North East Link
Technical Summary

August 2017

Contents

1 Overview

1.1 North East Link project

North East Link is a proposed freeway standard road connection that plans to complete the missing link in Melbourne's metropolitan ring road, giving the city a fully completed orbital connection for the first time.

North East Link proposes to connect the M80 Ring Road (M80) to the Eastern Freeway / EastLink. While the final route for North East Link has yet to be determined, in general it is proposed to connect the M80 at Greensborough with either the Eastern Freeway at Bulleen Road or EastLink at either Ringwood or further to the south.

North East Link will be informed by and progressed through planning, technical, environmental and social investigations, along with community and stakeholder engagement, to determine the best corridor for the project, with a key focus on protecting existing urban areas and minimising environmental impacts.

Purpose of this summary

As the project proceeds, the North East Link Authority (NELA) will provide project updates from time to time, giving people with an interest in the project access to emerging information relevant to key aspects of North East Link. These project updates will be available for reading and downloading on the NELA online hub and notice of their publication will be given on the NELA website and in regular Community Updates distributed to households across Melbourne's north-east.

This summary provides a snapshot of the NELA's investigations and analysis so far relating to:

- Why we need North East Link, including an overview of key existing conditions in Melbourne's north-east
- Potential corridor options for North East Link
- How each of the options may perform against key areas of interest identified by stakeholders

Information is preliminary and provided to inform conversation about what North East Link should achieve.

Significant development of the project is still required and is underway. Key next steps have been identified by the NELA, with community engagement being a vital input.

1.2 Project background

Since 1969, successive Victorian Governments have identified the need for a freeway standard road link through Melbourne's north-east to complete the city's orbital connection. Potential links and routes have been identified through:

- Victorian Government (1969), Melbourne Transportation Plan
- Victorian Government (1974), F35 Study: Eastern Freeway – Ringwood to Greensborough
- Victorian Government (1979), Outer Ring Study, Diamond Creek to Ringwood: Technical Report: Transport and Economic Evaluation
- Victorian Government (2008), Victorian Transport Plan.

Most recently, in 2016, a North East Link was identified as Victoria's next priority road project in Infrastructure Victoria's 30-year strategy, which sets out a pipeline of initiatives to be delivered over the next three decades to help create the best possible future for the State of Victoria. The strategy undertook a high-level analysis and nominated North East Link as a short- to-medium-term project

that would enhance access to major employment centres and improve the capacity of the freight network, and recommended that a detailed assessment of corridors be undertaken as a first step.

As part of developing the business case, the NELA is completing a number of technical and environmental investigations, engaging with a wide range of stakeholders and members of the community and developing and assessing the benefits, challenges and costs for potential corridors for North East Link. The NELA is also looking at ways to improve existing roads, public transport services and cycling opportunities to make North East Link work effectively and maximise the transport, economic and social benefits it delivers.

1.3 Project objectives

North East Link has a strong focus on supporting business and jobs growth in communities across Melbourne's north, east and south-east, while also improving cross-city connectivity and helping to address critical traffic, freight and amenity issues. High-level Project Objectives and Guiding Principles reflecting this focus have been established for the project, as outlined in the table below.

Table 1 – North East Link Project Objectives and Guiding Principles

Project Objectives			
Objective 1 Improve business access and growth in Melbourne's north, east and south-east	***Objective 2*** Improve household access and growth in Melbourne's north, east and south-east	***Objective 3*** Improve freight and supply chain efficiency and industrial growth across the north, east and south-east	***Objective 4*** Improve access, amenity and safety for communities in Melbourne's north-east

Guiding Principles			
Guiding Principle 1 Minimise impacts on communities	***Guiding Principle 2*** Minimise impacts on environmental and cultural assets	***Guiding Principle 3*** Minimise impacts during the construction phase	***Guiding Principle 4*** Optimise the efficient use of resources

In developing the Project Objectives and Guiding Principles, the NELA has had regard to:

- The objectives and decision-making principles in the *Transport Integration Act 2010*
- Identification of key problems in Melbourne's north-east and consultation undertaken to date
- Key policy objectives of Government, including *Plan Melbourne.*

1.4 Initial investigations and stakeholder engagement activities

The NELA's initial investigation and stakeholder engagement activities have focused on understanding the existing conditions in Melbourne's north-east, exploring potential corridor options and identifying key areas of interest that people consider to be important.

Some of the key observations from these initial investigations are outlined in this Technical Summary. The key steps undertaken by the NELA to develop these observations are outlined below.

Existing conditions and potential corridor options

Work commenced earlier this year to investigate and analyse key problems and existing conditions in Melbourne's north-east, set key objectives and guiding principles for the project, identify potential corridors for North East Link, and identify the initial potential challenges and impacts of the existing conditions and corridor options. This work incorporates initial desktop and field work analyses of existing conditions, including:

- Identification of key demographics in relation to residents, workers, businesses and tertiary education in Melbourne's north-east and in the areas to the north, south and east of Melbourne
- Review of travel patterns and on-site traffic surveys, including identification of truck volumes
- Geotechnical investigations to identify ground conditions that will inform the project's design and construction methods, assessment of risks and cost of road pavement, structures and tunnels
- Environmental and heritage ground surveys to identify sensitive areas that need to be protected or offset.

Investigations are ongoing, with a focus on geotechnical investigations and environmental, heritage and traffic surveys.

The NELA has also been undertaking preliminary analysis of the effects of each potential corridor option, including:

- Preliminary transport modelling to identify the effects of each of the options on travel patterns and land use
- Engineering design to identify the potential location of options and the design and construction challenges associated with each option.

Investigations to date indicate that each corridor option has benefits and challenges. While there is still more work to do, this Technical Summary outlines some of the key observations to date on how each option addresses the key areas of interest identified through the NELA's initial stakeholder engagement activities.

Initial consultation and key areas of interest

The NELA commenced consultation for North East Link in May 2017, engaging with a range of stakeholders through activities that include:

- North East Link online community survey
- Discussions with local government
- Discussions with community groups
- Discussions with industry
- Discussions with government authorities including Transport for Victoria (TfV), VicRoads, Public Transport Victoria (PTV), the Victorian Planning Authority (VPA) and the Department of Environment, Land, Water and Planning (DELWP).

Through these initial interactions, the following issues have been identified as important:

- Reducing congestion on key roads in Melbourne's north-east
- Removing trucks that don't need to be on roads in Melbourne's north-east
- Providing better connectivity for people to access existing and new jobs and education opportunities
- Helping businesses better connect to each other and to workers across Melbourne
- Making freight journeys more efficient
- Improving public transport connections and travel times
- Improving connections for pedestrians and cyclists
- Protecting the environment, culture, heritage and open spaces
- Minimising the impacts from construction-related traffic as the project is being built.

2 Why do we need North East Link?

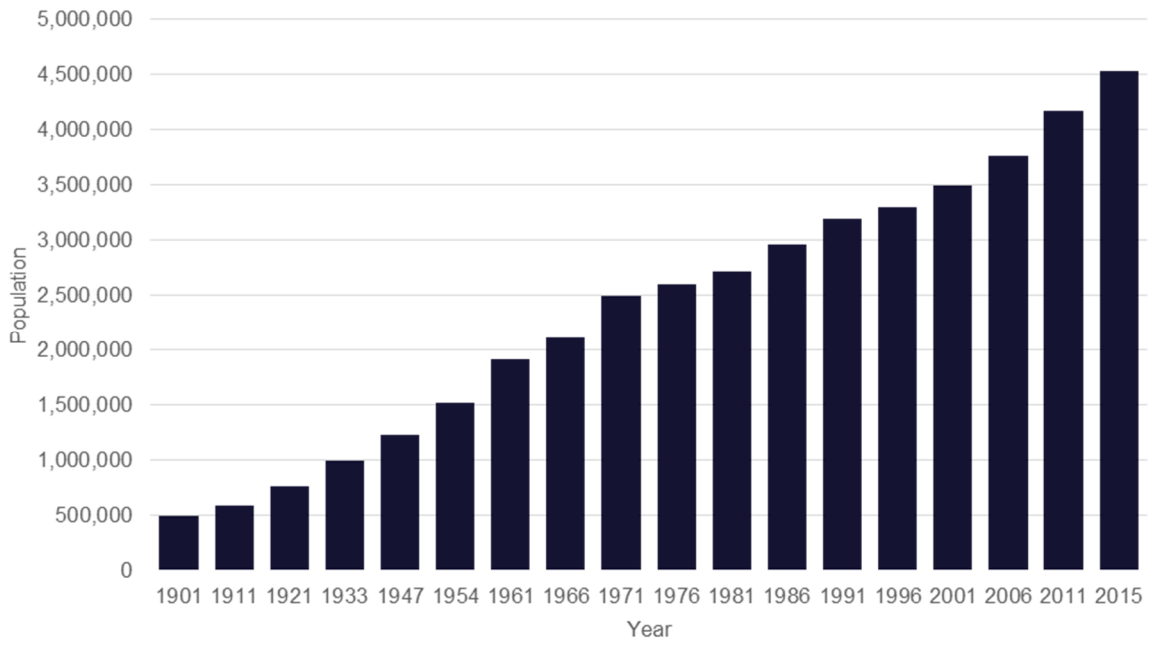
Over the last 50 years, Melbourne has undergone substantial changes in its population, economic structure and land use structure. These changes have been central to the city's success, but have also created numerous challenges in ensuring that Melbourne continues to play a part in growing Australia's economy and improving the living standards of all Victorians. As Melbourne has grown and its economy has evolved, demand for movement across the city and around its periphery has increased significantly.

2.1 A growing population and city

Although Melbourne's population has long been increasing, the recent scale of growth is unprecedented for an Australian city. From a population of just over 500,000 people at the turn of the 20th century, Melbourne today has grown to a population of more than 4.5 million (Figure 1).

In the year to June 2016, the Australian Bureau of Statistics (ABS) estimates that almost 30% of Australia's population growth occurred in Melbourne. During that time, the city swelled by an additional 108,000 people or 2.3%– nearly twice the rate of growth of the rest of the country (which grew by 1.2% cent over the same period). This is above the 10-year trend of around 2% annually, during which time – between 2006 and 2016 – the city's population increased by 857,000.

Figure 1 – Melbourne's Population 1911 - 2015

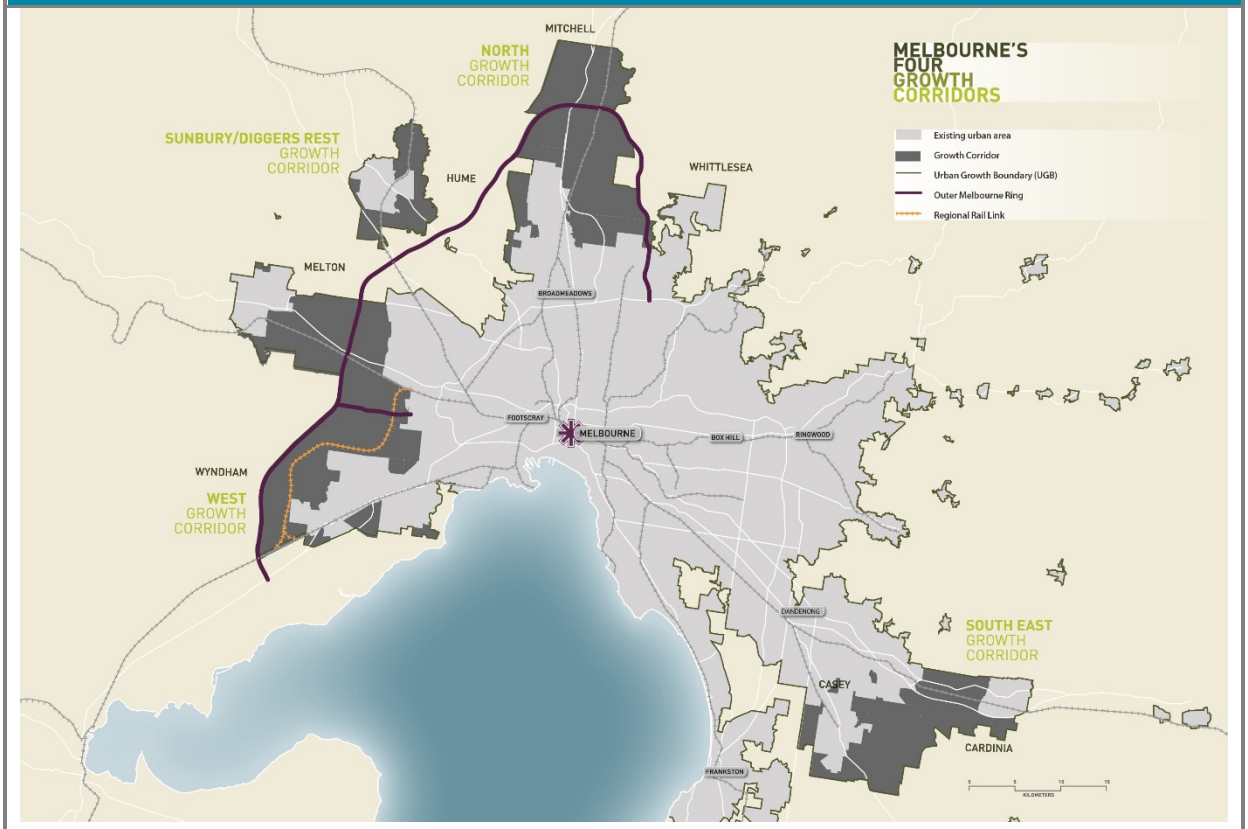


Source: Australian Bureau of Statistics, 2014, Australian historical population statistics catalogue number 3105.0.65.001- Greater Melbourne, ABS

While an Urban Growth Boundary was legislated in 2002 with the aim of reducing urban sprawl (a key policy direction in *Plan Melbourne 2017-2050 Strategy*[1]), the high demand for housing from a rapidly growing population has led to some adjustments to the boundary in subsequent years. This growing population and expanding footprint is continuing to place stress on existing infrastructure, which is increasingly struggling to accommodate the additional demand.

The changes to Melbourne's Urban Growth Boundary over the last decade are presented in Figure 2. The northern corridor of Melbourne is one of the city's fastest growing areas. South Morang was Australia's fastest growing suburb in 2015-2016 and has been in the top 3 for population growth for the last 3-4 years. Epping was also in the top 10 in 2016, with these two suburbs adding over 8,000 people, around 7.5% of Melbourne's total growth. This northern corridor with a future estimated population capacity of up to 330,000 people and job capacity of up to 105,000[2]. This is expected to place additional pressure on Melbourne's north-east transport network in the coming years.

Figure 2 – Expansion of the Urban Growth Boundary between 2002 and 2017



Source: Victorian Planning Authority, 2012, Growth Corridor Plans – Managing Melbourne's Growth

This growth pressure results in a range of issues that can be represented by three key problems for Melbourne as a liveable and competitive city, particularly in Melbourne's north-east:

[1] Victorian Government (2017) *Plan Melbourne-2017-2050 Strategy*, Policy 2.1.1, Maintain a permanent Urban Growth Boundary around Melbourne to create a more consolidated, sustainable city

[2] Victorian Planning Authority (2012) *Growth Corridor Plans – Managing Melbourne's Growth*

- Growing congestion and heavy vehicles are impacting liveability in Melbourne's north-east
- Inefficient freight movements are impacting business
- Poor connections are constraining economic potential.

The following sections outline the challenges in meeting the requirements of this growth in Melbourne's north and some of the key issues identified through NELA's initial investigations.

2.2 Growing congestion and heavy vehicles are impacting liveability in Melbourne's north-east

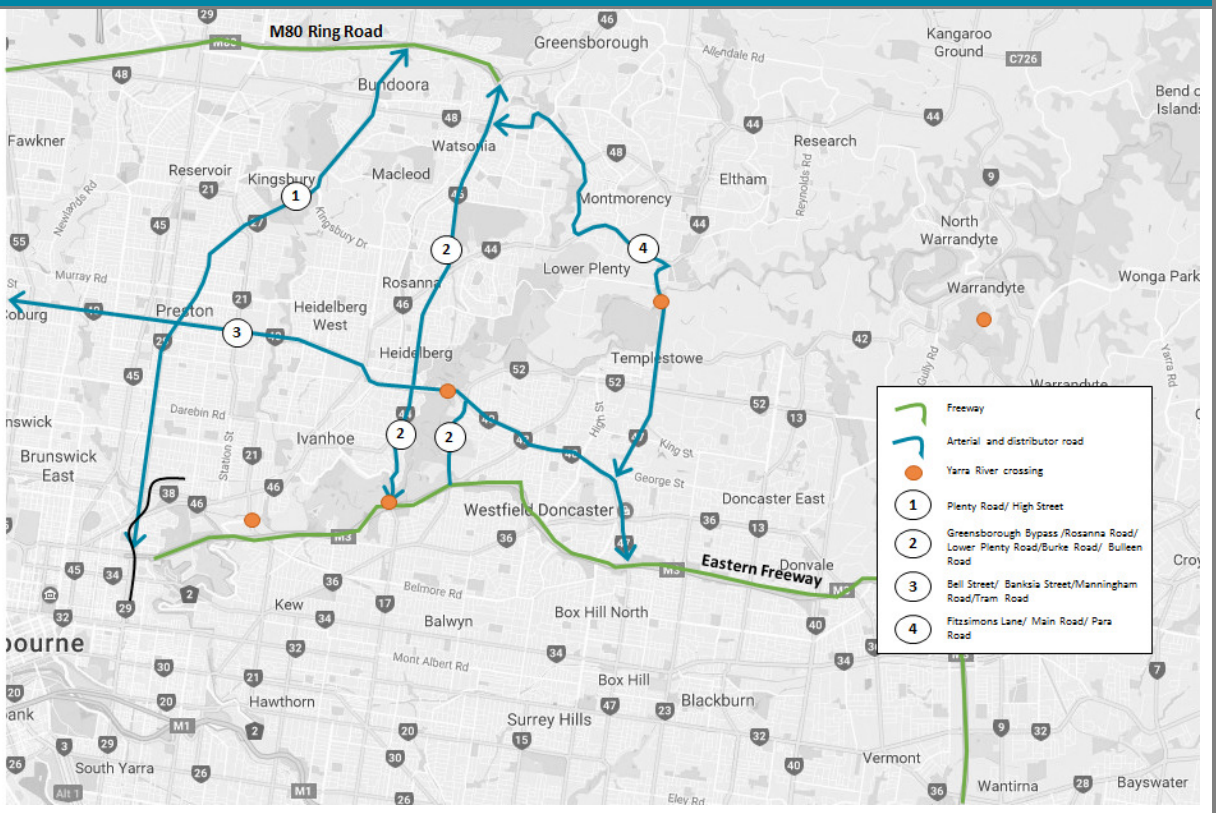
Between Melbourne's west and north, orbital movements are facilitated via the M80, which runs from the Princes Freeway in Altona to the Greensborough Bypass in Greensborough. Movements between the east and south-east are enabled by the EastLink tollway, which traverses the outer eastern suburbs between Donvale and Seaford. Unlike these other parts of Melbourne, the limited arterial road network in Melbourne's north-eastern suburbs has to cater to a range of both local and orbital movements; including commuter and business traffic, heavy freight vehicles, buses and active transport. All of these routes are operating at or well above their capacity, which is resulting in longer and less predictable travel times.

There are also key natural barriers to these movements, the main one being the Yarra River forming a barrier that funnels traffic on to a few key routes through Melbourne's north-east.

As a result, key local destinations such as shopping precincts, schools, medical facilities, recreation areas, parklands and other community infrastructure are becoming more and more difficult for local residents to access; not only by driving, but public transport, walking and cycling, as congestion is also impacting the performance of on-road public transport such as the orbital SmartBus routes on Fitzsimons Lane (bus routes 901 and 902), Para Road (bus routes 901 and 902) and Banksia Street (bus route 903).

Figure 3 identifies the key routes in Melbourne's north-east that are performing an orbital function along with the other local access functions and identifies the locations of the road network as it crosses the key barrier of the Yarra River.

Figure 3 – Existing key orbital movement routes



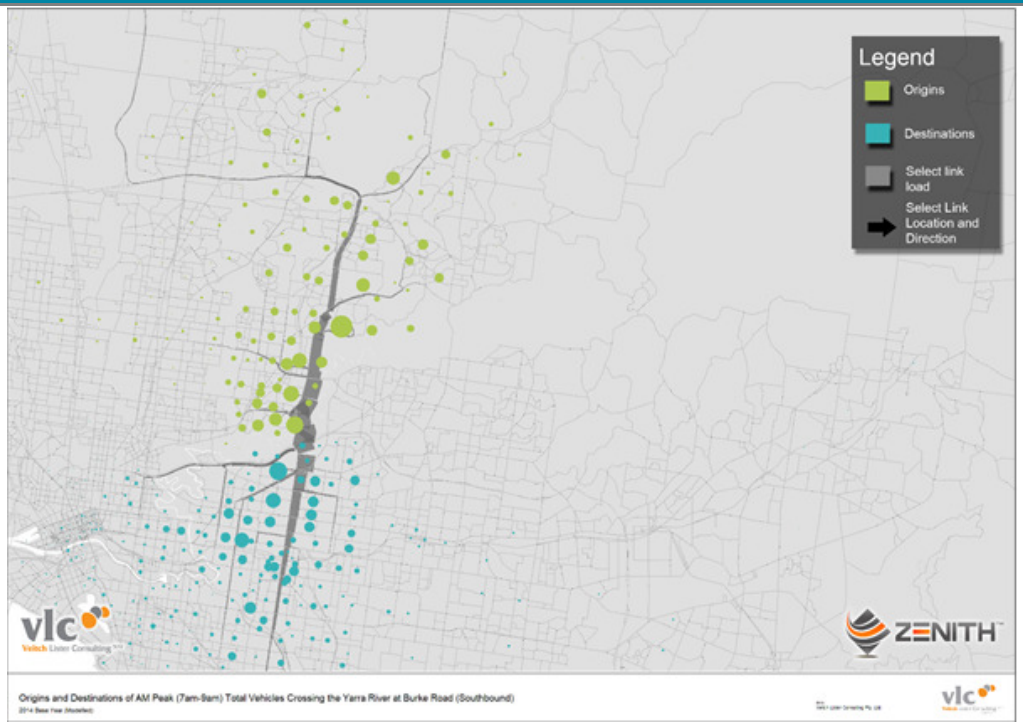
The origins and destinations of the trips that cross the Yarra River in the AM peak are presented in Figure 4 to Figure 7. The main crossing locations are at Burke Road, Banksia Street and Fitzsimons Lane, which account for the majority of all southbound trips across the Yarra River in the AM peak period. The Kangaroo Ground-Warrandyte Road crossing in Warrandyte has a relatively low share of river crossing trips due to the lower population density and road connectivity in this area.

The bulk of vehicles travelling across the Yarra River have origins mainly between Eltham and Ivanhoe, with another cluster of origins within the industrial precincts in Epping and Lalor further north. The river crossings, with the exception of Banksia Street all have narrow catchments typically immediately to the north of each of the bridges. Trips across the bridges at Burke Road and Fitzsimons Lane generally have origins within the local area, with relatively few longer distance trips. The crossing at Banksia Street on the other hand has a wider dispersal of origins, due to this location providing the best access between the M80 and Bell Street in the north and west respectively and the Eastern Freeway south of the river.

Destinations are generally focused along the Eastern Freeway corridor with the majority of destinations in Bulleen, Doncaster, Kew and Box Hill, and some destinations along EastLink in the vicinity of Ringwood and the Scoresby industrial precinct. The destinations of trips using Burke Road are concentrated between the Monash Freeway and Eastern Freeway around Kew, while the destinations of trips using the Fitzsimons Lane are concentrated around the Templestowe, Doncaster and Box Hill areas. While the Banksia Street crossing caters for some longer distance trips using

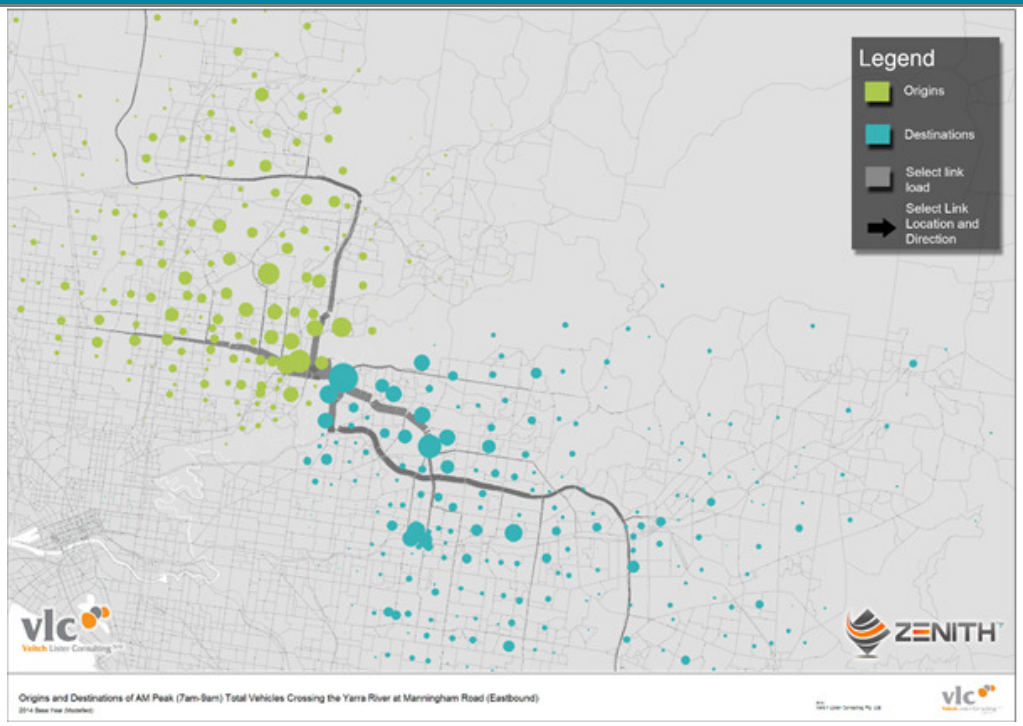
EastLink, a high proportion of trips still have destinations in the vicinity of the Eastern Freeway in suburbs such as Bulleen, Doncaster and Box Hill.

Figure 4 – Origins and destinations of traffic crossing Burke Road Bridge during the AM peak



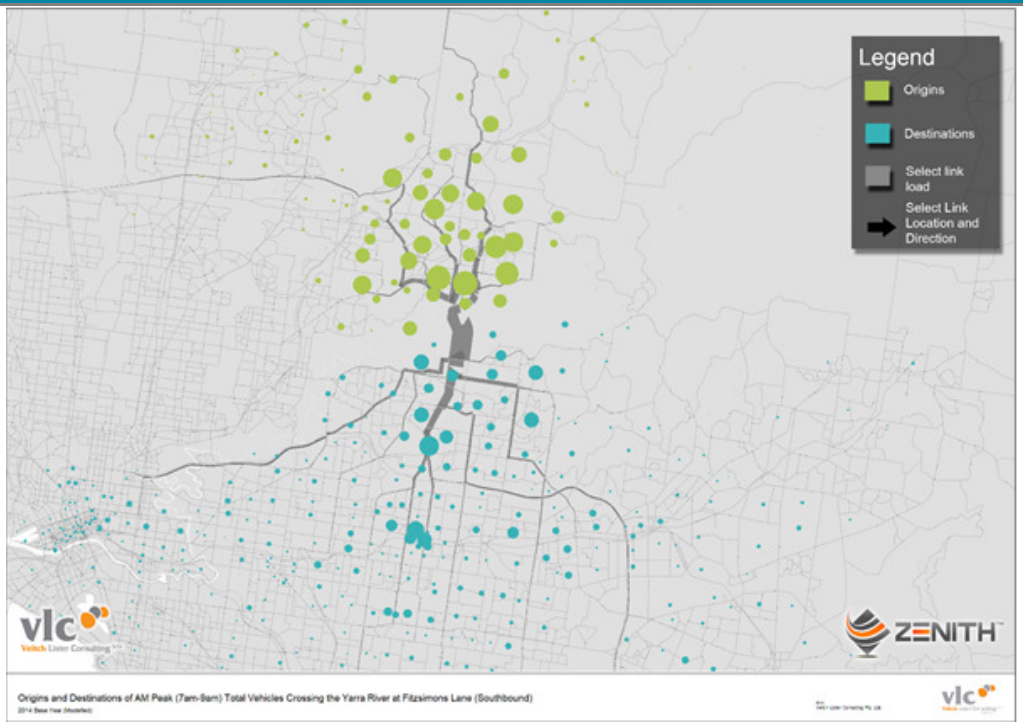
Source: VLC Zenith Model – Preliminary modelling for North East Link

Figure 5 – Origins and destinations of traffic crossing Banksia Street Bridge during the AM peak



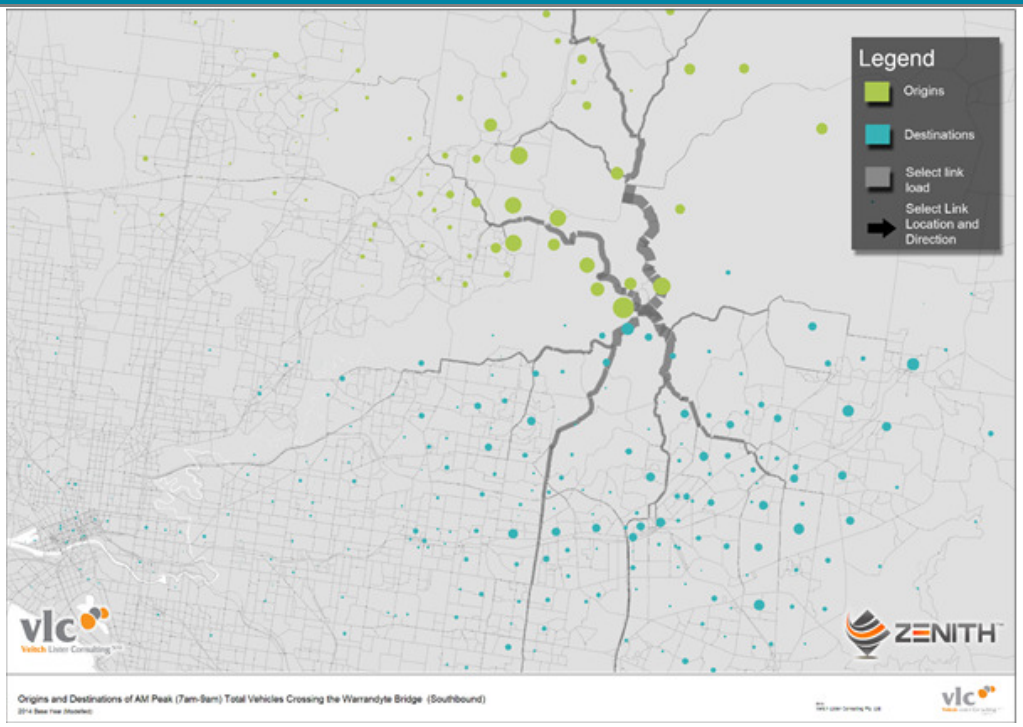
Source: VLC Zenith Model – Preliminary modelling for North East Link

Figure 6 – Origins and destinations of traffic crossing Fitzsimons Lane Bridge during the AM peak



Source: VLC Zenith Model – Preliminary modelling for North East Link

Figure 7 – Origins and destinations of traffic crossing Warrandyte Bridge during the AM peak

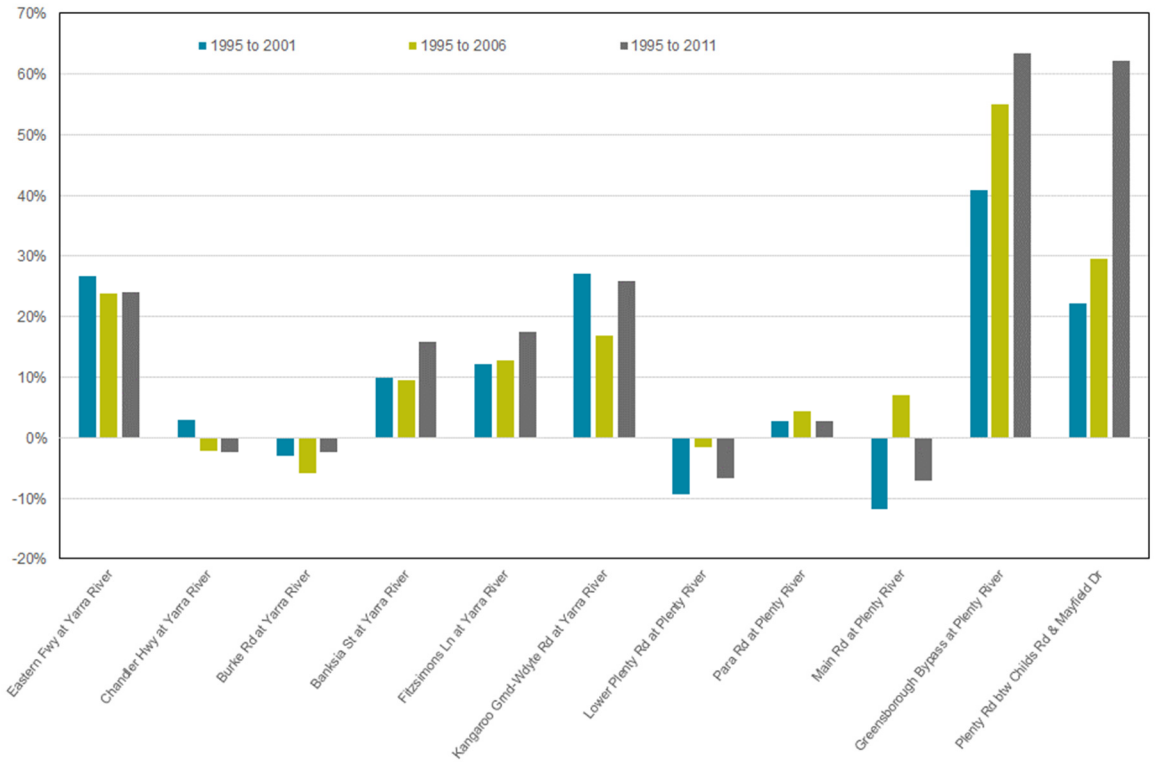


Source: VLC Zenith Model – Preliminary modelling for North East Link

Traffic volumes are growing

Residents and workers in Melbourne's north-east overwhelmingly rely upon the road network for travel (either using private vehicles or buses). This reliance on the road network has become more entrenched as traffic volumes on the outer suburban north-east arterial road network have grown over the past decade, compounding the issues of traffic congestion and delays, as presented in the Figure 8.

Figure 8 – Daily traffic volumes through Melbourne's north-east – 1995 to 2011



Source: VicRoads Screenline traffic volume data

These growing traffic volumes are placing the arterial road network in Melbourne's north-east under increasing pressure, making it more and more difficult for these roads to accommodate the varied travel demands competing for limited road space through the area.

This conflict of movement and road use is compounding congestion and is leading to high variability in trip duration and unreliability.

The busiest locations on Melbourne's north-east arterial road network are typically at the bridge crossings of the Yarra River (Chandler Highway, Burke Road, Manningham Road, Fitzsimons Lane, and Kangaroo Ground-Warrandyte Road). Other heavily congested locations are Bell Street, Banksia Street, Rosanna Road, Greensborough Road, Diamond Creek Road and Main Road.

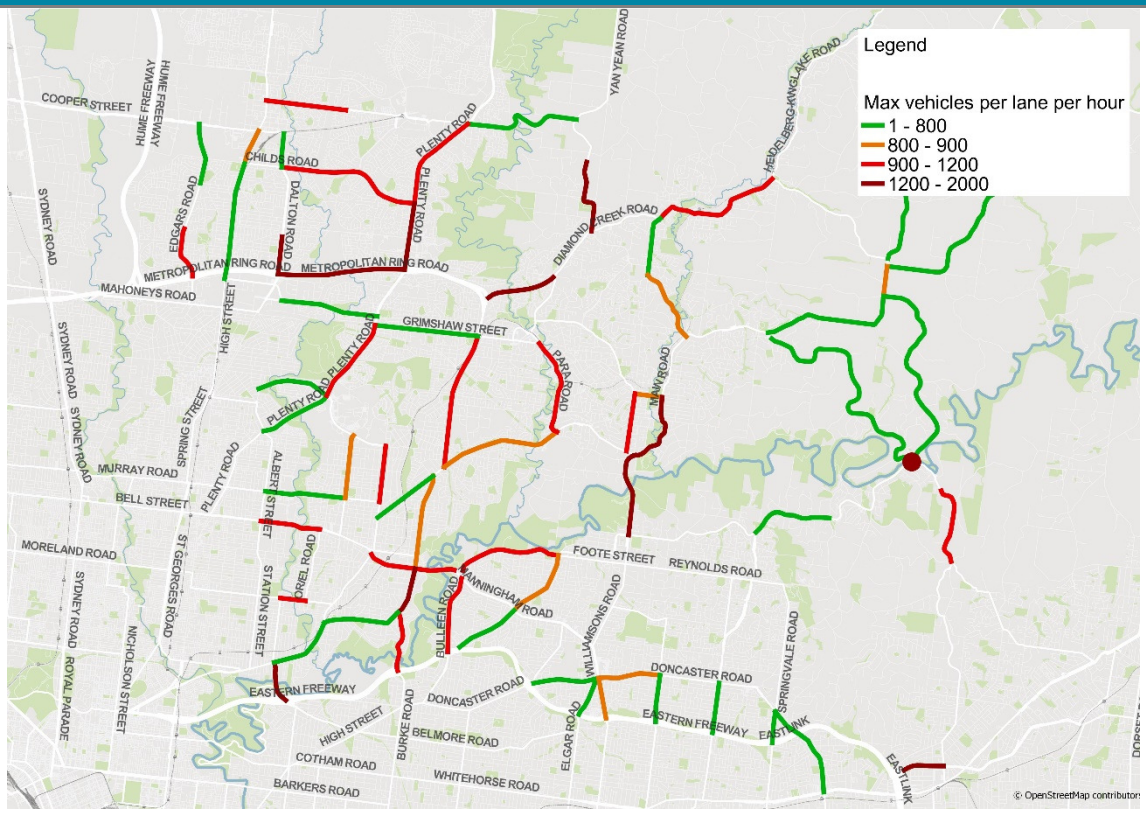
Melbourne's north-east arterial road network is at capacity

Traffic data for these roads indicate that they are often close to or at capacity during extended peak periods, as different travel demands compete for road space across the whole day.

The capacity issues on the arterial roads that cater for the movement of significant traffic volumes – including important cross city and orbital journeys – are exacerbated by the fact that many still provide a local access function. As a result, they often interface with numerous property accesses, priority intersections and signalised intersections. For example, vehicles travelling from the M80 to the Eastern Freeway via Rosanna Road must pass through 19 sets of signals over a 6 kilometre length of road. This means that road users encounter one set of traffic lights every 316 metres, resulting in 'stop/start' conditions and inconsistent travel speeds along the corridor. Having to service these local access functions impacts road capacity and reduces traffic throughput compared with the conditions experienced along a modern, access-controlled arterial road. It also impacts on the needs of other road users such as pedestrians and cyclists who face difficulty in travelling along or crossing these busy roads. Balancing the needs of all the road users along these roads is a key challenge.

Figure 9 presents the highest number of vehicles per lane observed during the AM and PM peak period(s), showing that during the peak hours (and for a large part of the day), the majority of the road network in Melbourne's north-east is already at capacity. An arterial road typically carries 800 to 900 vehicles per hour in peak periods. A number of the roads in Melbourne's north-east carry in excess of 1,000 vehicles per lane, leading to significant congestion, delay and poor reliability.

Figure 9 – Vehicles per lane during the AM and PM peak – 2017



Source: NELA Traffic Survey 2017

Where the weekends were once a less busy time on the road network and roads could be closed for maintenance or construction work, this is no longer the case. On Saturdays and Sundays, the traffic volumes recorded on the arterial road network can rival that of the weekday peak periods.

Overall, on average, weekend traffic volumes reach approximately 74% of the weekday peak volumes[3]. On many of these roads, traffic congestion is often worse on the weekend peak period due to the lack of weekend clearway periods, reducing road capacity and traffic throughput. Even though traffic volumes may be 25% lower than the weekday peak, a typical road with two lanes in each direction may have 50% less capacity due to on-street parking on weekends.

The top eight locations in Melbourne's north-east with similar weekend and weekday peak volumes are presented in Table 2. These locations often experience high levels of congestion throughout the week, including weekends.

Table 2 – Weekend peak vs weekday peak - 2017

Road (Direction) *Note: Northbound(NB); Southbound(SB); Eastbound (EB)*	Weekend peak as a percentage of the weekday peak
Edgars Road (NB)	98%
Banksia Street (EB)	98%
Chandler Highway (SB)	93%
Plenty Road at Darebin Creek (EB)	93%
Main Road at Diamond Creek (SB)	91%
Lower Heidelberg Road (NB)	91%
Doncaster Road (NB)	90%
Bell Street at Darebin Creek (EB)	87%

Source: NELA Traffic Survey 2017

Adding to these problems is the growing number of freight vehicles using arterial roads for through movements between the north and east or south-east. Traffic counts undertaken for the North East Link project identify that 7% of trips along Rosanna Road and 8% of trips along Fitzsimons Lane are commercial vehicle trips. Along Fitzsimons Lane, which has steep grades unsuited to heavy vehicles, these freight vehicles are predominantly smaller heavy vehicles with over 90% being two to three axle trucks or buses, with less than 7% being larger articulated vehicles. This results in Rosanna Road attracting these larger vehicles as one of the only routes in the north-east that has grades that suit them and the connectivity to the freight network. Nearly 30% of freight vehicles on Rosanna Road are large articulated trucks[4].

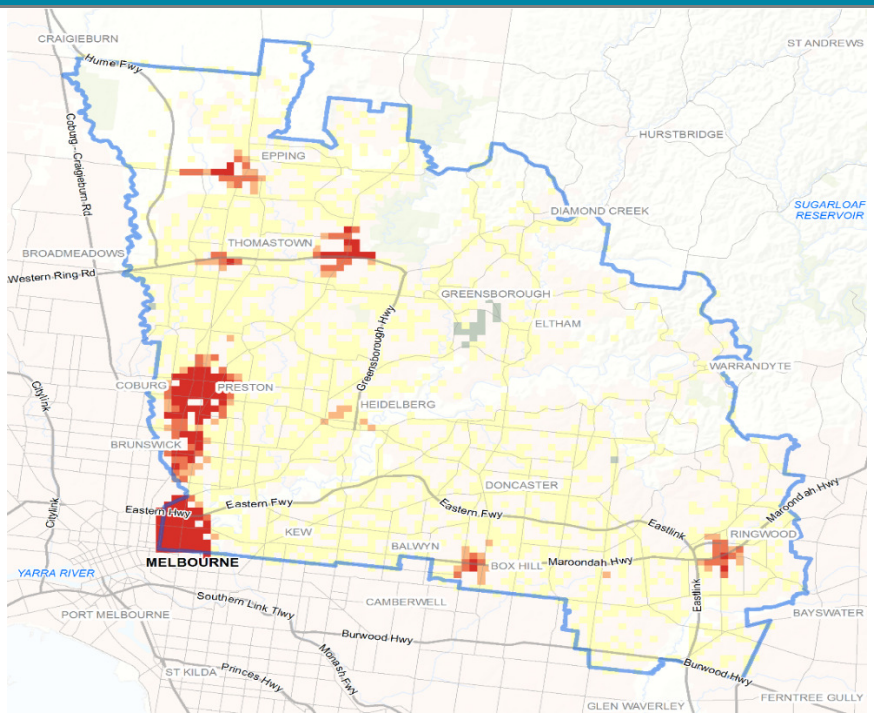
These freight movements are a significant factor in growing local traffic congestion and contribute to increased emissions and traffic noise. Residents are also exposed to increased traffic noise and emissions, and a growing risk of road accidents. The analysis of crash hotspots in Melbourne's north-east is presented in Figure 10. It shows significant hotspots that are likely to be due to increased levels of congestion. The most common cause of crashes are rear end collisions followed by collisions

[3] NELA Traffic Survey 2017

[4] NELA Traffic Survey 2017

between right turning and through-movement vehicles. These crash types are typically associated with high levels of congestion, flow breakdown and poor control at heavily used intersections.

Figure 10 – Hot spots of all vehicle crashes 2012 to 2016



Source: VicRoads Crash Statistics

Traffic will continue to grow

Overly trafficked roads in Melbourne's north-east also increase local residents' daily commute to their workplaces. For working members of households in Melbourne's north-east, a significant part of their commute time is spent moving through local and arterial roads to access higher capacity parts of the network.

Although these distances can be short in terms of overall distance travelled, they account for a significant proportion of the total journey time. For example, travel times in Table 3 shows that current travel time to travel the 10 kilometres between Greensborough and Heidelberg in the morning peak is in the range of 10 to 35 minutes and for the 15 kilometres between Epping and Northland is estimated to be in range of 25 to 60 minutes – an average additional 20 minutes for a further 5 kilometres. By 2031, this is estimated to increase by 25% to 45% for a further 5 kilometres. This will impact travel time and reliability for not only private vehicles but, also freight and on-road public transport.

Table 3 –Potential future travel time changes between selected locations for Melbourne's north-east in the AM peak without North East Link (2017 and 2031)

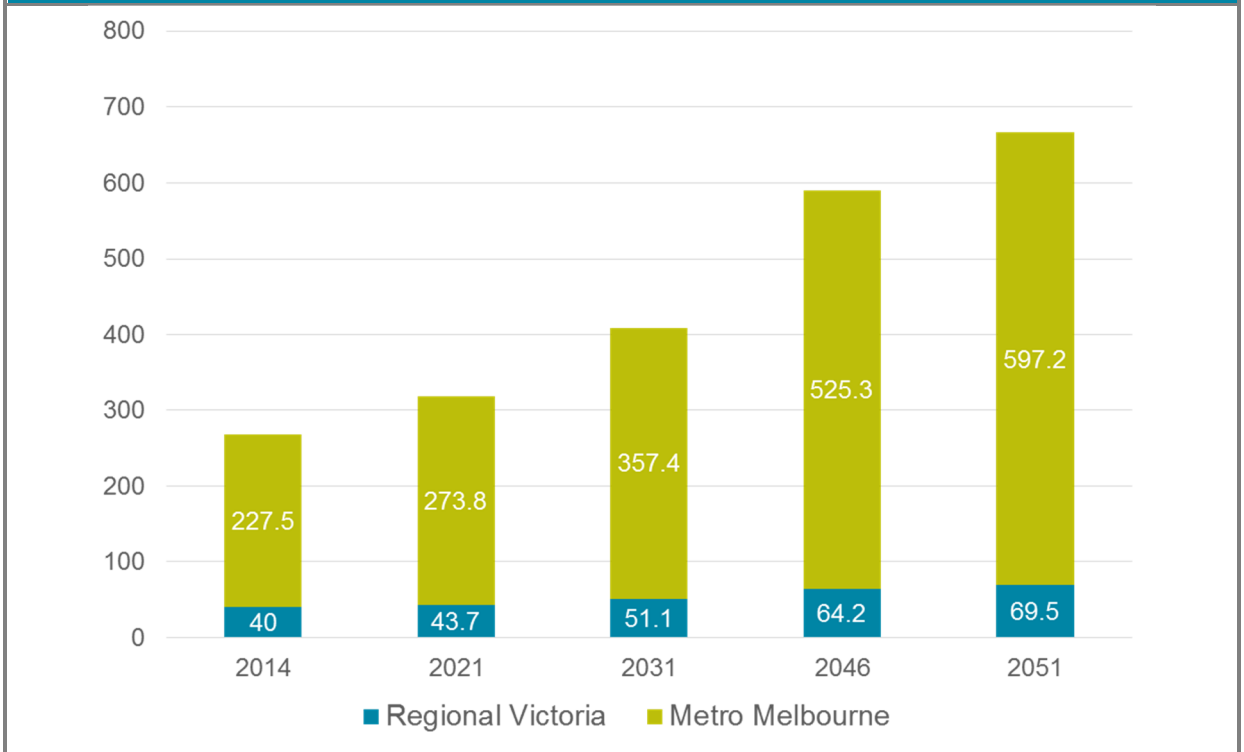
Origin	Destination	2017 travel time (mins)	Percentage change (2017 – 2031)
South Morang	Box Hill	45 to 100	+10% to +20%
Eltham	Ringwood	25 to 50	+5% to +15%
Greensborough	Heidelberg	10 to 35	+15% to +25%
Doncaster	La Trobe	20 to 40	+5% to +15%
Epping	Northland	25 to 60	+25% to +45%
Eltham	Swinburne University	30 to 70	+5% to +10%

Source: Google Maps and VLC Zenith Model – Preliminary modelling for North East Link

2.3 Inefficient freight movements are impacting business

The metropolitan freight task currently makes up around 85% of total Victorian freight volumes, at nearly 230 million tonnes in 2014 (Figure 11). That number is forecast to more than double over the next 30 years, growing at around 3% annually.

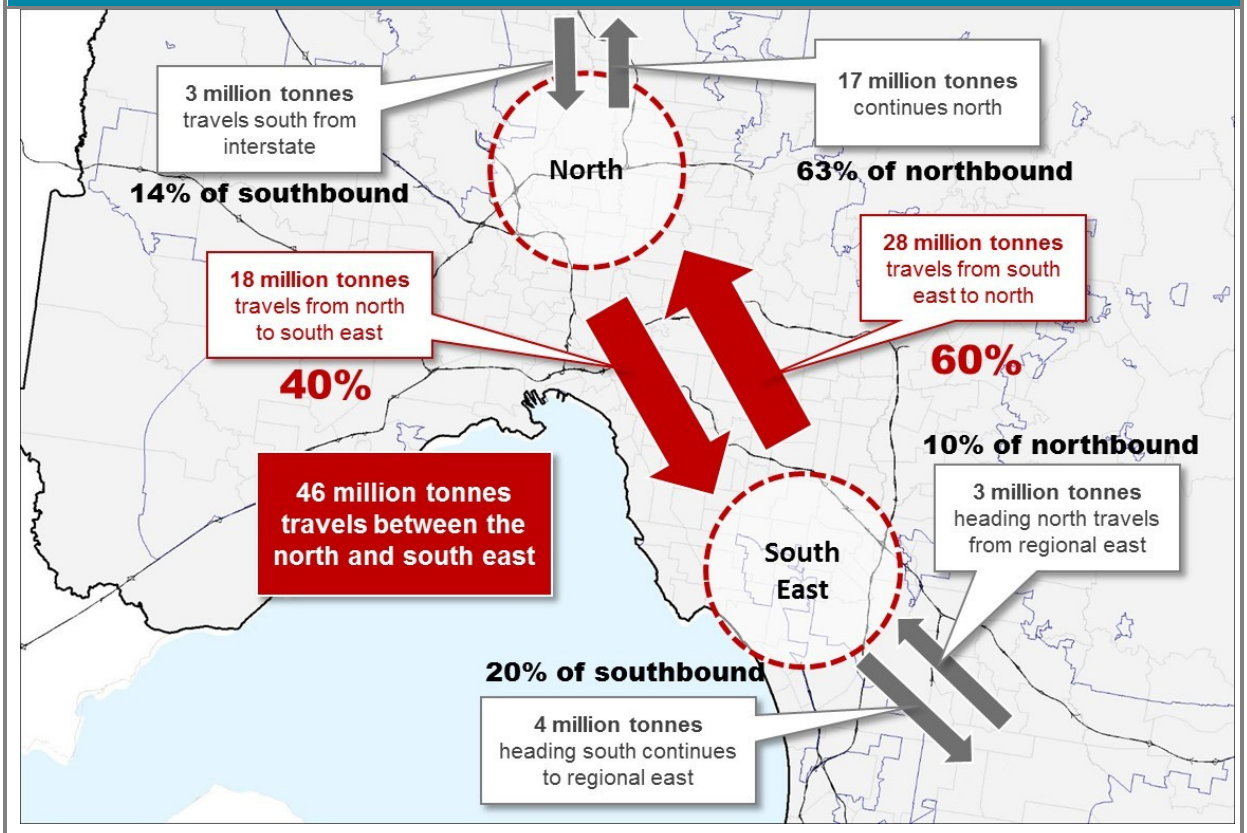
Figure 11 – Victorian freight task 2014 to 2051



Source: Department of Economic Development, Jobs, Transport and Resources, 2015, Review of Victoria's Freight and Logistics Task

Freight moving between the north and south-east of Melbourne accounts for 20% of all metropolitan freight volumes – or around 46 million tonnes. Of this volume, 60% travels from the south-east to the north, while 40% moves from the north to the south-east, as outlined in Figure 12.

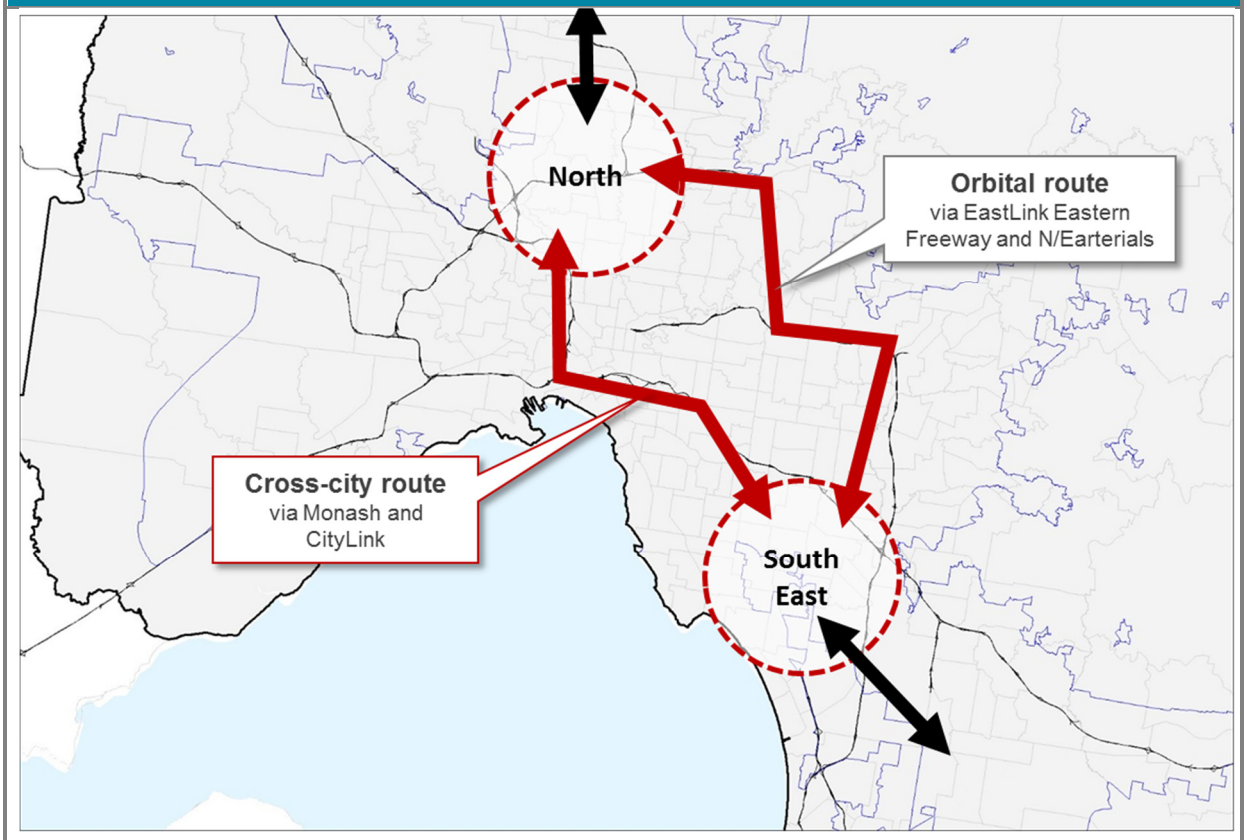
Figure 12 – Melbourne's north-east corridor freight flows



Source: XAct Solutions, 2017, North East Link Needs Assessment

Freight travelling between the north and south-east uses two primary routes; an orbital route via EastLink, the Eastern Freeway and through arterial roads such as Bulleen Road, Manningham Road, Rosanna Road and Greensborough Road in Melbourne's north-east, or a cross-city route via the M1 and CityLink, as shown in Figure 13.

Figure 13 – Primary routes for freight between the north and south-east of Melbourne



Poor freeway connectivity through the north-east leads to significant inefficiencies (and associated costs) in the freight task between Melbourne's north and south-east:

- With access for High Productivity Freight Vehicles (HPFVs) restricted in Melbourne's north-east, more trucks are required to move the same volume of freight, resulting in increased congestion and impacts on noise, air quality and road safety. Businesses based in Melbourne's north-east also have less flexibility and limited (and costlier) options for transporting larger loads.
- The 'gap' in the orbital network is a significant supply chain bottleneck that increases the cost of transporting goods from where they are produced to customers in Melbourne, Victoria or overseas. This is potentially a significant competitive disadvantage for businesses operating in high value industry sectors.
- Traffic congestion and poor reliability on key transport routes diminishes the provision of efficient freight systems to support the requirements of businesses.
- The lack of efficient orbital access through Melbourne's north-east places additional pressure on other key routes across the network, with supply chains increasingly reliant on the M1 corridor, which is heavily congested for a large and growing part of the day, and is increasingly susceptible to incidents and long periods of disruption.

- Melbourne has a strong competitive advantage in being home to the nation's largest curfew-free airport. Poor orbital connectivity means that the opportunities presented by this advantage are not being fully realised.

A key industry sector affected by these constraints is the food and fibre sector. Victoria is Australia's biggest food and fibre exporter, with exports reaching an all-time high of $12 billion in 2014-15[5]. The sector accounts for 4.9% of Gross State Product and in 2014-15 accounted for around half of the state's total goods exports. Recently, the Victorian Government has focused on promoting food and fibre products from east Victoria to export markets. However, poor orbital access in Melbourne's north-east is affecting the competitiveness of agriculture and manufacturing industries in Victoria's east. Excluding congestion impacts, the lack of orbital access across Melbourne's north-east is estimated to cost operators 12% more than equivalent distance deliveries in the north-west[6].

Poor orbital connectivity in Melbourne's north-east represents a significant supply chain bottleneck that increases the cost of transporting goods from where they are produced to customers in Melbourne, Victoria or overseas. This is potentially a significant competitive disadvantage for businesses operating in high value industry sectors, including those moving time-critical goods to Melbourne Airport. With supply chains increasingly reliant on the M1, many freight reliant and logistics industries have migrated to the western and northern suburbs of Melbourne. There is a further risk that, as freight costs increase, business may start to move to different cities to avoid higher prices.

[5] DEDJTR (2016) Food and Fibre: Sector Strategy

[6] XAct Solutions, 2017, North East Link Needs Assessment

Rosanna Road and the 14-hour peak period

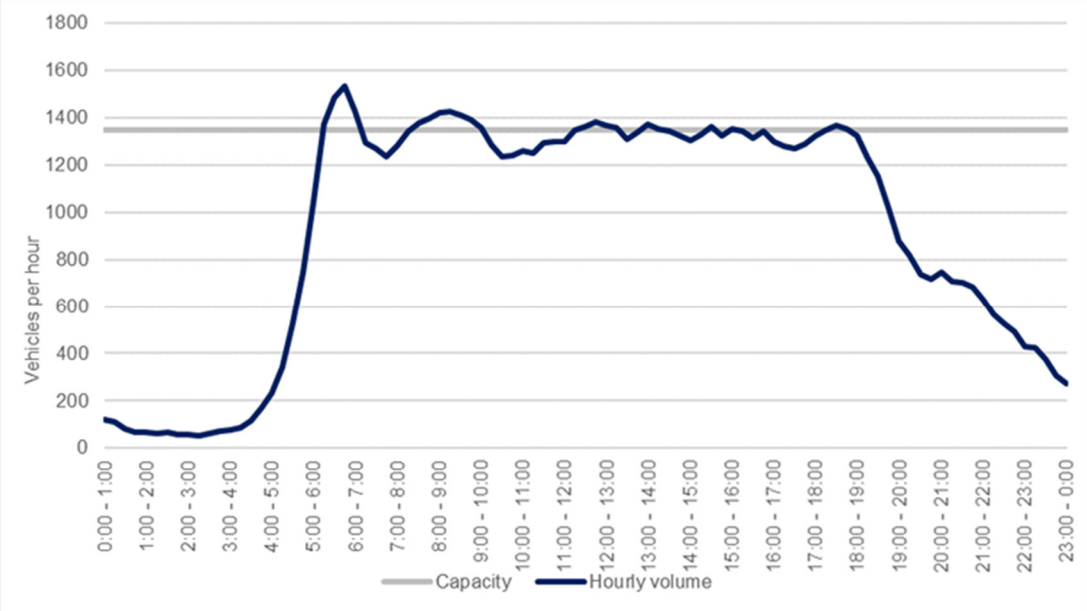
Rosanna Road is one of the busiest arterial roads in Melbourne's north-east, carrying approximately 45,000 vehicles per day, of which roughly seven percent are commercial vehicles. It is a four-lane, two-way undivided road, with low density residential dwellings along both sides of the road.

High volumes of trucks often take up space on the narrow lanes, causing other vehicles to move into less desirable locations. With limited separation between on-coming traffic or between the road and the footpaths, this leads to poor amenity outcomes for nearby residents.

Additionally, the lack of alternative north-south routes in the area means that there is a high degree of reliance on Rosanna Road for general traffic movement through the north-east. This means that there are long periods of congestion throughout the day and significant reliability issues.

The hourly traffic flows over a typical weekday on Rosanna Road (in the southbound direction) is presented in the figure below. Across the two lanes of traffic, the road can accommodate approximately 1,350 vehicles an hour (due to capacity constraints at the Lower Plenty Road and Banksia Street intersections). This means that the road reaches capacity at around 5:00 am in the morning, and remains busy all day until 7:00 pm at night; for 14 hours a day there is significant delay and congestion on Rosanna Road.

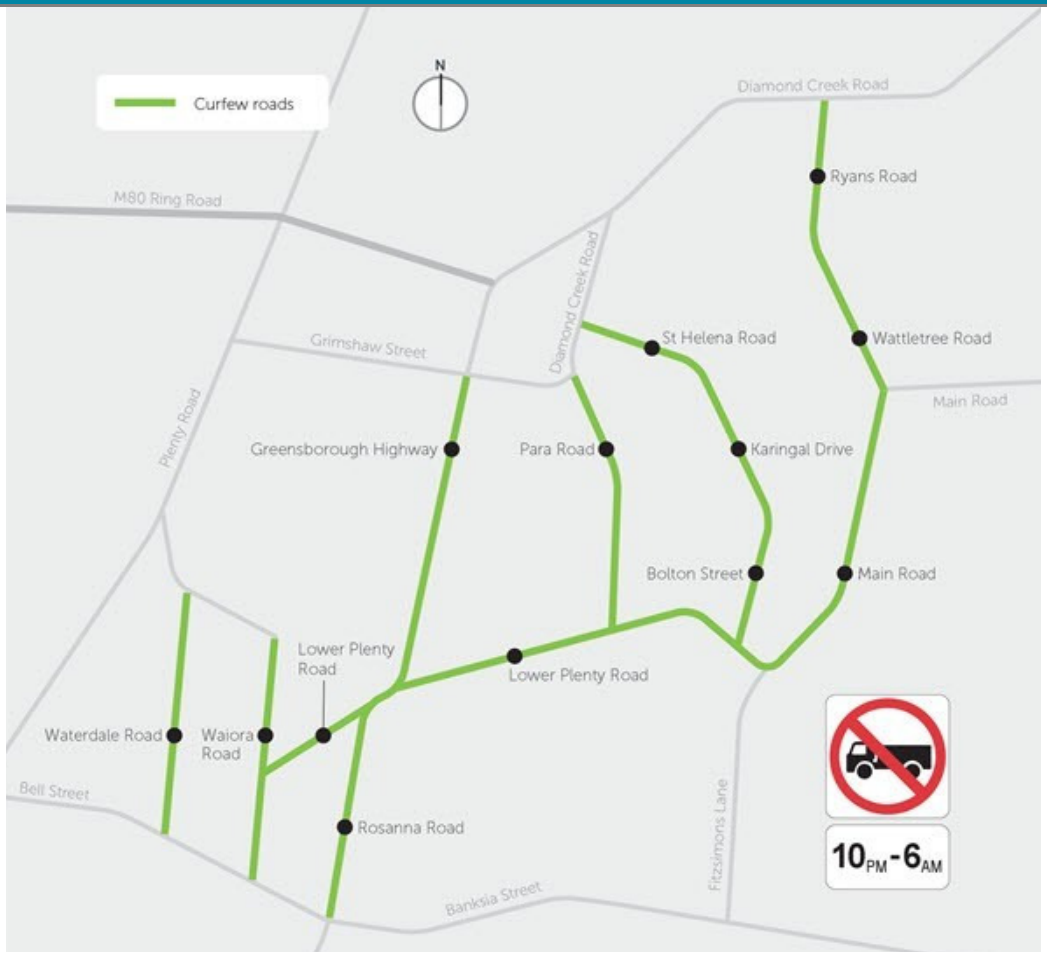
Figure 14 – Hourly traffic volumes on Rosanna Road (southbound)



Source: NELA Traffic Survey 2017

To address the amenity issues resulting from truck traffic on roads in Melbourne's north-east, a truck curfew is currently in place across several arterial roads across Melbourne's north-east. VicRoads introduced this curfew in 2015 to reduce truck traffic through the area at night and potential impacts on the community. Trucks in excess of 16.5 tonnes are restricted from using certain roads between the hours of 10:00 pm and 6:00 am. These restrictions, coupled with congestion throughout the day on these key routes further limits efficient freight movement through Melbourne's north-east as shown in Figure 15.

Figure 15 – Truck curfews on key roads in Melbourne's north-east (Trucks over 16.5 tonne)



Source: VicRoads

2.4 Poor connections are constraining economic potential

Orbital movements through Melbourne's north-east connect major population, employment and industrial centres across the city's north, east and south-east. Trips through this area are accessing Melbourne Airport and other significant gateways and freight hubs. There are a range of important economic journeys across and around Melbourne's north-east, including commuter journeys to employment precincts and activity centres, business-to-business trips and metropolitan, regional and interstate freight movements.

With no freeway standard link in this part of the corridor, arterial roads have to accommodate strategic orbital movements between employment and industrial clusters, as well as local movements between residential areas, amenities and services in the immediate vicinity.

As a consequence of poor orbital mobility, businesses located in employment and service centres in Melbourne's major population areas in the north, east and south-east lack access to the large labour markets that underpin productivity and competitiveness. Movement between businesses in these areas and their customers and suppliers is constrained, putting them at a disadvantage compared to

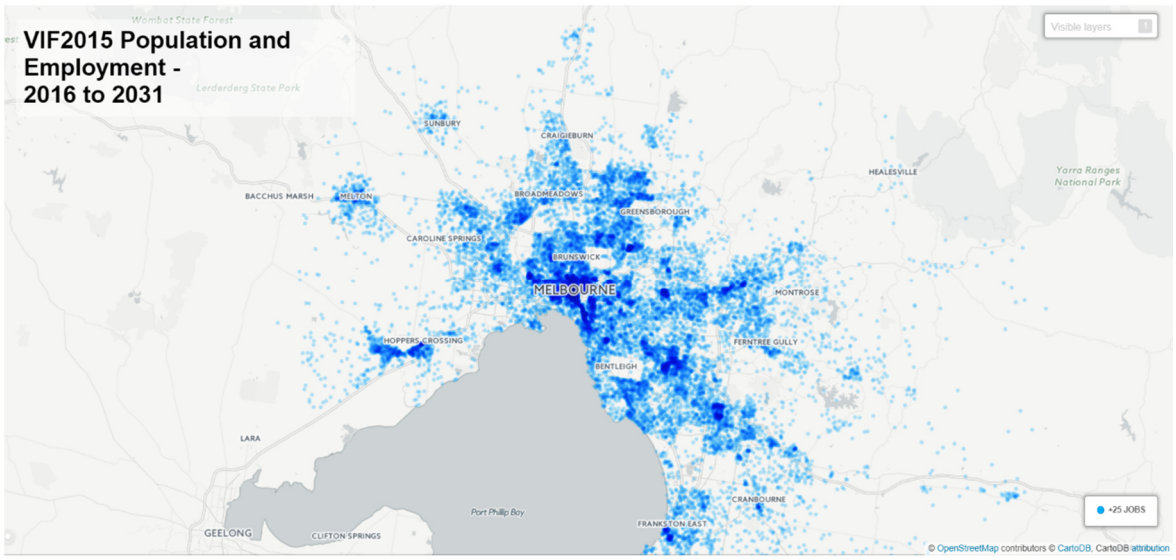
businesses in other locations with greater connectivity. Workers are restricted in accessing employment opportunities across the metropolitan area, which disproportionately affects lower-income households and entrenches social and housing market divisions.

Businesses in the north, east and south-east lack access to deep labour catchments

Maximising the full economic potential of a large city requires workers, consumers and suppliers to exchange labour and goods easily and to interact frequently. As a consequence of poor orbital mobility, businesses located in key employment and service centres in Melbourne's major population areas in the north, east and south-east lack good access to each other and to the large labour markets that underpin productivity and competitiveness. Poor cross city and orbital mobility also prevents workers from accessing employment opportunities across the metropolitan area.

Although central Melbourne has an advantage in terms of labour market accessibility, close to 80% of all jobs are located outside the central city[7]. A significant proportion of these are dispersed throughout the city's north, south and south-east as shown in Figure 16.

Figure 16 – Growth in employment in Melbourne 2016 - 2031



[7] Department Environment, Land, Water and Planning, 2017, Victoria in Future (VIF) 2015, Population and Employment Projections, Victorian Government

With Melbourne's population centre now lying to the east of the central city between the middle northern and south-eastern suburbs, the Monash and La Trobe National Employment and Innovation Clusters (NEICs) have an important role to play in boosting employment and productivity growth[8].

However, compared to the central city, these NEICs have much smaller accessible labour market catchments. In particular, only 5% of Melbourne's total workforce is accessible to the La Trobe NEIC within 60 minutes by public transport in the morning peak period. The Monash NEIC, which has greater train and bus accessibility, fares slightly better: 13% of the city's workforce can get to the centre within one hour by public transport.

Access to skilled workers is even more constrained, with approximately two thirds of all highly skilled workers living in Melbourne able to access the central city within 50 minutes by car and 51% able to access the city within 60 minutes by public transport. Just 6% of the city's highly skilled workforce is accessible to the La Trobe NEIC within 60 minutes by public transport[9].

These relatively low levels of accessibility suggest that businesses located in these NEICs (and in nearby metropolitan and major activity centres) may face difficulties in attracting and retaining workers, and building the skilled workforces necessary to lift their levels of productivity.

A comparison of labour market catchments for central Melbourne and La Trobe NEIC are shown in Figure 17 below.

La Trobe and Monash NEICs

To grow the economy and create competitive industries, the Victorian and Australian Governments promote the clustering of business activity of national significance in National Employment and Innovation Clusters (NEICs). These centres will become the focus for knowledge-based businesses and are considered crucial for maximising access to high-productivity jobs for Melbourne's middle and outer suburbs and growth areas.

The Monash NEIC is the largest concentration of employment outside the central city, with approximately 75,000 jobs. Monash NEIC includes Monash University and several leading education, health, research and commercialisation facilities. It also encompasses three major activity centres: Brandon Park, Clayton and Springvale.

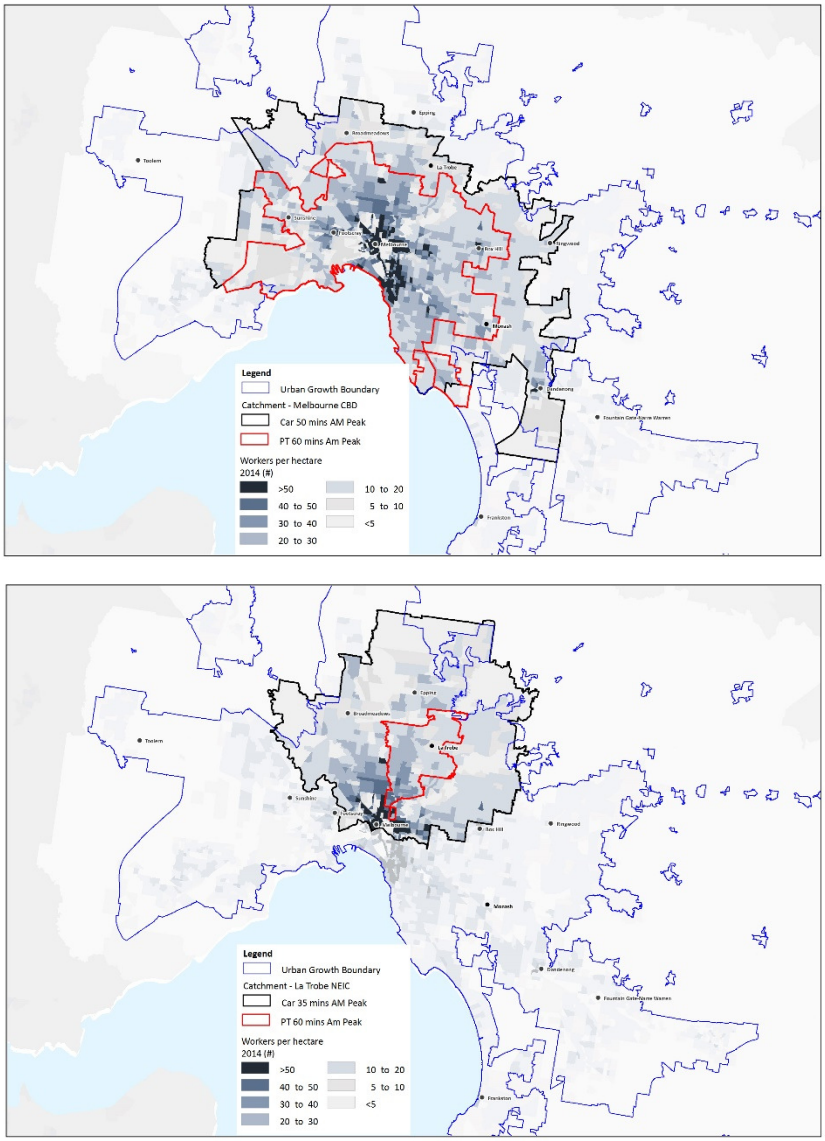
La Trobe NEIC is an emerging cluster with an expanding education, health and research role, home to approximately 28,500 jobs. It includes La Trobe University and the Austin Biomedical Alliance Precinct, and retail activities in and around the Northland Shopping Centre and the Heidelberg major activity centres.

These centres will need access to a large pool of workers if they are to make a major contribution to the Victorian and Melbourne economies, deliver significant regional services and generate and sustain jobs outside central Melbourne. They will also need good transport links with other major industrial areas, export gateways, health and education precincts and metropolitan and major activity centres.

[8] Victorian Government,2017, Plan Melbourne-2017-2050 Strategy, Policy 1.1.3 Facilitate the development of National Employment and Innovation Clusters

[9] Analysis of VLC Zenith Model – Preliminary modelling for North East Link

Figure 17 - Labour catchment analysis – central Melbourne and La Trobe – 2014 Base Case



Source: VLC Zenith Model – Preliminary modelling for North East Link

In addition to accessing labour markets, fast and reliable transport connections between businesses and their customers and suppliers are critical to keeping transport costs down and boosting business productivity. Efficient business-to-business interaction also enables the exchange of ideas and promotes collaboration and innovation.

Business-to-business travel between key economic and employment locations in the north, east and south-east is compromised by poor orbital mobility. As shown in Table 4, there are significant variations in travel times for business travel by car between key employment and service centres. Travel times for trips from Monash can vary between the ranges of 10 – 20 minutes to 41 – 60 minutes. Similarly, business-to-business trips from Epping to other key business destinations can

vary from 80-100 minutes for the longest journey to 20 to 40 minutes.[10] Travel between the La Trobe and Monash NEICs can take around one hour, as does travel from Ringwood and Box Hill in the south to Broadmeadows and Epping in the north.

The lengthy trip times shown in the table indicate that many critical business-to-business travel demands are under pressure, suggesting that NEICs and other employment centres along the orbital corridor may be missing out on vital opportunities to expand.

Table 4 – Business-to-business to travel by car between NEICs and other MACs in AM peak – 2014 Base Case

Travel times (mins)		Destination								
		La Trobe	Monash	D'nong	Narre Warren	Epping	B'meadows	Box Hill	R'wood	Melb CBD
Origin	La Trobe		61-80	61-80	61-80	21-40	21-40	41-60	41-60	41-60
	Monash	41-60		11-20	21-40	61-80	41-60	21-40	21-40	41-60
	Dandenong	61-80	21-40		11-20	61-80	61-80	21-40	21-40	41-60
	Narre Warren	61-80	21-40	21-40		81-100	61-80	41-60	41-60	61-80
	Epping	21-40	81-100	81-100	81-100		21-40	61-80	61-80	61-80
	Broadmeadows	21-40	41-60	61-80	61-80	21-40		41-60	41-60	21-40
	Box Hill	21-40	21-40	21-40	21-40	41-60	41-60		11-20	21-40
	Ringwood	41-60	21-40	21-40	21-40	41-60	61-80	21-40		41-60
	Melbourne	21-40	21-40	21-40	21-40	41-60	21-40	21-40	21-40	

Source: Analysis based on VLC Zenith Model – Preliminary modelling for North East Link

With no direct orbital connection, business trips to Melbourne Airport from the east and south-east are also taking longer and are less reliable and more expensive. The time and cost associated with travel to the airport is an important consideration for many businesses when choosing where to locate, especially those involved in knowledge-intensive sectors. If travel to the airport from centres in Melbourne's east and south-east becomes even further constrained, businesses will be less interested in locating to these centres. This will undermine efforts to distribute jobs in these expanding sectors across the metropolitan area.

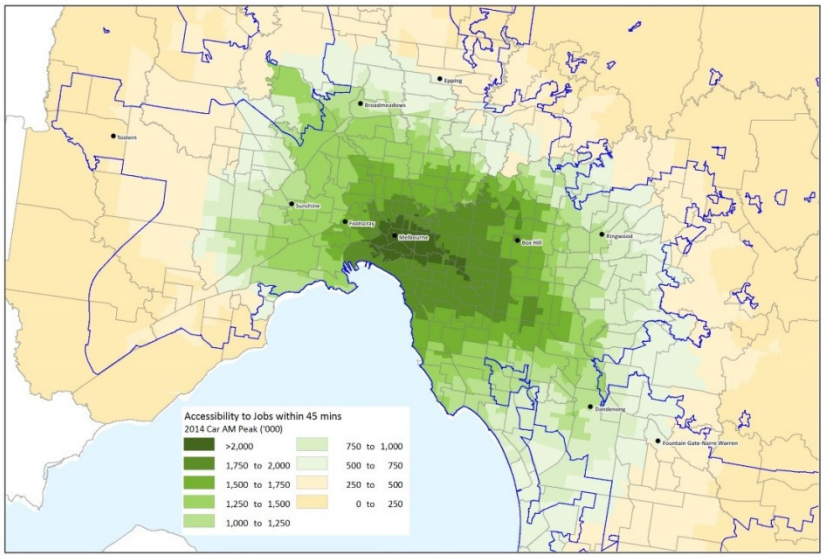
For people accessing economic opportunities across Melbourne, the number of jobs available within a reasonable travel time diminishes significantly the further away one lives from the central city. Figure 18 shows that access to jobs (by car and public transport) is highest for those living in the inner and middle suburbs, while access to jobs in the densely populated outer north and eastern areas is lowest.

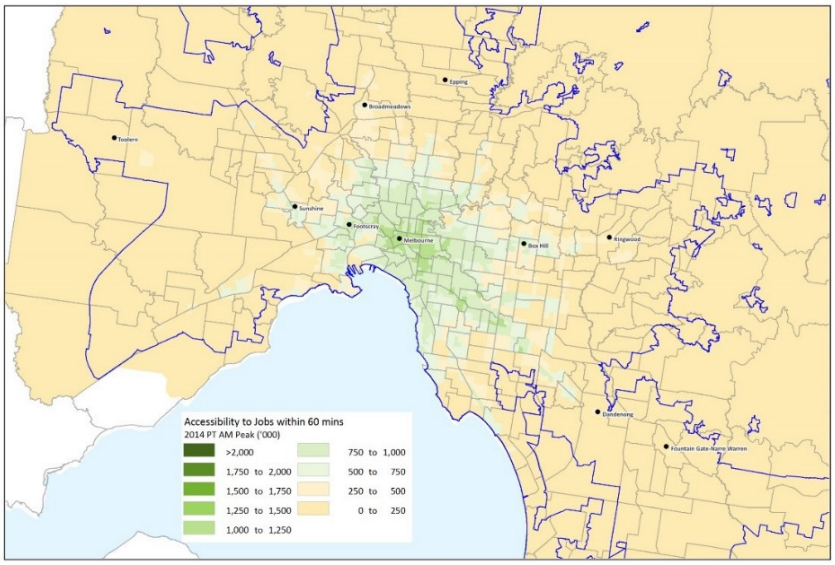
[10] Analysis based on VLC Zenith Model – Preliminary modelling for North East Link

Because transport is the main means to reach employment and educational opportunities, barriers to travel can entrench disadvantage. Worsening orbital connectivity will exacerbate this disadvantage, making it even harder for households in the north, north-east and south-east to access economic opportunities.

If current settings remain unchanged, ongoing fragmentation of labour markets, poor business-to-business travel and diminished levels of employment access will continue to impose costs on businesses and households, and constrain productivity growth and competitiveness for Melbourne and Victoria.

Figure 18 – Accessibility to jobs analysis around key employment locations – 2014 Base Case





Source: VLC Zenith Model – Preliminary modelling for North East Link

3 Potential corridor options

3.1 Overview

Numerous studies extending back to 1969 have recognised the need for a link between the M80 and the Eastern Freeway/ EastLink. However no continuous established road reservation exists to accommodate or protect such a link.

While there are numerous ways to provide such a connection, the NELA's team of specialists has identified four of the most practical potential corridor options for North East Link, as displayed in Figure 19 and outlined below.

Figure 19 – Potential corridor options for North East Link

These corridors were identified by assessing existing traffic conditions and transport movements, investigating existing road corridors and utilities easements that could be used for motorway corridors, identifying potential surface road corridors and constraints to these corridors (such as difficult terrain, sensitive environmental areas and important community assets) and considering treatments such as tunnels to avoid these sensitive environmental and urban areas or to mitigate substantive surface impacts. The team is also developing an urban design framework to make sure that the design of the project fits into the local landscape. Further data gathering and analysis in

relation to these corridor options is being undertaken, along with community consultation. The views of residents, businesses, industry and community groups and other key stakeholders will be important inputs into these assessments to ensure the key issues identified as important for the project to deal with are properly considered.

Detailed assessment of each potential corridor option will provide the basis for identifying the preferred corridor for North East Link. Through these assessments, NELA will identify the option that best addresses Melbourne's poor orbital connectivity and the problems facing the north-east and that provides the most benefits when compared against the costs and impacts associated with building North East Link.

The following issues are common to all corridors and therefore are reflected in each of the corridor options:

- A continuous road reservation does not exist between M80 and Eastern Freeway and EastLink
- Steep natural grades are encountered throughout Melbourne's north-east and are therefore reflected in elements of the concept design
- Acquisition of some property is anticipated, and may affect commercial, industrial and residential properties. Government owned land may also be affected by some corridors
- North East link will require integration with M80 and Eastern Freeway or EastLink. These roads are anticipated to be Managed Motorways with Intelligent Transport Systems to manage traffic flow, and improve safety and provide travel information to the driver
- Arterial roads adjacent to North East Link will require upgrades to support interchanges. This typically involves additional through lanes, turning lanes and corridor improvements to allow traffic to move safely and efficiently between the wider road network and North East Link
- North East Link is required to integrate with various modes of public transport
- Enhancement of walking and cycling routes will form part of the broader project. This may include routes adjacent to North East Link corridor or those that may cross it to minimise severance. There are also opportunities for pedestrian and cycling traffic to use areas which are subject to lower traffic volumes as a result of the project
- The use of tunnelling will be critical to protect environmentally sensitive areas that may be affected by the proposed corridors
- All options cross the Yarra River valley by either tunnel or bridge structures
- Major utilities easements are affected by the proposed works and will require protection or relocation.

3.2 North East Link corridor options

Corridor Option A

This option would use the existing road reserve to link to the M80, follow the Greensborough Bypass south to connect with the Eastern Freeway near Bulleen Road. It provides a motorway solution that connects the northern and north-eastern growth areas and activity centres and employment / innovation clusters (particularly La Trobe NEIC) to communities and businesses in the east and south-east.

Figure 20 provides the location of Corridor A and includes potential interchanges and the estimated extent of upgrades required to existing roads. Figure 21 shows the terrain along which Corridor A will traverse between the M80 and Eastern Freeway.

Figure 20 - Corridor A: location

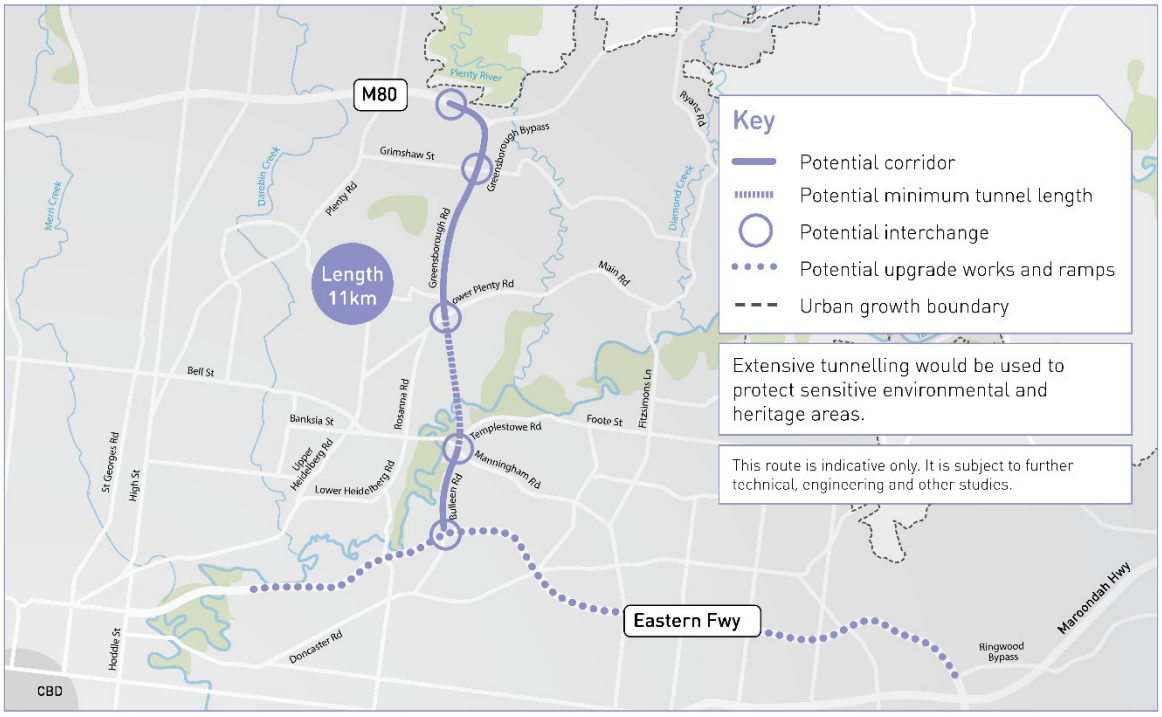
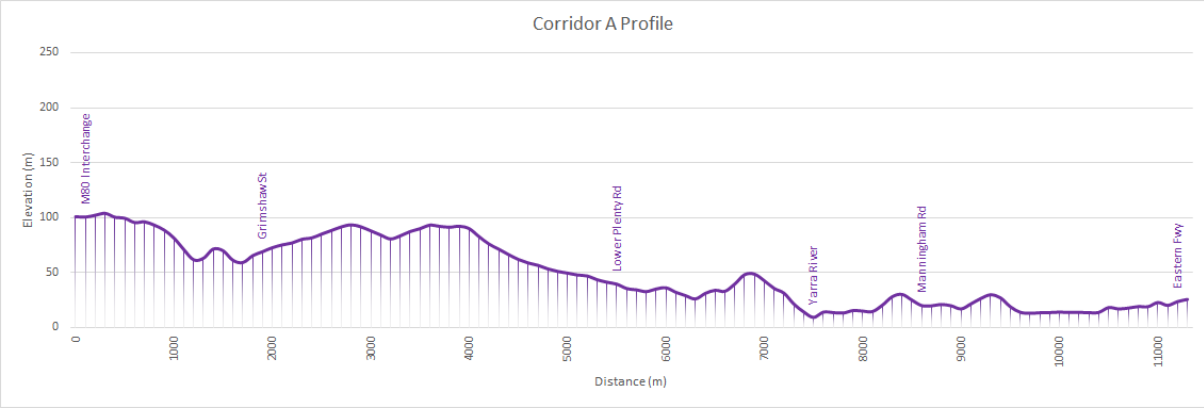


Figure 21 – Corridor A: natural surface profile M80 to Eastern Freeway



Initial development of design solutions for this corridor indicates that:

- It is approximately 11 kilometres in length from the M80 to Eastern Freeway
- It will necessitate upgrades when connecting to the Eastern Freeway to increase its capacity in both directions to accommodate merging between Bulleen Road and Chandler Highway and additional capacity and merging between Bulleen Road and Springvale Road
- Up to 50% of its length would likely be in tunnel, particularly under significant areas such as the Yarra River and Banyule Flats
- It provides the potential for a number of interchanges with the key arterial roads on the existing network including Grimshaw Street, Lower Plenty Road and Banksia Street; enabling a good level of connectivity to a range of areas in Melbourne's north-east
- It provides good access to the La Trobe NEIC
- Indicative modelling suggests that Corridor A may carry between 100,000 to 120,000 vehicles per day, 10 years after opening, with the volumes largely consistent along the length of the corridor
- It enables good gradelines to be achieved to accommodate heavy vehicles along the length of the corridor
- It provides good opportunities to connect to cycling routes due to its proximity to existing paths.

Corridor Option B

This option would provide a direct connection from the M80 at Greensborough to EastLink at Ringwood. It provides the functionality of an orbital motorway section that connects the northern and north-eastern growth areas to south-east Melbourne via EastLink, with connectivity to the La Trobe NEIC.

Figure 22 provides the location of Corridor B and includes potential interchanges and the estimated extent of upgrades required to existing roads. Figure 23 shows the terrain along which Corridor B will traverse between the M80 and EastLink.

Figure 22 – Corridor B: location

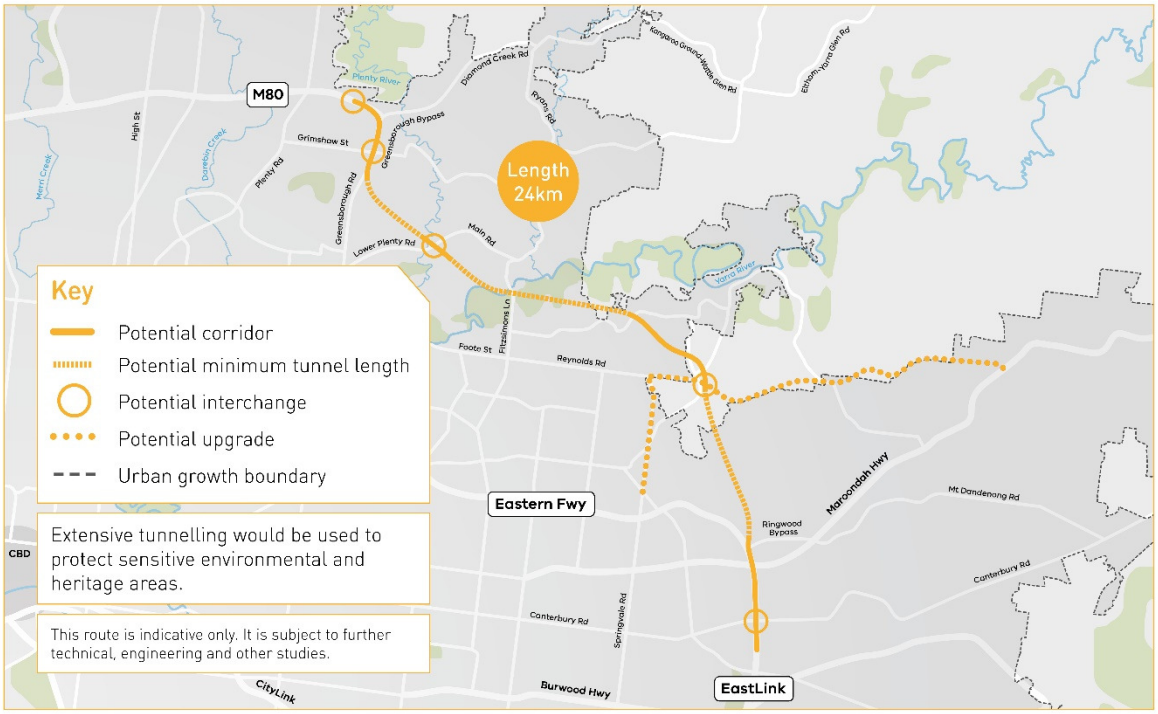
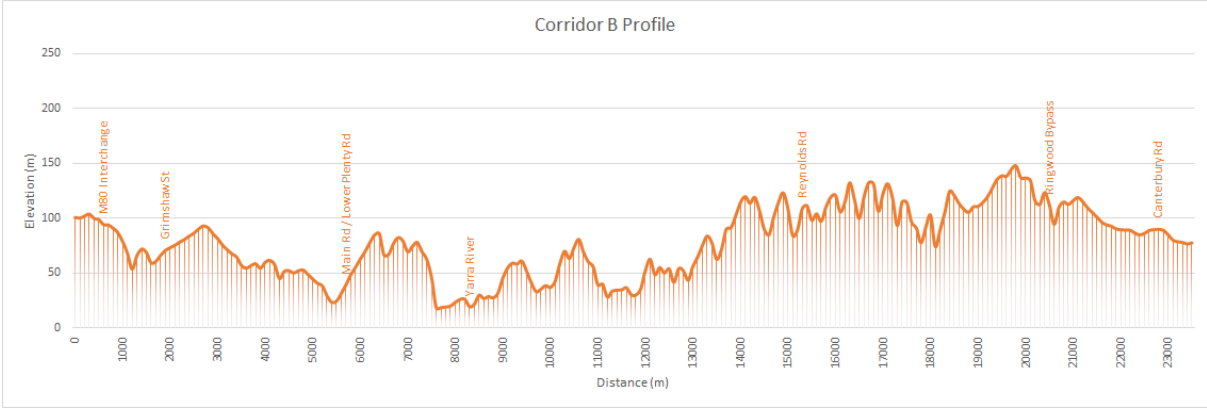


Figure 23 - Corridor B: natural surface profile M80 to EastLink connection



Initial development of design solutions for this corridor indicates that:

- It is approximately 24 kilometres in length from the M80 to EastLink
- It will necessitate significant works along the EastLink corridor to provide adequate connections
- It will require upgrades to Springvale Road, north of the Eastern Freeway and an extension to Reynolds Road to provide operational connectivity to the existing road network
- Up to 70% of its length would likely be in tunnel, particularly in significant areas such as the Yarra River
- It is challenging to achieve good gradelines that will accommodate heavy vehicles along the length of the corridor
- It provides potential for a number of interchanges with existing roads including Grimshaw Street, Lower Plenty Road and Reynolds Road, enabling connectivity to a number of areas in outer Melbourne's north-east
- Indicative modelling suggests that Corridor B may carry between 60,000 to 110,000 vehicles per day, 10 years after opening, with the lower volumes on the southern sections of the corridor.

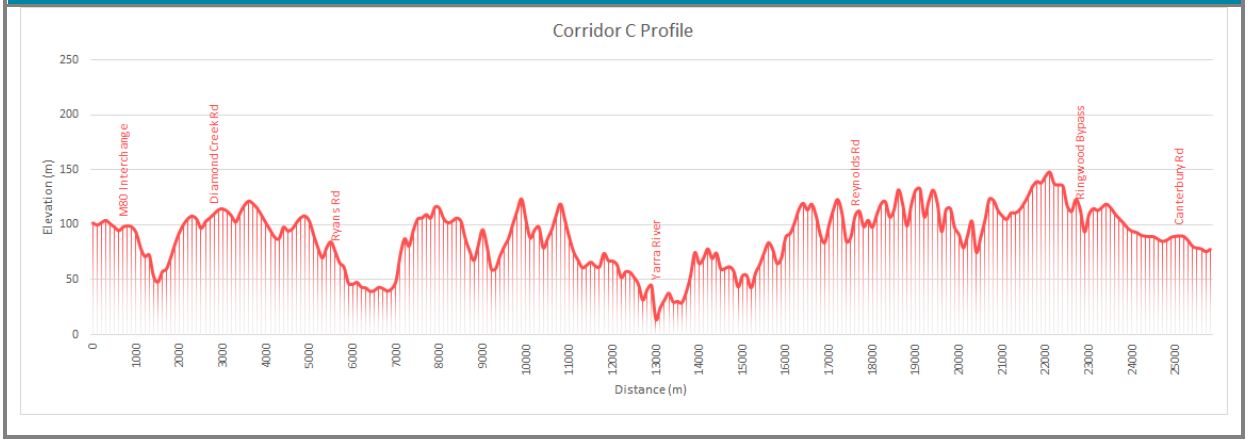
Corridor Option C

The northern end of this option would connect to the M80 using a previous road corridor that runs from the Greensborough Bypass / Diamond Creek Road roundabout to Ryans Road. Its southern end would connect to EastLink at Ringwood. It provides the functionality of a traditional orbital motorway section that connects the northern growth area to south-east Melbourne via EastLink.

Figure 24 provides the location of Corridor C and includes potential interchanges and the estimated extent of upgrades required to existing roads. Figure 25 shows the terrain along which Corridor C will traverse between the M80 and EastLink.

Figure 24 - Corridor C: location

Figure 25 - Corridor C: natural surface profile M80 to EastLink connection



Initial development of design solutions for this corridor indicates that:

- It is approximately 26 kilometres in length from the M80 to EastLink
- It will necessitate significant works along the EastLink corridor to provide adequate connections
- It will require upgrades to Ryans Road, Springvale Road north of the Eastern Freeway and an extension to Reynolds Road to provide operational connectivity to the existing road network
- Up to 55% of its length would likely be in tunnel, particularly in significant areas such as the Yarra River
- It is challenging to achieve good gradelines that will accommodate heavy vehicles along the length of the corridor
- It traverses outside the Urban Growth Boundary
- It provides potential for a limited number of interchanges with existing roads including Diamond Creek Road, Ryans Road and Reynolds Road; however these roads are not key arterial roads, thus providing limited connectivity in Melbourne's north-east
- Indicative modelling suggests that Corridor C may carry between 50,000 to 110,000 vehicles per day, 10 years after opening, with the lower volumes on the southern sections of the corridor.

Corridor Option D

This option would connect with EastLink south of Ringwood and travel east using part of the proposed Healesville Freeway Reserve and travel east to Lilydale. It would then turn back and head west to the M80 travelling though Bend of Islands and Kangaroo Ground. It provides a longer distance orbital solution using some existing reservations that connect the northern growth area to south-east Melbourne via an eastward orbital route largely outside the Urban Growth Boundary.

Figure 26 provides the location of Corridor D and includes potential interchanges and the estimated extent of upgrades required to existing roads. Figure 27 shows the terrain along which Corridor D will traverse between the M80 and EastLink.

Figure 26 - Corridor D: location

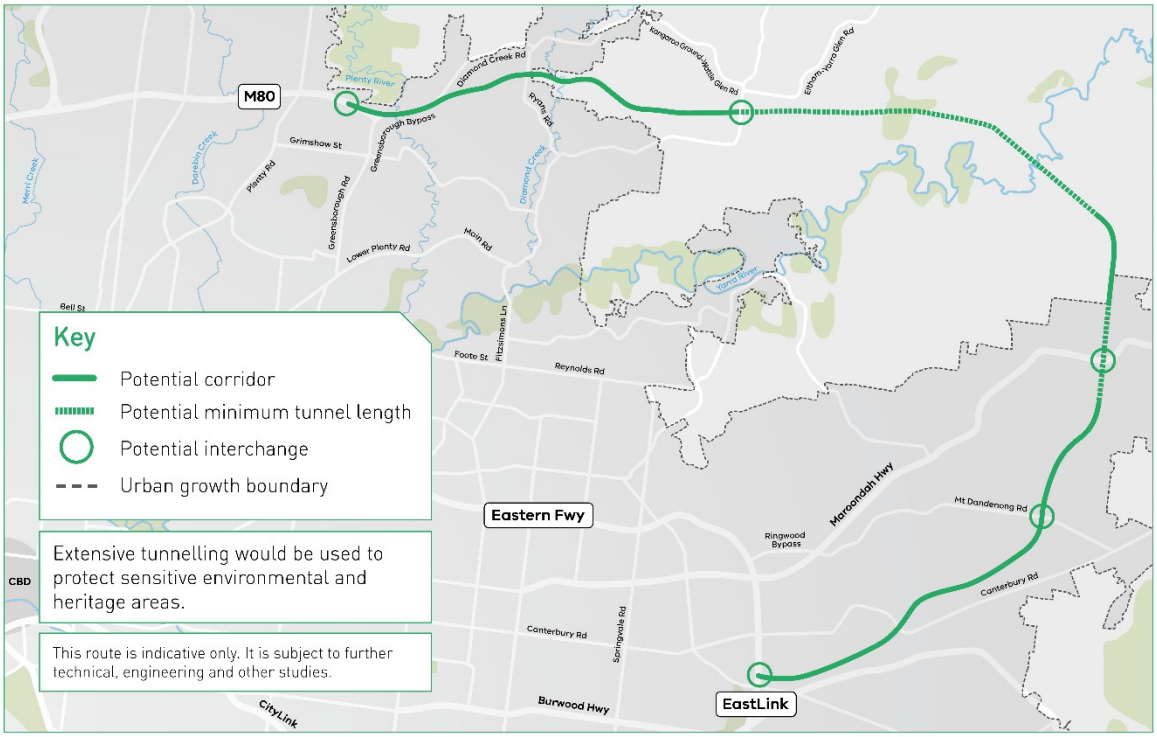
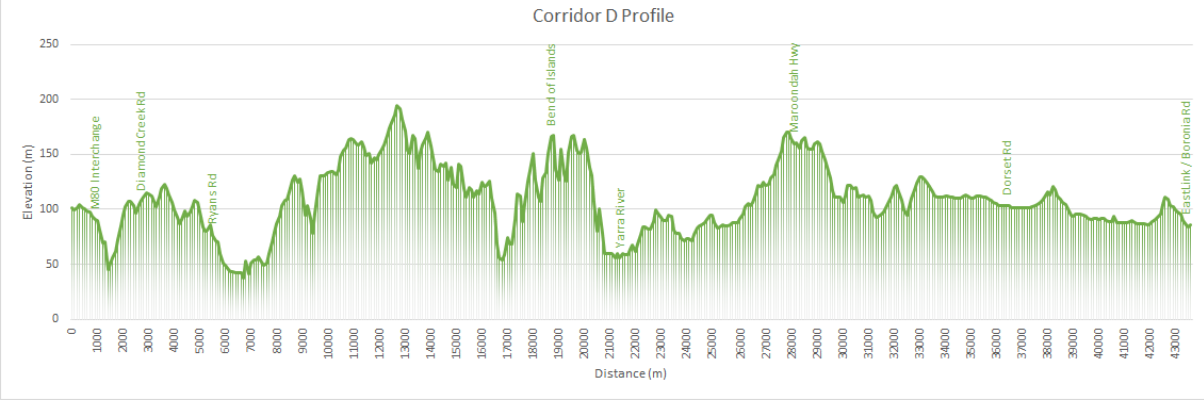


Figure 27 - Corridor D: natural surface profile M80 to EastLink connection



Initial development of design solutions for this corridor indicates that:

- It is approximately 40 kilometres in length from the M80 to EastLink
- It will necessitate works at EastLink interchanges to provide adequate connections
- Up to 40% of its length would likely be in tunnel, particularly in significant areas such as the Yarra River
- It is challenging to achieve good gradelines that will accommodate heavy vehicles along the length of the corridor
- It traverses primarily outside the Urban Growth Boundary
- It provides potential for a limited number of interchanges with existing roads including Diamond Creek Road, Ryans Road, Eltham-Yarra Glen Road, Maroondah Highway and Mt Dandenong Road, however these roads provide limited connectivity in Melbourne's north-east
- Indicative modelling suggests that Corridor D may carry between 45,000 to 90,000 vehicles per day, 10 years after opening, with the lower volumes on the southern sections of the corridor.

4 Areas of stakeholder interest: current observations

As noted in the Overview, NELA's preliminary community and stakeholder consultations identified several areas of interest as being important to people. This section of the Technical Summary outlines some observations from NELA's investigation and analysis to date in relation to these areas of interest. These areas of interest are reflected in the Project Objectives (see section 1), indicating that NELA's assessment of options for the project aligns with – and will address – community and stakeholder views, experiences and concerns.

Assessing the project's benefits

At the same time as we are investigating potential options for the project, NELA is also identifying, quantifying and assessing the potential benefits that are expected to be delivered by North East Link.

Current investigations indicate that the key benefits would be:

- *Economic and employment growth* – with better transport links between Melbourne's north, east and south-east attracting more investment in these areas
- *Increased economic opportunity for households in the north, east and south-east* – with enhanced orbital connectivity through the north-east reducing congestion and improving access to jobs and education
- *Improved competitiveness of the State of Victoria* – with more efficient connections, less congestion and fewer delays reducing costs to businesses and improving the productivity and competitiveness of Melbourne and Victoria
- *Improved liveability and thriving communities in the north-east* – with a decreased reliance on arterial roads for orbital travel reducing heavy vehicle traffic through residential areas and improving safety and access to local destinations.

Specific indicators to measure these benefits will be identified and included in the development of the design for the project.

What we've looked at for each of the areas of interest:

How can each corridor option provide opportunities to reduce traffic on roads in the north-east?

How can each corridor option attract trucks so they don't need to use existing roads?

How can each corridor option provide better and quicker access for people to get to jobs?

How can each corridor option provide businesses with faster connections and better access to more workers?

How can each corridor option improve the efficiency of freight movement to maintain industry competitiveness?

How can each corridor option provide opportunities to improve public transport services?

How can each corridor option provide opportunities to improve walking and cycling connections?

How can each corridor option help in reducing impacts to sensitive areas?

What are the potential impacts of construction traffic on roads in the north-east?

4.1 Reducing congestion in the north-east

Overview

As previously discussed, Melbourne's north-east currently experiences significant road congestion. This increases travel times, reduces the reliability of trips and impacts on accessibility for the local community. This area of interest explores how each potential corridor option reduces the severity of congestion on key roads in Melbourne's north-east. The preliminary indicators based on early analysis for this includes the forecast reduction of traffic on key roads.

Reducing congestion on the arterial road network will result in faster and more reliable journeys to work and an improvement to local amenity through a reduction in traffic noise, improvements in air quality and improvements to road safety. This also assists in improving the capability to operate public transport on these roads and can provide more opportunity for priority treatment.

Table 5 – Reducing congestion in the north-east: how the corridors perform

	Summary	Overall performance
Corridor A	Provides the potential to significantly reduce traffic and congestion in Melbourne's north-east, particularly on Rosanna Road, Lower Plenty Road east of Rosanna Road, Banksia Street and Fitzsimons Lane.	Performs very well
Corridor B	Provides the potential to reduce traffic and congestion on Banksia Street and Rosanna Road but would provide limited congestion relief to key north-south roads such as Fitzsimons Lane, Plenty Road and Burke Road.	Neutral
Corridor C	Performs well as it is expected to provide moderate reductions in traffic and congestion across the majority of key north-south roads.	Performs well
Corridor D	Does not provide a direct connection to the existing road network in the north-east, therefore unlikely to help reduce congestion. It is expected to instead provide moderate benefits for the outer eastern suburbs.	Performs poorly

Forecast reduction of traffic on key roads

Preliminary analysis indicates that each of the corridor options would provide varying levels of traffic relief on the arterial road network. This analysis focused on key roads (shown in Figure 28) in Melbourne's north-east identified by the community and stakeholders with known issues regarding amenity and traffic congestion. While the level of traffic and congestion varies along each road, the following locations were selected as reasonable indicators for the key arterial roads. Anticipated changes in daily weekday traffic at these locations for each corridor option are set out in Table 6.

Figure 28 – Key arterial roads in Melbourne's north-east

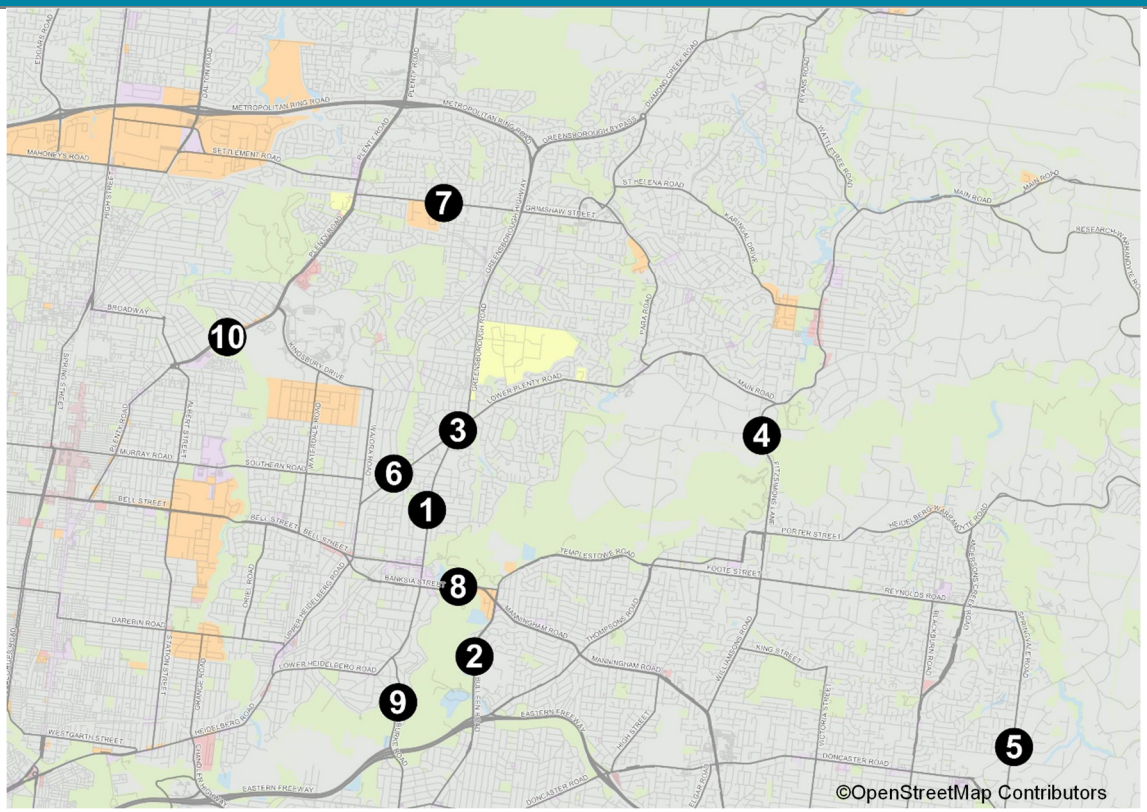


Table 6 – Estimates of potential changes in daily weekday traffic on key arterial roads in 2031 - Project case vs Base case (without the project)

	Corridor A	Corridor B	Corridor C	Corridor D
1. Rosanna Road south of Lower Plenty Road	-12,000 to -15,000	-9,000 to -12,000	-5,000 to -6,000	-500 to -1,500
2. Bulleen Road north of Eastern Freeway	-2,500 to -3,500	-4,000 to -5,000	-2,000 to -3,000	-500 to -1,500
3. Lower Plenty Road east of Rosanna Road	-17,000 to -20,000	-12,000 to -15,000	-7,000 to -8,000	-500 to -1,500
4. Fitzsimons Lane at the Yarra River	-9,000 to -11,000	-500 to -1,500	-6,000 to -8,000	-1,500 to -2,500
5. Springvale Road north of Mitcham Road	-2,000 to -3,000	3,500 to 4,500	3,000 to 4,000	500 to 1,500
6. Lower Plenty Road west of Rosanna Road	-4,000 to -5,000	-2,500 to -3,500	-1,000 to -2,000	-500 to 500
7. Grimshaw Street west of Watsonia Road	3,000 to 4,000	5,000 to 6,000	4,000 to 5,000	1,500 to 2,500
8. Banksia Street at Yarra River	-8,000 to -10,000	-10,000 to -12,000	-5,000 to -6,000	-500 to -1,500
9. Burke Road north of Eastern Freeway	-6,000 to -8,000	-1,500 to -2,500	-500 to 500	-500 to 500
10. Plenty Road at Darebin Creek	-3,000 to -4,000	-500 to 500	-500 to 500	-500 to 500

Corridor A can provide a direct alternative to congested roads in Melbourne's north-east due to good connections to the existing road network. While traffic increases are forecast on Grimshaw Street, significant reductions in traffic and congestion are expected on Rosanna Road, Lower Plenty Road east of Rosanna Road, Banksia Street and Fitzsimons Lane.

Corridor B can reduce traffic on the Eastern Freeway, Banksia Street, Rosanna Road and Lower Plenty Road but would provide limited congestion relief to key north-south roads such as Fitzsimons Lane, Plenty Road and Burke Road.

Corridor C can provide moderate reductions in traffic and congestion throughout Melbourne's north-east. Traffic volumes are expected to decrease on Rosanna Road, Bulleen Road, Lower Plenty Road, Fitzsimons Lane and Banksia Street.

Corridor D offers the fewest connections into the existing road network in Melbourne's north-east and therefore will be unlikely to help reduce congestion in the area. The corridor results in relatively few people currently travelling through Melbourne's north-east using the corridor. Moderate benefits are instead realised in the outer eastern suburbs, rather than through the congested north-eastern suburbs; as a result, the changes in traffic on the key arterial roads are negligible.

Further work to inform and shape this area of interest

These early observations are drawing on complex analytical tools such as strategic transport models. As we continue to develop our thinking and understanding of the range of issues in Melbourne's north-east, we will continue to refine the models and tools in our more detailed analysis.

Further work is being done to understand how the corridor options will impact congestion in Melbourne's north-east. This includes:

- Ongoing traffic data collection and modelling is being performed to understand the requirements for traffic movement on the M80 and the Eastern Freeway arising from connection to North East Link.
- Ongoing development of engineering solutions, to integrate with the connecting freeways (M80 and Eastern Freeway / EastLink), arterial and local road networks.
- Analysis of future trends and technologies that will impact on how and why people travel, what the vehicle fleet of the future looks like and how this might impact how roads and public transport will operate and integrate.
- Travel time and travel preference surveys and reliability research to understand travel behaviour and the effect the road will have on travel time reliability.

North East Link forms part of a wider strategy to improve movement in the north-east. Other key transport initiatives that are being considered in this context include:

- Hurstbridge rail line upgrades
- Level crossing removal project
- Mernda rail extension
- Upgrades to the local and arterial road network.

This further thinking and refinement then allows us to analyse the potential benefits that North East Link may have in reducing congestion in this region.

4.2 Getting trucks off residential roads in the north-east

Overview

The absence of alternative direct freeway or high capacity arterial road connections between industrial precincts and distribution centres in the north, east and south-east of the city has led to a number of roads abutting residential properties becoming heavy vehicle routes. Trips between locations such as Dandenong and Epping typically use the arterial road network in the north-east, travelling through residential neighbourhoods along Rosanna Road, Lower Plenty Road, Greensborough Road and Para Road.

These heavy vehicles are often in conflict with the residential or community nature of the road network, passing land uses such as residential properties, schools, community facilities and shops.

This area of interest assesses how each option can improve community amenity and safety in the north-east by reducing the number of heavy vehicles on roads used by local residents and on roads with a primarily residential land use.

Table 7 – Getting trucks off residential roads: how the corridors perform

	Summary	Overall performance
Corridor A	Best aligns with existing truck patterns in the north-east, and can accommodate the majority of freight trips, including those originating from south of the Eastern Freeway. Provides the most suitable grades in tunnels for trucks.	Performs very well
Corridor B	Accommodates some truck movements in the north-east, however does not serve trucks immediately south of the Eastern Freeway. The alignment does not meet standards and has undesirable grades for trucks along a high proportion of the route due to the topography of land.	Neutral
Corridor C	Accommodates some truck movements in the north-east, however does not serve truck origins immediately south of the Eastern Freeway. The alignment generally meets the standard for trucks except in one location, with some grade issues.	Performs well
Corridor D	Does not cater for truck movements within the north-east. Provides mostly good grades for trucks with some steep sections, however the length of route makes it less desirable than other corridor options.	Performs poorly

Heavy vehicle trip desire lines

Heavy vehicles in the north-east currently cross the Yarra River at one of five bridge crossings:

- Chandler Highway;
- Burke Road;
- Banksia Street;
- Fitzsimons Lane; or
- Kangaroo Ground-Warrandyte Road.

The crossings at Banksia Street and Fitzsimons Lane currently carry approximately 60% of all trucks travelling across the river, with moderate usage at Chandler Highway and Burke Road. Heavy vehicles

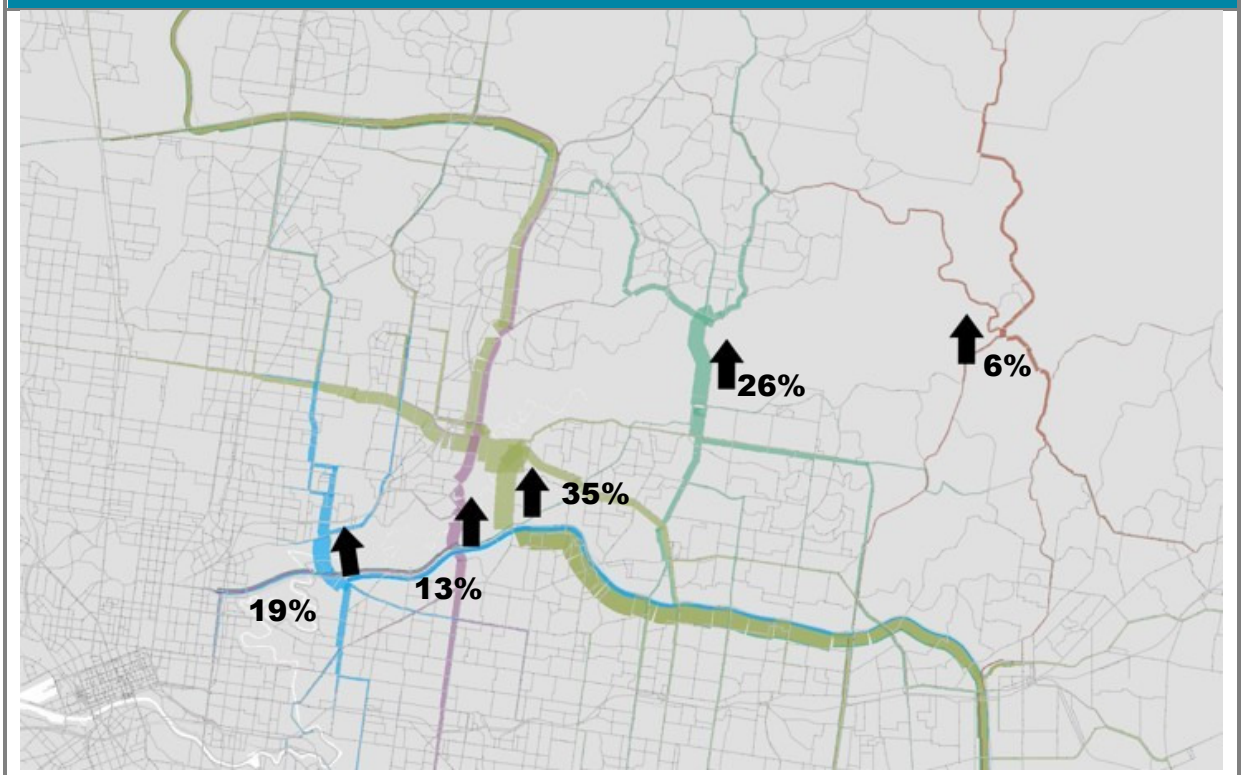
on Fitzsimons Lane comprise over 90% small trucks with larger trucks travelling down Rosanna Road to the river crossings at Banksia Street and Burke Road.

Relatively few trucks use the crossing at Kangaroo Ground-Warrandyte Road in Warrandyte. This is presented in Figure 29. The various colours in this figure represent the routes that the truck trips take prior to and after the river crossing point.

For example, it can be seen that for the trucks using Chandler Highway (the blue lines), there is a proportion that have come from the Eastern Freeway, with a proportion of these trucks also having used EastLink. However, there is a large proportion that have come from south of the Eastern Freeway along roads such as Princess Street.

When Burke Road is considered (the purple lines), the majority have come from Burke Road south of the Eastern Freeway. At Banksia Street, there is a split of origins of these truck trips; some originate back along EastLink, while many others join from the various arterial roads south of the Eastern Freeway.

Figure 29 – Existing truck movements across the Yarra River



Source: VLC Zenith Model – Preliminary modelling for North East Link and NELA Traffic Survey 2017

These travel patterns for truck trips through this area are an important consideration when assessing the potential for each corridor option to accommodate truck trips through the north-east, and thereby providing relief for the residential roads.

Corridor A provides the greatest opportunity to capture truck traffic from the south of the Eastern Freeway that currently use the crossings at Burke Road, Banksia Street and Fitzsimons Lane, while also capturing trucks that use Chandler Highway and the Eastern Freeway.

Corridors B and C are located further east, and as such would provide limited opportunity to capture the truck traffic directly south of the Eastern Freeway that use the Chandler Highway, Burke Road and Banksia Street crossings. The trips that currently use EastLink, which is a proportion of the Chandler Highway, Banksia Street and Fitzsimons Lane bridge crossings, have potential to use Corridors B and C, however this is a limited catchment when compared to Corridor A. These corridor options provide some limited potential to remove truck traffic from residential streets.

Corridor D is located the furthest east, and is in close proximity to the current crossing in Warrandyte. Only 6% of all trucks currently crosses the river at this location. It is very unlikely that Corridor D will cater for many truck movements through the north-east.

Likely truck usage

Connections through the north-east provide crucial access between key freight destinations in Melbourne, Victoria and Australia, linking regional areas such as Gippsland and industrial areas, freight gateways and distribution centres in the south-east (such as Dandenong) with the Hume Freeway and Melbourne Airport to facilitate interstate and international exports.

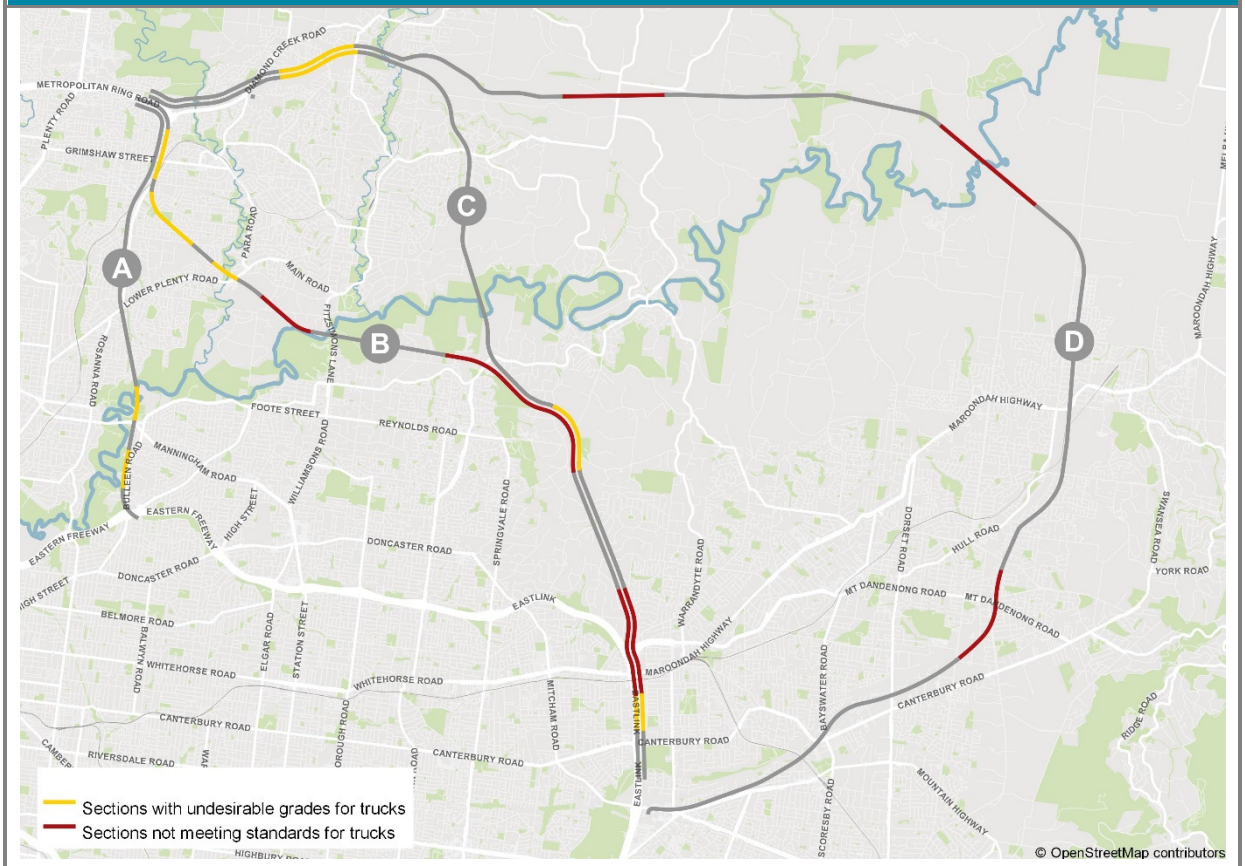
North East Link will only be successful in removing trucks from residential roads in the north-east if the new link provides an attractive alternative to the current arterial road network. Freight operators often base routes on a combination of travel time, distance, reliability, suitability for trucks and vehicle operating costs.

One major factor that affects most of those metrics is the steepness of the road. Depending on the terrain and along each alignment, some tunnels will likely be long and steep, which will significantly increase fuel consumption and slow trucks down, sometimes to below 40 km/hr which impacts on the performance of the road for other traffic and introduces potential safety issues. Trucks climbing at steep and extended grades also places additional strain on the vehicle and increases operating costs. These factors reduce the attractiveness of some of corridors, and as a result it is likely that some freight operators will instead opt to continue using the arterial road network.

Sections of each corridor that may be an issue for trucks are presented in Figure 30. The sections highlighted in yellow show lengths of the alignment that have undesirable grades for trucks, while sections in red show areas where minimum standards for trucks are not met. These have been determined based on the concept design of the corridors needing to cross the Yarra River in tunnel and connect to the existing road network, while avoiding urban and environmentally significant areas.

Also of importance to the efficiency of the freight task is the ability of the freight industry to utilise High Productivity Freight Vehicles (HPFVs), reducing vehicle costs and the number of freight trips required. Lack of continuous access for these vehicles across the north-east and high levels of congestion are reducing freight industry competitiveness. North East Link will play an integral role in facilitating interstate line haul through the north-east and a link that is attractive for these vehicles will link Melbourne's freeway network and assist in reducing the overall volume of trucks needed to undertake the growing freight task.

Figure 30 – Attractiveness of each corridor option for trucks



Corridor A provides for the most suitable grades within the tunnel, with the entire length meeting standards for trucks and only two short sections that have potentially undesirable grades for trucks; this means that trucks can maintain their speed for most of the route. This assists in reducing operating costs, making the more route desirable than other options. Trucks are likely to divert away from the arterial road network, reducing the number of trucks along residential roads in the north-east.

Corridor B has extended sections of steep tunnel grades, resulting in reduced speed for trucks and increased operating costs. Three long sections of the alignment do not meet standards for trucks and four other sections have undesirable grades for trucks.

Corridor C has only one section that does not meet standards for trucks, but three sections that have undesirable grades. While this corridor option generally has better grades than Corridor B, these undesirable sections, combined with the length of the corridor option, reduces its attractiveness to trucks.

Corridor D mostly provides good grades for trucks, but still has three sections that do not meet the standards for trucks and one section with potentially undesirable grades. Overall, the long length of the corridor option and these grade issues make it unattractive to trucks.

Further work to inform and shape this area of interest

Further work is being done to better understand the impact North East Link may have on truck movements in Melbourne's north-east, including:

- Refinement of the traffic modelling to better estimate the number of trucks remaining on local roads following construction of North East Link
- Investigating the outcomes and key learnings of the recent trial of the truck bans in Melbourne's north-east
- Analysis of future trends and technologies that will impact on freight trips such as the use of autonomous trucks, the increasing usage of on-line shopping and just in time delivery.
- Truck surveys to better understand truck origin-destination movements and volumes throughout the north-east
- Consultation with the freight and logistics industry and community groups to understand issues in the area and future freight needs
- Further development of the strategic traffic model to replicate the complex truck trip patterns in the area.

Additional and more refined analysis and research will allow NELA to further analyse the potential benefits provided by North East Link in removing freight movements from residential roads in the north-east.

4.3 Connecting more people to jobs and education

Overview

This area of interest has been assessed by identifying how each corridor option will provide the opportunity to facilitate greater access for residents to employment clusters and activity centres located in the north, east and south-east. The preliminary indicator based on early analysis for this include the ability of the options to improve accessibility to employment and education opportunities.

Ability to access jobs and broad range of services such as education opportunities is essential to improve socio-economic outcomes, support social sustainability and drive economic growth for communities in the region. Inability of residents to access these opportunities will mean higher costs for households (such as higher travel times for residents) or restrict households' access to quality jobs or particular types of job and education opportunities.

Table 8 – Connecting more people to jobs and education: how the corridors perform

	Summary	Overall performance
Corridor A	Connects residents in the north-east to local employment rich areas such as La Trobe and West Heidelberg. Improves connectivity to tertiary education opportunities around La Trobe University and Royal Melbourne Institute of Technology in Bundoora.	Performs well
Corridor B	Provides accessibility for residents in the north-east to employment clusters such as La Trobe and further down to Monash and Dandenong. Performs well in connecting residents to tertiary education opportunities in the north-east.	Performs well
Corridor C	Provides accessibility for residents in the north-east to employment areas in the north-east and to some extend the south-east. Performs well connecting residents to tertiary education opportunities in the north-east.	Performs well
Corridor D	Provides only marginal improvement to connect people to jobs and provides little benefit to students seeking access to education opportunities. Overall it is likely to improve accessibility for areas with low population densities outside the Urban Growth Boundary.	Performs very poorly

Improved accessibility to employment and education opportunities

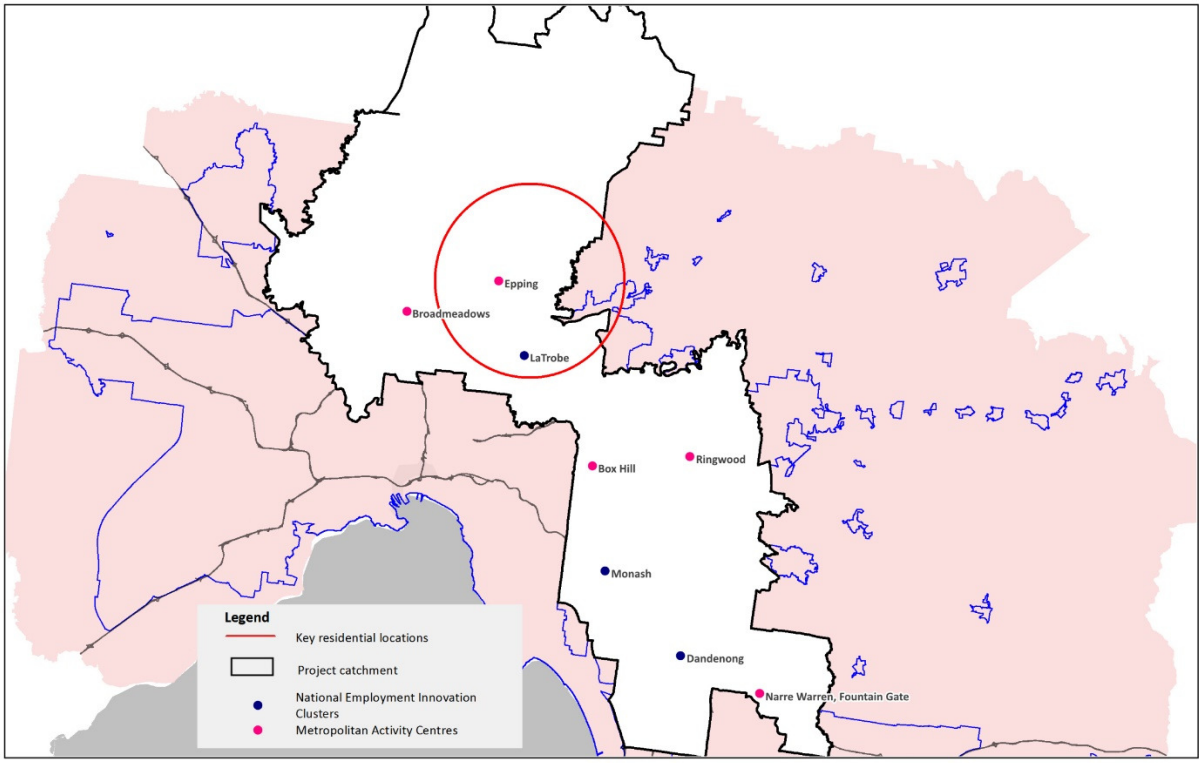
This indicator assesses how each corridor may provide the opportunity to better connect residents in Melbourne's north-east to employment and education opportunities in the north, east and south-east.

Each of the corridor options was analysed in terms of its potential to impact on accessibility to employment and education for key residential locations, which were identified as being significantly impacted by conflicting local and strategic orbital movements between the M80 and Eastern Freeway / EastLink.

The potential changes in accessibility to employment and education opportunities for each of the corridor options were identified by comparing the difference in the number of jobs within a 45 minute car travel time radius from a given location. This information is based on early transport modelling of the base case (the situation without the project) and an indicative project case for each corridor option.

The key residential locations, National Employment and Innovation Clusters and Metropolitan Activity Centres identified for this assessment are depicted in Figure 31.

Figure 31 – Residential locations analysed



Indicative accessibility changes arising from each corridor option are summarised in Table 9.

Table 9 – Potential change in car accessibility to jobs and education in 2031 – Project case vs Base case (without the project)

	Corridor A	Corridor B	Corridor C	Corridor D
Additional jobs accessible in key residential locations	65,000 – 75,000	65,000 – 80,000	85,000 – 100,000	45,000 – 55,000
Additional education places accessible in key residential locations	11,000 – 13,000	3,000 – 4,000	6,000 – 7,000	<2,000

The potential change in household accessibility to jobs is relatively comparable for residential locations analysed across Corridors A, B and C.

Due to changes in accessibility, each of the proposed corridor options for North East Link have the potential to increase property demand in residential areas where household accessibility gains are most prominent. Corridors B, C and D are likely to create development pressures in areas further east (e.g. Warrandyte, Lilydale) and in areas outside the Urban Growth Boundary.

Corridor A is estimated to perform well in connecting households in Melbourne's north-east to employment clusters around La Trobe, Heidelberg and West Heidelberg industrial hubs and to some extent Box Hill and Ringwood. Corridors B and C are estimated to perform marginally better as these options better connect households in Melbourne's north-east, such as Greensborough, Rosanna and Eltham, to Monash and Dandenong employment clusters in the south-east, but access will potentially be widely dispersed along the corridors. Corridor D shows a significantly lower potential change in accessibility to jobs as it extends into areas with low population densities.

In terms of each corridor option's impact on accessibility to tertiary education opportunities, Corridor A has the most significant impact on connectivity into the La Trobe University and Royal Melbourne Institute of Technology campuses in Bundoora. Corridor D is estimated to provide very limited improvement to access to tertiary education opportunities.

Further work to inform and shape this area of interest

Further work is being done to understand how the corridor options can facilitate better access to jobs and education opportunities for residents and households in Melbourne's north-east. This includes:

- Refining the assumptions included in the traffic modelling to better estimate the traffic demand and conditions during peak hours following the construction of North East Link
- Further data gathering on population and employment in Melbourne's north-east, including local strategies and business plans that might impact future employment growth
- Investigating the potential of the corridor options to improve public transport accessibility to jobs and education for residents who are public transport users
- Sensitivity analysis to better understand how variance from predicted forecasts might impact population, employment and land use in Melbourne's north-east
- Investigating the potential for the corridor options to support local and State's strategic land use policies and plans such as Plan Melbourne.

This additional and more refined work will allow NELA to further analyse the potential benefits provided by North East Link in improving access to jobs and education opportunities.

4.4 Connecting businesses

Overview

This area of interest has been assessed by identifying how each corridor option will potentially improve business access and growth in Melbourne's north, east and south-east. The preliminary indicator based on early analysis for this include the ability of the options to connect businesses to potential workers i.e. labour market accessibility.

This indicator was selected because they indicate the interconnectivity of businesses in the north-east, as well as the ability of businesses to attract workers.

Table 10 – Connecting businesses: how the corridors perform

	Summary	Overall performance
Corridor A	Delivers significant gains in accessibility to potential workers for the key employment clusters such as La Trobe and metropolitan activity centres such as Epping and Ringwood	Performs very well
Corridor B	Delivers some improvement in labour market accessibility to businesses in metropolitan activity centres such as Ringwood and Box Hill but reduction in accessibility for businesses in key employment clusters such as La Trobe, Monash, Epping and Dandenong.	Performs well
Corridor C	Delivers some improvement in labour market accessibility to businesses in metropolitan activity centres such as Ringwood and Box hill but limited improvement to key employment clusters such as La Trobe, Monash, Epping and Dandenong.	Performs well
Corridor D	Performs very poorly as it is estimated to deliver some labour market accessibility improvement to areas outside of the Urban Growth Boundary that are not identified for future commercial activity.	Performs very poorly

Connecting businesses to potential workers

Access to a pool of labour with skills matching the needs of employers is a key factor in the location decisions of businesses. Further, bringing jobs closer to workers generates important benefits, including reductions in vehicle kilometres travelled, fuel consumption and congestion, with increases in earnings and productivity and improved community health, safety and living standards.

An indicative change in business accessibility to workers was calculated by comparing the difference in the number of workers within a 35 minute travel time by road between key business locations in Melbourne's north-east, based on preliminary modelling results of the base case (without the project) and an indicative project case representative of each corridor option. The 35 minute travel time 'catchment' is based on analysis showing that the willingness to travel beyond this timeframe diminishes significantly for workers travelling to middle and outer suburban employment locations. The analysis is provided in Table 11 below.

Table 11 – Potential change in business accessibility to workers in 2031 - Project case vs Base case (without the project)

	Corridor A	Corridor B	Corridor C	Corridor D
Additional workers accessible to firms within key National Employment and Innovation Clusters and Metropolitan Activity Centres	8,500 – 10,500	2,000 - 2,600	5,100 – 6,200	5,800 – 7,200*

**Note: outside the Urban Growth Boundary*

All corridors have the potential to deliver a net gain in accessibility for the employment clusters and activity centres considered together.

In particular, Corridor A is expected to provide the most significant gains in accessibility to the La Trobe NEIC.

Both Corridors A and B provide increased opportunities for growth in business activity resulting from labour force accessibility gains relating to North East Link. Specific opportunities would be likely to arise around La Trobe and Epping. Corridor C provides opportunities further east and in areas outside the Urban Growth Boundary, where businesses are unlikely (or unable due to planning restrictions) to set up or relocate.

While there is limited data for Corridor D, preliminary modelling shows that the option has the potential to provide considerable improvements to labour force accessibility; however, much of this improvement is to areas outside of the Urban Growth Boundary with limited existing or planned commercial activity.

Further work to inform and shape this area of interest

Further work is being done to understand how the corridor options will improve connectivity for businesses to workers and other businesses. This includes:

- Refining the assumptions included in the traffic modelling to better estimate the traffic demand and conditions during peak or inter-peak hours following construction of North East Link
- Consultation with local business groups to understand issues in the area and local strategies and business plans that might impact future employment growth
- Investigating the potential of the corridor options to improve public transport accessibility between key employment locations and connectivity for businesses in Melbourne's north-east to potential workers
- Investigating the potential for the corridor options to support local and State's strategic land use policies and plans such as Plan Melbourne
- Developing analysis on the potential reduction in travel times and improvement in travel time reliability for business trips.

Additional and more refined analysis will allow NELA to further analyse the potential benefits delivered by North East Link in providing greater connectivity for businesses.

4.5 Making freight move more efficiently

Overview

The movement of freight goods, including fruit and vegetables, livestock, machinery, construction materials and consumer products, underpins the everyday operations and expenses of small businesses and households across Victoria. A more efficient freight network means lower transportation costs to supermarkets and other suppliers, and lower prices to households.

To estimate the potential for each identified corridor option to improve freight access and growth in Melbourne's north, east and south-east, the preliminary indicators based on early analysis include:

- Heavy commercial vehicle travel time savings
- Improving access for placarded and over-dimensional (OD) freight loads.

These preliminary indicators will provide the network performance between freight distribution centres, industrial precincts and the broader project catchment. Each of these indicators has been linked empirically to freight productivity.

Also a key indicator for improving freight efficiency is the design of the road and the ability for trucks to travel at speed. As discussed in section 4.2, the potential gradelines of each option will be a key factor in making a route attractive to heavy vehicles and achieving efficiency for trips along a corridor.

Table 12 – Making freight move more efficently: how the corridors perform

	Summary	Overall performance
Corridor A	Expected to deliver significant travel time improvement between key freight locations in the north-east. Some potential for integration with the over-dimensional load and placarded load networks.	Performs well
Corridor B	Expected to deliver modest travel time improvement between key freight locations in the north-east. The corridor does not provide for over-dimensional or placarded loads.	Performs poorly
Corridor C	Expected to deliver modest travel time improvement between key freight locations in the north-east. The corridor does not provide for over-dimensional or placarded loads.	Performs poorly
Corridor D	Does not provide a direct connection between many of the industrial precincts in the area. The corridor does not integrate with the over-dimensional load or placarded load networks.	Performs very poorly

Heavy commercial vehicle travel time savings

The travel times of heavy commercial vehicles (HCVs) are key to the productivity of the freight industry and are critical considerations in the route selection of vehicles. The freight industry will often select the quickest route, as this will assist in minimising operating costs.

The change in travel times between the Monash Freeway-EastLink interchange and the Greensborough Bypass-M80 interchange has been used as a proxy, as this route (or portions of this route) will be used for journeys by a number of the industrial precincts within Melbourne's north-east. This route is also the most likely alternative for the freight trips across Melbourne that do not

use the M1. Further, the selection of this route is considered a reasonable basis upon which to assess the four corridor options.

Each of the corridors provides varying forms of connectivity to the arterial road network; however, all provide a reasonable connection between the freeway network being used as the basis for this assessment. The key difference is the use of the Eastern Freeway for Corridor A.

To undertake the assessment, several factors were considered: the length of the route, the forecast traffic on the route and the vertical constraints present on the route. This last point is very important for trucks. The effect of steep grades is a critical factor for the freight industry as it can result in significantly reduced speeds and additional strain on the freight vehicle in climbing the incline. While only preliminary at this stage, the current assessment indicates that Corridors B, C and D are likely to contain long lengths of undesirable steep incline grades, while Corridor A is likely to have some short sections of steep grades.

Using this information, combined with a knowledge of the undulating topography of the area, the preliminary travel time savings for the M1 to M80 route are presented in Table 13 below.

Table 13 – Estimated travel time savings between M1 and M80 in 2031 - Project case vs Base case (without the project)

	Corridor A	Corridor B	Corridor C	Corridor D
Change in travel time (M1 to M80)	16-19 min	8-9 min	10-12 min	7-8 min

Corridor A can provide an upgraded Eastern Freeway and direct connection to the M80. The potential grades within tunnels is the most suited to trucks of all the corridors.

Corridor B is likely to have long tunnel sections, as is Corridor C. The grades for both Corridors B and C have extended steep sections, which results in slower operating speeds and longer travel times.

Corridor D has the longest length of approximately 40 kilometres. It is also expected to require significant tunnel length to avoid sensitive areas. This extended length compared to the other corridors has an impact on the overall travel time savings. Additionally, Corridor D does not provide a direct connection between many of the industrial precincts in the area.

Improving access for placarded and over-dimensional (OD) loads

While a focus of North East Link is removing trucks from arterial roads, there is a limitation with respect to the movement of dangerous goods. While some road tunnels overseas have been designed to accommodate placarded loads, no tunnel in Victoria currently permits the running of such vehicles. Current volumes of placarded loads travelling through the north-east have been identified, as outlined in Table 14.

Table 14 - Placarded vehicle numbers 10 am – 2 pm

Road	Total truck volume	Number of placarded vehicles	Percentage placarded vehicles
Fitzsimons Lane at Yarra River	518	3	0.5%
Plenty Road at Darebin Creek	266	4	1.5%
Lower Plenty Road at Rosanna Road	1,092	14	1.3%
Total	1,876	21	1.1%

Source: NELA Traffic Survey 2017

North East Link has potential to remove placarded and OD vehicles from the local road network, unless they have local destinations such as service stations, supermarkets or businesses. The options can potentially remove large vehicles from residential roads and improve the operation of these roads due to the removal of slow vehicles.

To understand the potential for each option to cater for placarded and over-dimensional vehicles, it has been assumed that sections of tunnel cannot accommodate a vehicle carrying dangerous goods. The analysis of how each option can accommodate placarded and over-dimensional loads is summarised in Table 15.

Placarded vehicles will be required to travel on a suitable existing road network to divert around any section of tunnel on each of the corridors. Their ability to do this will depend upon the types of roads available for these vehicles to use.

Over-dimensional vehicles are restricted to defined routes due to their size. These vehicles are wider than standard vehicles and can only use certain roads. OD vehicles can often be at odds with general traffic due to their size and speed. Some of the existing OD routes within Melbourne's north-east are along residential roads, which means these vehicles also clash with local traffic movements and residential access.

Table 15 – Classification results: potential ability to cater for placarded loads (based on current minimum tunnel lengths for each corridor)

	Corridor A	Corridor B	Corridor C	Corridor D
Ability to carry placarded loads	Can use the corridor between the M80 and Lower Plenty Road.	Cannot accommodate placarded loads	Cannot accommodate placarded loads	Can use the corridor between the M80 and Kangaroo Ground; however, no connectivity from Kangaroo Ground
Ability to carry over-dimensional loads	Can use the corridor between the M80 and Lower Plenty Road.	Over-dimensional vehicles cannot use the corridor	Over-dimensional vehicles cannot use the corridor	Can use the corridor between the M80 and Kangaroo Ground; however, there are no over-dimensional routes in this area

Corridor A has the potential to allow placarded loads to travel between the M80 and Lower Plenty Road. From here, placarded vehicles would travel along Rosanna Road, Banksia Street and Bulleen Road to connect to the Eastern Freeway. Corridor A has the potential to provide the best opportunity to remove placarded trucks from residential roads within Melbourne's north-east. Corridor A is the only corridor that has full integration with the existing over-dimensional routes.

OD vehicles could use Corridor A between the M80 and Lower Plenty Road. From there, OD vehicles could use OD Route 1, which runs along Rosanna Road, Manningham Road and Bulleen Road to access the Eastern Freeway.

Corridors B and C would not be able to carry placarded loads due to their extensive use of tunnels. This would mean that placarded trucks would continue to use the same residential roads as they currently use. Corridors B and C will not be able to accommodate OD vehicles due to the significant lengths of tunnel. This would mean that OD vehicles would continue to travel along residential roads.

Placarded loads could use Corridor D from the M80 to Kangaroo Ground; however, once at Kangaroo Ground there are limited suitable routes for these vehicles to reconnect to the arterial road network. At the southern end, placarded loads could travel along Corridor D from EastLink to Mt Dandenong Road; however, they would need to back-track to reconnect to the main arterial road network.

Corridor D may be able to accommodate OD vehicles from the M80 to Kangaroo Ground and from EastLink to Mt Dandenong Road; however, none of these locations connect to the existing OD network. This prevents the use of Corridor D for OD vehicles, meaning that these vehicles will continue to travel along residential roads.

Further work to inform and shape this area of interest

More work is being done to understand the impact of the potential corridor options on the efficiency of freight and supply chain networks, including:

- Consultation with the freight and logistics industry to understand:
    - Changes in freight accessibility to key freight areas
    - Freight fleet requirements
    - Freight travel time reliability
- Further engineering work to better define the details of corridor grades and their impacts on traffic flow and freight costs
- Analysis of future trends and technologies that will impact on freight trips such as the use of autonomous trucks, the increasing usage of on-line shopping and just in time delivery.

North East Link is also part of a broader strategy to improve the productivity of freight networks, with other complementary works including the West Gate Tunnel project, the widening of the M80 and the provision of managed motorways systems on the M80 and EastLink. The combined impact of these works and North East Link will need to be taken into account.

4.6 Improving public transport connections and travel times

Overview

This area of interest considers how each corridor option provides the opportunity for improving public transport in Melbourne's north-east. The preliminary indicators based on early analysis for this area include:

- Improving public transport services
- Providing greater public transport priority.

Improving public transport connections and travel times can encourage more people to leave their cars at home, reducing congestion on roads within Melbourne's north-east.

Table 16 – Improving public transport connections: how the corridors perform

	Summary	Overall performance
Corridor A	High potential for public transport priority on the Eastern Freeway and public transport services along the project corridor. Provides the best opportunity to enable greater priority for existing bus services on the arterial road network through the largest traffic reductions on routes used by buses.	Performs very well
Corridor B	Potential for public transport services along the project corridor. Reduces traffic volumes on some key roads, but increases traffic volumes on other roads used by public transport services.	Neutral
Corridor C	Potential for public transport services along the project corridor. Reduces traffic volumes on key roads, allowing for improved services, but not as much as Corridor A.	Performs well
Corridor D	Limited opportunity for public transport improvements or improvements to public transport services in the north-east.	Performs poorly

Improving public transport services

The project has the potential to enable the creation of new public transport services or enhance existing routes within the corridor. Initial stakeholder consultation has indicated that the potential for enhancing the Doncaster Area Rapid Transit (DART) bus services along the Eastern Freeway is a high public transport priority in Melbourne's north-east.

Corridor A would provide the best opportunity to enable greater priority for existing bus services on the arterial road network through the largest traffic reductions on routes used by buses. The upgrade to the Eastern Freeway also provides the opportunity to provide more dedicated DART bus lane facilities along the length of the freeway.

Corridors B and C have some potential for public transport network upgrades, improving connections between residents and employment. However, Corridor B has slightly more opportunity to improve connections to key locations, with its corridor connecting to more populated areas compared to Corridor C.

Corridor D has limited opportunity for public transport improvements given its corridor is away from residential areas and limited connectivity to employment locations.

Corridors A and B have the slight added benefit of providing improvements to access and car parking at Watsonia railway station. Additionally, Corridor A is located the closest to the La Trobe NEIC, which provides opportunities to deliver express bus services along the corridor to service the cluster, which currently has relatively poor public transport access.

This analysis is summarised in Table 17.

Table 17 – Classification results: potential for public transport on the new road

	Corridor A	Corridor B	Corridor C	Corridor D
Potential for public transport on the new road	Potential public transport priority on the Eastern Freeway and public transport services along the project corridor	Potential for public transport services along the project corridor	Potential for public transport services along the project corridor	Limited opportunity for public transport improvements

Providing greater public transport priority

This assessment investigated the ability for each corridor option to enhance existing public transport services on the arterial road network. This can be achieved by reducing traffic on arterial roads currently used by bus services. A reduction in traffic volumes can either improve travel times for buses by reducing congestion along a route or provide the ability to prioritise public transport at intersections. A reduction in traffic on one road may also give the ability to give additional green time at an intersection to a cross road that has bus services.

This assessment has focused primarily on the impact to the high patronage SmartBus network in Melbourne's north-east, with a lower focus on the suburban bus network. This is due to the significant number of passengers carried by the SmartBus service every day. It also provides an orbital service, connecting communities over longer distances.

Corridor A can provide the best opportunity to enable greater priority for existing bus services on the arterial road network through the largest traffic reductions on routes used by buses. Significant decreases in traffic are expected on Fitzsimons Lane (bus routes 901 and 902), Para Road (bus routes 901 and 902) and Banksia Street (route 903).

Corridor B can provide improvements to the public transport network, with some reductions in traffic volumes allowing for improved services. Significant decreases in traffic are expected on Para Road (route 901 and 902) and Banksia Street (route 903), however, this corridor option also increases traffic significantly on some roads, potentially impacting other services.

Corridor C can reduce traffic volumes on key roads, allowing for improved services, but not as much as Corridor A. Significant decreases in traffic are expected on Para Road (route 903). It also potentially services a lower number of residents compared to Corridors A and B.

Corridor D does not provide any opportunity for improvements to public transport services in the north-east as it has minimal reductions on key roads and poor connectivity to residential areas.

Table 18 – Classification results: change in traffic volumes on bus routes in the north-east

	Corridor A	Corridor B	Corridor C	Corridor D
Change in traffic volumes on bus routes in the north-east	Major positive impact	Neutral	Moderate positive impact	No benefit

Further work to inform and shape this area of interest

Further work is being done to undertake these assessments, particularly in relation to how the project corridor options will influence the behaviour of the transport network for public transport. Some of this additional analysis and work includes:

- Defining accessibility improvements using additional sources of data
- Working with local councils, the Level Crossing Removal Authority (LXRA), Public Transport Victoria (PTV) and Transport for Victoria (TfV) to determine ways to integrate potential North East Link public transport initiatives with existing and future projects and more broadly with the Transport Network Development Strategy
- Identifying options for public transport priority on North East Link and feeder arterial roads and investigating the impact of these complementary initiatives
- Investigating the desired future for the public transport network and future routes, including access to the La Trobe NEIC and other key activity centres in Melbourne's north-east
- Investigating the potential for improving public transport priority along the Eastern Freeway and priority treatments at freeway interchanges where Corridor A interfaces
- Investigating the potential for improving connectivity to train stations and bus stops, which may be achieved through the reduction of general traffic on roads across the north-east.

This additional work will allow NELA to further analyse the potential benefits provide by North East Link in improving public transport connections and travel times.

4.7 Improving connections for pedestrians and cyclists

Overview

The corridor options have the potential to improve walking and cycling networks in Melbourne's north-east, increasing accessibility to activity centres and completing the missing links in Melbourne's Strategic Cycling Corridors network.

While roads are typically seen as severing communities and being barriers to movement, North East Link offers an opportunity to provide new and upgraded walking and cycling infrastructure that will improve accessibility to activity centres, schools and community facilities. This would help to advance the concept of a '20-minute neighbourhood', in line with the goals of Plan Melbourne.

This analysis has focused on potential walking and cycling paths or trails that each of the corridors may be able to provide to benefit communities in Melbourne's north-east.

Table 19 – Improving walking and cycling connections: how the corridors perform

	Summary	Overall performance
Corridor A	Provides the most opportunity to improve existing and new walking and cycling connections in Greensborough, Watsonia, La Trobe, Diamond Creek and Heidelberg.	Performs very well
Corridor B	Offers some opportunity improve cycling connections in activity centres such as Greensborough, Diamond creek and Watsonia.	Performs well
Corridor C	Delivers some opportunity to provide shared use paths and on-road connections to connect activity centres such as Eltham, Diamond Creek and Greensborough.	Performs well
Corridor D	Offers limited opportunity to improve cycling connections and does not improve walking and cycling connections into key activity centres in the north-east.	Neutral

Potential to better connect with existing pedestrian and cycling routes

A high-level review has been undertaken of walking and cycling network gaps and issues in Melbourne's north-east. Opportunities to provide walking and cycling infrastructure to improve access identified in Figure 32, which also highlights the gaps in the current network.

Each corridor's ability to provide the identified potential shared use paths and cycling facilities is presented in Table 20.

Figure 32 – Potential walking and cycling improvements in the north-east

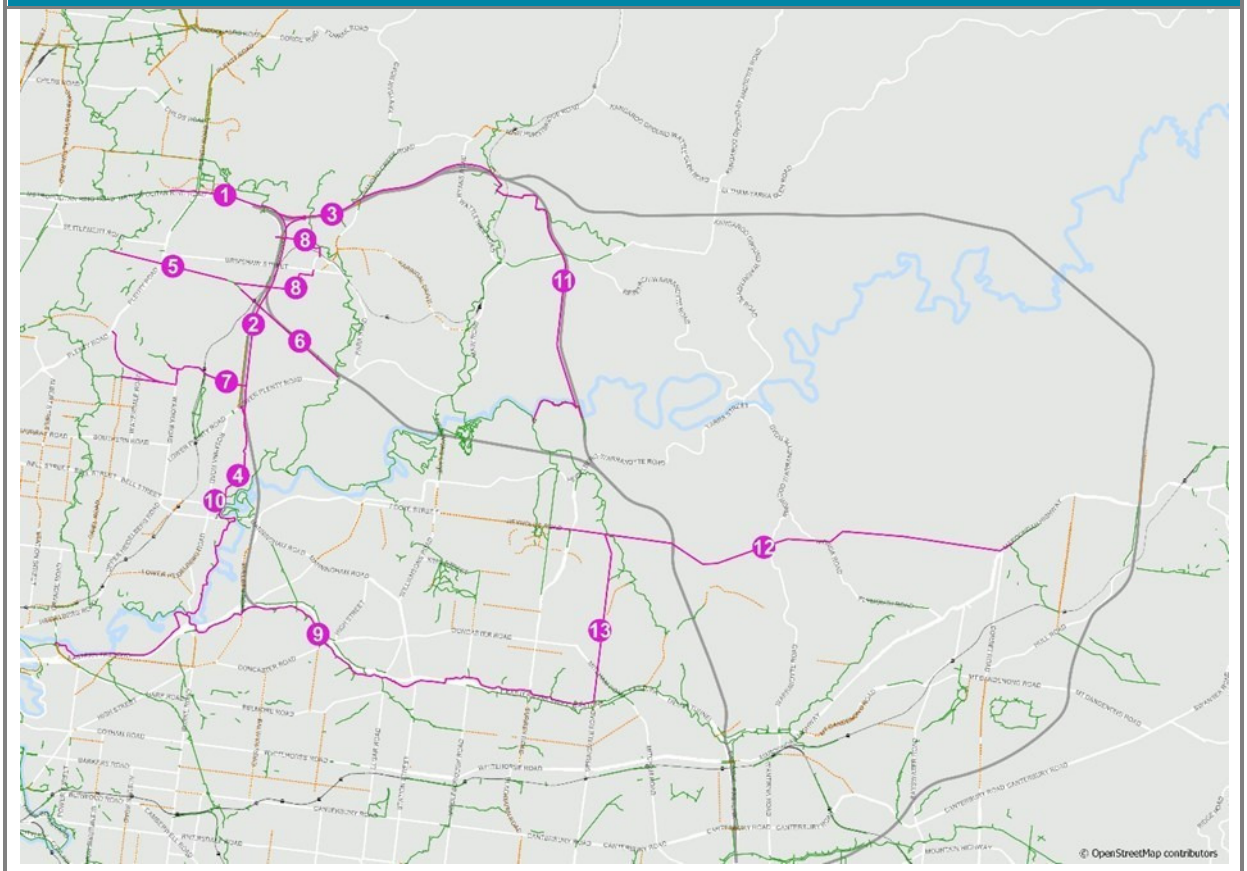


Table 20 – Potential walking and cycling improvements

No.	Description	Improves accessibility to north-east activity centres	Does the Corridor provide the opportunity for this link?			
			Corridor A	Corridor B	Corridor C	Corridor D
1	Upgraded M80 trail from Greensborough Bypass to Plenty Road	Yes	Yes	Yes	Yes	Yes
2	Complete missing link on Greensborough Road, including upgrade of the Greensborough Road trail	Yes	Yes	Yes	No	No
3	Extension of the M80 trail east of Greensborough Road	Yes	Yes	Yes	Yes	Yes
4	Upgrade of River Gum Walk trail	Yes	Yes	No	No	No
5	Completion of Transmission Line Linear Reserve trail west of Greensborough Road to Darebin Creek Trail	Yes	Yes	Yes	No	No
6	Completion of Transmission Line Linear Reserve east of Greensborough Road to Lower Plenty Road and Plenty River Trail	Yes	Yes	Yes	No	No

No.	Description	Improves accessibility to north-east activity centres	Does the Corridor provide the opportunity for this link?			
			Corridor A	Corridor B	Corridor C	Corridor D
7	New connections to La Trobe University	Yes	Yes	No	No	No
8	On-road cycling upgrades to Greensborough	Yes	Yes	Yes	Yes	Yes
9	Widening and upgrade of the Koonung Creek Trail (Eastern Freeway)	No	Yes	No	No	No
10	New connections into Heidelberg	Yes	Yes	No	No	No
11	New shared use path between the M80 Trail and the Main Yarra Trail	No	No	No	Yes	No
12	New shared use path along Reynolds Road extension	No	No	Yes	Yes	No
13	New shared use path along upgraded Springvale Road	No	No	Yes	Yes	No

Corridor A offers more opportunity to improve walking and cycling connections for people in Melbourne's north-east than other corridors, including opportunities for new shared use paths. This corridor presents the opportunity to improve connections to Greensborough, Watsonia, La Trobe University, Diamond Creek and Heidelberg, including strengthening the existing cycling corridor along the Eastern Freeway which services the eastern suburbs.

Corridor B offers some opportunity to improve cycling accessibility to activity centres in Melbourne's north-east. New connections can be provided into Greensborough, Diamond Creek and Watsonia.

Corridor C offers some opportunity to improve cycling accessibility to communities in Melbourne's north-east. Potential paths include shared use paths and on-road facilities to connect to Eltham, Diamond Creek and Greensborough.

Corridor D offers very limited opportunity to improve cycling accessibility to communities in Melbourne's north-east. While it may be possible to build a shared use path along the length of the corridor, this will not connect into metropolitan or major activity centres and is more likely to be a recreational trail.

Proposed path and trail enhancements will be undertaken in the context of the Northern Regional Trails Strategy.

Further work to inform and shape this area of interest

Work is continuing for these assessments, particularly in relation to how the project corridor options will influence the behaviour of the transport network for active transport. Some of this additional analysis and work includes:

- Seeking and incorporating further input from the community
- Working with local councils, the Level Crossing Removal Authority (LXRA), Public Transport Victoria (PTV) and Transport for Victoria (TfV) to determine ways to integrate potential North East Link active transport initiatives with existing and future projects and more broadly with the Network Development Strategy
- Investigating the desired future for the public transport and active transport network and future routes, including access to the La Trobe NEIC and other key activity centres in Melbourne's north-east
- Exploring opportunities to improve existing cycling facilities
- Consulting with the community and with key stakeholders such as Bicycle Network, local councils and community groups and incorporating their feedback
- Developing shared use path design options.

This additional work will allow NELA to further analyse the potential benefits provided by North East Link in improving road safety, general amenity and connections for pedestrian and cyclists in Melbourne's north-east.

4.8 Ability to protect the environment, culture, heritage and open spaces

Overview

This measure assesses how each corridor option performs in terms of its ability to protect the environment, culture, heritage and open spaces in the north-east. This can be achieved by considering:

- Potential impacts on areas of high ecological value
- Potential impacts on cultural and historic heritage
- Potential impacts on areas of sensitive landscape character
- Potential impacts on open spaces and recreation areas.

Each of the four corridor options is likely to have some impact; however, the extent of sensitive areas varies between the corridors.

Available databases, registers and previous reports have been reviewed to provide an initial view of areas of sensitivity. Field surveys have commenced to verify this information and fill any gaps in this data.

Table 21 – Protecting the environment, culture, heritage and open spaces: how the corridors perform

	Summary	Overall performance
Corridor A	Offers opportunities to protect areas of high ecological value, sensitive landscapes and areas with cultural heritage and historical significance, particularly the Banyule Flats and the Yarra River through tunnelling, but will potentially involve some environmental impacts associated with surface works in other areas.	Neutral
Corridor B	Provides opportunities to protect sensitive areas including the Yarra River by tunnelling, however the option may potentially impact on land with greater ecological value and landscape sensitivity.	Performs poorly
Corridor C	Offers some opportunities to protect sensitive areas including the Yarra River by tunnelling however surface works will impact on land with ecological value and sensitive landscapes.	Performs poorly
Corridor D	Offers opportunities to protect sensitive areas including Bend of Islands by tunnelling but surface works will have considerable impacts on areas of high ecological values. More importantly it will place development pressure on the green wedge and semi-rural communities outside the Urban Growth Boundary.	Performs very poorly

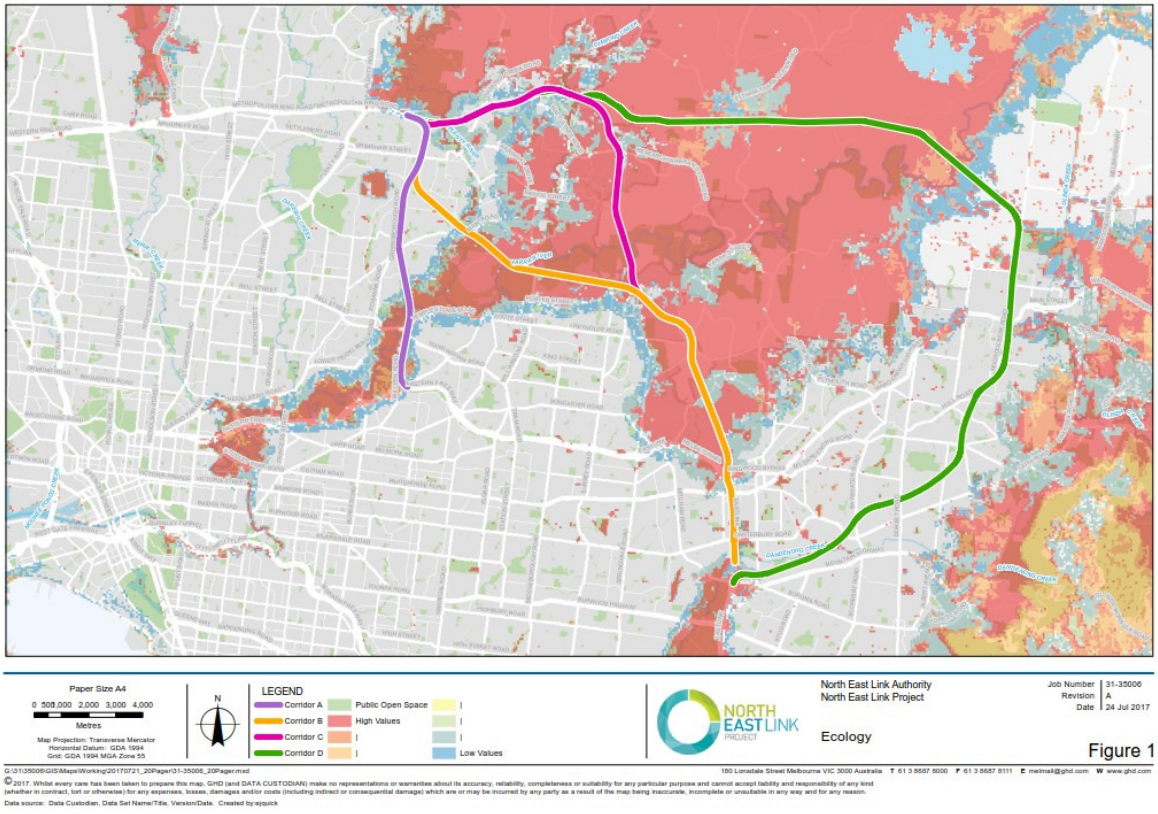
Areas of high ecological value

To identify areas of high ecological value, the NELA team has used the Department of Environment, Land, Water and Planning's NaturePrint Strategic Biodiversity Values map. This mapping tool identifies priority areas for protection based on the importance of the natural values in that location. It combines landscape importance information, such as where there is habitat for threatened species or where many threatened species occur, with connectivity and fragmentation information to show the relative biodiversity value of landscapes in Victoria.

The Strategic Biodiversity Values map helps to identify how development projects can be designed to have the least impact on biodiversity assets and is recommended to be used in the early stages of major infrastructure projects, such as North East Link.

Figure 33 shows the Strategic Biodiversity values map and the four corridor options for North East Link. The red areas represent the highest biodiversity value, while the blue areas represent the lowest biodiversity value[11]. This figure shows that Corridors B, C and D travel through greater areas of highest biodiversity value than Corridor A.

Figure 33 – Strategic Biodiversity Values



Source: Department of Environment, Land, Water and Planning NaturePrint Strategic Biodiversity Values

Cultural heritage

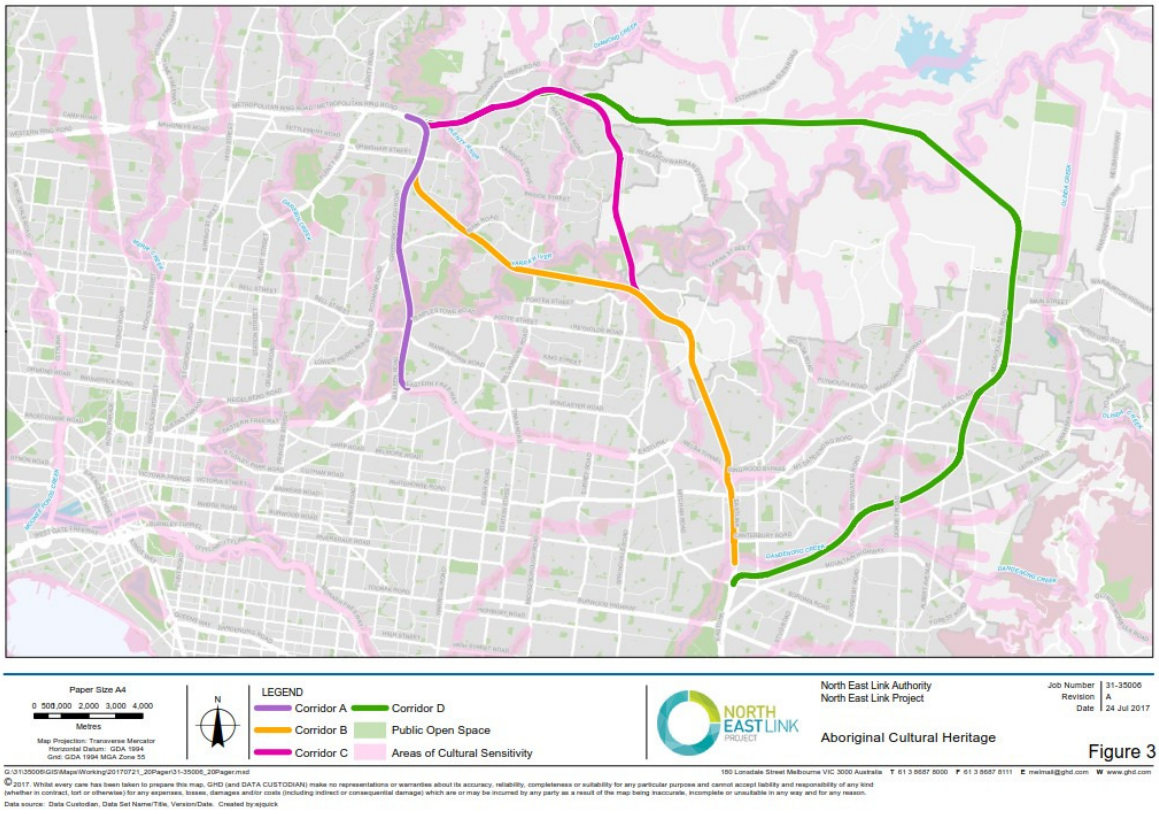
The Aboriginal Cultural Heritage Register Information System has been used to identify areas of high Aboriginal cultural heritage value. This system includes spatial and place information for all registered Aboriginal cultural heritage places on the Victorian Aboriginal Heritage Register, along with information regarding previous investigations undertaken in the study area.

[11] More information on the Strategic Biodiversity Values map can be found at the NaturePrint website: environment.vic.gov.au/biodiversity/natureprint

Registration of Aboriginal cultural heritage places is largely dependent upon whether previous investigations have been undertaken and the way in which these investigations were undertaken. Only approximately 10% of the study area has been subject to previous investigations and the vast majority of this previous work has focused on small study areas of less than 10 hectares in size. Because of this relative paucity of investigations, large swathes of the study area remain relatively unknown in terms of the distribution of Aboriginal cultural heritage places.

It is widely accepted that the availability of water and the resources associated with water have acted as a powerful modifier to hunter gatherer behaviour and use of the broader landscape by Aboriginal people. Within cultural resource management studies, the acceptance of this relationship has resulted in the almost uniform treatment of all areas of land located near to water (that is, within 200 metres) as areas of high archaeological potential or sensitivity. Figure 34 below shows areas of high archaeological sensitivity within 200 metres of watercourses and the four corridor options for North East Link.

Figure 34 – Areas of high archaeological sensitivity within 200 metres of watercourses



Source: Aboriginal Cultural Heritage Register Information System

The high level of suburban development throughout most of Corridor A, and parts of Corridors B and C, means that waterway corridors are likely to be the more sensitive landform features. These

corridors have a higher potential for preservation of Aboriginal cultural heritage places than in more highly developed areas.

Areas of open farmland and bushland associated with Corridor D in particular, and parts of Corridors B and C, are likely to have undergone significantly less development. This means that there is greater potential for a wide variety of cultural heritage places to be preserved in areas other than waterways.

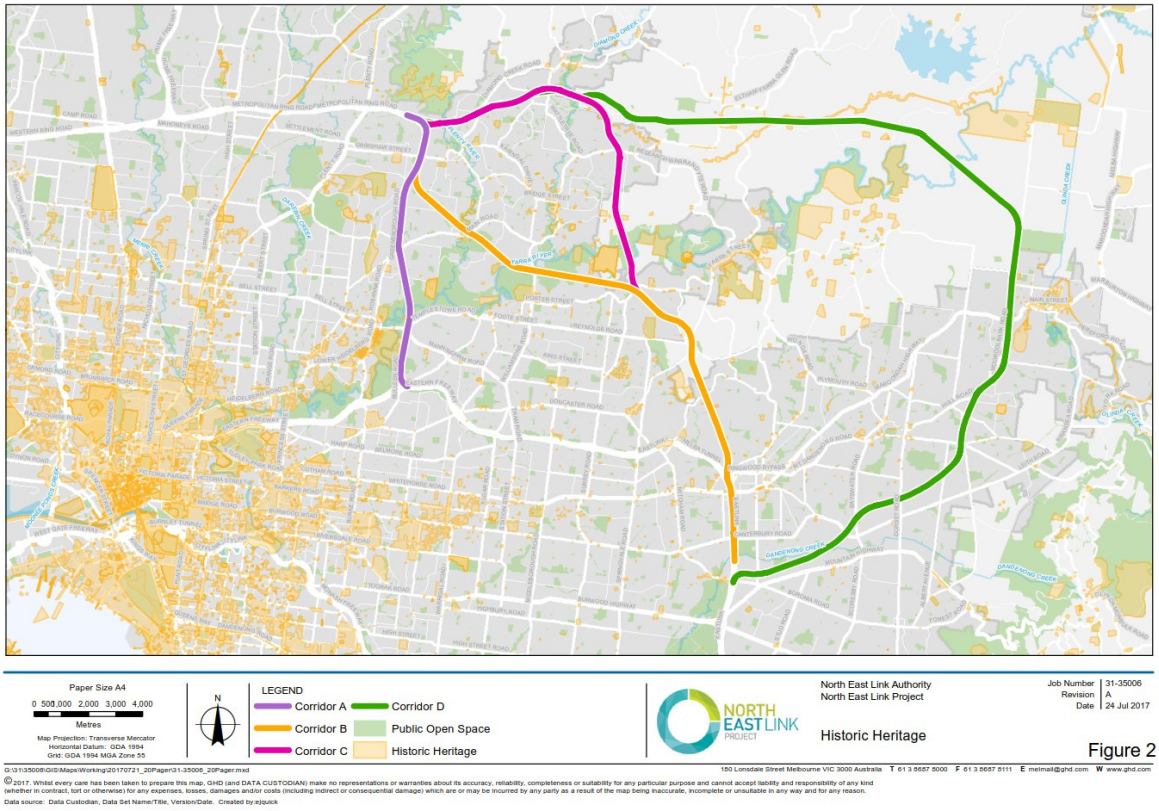
Historic heritage

To identify areas of high historic heritage value, the NELA team has examined the following:

- Victorian Heritage Register, which lists Victoria's most significant heritage places, objects and historic shipwrecks protected under the *Heritage Act 1995*
- Victorian Heritage Inventory, which lists all known historical archaeological sites in Victoria
- Heritage Overlays within local council planning schemes, which identify places of recognised local significance.

Figure 35 shows areas and places of high historic heritage value and the four corridor options for North East Link. This figure shows that there are areas and places of high historic heritage value in and near each of the four corridor options.

Figure 35 – Areas and places of high historic heritage value



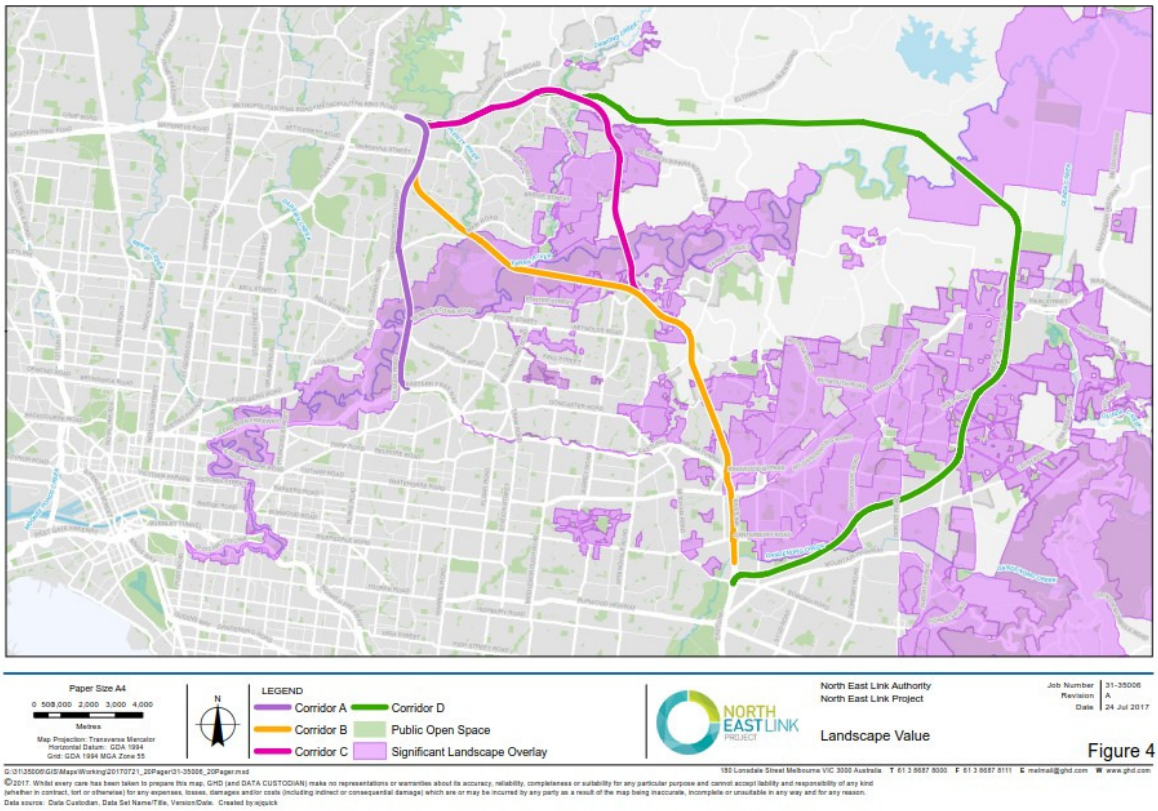
Source: Various sources

Sensitive landscapes

Significant Landscape Overlays within local council planning schemes have been used to identify sensitive landscapes. The Significant Landscapes Overlay is used to identify landscapes of natural and cultural significance at the local government level, and recognises that the value of landscapes and significant open spaces is derived from their environmental performance as well as the aesthetic qualities and the contribution they make to the spatial character and identity of areas of Victoria.

Figure 36 shows areas subject to Sensitive Landscape Overlays and the four corridor options for North East Link. This figure shows that large sections of Corridors B, C and D travel through areas subject to a Sensitive Landscape Overlay, while the southern section of Corridor A travels through such areas.

Figure 36 – Areas subject to Sensitive Landscape Overlay



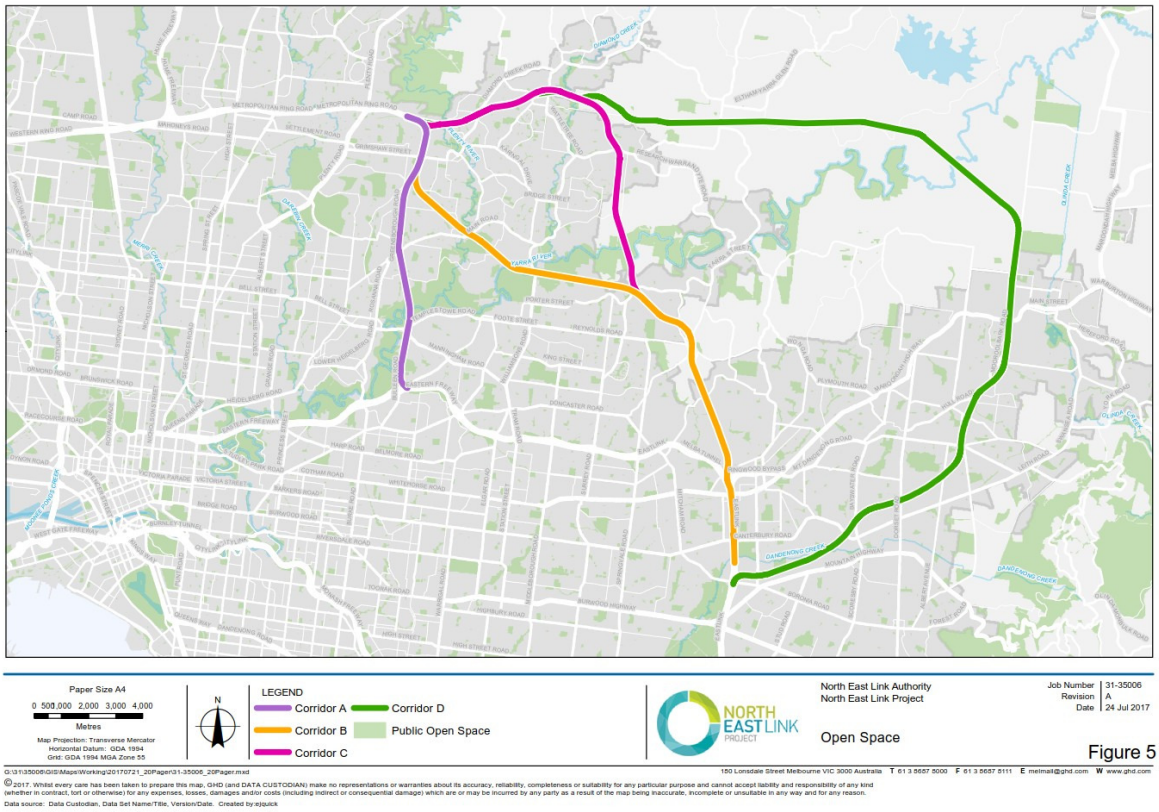
Source: Victorian Planning Schemes, Significant Landscapes Overlay

Open space and recreation areas

Public open space and recreation areas, such as playing fields, are important to and high valued by communities. Open space zones and overlays in planning schemes, as well as publicly available mapping, were used to identify these areas.

Figure 37 shows public open space and recreation areas and the four corridor options for North East Link.

Figure 37 – Public open spaces and recreation areas



Source: Victorian Planning Schemes, various zones and overlays

Further work to inform and shape this area of interest

The analysis outlined above is an indicative representation of the detailed analysis being undertaken. Further work is being done to understand how the corridor options will impact on the ability to protect the environment, culture, heritage and open spaces in Melbourne's north-east. This work includes:

- Ongoing specialist field investigations to confirm available desktop information and provide more detailed information to fill gaps. These investigations cover the areas of ecology, historical and Aboriginal cultural heritage, landscape and visual attributes, surface water and groundwater, and social, community and business characteristics and values
- Identification of private property, businesses, community facilities and open space likely to be impacted by each corridor option to gain an understanding of the potential land required to build the project
- Identification of sensitive receptors that might be affected by amenity impacts
- Preliminary quantification of greenhouse gas emissions during the construction and operation of the project.

4.9 Ability to minimise impacts from construction-related traffic

Overview

The construction of North East Link will take a number of years to complete. Construction works and activities have the potential to impact on the local community depending on the construction methodology selected and the preferred corridor.

The NELA team is assessing the broad impacts of the project's construction on the local community and on the existing road network. The main impacts are expected to be related to traffic performance on the road network from construction traffic and impacts to communities in the north-east from:

- The movement of materials throughout the construction area
- The removal of spoil materials from the construction of the tunnels
- General construction activities undertaken in the area of the project throughout the construction period.

All of these impacts will be mitigated in various ways, using well-tested construction practices and in accordance with the relevant laws and standards. The activities of the contractors delivering the work will be closely monitored and managed by NELA.

Table 22 – Minimising construction impacts: how the corridors perform

	Summary	Overall performance
Corridor A	Generates the fewest truck movements during the construction phase. May require lengthy disruptions to the Eastern Freeway between Chandler Highway and Springvale Road.	Neutral
Corridor B	Generates significant truck movement during construction phase. May require lengthy disruptions to the transport network including building a highly complex interchange at EastLink.	Neutral
Corridor C	Generates significant truck movement during construction phase. May require lengthy disruptions to the transport network including building a highly complex interchange at EastLink.	Neutral
Corridor D	Generates the most number of truck movements however construction sites are expected to be far away from residential areas hence overall impacts to residents and transport network is expected to be minimal.	Performs very well

Construction phase truck movements

The estimated number of construction phase truck movements required for each of the corridors is a good indicator of the impacts of construction. Trucks will be required to haul spoil away from the construction and tunnel sites, and to deliver plant, equipment and other construction materials (such as bridge beams and tunnel lining components) required for the road. These trucks have the potential to impact on traffic performance and local amenity surrounding the construction sites.

A high-level assessment has been undertaken to determine an indicative number of truck movements that are likely to be generated during the project. This assessment has been based on estimates of the amount of material that will be removed from the tunnels and where it needs to be

taken to, the amount of precast concrete components (bridge beams, tunnel linings, noise walls and so on), and the general construction-related traffic that a project of this size and complexity typically generates. The estimates provided in the table below are conservative and it is possible these could be reduced with further refinement.

Table 23 – Estimated total number of truck movements during construction phase (based on minimum tunnel lengths and estimated at four to seven years)

	Corridor A	Corridor B	Corridor C	Corridor D
Estimated total number of truck movements during construction phase	300,000	950,000	900,000	1,300,000

Corridor A is expected to require the smallest number of construction phase trucks, with Corridors B, C and D all requiring up to four times the number of trucks due to longer tunnel lengths and longer overall corridor lengths. However, Corridor A will potentially require the upgrade of the Eastern Freeway, which could cause disruption to this route.

Corridor A is expected to have tunnel portals in close proximity to the Eastern Freeway. This means that the majority of trucks will be able to travel to and from the construction sites without passing along local residential roads.

Corridors B and C have tunnel portals near EastLink. However, due to the complexity of the site, it is expected that spoil may not be removed from this location. Therefore, the majority of trucks will most likely have to use narrow residential roads to access the construction sites, causing significant disruption and impacts to local communities.

Corridor D is expected to generate the most trucks out of the four options. However, the corridor and construction sites are expected to be far away from built up residential areas. Therefore, the construction impacts on local communities and the overall network is expected to be minimal.

Further work to inform and shape this area of interest

The following activities are currently being undertaken:

- Continuing geotechnical investigations to understand the ground conditions likely to be encountered
- Development of approaches and requirements for the management of the possible impacts on the environment during the works.

5 References

Australian Bureau of Statistics, 2014, *Australian historical population statistics catalogue number 3105.0.65.001- Greater Melbourne,* ABS

Department of Economic Development, Jobs, Transport and Resources, 2016, *Food and Fibre: Sector Strategy,* viewed 10 July 2017, www.business.vic.gov.au/futureindustries

Department of Economic Development, Jobs, Transport and Resources, 2015, *Review of Victoria's Freight and Logistics Task,* Victorian Government

Department Environment, Land, Water and Planning, 2017, *Victorian Heritage Inventory,* Victorian Government

Department Environment, Land, Water and Planning, 2017, *NaturePrint Strategic Biodiversity Values* viewed 18 July 2017, ww.environment.vic.gov.au/biodiversity/natureprint

Department Environment, Land, Water and Planning, 2017, *Planning Schemes Online* viewed 18 July 2017, www.planning-schemes.delwp.vic.gov.au/

Department Environment, Land, Water and Planning, 2017, Victoria in Future (VIF) 2015, *Population and Employment Projections*, Victorian Government

Department of Premier and Cabinet, 2017, *Aboriginal Cultural Heritage Register Information System*, Victorian Government

Heritage Council of Victoria, 2017, *Victorian Heritage Register*, Victorian Government

North East Link Authority, 2017, *Traffic Survey 2017*, NELA

Veitch Lister Consulting (VLC), 2017, *Zenith Model – Preliminary modelling for North East Link*

VicRoads, 2017, *Crash statistics 2012 – 2016*, VicRoads

VicRoads, 2017, *Screenline traffic volume data 1995 to 2011*, VicRoads

Victorian Government, 2017, *Plan Melbourne 2017-2050 Strategy*, viewed 10 July 2017, www.business.vic.gov.au/futureindustries www.planmelbourne.vic.gov.au/

Victorian Planning Authority, 2012, *Growth Corridor Plans – Managing Melbourne's Growth* viewed 10 July 2017, *https://vpa.vic.gov.au/greenfield/growth-corridor-plans/*

XAct Solutions, 2017, *North East Link Needs Assessment*, NELA