

From Roots to Routes

A ground up approach to freight and supply chain planning for the Northern Rivers NSW



Ken Doust

Andrew Swan

Elnaz Irannezhad

Hanna Grzybowska

David Wilson

Ofir Kuberman

January 2019 Research Report Prepared For:



ACKNOWLEDGMENTS

The study team acknowledge the Bundjalung People and Gumbaynggir People as traditional owners and custodians of the land on which the Northern Rivers Region exists.

This project has only been made possible with funding provided by;

- Regional Development Australia (Northern Rivers Branch)
- Northern Rivers Joint Organisation (formally NOROC)
- NSW Department of Premier and Cabinet

This study has benefited with the willing participation of many companies, agencies and individuals both within and external to the Region. The study team would like to express their sincere thanks for the willing participation of all stakeholder involved.

DISCLAIMER

While every reasonable effort has been made to ensure that this document is correct at the time of completion, Southern Cross University, its agents and employees, disclaim any and all liability to any person in respect of anything or the consequences of anything done or omitted to be done in reliance or upon the whole or any part of this document.

CONTENTS

APPENDIX A – Research Report (From Roots to Routes)	A1
Acknowledgments	A3
Disclaimer	A3
Introduction	A6
The Northern Rivers Region in profile	A7
Study area	A7
Regional characteristics	A8
Regional economic profile	A8
A short history of cooperatives in the Northern Rivers Region	A11
The Northern Rivers Region freight task	A12
The Northern Rivers Region freight connectivity	A13
Overview	A13
Domestic connections	A17
Framing a freight & supply chain strategy	A19
The need for a regional freight & supply chain strategy	A19
Relationship to other plans and strategies	A19
The methodology for this research	A20
Embedding resilience into freight planning	A20
Global supply chain trends	A22
The history and trends of supply chain Innovation and development	A22
Logistics 4.0 and digital disruption	A23
The agricultural supply chain	A24
Hubs	A27
Freight hub	A27
Inter-modal hub	A28
Food & Innovation Hubs	A28
Cool and cold storage	A28
Virtual hubs	A28
Stakeholder engagement	A29
Stakeholder identification	A29
Stakeholder prioritisation and evaluation	A29
Stakeholder engagement techniques	A29
Interview Issues and opportunities	A30
Assimilation of interview and workshop outcomes	A34
Modelling freight movements	A34
Findings: Improvement Initiatives in Freight and Supply Chain	A38
Global	A38
Access to ports	A38
Access into Asian markets	A41
Access for fresh goods into distant markets	A42
National & State	A42

B-double access to national markets and regional centres	A42
Availability, competition and scheduling	A43
Custom trailers v. standard trailers	A44
Government planning, regulation & approvals	A44
Regional and Local Scale	A45
Safety and wellbeing In freight and supply chain	A45
Supply and demand	A45
First-mile/last-mile	A46
The link with economic development & a food plan	A47
Cooperative approach	A48
Strategy for the Northern Rivers Region freight and supply chain	A48
Findings: Guiding Principles	A50
Resilience	A50
Cool and cold store locations and sizing	A51
Gold Coast Airport	A51
Toowoomba (Wellcamp) Airport	A52
Regional airports	A52
Rail Shuttle	A52
Bruxner Highway Upgrade	A53
Alternative road network route to Brisbane (not Pacific Highway)	A53
Food strategy	A54
Industry collaboration	A54
Safety and wellbeing in freight and supply chain	A54
References	A55

INTRODUCTION

The concept to research the freight and supply chain constraints and improvements in the Northern Rivers Region of NSW was borne from a partnership comprising Regional Development Australia – Northern Rivers Inc. (RDA-NR), Northern Rivers Region of Councils, NSW Department of Premier and Cabinet and Southern Cross University as research partner. Under this partnership, Southern Cross University has undertaken the research study and Strategy development as an important priority for all partners who need to better identify and understand the critical aspects of the freight infrastructure and supply chain issues in the Northern Rivers Region of NSW.

This Strategy and the underpinning research study has built upon the Scoping Report for a Northern Rivers Freight and Supply Chain Study completed by Southern Cross University in 2016, responding to the need for a strategy to improve the efficiency of freight movements to assist local industry and other stakeholders and improve the economic potential of the Region.

The objectives was therefore to make visible the impediments and supply chain restrictions of the Region's freight network, together with the opportunities, and develop strategies to facilitate the efficient and effective movement of freight to and from the Northern Rivers Region.

As a good quality transportation network is vital to a region achieving its economic growth potential, this would enable the appropriate regional development for the Northern Rivers Region of NSW.

A five step process was followed to meet these objectives by;

1. Identifying network and system deficiencies and opportunities, through in depth consultation with stakeholders,
2. Generating detailed and quantifiable network information using agent based modelling, that assists industry stakeholders to identify value adding initiatives and assist relevant levels of government to make transportation network planning decisions,
3. Analysing the information leading to a number of principles that characterise good supply chain approaches,
4. Determining a list of potential projects (initiatives) for the freight & supply chain network,
5. Proposing a Regional Freight & Supply Chain Strategy, providing a mechanism by which business and industry in the Region will have direct input into the ongoing formulation of the freight and supply chain initiatives.

The study included extensive stakeholder engagement and employed participatory techniques to seek stakeholder input, including interviews and participatory workshops. As a result, the study has benefited from the valued local input from the Northern Rivers' producers, manufacturers, council staff and industry bodies who took part in the interviews and workshop across the consultative months of the study.



THE NORTHERN RIVERS REGION IN PROFILE

STUDY AREA

The area that is the subject of this report is known as the Northern Rivers Region of New South Wales, Australia.

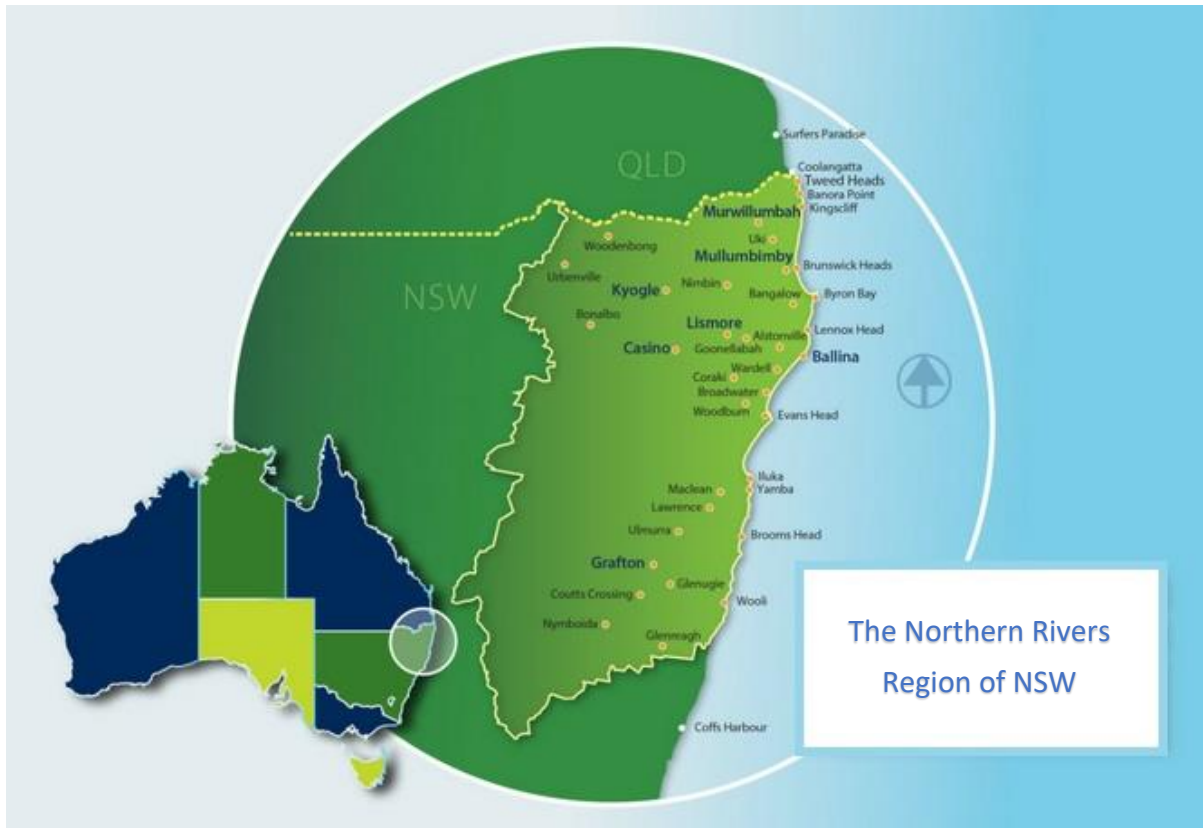


Figure 1 - Northern Rivers Region (Regional Development Australia - Northern Rivers, 2018)

The Region includes the following local government areas;

- [Ballina Shire Council](#)
- [Byron Shire Council](#)
- [Clarence Valley Council](#)
- [Kyogle Council](#)
- [Lismore City Council](#)
- [Richmond Valley Council](#)
- [Tweed Shire Council](#)

All councils except Clarence Valley Council are part of the [Northern Rivers Joint Organisation](#), a body which was formed on 22 June 2018, replacing the Northern Rivers Regional Organisation of Councils (NOROC). However the Clarence Valley Council area has been traditionally considered part of the Northern Rivers Region and is an integral part of the regional transport network.

REGIONAL CHARACTERISTICS

The Northern Rivers Region is located in north-eastern New South Wales, covering an area of 20,706 square kilometres. As shown in Figure 1, the Region is bounded by the NSW state border to the north, the Great Dividing Range to the west, coastline to the east, and the Mid-North Coast Region to the south. It has a population of almost 300,000 people and comprises the areas of Tweed, Byron, Kyogle, Lismore, Ballina, Richmond Valley and Clarence Valley. The Region is characterised by a unique sub-tropical climate, diversity of soils (e.g. alluvial, volcanic), rolling hills and valleys, coastal hinterlands, rivers and streams and a variety of pasture types.

This Region is characterised by some of the NSW coast's largest river systems in the Richmond, Clarence and Tweed River systems, indigenous protected areas, and national parks and nature reserves which occupy 23% of the reporting region.

The area sustains increasing population levels, with associated industry, development and agriculture. Significant changes have occurred since European settlement, with major timber industries clearing large parts of the North Coast Region in the late 1800s, clearing for agricultural use, and alterations of rivers and estuaries for water supply, cropping and other purposes. Current industries in the Region include grazing, timber, horticulture, cropping, commercial fishing, dairying, aquaculture and tourism.

The Region faces a range of pressures including an increasing population centred on the coast, associated increasing natural resource use and demand for agricultural lands. (based on the 2016 State of the Environment report (NSW EPA, 2016)).

The Region's demographic makeup is reflected in the following infographic.



Figure 2 – Demographics (Source: www.communityprofile.com.au)

REGIONAL ECONOMIC PROFILE

Three Regional Economic Development Plans (REDS) collectively make up the strategy for underpinning the future of the Northern Rivers Region economies. The Clarence Valley, The Northern Rivers and the Tweed Shire REDS were all completed in 2018 and provide economic direction for the next 5 years. The economic profile of the whole of the Northern Rivers Region, is shown at a high level, in Figure 3 below.

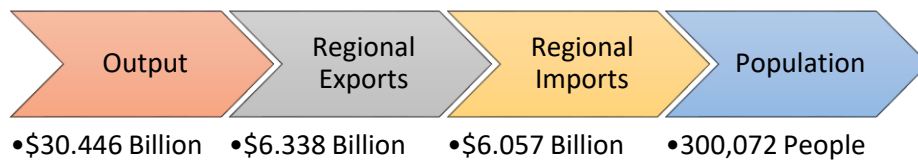
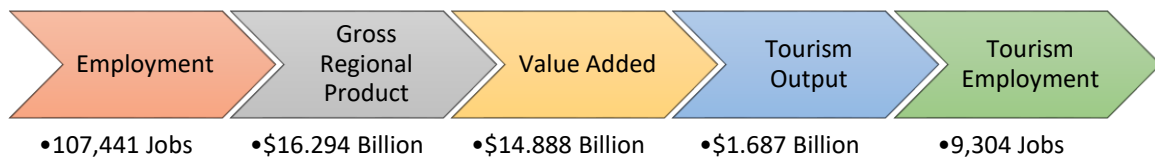


Figure 3– Northern Rivers economic profile information (source: profile.id.com.au)

The industry and employment profile is shown in the following figures, for each of the three zones of the Clarence Valley, Northern Rivers and the Tweed Shire within the Northern Rivers Region,

Employment by Industry: Clarence Valley Compared to NSW 2011-2016

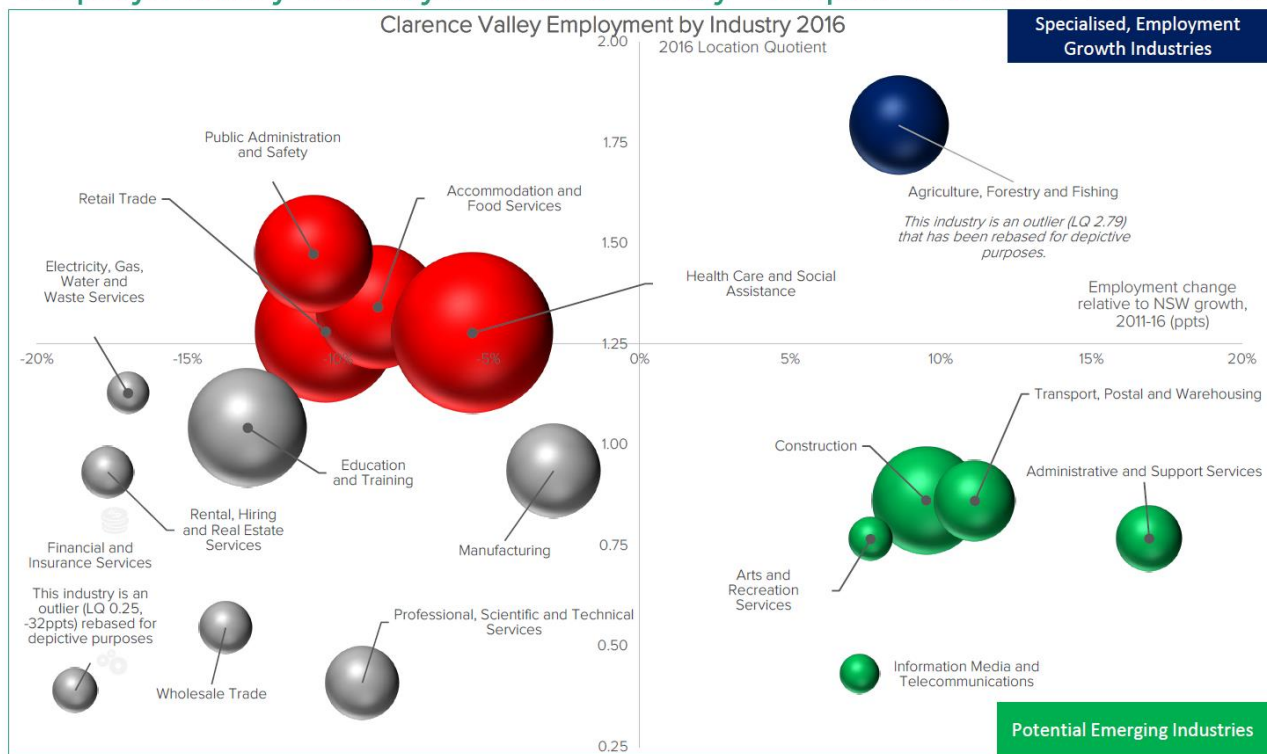


Figure 4 – Clarence Valley zone (source: Clarence Valley, 2018)



Specialisations and Shifts in Employment Over Time

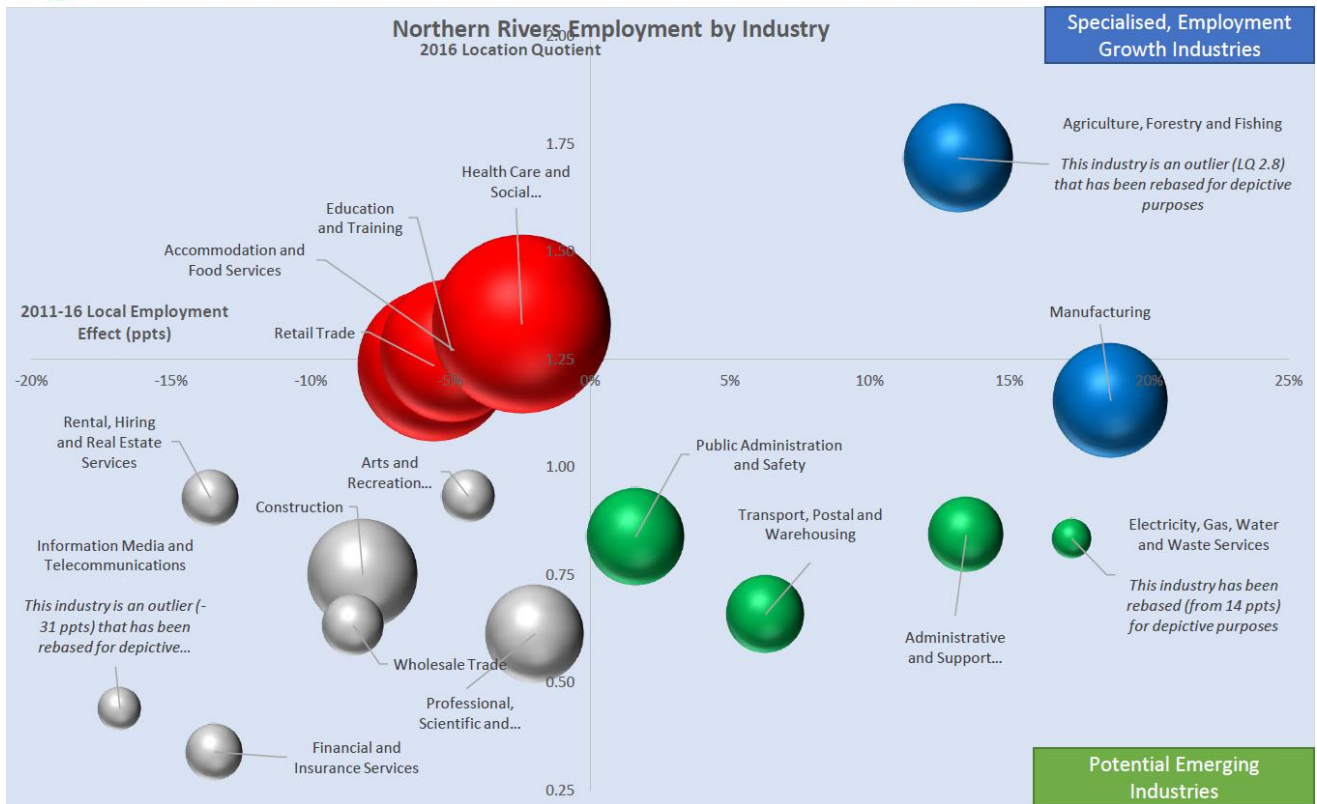


Figure 5 – Ballina Shire, Byron Shire, Lismore City, Kyogle, Richmond Valley zone (source: Northern Rivers, 2018)

Employment by Industry: Prevailing Strengths and Recent Changes

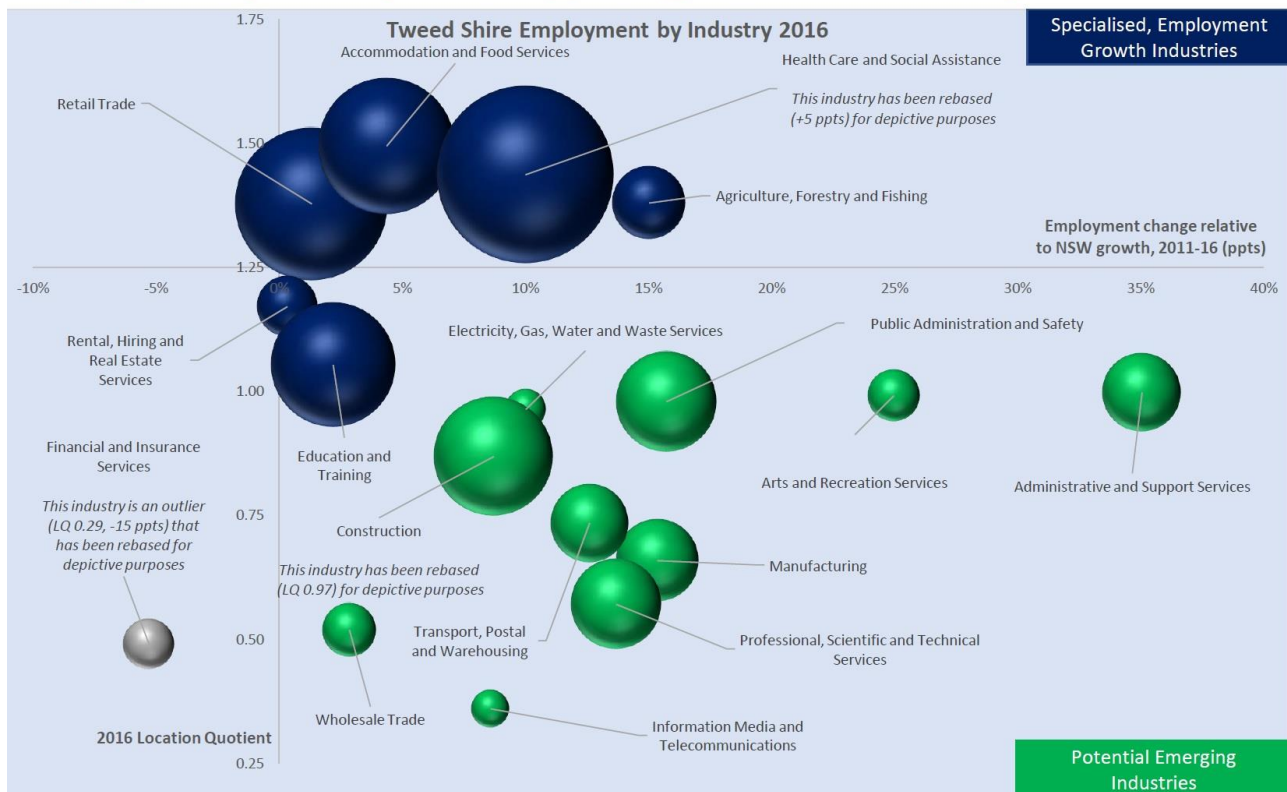


Figure 6 – Tweed Shire zone (source: Tweed Shire, 2018)

Of these, the agriculture, forestry and fishing are growing at a faster rate than the NSW average in each zone, Clarence Valley (9% more), the Tweed Shire (15% more) and the Northern Rivers (14% more). Manufacturing is a little below the state average in the Clarence Valley zone, however a major boat manufacturing initiative has been established in 2018 which will stimulate this sector. Manufacturing is emerging with high growth compared to the state average in the Tweed Shire zone (25% more) and the Northern Rivers zone (19% more). Both of these industry sectors have important supply chain dependencies.

A SHORT HISTORY OF COOPERATIVES IN THE NORTHERN RIVERS REGION

Cooperatives have been a part of the Northern Rivers Region from before the 1950's. Fishermen's cooperatives for example were established on the Richmond River at Ballina and on the Clarence River at McLean and Yamba in the 1940's as a way of gaining a stronger market presence and more cost effective logistics and support for fishing, by pooling product to gain a better price, investing in market initiatives and sharing resources. Large cooperatives such as NORCO and the Northern Cooperative Meat Company Ltd are other key examples of pooling together to enable anchor manufacturing facilities for the Northern Rivers economy. Cooperatives whether formal or less formal collaborations, continue to be an important feature of the Northern Rivers Industry and economy. Some of the newer directions are at a smaller scale in virtual networks, in sustainable agriculture approaches, increasing brand awareness e.g. Northern Rivers Food a

network in the eastern precinct of the Northern Rivers. The Farming Together Program hosted by Southern Cross University, has seen a great enthusiasm to take up on new small scale cooperatives across Australia, an important share of these being in the Northern Rivers. The program is providing a resource for guiding and building the establishment of cooperatives and other forms of collaboration.

THE NORTHERN RIVERS REGION FREIGHT TASK

The freight task in the Northern Rivers is predominately a diverse mix of trucking activities which support farming, food processing, manufacturing and other activities in the Region.

Freight activity in the Northern Rivers Region requires interconnectivity between regional, inter-regional and international producers, manufacturers and markets. Many different industries rely on these supply chain connections to operate and thrive. Production and manufacturing in the Region is a diverse mix of types and scales; with boutique, local goods production (tea, coffee, construction materials, extracts and so on), to major activities in forestry and the sugar industry. The Region includes fisheries, a diverse mix of fresh fruit, vegetables, nuts, meat, milk and milk goods and beverage manufacturing, all at both a small and larger scale.

At the larger scale, there is the sourcing of raw materials/milk/livestock from neighbouring regions in NSW and QLD for processing in the macadamia, milk product and meat industries, through to the regional movements of raw and processed sugar and seafood to Australian markets and international shipping exports for milk products and wagu beef. At a smaller scale of production, specialist tea and coffee producers rely on international imports for mixed and single original tea leaves, specialist coffee beans, through to the export of the Region's goods to the growing Asian markets for boutique Northern Rivers Region goods (such as hemp goods or fruit extracts).

Many Northern Rivers Region producers and manufacturers compete effectively in the national and international marketplace and rely on this competitiveness to survive and prosper. Freight efficiency within and outside the Region is one factor that can affect competitiveness, both in the ability to access raw materials and to reach markets in a timely manner. It is both an enabler and a limiter to economic activity across the Northern Rivers Region, a key ingredient to the productivity of the Region. The coordination and efficiency of these freight movements range from advanced scheduling programs which direct truck movement based on remote sensor results, to traditional demand driven freight scheduling.

The strength of the Northern Rivers Region freight and supply chain is the local knowledge of established, community based businesses and the history of cooperative businesses, the relationships between and within industries and government and some key infrastructure such as the recent (and continuing) upgrades of the M1 Pacific Highway links to Brisbane and Sydney.

However; without change, businesses and communities will find it increasingly hard to compete against other regions and international suppliers for market share. The Region needs increased connectivity to raw materials available from outside the Region for processing and more efficient and new ways of reaching domestic and international markets.

THE NORTHERN RIVERS REGION FREIGHT CONNECTIVITY

This section describes how the Region is connected both internally and externally.

OVERVIEW

Within the Region are four major road corridors, two north-south links and two east-west links, as well as the main north-south rail corridor from Brisbane to Sydney/Melbourne, as shown in Figure 7. Any existing transport limitations would challenge industries in the Region, affecting the delivery of raw materials and the export of finished products, particularly to markets and gateways in south-east Queensland.

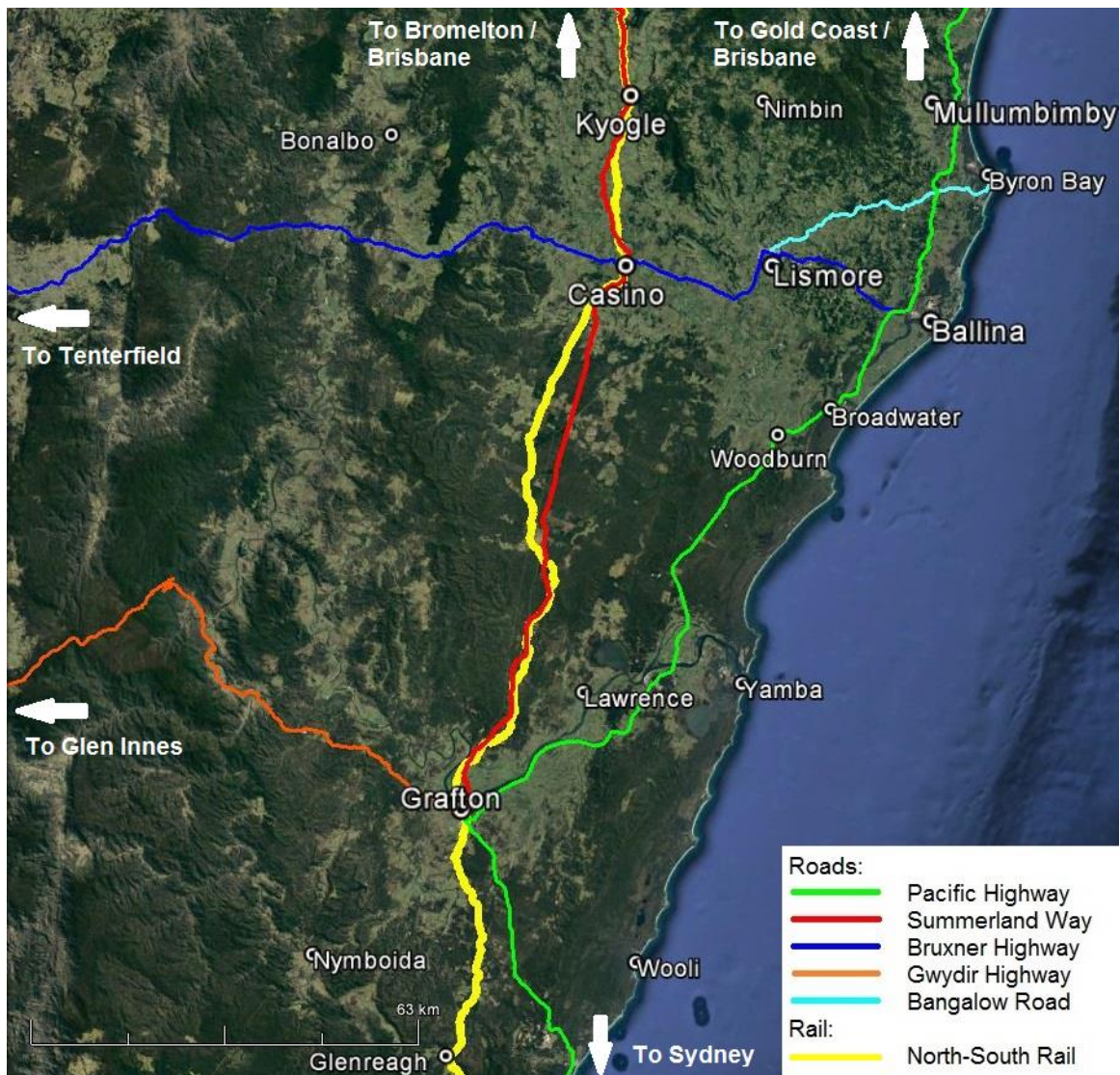
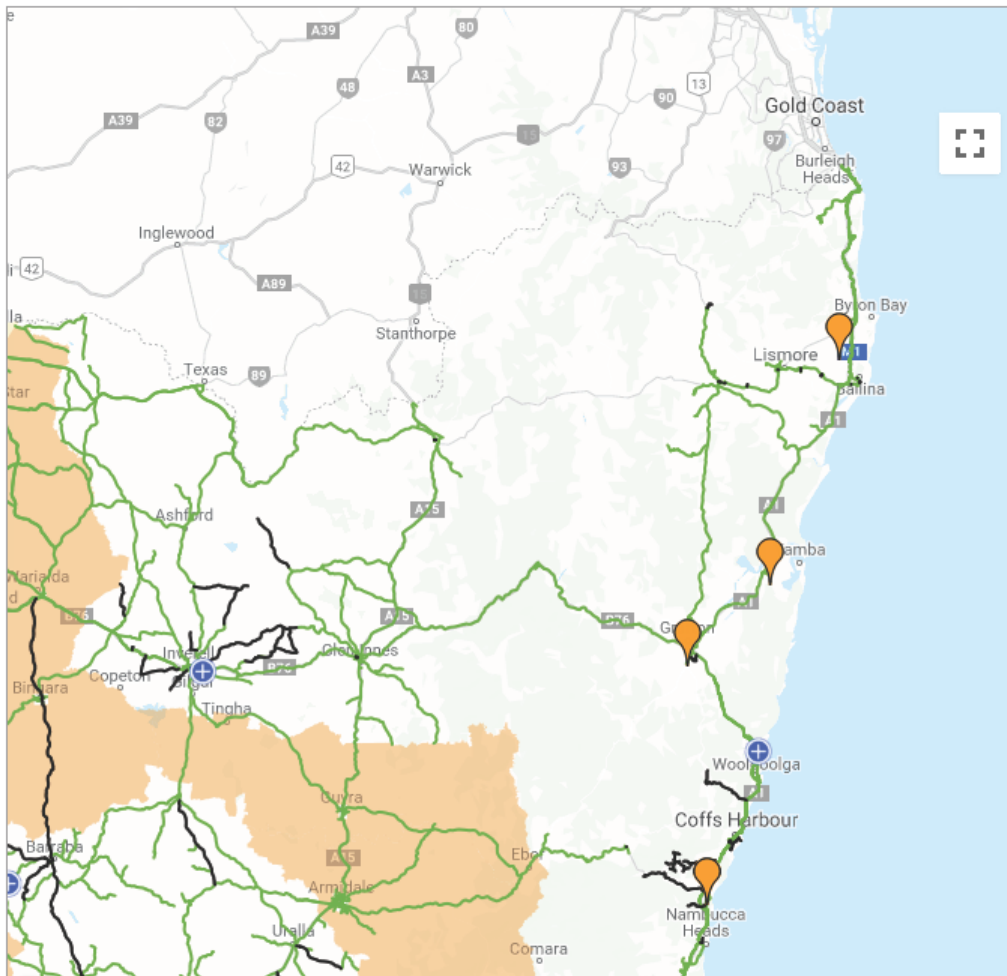


Figure 7: Northern Rivers Region major road and rail corridors (Source: Google Maps)

NSW Combined Higher Mass Limits (HML) and Restricted Access Vehicle (RAV) Map



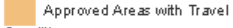

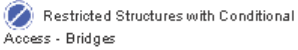
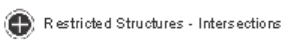
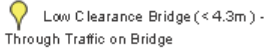
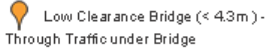
Map last updated: 12/12/2018



Map data ©2018 Reporta/Mapbox

Legend

GML and CML networks

 23m B-double Routes	 Approved Routes With Travel Conditions	 Exception Routes (not approved)
 Approved Areas	 Approved Areas with Travel Conditions	 Restricted Structures - Bridges
 Restricted Structures with Conditional Access - Bridges	 Restricted Structures - Intersections	 Restricted Structures - Intersections with Conditional Access
 Low Clearance Bridge (< 4.3m) - Through Traffic on Bridge	 Low Clearance Bridge (< 4.3m) - Through Traffic under Bridge	

Network Disclaimer
 The networks are available for short combinations (up to 19 metres long) and B-doubles that comply with the requirements contained in the Heavy Vehicle National Law (HVNL); the [National Class 2 Heavy Vehicle B-double Authorisation \(Notice\)](#) and the [adjoining NSW Schedule](#) and for Higher Mass Limits (HML) the [New South Wales Higher Mass Limits Declaration 2015](#). These networks are based on a maximum vehicle width of 2.5 metres and are subject to sign-posted restrictions.

Figure 8 - NSW B-double routes (source: NSW RMS)

ROADS

- A network of arterial roads includes
 - Pacific Highway running north-south on the coast, connecting the Northern Rivers Region to Sydney and Brisbane via the Gold Coast. This is one of the busiest road corridors in Australia and the busiest within the region. It is currently undergoing major upgrade works aimed at increasing capacity from a two lane highway to a four lane divided road along the entire length of the highway. Major sections between Woolgoolga and Ballina are under construction due for completion in 2020. An emerging issue for this link to Brisbane is the increasing congestion during peak periods north of the Gold Coast Airport.
 - Summerland Way, running north south inland via Grafton, Casino, Kyogle and connecting with the Mt Lindesay Highway to Beaudesert and beyond. This corridor provides important cross connectivity between the Pacific/Gwydir Highways at Grafton and the Bruxner Highway at Casino, giving a more direct southern connection to the Casino region and serving as an important detour route if the Pacific Highway is closed between Grafton and Ballina. The Summerland Way route is recognised as a potentially alternative route from Grafton to freight centres and the Port of Brisbane. However, while both the Pacific Highway and Summerland Way corridors play important roles as north-south regional freight routes, only the Pacific Highway accepts up to 26 metre B-doubles along the full length of its corridor, Summerland Way only accepting 26 metre B-doubles south of Kyogle. B-doubles needing to divert back to the Pacific Highway via the Bruxner Highway from Casino to Ballina to continue their trip north. In conjunction with the lack of a viable east-west corridor for larger heavy vehicles west of Casino, this sees the Pacific Highway as the only feeder for B-double vehicles into the South-East Queensland growth areas from much of the Northern Rivers Region.
 - The Gwydir Highway in the south of the region also provides a route for 26 metre B-doubles from Grafton to Glen Innes, Inverell and Moree. It links with the Pacific Highway and Summerland Way near South Grafton, after which it continues to the New England Highway at Glen Innes and further west through Moree and up to the Southern Downs area of Queensland.
 - Bruxner Highway running east-west, connects the Pacific Highway, Summerland Way and Tenterfield. While both the Gwydir and the Bruxner highways play important roles as east-west regional freight routes, of the two links only the Gwydir Highway accepts up to 26 metre B-doubles on its full length between the New England Highway and the Pacific Highway (RMS 2009). This is due to mountainous terrain and limited pavement suitability on the Bruxner Highway west of Casino, currently proving unsuitable for the larger B-double vehicles. The B-double route from Casino to the Pacific Highway at Ballina provides the key B-double access for the western precincts of Casino, Kyogle and Lismore to Queensland destinations such as the Port of Brisbane. The route through Lismore is frequently congested due to traffic volume limitations at the Wilson River Bridge (currently single lane each way) and a sequence of roundabouts between South Lismore and Goonellabah. Alternatively, there exists a designated 26 metre B-double route between Casino and North Woodburn, however this a longer journey for north bound trips from the Casino area, than journeying via the Bruxner Highway.
 - Bangalow Road running north east between Lismore and Bangalow on the Pacific Highway is designated for semi-trailer traffic and not currently designated for B-double traffic.

RAIL

- The coastal north south rail corridor operates between Sydney and Brisbane runs through the Northern Rivers Region. The alignment of this corridor passes through Grafton, Casino and other

towns such as Glenreagh and Kyogle. This standard gauge corridor is largely single track with multiple stations, passing loops, private sidings and support sidings between Glenreagh and the Queensland border. Due to corridor conditions, such as difficulty in gaining reliable train paths through metropolitan Sydney on the passenger network, trains using this alignment are limited to lengths of 1500 metres. Freight services predominately go through the region, though some producers utilise the service for dispatch of bulk goods. The current train consists that travel between Melbourne, Sydney and Brisbane make it difficult to stop and pick up from intermodal terminals such as Grafton Casino and Kyogle. Some operators advise that to leave capacity on the train to pick up from the Northern Rivers Region for destinations in Brisbane would require the train to be left short from Sydney impacting the viability of servicing with through trains which are currently limited to 1500 metres in length. This would not be a limitation for pickups from the Northern Rivers Region for destinations in Sydney or Melbourne. Currently the only designated intermodal terminal location in the Northern Rivers Region is at Casino.

The coastal north south rail corridor into Queensland connects the Northern Rivers Region with the significant rail supply chain network in Brisbane and its western and south-western hinterland, known as the scenic rim. Presently, the major intermodal terminal in Brisbane is Acacia Ridge, to the south of Brisbane CBD and a key terminating point for the north south rail services from Sydney and Melbourne. Acacia Ridge is also connected to the Brisbane Multimodal Terminal at the Port of Brisbane via a dual standard and narrow gauge corridor which enables inbound containers to be sent by rail through to Sydney and Melbourne and outbound containers to be shipped from the Port of Brisbane. A shuttle service is planned to operate between the Port of Brisbane and Acacia Ridge to increase the mode share by rail into and out of the Port.

While the Acacia Ridge terminal has sufficient capacity at present for both its interstate and intrastate freight task, increasing growth in freight volumes by rail and increasing congestion in the inner Brisbane region is beginning to shift longer term planning towards additional terminals in the west and southwest of Brisbane. An emerging intermodal terminal in this area that has close proximity with the Northern Rivers Region is at Bromelton, to the west of Beaudesert. The Bromelton Intermodal Terminal and industrial site is now a designated State Development Area and is shaping to play an increasing role strategically in the southern Queensland freight distribution network. The terminal is located on the north south rail corridor from Sydney and will be connected to the inland rail corridor via a triangle junction at Kagaru, 13 km to the north of Bromelton. More recently, freight operator SCT has established an intermodal terminal that commenced operation in 2017 and are considering utilising shuttle trains between the Port of Brisbane and Bromelton as a strategic addition to their current rail operation based within Brisbane.

The Inland Rail corridor is expecting completion in 2024/25 and will allow access to full inland rail services from the Northern Rivers Region. The nearest location to the Northern Rivers is the Bromelton intermodal facility which is accessible via road (B-double through the Pacific Highway) or rail (existing coastal rail network). Toowoomba, Narrabri, Parkes and Melbourne are also accessible via the inland rail corridor.



Figure 9: Principal stops along the Inland Rail Corridor between Brisbane and Melbourne (Source: ARTC 2018a)

AIR

- International air freight is currently serviced with three airports; Brisbane, Gold Coast and Toowoomba (Wellcamp). Brisbane and Gold Coast airports provide mixed passenger / freight services whereas Wellcamp provides dedicated freight services.
- Wellcamp’s services include a weekly flight (on Tuesdays) direct to Hong Kong. This allows connection to Cathay Pacific’s worldwide air cargo freight distribution network (Toowoomba Wellcamp Airport , 2018).
- Due to limited current use of airfreight in the Northern Rivers; air freight, where it does occur, is typically ex-Brisbane airport.

SEA

- International export is currently accessed via the Port of Brisbane. The Port of Brisbane is the third largest seaport in Australia, importing containers and exporting both bulk and containers.
- Some goods are transported domestically via the Port of Melbourne (to Perth).
- Some small scale non container load shipping to Pacific Islands takes place from Yamba.

DOMESTIC CONNECTIONS

TO/FROM MARKET

Currently, the majority of freight is transported via road between the Northern Rivers Region, Brisbane, Sydney and Melbourne. Rail services are utilised for Melbourne and Adelaide connections, with rail and sea services connecting the Region to Perth. However, regardless of destination road services provide access and flexibility to reach any domestic location or port.

TO/FROM REGIONAL

For finished goods, there are many examples of goods produced within the Northern Rivers Region being used within the Northern Rivers or by adjacent regions. Typically, these goods are first shipped to central locations (Sydney, Brisbane) before being sent back to the Region.

For the supply of raw goods to their relevant processing facilities, there is no ‘line’ which separates between regions. Farm gate to processor movements are likely to occur between the regions as within the Northern Rivers (see below).

WITHIN THE REGION

Farm gate to manufacturer / processor services are a substantial portion of goods movements within the Region. Examples include sugar cane to mill, blue berries to packaging and macadamias to processor. These same movements, which occur within the Region, also occur between the Northern Rivers Region and nearby regions including significant movements between the Northern Rivers Region and the Southern Downs (QLD) (i.e. macadamias and blueberries), the movement of livestock within and around the Region and the transport of fresh milk to processing facilities outside the Region (or from outside into the Region).

Examples of this include;

- beef from Northern Territory, SE Queensland and Victoria to Casino for processing,
- pigs from Chinchilla for processing at Booyong
- milk from Melany, Dorrigo, north Queensland and even Victoria and South Australia to Casino and Lismore for processing into dairy products
- Macadamia nuts from Nambucca, SE Queensland and Bundaberg, Toowoomba, Kingaroy, shells to Gympie

A unique feature of this transport activity, is that there is little control on behalf of the producer in terms of the variability / seasonality of the task. Apart from onsite storage, which is typically used to store goods until they are in volumes enough to be transported by B-double (where B-double access exists).

FRAMING A FREIGHT & SUPPLY CHAIN STRATEGY

THE NEED FOR A REGIONAL FREIGHT & SUPPLY CHAIN STRATEGY

In 2017, the Northern Rivers Regional Organisation of Councils (NOROC), together with the NSW Department of Premier and Cabinet and Regional Development Australia (Northern Rivers) engaged Southern Cross University to scope the need for a regional freight strategy.

This strategy was to align with the NSW Freight and Ports Plan as well as be comparable to the adjacent plans prepared by other Regional Organisations of Councils (ROCs). The scoping study identified that a regional freight study and strategy for the Northern Rivers was a 'missing link' for freight planning and an important factor to economic prosperity for the Region.

RELATIONSHIP TO OTHER PLANS AND STRATEGIES

In 2018 the NSW State Government released the NSW Freight and Ports Plan. This Plan has five strategic objectives; economic growth, efficiency, capacity, safety and sustainability. The Plan highlights the near \$1b available to assist the implementation of freight improvement opportunities under the Restart NSW program (Fixing Country Roads \$543 and Fixing Country Rail \$400m), the Saving Lives on Country Roads Program (\$640m), Bridges for the Bush as well as the Regional Road Freight Program which has the goal of ensuring that funding for road upgrades target freight improvements also.

The Plan also specifically mentions proposed improvements to the Summerland Way "which operates as a key freight link for the timber, cattle farming and meat manufacturing industries, including lane widening, intersection upgrades, safety infrastructure upgrades improvements, flood immunity works and maintenance" (TfNSW, 2018a).

Also released in early 2018 was the Regional NSW Services and Infrastructure Plan by the NSW State Government. This plan identified a number of infrastructure initiatives which have been listed in Appendix F of this report. The directions from the Regional NSW Services and Infrastructure Plan are to establish more detailed regional plans, together with detailed place based plans specific to priority centres and corridor plans that integrate initiatives along linear corridors (TfNSW, 2018b).

Other relevant initiatives within NSW are;

- Regional Airports, (particularly the use of Toowoomba (Wellcamp Airport))
- Heavy Vehicle Road Reform – though the 'user pays' system of Heavy Vehicle Road Access is still in early stages of development and it is not yet clear if or how this will affect freight in the Northern Rivers.
- Assistance to Local Government Agencies, through education and access to resources (such as the Restricted Access Vehicle Route Assessment Tool (www.ravrat.com)).

This report aligns with the NSW Freight and Ports Plan but has also been developed to complement the existing Council (and other) strategies in the Region.

These other supporting strategies include;

- A. Regional Economic Development Strategies for the Northern Rivers, Tweed and Clarence Valley
- B. Economic Development Plans for each Local Government Area
 - Tweed, Byron, Ballina, Clarence, Richmond Valley, Lismore and Kyogle.

- C. RMS Corridor Studies for Summerland Way (Draft), Bruxner Highway (Ballina to Tenterfield) and Bangalow Road (Draft).
- D. South East Queensland Draft Regional Transport Plans 2018
- E. Community Strategic Plans for each Local Government Area
- F. Kyogle Council Advocacy Reports
 - The Summerland Way – A long term Plan
 - Briefing Note “Legume to Woodenbong”
 - Cross Border Issues
 - Bridges Briefing Paper
 - Clarence Way – Briefing Paper
 - Tabulam Agribusiness Precinct Briefing
 - Kyogle Council issues Briefing
 - Kyogle Council Submission Summerland Way
- G. Clarence Valley Council Advocacy Reports
 - Clarence Valley Transport Hub Pre-feasibility Report
 - Transport Precinct Study
- H. Tweed Council Advocacy Reports
 - Tweed Road Development Strategy 2017
- I. Adjacent Regional Transport Strategies
 - New England
 - Mid-North Coast

THE METHODOLOGY FOR THIS RESEARCH

This methodology of this study was to undertake a ground-up investigation of freight movements, needs, barriers and aspirations in the Region. Having identified these local needs there was a testing against current industry trends and opportunities and testing with a freight model developed for the Region.

The freight model was developed in alignment with the Freight Model published under the NSW Freight and Ports Plan.

An important objective of this study is to identify vulnerabilities within the ‘system’ and as such incorporate resilience factors into the developed strategies. This may result in unique strategies that align specifically with resilience issues, or a modification of, or confirmation that the identified strategies will improve or at least not negatively affect resilience. Of course, what is resilience in this context? This is discussed in the next section.

EMBEDDING RESILIENCE INTO FREIGHT PLANNING

There is not a large body of literature that supports an understanding of the application of resilience in an infrastructure planning context (Susara E. van der Merwe, 2018). There is little sense of a consistent use of the definition of resilience, instead the ‘common understanding’ of the term seems to be used in preference to a unifying definition. For example the National Climate Resilience and Adaptation Strategy does not define the meaning of the terms resilience or adaption used in their report. The 100 Resilient Cities Network (a group that aims to improve the resilience of cities around the globe) defines urban resilience as ‘the capacity of individuals, communities, businesses and systems in a city to survive, adapt and grow, *no matter what chronic stresses and acute shocks they experience*’ (100RC, 2019).

This would imply that resilience planning is firstly interested in understanding chronic stresses and acute shocks that affect, in this case, the freight and supply chain of the Northern Rivers. Next, if these stresses/shocks affect the ability of the affected to survive, adapt and grow then planning measures should be introduced to improve the capacity of the affected to survive, adapt and grow.

In this case, to survive would mean to continue with the existing business activity /freight task in the Region. To grow would be to increase the productivity or efficiency of the business activity / freight task. And to adapt would be to have the ability to change the nature of the business activity / freight task in the future.

There seems little in this understanding of resilience that is not ‘business-as-usual’ risk based infrastructure planning. So, our current time’s focus on ‘resilience’ is either a rebranding of the existing processes of planning or has somehow emerged into collective consciousness for some other reason. The perceived need for emphasising resilience could be;

- The acute awareness of the looming need to consider climate change risks to existing and new infrastructure
- The increasing speed of emergence of new stresses and shocks (apart from and including climate change) and therefore the likely appearance in the near to medium term future of as-yet unknown stresses and shocks
- An awareness that ‘status quo’ methodologies of the past have contributed to the vulnerabilities of the present

In response to this current context, the 100RC framework Table 1, suggests a set of attributes that define resilient cities that can also be translated to communities and regions.

Table 1 - Attributes of resilient cities. (Source; www.100resilientcities.org)

Attribute	Definition
Reflective	using past experience to inform future decisions
Resourceful	recognising alternative ways to use resources
Robust	well-conceived, constructed and managed systems
Redundant	spare capacity purposively created to accommodate disruption
Flexible	willingness and ability to adopt alternative strategies in response to changing circumstances
Inclusive	prioritize broad consultation to create a sense of shared ownership in decision making
Integrated	bring together a range of distinct systems and institutions

The participatory techniques employed by this study have been designed to bring about more resilient outcomes. One thing to note here is that resilient solutions are integrated with other systems and this report is targeted specifically towards one system – freight and supply chain. It is important, that as the initiatives identified in this report are progressed that they are considered in a holistic and participatory way, with a broad stakeholder base, so they are integrated with broad community and government opportunities.

GLOBAL SUPPLY CHAIN TRENDS

THE HISTORY AND TRENDS OF SUPPLY CHAIN INNOVATION AND DEVELOPMENT

To sketch out the idea of best practice in supply chain today we begin by looking at the history of the development of supply chain management. When, for instance, did the term “supply chain” appear in academic and industry literature? When did universities begin to market courses in supply chain management that promised delivering best practice skills? When did organisations create positions of supply chain management executive reporting directly to the CEO on the same level as other organisation functions?

The idea of supply chain management was developed from integrated logistics which was in turn developed from logistics. Logistics as a concept developed from the study and practice of physical distribution in a business, typically a manufacturing business. Physical distribution was usually taught in universities and colleges as part of a marketing course. It was the “place” in the original 4P’s of marketing (Price, Product, Promotion and Place). Physical distribution concentrated on the relationship between a manufacturing company and a customer. Typically, it involved warehousing and transport of goods to customers from factories.

The importance of physical distribution was identified in a 1962 Fortune article by Peter Drucker “The Economy’s Dark Continent”. This article was significant because it focussed readers of Fortune (senior managers and CEO’s) attention on the value of activities that they never identified as critical to their business, warehousing and transport. Up until that time (and for a substantial period after) organisations identified manufacturing, finance and marketing as the key components to be managed in a business. Organisational structures reflected this until relatively recently. In the latter half of the 20th century, physical distribution was usually a department reporting either to a factory or marketing manager. The physical distribution function was subordinate to manufacturing, finance and marketing. Today most large corporations have a logistics manager or a supply chain manager at an executive level reporting directly to the CEO. This change might be attributed to Drucker and his 1982 Fortune article.

In 1963 in the USA the National Council of Physical Distribution (NCPDM) was created in response to the growing recognition of the importance of physical distribution. The focus in the early days was very much on processes within a company involving inventory, warehousing and transport of orders to customers. Then came the realisation that inwards raw materials needed to be managed as well as outbound delivery. From this realisation came the use of the word logistics which began to be taught in universities and colleges in the 1960’s. University departments were created with names such as marketing and logistics which reflected the nexus between those two business functions.

In 1985 the NCPDM changed its name to the Council of Logistics Management (CLM). Logistics in organisations was recognised as an important function which began to include purchasing and management of inwards raw materials and services, order processing and management, inventory, warehousing, transport to customers and customer service. A popular classic customer service text in 1987 was Carlzon’s “Moments of Truth” which described his management of the customer experience when he was at SAS. It is worth pointing out that the term “customer experience” was not used in corporations until more recently. Pre-the 20th century and the rise of the internet the term used in business and academia was “customer service”. Logistics managers knew that customer service was critical to their organisations performance and metrics to measure customer service were used to improve customer service. This meant aiming for orders to be delivered in full and on time (DIFOT).

In 2005 the CLM changed its name to Council of Supply Chain Management Professionals (CSCMP) to reflect the changing nature of logistics in corporations. This has also occurred in the name change in the United Kingdom, Chartered Institute of Transport to Chartered Institute of Logistics and Transport.

In 1989 the CLM began an annual survey of logistics practices in the USA and around the world. Each year a report was produced which covered a multitude of variables important to logistics and supply chain. An excellent discussion of the 2018 report by a panel of experts is available on YouTube as the 29th Annual State of Logistics Panellists video (Monahan, 2018). It is a two-part video discussing the results of the survey. The panellists were a port operator, a consumer products and industrial products supply chain manager, a 3PL provider, a railroad operator and a supply chain consultant. The following list of technologies and strategies were discussed by the panel.

Table 2 - Technologies and Strategies identified in 29th Annual State of Logistics video

Technologies	Strategies
1. Block chain (invented 20 years ago)	1. Omni channel
2. Internet of Things	2. Pop up warehouses
3. Robotics	3. Network design optimisation
4. Artificial intelligence	4. Simulation
5. Automatic guidance	5. Transparency in supply chain – track and trace
6. Drones	6. Fast/Flexible/Reliable/Lowest Cost
7. Ecommerce – email/www/social media	7. Last mile delivery
8. Electronic logging devices (limit driving hours leading to driver shortages)	

The leading edge of technology applications in supply chain occurs within organisations usually not in research or teaching oriented institutions such as universities. The state of the art is being applied in supply chains currently. Industry forums, seminars and meetings are the best sources of current information on technology applications- see for example 29th Annual State of Logistics Panellists YouTube video. Learned journals such as those in the appendix lag in their discussion of current technologies by at least a year if not more. There are a few reasons for this. Commercially sensitive technologies that confer a strategic or operational advantage in an organisation are usually closely guarded. Then there is the editorial review process of getting a journal published in a high-quality logistics or supply chain journal.

The leading technologies in supply chain today are based on the growing digitisation of data and the use of big data collected by embedded sensors. GPS technologies available on mobile phones can geo-locate crops, soils, pests and other agricultural variables in both time and space. Corning, for example, uses a combination of pressure and strain sensors attached to glass panels to determine when and where breakages occur in the supply chain. This data is collected in a block chain which tracks the movement of the glass panels through all the carriers to the final customer. It is then straightforward to identify which carriers are responsible when damage occurs, and management can focus on how to prevent this occurring in the future.

LOGISTICS 4.0 AND DIGITAL DISRUPTION

Logistics 4.0 is a term coined in response to the trend towards automated and connected systems of production (commonly called the fourth industrial revolution or Industry 4.0).

Logistics 4.0 is then the application of Industry 4.0 concepts to the supply chain and commonly includes the following initiatives;

- Blockchain, including cold-chain management and monitoring. Also facilitating customer based ethical decision making in select goods
- Increasing direct customer / farmer virtual interactions
- Increasing component connectivity and sensor installations to assist in automated farming and autonomous vehicle (in road and rail transport)
- Drones for farming and delivery applications
- Sharing and processing of multi-industry data (i.e. big data)
- The application of Artificial Intelligence to provide supply chain solutions, for example to plan freight movements or production

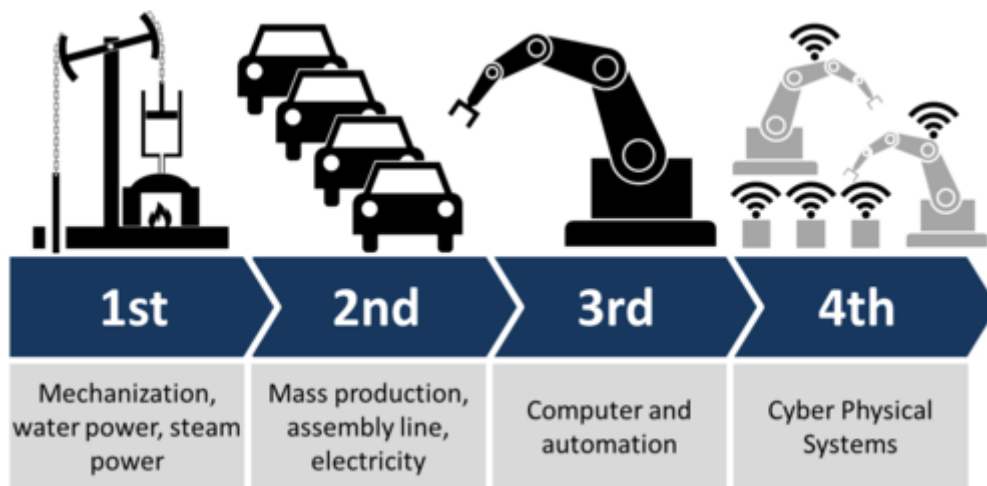


Figure 10 - The Four Industrial Revolutions (source: Roser 2015)

THE AGRICULTURAL SUPPLY CHAIN

Acquiring current information on best practice in the agriculture supply chain is relatively easy given the substantial resources available on the internet, in the agricultural and food journals and the Commonwealth of Australia Department of Agriculture. Using a simple Google search with the term “agricultural supply chain” led to many useful resources. Among these, Spencer and Kneebone (2012) and Routroy and Behara (2016) were of high value. Spencer and Kneebone were the authors of the Australian Department of Agriculture, Fisheries and Forestry study: “FOODmap: An analysis of the Australian food supply chain”. Routroy and Behara provided a comprehensive systematic literature review of the agricultural supply chain that is an excellent place to catch up on current and past research throughout the world.

“FOODmap” is a report produced by Spencer and Kneebone which considers the whole Australian food supply chain from production to consumption and aims to identify the scope for improved performance. The report focussed on agricultural sectors (animal protein, grains, dairy and horticulture). Kneebone is the managing director of “freshlogic” (<http://freshlogic.com.au/thruchain>) which is a consulting company that specialises in consulting to the food industry. One of his company’s research tools is “THRUchain” which maps and models

the agricultural food supply chain. The “FOODmap” report used “THRUchain” to identify market size, consumer preferences, pressure points in the supply chain, trends and future directions. This report identified that consumers were interested in sustainability, waste reduction, integrity of food production systems and healthy eating. Each of these topics have consequences for all the actors in the supply chain from farmers, to food processors and retailers.

Section 4 of the “FOODmap” report mapped the food categories to measure the security of the food supply chain. To do this they measured a category’s self-sufficiency and stability of supply. They also measured a category’s exposure to short term volatility by factors occurring throughout the supply chain. These factors are given in the table below for each agricultural category. One of the factors was supply chain invisibility – that is how much each partner in the supply chain had a knowledge of the other partners in the chain. It is clear from the table that many product categories had high levels of invisibility which can contribute to short term volatility in supply. This is another manifestation of the classic “bullwhip effect” identified in the industrial and consumer product supply chains.

Table 3 - Stability of Supply (10 is highest exposure to volatility)

Item	Production complexity	Supply chain invisibility	Import threats	Risk Management	Price Movements	Influence of climate	Currency movements
Fresh Fruit & Vegetables	7	8	5	7	8	8	7
Dairy Products	8	7	4	6	6	8	8
Fresh Dairy	8	6	2	6	3	7	3
Red Meat	7	7	3	7	7	7	8
Lamb and sheep meat	7	7	3	7	7	7	8
Pork	7	5	7	6	5	3	7
Poultry	5	7	2	3	6	6	2
Fresh Seafood	5	8	8	5	3	1	7
Processed Seafood	4	6	7	5	3	1	7
Eggs	6	8	2	5	7	6	2
Bread & Baking	4	5	6	7	3	3	4
Beveridge’s	7	6	7	8	4	5	7
Wine	7	5	7	2	3	6	7

The table above shows volatility levels for the 13 agricultural categories. In terms of supply chain invisibility, wine, bread & baking and pork had the least invisibility levels whilst fresh fruits & vegetables, fresh seafood and eggs had the highest levels. The “FOODmap” report suggests that high levels of invisibility lead to supply instability.

Routroy and Behara (2016) reviewed 203 research papers on various aspects of the agricultural supply chain (AGC). Research on AGC from the USA, India and the UK accounted for 40% of the papers. Practitioners in agriculture only accounted for about 16% of the research. Australian research accounted for 8% of the total papers reviewed. The research identified the unavailability of cold storage, lack of government policies, improper connectivity, unavailability of sorting and grading technology, poor handling and packaging, unskilled labour and poor linkage between facilities. The literature also reported that 30 – 35% of all food produced was wasted due to lack of infrastructure and food processing facilities. Post-harvest losses and traceability were the highest areas of research in the AGC. The authors note “Good traceability systems will help to minimize the production and distribution of unsafe or poor-quality products thereby minimizing the potential for bad publicity, liability and recalls... traceability is becoming an integral component of modern ASC’s.”

It is interesting to note that studies of supply chains in India relate lack of supply chain visibility in horticultural products to increased levels of waste.

A Youtube clip on Digital India (https://www.youtube.com/watch?v=lbpo_ncAjRk) is a recorded interview at a Digital India conference with an IT expert on how stakeholders in the agricultural supply chain were mapped into clusters and sub-clusters so that all actors in a supply chain can have upstream and downstream visibility. A farmer in India must have information on the location of warehouses, cold stores and mills so that they can obtain the information that they require. The mapping tool shows Indian farmers where to buy seeds, fertilizers and the location of potential customers. Lack of information on suppliers and markets results in huge losses, up to 30% of production, due to supply chain invisibility. Many farmers in India are semi-literate but the use of maps that are geocoded provides farmers with supply chain visibility to improve their decision-making. The discussion provided in the Youtube video suggests that the mapping process was like that provided by Spencer and Kneebone’s Foodmap report for Australian agriculture.

There are several companies developing IT platforms specifically directed at agriculture. The following URL’s are examples of companies applying IT technologies, remote sensing and geo-location systems to optimise farm production. They provide a flavour of the current state of the art in technology applications in agriculture.

Table 4 - example ag-tech companies

Company	URL	Description
Taranis	http://www.taranis.ag/	Ag-tech start-up offering high precision aerial surveillance to pre-emptively avert crop yield losses due to insects, crop disease and nutrient deficiency.
Farmdog	https://farmdog.ag/	Crop health data base. Combines mobile technology to log agriculture data from the field from mobile phones and tablets. Tracks disease hot spots.
Mavrx	https://www.mavrx.co/	Remote sensing, high resolution field imaging to identify crop disease, yield at risk.

CropX	https://www.cropx.com/	Integrated hardware and software system to measure soil moisture, temperature and electrical conductivity remotely to optimise irrigation.
onfarm	http://www.onfarm.com/	Manage and integrate data from a range of diverse sensor systems. A centralised place to collect, manage and share information to improve decision making.

In agriculture the leading farming organisations are applying “The Internet of Things” with the application of an array of widespread sensors that measure variables critical to crop yield management such as rainfall, sunshine, soil moisture, temperature and humidity. Farmers can use software applications which predict weather, the spread of diseases and pests to enable farmers to make better crop management decisions. Farmers can use applications to share their sensor data with plant agronomists to obtain advice on the best crop strategies in real time.

The combination of technologies in information systems, data collection and analysis lead to the development of the “Smart Supply Chain”. These same technologies combined with strategy create the “Smart Farmer” with the “Smart Farm”. The integration of sensor technology to remotely control farm equipment such as irrigation systems or robotic planting and harvesting equipment is a further development of the Smart Farm. “The Internet of Things” is enabling supply chain visibility from the location of the crop or animal through to the manufacturers’ plant and end-product. Supply chain managers now have visibility through all processes. This is not new because when radio frequency identification (RFID) and bar-coding was introduced these enabled individual trees and their yield to be tracked through the supply chain. However, what is new is the data harvesting, storage and analytics available to supply chain managers to optimise outcomes.

Best practice in farming in 2018 and beyond is likely to have the following characteristics. Farmers are “tech savvy” with significant experience employing relevant software applications using the Internet and mobile phone and tablet technology. They will likely have some variation of an enterprise management system where they have real time data feeds from their farming activity. They use the data to model or simulate various scenarios in the environment and the market to optimise their returns. Depending on their farming, they will use different automation systems to perform farming functions. The systems they use generate large volumes of data which they analyse to establish productivity metrics. The farmer in 2018 and beyond uses the power of information technology, automation and data analytics to manage their business. The farmer of today combines operational skills with a strategic approach to the management of their farm.

HUBS

FREIGHT HUB

A ‘freight hub’ is a term used in this report to describe a place where freight is aggregated or dis-aggregated for transport purposes. Well placed and sized freight hubs give the advantage of reducing the need for suppliers to stockpile goods prior to dispatch (some goods cannot be stockpiled due to shelf life limitations). These hubs do not hold stock for ordering but they may have cool, cold and un-refrigerated storage to assist in the aggregation process. The relative size of the storage areas will depend on the size of the transport vehicle carrying the goods and the supplier’s ability to deliver goods precisely at the time needed for dispatch.

An ‘ideal’ aggregation task would see suppliers vehicles of different sizes (from bicycle to flatbed) arrive just prior to the departure of the aggregated transport vehicle. The incoming items would be loaded directly onto the outbound vehicle that, once full from the inbound suppliers, immediately departs. The reality of course is

that incoming items arrive prior to the departing vehicles and are stored for some period of time (sometimes in temperature controlled environments, sometimes not). This 'holding' period helps balance the risk of delaying the departing vehicles (or sending them part full) because the planned-for items have not arrived in time and the convenience of being able to send items for sale at a time convenient for the producer (even if a full-load is not yet ready by the freight services provider).

Nominally freight hubs should be located as close to the producer/manufacturer as possible (or retailer in the case of a dis-aggregating hub), while still having access to the road infrastructure that supports the freight task, with the 'best' freight hub being 'whole' movements out of the producer/manufacturers/retailers front gate (either in the form of a B-Double or rail siding). The closer the hub is to the source of goods, the more hubs are required to service multiple areas. Whether the most efficient allocation of freight hubs is multiple hub locations, each with a lower number of movements, or more centralised hubs with greater movements per hub will depend on a number of factors (labour costs, fuel costs, land use and regulatory costs) and is best determined by market forces at any point in time. Noting particularly that this may change over time flexibility in long term planning may yield better results than the specific allocation of a place, or places, as 'Freight Hubs'.

INTER-MODAL HUB

An 'inter-modal' hub is a location where goods can be transferred from one transport mode to another. For example from road to rail, rail to air, road to sea, etc. For international import/export tasks there may also be customs / Australian Quarantine and Inspection Services requirements to be met in transport that affect the timing and timeliness of the freight task.

FOOD & INNOVATION HUBS

Food Hubs are places where food is brought, bought, made or processed. There is no real formula for what a food hub should consist of, or when they should be developed. Recent food hubs are a result of those with the possibility of providing food hub (Land developers / Councils) engaging with the local community to identify if tenancies will be taken up for that purpose.

An innovation hub here is defined as a place for small, boutique manufacturers/procedures who are entering the market and would benefit from a facility constructed for this purpose. This would be inclusive of good freight access but what happens when the companies grow? A question that needs further exploration.

COOL AND COLD STORAGE

Other than for coordinating for dispatch, storage can be required to balance supply and demand. This balance can be important due to the seasonal nature of supply of fluctuating demand patterns. In a purely manufacturing minded way, storage should be limited as it can lead to production inefficiencies, quality issues and wastage. Care should be taken when considering the development of storage solutions for the Region that this is done in a way that doesn't compromise production efficiency and quality.

VIRTUAL HUBS

There are already some 'virtual hubs' like the Northern Rivers Food Network. The expansion of this idea to assist with freight and supply chain efficiency will assist in the implementation of data sharing and freight coordination activities.

STAKEHOLDER ENGAGEMENT

STAKEHOLDER IDENTIFICATION

Stakeholders were originally identified in a RDA/SCU meeting on 20/06/2018. These stakeholders were categorised according to stakeholder type, whether they were a producer/manufacturer, freight company, government organisation or other.

This identified stakeholder list was added throughout the progress of the project. Contact was attempted with all identified stakeholders, either for a one-on-one interview or invitation to the workshop processes. Not all stakeholders responded, or were available to respond, to the invitation to participate in the project.

STAKEHOLDER PRIORITISATION AND EVALUATION

This project recognises the wealth of experience and perspective within (and outside of) the Northern Rivers. As such there was no evaluation or prioritisation of stakeholders and all stakeholder inputs (through interviews, workshop or in response to draft documentation) were incorporated into the report considerations.

According to the Project Ethics Approval (ECN-18-150) all stakeholder inputs are treated anonymously in the report and as much care as possible has been taken to ensure that inputs have been de-identified. In some cases there is some information provided through interviews or workshops that is also in the public domain, so some identified information is included in this report.

STAKEHOLDER ENGAGEMENT TECHNIQUES

There have been five avenues of stakeholder engagement employed in this project;

1. Formal interviews

Around one hour in duration – these interview were typically carried out on site at the producer/manufacturers/transporter/Council's facility.

SCU developed a comprehensive interview question set to support the interview process – though the interviews were conducted less formally with outcomes being mapped against the interview set and freight profiles developed later.

Outcomes from the interview process were fed into the workshop process and also incorporated into the development of initiatives documented in this report.

2. Full day workshop

A full day workshop was carried out in in two parts. Firstly producers and manufacturers were invited to participate in an opportunity development exercise. Then, secondly, local and state government agencies further developed the opportunities that emerged from this process and identified implementation roadblocks and strategies to move forward with these.

Outcomes from the workshop were incorporated into the initiatives documented in this report.

3. Presentations to the Northern Rivers Joint Organisation (NRJO)

The one-day workshop consisted of two parts; producers and manufacturers in the morning, and agencies in the afternoon.

All workshop participants were asked:

‘What are the external factors that will effect resilience of the Region?’.

Responses were recorded to tell a story of the current state external factors affecting the Northern Rivers freight and supply chain. The PESTEL chart below provided prompts to identify these external factors during the session.

Table 6 – PESTEL Chart of external factors that will effect resilience of the Region.

Producers / Manufacturers Group	Agencies Group
<ul style="list-style-type: none"> - Rural residential encroachment on productive land - Youth unemployment - Regional strategy to be cohesive with national strategy - Timing and outcome of upcoming elections - Lack of affordable land - Cross jurisdictional issues - Unemployment - Support and stimulus for new / young farmers - Capital investment attraction - Preservation of agriculture land - Urban encroachment - Regulatory influence or drivers - New technology - International competitiveness - Youth employment opportunities - Linkages to south east Queensland - Regional “brand” / provincial identity - Connectivity challenges - Regulations creating barriers to entry - Restrictions on access - Export market access - Demographic shifts - Lack education facilities that focus on local industry needs 	<ul style="list-style-type: none"> - Slow technology uptake - Trade regulations and export opportunities. - Cost and availability of land - Animal welfare - NIMBYs and environmental campaigners impacting political/government expediency and investment - Climate change adaptation. - Changes in lifestyle and trend - Capacity to compete with increasing competitiveness in freight costs. B-double access, rail - International investment - Weather events - Climate change - High cost of infrastructure upgrades making regional areas unattractive to new expanding business. - Planning laws and urbanization pressures. - Environmental & technological & political (regulation & red tape) - Government regulations restricting market development - Trade regulations - Too much regulation - State Government regulations - Social factors effecting demand for health and lifestyle products that are our region’s key strength

<ul style="list-style-type: none"> - Trade education facilities that focus on local industry needs - Trade regulations - Marginal seats - Technology - Energy policies - Changes to land use planning in LGA areas to allow for diversification on farms - Regional food policies - On an international market Aust. Clean and green as marketing advantage - Lack of infrastructure - Social license to farm - Lack of collaboration between industry and government agencies - Localizing food economies - Expanding residential areas - Improved communication facilities, or NBN to all areas - International air freight - Lack of local government cohesion/alignment with state or national strategy - Impact of drought - Improved collaboration between industry and government agencies - Residential complaints against existing operations - Getting young farmers onto the land - Shifting to short supply chain models - Create efficiencies by determining synergies of regional industry and sharing freight opportunities - Governments taking a risk on investments - Access to competent, reliable labour - Implementation of a Northern Rivers food strategy – covering provenance, distribution, access to affordable local food - Infrastructure to address high energy costs - Support for educational opportunities 	<ul style="list-style-type: none"> - Cost prohibitive legislative requirements - Network capacity - Cost of compliance with health and safety regulations - Population growth and demand - Intra region competitiveness stymying investment - Red tape - Flood protections and infrastructure resilience. - Political ideology e.g. food miles driverless vehicles - National consistency - Funding availability - Political commitment to fund local infrastructure - Availability and access to technology - RMS investing sufficient funds in regional road network - Connectivity to the south east Queensland markets and infrastructure - Increase in value adding within region. Processing bulk goods to processed goods.
--	--

The workshop methodology resulted in 100 ideas being generated, summarised in Table 7. See Appendix D for detailed summary of these workshops.

Table 7 – Summary of the 100 Ideas Generated in the Workshops.

<i>Focus Area</i>	<i>No. of Idea's</i>
Collaboration	18
Supply Chain	48
Domestic	25
Export	9
Grand total	100

These were grouped, assessed and screened and finally the top three emergent ideas of the workshop were;

1. The development of Hubs that link farmers/producers with people, including virtual hubs
2. Development of cold storage opportunities
3. Greater collaboration between the three levels of government

All of the workshop ideas were incorporated in the initiatives that were identified in this report,

ASSIMILATION OF INTERVIEW AND WORKSHOP OUTCOMES

The design of this study was from the outset to be informed by the users of the supply chain, the producers and the manufacturers and the providers of the supply chain, namely logistics companies and the local policy makers and planners. The study team has drawn insights from this stakeholder information, together with a range of other credible inputs where they were deemed relevant. Collectively, the interview and workshop outcomes were used to gain an understanding of the needs and issues both now for the Region as well as a vision for the future. Coupled with research into industry trends and input from the subject matter experts of the research team, these insights have been incorporated into the narrative of this report and resulted in the identified initiatives.

MODELLING FREIGHT MOVEMENTS

Part of the study design included modelling of information gathered on industry freight movements to underpin these insights and to apply some rigour to testing new route and service options. The modelling work provided insight into the expected financial benefits of some of the initiatives. This was achieved through the development of an agent-based model for this Region. In comparison to the traditional four-step frameworks, an agent-based modelling framework is less coarse in resolution, making it easier to reliably and efficiently inform policy developments.

Two different approaches were used in the initial modelling. A region based analysis, using secondary data sources and an industry-based analysis based on the stakeholder interviews. Figure 13 presents the various inputs of the model and the targeted outputs from the analysis.

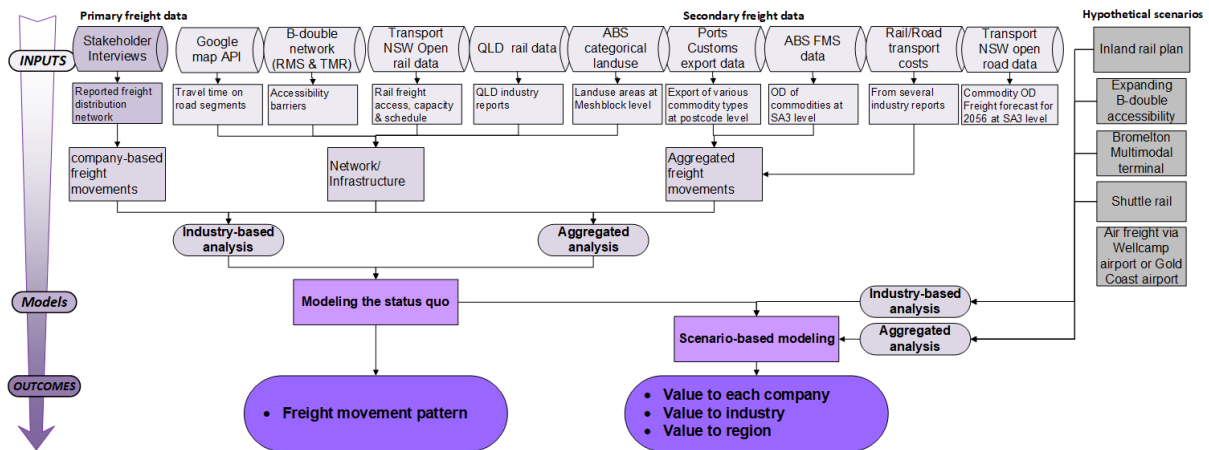


Figure 13: Modelling methodology

The industry analysis provided the freight transport cost for existing freight patterns by industry sectors. This was based on information nominated by specific companies in interviews and other secondary government agency data sources. Specific data from companies was provided confidentially and has been generalised to maintain anonymity. It became apparent during the study, through the consultations with the producer and manufacturer stakeholders, that they saw untapped potential for future production and manufacturing with the potential to reach expanded markets. Whilst modelling the industries' current situations provided visibility of existing supply chain networks and current constraints, the as yet potential future markets are not sufficiently defined at this stage to enable modelling of these freight flows. However, the export ports and domestic destinations have been taken into account. The modelling methodology was shifted to a third approach, with focus on the modelling of freight pricing unit rates for various existing and future supply chain scenarios as the prime means of assessing value to the industries.

As a measure of value, the unit cost of an individual truck type (e.g. B-double load) from an origin (e.g. freight hub) to a destination (e.g. port or distribution centre) trip is calculated as a unit rate on the basis of real pricing a customer is likely to be charged. The unit rate is specific to the mode (truck, rail or combination) and route (inclusive of the distance travelled) enabling comparison across different origin/route/mode/destination configurations. The lower the unit rate, the lesser the freight cost and the better the value.

An example from the modelling are the outputs in Figures 14 & 15 showing the relative pricing between B-double journeys from each Council Precinct to the Port of Brisbane on existing B-double routes relative to the unit rate from Casino.

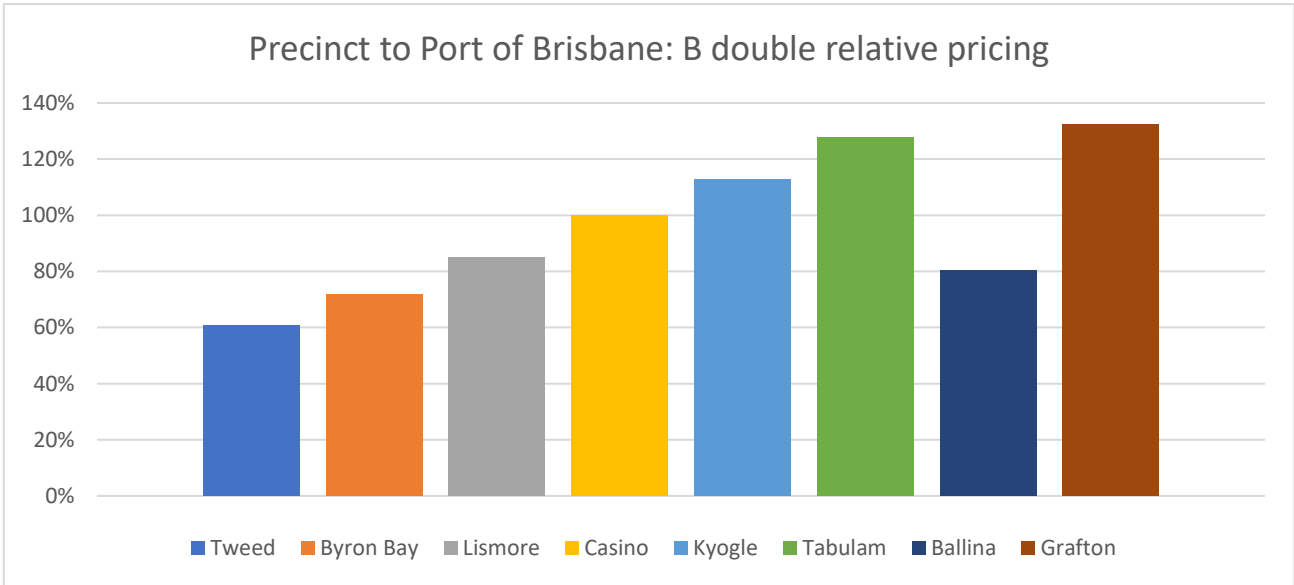


Figure 14 – Comparison of B-double freight costs from council precincts to Port of Brisbane via existing routes

Figure 15 shows the comparison of unit pricing for different route and mode scenarios in reaching the Port of Brisbane for each western precinct, relative to the unit rate via the Pacific Highway.

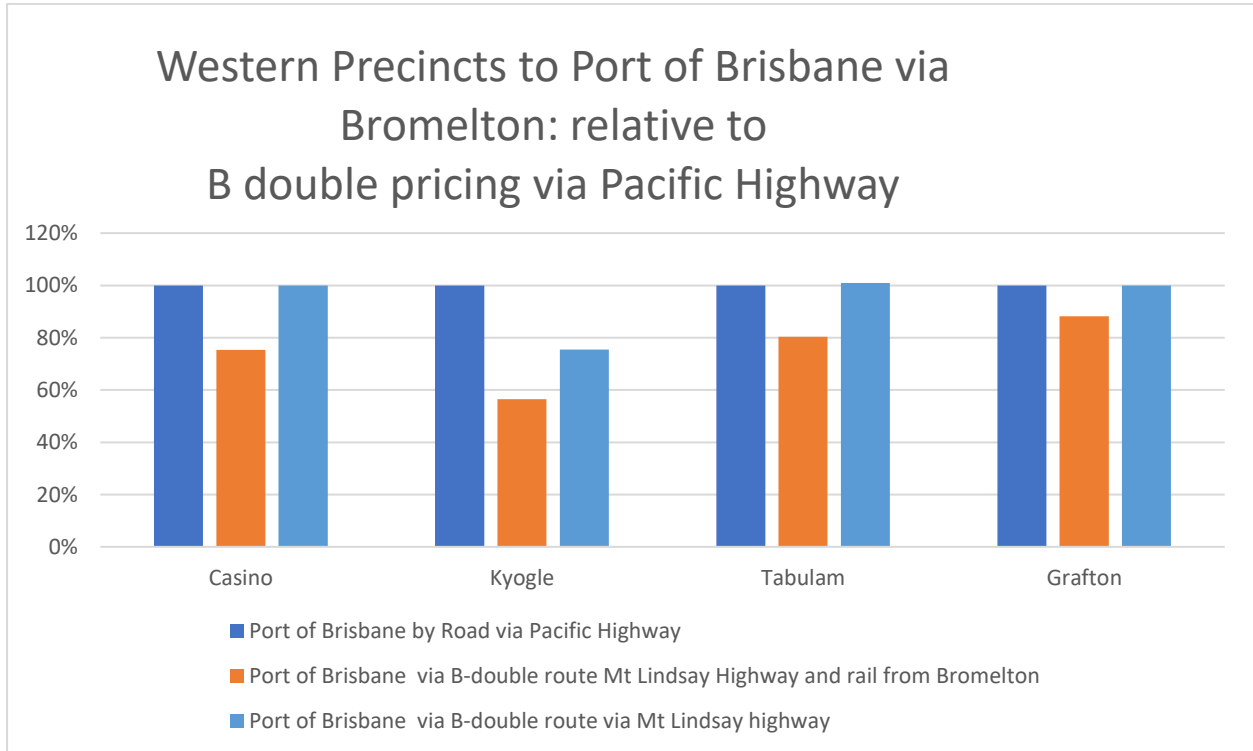


Figure 15 – Comparison of B-double unit rate freight costs from precincts to Port of Brisbane via other routes and freight transport modes

The modelling has also been able to generate collective industry estimates from the freight pricing for existing trips and for different scenarios, as shown below for the macadamia industry in the Northern Rivers in Figure 16.

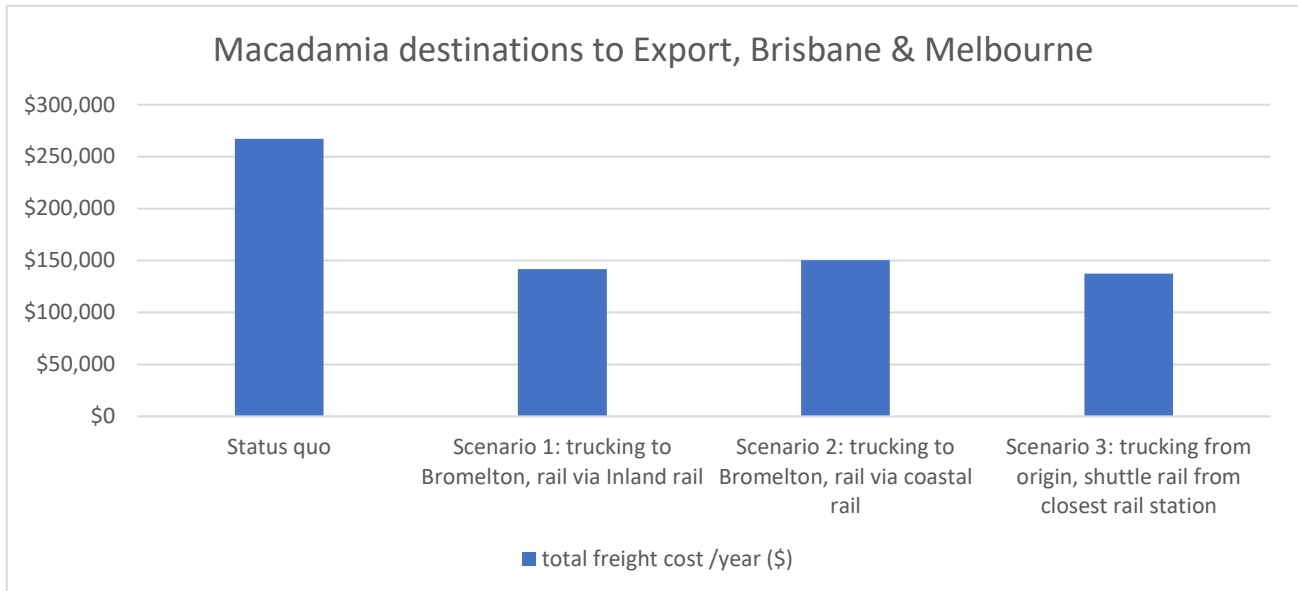


Figure 16 – Comparison of collective industry freight costs via current and alternative routes and freight transport modes

The modelling implications of this example is a saving in freight costs for these existing trips of \$100, 000 per year if one of the three scenarios are taken up.

While the modelling has been able to generate these snap shots from the different industries in the Region, there is currently insufficient data available to provide a complete picture of the current freight cost for the whole Region. This limitation will be one of the tasks needing further collaboration and research going forward in order to gain a region wide measure of the overall value of the supply chain scenarios. In addition, there will be a need to continue to update this going forward, as the regional value will also depend on the future volume of goods being shifted as the potential producer, manufacturing and market ambitions unfold. It is anticipated that the investment decisions that will enable these volumes to increase will take into consideration the freight pricing unit rates when determining the investment viability, although other factors, such as land availability, government support and other financial factors will form part of the suite of considerations for investments. Over time, as these forward volumes become clearer, the unit rates based modelling can also be applied to estimate the supply chain cost for the specific industries and therefore the value of lower freight costs to the Region.

A summary of the modelling inputs, context maps and outputs are included in Appendix B. Individual industry data sources and profiles were collected on a confidential basis, but has been generalised for publication beyond the study team.

FINDINGS: IMPROVEMENT INITIATIVES IN FREIGHT AND SUPPLY CHAIN

The study team's discernment of the information gained from stakeholder engagement, reinforced with secondary information and trends at global, national, regional and local scale and modelling inputs has led to the formulation of the 20 initiatives to form the substance of the proposed regional level strategy.

This section of the report provides the background leading to each of the initiatives that have emerged through this process.

GLOBAL

Efficiencies or limitations in freight and supply chain efficiency can impact the ability of businesses within the Northern Rivers Region to reach international markets. Identified limitations align with the following areas;

- Access to ports
- Access to / presence in Asian markets
- Access for fresh food in foreign markets

ACCESS TO PORTS

The major export port for the Region is the Port of Brisbane, with some limited use by some industries of the Brisbane Airport. On top of existing congestion on the road to the Port of Brisbane, and Brisbane Airport, advice from the Port of Brisbane Authority (GHD, 2016) states that demand for freight services in the future will increase the road congestion to the Port of Brisbane and potentially reduce access.

Initiative 1 - Investigate alternative methods to reach the Port of Brisbane for freight export. For example utilising rail access into the Port and a second B-double route across the Queensland Border.

There are three available alternatives to the current Pacific Highway B-double road access to the Port of Brisbane;

1. Truck via an alternate route. For example if B-double access was made possible through the Summerland Way into Queensland then an alternate route would be available. This does not provide much cost advantage compare to current operations but may become of increasing importance as road congestion in South East Queensland worsens. It would also bypass the congestion which currently occurs at the Lismore Wilson River Bridge and associated Bruxner Highway roundabouts. Though this route would not be immune from road congestion nearer to Brisbane.
2. Truck to Bromelton then via rail to the Port of Brisbane. If using the Pacific Highway to reach Bromelton then this route does not provide any cost advantage. This may become a useful option if congestion prevents growth in services to the Port of Brisbane or if the broader operating time at Bromelton better suits the freight movements of the Region at the Port of Brisbane, which has restricted operating hours, however freight can be received at Bromelton at any time – this did not emerge as an issue for stakeholders through the participatory process but may provide additional flexibility to freight service providers.

If B-double access was made possible through the Summerland Way into Queensland then an alternate route would be available to reach Bromelton. This route would be advantageous from a trucking perspective for most of the Region and has the advantages of not being subject to road congestion or hours of operation. While there would be additional double handling costs, there is

also the possibility for a future customs/AQIS service at Bromelton, and co-locating this activity with the intermodal activity will reduce double handling costs.

3. Direct rail access via a rail shuttle within the Region to the Port of Brisbane (either via Bromelton or direct)

This study has included a feasibility review of the possible implementation of a rail shuttle, utilising the existing coastal rail line and providing a regular rail access to; the Port of Brisbane (Sea Export), Toowoomba Airport (Air Export to Hong Kong) and other Australian domestic Markets (Adelaide, Perth, Melbourne).

The freight model developed during the course of this study has demonstrated that the rail shuttle would change the relative cost of shipping in the following way (note that costs are given with Casino to Port of Brisbane via B-double as a reference point).

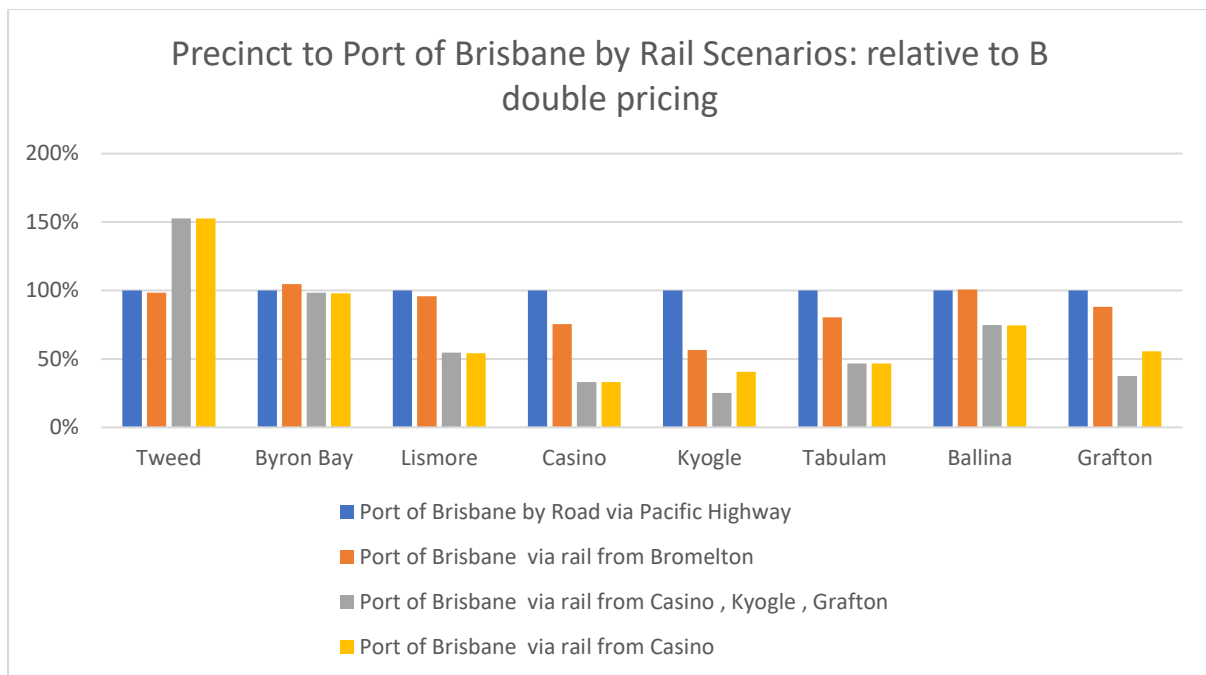


Figure 17 - Precinct to Port of Brisbane by rail scenarios: relative to B-double pricing

This modelling shows that there could be an overall reduction in cost of the current freight export shipping costs of up to 40% to 66% for western precincts and a lesser reduction for other precincts (apart from Tweed and Byron where road freight remains more cost effective).

There has been other investigations into the precursors for running a rail shuttle. One report (PwC, 2017) states there are eight pre-conditions for a rail-shuttle service. They are listed below in the context of the Northern Rivers Region.

1. Are the goods suitable for rail transport

There is a very diverse mix of goods in the Northern Rivers Region, much of which is already containerised or palletised and suitable for rail transport.

2. Do the goods meet the minimum volume thresholds

In 'round' numbers there would need to be around 5,200 containers/wagons per year to support a weekly rail shuttle activity. From the data gathered during the interview process this figure appears achievable

solely with Casino based businesses to the Port of Brisbane (assuming the product can be 'held' for the weekly delivery).

Let alone sourcing additional cargo from within the region either via truck to Casino (or where-ever the terminal is) or with multiple terminals in Kyogle, Casino and Grafton.

This is also without recognising the market opportunities that would open up with a) air freight access via Wellcamp Airport to Hong Kong and b) access to the Inland Rail network and other capital cities.

Additionally, rail shuttle planning does not result in a rail-only transport solution. A rail shuttle would become a part of the supply chain solution and, generally, road transport would continue to run in parallel with rail transport.

Another consideration is the 'return' trip and the source of material both a) from further afield that before via the Inland Rail link and b) direct from the Port of Brisbane to the region via rail. It was observed during the interview process that many smaller business (tea/coffee/speciality goods) include freight importing or raw materials through the Port of Brisbane as a large component of their business activity. Having access to a rail connection would significantly advantage these businesses and potentially stimulate the movement of such businesses 'towards' the rail corridor. Already (during the interview process) some of the smaller businesses noted that land pricing and availability (competing for residential uses) and inadequate infrastructure in the coastal zone of the region is encouraging businesses to grow by moving inland.

3. Does the rail shuttle meet minimum frequency, transit time and reliability requirements?

The current frequency requirements have not been determined, nor the potential for changing frequencies if needed. The PwC report (PwC, 2017) suggests that rail shuttle services need to provide comparable accessibility as to road transport in order to be effective (regardless of costs).

While this is understandable, it does not necessarily allow for some freight tasks being more flexible than others to different transit frequencies and times.

Additionally, whether less frequent services (say weekly) are made more attractive for businesses by having an associated cold storage facility is a detail that needs to be explored further.

4. Is the demand for goods subject to peaks and troughs?

Certainly some goods are subject to peaks and troughs. This is another reason why, having a good road transport system alongside the rail system is critical to the success of a rail shuttle. 'Peak' times can be met through growing the train length or increasing the frequency of services, but where there is not sufficient additional demand, then road transport can meet the need.

5. Is there suitable infrastructure in place?

The rail infrastructure is in place, however the storage and intermodal infrastructure is not in place and would need to be constructed to allow most businesses to participate in the rail shuttle. There are already some proposals for this in Casino. These developments should be encouraged to think broadly about the producers/manufacturers' needs including incorporating suitable cold and dry storage.

6. Optimal train operating solution

The train operating solution will need to be optimised to suit the specific freight task of the Region and it will change over time as the goods and freight needs change. The rail network operator(s) should employ

a systems engineering approach to best determine this. The optimal solution will be refined during the feasibility, concept and business case stages of the implementation of this initiative and continue to be refined through the life of the operation.

7. Have commercial arrangements been determined?

While the development of this strategy has included engagement with industry representatives (including rail operators) to map a pathway for implementation, it will be imperative that rail network operators are involved through the implementation of the initiative so that the commercial arrangements be discussed early in the process to best meet the desired outcomes for rail network operators and users of the scheme.

8. Is the rail option cost competitive with other forms of transport?

The modelling that supports this report shows that the rail option is preferable from a cost perspective.

A finding of this strategy is that there is a strong case to support a rail shuttle service in the region. The next step of this initiative will be to develop a business case for the rail shuttle service. This will be inclusive of capital works, initial and long term terminal locations. The business case will set out the potential for staging of the project and also any ancillary features such as cold and dry storage and the potential co-location of manufacturing facilities and boutique or innovative industry.

There may also be 'user' costs in changing operations to adapt to the new transport method. Any transitioning costs for users should also be considered in the Business Case.

Initiative 2 - Develop a concept for the Northern Rivers Rail Shuttle Transport Model. This will include site selection for intermodal facilities and a preliminary business case to support the project.

ACCESS INTO ASIAN MARKETS

Most business that were interviewed expressed a commercial aspiration to sell directly into Asian markets, or increase that activity where some export already occurs. However import restrictions on the market side of the activity (particularly China) were cited as the main difficulty in entering those markets. A second difficulty cited was a lack of transparency on what happens to the product once it is in the foreign country.

While access through Gold Coast Airport was seen as a possibility for the future, it was not considered a current restriction in the ability to access those markets, as the value of goods that are likely to be transported is high. The potential perceived margin reduction of the freight costs, with a nearer airport, do not impact the market competitiveness of the goods.

Similarly, the use of the Toowoomba (Wellcamp) Airport (dedicated air freight) was seen as a potential future option for large international, freight tasks, but is not currently limiting the ability of Northern Rivers business to reach export markets.

Initiative 3 - Improve presence of Northern Rivers businesses in foreign markets to improve access into markets and the visibility of the supply chain once the goods reach the foreign market

Notwithstanding this main limitation in reaching overseas markets, the freight model was used to demonstrate the advantage to the Region in using alternative airports (other than Brisbane Airport) to reach international markets. The obvious advantage of the Gold Coast area is its proximity to the Region, and Toowoomba (Wellcamp) is the dedicate air-freight operations into Asian markets. Toowoomba (Wellcamp) has been highlighted by the National Government as a hub location for air-freight export to Asian markets.

This demonstrated that the Gold Coast Airport is a more efficient location for the Northern Rivers Region to reach for international air freight compared with Brisbane Airport, on the basis of road freight costs. With a greater percentage impact, the closer the source location is to the Gold Coast (i.e. Tweed has the highest percentage benefit).

Toowoomba (Wellcamp) airport was not more attractive than Brisbane airport via road transport, however if combined into a regional rail shuttle activity, then Toowoomba (Wellcamp) is a more effective location than the Gold Coast for all Northern Rivers air export activities.

Similarly, with increasing congestion, accessibility to Brisbane Airport will reduce and become more expensive over time. Access to alternative airports may be required if the produce being exported is struggling with price-competitiveness in the export market (noting that currently most air-freight export products from the Northern Rivers are higher-value commodities that may not be impacted significantly by marginally increasing freight costs).

Initiative 4 - Investigate alternative airports to service air-freight export needs (Toowoomba/ Gold Coast)

ACCESS FOR FRESH GOODS INTO DISTANT MARKETS

In order to reach foreign markets, food producers must rely on speed or preservation methods or both in order for goods to arrive in the destination market with a suitable shelf life. Air-Freight from any of the accessible airports is the fastest way of reaching destination markets but is high cost and has less established freight routes than sea freight. Trends in international shipping shows that temperature and climate control in sea freight (containers) may make foreign markets more accessible for Northern Rivers Region fresh foods as an alternative to (or complimenting) expanded air freight routes.

Initiative 5 – Collaborate with shipping companies and industry to improve Northern Rivers use of climate controlled containers for fresh produce into international markets

NATIONAL & STATE

National connectivity for the Northern Rivers Supply Chain means getting freight to and from capital cities and regional centres in efficient ways.

B-DOUBLE ACCESS TO NATIONAL MARKETS AND REGIONAL CENTRES

CAPITAL CITIES

B-double access to capital cities and regional centres (outside of the Northern Rivers) is solely via the Pacific Highway. However, urban sprawl in Sydney and Brisbane has outpaced the re-location of freight hubs to suit that purpose. This means that trucks are entering congested city roads to offload goods for further dispatch. This 'last-mile' can add significant cost to the long-haul trip, particularly as fatigue management is important on these routes and any inefficiencies can significantly impact the trip.

It is important for the Northern Rivers to participate in State Government (and other) planning initiatives that create freight hubs on the fringes of Brisbane and Sydney. For example; the Gold Coast / Tweed area has been identified by others as a potential freight dispatch location. This will mean that, say, B-double travel times would decrease to the dispatch location – which then would dispatch in smaller configuration vehicles to market.

The Gold Coast Airport has the advantage of also providing air freight export opportunities along with the freight forwarding opportunity.

Initiative 6 - Pursue opportunities for freight hubs that are located outside capital cities. To reduce the costs of the freight task to the capital city.

SOUTHERN DOWNS

The Region does not have direct B-double access to the Southern Downs Region of Queensland. This area is becoming increasingly important for Northern Rivers Region manufacturing capabilities (supply of Macadamias and Blue-berries). Additionally, an improved B-double route from Kyogle through to Bromelton would provide an alternative freight route from Grafton to Brisbane. This would help to separate freight movements from passenger cars which would improve safety and freight efficiency (reduce the exposure to congested routes). It may also be possible to construct this section of road as a dedicated autonomous vehicle route, especially for freight vehicles. This section of road could become a global flag-ship of alternate route planning for freight movements.

Initiative 7 - Mt Lindesay Hwy / Summerland Way/Clarence Way Freight Road Network Upgrade

TENTERFIELD / NEW ENGLAND HIGHWAY

The Region does not have direct B-double access to Tenterfield. The Bruxner Highway currently only provides B-double access to Casino. The Tabulam bridge upgrade once complete, will provide a significant step in the potential for B-double access to the west of Casino. In order to be able to improve the efficiency of outbound and inbound freight services between the Northern Rivers and the Tenterfield area, there needs to be a large upgrade of the Bruxner Highway, inclusive of the intersection with the New England Highway.

Providing this connection will increase the competitiveness of the Northern Rivers Region manufacturers, against other manufacturers, for raw materials that otherwise travel along the New England Highway.

Initiative 8 - Upgrade the Bruxner Highway for B-double access from Casino to Tenterfield / New England Highway

AVAILABILITY, COMPETITION AND SCHEDULING

It was observed that there are issues, at many scales, in the Region with availability of freight services and lack of competition within the logistics services market. At the boutique end of the market, when producers are seeking to send goods that are smaller than a pallet (say individual parcels), goods 'pickups' are often limited to certain days of the week and suppliers can struggle to meet their customer expectation of next day / day after delivery – particularly to capital cities where the expectation for immediate delivery is high. Also, the price of these services can add a significant portion to the overall price of the goods and affect the price-competitiveness of the product.

Improved coordination between different producers may help to improve the frequency and reliability of these activities. This collaborative activity may be simply the sharing of freight activities between businesses, or the shared ownership of freight facilities and vehicles. Whatever the scale of the collaboration the resultant initiative may help improve the price competitiveness and delivery speed of goods from the Northern Rivers Region.

Initiative 9 - Develop a collaborative activity to improve access to, and the reliability of, freight in the Region. Particularly through sharing of data and services (combined pickups / drop-offs) between businesses

CUSTOM TRAILERS V. STANDARD TRAILERS

A sub-issue of market competitiveness is the availability of customer trailers to support local industry. For example some sea food products are not shipped in their ideal truck type because it is not economical for the freight service provider to use the correct trailer type for such a limited activity. This results in difficulty ensuring the product is meeting its cold-chain requirements during transport and the need for custom made transport boxes that have also been difficult to return back to the Region after delivery.

Initiative 10 - Collaborate with markets and industry to develop a reliable 'packaging return' process from market back to local industry.

GOVERNMENT PLANNING, REGULATION & APPROVALS

Regulation is a key component to the delivery of safe and consistent freight services throughout the Northern Rivers Region. Good and effective regulation improves the safety of trucking operations, provides clarity to the requirements for freight users, is seamlessly integrated into the freight planning activity and delivered in a cost-effective way.

Regulation impacts the freight and supply chain in many stages. From fatigue management for truck and train operations, labour laws, to development approvals for producers, manufactures and freight hubs– the freight activity is considered and assessed at many stages of the lifecycle of a business.

Government plans (whether freight planning, economic development and land use planning or some other kind of planning – like climate change response planning) occurs across multiple departments from multiple levels of government (national, state and local government agencies). Successful planning requires mature planning process, which engage broadly and meaningfully with stakeholders and recognise interdependencies. Unsuccessful planning results in misaligned planning outcomes that do not meet the user's requirement, impacting effective and efficient freight and supply chain solutions.

A lack of aligned planning between different levels of government, as well as a lack of 'user' involvement in planning and regulation development was identified as a critical issue for the Region. The participatory techniques implemented in the development of this strategy is a step toward better integrated planning. An important step is to ensure the outcomes of this planning are integrated into the NSW Government's Northern Rivers Regional Future Transport Plan – to be developed by Transport for NSW in 2019/2020 and the associated place and corridor plans.

Initiative 11 – Advocate for the inclusion of priority initiatives from this Strategy to be further developed by Transport for NSW in the Northern Rivers Regional Future Transport Plan

Another issue across the Region is the consistent provision of Restricted Access Approvals by local government authorities. This process can be difficult for local government to consistently apply due to resourcing availability and also subject to community and political pressure. Conversely freight companies also require clear approval guidelines, engagement of local expertise and quick turnaround times for approval to support commercial activities.

The NSW Freight and Ports Plan supports providing education to local government and communities to support local government in determining Heavy Vehicle Access issues and additionally will continue to promote the use of the Restricted Access Vehicle Route Assessment Tool – an online tool designed to support councils in the approvals process.

Initiative 12 - Utilise the state approvals framework / tool while at the same time keep local contact between local government and freight services providers

SAFETY AND WELLBEING IN FREIGHT AND SUPPLY CHAIN

While there are many initiatives on safety and wellbeing in freight and supply chain; through this report two initiatives have emerged so far as they relate to road transport infrastructure.

Firstly, wellbeing. There are many restrictions to the movements of truck drivers with respect to fatigue management etc., and also locations where truck drivers can park their vehicle at night time, as well as legislated driving time truck drivers are required to park at rest stops overnight because the receiving business is not open (until the next morning). Existing RMS truck stops can lack preferred amenity for drivers. In some cases, by their very nature, they are busy terminals that are not ideal sleeping locations. In other cases the distance from the truck stop to the destination (say a nearby industrial area) adds additional, potentially unnecessary, transit time for the truck driver into the next day's activities. This additional time may either affect the subsequent day's productivity or, in the case that it is the driver's final load before going home, can eat into the available time that truck drivers have at home with family.

It would be ideal if truck drivers can park their vehicle for over-night stays as close as possible to the loading/unloading destination, in many cases this will be in or near industrial or commercial zones (i.e. precincts - see below). It is recognised that this can impact mixed-residential development and that careful and specific planning should occur to identify those zones that would benefit from designated or constructed truck stop / rest zones near destinations.

Initiative 13 - Better rest areas in better places (i.e. nearer delivery locations in industrial areas etc.

Secondly; it is generally desirable to separate freight and passenger vehicles from a safety perspective. Even to move as much freight as possible to rail (where freight/passenger interactions are the most directly controllable). An emerging technology (already implemented in the US) sees autonomous vehicle, currently under driver supervision, being used to further improve the safety and efficiency of trucking operations.

This is only seen as a viable option (with current technology) when there is a low mixing of freight and passenger vehicles. The alternative route to Southern Downs / Brisbane may provide the opportunity to construction a freight preferred route to Brisbane from Grafton that is specifically design for autonomous trucks. This would provide freight from Sydney to Brisbane a section of road that is separated from the significant number of passenger vehicles in South East Queensland and also autonomously driven (if/when regulation permits).

SUPPLY AND DEMAND

In general, demand for Northern Rivers' goods is greater than the supply of goods from the Region. The Region also has a greater manufacturing capacity than rate of the supply, meaning that processing facilities could run at greater capacity if there was greater supply of goods. This results in an overall competition for land within the Region to supply raw materials to the different markets available.

While one solution is to increase access to outside of the Region (detailed above), another is to recognise that land usage (and therefore road network usage) is subject to change, potentially rapid and significant change (at the local level).

For example the conversion of bananas to blue-berries, sugar cane to macadamia or macadamia to ground water extraction. At the state and national level the impact to freight and supply chain will be relatively

insignificant – at least at the individual scale, cumulative changes may have a noticeable effect. However even one land use change can significantly impact the freight needs at the local level, even the whole community.

Local government authorities are responsible for the land use planning that will support the change in load and road usage and successful planning will result in clear and consistent rules for developers and freight transport companies while providing for the flexibility that results from a demand driven supply chain.

Initiative 14 - Develop a framework to assist Local Government to adapt to changing land use requirements

One way of thinking about freight needs which has emerged from this study is the consideration of geographically locations as ‘precincts’. These precincts (called ‘clusters’ by some others (Regional Development Australia - Northern Rivers, 2018)) may be groups of similar or dissimilar industries but they have in common a shared reliance on ‘facilitating’ infrastructure. This may include; reliability of electrical supply, water and sewerage services, availability of residential housing supply but also freight and transport needs.

Precincts may be of varying size, from high density industrial precincts to low density agricultural precincts. In terms of freight and supply chain needs; ‘precinct’ thinking gives rise to an understanding of aggregated freight and supply chains. For example;

- In precinct issues;
 - Dry, Cool and Cold Storage
 - Freight Aggregation – shared freight movements
 - Turning circles, drive ways
 - Driver rest areas
- Out of precinct issues;
 - Local roads and bridges
 - Regional & interregional connectivity
 - Driver rest areas

One factor which can affect the viability of any supply chain upgrades can be the ‘economic density’ of the benefiting precinct. In response to this, the creation of ‘hubs’ (see discussion above on hub types) can act to intensify the economic density of the precinct. By gaining further, more detailed information, on precinct it will be possible to create scenario based analysis of various ‘what-if’ infrastructure scenarios. Further, it may also show that in some precincts that are clear ‘anchor’ businesses which can drive development activities.

This report has been developed in a ‘ground-up’ fashion, commencing with user and freight services providers needs and aspirations and following through with agency information, research and modelling. It will be vital to the successful implementation of many initiatives that the users and service providers continue to have a ‘front-seat’ to the decision making processes. In this report it is recommended that Precinct Working Groups be established to provide input and momentum to these initiatives (see initiative 20).

Initiative 15 – Develop a detailed understanding of the Freight and Supply Chain activity for each precinct in the Northern Rivers.

FIRST-MILE/LAST-MILE

Generally (though not always), infrastructure that supports the ‘first-mile/last-mile’ (called first-mile here-on) of the freight task relates to road infrastructure belonging to Local Government Authorities. By their very nature, first-mile infrastructure supports the activities of a few businesses, as low as but potentially more where the density of activity increases (say in a light-industrial estate) are such as the Bangalow Industrial

Estate. Conceptually, if a “precincts model” is adopted then the first-mile limitations are concerned with road and rail access in to and out of the precincts.

Additionally, first-mile issues can be unique barriers to economic development for other reasons than the specific limitation of freight capacity. Poor roads and long transit times can reduce tourism, prevent residential development and has been observed to limit the activities of some business because suitable staff cannot be found to work on the site due to poor roads. So in addition to the freight advantage in improve first-mile access; any business case for first-mile improvements should also factor in the other benefits of the improvements.

In practice, responsibility for the suitability of the road infrastructure in the first-mile is usually shared between the users and Local Government. With local government often funding, or seeking grant funding, for the major portion of any infrastructure upgrades and industry, preferably, providing funds that demonstrate their commitment to the economic activity that will take place after the upgrade. While this may be counter-productive to an economic rationalist / user pays view of infrastructure provision, that view is often balanced against regional economic development priorities and the practicality of decisions made by commercial enterprises.

The freight model developed for this strategy is predominately developed on a ‘unit-rates’ basis to compare the relative advantage given to users between the various infrastructure scenarios.

Where the specific source-destination-truck type-cost information for a precinct is known then the freight model can be employed to calculate a) their base cost for the existing activity and b) the cost advantage to that specific precinct in the case of any upgrades to access, roads, bridges etc.

Initiative 16 - Promote the use of the Northern Rivers freight model to make funding applications for individual first mile / last mile initiatives

THE LINK WITH ECONOMIC DEVELOPMENT & A FOOD PLAN

The productivity and efficiency of the supply chain is an enabling factor to support economic development in the Region. This can be observed through the various economic development plans that have been developed in the Region, such as the Northern Rivers Regional Economic Development Plan (RDA, 2018) which describes supply chain efficiency as one of the “engines of growth”.

Similarly, as the majority of the production in the Region is food related (there are limited extractive or ‘heavy’ industries), the productivity and efficient of the supply chain the Northern Rivers is also a dominant contributor to the food productivity to the Region.

Particularly noting the high (relative) production capacity of the Region and the supply of (competitively sourced) raw materials being a limiting factor to growth in food production, it should be recognised that any increase to freight productivity will result in a corresponding increase to food productivity. The opposite is therefore also true, that any desire to increase food productivity should also seek to increase the freight productivity of the Region to increase the ability of producers in the Region to competitively source raw materials from outside the Region.

Initiative 17 - Contribute to the development of a Northern Rivers Regional Food Strategy and ensure that there is an awareness of the supply chain limitations and opportunities that affect food productivity

Although on a smaller scale, the local food economy is also a significant factor for the livelihoods of many in the Northern Rivers Region and there are opportunities to better connect the retailers and consumers of local foods to the growers of local foods within the Region. Opportunities exist because there is often a

disconnection between the retailer/consumer and the producer as to the availability, quality and quantity of goods being produced, often complicated by the seasonality and perceived unreliability of the local food economy.

Initiative 18 – Increase the transparency and sharing of information between supply and demand in the local food economy, potentially through a virtual hub or similar system

COOPERATIVE APPROACH

Through the interview and workshop process it was observed by many that the Region had a high portion of small freight movements of part empty vehicles. It was thought that data sharing / coordinating capability in the Region would reduce the movement of part empty vehicles but also increase the availability of services to smaller business. While this was coined “uber for freight” during the work shop activities there actually is an “uberfreight” service (www.uberfreight.com) but also other services providers such as “freightlancer” (www.freightlancer.com) which operates in the Australian environment.

An issue exists for some producers, being the need for custom or dedicated trailers or compartments to move the goods. For example, fish need specialised equipment for correct shipping.

Initiative 19 – Data sharing within the Region for freight movements to better coordinate smaller scale movements and reduce the number of part filling trucks etc., i.e. an “Uber for freight”

It is considered that the majority of initiatives within this report should be driven by a regional, collaborative group with representatives from industry (producer, manufactures and freight services) and government. This group would have the representative capacity and initiative to progress some or all of the initiatives and may be able to use their collective voice to secure any funding for implementation – particularly if joint industry funding is available as this is often seen as a beneficial thing when securing state or national funding.

Care must be taken in the design of this group to ensure that the stakeholder group is broad enough and diverse enough – particularly in response to resilience issues.

It is proposed that this be achieved by the establishment of *Precinct scale Working Groups* (PWGs) and an overarching *Precinct Collaborative Network* (PCN). These groups would consist of freight users and services providers within the *Precinct* but also participation by local government and other government agencies to help create alignment across government and industry in the pursuit of freight and supply chain improvements.

Initiative 20 - Regional Collaborative Group(s) to Implement Initiatives in the Strategy

STRATEGY FOR THE NORTHERN RIVERS REGION FREIGHT AND SUPPLY CHAIN

The 20 initiatives that emerged through the process of this study, when combined, form a strategy to improve the productivity and economic activity of the Region through improving the freight and supply chain.

Implementation of the strategy will occur at various levels within the Region, some actions will also need to occur at a state, inter-state or even national level. It is key to embedding resilience that stakeholders participate in the decision making processes through the implementation phase (as a continuation of their ongoing involvement in the identification of freight and supply chain improvement initiatives). The following approach (the ‘how’ of the strategy) includes establishment of Precinct Working Groups (one working group per precinct) and an overarching Precinct Collaborative Network.

This will give the users and providers of freight and supply chain services a front-seat in the implementation of the initiatives.

Regional Level Implementation with broad industry consultation

Activities within this group will be implemented by regional groups within the Northern Rivers in collaboration with industry and other agencies. For example, this study was funded by Regional Development Australia (Northern Rivers), the Department of Premier and Cabinet and the Northern Rivers Councils.

- J. Freight and Supply Chain Initiatives (complete Jan 2019)
 - Create a common understanding of the principles that drive freight and supply chain improvements.
 - Develop a regional model for freight and supply chain to support the initiatives and any future business case development.
 - Identify freight and supply chain improvement initiatives.

- K. Precinct Working Groups
 - Identify *Precincts* of businesses and service providers whose ability to survive, adapt and grow is reliant on common freight and supply chain needs.
 - Initiate *Precinct Working Groups* to drive the freight and supply chain initiatives from the Strategy, that support improvements for their precinct.

- L. Precinct Collaborative Network
 - Develop a network for inter-precinct cooperation.
 - Create a preliminary profile of which initiatives will be pursued at the Network level, e.g. common markets or supply chain, changing technologies and regulation etc.

Precinct (Industry) Level Implementation with Local Government and Other Agency Support and Involvement

These precincts may be groups of similar or dissimilar industries, but they have in common a shared reliance on 'facilitating' infrastructure, such as roads, bridges and the rail link. The industries that would participate in the precinct level collaboration would include the producers and manufacturers within the precinct, but also the freight services providers to that precinct.

- M. Freight Movement Analysis
 - Data collection and analysis, including data logging of vehicle movements.
 - Load the precinct level data into the Northern Rivers Freight Model to develop a business case that supports alternative supply chain configurations (e.g. upgrades to local roads or bridges). The business case will need to consider forecasting future freight movements over the life of the analysis.

- N. Implementation of specific initiatives that apply to the precinct
 - Consider commercial arrangements and potential service providers.
 - Work with service providers to identify anchor businesses that will facilitate the initial stages of development.
 - Seek government funding for the initiative(s)

- O. Participate in the Precinct Collaborative Network

Precinct Collaborative Network Level Implementation

- P. Develop a virtual communication hub to support the PWGs and enable inter-precinct collaboration to occur in a virtual environment
- Q. Maintain oversight of the strategy
 - Monitor the activities of the PWGs and report successes
 - Provide regular review of the strategy
- R. Pursue major infrastructure initiatives in collaboration with state, inter-state and national government

It is envisaged the 20 initiatives of this report will be implemented by the PWGs and PCN established in the process above. This process will address the need to embed resilience in the planning process by ensuring there is a broad and comprehensive stakeholder base that is engaged in the process. Additionally, by drawing businesses and services providers for precincts together into Precinct Working Groups there will be a natural tendency to also draw together external synergies (not just the freight and supply chain initiatives) into consideration – meeting the need for resilience to be ‘integrated’ into diverse systems (e.g. telecommunications, land use planning, etc).

FINDINGS: GUIDING PRINCIPLES

The section below discusses the guiding principles that will need to shape the development of the initiatives.

RESILIENCE

This Region is generally reliant on services which have no backup or spare capacity. Whether these are freight transport providers, road networks or market destinations.

Specific Resilience (van der Merwe et al, 2017) is a prevalent issue for first-mile activities where single roads and bridges can affect the ability to carry out operations on a farm or in a factory. While this came up as an issue through the interview process it was not a high priority one as the kind of agricultural and manufacturing activities that existing in the Region can continue during short term flooding events (or pause but then continue afterwards, such as macadamia processing. The macadamias remain on site and get collected in subsequent days, some crop loss can occur during this time. Macadamias may be more affected by longer term stresses such as climate change, where changing rainfall and temperature patterns may affect crop yield.

While the provision of a cold store has the capacity to improve resilience, it is found in this report that a better outcome would be to increase the number of available markets for goods (for example better presence in overseas markets, better inter-regional connectivity). Having access to a more diverse set of markets will help over and under supply periods (not eroding price during over supply but also keeping prices higher during undersupply due to increased demand).

Another important activity to support the general resilience (van der Merwe et al, 2017) of the Region will be to foster and facilitate collaborative relationships between industry (producer, manufacture and freight companies) and industry, government and government (different department and different tiers of government) and industry and government, supported with subject matter expertise of consultants and researchers.

COOL AND COLD STORE LOCATIONS AND SIZING

Storage within any manufacturing process is counter-productive to lean manufacturing principles. Demand driven or 'just-in-time' manufacturing aims to reduce storage throughout the supply chain. Nonetheless storage is a feature of all manufacturing processes, whether it is a hopper above a conveyor belt or a finished goods store getting ready for dispatch.

It was observed through the interview process that there are a number of disparate locations around South East Queensland that are used for medium to long term cool and cold storage of goods, both raw materials and finished product. Additionally, storage occurs as a part of the freight aggregation and dis-aggregation activity and is a normal part of balancing the timeliness of supply from producers at a freight forwarder's depot or to hold on to finished goods waiting for collection.

As such, storage (of raw materials or finished goods) has a natural affinity for the following locations;

- On site, as part of the producers / manufactures process
- At a freight forwarder's depot, including rail, air and sea port

But ideally this storage should only be used to balance the flows of incoming and outgoing goods and should not be used to store unsold product.

It would be better to find markets for those goods and produce directly to market rather than to produce and then seek markets for produced (similar to stockpile raw materials above that needed for current sales / sales projections). This applies particularly to seasonal goods, where they may be some logic to storing goods for later processing or sale. If then considering investment in storage, this should be balanced against investment in processing capacity or developing new markets to sell in to.

GOLD COAST AIRPORT

Due to its proximity to the Northern Rivers, the Gold Coast Airport is a cheaper location to reach for international export than Brisbane Airport. Both Gold Coast and Brisbane Airport provide freight services in mixed freight / passenger aircraft only. While the trucking component of the supply chain journey would be reduced if going from Gold Coast, the down side is that there are currently less available destinations compared to Brisbane Airport. However, the current throughput of aircraft are set to increase and can be gauged by the forecast increase in passenger numbers from the Gold Coast Airport Master Plan, anticipating a jump in passengers from 6.6 million passengers per annum in 2018, to 16 million passengers per annum in 2037.

The Gold Coast Airport has already identified two locations on their land that are capable of being developed for freight activity (the Western and Southern Zones). The southern zone (precinct) is a 5 hectare site adjacent Wollemi Place near the Junction off the M1 into the Gold Coast Highway. The site could provide a suitable location for a freight storage and distribution hub for dry product. A second site to the west of the airport is a much larger zone (precinct) 39 to 60 hectares in area, immediately adjacent the airport operational lands. This site has the most potential for integration of an air freight facility with a cold store capability, but would require off and on ramps on the M1 Pacific Highway to provide efficient access to the site. This is considered key to unlocking this parcel for logistics and freight opportunities.

The western zone particularly has the capacity to be a major freight hub for the Region. It is anticipated that the major activity to be carried out on this land would be to intercept freight from Sydney heading to Brisbane and then dispatch it from this location. This would negate the need for freight to travel past its ultimate destination before being 'shipped back' (i.e. Freight from Sydney to the Gold Coast being sent to Brisbane first for subsequent dispatch to the Gold Coast). Subsequently, the design of the freight hub at this location (or

other similar locations) would not be to specifically support Northern Rivers' activities. The advantage is that there are other (larger) driving factors that will see this development progressed without the need for specific resources from the Region.

There is also an opportunity for the Region to participate in the overall design of the facilities (should they go ahead) but this is something that would need to be progressed by major producers in the Region who have a specific need (such as a combined cold store / air freight export opportunity) that can be met at the Gold Coast Airport – e.g. Blueberry Growers.

TOOWOOMBA (WELLCAMP) AIRPORT

The Toowoomba (Wellcamp) Airport has been identified by multiple levels of government as an ideal location for airfreight export to Asian markets. It also has connection to the Inland Rail Network and could be part of a Northern Rivers Region rail shuttle network.

By road it is not more effective to get Toowoomba (Wellcamp) Airport than other airports (Brisbane or Gold Coast), but as a port, alternate market destinations may emerge at this location that are not available at other airports. As a result, the use of Toowoomba (Wellcamp) Airport may become more prevalent in the future even without progression of the rail shuttle initiative.

As previously discussed, it is more critical to establish a foreign presence in Asian markets which will lead to the emergence of the best supply chain configuration.

REGIONAL AIRPORTS

The Northern Rivers has a number of smaller, regional airports that could, at some future stage, be considered for distant domestic and international export.

It is anticipated that this would emerge as an industry driven initiative and be linked very closely to one or two major activities that would drive this option.

For example; if a new industry or market destination emerges that could utilise dedicated freight export (or even combined passenger / freight export) from a small airport into distant domestic destinations or in a foreign market, then the cost savings of a shorter trucking distance would need to be compared to the cost of any upgrades or other costs (intermodal costs, other airport costs) to support a business case for the upgrade.

Alternatively, the smaller regional airports may be able to provide Regional freight flights to nearby larger domestic/international airports, such as Brisbane, Gold Coast or Toowoomba (Wellcamp) Airport, for ongoing connections to more distant domestic and international destinations.

It is suggested that airport operators consider the option of distant domestic and international freight in their long term planning. This would involve understanding the supply and demand characteristics of nearby industry. The Precinct Working Groups would be ideal mechanisms to further examine this possibility.

RAIL SHUTTLE

It is likely that use of the coastal rail network as a long-haul (Melbourne to Brisbane) link will decrease due to the likely change in rail operations to utilise the Inland Rail Network. This decrease in long-haul services opens up capacity at either end of the network to run rail shuttle services.

The Rail Shuttle concept involves the use of Casino, Kyogle or Grafton (or a combination of some or all of these) as rail shuttle terminals to reach the Port of Brisbane, Toowoomba (Wellcamp) Airport and other domestic markets through the Inland Rail. Modelling has indicated that there are significant savings (50% to

66% to Melbourne by inland rail) for most areas of the Northern Rivers Region if a rail shuttle is used and that there is likely to be sufficient economic density to support the rail activity.

While this study has focussed more specifically on Regional exports – there is a significant volume of Regional imports that could be serviced by using a rail shuttle network. This could include goods such as fuel, gas, raw materials for manufacturing, building supplies etc.

Pursuit of these initiatives will have the potential to;

- Provide better access for Northern Rivers manufacturers to source raw materials (macadamias, milk, hemp seed etc.) from around Australia via the Inland Rail network),
- Reduce the costs of getting to market both domestically and internationally,
- Provide alternative routes to get to market in the case of network interruptions (infrastructure failure etc.),
- Stimulate economic growth around the shuttle terminal locations through co-located manufacture and transport services.

The opportunity for a two way flow of goods will provide for a stronger business case for a shuttle service.

BRUXNER HIGHWAY UPGRADE

There are a number of infrastructure hurdles (6-8 bridge upgrades, road widening, overtaking lanes, Tenterfield connectivity) to upgrade the Bruxner Highway to allow full East-West B-double connectivity for the Region. However, doing this will provide further capacity for the Region to source raw materials for processing from western regions of NSW as well as other more distant locations.

As a resilience initiative, this provides alternative means for sourcing raw materials and for distribution of finished product. As an initiative, there is presently no specific ‘what-if’ data that is available to identify the increase in goods that could be sourced or sold in the case of an upgraded Bruxner Highway.

ALTERNATIVE ROAD NETWORK ROUTE TO BRISBANE (NOT PACIFIC HIGHWAY)

The current corridor via Mt Lindesay Highway does not permit the passage of B- double trucks, requiring smaller trucks up to a semi-trailer size to be used. Presently, B-double traffic is only able to use the Pacific Highway route from Kyogle, Casino, and via Lismore, joining the Pacific Highway at Ballina to reach Queensland destinations. This is also a restriction for incoming produce and stock from western Queensland and NSW, in servicing food manufacturing plants in Casino and Lismore, which currently restricts the use to either single body or semi-trailer loads to access the Region via Tenterfield or Summerland/ Mt Lindesay Highway from Queensland.

A number of deviations to the East of Mt Lindesay have been identified by Kyogle Council, together with specific sections of upgrade to the existing Summerland Way and Mt Lindesay Highway. In particular, providing B-double access via a 10km deviation from near Dairy Flat on Summerland Way to near Palen Creek on the Mt Lindesay Highway is of interest. Also of interest is the potential for a B-double route from Tabulam via Bonalbo and Woodenbong to Mt Lindesay Highway, upgrading to B-double standard.

An East of Mount Lindesay deviation would potentially reduce the freight cost of a B- double journey in the order of 10% over the existing Pacific Highway route for most western precincts. For Kyogle precincts, this reduction would be 35%. However whilst the road freight cost reduction is mainly of benefit to the Kyogle precinct, it is important to note the benefits of a combined B-double and intermodal at Bromelton can only occur for the western precincts if the Summerland Way /Mt Lindesay B-double route is developed. The comparison of a Bonalbo Woodenbong upgrade to Bromelton and Brisbane could be a 25% reduction in

transport cost for B-doubles originating from Tabulam compared with a route via Casino. Capital cost of routes have not been considered in these comparisons.

FOOD STRATEGY

Implementation of a Northern Rivers food strategy – covering provenance, distribution, access to affordable local food. There was much support for the idea of a food strategy for the Northern Rivers at the producer, manufacturer workshop group. It did mean many things to the different stakeholders. One of the recognised benefits of a Northern Rivers food strategy is that it could muster a recognisable brand that covered collectively, produce from the Northern Rivers Region.

It was seen to include sharing of information for the producers, in being better organised and connected. To sell directly from farms and local markets to not only local consumers, but also making the Region and its local smaller producers visible to the food tourist from outside the Region. Consumer education was seen to be coupled with the food strategy. Much interest from the smaller newer generation farmers, growers and providers, particularly from the eastern precincts of the Region.

Some key aspects direct from the workshop are: branding Identity; tourist pay premium to experience our lifestyle e.g. camping, indigenous export, need to get tourists to explore more; differentiators, images and branding, organic resto, authenticity - educate, bring history to tourists, eat fresh clean and green, sustainability travel, protect the brand - clean & green, mystery. Examples that are actually happening to showcase the Region's foods include Harvest Food Festival, Harvest Food Trails by Northern Rivers Food. These type of initiatives could form the building blocks for a Northern Rivers food strategy.

INDUSTRY COLLABORATION

A key to a resilient region and the implementation of a resilient freight and supply chain strategy is to involve a broad stakeholder base in the decision making processes in a meaningful way. This report suggests that the Precinct Working Groups and a Precincts Collaborative Network be established to ensure that the participatory methods that have led to the development of initiatives in this report continue to occur through implementation.

A number of the major initiatives, including the Bruxner Highway Upgrade, the Summerland Way/ Mt Lindesay Upgrade and the Rail Shuttle initiative will require coordination with the RMS and TfNSW (as part of the broad stakeholder groups) as part of the further development of the initiatives.

SAFETY AND WELLBEING IN FREIGHT AND SUPPLY CHAIN

The NSW Government and local councils are very aware and focused on ensuring safety not only for the truck drivers, but also for other motorists, community and environment. Truck accidents are usually very serious and can result in fatalities, road blockages and contamination of environment. Separation of road users through dual roads, and town bypasses are an inherent feature of the newer road design in the Pacific Highway investments of recent years. However, the opportunity for additional separation via a western north south route between Grafton and Brisbane via Casino, use of newer safer trucks as B-double routes are provided, greater integration with rail and roles for future autonomous vehicles should all be explored with earnest given the safety benefits that will parallel any productivity benefits.

Driver wellbeing was observed to be an important issue when it comes to overall safety and productivity of drivers. It was observed earlier that existing RMS truck stops can lack preferred amenity for drivers. An important consideration when planning precincts is the provision of driver rest locations and amenities close

to the destination, enabling driver's safe and easy access to their destinations at opening of business. Innovative ideas that could be considered include provision of gymnasium facilities at the driver rest locations. The Precinct Working Groups should include this need as an important part of the precinct planning. As these facilities can impact mixed-residential development areas, careful and specific planning should occur to identify zones and planning controls. It should be recognised that local government and state planning guides and controls may need careful application to enable well designed facilities to be integrated into the community.

REFERENCES

- AEC Group. (2008). *Clarence Valley Transport Hub Pre-Feasibility Final Report*, Clarence Valley Council.
- AEC Group. (2016). *Clarence Valley Transport Precinct Study – Clarence Valley Council*, Clarence Valley Council.
- Australian Rail Track Corporation (ARTC). (2018a). *Inland Rail Illabo to Stockinbingal Project*, <https://inlandrail.artc.com.au/I2S> [accessed 5/10/2018]
- Bitzios Consulting. (2017). *Tweed Road Development Strategy*, Tweed Shire Council, Queensland.
- Brynjolfsson E. and McAfee A. (2014). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, W.W. Norton.
- Bureau of Infrastructure, Transport and Regional Economics. (2016). *Why short haul rail services succeed. Canberra*, Commonwealth of Australia.
- Clarence Valley Council. (2018). *Clarence Valley Regional Economic Development Strategy 2018-2022*, NSW Government.
- Department of Transport and Main Roads. (2018). *South East Queensland North Coast-Metropolitan-South Coast Draft Regional Transport Plans*, Queensland Government.
- Digital India, (2016). *Story Telling: Supply Chain Linkages in Agriculture Sector*, (https://www.youtube.com/watch?v=lbpo_ncAjRk), [accessed 5/10/2018]
- GHD. (2016). *Port of Brisbane Pty Ltd Priority Infrastructure Interface Plan (Brisbane Port Land Use Plan 2015 – Schedule 1)*, Port of Brisbane
- Kyogle Council. (2017a). *The Summerland Way, A long term alternative to complement the Pacific Highway*, Kyogle Council.
- Kyogle Council. (2017b). *Clarence Way, Supporting Community Access, Agriculture, Industry and Tourism*, Kyogle Council.
- Kyogle Council. (2018). *Tabulam Agribusiness Precinct, Supporting Industry Access, Agriculture, and Economic Growth*, Kyogle Council.
- Monahan S. (2018). CSCMP's Annual State of Logistics Report, A.T. Kearney. *Presentation at The National Press Club*, Washington, D.C. Available on YouTube at: <https://www.youtube.com/watch?v=uTQI7v7k12k> [accessed 30/10/2018].

- Northern Rivers Councils. (2018). *Northern Rivers Regional Economic Development Strategy 2018-2022*, NSW Government.
- Northern Rivers Joint Organisation. (2018). *About*, Retrieved from Northern Rivers Joint Organisation: <http://www.northernriversjo.nsw.gov.au/about-us>, [accessed 5/12/2018].
- NSW EPA. (2016). *Regional State of the Environment for the Far North Coast Region of New South Wales*, NSW Government.
- Pendall, R., Foster, K.A. and Cowell, M. (2010) "Resilience and regions: building understanding of the metaphor", *Cambridge Journal of Regions, Economy and Society*, Vol. 3 No. 1, pp. 71-84.
- Power D. (2005). "Supply chain management Integration and implementation, a literature review", *Supply Chain Management, An International Journal*, Vol 10, 4, pp252-263.
- PricewaterhouseCoopers. (2017). *Optimising the use of rail in landside transport networks*.
- Regional Development Australia - New England. (2012). *Northern Inland Region of NSW – Freight Study*. Retrieved from https://www.rdani.org.au/files/pages/projects/road-freight-study/RDANI_freight_study_final_report_v2.pdf, [accessed 5/12/2018].
- Regional Development Australia - Mid North Coast. (2015). *Mid North Coast Freight and Distribution Study*. Retrieved from http://www.rdamnc.org.au/wp-content/uploads/3.2_FINAL-Mid-North-Coast-Freight-Distribution-Study-REV-B.pdf, [accessed 5/12/2018].
- Regional Development Australia - Northern Rivers. (2018). *About*, Retrieved from Regional Development Australia - Northern Rivers: <https://rdanorthernrivers.org.au/about/>, [accessed 5/12/2018].
- Resilient Cities Network. (2019). *What is Urban Resilience?* Retrieved from Resilient Cities Network: <https://www.100resilientcities.org/resources/#section-2>, [accessed 5/12/2018]
- Roads and Maritime Services (RMS). (2009) *Ballina to Tenterfield Corridor Strategy*, NSW Government.
- Roads and Maritime Services (RMS). (2018). *NSW Combined Higher Mass Limits (HML) & Restricted Access Vehicles (RAV) Map*, Retrieved from RMS <https://www.rms.nsw.gov.au/business-industry/heavy-vehicles/maps/restricted-access-vehicles-map/map/index.html>, [accessed 12/12/2018].
- Roads and Maritime Services (RMS). (2016) *Summerland Way Corridor Strategy*, NSW Government.
- Roser, C. (2015). *A Critical Look at Industry 4.0*, <https://www.allaboutlean.com/industry-4-0/>, [accessed 5/12/2018]
- Spencer, S., Kneebone, M. (2012). *FOODmap: An analysis of the Australian food supply chain*, Department of Agriculture, Fisheries and Forestry, Canberra.
- Srikanta Routroy, Astajyoti Behera (2017). "Agriculture supply chain: A systematic review of literature and implications for future research", *Journal of Agribusiness in Developing and Emerging Economies*, Vol. 7 Issue: 3, pp.275-302.
- Transport for NSW (TfNSW). (2018a). *NSW State Government released the NSW Freight and Ports Plan*, NSW Government.
- Transport for NSW (TfNSW). (2018b). *Regional NSW Services and Infrastructure Plan*, NSW Government.

Toowoomba Wellcamp Airport. (2018). *Toowoomba Wellcamp Airport*. Retrieved from Toowoomba Wellcamp Airport: <https://www.wellcamp.com.au/corporate/cargo/cargo-services/>, [accessed 5/12/2018].

Tweed Shire Council. (2018). *Tweed Shire Regional Economic Development Strategy 2018-2022*, NSW Government.

Van der Merwe, S. E., R. Biggs, and R. Preiser. (2018). A framework for conceptualizing and assessing the resilience of essential services produced by socio-technical systems. *Ecology and Society* 23(2):12. <https://doi.org/10.5751/ES-09623-230212>

Two different approaches were used in the initial modelling. A region-based analysis using secondary data sources and industry-based analysis based on the stakeholder interviews.

As part of the modelling process the primary data collected from interviews with producers and manufacturers provided a profile of the existing operations and supply chain patterns and needs in their individual companies. This primary data was utilised in understanding the various existing supply chain volumes and contexts and painted a picture of potential future demands. However due to confidential data being collected, the modelling information from this data has not been included in this appendix. The primary data has been used to provide a snapshot of the supply chain needs for each company and has been used to inform the study team in the analysis and recommendations being put forward in the body of this Report. However, the information presented here in this appendix is derived from the various secondary data sources below.

Figure presents the various inputs of the model and the targeted outputs from the analysis. The main secondary data sources for region-based analysis include:

1 – Strategic Freight Model (SFM), Transport for NSW, 2016

This open dataset, released in October 2018, presents the base case, business as usual (BAU) projections of the future unconstrained freight tasks. These forecasts are used to set the overall growth rates for each commodity which is then applied to the respective supply chains for each commodity, this movement dataset is then used in network modelling and assessment of the freight task. The preparation of the current freight forecasts took into consideration:

- TPA's Land Use 2016 (LU16) population and employment projections;
- Medium term projections available from the Common Planning Assumptions Group and long term economic outlook by commercial forecasters in particular Deloitte Access Economics.

The preparation of the freight task forecasts used a mixture of methods including:

- General economic research and literature review as well as specific industry freight investigations (including those on construction materials, waste, forestry and electric vehicles);
- Data analysis and statistical modelling;
- Application of EFF's transport models including the Sydney Freight Movement Model (FMM) and the Port Botany Sydney Airport Freight Movement Model (PB_SA_FMM).
- Consultation with other agencies including BITRE and Department of Industry NSW.

2 – Survey of Motor Vehicle Use (SMVU), Australian Bureau of Statistics, 2016

The SMVU (rail, sea and air component) currently and historically produces quarterly estimates of freight movements by rail, air and sea. Movements are classified by origin, destination, commodity and method (solid bulk, other bulk (liquid/gas), containerised or other) and whether the goods are dangerous and /or refrigerated. Data on commodity uses selected articles (21 items) from the Australian Transport Freight Commodity Classification (ATFCC) and whether these goods are categorised as dangerous.

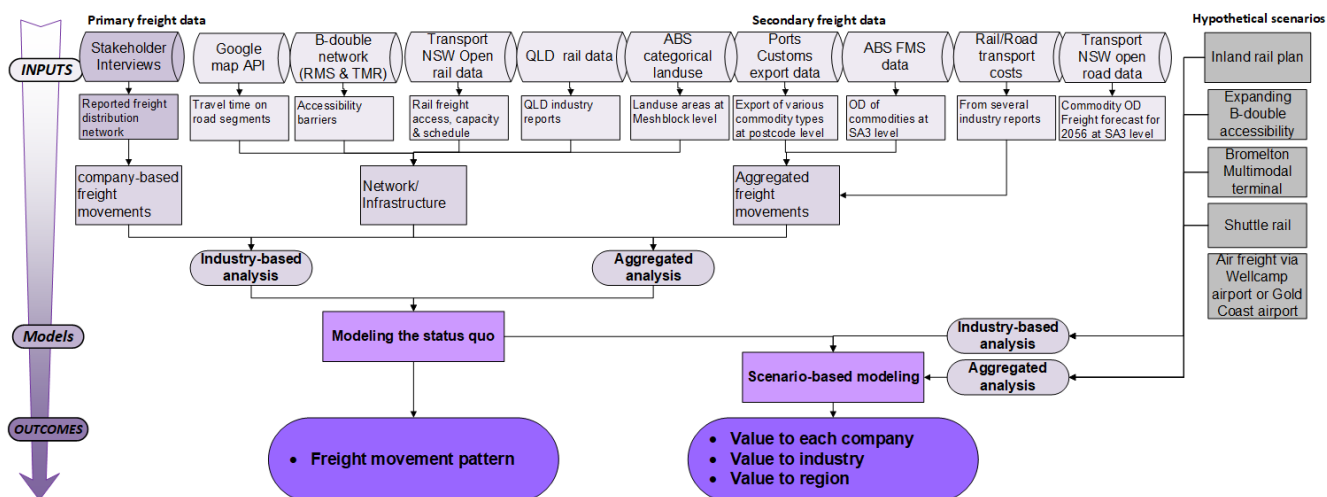


Figure B1: Modelling Methodology

3- Other secondary data sources

In this study, directional travel time on road segments has been extracted by Google map API for the AM peak hour (8-9 AM) of a typical weekday. The distance and transit time of routes has been considered for the shortest path except for case studies where the information of undertaken routes has been reported in the interviews.

The unit operational cost attributes for the analysis are assumed according to the Table and Table B2. Truck operating costs include capital cost, vehicle stamp duty, miscellaneous costs, maintenance and service costs, tyre wear, and fuel levy. The charged costs are the price that customers have to pay which includes the operational costs and fixed cost per service.

Table B1: Unit road operational cost for different trucks [source: Freight Metrics, 2018 and SKM, 2013]

items	Curtain sider single	Curtain sider B-double	Curtain sider B-triple	Reefer single	Reefer B-double	B-double tanker	semi tanker
fuel cost (\$ per litre)	1.6						
Fuel cost including delivery & rebate (\$ per litre)	1.5						
Average Vehicle Fuel Burn Rate (km/litre)	2.1	1.6	1.1	2.1	1.6	1.6	2.1
Operating cost per tonne (\$)	70.9	86.0	105.2	74.8	94.1	93.8	74.8
Operating cost per km (\$)	2.3	2.8	3.4	2.4	3.0	3.0	2.4
Estimated charge per tonne (\$)	78.8	95.6	116.9	83.1	104.6	104.2	83.1
Estimated charge per km (\$)	2.5	3.1	3.7	2.7	3.4	3.3	2.7
Estimated charge (\$/ntk)	0.1372	0.1178	0.0924	0.1300	0.1033	0.1037	0.1300

Table B2 presents a comparison of operational cost for inland Rail and existing coastal railway. Inland rail connects Melbourne to Brisbane stretches 1,700km rail line, divided into 13 separate projects, to be delivered over 10 years due for completion in 2024/25.

Table B2: Unit rail operational costs [source: Inland Rail Business case, and Trainline5 by BITRE 2018]

	Melbourne to Brisbane container freight		Agricultural freight	
	Coastal route	inland rail	existing rail	inland rail
Rail operating cost per net tonne km (\$)				
Train crew cost (\$)	0.0037	0.0017	0.0067	0.0061
Fuel cost (\$)	0.0138	0.0118	0.0176	0.0176
Rolling stock maintenance cost (\$)	0.0038	0.0028	0.0055	0.0055
Annual depreciation and return on economic capital (\$)	0.0019	0.0012	0.0017	0.0017
overhead and admin (\$)	0.0009	0.0007	0.0013	0.0012
Total operating cost (\$/ntk)	0.0242	0.0183	0.0329	0.0322
Estimated charge cost (\$/ntk)	0.0406	0.0349	0.0488	0.0482

SCENARIO-BASED ANALYSIS

As presented in Figure B1, various scenarios were considered, including:

- Expanding B-double accessibility
- Trucking to Bromelton terminal and using Inland rail for domestic market or export shipments
- Trucking to Bromelton terminal and using existing coastal rail for domestic market or export shipments
- Trucking to the closest rail station in the Region (Kyogle, Casino, Grafton) and using shuttle rail for domestic market or export shipments
- Using Wellcamp and Gold Coast airport for export

B-DOUBLE ACCESSIBILITY

Route restrictions on B-double vehicles are an issue for industries and exporters located in the Region. Special permits have to be sought from local government to gain access to local roads by every type of trucks. The B-doubles vehicles also require additional modifications to ensure they comply with national mass limit regulations. Road transport also faces several other non-monetary restrictions which add to the cost of transporting include mass limits chain of command legislation, driver fatigue legislation and road train access restrictions. Given B-double vehicles are not allowed to operate in some road segments, the trailer of a B-double has to be detached at a designated location and then handled in the next round. This scenario is not applicable for livestock and perishable shipments because of animal welfare and time-sensitivity of commodities.

B-double network was extracted from Transport Road and Maritime Services of NSW¹, and Queensland Transport and Main Roads². The networks are available for B-doubles that comply with the requirements contained in the Heavy Vehicle National Law (HVNL); the National Class 2 Heavy Vehicle B-double Authorisation (Notice). These networks are based on a maximum vehicle width of 2.5 metres and are subject to sign-posted restrictions.

¹<https://www.rms.nsw.gov.au/business-industry/heavy-vehicles/maps/restricted-access-vehicles-map/map/index.html>

² <https://www.tmr.qld.gov.au/business-industry/Heavy-vehicles/Heavy-vehicle-routes-and-restrictions>

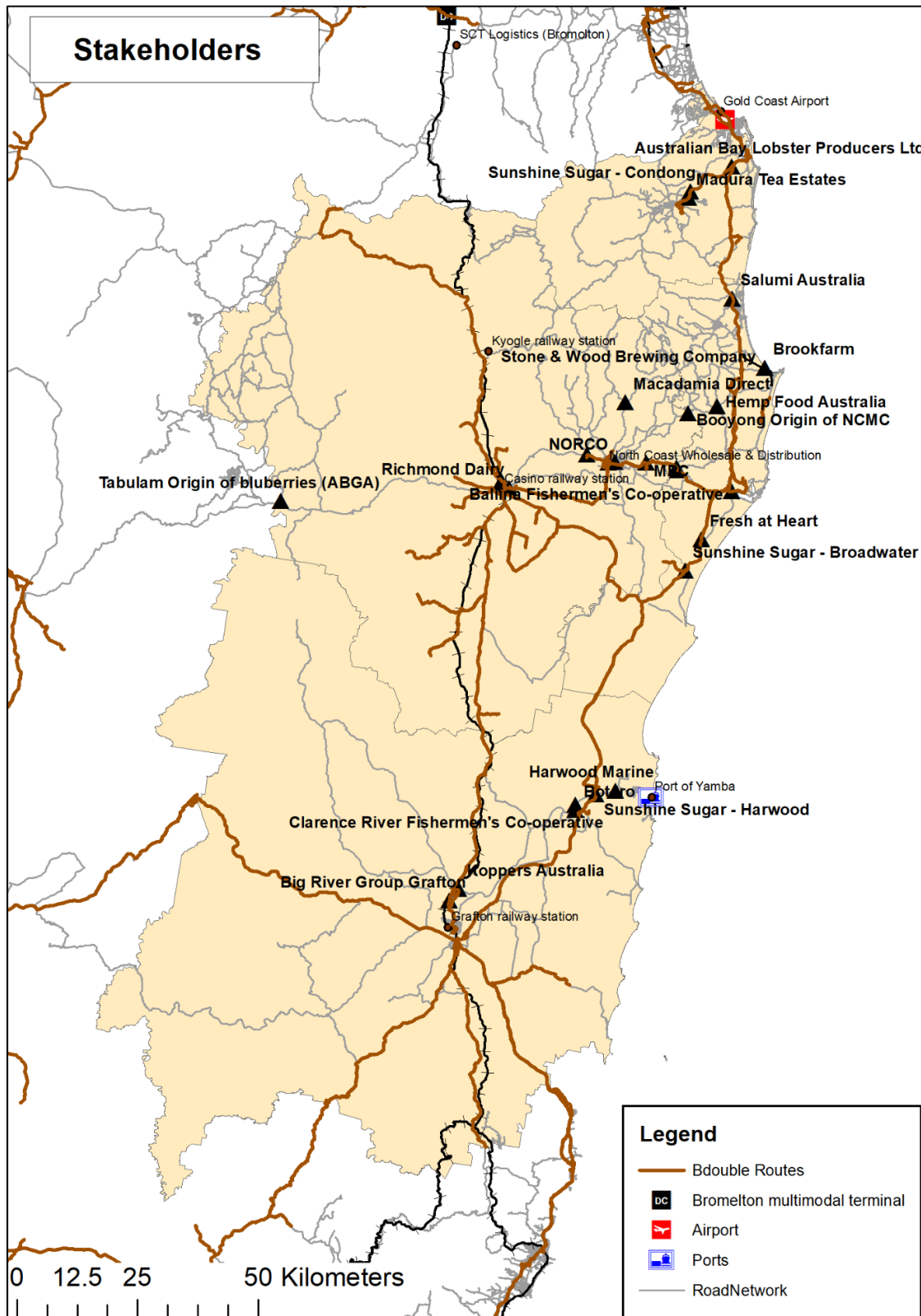


Figure B2: 19 metre B-double accessibility

CASE STUDY OF B-DOUBLE OPTIONS FROM TABULAM TO BROMELTON

Modelling of a number of route options between Tabulam and Bromelton to make visible the freight costs of each route was conducted. The basis for comparison was the Unit Price per B-double truck journey between Tabulam and Bromelton with the different route options. The options considered were:

1. Option 1 includes 52 km upgrade of Bruxner Highway (from Tabulam to Casino), and 84 km upgrade of the route from Wiangaree to Bromelton.
2. Option 2 includes upgrading 52 km of Bruxner Highway (from Tabulam to Casino), and 63 km upgrade of Mt. Lindsay highway when it enters the Queensland border (from Mt. Lindsay Quarantine station to Bromelton).
3. Option 3 includes upgrading a route from Tabulam through Bonalbo, Woodenbong to Bromelton for 354.6 km which is not accessible by B-double trucks except the segment between Woodenbong and Mt. Lindsay highway up to the QLD border for 14 km.
4. Option 4, includes the Mt. Lindsay bypass where a 10 km deviation from Dairy Flat on the Summerland way to Palen Creek cuts the route, shortening of 18 km but with a higher speed.

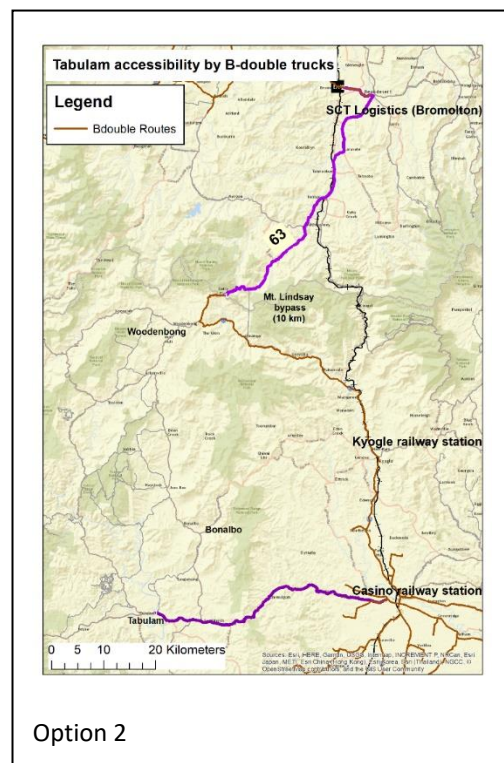
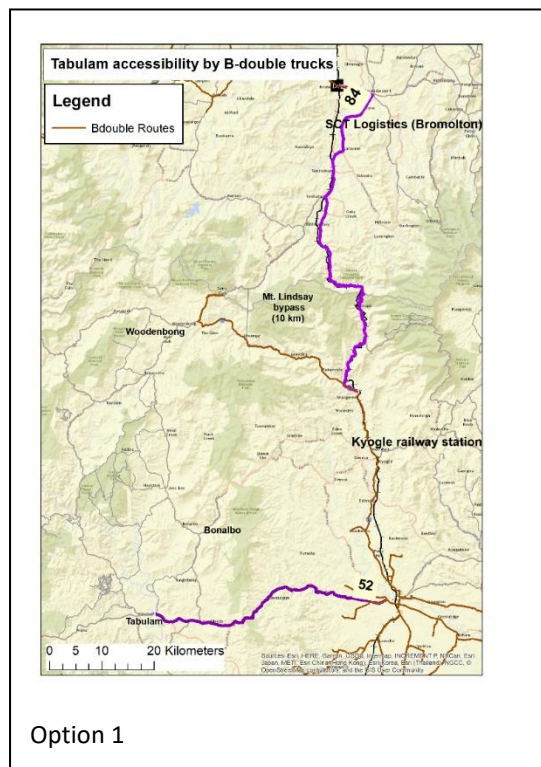
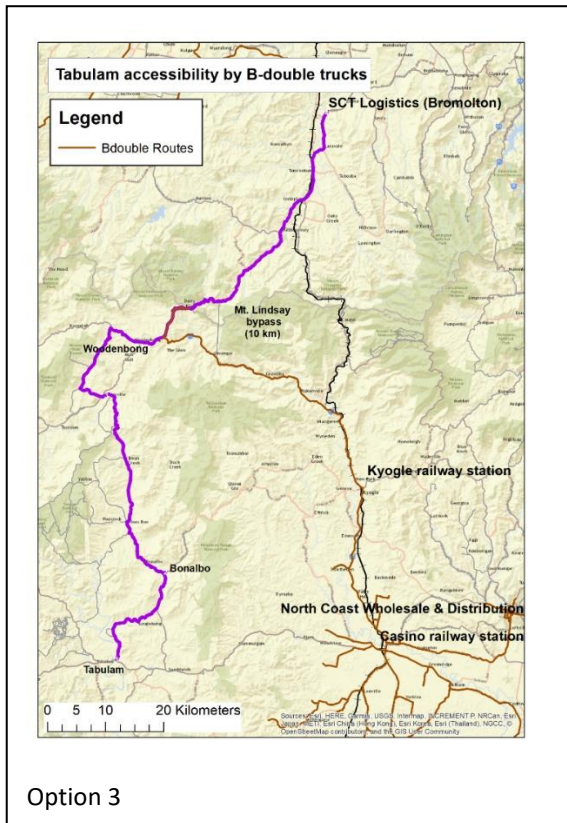
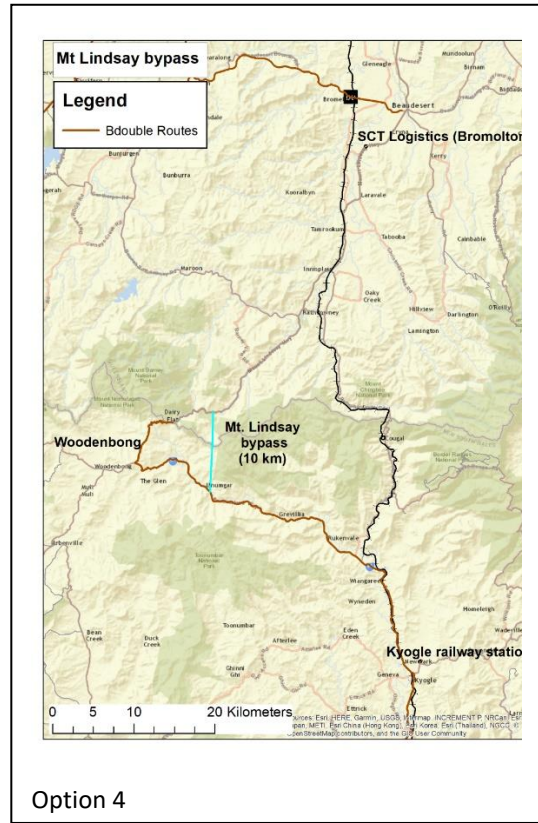


Figure B3: B-double Options 1 & 2 Tabulam to Bromelton



Option 3



Option 4

Figure B4: B-double Options 3 & 4 Tabulam to Bromelton

The comparison of route options using the Unit Price per B-double journey is shown in Figure B5 and relative to Option 1 in Figure B6. For Tabulam, the modelling indicates that on a freight cost comparison without recovery of capital costs, there could be a 25% reduction in cost via Option 3, a Bonalbo Woodenbong upgrade. This translates into a potential 25% reduction in freight cost compared to any of the other Tabulam via Casino routes.

The modelling also indicates that the East of Mount Lindsay deviation Option 4, with a 10 km deviation over Option 1, would potentially reduce the freight cost of a B-double journey in the order of 10% over the existing Pacific Highway route, for most other western precincts. However, for the Kyogle precinct, this reduction would be 35% (inclusive of a 25% reduction from Option 1 over the Pacific Highway Route). Whilst the road freight cost reduction of Option 4, is mainly of benefit to the Kyogle precinct, it is important to note the benefits of a combined B-double and intermodal at Bromelton can only occur for the western precincts if the Summerland Way /Mt Lindsay B-double route is developed. This advantage to Kyogle, Casino, Grafton and Tabulam producers and manufacturers may be a more significant benefit to the Region's industry.

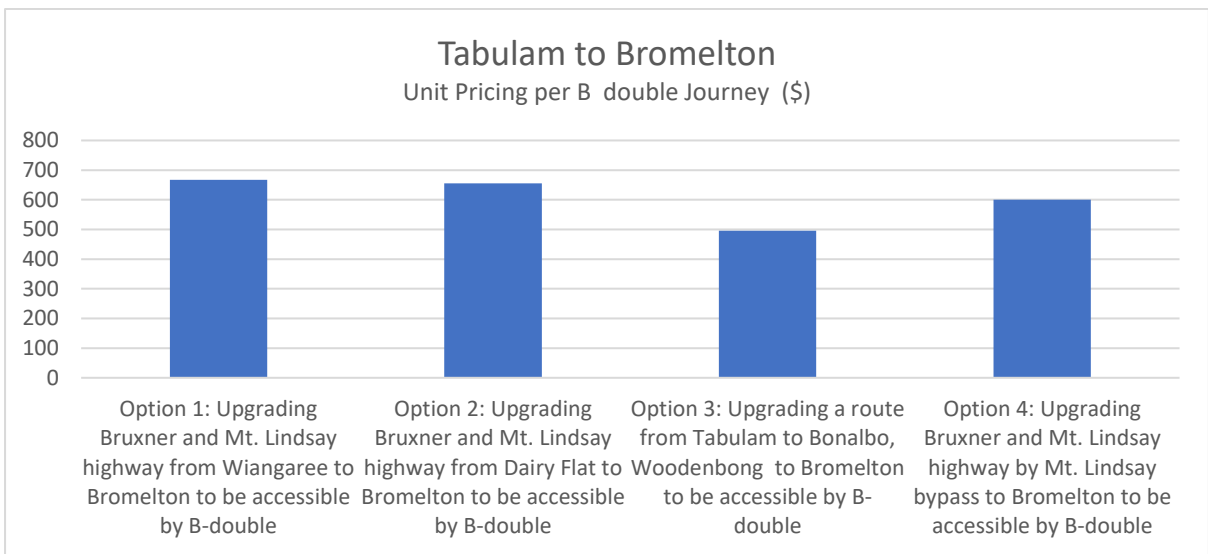


Figure B5: B-double Options Unit Price Comparison Tabulam to Bromelton

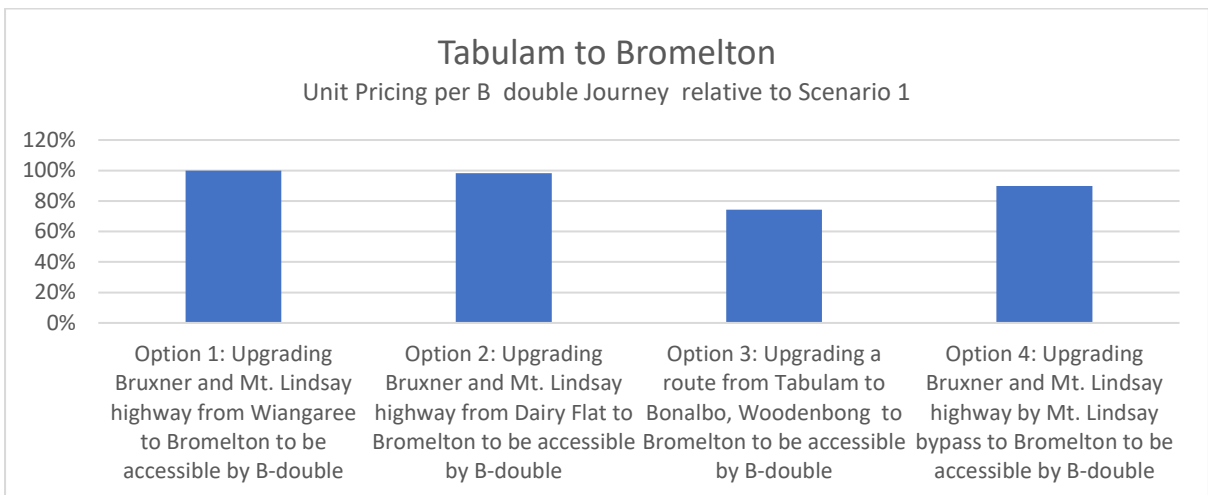


Figure B6: B-double Options Comparison to Option 1 Tabulam to Bromelton

INLAND RAIL

Inland rail may provide a cost-effective alternative for long-haul movements from the Region to the domestic market in Brisbane, and Melbourne. Figure B7 represents the Inland rail route.

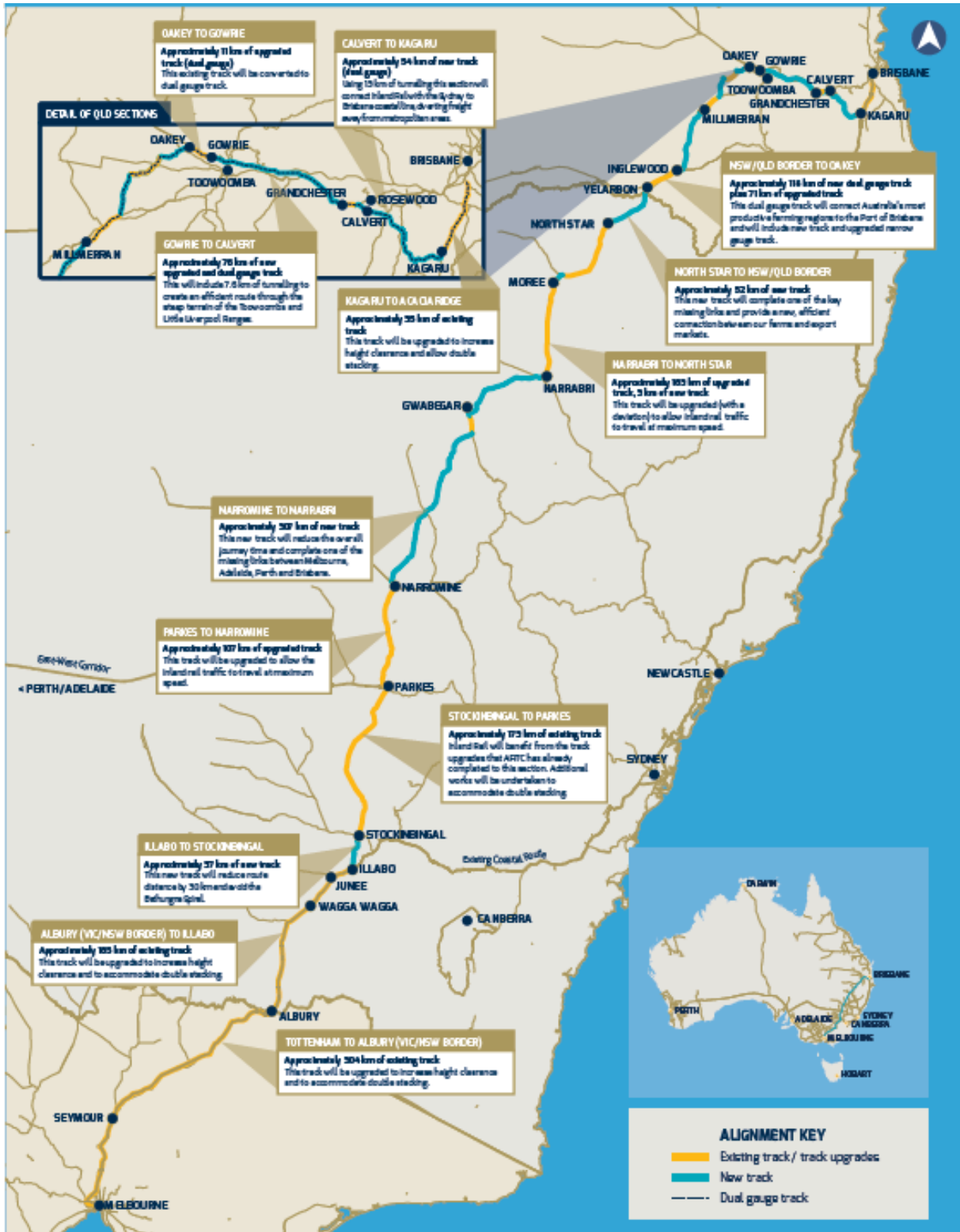


Figure B7: Inland rail route [source: Inland Rail Business case]

The Kagaru to Acacia Ridge and Bromelton (K2ARB) section is one of 13 projects that complete Inland Rail. This section of the Inland Rail Programme consists of enhancements to, as well as commissioning of, dual gauge operations along the existing interstate track between K2ARB. The project utilises the existing Sydney to Brisbane Rail Corridor, operated by ARTC pursuant to a sub-lease with the Queensland Department of Transport and Main Roads (TMR).

This is an existing operational rail corridor and Acacia Ridge has been a longstanding, nationally-significant intermodal terminal in operation for decades. There is about 49km of existing track to be upgraded enabling double-stacking capability along the existing interstate route both south from Kagaru to Bromelton and north from Kagaru to Brisbane’s major intermodal terminal at Acacia Ridge. It crosses the three Local Government Areas of Scenic Rim, Logan City and Brisbane City. It will involve lowering of the rail under five bridges (Beaudesert Road, Learoyd Road, Johnson Road, Middle Road and Pub Lane), the construction of two new crossing loops at Larapinta and Kagaru; and the extension of the existing ones in Greenbank and Bromelton.



Figure B8: Kagaru to Acacia Ridge and Bromelton section in inland rail

The NSW/QLD Border to Gowrie section is one of 13 projects that complete Inland Rail. It comprises approximately 146km of new dual gauge track and 78km of upgraded track from the NSW/QLD border, near Yelarbon, to Gowrie Junction, north west of Toowoomba in Queensland. Gowrie, located within 17 km (17.3 min transit time) of Wellcamp Airport can be the closest intermodal hub for air freight exported through the Toowoomba Wellcamp Airport.

This section will link one of Australia’s most productive farming regions by rail to Brisbane, Melbourne, Adelaide and Perth.



Figure B9: NSW/QLD border of inland rail

Parkes, is set to be a logistics hub soon, reserving 616 hectares. The Hub has about three times the amount of land as Sydney’s Moorebank freight terminal. SCT Logistics and Pacific National each have around 300ha with bespoke warehousing, manufacturing, and distribution opportunities. Linfox also boasts a significant footprint.

Parkes has access to all major cities in Australia and this includes readily accessible rail connections to all major seaports. Transit time to the Port of Brisbane is 11 hours by road, and 18 hours by rail.

The centralised location of Parkes reduces the average distance that freight needs to travel to reach the major markets throughout Australia. This results in significantly lower transport costs for distribution. Other cost savings can also be achieved with lower industrial land costs and wage costs.



Figure B10: Parkes logistics hub

Melbourne is accessible by inland rail which makes it easier and cheaper for the shipments travelling from the region to Melbourne.

Table presents the distance and transit time in Inland rail versus the existing coastal railway.

Table B3: Distance – transit time matrix

	Inland rail		Coastal line	
	distance (km)	transit time (min)	distance (km)	transit time (min)
Kyogle railway station - Port of Brisbane	-	-	177	179
Casino railway station - Port of Brisbane	-	-	207	209
Grafton railway station - Port of Brisbane	-	-	312	302
Kyogle railway station - Bromelton	-	-	84	96
Casino railway station - Bromelton	-	-	114	126
Grafton railway station - Bromelton	-	-	219	219
Acacia Ridge - Port of Brisbane	30	22	33	33
Acacia Ridge - Bromelton	-	-	60	50
Bromelton – Kagaru on existing rail line	-	-	12.8	11

	Inland rail		Coastal line	
	distance (km)	transit time (min)	distance (km)	transit time (min)
Acacia Ridge – Kagaru on existing rail line	35	29	-	-
Bromelton-Port of Brisbane on inland rail*	81	73	-	-
Bromelton – Parkes on inland rail	913	13656	-	-
Bromelton – Melbourne on inland rail	1609	26700	-	-
Bromelton – Port of Brisbane on existing rail line	-	-	93	77
Bromelton - Sydney	-	-	922	876
Bromelton - Melbourne	-	-	1882	1686

*Assuming the upgrade of the existing rail line in inland rail project, and a few planned loops to shorten the distance

AIR FREIGHT

Sydney, Melbourne and Brisbane are currently the only airports in Australia with markets large enough to sustain dedicated international freighter services, except for one weekly service operating from Toowoomba Wellcamp Airport.

While there are dedicated air freighters servicing Australia’s major capital city airports, the bulk of domestic and international air freight is carried in the holds of passenger aircraft. Nationally, only 17% of scheduled international air cargo carried to and from Australia is on dedicated freighter aircraft while the rest is on passenger aircraft. Dedicated freight aircraft within Australia are operated by Toll, Qantas and Virgin, providing services for freight forwarders, corporate shippers, businesses and individuals³.

Australia’s major capital city airports are owned by the Commonwealth and operated by private companies with very long-term leases and provide a range of aviation infrastructure dedicated to freight operations, including hangars, freight aprons, aircraft parking bays and cargo handling facilities. Air freight activities at airports compete with passenger based facilities, including passenger terminals, passenger parking and other airport-related businesses.

The airport’s good road connections and proposed links to the Inland Rail project create air freight opportunities for agricultural and other products. Wellcamp Airport at Toowoomba is considered as one possible scenario for air freight as an alternative for Brisbane Airport.

WELLCAMP AIRPORT

Toowoomba Airport at Wellcamp, located about 25 kilometres west of the city, can be considered as another alternative for the Brisbane Airport. The privately owned and operated Toowoomba Wellcamp Airport opened in 2016, but presents a new model for air freight in Australia. A new road bypass of the city (Second Range Crossing bypass) will make road transport far more efficient for road heavy vehicles, while the Inland Rail from Melbourne to Brisbane will run through the vicinity of the Wellcamp Airport.

³

https://infrastructure.gov.au/transport/freight/freight-supply-chain-priorities/supporting-papers/files/Supporting_Paper_No1_Air_freight.pdf

Currently, Cathay Pacific run a weekly freight flight from Wellcamp Airport to Hong Kong, carrying mostly fruit and vegetables from the local Darling Downs region and the Lockyer Valley as well as some manufactured goods. However, by completing the Second Cross Range bypass and inland rail projects, it is expected that this airport will be used for commodities coming from NSW and Victoria instead of airports at Sydney, Brisbane, or Melbourne. As presented in Figure B11, Wellcamp Airport is accessible by highways and rail. However, it seems that the B-double and road-train accessibility should be provided to promote this airport as a freight hub in future.



Figure B11: Wellcamp airport road and rail accessibility

GOLD COAST AIRPORT

Air freight data to and from the Gold Coast, is currently showing a minimal demand, Table B4. Gold Coast Airport has restrictions on the level of operations and the type of aircraft allowed to operate. As presented in Figure B12, the Gold Coast airport is not accessible by rail, but is accessible by B-double by the Pacific highway.



Figure B12: Gold Coast airport road accessibility

BRISBANE AIRPORT

Brisbane Airport Cargo has four cargo terminal operators, and an 82,000 m² apron to accommodate freighters. Brisbane Airport has 13% share of Australian freight import/export, and provides 380 destinations for freight export. As presented in Figure B13, Brisbane Airport also, is not accessible by rail for freight transport purposes (only passenger), however is accessible by B-double trucks.



Figure B13: Brisbane airport road accessibility

SYDNEY AIRPORT

Sydney airport has seven cargo terminals controlled by five cargo terminal operators. Approximately 80 per cent of freight is carried in the holds of passenger aircraft with the remainder transported in dedicated freight aircraft. Sydney Airport handles in excess of 517,000 tonnes of air freight per year (of which over 408,000 tonnes was international air freight), more than half of Australia's total. Exports include fresh, chilled or frozen perishables such as meat, seafood and fruit as well as manufactured items. Imports are typically high value manufactured items such as computers and car parts.

Curfews restrict dedicated air freight movements between 11.00pm and 6.00am at Sydney and airport. The *Sydney Airport Curfew Act 1995* allows only 74 freight take-offs and landings each week during the curfew period, with only BAE-146 aircraft permitted to operate.

Table B4: International air freight (tonnes) from the Wellcamp, Gold Coast, Brisbane, and Sydney airports [source: Air traffic data, BITRE 2017⁴]

Airport	International air freight (tonnes)			
	Year	Inbound	Outbound	Total
TOOWOOMBA WELLCAMP	2016	0	87	87
TOOWOOMBA WELLCAMP	2017	42	619	661
GOLD COAST	2016	3,942	2,675	6,617
GOLD COAST	2017	5,770	2,320	8,090
BRISBANE	2016	50,632	71,959	122,591
BRISBANE	2017	59,373	74,592	133,965
SYDNEY	2016	274,071	203,206	477,277
SYDNEY	2017	297,206	214,177	511,383

Table B5 presents the unit rate operational costs for various trucks from the Northern Rivers Region to the listed airports.

Table B5: Unit rate cost (\$/net tonne) to airports for different classes of heavy vehicle

Origin	Destination	distance (km)	Curtain sider single	Curtain sider B-double	Reefer single	Reefer B-double	B - double tanker	semi tanker
Grafton	Gold Coast Airport	228.8	31.4	27.0	29.7	23.6	23.7	29.7
Grafton	Brisbane Airport	303.5	41.6	35.8	39.5	31.4	31.5	39.4
Grafton	Toowoomba Wellcamp Airport	366.2	50.2	43.1	47.6	37.8	38.0	47.6
Grafton	Sydney Airport	621.9	85.3	73.3	80.8	64.2	64.5	80.8
Grafton Region	Gold Coast Airport	256.8	35.2	30.3	33.4	26.5	26.6	33.4
Grafton Region	Brisbane Airport	331.5	45.5	39.1	43.1	34.2	34.4	43.1
Grafton Region	Toowoomba Wellcamp Airport	394.2	54.1	46.4	51.2	40.7	40.9	51.2
Grafton Region	Sydney Airport	639.8	87.8	75.4	83.2	66.1	66.3	83.1
Ballina	Gold Coast Airport	91.3	12.5	10.8	11.9	9.4	9.5	11.9
Ballina	Brisbane Airport	199.7	27.4	23.5	26.0	20.6	20.7	26.0
Ballina	Toowoomba Wellcamp Airport	299.1	41.0	35.2	38.9	30.9	31.0	38.9
Ballina	Sydney Airport	782.0	107.3	92.1	101.7	80.8	81.1	101.6
Ballina Region	Gold Coast Airport	95.2	13.1	11.2	12.4	9.8	9.9	12.4
Ballina Region	Brisbane Airport	203.7	27.9	24.0	26.5	21.0	21.1	26.5

⁴ https://bitre.gov.au/publications/ongoing/airport_traffic_data.aspx

Origin	Destination	distance (km)	Curtain sider single	Curtain sider B-double	Reefer single	Reefer B-double	B - double tanker	semi tanker
Ballina Region	Toowoomba Wellcamp Airport	303.1	41.6	35.7	39.4	31.3	31.4	39.4
Ballina Region	Sydney Airport	770.9	105.8	90.8	100.2	79.6	79.9	100.2
Casino	Gold Coast Airport	126.8	17.4	14.9	16.5	13.1	13.1	16.5
Casino	Brisbane Airport	201.5	27.6	23.7	26.2	20.8	20.9	26.2
Casino	Toowoomba Wellcamp Airport	264.2	36.2	31.1	34.3	27.3	27.4	34.3
Casino	Sydney Airport	722.0	99.1	85.1	93.9	74.6	74.9	93.8
Kyogle	Gold Coast Airport	120.0	16.5	14.1	15.6	12.4	12.4	15.6
Kyogle	Brisbane Airport	159.2	21.8	18.8	20.7	16.4	16.5	20.7
Kyogle	Toowoomba Wellcamp Airport	215.2	29.5	25.4	28.0	22.2	22.3	28.0
Kyogle	Sydney Airport	771.0	105.8	90.8	100.2	79.6	80.0	100.2
Lismore	Gold Coast Airport	102.3	14.0	12.1	13.3	10.6	10.6	13.3
Lismore	Brisbane Airport	210.8	28.9	24.8	27.4	21.8	21.9	27.4
Lismore	Toowoomba Wellcamp Airport	296.5	40.7	34.9	38.5	30.6	30.7	38.5
Lismore	Sydney Airport	750.0	102.9	88.4	97.5	77.5	77.8	97.5
Lismore Region	Gold Coast Airport	110.4	15.1	13.0	14.4	11.4	11.4	14.3
Lismore Region	Brisbane Airport	213.8	29.3	25.2	27.8	22.1	22.2	27.8
Lismore Region	Toowoomba Wellcamp Airport	293.7	40.3	34.6	38.2	30.3	30.5	38.2
Lismore Region	Sydney Airport	756.9	103.8	89.2	98.4	78.2	78.5	98.4
Tweed Heads	Gold Coast Airport	12.6	1.7	1.5	1.6	1.3	1.3	1.6
Tweed Heads	Brisbane Airport	121.1	16.6	14.3	15.7	12.5	12.6	15.7
Tweed Heads	Toowoomba Wellcamp Airport	220.5	30.3	26.0	28.7	22.8	22.9	28.7
Tweed Heads	Sydney Airport	852.1	116.9	100.4	110.8	88.0	88.4	110.7
Tweed Heads South	Gold Coast Airport	6.8	0.9	0.8	0.9	0.7	0.7	0.9
Tweed Heads South	Brisbane Airport	115.2	15.8	13.6	15.0	11.9	11.9	15.0
Tweed Heads South	Toowoomba Wellcamp Airport	214.7	29.5	25.3	27.9	22.2	22.3	27.9
Tweed Heads South	Sydney Airport	842.1	115.5	99.2	109.5	87.0	87.3	109.4

AGRICULTURAL AND FORESTRY COMMODITIES

The tabulations and flows summarised here are derived from the following secondary data source. The Survey of Motor Vehicle Use (SMVU) by ABS provides the origin and destination flow (annual tonnage) of agricultural commodities including through movements. The Strategic Freight Model (SFM) by Transport NSW also provides the estimation based on SMVU, for 2016 and the forecasts in future years.

Table B6 and Figure B14 presents the distribution pattern of agricultural commodities in the Region and neighbouring regions. In the following tables, intrastate stands for the movements within NSW, interstate flow includes Movement from/to NSW where some through movements (Origin and Destination not within NSW) are included.

Table B6: Origin-destination pattern for agricultural commodities (kilo- tonnes) in the Northern Rivers Region [source: SFM 2016, Transport NSW 2018]

Commodity type	Origin- Intrastate							Origin of Export through Port of Brisbane
	Grain	Horticulture	Livestock	Meat	Milk	Other diary	Total	Meat
Clarence Valley		8.82	67.355		23.44		99.615	
Richmond Valley - Coastal		3.36	10.03				13.39	
Richmond Valley - Hinterland	9.771	26.11	121.162	58.403	131.145	3.456	350.047	61.261
Tweed Valley		0.2	3.079				3.279	

Commodity type	Destination – Intrastate						Destination - Interstate
	Grain	Horticulture	Livestock	Meat	Milk	Total	Livestock
Clarence Valley		23.39	39.469	5.32	5.711	73.89	0.883
Richmond Valley - Coastal		26.56		6.058	8.68	41.298	
Richmond Valley - Hinterland	68.129	30.63	184.816	0.72	212.088	496.383	81.043
Tweed Valley	16.038	126.66		1.651	10.301	154.65	

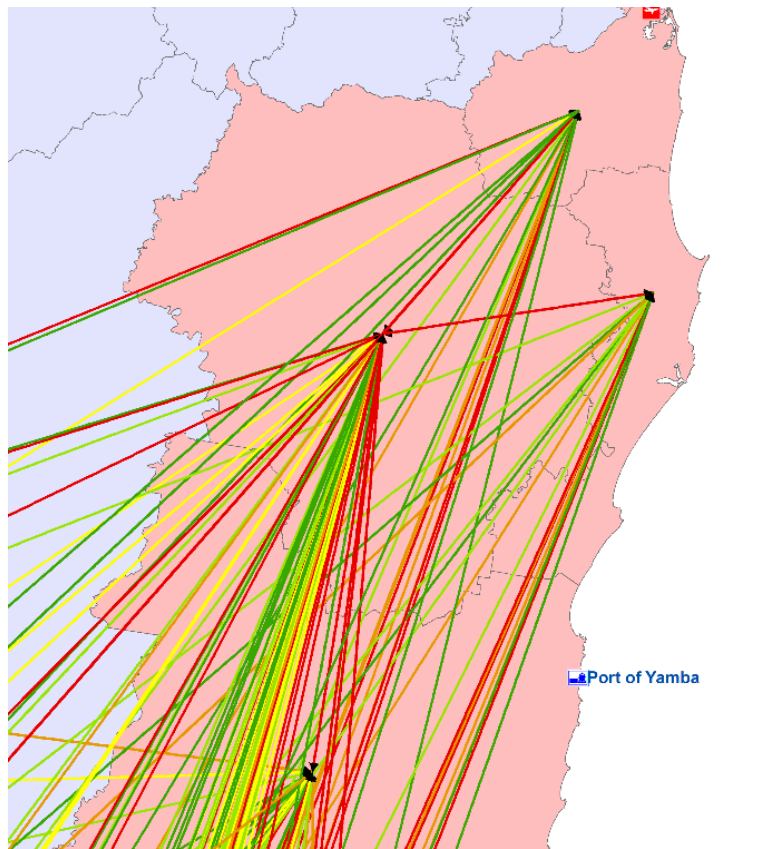
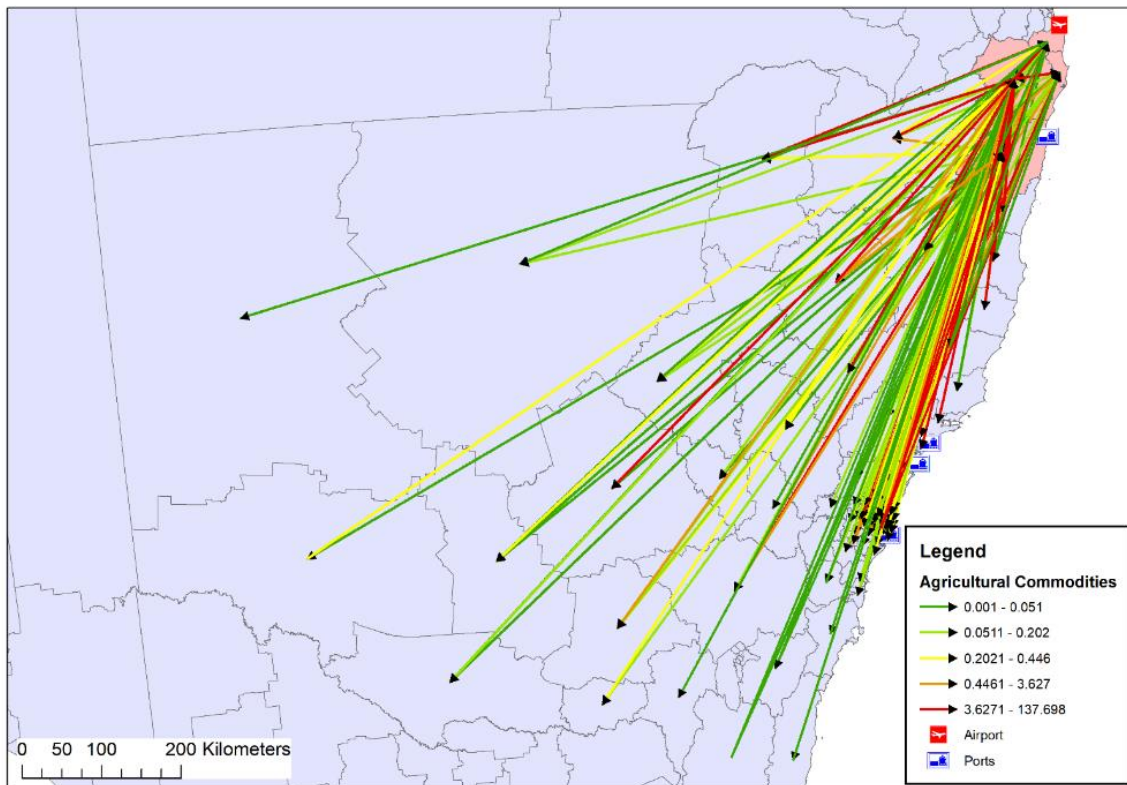


Figure B14: Agricultural commodities (kilo- tonnes), (produced from & attracted to) the Northern Rivers Region to other NSW regions

[source: SFM 2016]

As presented in Table B6, SFM includes 61.26 kilo-tonne of beef originating in this Region (Richmond Valley hinterland) as export to the Port of Brisbane. The lack of information on other horticulture and agricultural commodities produced in this Region prevents further region-based analysis for these products.

However, the lack of agricultural export in SFM and SMVU datasets are inconsistent with the customs data and the stakeholder interviews. For example, Table B7 represents the export of live animals and beef originated from the Region and exported through the Port of Brisbane in 6 months (January to June 2017). The customs dataset however does not include the other commodities exported through these ports, which is a difficulty for forming a conclusion of the export volume originating from the Region.

Table B7: Tonnage/Head of export commodities through ports (\$ value) in Jan – July 2017 [source: Customs]

Region Area	Fresh or chilled beef cuts, with bone in (tonne)	Live Australian endemic animals (incl. parrots, parakeets, macaws and cockatoos) (head)	Live mammals (head)	Live pure-bred breeding horses (head)		Grand Total
				Port of Melbourne	Port Botany	
	Port of Brisbane	Port Botany	Port of Brisbane			
Brunswick Heads				1000 (\$ 5,810)		1000 (\$5,800)
Casino	2865 (\$10,000)		34 (\$50,000)	500 (\$14,810)	500 (\$13,900)	3899 (\$43,710)
Evans Head			81 (\$5000)			81 (\$5,000)
Grafton			28 (\$3,200)			28 (\$3,200)
Grafton Region		1476 (\$70,000)			3000 (\$90,600)	4476 (\$160,600)
Grand Total	2865 (\$10,000)	1476 (\$70,000)	143 (\$13,200)	1500 (\$104,500)	3500 (\$125,120)	9484 (\$218,320)

FORESTRY COMMODITIES

The estimates of inter-state forestry shipments transported by road in the NSW Strategic Freight model, as well as the predictions is presented in Table B8 and Figure B15. Intrastate and export of forestry products are estimated to be zero in the SFM.

Table B8: Forestry tonnage (kilo tonnes) [source: SFM, 2016]

Region Area	2016		2021		2026	
	Origin	Destination	Origin	Destination	Origin	Destination
Clarence Valley	313.956	138.576	299.306	133.545	284.654	128.513
Richmond Valley - Coastal	0	15	0	15.13	0	15.26
Richmond Valley - Hinterland	72.418	200.716	67.494	188.965	62.571	177.213
Tweed Valley	9.465	23.2	9.14	22.4	8.815	21.6
Total	395.839	377.492	375.94	360.04	356.04	342.586

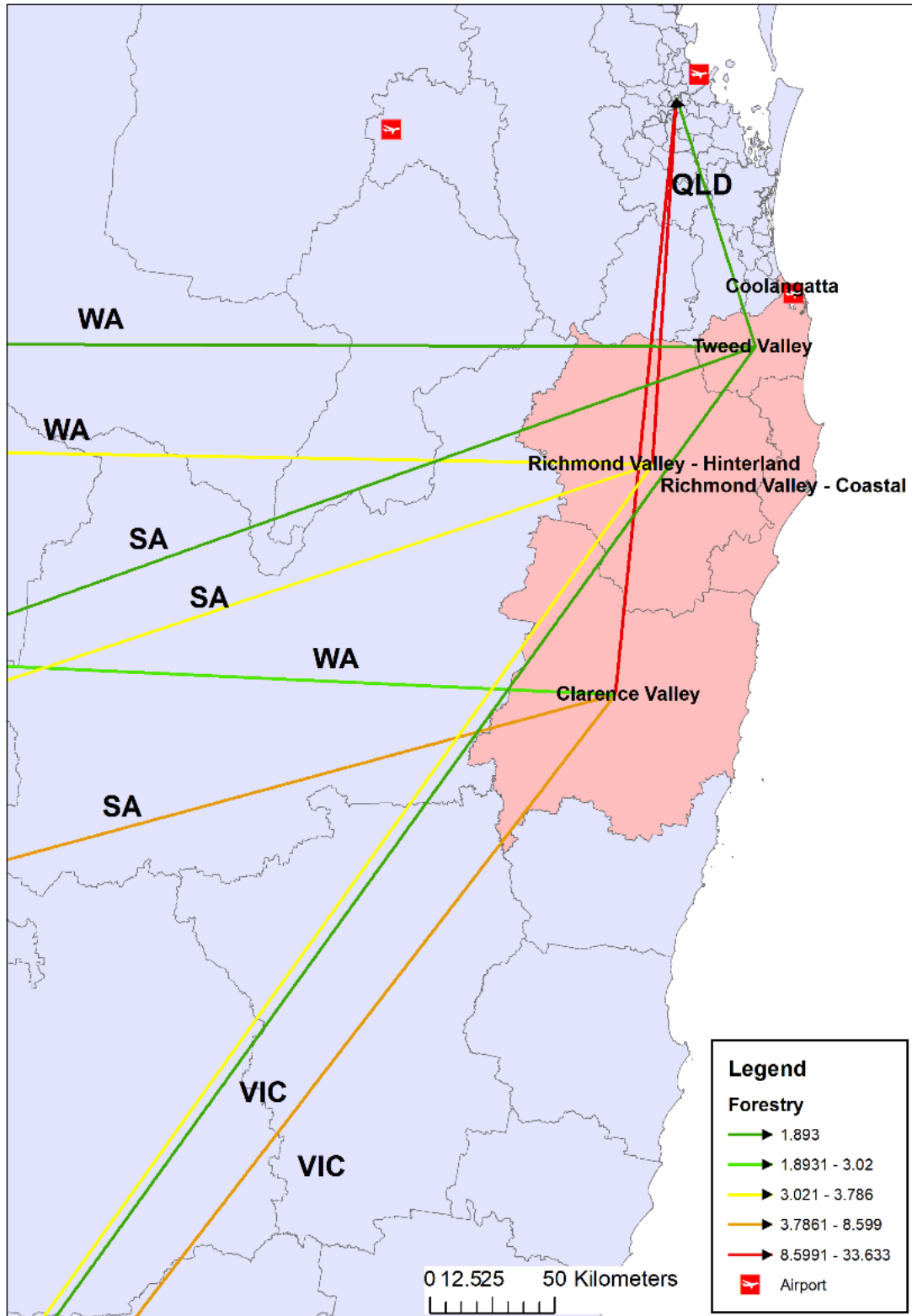


Figure B15: Forestry movements from NR to other states (kilo tonne) [source: SFM, 2016]

MANUFACTURED COMMODITIES

Manufactured products include food, beverages and tobacco, wood products, petroleum and coal products, chemical, metal products, machinery, motor vehicles. SFM and SMVU both include data on these products, discussed in this section and presented in Tables B9, B10 and B11.

MANUFACTURED FOOD PRODUCTS

Food products make up 50% of all retail and wholesale sales⁵. Manufactured food products are either exported through ports or are sold in the domestic market through retailers.

Retailers receive deliveries of chilled, fresh and ambient products daily, with freezer products delivered approximately four to five times a week. Direct-to-store deliveries are still used for a small range of products, for example bread, as recent attempts to eliminate the practice were not found to provide a viable outcome⁶.

The food product consumption in domestic market is expected to be directly proportional to population. Table B9, Figure B16 and Figure B17 presents the flow (in tonnes) of manufactured food products and beverages originating from/destined to the Region.

IRON ORE AND STEEL

At most of the larger iron ore mines in Australia, ore is transported direct from mine to export port by rail, and then loaded on bulk carriers for export. For mines where rail infrastructure is not available, the transport task may involve an intermediate movement, by road or conveyor, to nearby rail infrastructure and subsequent rail transport to port. At other, smaller mines, where ore volumes would not support construction of dedicated rail infrastructure, ore is often moved direct by road to port for export, typically in large road trains using bespoke trailers. Figures B18, B19 & B20 presents the flow (in tonnes) of chemicals, iron ore, steel and machinery & transport equipment originating from/destined to the Region.

Australia's economy is built on key industries that rely heavily on fuel consumption including crude oil and refined petroleum and other products. There is no crude oil produced in the Region, but as SMVU and SFM represent, there are significant volume of petroleum and its products moved in the Region. Petroleum products refer to imported or locally refined and exported products, including diesel, gasoline, LP, solvents, lubricants, bitumen, waxes and etc. Figure B21 presents the supply chain of petroleum products, and as Figure B22 explains, the majority of petroleum products consumed in the Region are imported from the Port of Brisbane/Acacia Ridge rail yard by road tankers.

⁵ <http://www.retail.org.au/about-ara.aspx>

⁶ A case study by QTLC on FMCG national retailer

Table B9: Manufactured Food (tonnes) [source: SMVU, 2016]

Region Area	Food (for animal or human consumption)		Beverages and tobacco	
	Origin	Destination	Origin	Destination
Clarence Valley	333	366.4	0	53.5
Richmond Valley - Coastal	186.4	236.4	0	53.5
Richmond Valley - Hinterland	471	323	374.7	267.7
Tweed Valley	30.6	128	0	0
Grand Total	1021	1053.8	374.7	374.7

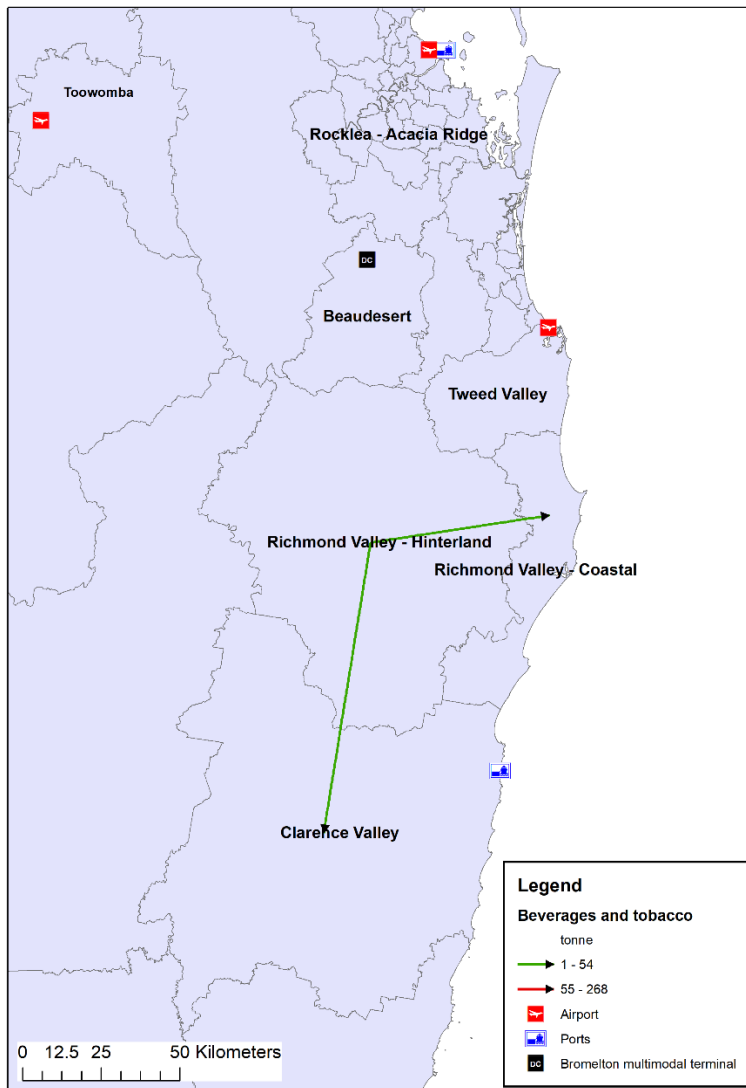


Figure B17: Beverages and tobacco (tonnes) [source: SMVU, ABS 2016]

Table B10: Manufactured industrial goods (tonnes) [source: SMVU, 2016]

Region Area	Chemicals		Iron and steel		Other manufactured articles		Miscellaneous manufactured articles		Machinery and transport equipment	
	Origin	Destination	Origin	Destination	Origin	Destination	Origin	Destination	Origin	Destination
Clarence Valley	0	0	0	0	15.9	16.3	1.3	8.4	53.2	47.1
Richmond Valley - Coastal	0	0	0	0	0	3.6	1.3	1.3	72.8	194.3
Richmond Valley - Hinterland	0	5.2	0	2.7	0	48.1	12.1	17.6	265.3	302.2
Tweed Valley	5.2	10.4	113.8	144.2	3.6	0	6.9	17.9	826.4	798.7
Grand Total	5.2	15.6	113.8	146.9	19.5	68	21.6	45.2	1217.7	1342.3

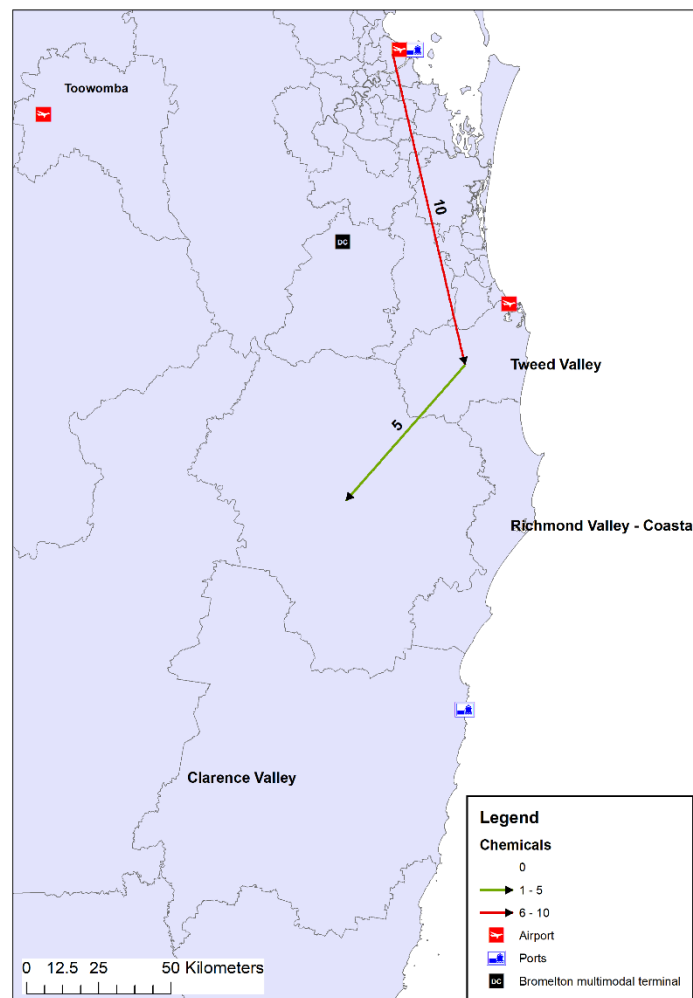


Figure B18: Chemicals (tonnes) [source: SMVU, ABS 2016]

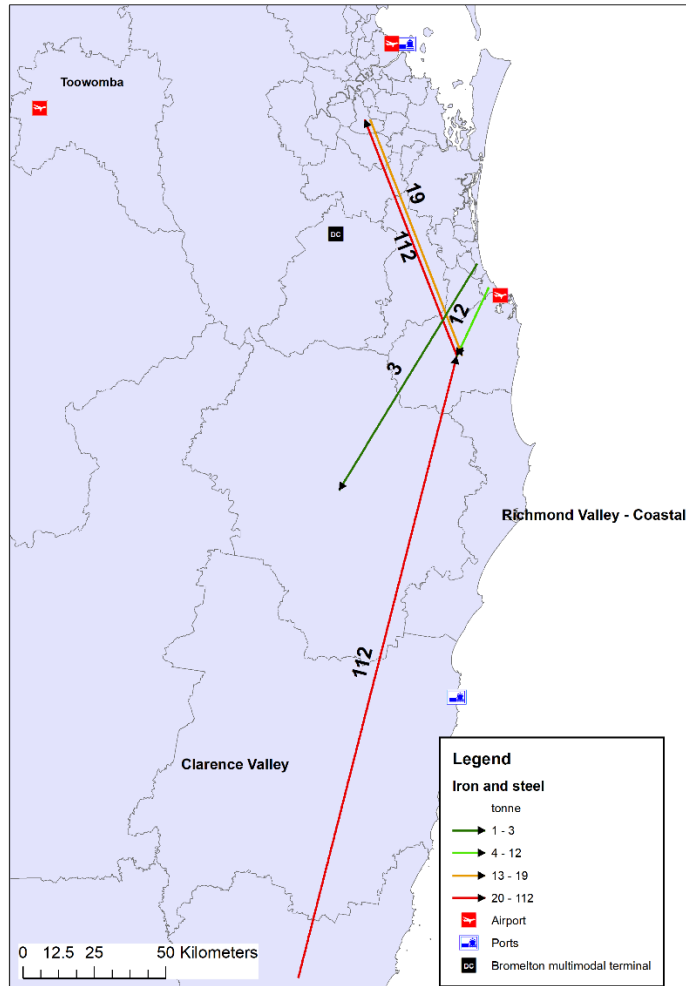


Figure B19: Iron and steel (tonnes) [source: SMVU, ABS 2016]

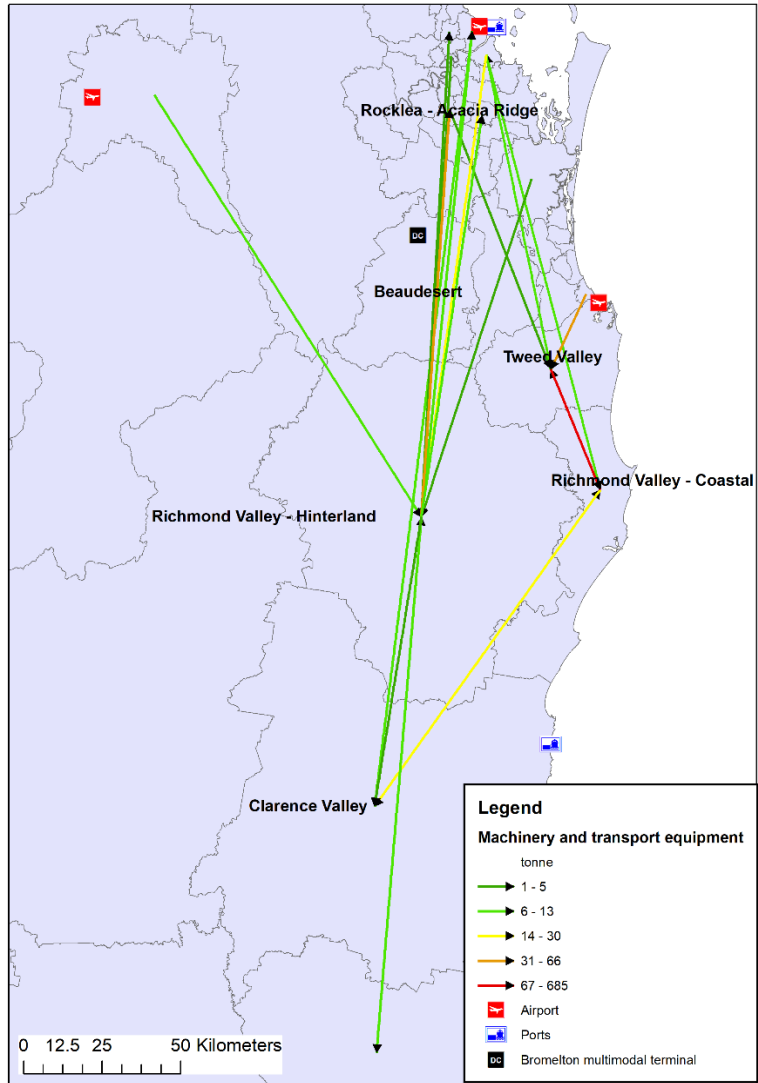


Figure B20: Machinery and transport equipment (tonnes) [source: SMVU, ABS 2016]

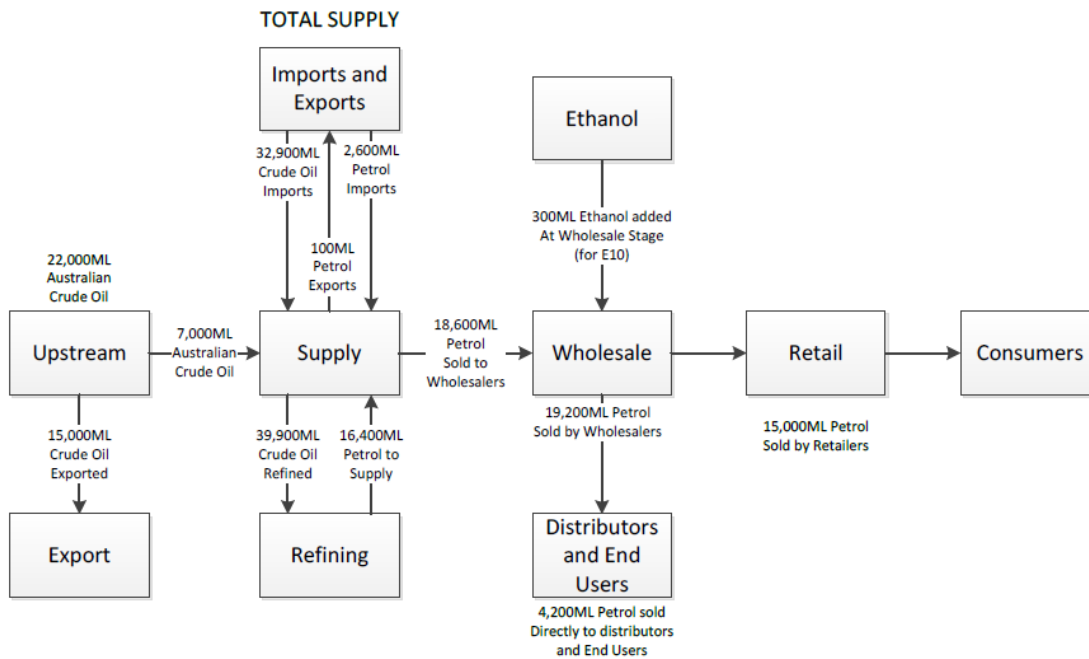


Figure B21: Australian petroleum flow, (mega litres), Energy White Paper 2012, Department of Resources, Energy and Consumption

Table B11: Manufactured petroleum & petroleum products (tonnes) [source: SMVU, 2016]

Region Area	Petroleum and petroleum products	
	Origin	Destination
Clarence Valley	393.7	593.8
Richmond Valley - Coastal	0	53
Richmond Valley - Hinterland	86.4	448.9
Tweed Valley	0	226.7
Grand Total	480.1	1322.4

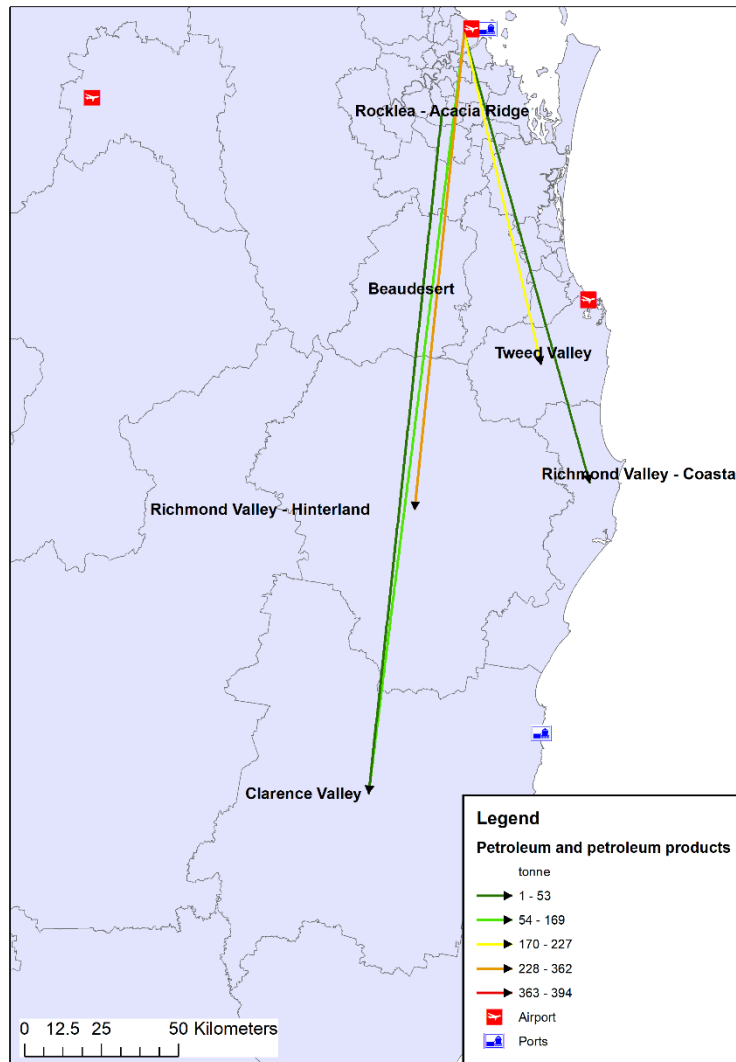


Figure B22: Petroleum & petroleum products (tonnes) [source: SMVU, ABS 2016]

CONSTRUCTION AND MINING COMMODITIES

Construction activity is a major contributor to the Region's economy. This industry produces significant construction commodity movements related to residential/non-residential building and engineering construction projects. The projects and construction supply chain is difficult to quantify in terms of identifying the number of movements, because the freight task occurs at multiple levels in a project.

Key nodal activity points to consider in network design include⁷:

- ports
- quarries
- water sources

⁷ QTLC Supply chain Report

- concrete batching plants
- hardware supply points and distribution centres
- fabrication and manufacturing operations
- industrial estates

Mining is also another contributor to the NSW economy. While there is no land-uses specified as mines in the Northern Rivers, SMVU presents a volume of mining commodities originating from or arriving into the Region.

According to the SFM, the interstate movements of construction material includes 0.224 kilo tonne, which is estimated to decrease to 0.218 by 2021. Table B12 presents the volume of construction materials originating from/ or arriving into the Region.

Table B12: Mining and construction commodities (tonnes) [source: SMVU, 2016]

	Crude materials		Metalliferous ores and metal scrap		Sand, stone and gravel		Cork and wood		Cement and concrete	
	Origin	Destination	Origin	Destination	Origin	Destination	Origin	Destination	Origin	Destination
Clarence Valley	170.1	599.9	43.3	0	179.9	179.9	15.3	94.1	0	38.1
Richmond Valley - Coastal	0	0	0	0	1871.2	1871.2	9.7	294.5	187.4	245.9
Richmond Valley - Hinterland	0	0	210.5	132.6	512.8	512.8	834.5	197.9	325.3	325.3
Tweed Valley	0	0	7.6	7.6	576.1	590.1	0	442.3	153.8	171.4
Grand Total	170.1	599.9	261.4	140.2	3140	3154	859.5	1028.8	666.5	780.7

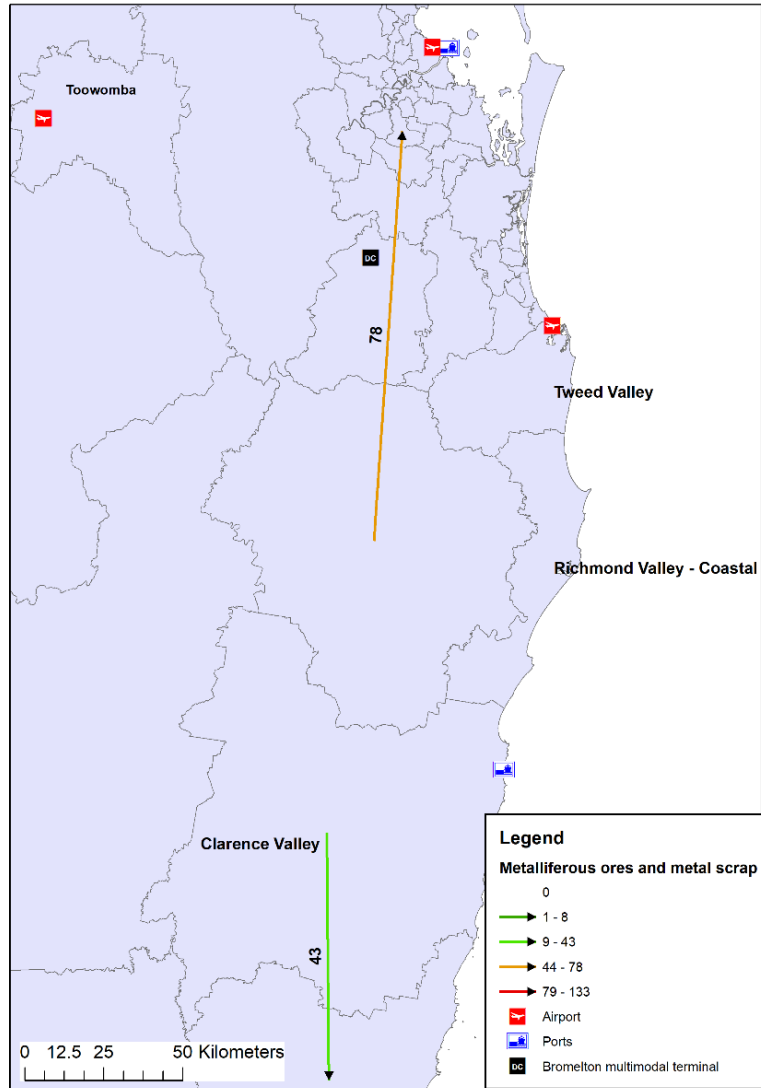


Figure B23: Metalliferous and metal scrap (tonnes) [source: SMVU, ABS 2016]

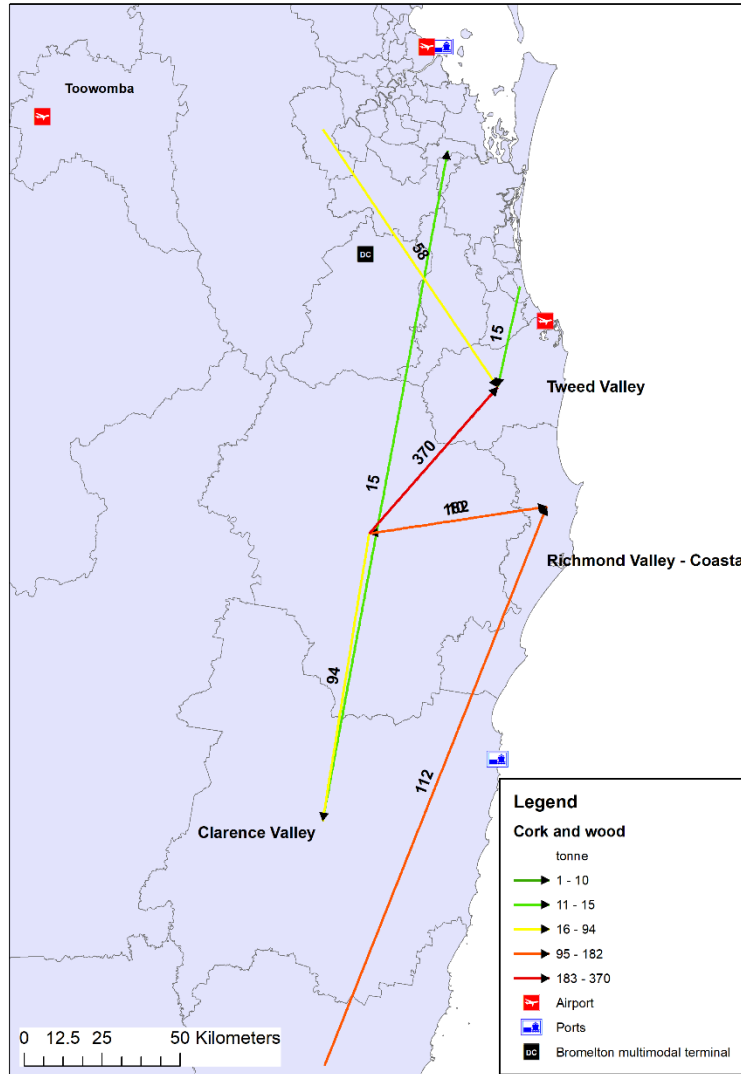


Figure B24: Cork and wood (tonnes) [source: SMVU, ABS 2016]

GENERAL FREIGHT

General freight can be broadly categorized as consumer goods, with a number of discrete sectors such as retail goods including electrical goods, books and recreational supplies, goods for cafés and restaurants, cosmetic and pharmaceutical products.

The sector is dominated by a small number of large retailers who operate using global supply chain practices. The sector is characterised by a large international supply chain task, with retailers maximising the use of global sourcing and off-shore manufacturing. Figure B25 represents the estimates of general freight movements from/to and within the Northern Rivers Region.

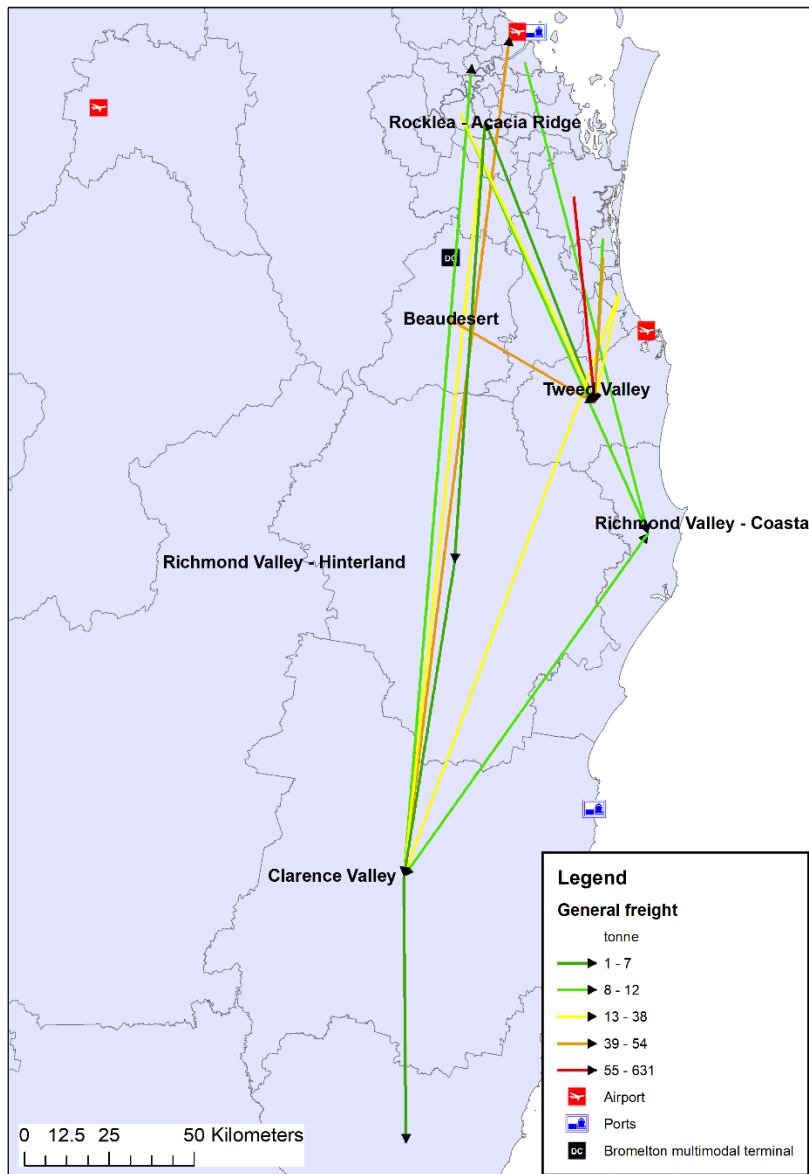


Figure B25: General freight movements (tonnes) [source: SMVU, 2016]

REFERENCES

- Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). (2015). *Australia's Wheat Supply Chains Infrastructure Issues and Implications*
- Australian Bureau of Statistics (ABS). (2015). *Road Freight Movements, Australia, 12 Months Ended 31 October 2014 - Category No. 9223.0*. Publisher.
<http://www.abs.gov.au/AUSSTATS/abs@.nsf/ProductsbyCatalogue/7480A96EA1DF4527CA257EEC000EEB5D?OpenDocument>.
- Australian Bureau of Statistics (ABS). (2017). *Survey of Motor Vehicle Use, Australia, 12 Months Ended 30 June 2016 - Category No. 9208.0*. Publisher.
<http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/9208.0Explanatory%20Notes112%20months%20Ended%2030%20June%202016?OpenDocument>.
- Australian Bureau of Statistics (ABS). (2018). *Motor Vehicle Census, Australia, 31 Jan 2018 - Category No. 9309*. Publisher.
<http://www.abs.gov.au/AUSSTATS/abs@.nsf/ProductsbyCatalogue/06D0E28CD6E66B8ACA2568A900139408?OpenDocument>.
- Australian Rail Track Corporation (ARTC). (2015). *Inland Rail Business Case*.
<https://inlandrail.artc.com.au/documents>.
- Bureau of Infrastructure, Transport and Regional Economics (BITRE). (2014). *Freightline 1- Australian Freight Transport Overview*.
- Bureau of Infrastructure, Transport and Regional Economics (BITRE), (2014). *Freightline 2 - Australian Iron Ore Freight Transport*. Canberra.
- Bureau of Infrastructure, Transport and Regional Economics (BITRE). (2015). *Freightline 3 - Australian Sugar Freight Transport*. Canberra, Australia.
- Bureau of Infrastructure, Transport and Regional Economics (BITRE). (2015). *Trainline 3- Statistical Report*. Canberra.
- Bureau of Infrastructure, Transport and Regional Economics (BITRE). (2017). *Trainline 5- Statistical Report*. Canberra. https://bitre.gov.au/publications/2017/files/train_005.pdf.
- Bureau of Infrastructure, Transport and Regional Economics (BITRE). (2018). *Air Traffic Data*.
https://bitre.gov.au/publications/ongoing/airport_traffic_data.aspx.
- Department of Agriculture and Water Resources, (2018) *FOODmap: An analysis of the Australian food supply chain*, Australian Government. <http://www.agriculture.gov.au/ag-farm-food/food/publications/foodmap-a-comparative-analysis>
- Department of Resources, Energy and Consumption (DREC). (2012). *Energy White Paper*. Publisher: Department of Resources, Energy and Consumption.

Department of Transport and Main Roads (TMR). (2018). *Heavy Vehicle Routes Restrictions - Queensland*. Publisher. <https://www.tmr.qld.gov.au/business-industry/Heavy-vehicles/Heavy-vehicle-routes-and-restrictions>

Productivity Commission. (2017). *The Australian Bulk Wheat Export Industry*.

Roads and Maritime Services (RMS). (2017). *Sustainability*. <https://data.nsw.gov.au/data/dataset/spatial-services-administrative-spatial-programs-gate>.

Roads and Maritime Services (RMS). (2018). *Restricted access vehicles map*. <https://www.rms.nsw.gov.au/business-industry/heavy-vehicles/maps/restricted-access-vehicles-map/map/index.html>.

Transport for NSW (TfNSW). (2018). *Strategic Freight Model - Data Dictionary*. NSW. Publisher: Transport for New South Wales