resource costs (excluding a 10% allowance for profit margin as per the ACIL Tasman study) of completing the Maldon-Dombarton rail line, as a predominantly single track freight line (with two passing loops) had been estimated by ACIL Tasman at between \$624 and \$667 million in 2011-12 dollars (Table 5-4), corresponding to \$686.6 to \$733.6 million in 2016-17 dollars.

**Table 5-4: Cost estimate SWIRL (AU\$ 2011-12)**

DESCRIPTION	COST ESTIMATES (\$ MILLIONS)
Site infrastructure	\$17.6 - \$18.8
Bridge crossings	\$53.5 - \$57.2
Tunnel construction & related costs	\$204.9 - \$218.9
Head hardened rail	\$9.5 - \$10.1
Earthworks and drainage	\$70.2 - \$75.0
Railway construction and minor works	\$42.9 - \$45.8
Railway electrical and signalling	\$10.7 - \$11.4
Sub-total	\$409.3 - \$437.3
Project indirect costs	\$145.0 - \$154.9
Total base estimate	\$554.3 - \$592.2
Risk contingency allowance	\$69.9 - \$74.7
Total risk-adjusted estimate	\$624.2 - \$666.9

Source: ACIL Tasman 2011.

A more recent Infrastructure Australia study estimated the costs of completing the Maldon-Dombarton rail line (as a freight line) at \$805.9 million in 2013-14 dollars (or \$849.1 million in 2016-17 dollars<sup>2</sup>). Of course, electrification of the entire route would be required to accommodate passenger trains.

Martin (2012) offers two estimates for the cost of electrification of railway lines of \$8.8 million per route-kilometre (Sydenham Line) and \$12.6 million per route-kilometre (Craigieburn Line). Martin's central estimate for the cost of electrification is \$10.7 million per route-kilometre in 2012 dollars, or around \$11.8 million per route-kilometre in 2016-17 dollars.

Table 5-5 summarises our 'best estimate' of the costs of the SWIRL:

- The central estimate of the costs of the proposed Maldon-Dombarton freight line is \$849.1 million.
- The costs of making the line a dual track (except of the two main bridges and 4 km tunnel) with electrification and other modifications costs are estimated to be \$840.0 million (essentially at \$20 million per km on average over 42 kms of electrified track).

<sup>2</sup> The measured average annual inflation rate between 2013-14 and 2016-17 was 1.8%.

- Adding these two cost components, our central estimate of total costs is \$1,689.1 million (see Table 5-5).

**Table 5-5: SWIRL estimated costs**

	ACIL TASMAN (2011) ESTIMATE (2016-17 DOLLARS)	INFRASTRUCTURE AUSTRALIA ESTIMATE (2013-14 DOLLARS)	SMART CENTRAL COST ESTIMATE (2016-17 DOLLARS)	ESTIMATE COST RANGE (2016-17 DOLLARS)
Complete Maldon-Dombarton rail line (35 kms)	\$686.6 to \$733.6 million	\$805.9 million	<b>\$849.1 million</b>	\$764 million / \$934 million
Construct the SWIRL with additional line and dual track electrification. Electrification of Moss Vale-Unanderra Line from Dombarton to South Coast Line (42 kms)			<b>\$840.0 million</b>	\$714 million / \$966 million
<b>Total costs</b>			<b>\$1,689 million</b>	\$1,478 million / \$1,900 million

Source: ACIL Tasman (2011), IA (2017) and SMART estimates.

#### **5.4 POTENTIAL BENEFITS OF THE SWIRL**

Given the limitations in the scope of this report, the approach adopted has not been to undertake a comprehensive CBA. Such an analysis would require a detailed engineering and economic/financial analysis of all aspects of the costs and benefits that would be incurred to assess the respective implications of either making incremental improvements to the South Coast Line or constructing the SWIRL.

Table 5-6 provides a generic overview of the types of benefits that can arise from rail investments or upgrades. In the case of passenger transport, for instance, travellers will often value faster journey times, reduced wait times and improved reliability, which may in turn induce passengers to switch from road to rail (with attendant cost savings). Improved travel times and reliability may lead to changes in the choice of residential or business location, which may in turn give rise to additional flow-on effects, for instance, in the form of higher regional growth. Alternatively, improvements in freight connectivity may lower costs to businesses and an impetus for greater productivity and output.

As is apparent from Table 5-6, identifying and (where possible) quantifying these benefits is a substantial and complex exercise requiring a detailed analysis of passenger movements and demographics. Such an analysis is beyond the scope of this research report. For the purpose of obtaining indicative estimates of the options considered in this report, we have therefore focused on a limited number of items where it is possible to derive approximate estimates of the types of benefits that could be expected.



**Table 5-6: Potential benefits of rail investments or upgrades**

<b>TYPE OF TRAFFIC</b>	<b>BENEFITS</b>	<b>DESCRIPTION</b>	
<b>PASSENGERS</b>	<b>DIRECT BENEFITS</b>		
	Rail user cost savings	Reduced waiting time penalties Reduced travel time penalties Reduced modal shift penalties Reduced accessibility costs, where ‘accessibility’ is broadly defined as the variety of opportunities provided to people through efficient arrangement of land use and various modes of transport	
	Rail user benefits	Improvements in service reliability due to reaching the destination in a consistent journey time Improved passenger comfort due to improvements in amenities	
	Benefits to the broader community	Induced and generated rail trips: <ul style="list-style-type: none"> <li>– Reduced car use / road congestion by shifting some car trips to public transport</li> <li>– Vehicle operating cost savings</li> <li>– Accident (crash) cost savings</li> </ul> Reduced environmental externalities	
	<b>INDIRECT BENEFITS</b>		
	Community development benefits	Transport investment improves the accessibility for new and existing transport users in catchment areas, which is often translated into enhanced land values.	
	Low-income mobility benefits	Availability of affordable transportation to low income people Budgetary savings arising from reduced social service outlays on home based health and welfare services such as home health care and unemployment benefits	
	Wider Economic Benefits	Wider economic benefits arising from: <ul style="list-style-type: none"> <li>– Agglomeration economies</li> <li>– Increased competition as a result of better transport</li> <li>– Increased output in imperfectly-competitive markets</li> <li>– Economic welfare benefits arising from improved labour supply</li> </ul>	
	<b>FREIGHT TRAFFIC</b>	<b>DIRECT BENEFITS</b>	
		Improved productivity	Reduced waiting time penalties Reduced travel time penalties Reduced modal shift penalties Improvements in service reliability Better coordination with attendant impact on inventories and spatial location with changing distribution network
Benefits to the broader community		Induced and generated rail trips (as above): <ul style="list-style-type: none"> <li>– Reduced car use/road congestion</li> <li>– Vehicle operating cost savings</li> <li>– Accident (crash) cost savings</li> </ul>	

TYPE OF BENEFITS	DESCRIPTION
TRAFFIC	Reduced environmental externalities
<b>INDIRECT BENEFITS</b>	
Wider Economic Benefits	<p>Contribution to economic growth:</p> <ul style="list-style-type: none"> <li>– Reduced logistic costs that can be passed on to consumers thereby increasing product demand or increased production thereby lower product costs</li> </ul> <p>Wider economic benefits (as above):</p> <ul style="list-style-type: none"> <li>– Agglomeration economies</li> <li>– Increased competition as a result of better transport</li> <li>– Increased output in imperfectly-competitive markets</li> <li>– Environmental benefits</li> </ul>

Source: NSW Government 2013.

## 5.5 SWIRL CBA

As noted above, the benefits associated with rail projects and described in Table 5-6 are difficult to quantify, given their estimation requires significant supporting analysis. For the purposes of this report, SMART has therefore limited itself to some high-level observations and analysis.

### 5.5.1 Benefits relating to rail freight services

The aim of constructing the SWIRL is to:

- meet capacity for rail freight to and from Port Kembla and the Illawarra region in the longer term and support economic development;
- improve efficiency of the rail freight supply chain to and from Port Kembla by providing greater flexibility in train arrival and departure times, improved reliability, shorter cycle times, separation of freight and passenger services and support future intermodal movement;
- maintain or reduce the level of safety risks to the rail network;
- minimise impacts on the environment, surrounding land users, and the community; and
- optimise overall rail network investment for the NSW freight task.

### 5.5.2 Benefits relating to passenger services

Table 5-6 indicates one of the benefits of rail upgrades or investments for passengers arises from faster travel times, which reduce travel and wait costs, and which may in turn give rise to positive flow-on effects. In the case of upgrades to the South Coast Line, SMART analysis and discussions with various experts indicate that commute times between Illawarra and Sydney may be improved, but significant reductions in travel times are limited owing primarily to topography.

For the SWIRL, passengers using the line would be able to reach south west Sydney stations more quickly than using the South Coast Line, although Parramatta station would still be quicker via the South Coast Line. The time difference to key stations in Western Sydney, assuming the passenger service travels at an average speed of 90 km/h on the Maldon-Dombarton sector and using the current timetable average peak times for journeys on other relevant sectors, is estimated as follows:

- Liverpool station (34 minutes quicker by SWIRL)
- Leppington station (39 minutes quicker by SWIRL)
- Campbelltown station (71 minutes quicker by SWIRL)

The fastest journey from Wollongong to Parramatta via the South Coast Line (based on the current timetable) takes 114 minutes. The estimated travel time via SWIRL, using the fastest time from Picton to Parramatta (based on the current timetable), is 123 minutes.

For the purpose of assessing infrastructure projects, the NSW Government (2013) applies various ‘value of travel’ time estimates that correspond to the opportunity cost that passengers on trains or buses attach to the time they are required to spend while travelling, whereby:

- the value of private travel time is estimated at \$15.14 per hour (\$16.65 in 2016-17 dollars), and applies to private car occupants, on-board train time, on-board bus time, and other modes of transport; while
- the value of business travel time is estimated at \$48.45 per hour (\$53.3 in 2016-17 dollars), and is applicable to all business travel.

It is difficult to forecast the amount of ‘latent demand’ for passenger rail travel between the Illawarra and south west Sydney. Nonetheless, SMART has constructed a high-level scenario where an additional 3,000 to 9,000 commuters use the SWIRL. Based on this scenario, we estimate the travel time savings to be 30 minutes (on average) relative to alternative options of driving or taking the South Coast Line to Sydney and then the Bankstown Line to south west Sydney. Based on these assumptions, we estimated a total private benefit of \$70.5 million per year, or \$939.5 million over the 50-year benefit period (being from 2021-22 to 2071-72) in NPV (2017-18) terms.

The above estimates of travel time savings represent only one aspect of a range of different direct and indirect benefits that the SWIRL may deliver. As indicated in Table 5-6, rail investments may deliver:

- various rail user cost savings, including reduced travel time penalties (as estimated above), reduced waiting time and modal shift penalties, benefits from greater reliability and comfort, and more generally, reduced ‘accessibility costs’ that refer to the ease with which people are able to find and reach the best suited opportunity either for work, study or other activities;
- various benefits to the broader community as a result of induced rail trips that arise because of reduced car use or road congestion and associated vehicle and crash cost savings;
- specific benefits that accrue to lower-income households from improved access to affordable transport; and
- a number of wider benefits that potentially translate into higher value added and economic growth, such as benefits from ‘agglomeration’ whereby the potential for scale and scope economies is harnessed, from greater competition, and from improved labour supply.

We undertook a high-level CBA that incorporated our estimates of passenger travel time savings, as well as estimates of freight travel time and operating cost savings, derived from the ACIL Tasman (2011) study. We also estimated the benefit of avoiding a proportion of the costs of the South Coast Line failing in the event of geological disturbances. In our central case, we found total private and social benefits of building the SWIRL to be \$1,776 million and total private and social costs to be

\$1,572 million (NPV 7%, 50 years). With estimated costs slightly above estimated benefits, our calculated Benefit Cost Ratio is 1.13 in the central case.

About one-half of the total private and social benefits of the SWIRL are derived from passenger travel time savings, both by taking the SWIRL but also those remaining in cars which will drive on less congested roads.

**Table 5-7: Indicative CBA for the SWIRL**

DESCRIPTION (2016-17 DOLLARS)	LOW CASE \$ MILLIONS	CENTRAL CASE \$ MILLIONS	HIGH CASE \$ MILLIONS
Freight travel time savings	111.786	124.207	136.627
Freight operating cost savings	296.233	329.148	362.063
Avoided externalities	169.294	188.104	206.915
Option value of South Coast Line failure	186.310	207.011	227.712
Passenger travel time savings and other benefits	835.223	928.025	1,020.828
Total private and social benefits (NPV, 7%, 50 years)	1,598.846	1,776.495	1,954.145
Total private and social costs (NPV 7%, 50 years) (Central estimate)	1,572.097	1,572.097	1,572.097
<b>BCR (7%, 50 years)</b>	<b>1.02</b>	<b>1.13</b>	<b>1.24</b>
<b>BCR (4%, 50 years)</b>	<b>1.40</b>	<b>1.56</b>	<b>1.71</b>

Source: SMART estimates.

## 5.6 SUMMING UP

In this section we have presented indicative estimates of the costs of infrastructure upgrades to the South Coast Line versus those of constructing the SWIRL:

- The costs of upgrades to the South Coast Line are estimated at around \$2 billion, with a possible range from \$1.4 billion to \$2.9 billion.
- The costs of constructing the SWIRL are estimated at around \$1.7 billion, with a possible range from around \$1.5 billion to \$1.9 billion.

In relation to the SWIRL we found:

- Under our central case assumption, the SWIRL achieves the BCR hurdle rate of 1.0. At a 7% discount rate over a 50-year infrastructure asset life, the BCR ranges from 1.02 to 1.24 with our central case estimate being 1.13. At a 4% discount rate, the BCR ranges from 1.40 to 1.71 with our central case estimate being 1.56.
- In addition, there are potentially significant additional and wider economic benefits for commuters and residents of the Illawarra and south west Sydney that have not been measured in this CBA eg benefits arising from connecting to the proposed Badgerys Creek airport.

## 6. Regional Economic Impact of Option 4

The results of the CBA reported in Section 4 indicate that constructing the SWIRL is a better priority option than significantly upgrading the South Coast Line. In this section, we report the results of the economic impact analysis of this option.

This section is structured as follows:

- Section 6.1 describes the concept of economic impact modelling;
- Sections 6.2 and 6.3 describes the economic variables we have modelled, including input assumptions and scenarios;
- Section 6.4 shows the modelling results relating to economic growth and employment; and
- Section 6.5 shows the results of a sensitivity analysis.

### 6.1 WHAT IS ECONOMIC IMPACT MODELLING?

As the name implies, economic impact modelling measures the effects across a defined region of some change to the normal (or equilibrium) structure of the economy. This type modelling attempts to answer the question: what are the effects over time on economic output, employment and other economic parameters of investing or spending, say \$1 billion, in the Illawarra. Importantly, the effects are compared to a BAU or ‘base case’, which accounts for the normal trend growth of the economy (that is, growth in the population, economic output, employment and productivity).

The economic impacts estimated in this report have been prepared using the Cadence Economics General Equilibrium Model (CEGEM) (see Appendix D). CEGEM utilises, among other things, the ABS Australian National Accounts: Input Output Tables data to represent the Australian economy.

For this assessment, we have developed a bespoke model of the Australian economy classified by the following regions:

- Illawarra (generally defined as the LGAs of Shellharbour, Kiama, Wollongong, Wingecarribee, Shoalhaven<sup>3</sup>)
- Sydney (Greater Metropolitan Sydney)
- Rest of NSW
- Rest of Australia (RoA)
- Rest of the World (RoW)

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<sup>3</sup> Technically, Shoalhaven and Wingecarribee are part of the ‘Rest of NSW’ and we then apportion that impact back to the Illawarra region. The Illawarra region is classified in the economic impact analysis using the Federal Government classification, that is, Wollongong, Shellharbour and Kiama local government areas (LGAs).

## **6.2 WHAT HAVE WE MODELLED?**

We have modelled the economic impact over time of constructing the SWIRL as a freight and electrified passenger service over four years at a cost of \$1,689 million (the ‘central case’).

This significant infrastructure investment is expected to provide a stream of benefits to the Illawarra and Sydney communities by expanding the supply of passenger and freight transport services to the region. The construction of the SWIRL is expected to increase overall network capacity and passenger and freight demand for rail services. In other words, in our view there is unmet demand for rail services between the Illawarra and south west Sydney (discussed in Sections 2 and 4).

## **6.3 MODEL ASSUMPTIONS**

The following outlines the key assumptions underpinning the economic impact analysis modelling.

### **6.3.1 Capital investment**

We have estimated that the cost of constructing the SWIRL, as both a freight and passenger service is \$1,689 million (in 2016-17 dollars).

Our estimate is based on the most recent publicly available cost estimate, being the ‘Project Business Case Evaluation’ published by Infrastructure Australia. This report estimated the total capital cost for completing the Maldon-Dombarton freight line to be \$805.9 million (in 2013-14 dollars), which is equivalent to \$849.1<sup>4</sup> in 2016-17 dollars.

Our study then considered the cost of a dual track passenger-freight line, which requires electrification and different specifications to the freight rail line, including related to the type of steel required and functional gradients. Based on previous work undertaken by SMART as well as publicly available estimates (such as provided in the Productivity Commission’s 2014 Inquiry into Public Infrastructure), we have estimated the total additional cost to be \$839.9 million. Adding these two numbers together (\$849.1 + \$839.9 million) results in our central case cost estimate for the SWIRL of \$1,689 million configured as an electrified passenger and diesel freight service.

### **6.3.2 Transport industry efficiency**

In terms of the flow of economic impacts, we examined the current transport industry structure in the Illawarra and made a high-level assumption around the potential for improved freight productivity.

We estimated the impact of a 1% improvement in freight productivity in the Illawarra as a result of the SWIRL (operating in conjunction with the South Coast Line and the existing road network). Our estimate of the size of the freight industry in the Illawarra is based on ABS National Accounts Input-Output tables and the NSW Ports report ‘*Navigating the Future: NSW’s 30 Years Master Plan*’ published by NSW Ports.

We estimated the improvement of rail transport productivity industry in Illawarra to be 1%, equivalent to \$20 million per year. Although derived differently, this estimate lines up with the ACIL Tasman assumptions around improved freight productivity.

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<sup>4</sup> The average annual inflation rate between 2013-14 and 2016-17 is 1.8%.

### **6.3.3 Population**

Improving the connectivity between Wollongong and Sydney will provide incentives (such as greater access to jobs, education and leisure opportunities) for residents of Sydney or other parts of Australia to move to Wollongong. We estimate that this improved connectivity will increase the population growth rate from the current rate of 1.1% (based on the latest ABS regional population growth data) to 1.4%. Considering the current population of 300,000 people (ABS, 2017) this will result in an increase of around 900 people per year. Two primary reasons people move between regions are job opportunities and housing costs. If people are able to find lower cost housing in the Illawarra and work in potentially higher wage jobs in Sydney, then we could expect the population growth rate to increase beyond its current annual average.

### **6.3.4 Labour force**

We also assumed a lowering of the natural rate of unemployment in the Illawarra (proxied by the long-run average unemployment rate) of 1,000 workers. In other words, the increased access to job opportunities is assumed to ‘pull’ 1,000 people into the labour force that would otherwise not be in the labour force. This is a key assumption that is not included in the CBA (see section 4). Increasing the supply of labour stimulates economic activity as new workers enter the workforce at lower wage rates.

### **6.3.5 Income repatriation**

Finally, based on existing workforce trends, we modelled an income repatriation effect whereby residents of the Illawarra work in Sydney and spend their income in the Illawarra region. In our central case scenario, we assumed an additional 2,500 people travelled to Sydney to work at an average salary of \$50,000 per year. Again, this assumption is not included in the CBA.

### **6.3.6 Summary of input assumptions**

Table 6-1 outlines our assumptions and scenarios across three cases – low, central and high. For the low-case scenario we assumed the required capital investment would be 10% lower than the central case (at \$1,520.1 million). Similarly, for the high-case scenario we assumed the required capital investment would be 10% higher than the central case (at \$1,857.9 million).

In terms of the other impacts, we assumed slightly larger variances reflecting the greater difficulty in estimating these impacts. For instance, the labour market effect is assumed to be 25% lower in the low-case (at 750 workers entering the Illawarra labour force) and 25% higher in the high-case (at 1,250 workers). Similarly, we assume the construction and operation of the SWIRL will improve the freight productivity as well as the transport industry in the Illawarra by \$15 million in the low-case and \$25 million in the high case scenario.

**Table 6-1: Option 4 assumptions and scenarios**

FOCUS OF THE ANALYSIS		LOW CASE	CENTRAL CASE	HIGH CASE
<i>Infrastructure capital investment</i>				
Additional capital expenditure on the SWIRL (full resource cost including new train sets)	\$ million	1,520	1,689	1,858
<i>Transport Industry efficiency</i>				
Improved freight productivity across NSW via a reduction in resource costs	\$ million per year	15	20	25
<i>Population and Labour Force</i>				
Additional population growth in the Illawarra over 20 years, from greater access to jobs, education and leisure opportunities	percentage point difference	0.2%	0.3 %	0.4%
Lower natural rate of unemployment in the Illawarra (additional people (FTEs) per year active in the Illawarra labour force)	FTEs	750	1,000	1,250
<i>Income transfer to the Illawarra (from Sydney)</i>				
Income repatriation in the Illawarra region (additional 2,500 people * \$50,000, central case)	(\$ million per year)	100	125	150

Source: Cadence Economics and SMART.



## 6.4 MODELLING RESULTS

The results of the modelling analysis are discussed in the following.

### 6.4.1 Gross Regional Product – Central Case

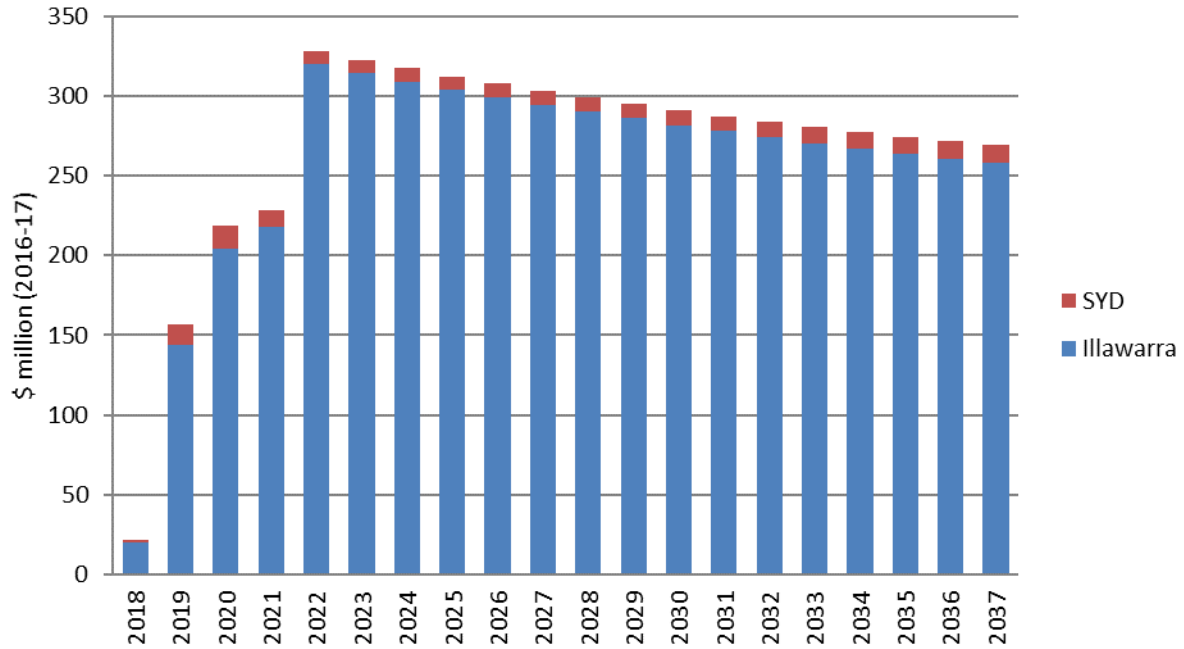
Under the central case scenario (at the standard 7% discount rate), we estimate the NPV of the total economic impact of Option 4 to be **\$2,579 million in the Illawarra region**. The total economic impact for Greater Sydney is \$97 million. The reason most of the impact occurs in the Illawarra is because most of the capital investment and the assumed stream of net benefits occurs in the Illawarra. Conceptually, the economic impact for NSW is the sum of the impacts for the Illawarra, Greater Sydney and the rest of NSW. The total economic impact for NSW is **\$2,635 million** in NPV terms.

In terms of the impact on the Illawarra, 71% (or \$1,833 million) occurs in Wollongong, while the share of Shellharbour and Kiama is approximately equal 15% and 14% respectively (\$381 million in Shellharbour and \$364 million in Kiama).<sup>5</sup> Figure 6-1 illustrates the economic impacts in annual terms. As the figure shows, the economic benefit is at a peak during the construction stage.

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<sup>5</sup> Technically, Shoalhaven and Wingecarribee are part of the 'Rest of NSW' and we then apportion that impact back to the Illawarra region. The Illawarra region is classified in the economic impact analysis using the Federal Government classification, that is, Wollongong, Shellharbour and Kiama local government areas (LGAs).

**Figure 6-1: Central Case Scenario – annual economic impact, by calendar year (\$m real, undiscounted)**



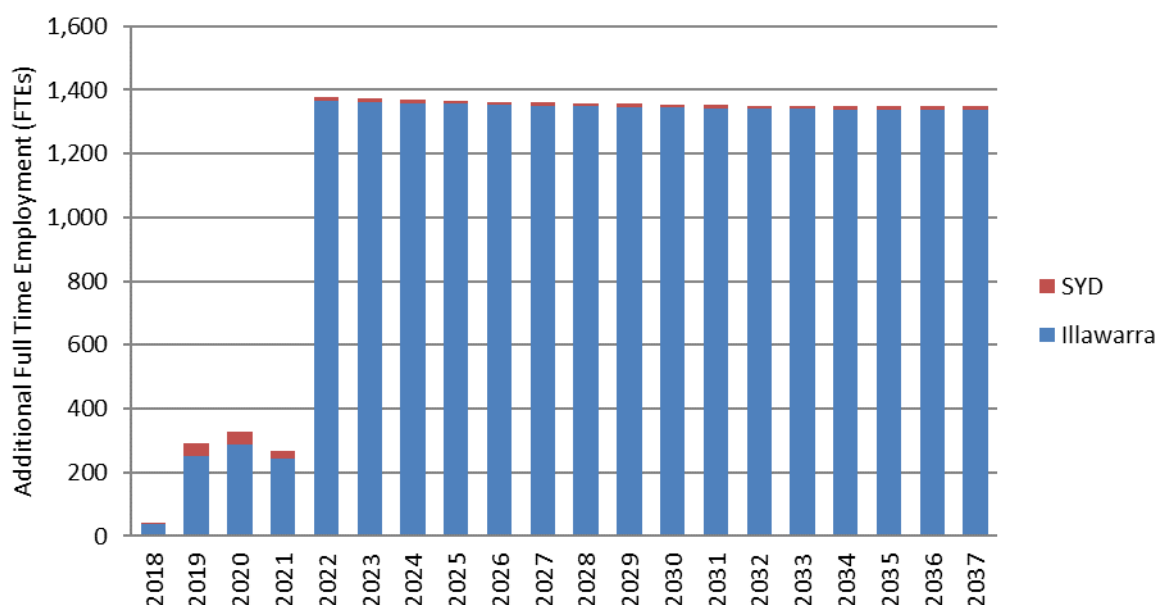
Source: Cadence Economics and SMART.

### 6.4.2 Employment – Central Case

In terms of employment impacts, we estimate that the **average annual additional employment** over the construction and operating period (2018-2037) is **1,119 FTEs in the Illawarra**, 14 FTEs in Sydney (Figure 6-2) and 1,135 in NSW.

**Peak employment occurs in 2022, at 1,367 FTEs in the Illawarra and at 1,387 in NSW, and 41 FTEs in Sydney in 2019.**

**Figure 6-2: Central Case Scenario – annual employment impact, by calendar year (FTEs)**



Source: Cadence Economics and SMART.

### 6.4.3 Summary of results

The overall results of the Central Case scenario for Option 4 are summarised in Table 6-2 below.

**Table 6-2: Central Case Scenario – summary of economic impacts by region**

ECONOMIC IMPACT ON... OVER THE PERIOD 2018 TO 2037	\$ MILLIONS, REAL GRP 2016-17 DOLLARS (NPV, 7%)	EMPLOYMENT (ANNUAL AVERAGE 2018-2037)	EMPLOYMENT (AT PEAK)
Illawarra Region	2,579	1,119	1,367
Sydney Region	97	14	41
NSW	2,635	1,135	1,387

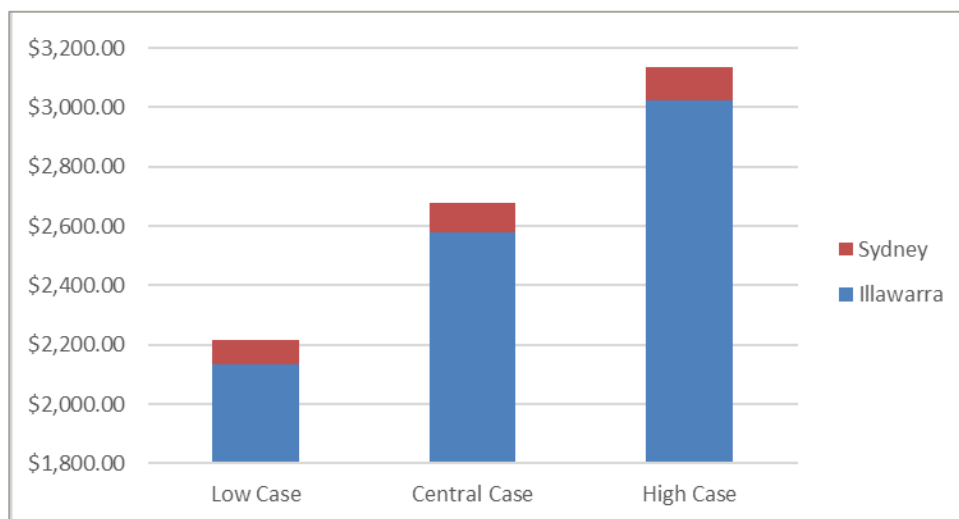
Source: Cadence Economics and SMART.

### 6.5 SENSITIVITY ANALYSIS

We also undertook sensitivity analysis of the economic impacts. To this end, we considered a low-case and a high-case scenario in which the effects of SWIRL are higher or lower than those of our estimations in central-case. The assumptions of those scenarios are explained in Section 5.3.5. Our sensitivity analysis also includes studying the effect of a lower discount rate on our results by reducing the discount rate to 4%.

Figure 6-3 illustrates the range of economic impacts across the three scenarios modelled when the discount rate is 7%.

**Figure 6-3: Scenario analysis, GRP impact (\$ million, NPV at 7% discount rate)**



Source: Cadence Economics and SMART.

Tables 6.3 and 6.4 report the results of the sensitivity analysis.

We estimate that when the discount rate is 7% the economic impact in the Illawarra region in terms of GRP ranges between \$2.1-\$3.0 billion (2016-17 dollars). This range represents the net present value of the stream of impacts between 2017-18 and 2030-31 (Table 6-3). Decreasing the discount rate to 4%, however, increases the economic impact by increasing the Illawarra GRP range to \$2.9-\$4.1 billion (Table 6-4).

**Table 6-3: Sensitivity analysis – summary of economic impacts by region (GRP) when discount rate is 7%**

ECONOMIC IMPACT ON...	\$ MILLIONS,		
	REAL GRP 2016-17 DOLLARS (NPV, 7%)		
OVER THE PERIOD 2018 TO 2037	LOW CASE	CENTRAL CASE	HIGH CASE
Illawarra Region	2,135	2,579	3,021
Sydney Region	79	97	115
NSW	2,174	2,635	\$3,094

Source: Cadence Economics and SMART.

**Table 6-4: Sensitivity analysis – summary of economic impacts by region (GRP) when discount rate is 4%**

ECONOMIC IMPACT ON... OVER THE PERIOD 2018 TO 2037	\$ MILLIONS, REAL GRP 2016-17 DOLLARS (NPV, 4%)		
	LOW CASE	CENTRAL CASE	HIGH CASE
Illawarra Region	2,802	3,401	3,997
Sydney Region	101	126	151
NSW	2,860	3,484	\$4,105

Source: Cadence Economics and SMART.

We also estimate the employment impact in the Illawarra region in terms of FTEs ranges between 834 and 1,403 permanent additional jobs (on average) over the period 2017-18 to 2036-37 (Table 6-5).

**Table 6-5: Sensitivity analysis – summary of employment impacts by region (FTEs)**

ECONOMIC IMPACT ON... OVER THE PERIOD 2018 TO 2037	EMPLOYMENT (FTEs, AVERAGE)		
	LOW CASE	CENTRAL CASE	HIGH CASE
Illawarra Region	834	1,119	1,403
Sydney Region	11	14	17
NSW	848	1,135	1,423

Source: Cadence Economics and SMART.

## 7. Funding Options

This section reviews the funding options for the South Coast Line upgrade and the SWIRL:

- Section 7.1 describes funding initiatives contained in the 2017-18 Federal Budget;
- Section 7.2 comments generally on the issues with funding public infrastructure;
- Section 7.3 discusses the implications of taxpayer funding of public infrastructure;
- Section 7.4 discusses public-private partnerships; and
- Section 7.5 comments on value capture options.

### **7.1 2017-18 FEDERAL BUDGET COMMITMENTS TO INFRASTRUCTURE**

In the 2017-18 Federal Budget, the Commonwealth Government made a significant commitment to expand the productive capacity of the economy by investing \$70 billion in transport infrastructure projects.

A key part of this funding commitment is the \$10 billion National Rail Program, which is designed to fund priority regional and urban rail investments, with funding to be provided over 10 years. The Commonwealth Government also committed to contribute \$20 million to the development of up to three business cases for infrastructure projects that will deliver faster rail connections between major cities and major regional centres.

Finally, the Government is establishing the ‘Infrastructure and Project Financing Agency on 1 July 2017 to assist in the identification, development and assessment of equity and debt financing options for investment in major infrastructure projects.’

### **7.2 FUNDING PUBLIC INFRASTRUCTURE**

Public infrastructure networks like rail lines, roads and water grids share some interrelated economic characteristics, including geographical specificity, long economic lives, high fixed costs that once engaged, are largely sunk, and relatively low operating costs. More frequently than not, they are local natural monopolies, and that – combined with their inherent reliance on public rights of way – brings them within the orbit of policy and regulation.

The natural monopoly characteristics also make the timely and efficient provision of infrastructure services crucial. That is simply because shortages and other inefficiencies are unlikely to prove as readily self-correcting as they would be in other areas: if bread is in short supply, price signals will soon enough attract resources into its production; not so for sewerage or roads. Moreover, with few good substitutes for infrastructure inputs, poor provision can impose high costs: for example, inadequate transport links can force excessively dispersed production (thus causing the loss of economies of scale, scope and agglomeration), create local pockets of monopoly power, and reduce the efficiency with which labour markets match job seekers and employers.

Yet securing timely and efficient supply of infrastructure services by non-market means is anything but easy: it involves all the challenges of central planning – not least, an accurate prediction of future demand without the benefit of the price signal guiding investment.

In Australia, state governments are primarily responsible for funding infrastructure albeit with significant financial support from the Commonwealth Government. For instance, national

highways are funded at a ratio of 80-20 because of the Commonwealth's much higher capacity to raise funds from taxpayers.

### **7.3 TAXPAYER FUNDING**

Many economists and public finance experts contend that the public sector should undertake all infrastructure projects that have a positive NPV when evaluated at the long-term bond rate (as opposed to the social discount rate or the actual 'riskiness' of the project under consideration) and should borrow to do so, presumably in a way that matches the maturity structure of its debt to the flow of net benefits over time. This view can be problematic.

That is because it confuses the headline bond rate with the cost of capital to taxpayers. After all, if the public sector can borrow at a relatively low interest rate it is because it has coercive powers of taxation. As a result, any sensible calculation of the effective cost to taxpayers of providing capital to the public sector must take account of the extent and exercise of those taxation powers. For example, if the government issues debt to undertake projects that will require increases in taxation at times when incomes are relatively low (so the marginal utility of post-tax incomes is high), then the burden of debt financing will be greater than the headline bond rate suggests.

It follows that it is only in the unusual case where the projects being financed involve pure public goods, yielding services whose net benefits are uncorrelated with the state of the economy that this prescription will hold. In all other cases, projects should only be undertaken if they have a net present value evaluated using a discount rate that reflects systematic risk and hence is likely to be equal or close to the private sector cost of capital.

### **7.4 PUBLIC-PRIVATE PARTNERSHIP**

The Productivity Commission (2014) defines public-private partnership (PPP) as a contract between the public and private sectors where a private party delivers infrastructure and associated services over the long-term and where some private financing is involved. PPPs may be delivered through a variety of models including where the private party designs, builds, finances and operates the infrastructure service, or designs, builds, finances, and maintains the service for a period before transferring it to government or owning it indefinitely. PPPs may be government funded through contractual payments from government, directly funded through a user-pays mechanism, or a combination of the two. Other models are also used.

While use of PPPs has grown over the last decade, the growth in the use of these types of arrangements have slowed, in part because of some notable commercial toll road failures and funding constraints associated with the global financial crisis. An important factor to note is that while risks may be transferred to private partners, the cost of risk will be factored into the cost of finance. The Productivity Commission (2014) has noted that the outcomes from PPP projects in Australia have been mixed, which is consistent with international project experience.

Increasingly, key risks are being transferred to government under PPP delivery arrangements, most notably traffic demand risk (large Australian road projects have a notoriously poor record in traffic forecasting). There is also anecdotal evidence that governments have reduced ability to adapt design to changing circumstances, both in construction and operation. In terms of infrastructure maintenance, further, PPP arrangements can tie up significant public resources for maintaining discrete parts of the transport network, which are often maintained to a higher standard than the rest of the network. Each of these issues, where they exist, can erode the value of PPPs.

In this regard, the Commission notes that there are greater risks from PPP arrangements if there is poor project selection process, if complex contracts with the private sector are inadequately written, and/or if short-term considerations dominate decision-making.

PPPs work best when government has considerable skill in contract negotiation and management, and where there is adequate competition for the projects. They can also potentially provide a timelier source of finance for important infrastructure investments that might otherwise be constrained by public debt pressures — an issue which may become more pressing in Australia over the medium-term.

## 7.5 VALUE CAPTURE

In the context of this study, value capture mechanisms harness part of the *unearned* windfall increase in land value arising from improvements in transport connectivity between the Illawarra and Sydney. If designed correctly, these mechanisms can be an efficient component of financing transport projects, along with user charges and general revenues.

However, value capture mechanisms need to be designed within the context of Australia's already extensive federal, state and local taxes that are linked to property values or unimproved land values, including capital gains tax, stamp duty and council rates, and company tax on developer profits. Further, good value capture design relies on extensive experience and datasets that, in SMART's view, are not yet available in Australia.

Issues to consider when designing value capture (VC) mechanisms include:<sup>6</sup>

- Forecasts of land value uplift could be misused to make poor projects appear more viable.
- There is potential for double taxation of land value uplift, due to the interaction between VC and the federal, state and local tax systems.
- VC should be levied on actual – rather than potential or forecast – value uplift delivered.
- Route selection or train station locations should not be unduly influenced by the financing mechanism, such as availability of parcels of crown land. Rather, route selection of public transport infrastructure should seek to maximise social welfare by addressing an identifiable need.
- Imposing higher densities and financing costs on existing and future residents in one neighbourhood while not imposing VC on past value uplifts or not every value uplift, could lead to inter-temporal and geo-spatial inequity.
- Impact on overall level of debt and taxation, and government credit ratings.
- Recent experience in relation to implementing taxes on windfall profits (such as mining profits) demonstrate the complexity in defining windfalls and implementing such taxes.
- Unimproved land valuations for rating purposes may not be well-suited to the measurement and implementation of VC mechanisms.

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<sup>6</sup> This section summarises SMART's Value Capture submission to the Inquiry into Transport Connectivity by the House of Representative Standing Committee on Infrastructure, Transport & Cities. Inquiry into Transport Connectivity by the House of Representative Standing Committee on Infrastructure, Transport & Cities



- VC should not be used as a second-best mechanism for recovering a sub-optimal pricing of public transport fares.
- Land value uplift due to a rezoning should not be confused with (or combined with, or attributed to) land value uplift from new transport infrastructure unless the two are truly inseparable.
- VC should be levied on true additionality rather than a redistribution of economic activity.
- When drawing lessons from overseas experience policymakers should be cognisant of our different circumstances, including Australia's system of federal financial relations, our relatively low population density, and relatively high reliance on income taxation.

## **7.6 FUNDING SWIRL**

There are a number of avenues available to fund the construction of the SWIRL.

The results of the CBA indicate the SWIRL will realise positive economic benefits towards the end of the 2020s assuming solid demand growth for freight and healthy passenger demand. Constructing the SWIRL could address many of the demographic and economic issues facing the Illawarra and south west Sydney.

There are a combination of funding sources from the Australian Government (including the \$10 billion National Rail Program), potential funding from the NSW Government and appropriate freight and passenger rail cost recovery mechanisms to make the project affordable and the benefits realisable within the next decade.

## **7.7 SUMMING UP**

An economic impact analysis of the SWIRL suggests that the regional economic benefits associated with this investment are potentially substantial, as follows:

- a \$2.6 billion increase in the Gross Regional Product of the Illawarra, which translates into a \$1.84 benefit to the Illawarra region for each dollar invested in the SWIRL;
- a permanent increase of over 1,100 jobs in the Illawarra;
- a significant reduction in the risk of congestion or failure of rail connectivity between the Illawarra and Sydney;
- potential to reduce congestion on existing road network and improve linkages between employment generating centres;
- a reduction in the natural rate of unemployment in the Illawarra;
- improved access to education choices for both south west Sydney and Illawarra residents; and
- improved access to leisure choices for both south west Sydney and Illawarra residents.

## 8. Conclusions and Recommendations

Passengers travelling by rail between the Illawarra and Sydney using the existing South Coast Line currently face a lengthy commute of, at best, 87 minutes each way. A 3-hour daily commute places a significant burden on rail commuters, and appears to force commuters into their cars, which in turn places a greater burden on the Illawarra-Sydney road network. The fact that passenger trains receive priority on the South Coast Line also places limitations on volumes of freight that can be transferred by rail into and out of Port Kembla.

SMART has found that reducing passenger commute times on the South Coast Line is severely constrained by the geological conditions of the Illawarra escarpment and the consequent engineering challenges, and would require a significant public investment in the order of \$2 billion.

Given these issues, SMART investigated the potential for an additional passenger and freight line between the Illawarra and Sydney, by completing the 35 km Maldon-Dombarton rail line, which was partially built in the mid-1980s, and adding a predominantly dual track electrified passenger and freight line with a 7 km link along the Moss Vale-Unanderra Line connecting to the South Coast Line south of Unanderra station. We estimate the cost of building the 42 km SWIRL would be around \$1.7 billion which is less than the cost of tunnelling through the Illawarra escarpment, necessary to deliver improvements in efficiency on the South Coast Line.

Constructing the SWIRL could provide many economic and social benefits and is worth serious consideration. For instance, the SWIRL and the South Coast Line operating together would increase total passenger and freight rail network capacity and open up jobs, export/import, education, leisure and housing opportunities for both regions. A new line could also limit the cost of congestion, short-term closures or a catastrophic geological failure on the South Coast Line.

SMART has estimated the economic impact on the Illawarra region of a suite of infrastructure measures aimed at significantly improving rail transport connectivity between the Illawarra and Sydney to be \$2.6 billion (in NPV terms) and over 1,100 permanent additional jobs (in FTE terms).

SMART recommends that:

- The NSW Government make a submission under the \$10 billion National Rail Program to secure funding to develop a detailed business case for the construction of the SWIRL and the upgrade of the South Coast Line.
- Infrastructure Australia and the Australian Government prioritise their consideration of the SWIRL given the significant potential economic benefits on offer and at a lower cost against alternative options to improve rail transport connectivity in the Illawarra.
- In addition to constructing the SWIRL, TfNSW, Infrastructure Australia and the Australian Government consider (and makes financial allocation for) further cost-effective incremental infrastructure improvements to the South Coast Line.
- TfNSW fast track the rollout of the ETCS2 onto the Sydney Trains Network, which should improve the efficiency, safety and reliability of the South Coast Line.

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## Appendix A Terms of Reference

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### Request for Proposal

#### Project title

Directed Research: Identification of measures to improve speed and reliability of rail transport connectivity between the Illawarra and Sydney.

#### Background

Illawarra First is focused on advancing economic development, business growth and long-term employment opportunities across the Illawarra region. The Illawarra First members are a select group of leading organisations sharing a commitment to driving development and prosperity of the Illawarra by identifying and championing initiatives such as improved transport.

#### Issue overview

The region is serviced by the South Coast Line which runs suburban services from Bondi Junction, though Central Station to Wollongong (including a spur line to Port Kembla) with the line terminating at Bomaderry.

Between Thirroul and Waterfall the South Coast Line follows the escarpment, which is a steep and winding route. This, in addition to the single track along some parts, results in slow train speeds, which contribute to an average speed of 50 km/hr.

The Illawarra escarpment limits the number and directness of east-west transport connectivity to three main road connections to the Southern Highlands and south west Sydney (Picton Road, Appin Road and the Illawarra Highway). Similarly, east-west rail connections are limited to the highly indirect dedicated freight line to Moss Vale.

#### Commuter and freight rail movements

Around 15% of the Illawarra's working population commute outside of the region for work purposes. These commuters travel distances of between 50 km (to the Sutherland Shire and Sydney outer south west, e.g. Campbelltown) and 100 km (to Sydney CBD) to reach their work destination.

Improved passenger and freight rail connectivity between the Illawarra, Sydney and West/South West Sydney would deliver economic and social benefit to all of the above regions. Enhanced rail infrastructure could boost productivity, reduce freight costs and travel times, improve safety and reduce congestion on some of Australia's most congested roads.

High public transport journey times, particularly for rail, impact negatively on the productivity of commuters who travel between the Illawarra and Sydney for employment. The focus on west and south west Sydney for both the state and federal government presents a new opportunity in the form of providing a solution that benefits the Illawarra.

#### Challenges and Opportunities

PricewaterhouseCoopers (PwC) in their report, *Linking The Illawarra: Improving the regions transport connectivity, assessing the key impediments and challenges faced in respect to rail transport between the Illawarra and Sydney*. The report includes a benchmarking exercise and highlights that the Illawarra's connectivity is around 25% worse than regional peers.

Estimates provided in this report identify the cost of moving passengers and freight between the Illawarra and Sydney are in the order of \$550 million per annum and that addressing existing bottlenecks and increasing travel times by both road and rail could reduce this cost by some \$400 million per annum.

<b>Rail transport opportunities and challenges</b>	
<b>Problems</b>	<b>Potential Opportunities and Challenges</b>
<p><b>Poor freight rail coverage</b></p> <ul style="list-style-type: none"> <li>• Indirect dedicated connection between Wollongong and major industrial land uses in Sydney's southwest.</li> <li>• Shared passenger rail network with no dedicated freight paths.</li> </ul>	<ul style="list-style-type: none"> <li>• Construction of a more dedicated rail corridor.</li> <li>• Negotiation of more dedicated freight 'paths' on the shared passenger network.</li> </ul>
<p><b>Below average passenger rail speeds</b></p> <ul style="list-style-type: none"> <li>• Commuters, as well as business and leisure travelers experience slow journey times when accessing Sydney.</li> </ul>	<ul style="list-style-type: none"> <li>• Existing rail infrastructure could be upgraded to deliver significant improvements to the accessibility to services and employment in the Illawarra.</li> <li>• The Illawarra escarpment limits the additional speed that can be provided without realignment.</li> </ul>
<p><b>Poor public transport frequency</b></p> <ul style="list-style-type: none"> <li>• Several major communities in the Illawarra experience long waits between train services.</li> </ul>	<ul style="list-style-type: none"> <li>• Existing rail infrastructure could be used more intensively to provide greater connectivity during the peak and non-peak periods.</li> </ul>

## Project Purpose

The Directed Research Report will be used to inform and support advocacy content and supporting strategies for Illawarra First. The report should be developed for a generic audience and cite relevant engineering specifications on an as-required basis. All material referred to during the research should be provided to Illawarra First.

The Report should provide detailed referencing to supporting evidence and should provide clear recommendations capable of influencing policy debate at senior government and business levels and support community engagement and consultation.

The Report should allow for the potential of either government or a combination of Private Public Partnerships to achieve outcome(s) and provide recommendations on how the proposed investment may be fast tracked.

The final report should cite, as necessary, quality research and evidence to support findings and observations and provide clear and concise recommendations.

## Scope

Respondents are asked to provide a proposal, including a suggested report framework for an Illawarra First Directed Research Report assessing the potential benefits from improved rail infrastructure between the Illawarra and Sydney. This proposal will form the basis of discussions between the proponent and Illawarra First about best ways to present the information to clearly demonstrate the return on investment for each recommendation.

The aim of the Report is to provide evidence-based policy solutions to influence political decision-makers and other opinion-makers to bring forward rail investments that will improve commuter and freight movements between the Illawarra and Sydney. It is the intention that this research be used to advocate for a 60 minute commute between Illawarra and Sydney.

Research should include, but not be limited to:

- Identification of measures and (if possible) gross order cost(s) associated with a projects, including information about the NSW/Australian Government's current commitments, total costs, timing, delivery methods, etc.
- Identification of infrastructure required to support high speed turnouts to reduce travel times and improve reliability of service.
- Value and details of investment required to improve freight rail access to Port Kembla.
- Future value and importance of the existing rail corridor following recommended upgrades/investment.
- Identification of the potential value to the NSW economy and relevant sectors (e.g. tourism, advanced manufacturing, education and health) of the delivery of the identified rail improvement measures.
- The associated benefits of improved rail transport against relevant criteria including the Illawarra First Project Prioritisation and Assessment Criteria provided.
- Potential costs associated with not investing in identified rail infrastructure. These costs may include foregone revenue, investment, employment or costs associated with reduced safety.
- Potential impact on key social indicators such as potential to support improved outcomes in social policy, e.g. housing affordability, employment creation, improved safety and general economic development.
- Identification of better approaches to identification and financing of such projects that might be pursued and advocated.
- How long-term investment plans for NSW rail may impact the future use and operation of the rail corridor between the Illawarra and Sydney for both commuter and freight movements.
- Provision of key messaging to be used in public advocacy and media messaging. It is expected that this research would include contacting key stakeholders to discuss relevant issues and information.

## Appendix B Stakeholder Consultation Summary

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SMART consulted several key stakeholders over the course of this project. We hosted two workshops to discuss options to improve transport connectivity (2 February 2017) and present our initial findings (8 June 2017). In the interim, information was sought from a number of sources including NSW Ports and Transport for NSW.

The workshop attendee list included:

- Illawarra First members
- NSW Department of Premier and Cabinet
- NSW Ports
- Port Authority of NSW
- SMART Infrastructure Facility academic staff

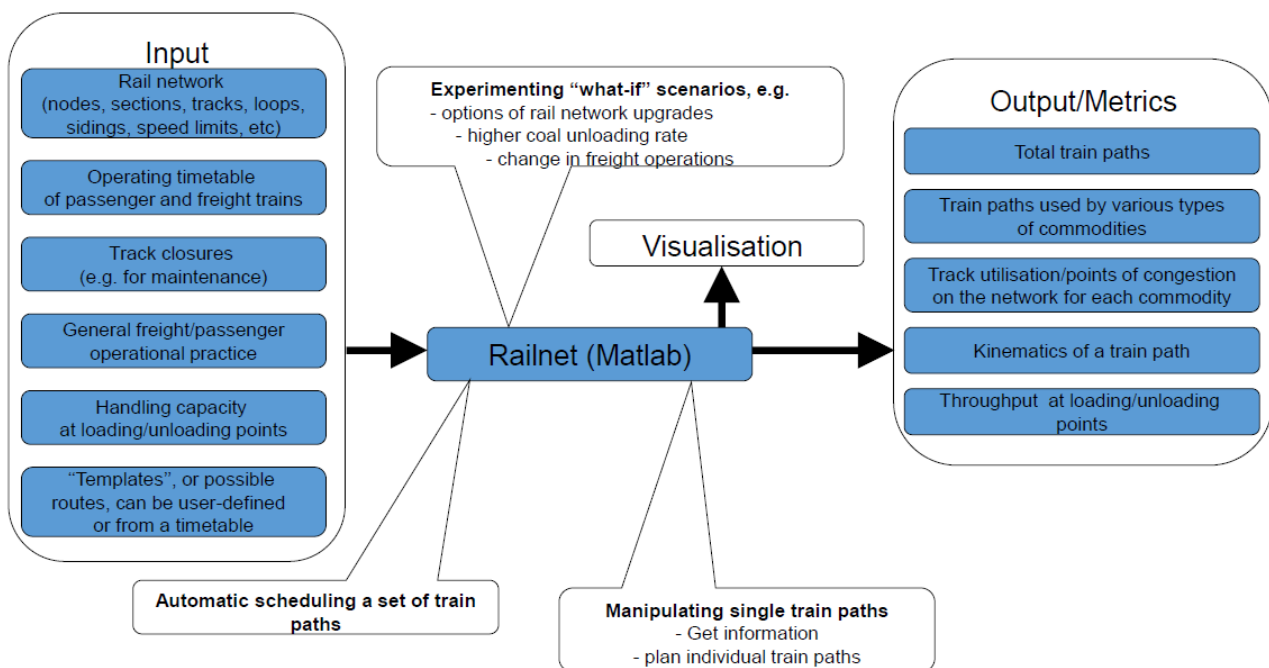
## Appendix C SMART’s RailNet Model

RailNet is a simulation-modelling platform for rail networks developed by the SMART Infrastructure Facility. It is formulated to describe rail movements within a network, in this case within the boundaries of the NSW RailCorp and ARTC rail network. The RailNet model maps the rail network components, for instance track sections, nodes and passing loops. The model also accounts for the attributes of the network such as speed limits, gradient, directionality, distances, etc.

The RailNet model runs in mathematical software called MATLAB<sup>7</sup>, where we upload the current network passenger and freight timetables and the various other ‘constraints’ on the network. RailNet is then used to simulate alternative timetables based on finding new available slots, changing speeds or other parameters (such as direction). The model can also be used to simulate the addition of new infrastructure, such as passing loops.

The model features a user-friendly graphical interface to perform operating/management tasks such as planning train paths, or viewing network statistics and performance.

The RailNet model can be schematically presented as follows:



As the figure above describes, the modeller is required to provide information including the operating train timetable, train network, trip to be planned, earliest departure time, minimum trip time, arrival time window and train length.

<sup>7</sup> <https://en.wikipedia.org/wiki/MATLAB>



The model then optimises the schedule of train paths (that is, in order to maximise the number or passengers or amount of freight moved along the network). The model can be used for both passenger and freight trains or in combination.

## Appendix D Cadence Economics CEGEM Model

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The SMART Infrastructure Facility has a commercial arrangement with Cadence Economics Pty Ltd to use its computable general equilibrium modelling software and database.

CEGEM is a multi-commodity, multi-region, dynamic model of the world economy. Like all economic models, CEGEM is based on a range of assumptions, parameters and data that constitute an approximation to the working structure of an economy. Its construction has drawn on the key features of other economic models such as the global economic framework underpinning models such as GTAP and GTEM, with state and regional modelling frameworks such as Monash-MMRF and TERM.

### **KEY ASSUMPTIONS IN CEGEM**

Labour, capital, land and a natural resource comprise the four factors of production. On a year-by-year basis, capital and labour are mobile between sectors, while land is mobile across agriculture. The natural resource is specific to mining and is not mobile. A representative household in each region owns all factors of production. This representative household receives all factor payments, tax revenue and interregional transfers. The household also determines the allocation of income between household consumption, government consumption and savings.

Capital in each region of the model accumulates by investment less depreciation in each period. Capital is mobile internationally in CEGEM where global investment equals global savings. Global savings are made available to invest across regions. Rates of return can differ to reflect region specific differences in risk premiums.

The model assumes labour markets operate whereby employment and wages adjust in each year so that, for example, in the case of an increase in the demand for labour, the real wage rate increases in proportion to the increase in employment from its base case forecast level.

CEGEM determines regional supplies and demands of commodities through optimising behaviour of agents in perfectly competitive markets using constant returns to scale technologies. Under these assumptions, prices are set to cover costs and firms earn zero pure profits, with all returns paid to primary factors. This implies that changes in output prices are determined by changes in input prices of materials and primary factors.

## Appendix E Discount Rate

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Estimating economic impacts across time periods can be problematic. For instance, aggregating the sum of economic impacts over, say, a decade in the future, can lead to an overestimation of impacts because, in very simple terms, “a dollar today is worth more than a dollar tomorrow”. We therefore discount future economic impacts in current dollar values so that we can then aggregate the dollar values of impacts into a single figure.

The question is, what is the appropriate discount rate to use? In general, there have been two approaches to selecting discount rates, namely:

- a ‘descriptive’ approach based on the opportunity cost of drawing funds from the private sector; and
- a ‘prescriptive’ approach that derives from ethical views about intergenerational equity.

When considering private sector infrastructure projects, the weight of argument favours choosing the descriptive approach to determining the discount rate. In practice, this means discounting future economic impacts at the ‘opportunity cost of funds’, which is reflected in the market interest rate. Harrison (2010) argues that:

“The efficiency-based approach to the social discount rate, which dates back at least to Harberger (1969), boils down to determining the opportunity cost of capital used in the project: what benefits to society would the funds have returned if left in the private sector. This ‘opportunity cost’ is the appropriate discount rate to determine a project’s capital value.” (p.16)

In order to be consistent with standard practice in Australia, we use a ‘social discount rate’ of 7% when calculating the ‘net present value’ of the economic impacts, which follows the Commonwealth Government guidelines as described in the Best Practice Regulation Handbook, Office of Best Practice Regulation (2007)<sup>8</sup>. It is arguable that this rate is a little high in the post-GFC world. For comparative purposes, we also estimate economic impacts using low (4%) and high (10%) discount rates and report results for 4% being, in our view, the more appropriate rate in the post-GFC environment.

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<sup>8</sup> [http://www.dPMC.gov.au/sites/default/files/publications/COAG\\_best\\_practice\\_guide\\_2007.pdf](http://www.dPMC.gov.au/sites/default/files/publications/COAG_best_practice_guide_2007.pdf)

**Illawarra Business Chamber/Illawarra First** is the Illawarra region's peak business organisation and is dedicated to helping businesses of all sizes maximise their potential. Through initiatives such as Illawarra First, the Chamber is promoting the economic development of the Illawarra through evidence-based policy and targeted advocacy.

The **SMART Infrastructure Facility**, at the University of Wollongong, is a multi-disciplinary applied infrastructure research centre. With a particular focus on infrastructure from an integrated and holistic perspective, SMART seeks to contribute to more resilient and productive infrastructure systems whilst supporting more liveable urban development.

**Illawarra First**

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