Appendix Q2
Assessment of potential land use impacts

February 2018

Assessment of potential land use impacts of North East Link

24 May 2018

As included in the Business Case as provided to Transport for Victoria on 9 February 2018, the analysis has not been updated since 9 February 2018

Building a better working world

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Mr Duncan Elliott
CEO, North East Link Authority
L14, 121 Exhibition St
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24 May 2018

As included in the Business Case submitted to TFV on 9 February 2018

Assessment of Potential Land Use Impacts Report

Dear Duncan,

We refer to the contract between the North East Link Authority (NELA) and EY dated 21 February 2017 and signed 22 February 2017 (the "Contract"), through which EY has been engaged to provide economic and financial advisory services to NELA on the North East Link.

As part of this engagement EY has produced this Assessment of Potential Land Use Impacts Report (the "Report"), attached to this letter. The status of this document is a working draft and is therefore subject to change.

Purpose of the Report and restrictions on its use

The Report may only be relied upon by NELA pursuant to the terms of the Contract. Any commercial decisions taken by NELA are not within the scope of our duty of care and in making such decisions you should take into account the limitations of the scope of our work and other factors, commercial and otherwise, which you should be aware of from sources other than our work.

EY disclaims all liability to any party other than NELA for all costs, loss, damage and liability that the third party may suffer or incur arising from or relating to in any way connected with the provision of the deliverables to the third party without our prior written consent. If others choose to rely in any way on the Report they do so entirely at their own risk. If NELA wishes to provide a third party with copies of the Report, then our prior written consent must be obtained.

Our Role

EY performed the following scope of work:

- Developed an land use impacts framework and land use impacts models to accommodate the project assumptions;
- Coordinated collation of data and assumptions from NELA and its advisors;
- Prepared an Assessment of Potential Land Use Impacts Report

This Report was prepared on NELA's instructions, solely for the purpose of presenting economic appraisal for the Business Case and must not be relied upon for any other purpose. In carrying out our work and preparing this Report, we have worked solely on these instructions and for this purpose.

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The analysis contained in this report has been prepared by EY and informed by material provided by, and through discussions with NELA, Department of Treasury and Finance (DTF) and third parties including GHD, Advisian, VLC and Smedtech. No verification or review of the information provided by these parties has been carried out by EY. EY has not altered the inputs or assumptions received from other parties for input into the financial analysis, except where identified in the relevant sections below.

If you would like to clarify any aspect of this Report or discuss other related matters, please do not hesitate to contact me on (03) 9288 8830.

Yours sincerely,

John Matthews
Partner

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1. Background

In 2016, Infrastructure Victoria released its 30 Year Infrastructure Strategy, identifying North East Link as the highest priority infrastructure project in Victoria. Infrastructure Victoria noted that the link will enhance access to major suburban business and employment centres, improve orbital road connectivity across Melbourne and boost the capacity of the city's freight network.

In October 2017, the Victorian Government's five-year *Victorian Infrastructure Plan* confirmed North East Link as one of several 'catalyst', state-shaping infrastructure projects designed to stimulate economic growth, create jobs and deliver positive, long-term benefits for Victorians.

Given the scale of the project and the significant accessibility improvements it will deliver for the north-east of Melbourne in particular, it is expected to impact Melbourne's city structure by encouraging households and businesses to locate in areas that will benefit most from the project.

Induced land use changes can affect the operating profile of the project and create benefits and costs in addition to traditional transport user and non-user benefits (including wider economic benefits or WEBs) that are usually included in transport cost-benefit analysis (CBA). Depending on the patterns of accessibility and induced land use changes, there could be additional benefits and costs associated with urban consolidation, particularly in relation to changing employment location and industry mix, the efficiency of urban development and the provision of infrastructure and services. There may also be implications for planning strategies and policy frameworks in place for the corridor.

The analysis presented in this report is focused on assessing the potential changes to employment and population location that may occur due to the construction of North East Link to inform key elements of the business case, including the:

- **Transport modelling and economic analysis**
  Population and employment forecasts are a key input to the transport model. The impact of the project on Melbourne's population and employment can change the demand for the project and patterns of land use across the network, as well as provide additional benefits and costs for inclusion in the CBA.

- **Identification of value creation opportunities**
  The North East Link Authority is committed to supporting the Victorian Government's *Value Creation and Capture Framework* to maximise social, economic and environmental value from infrastructure investment. In accordance with the framework, North East Link is considered to have the potential for significant value creation and value capture opportunities.

- **Implications for planning and policy**
  With North East Link expected to impact Melbourne's distribution of population and employment, this paper will explore the ability of the areas of interest to accommodate forecast growth in population and employment under the current planning policies and controls. This discussion will also explore the alignment of any induced land use change with Plan Melbourne and identify potential implications for planning policy.

2. Approach

2.1 Introduction

Until recent years, cost benefit analyses in Australia have typically not considered land use impacts as a result of infrastructure projects. The estimated costs and benefits of projects typically kept land use constant, which does not accurately represent the different future states of the world with and without the infrastructure, as large infrastructure projects may impact where people choose to live and where businesses locate. In this study we use a land use model and Land Use Transport Interaction (LUTI) framework for Victoria to estimate the potential city shaping impacts of NEL.

Land use modelling has been used to support transport CBAs in the UK for a number of years and is now becoming a feature of major project assessments in Australia. This type of analysis has been part of EY's efforts to support large infrastructure projects, such as the Level Crossing Removal Project and the Suburban Roads Upgrade (SRU) project in Melbourne, as well as for Sydney Metro and Western Sydney Airport. These detailed 'interactive' models have been well received, and have supported explicit measurement of city shaping benefits in economic appraisals.

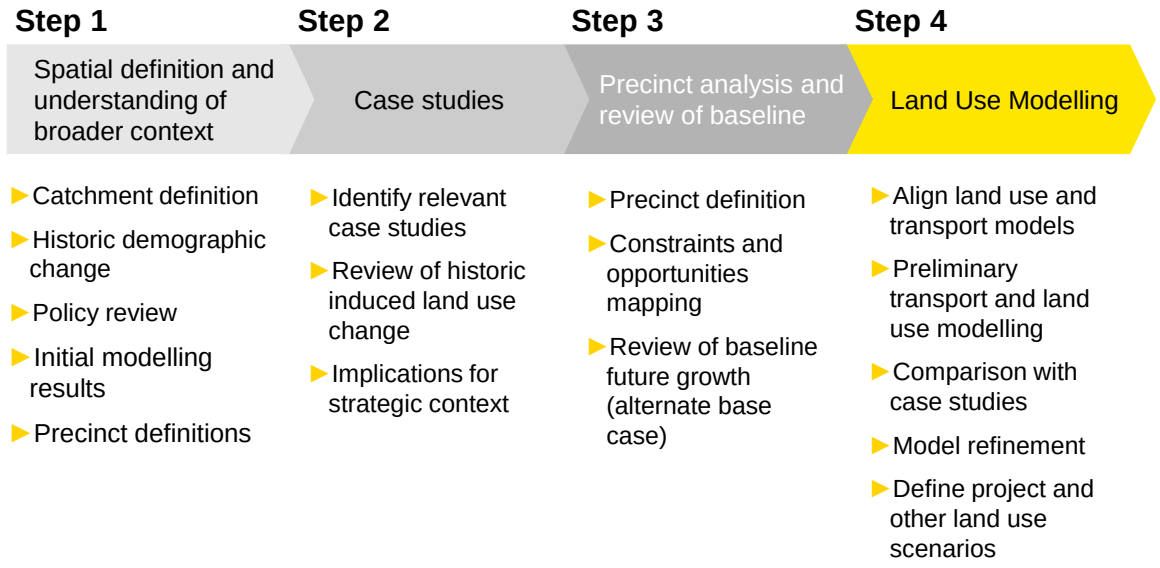
The guidance material published by Infrastructure Australia in its Assessment Framework (June 2017) provides the most relevant reference for the inclusion of city-shaping benefits in a transport CBA. Underpinning the application of this framework in many cases requires the development of a detailed land use model that can estimate how population and employment location may change across a city network in response to major infrastructure upgrades. The application of such a model for North East Link and supporting property and case study analyses is the focus of this report.

In line with the IA guidelines, EY has, together with UrbanGrowth NSW, developed a land use 'Benefits Catalogue', which enables the quantification of such 'urban consolidation' costs and benefits. Based on this work, the NSW Treasury has recently adopted a set of guidelines on how to quantify the benefits of urban renewal. The application of this benefits framework and the use of the land use modelling results as part of that is detailed in Appendix Q1 - Economic appraisal.

2.2 Outline approach

The approach we have followed for assessing the impacts of North East Link on urban land use is outlined in Figure 1 and described further below.

Figure 1 – Approach to assessing the land use impacts of North East Link



1. **Spatial definition and understanding of broader context**

This step of the process defines the areas of interest and provides the relevant land use context in the north east. This contextual background includes discussion of:

- **Study areas** – providing land use context including the:
  - Project catchment – the broad area of interest as defined in line with the project objectives and options analysis
  - National Employment and Innovation Clusters (NEICs), and Metropolitan Activity Centres (MACs) – locations in the catchment of strategic importance for employment growth as outlined in Plan Melbourne and identified as important to the project
  - Key Residential Locations – residential locations of importance across the project catchment.

- **Land use** – in the study areas currently, as well as the future. This includes:
  - Population and households - growth forecast (*Victoria in Future 2015*)
  - Employment - growth forecast by the Victoria in Future 2015
  - Zoning and policy – considerations, including planning schemes in the study areas, as well as the context for future development set out in Plan Melbourne and the relevant PSP's.

- **Initial modelling results** – provide understanding of the forecast improvement in traffic conditions and change in the attractiveness of the north-east due to the construction of North East Link. This information provides context to the selection of appropriate precincts which form the basis of more detailed analysis.

- **Spatial (precinct) definition** – The identification of precincts or areas that have been subject to detailed analysis as part of the development of land use scenarios.

2. Case studies

This section examines historic land use change in response to the provision of transport infrastructure. The demand response case studies will examine the change in employment and population in the vicinity of the M80, Mornington Peninsula Freeway and EastLink post construction relative to a broader area and the rest of Melbourne.

These case studies, as well as the initial modelling results provide the basis for a preliminary understanding of potential impacts to the north east's future land use with the construction of the project. These case studies will help to validate and refine results produced by the land use model in subsequent stages of the modelling and analysis.

3. Precinct analysis and review of baseline

While our land use model has been built to forecast changes in demand for housing and employment, it has a limited representation of supply constraints, such as planning system controls and property market factors which may limit development. This section characterises the precincts of interest defined in section 1 with reference existing land use and planning schemes, as well as demographic forecast by Victoria in Future 2015 estimates. This analysis provides the basis to undertake review of redistribution due to North East Link with reference to supply constraints.

Characterisation of the precincts includes:

- Locating of key features within each precinct
- Identification of constraints and opportunities on the basis of the following considerations:
  - **Statutory planning** - what the zoning and overlay controls offer to use, yield and density
  - **Land fragmentation** - how land is split up and how this impacts development centred around the idea that the market is less likely to amalgamate smaller lots in order to developer rather than subdivide larger lots in order to develop
  - **Surrounding features** - how physical constraints will impact development

- **Market readiness** – based on historic analysis of change the area and expected trends based on broad market understanding
- **Sensitive receptors** - areas within project corridor that will be unlikely to undergo further development due to constraints

- Historic growth trends for both employment and population

Following characterisation, the section reviews growth forecast by VIF for each precinct against its characterisation to determine any constraints to employment and population forecasts given existing conditions.

4. Land use modelling

This step involves using the land use model to estimate possible changes in population and employment density due to the project scenarios.

This requires aligning the zonal system of the land use modelling framework with the transport model. Then testing initial project scenarios and reviewing the results against the precinct analysis and case studies. This review helps to validate the results of the land use model and identify any model refinements required.

This refinement will also complemented by review of Melbourne's supply chain and factors influencing location decisions. This part of the analysis will focus on determining the impact of North East Link to Melbourne's supply chain and freight networks.

Additional information on the approach to land use modelling is provided in section 2.3.

2.3 Land use modelling

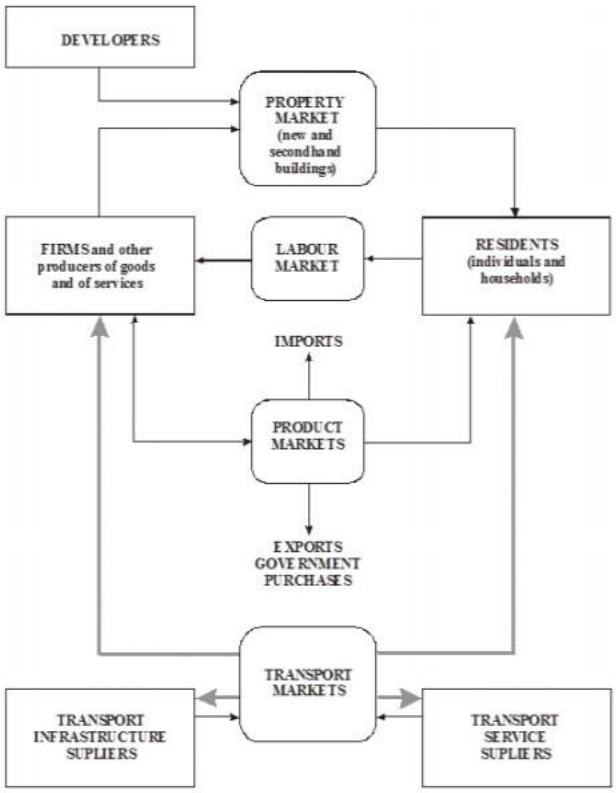
This section provides further information about EY's land use modelling and LUTI approach in the context of available guidelines and industry practice.

2.3.1 Land use models and available guidance

In order to estimate the potential induced land use change associated with transport projects, land use models seek to represent a range of complex interactions and relationships that drive household and business location choices, as well as supply side factors that may constrain or incentivise this development.

The UK's WebTAG guidance developed by the Department for Transport sets out a number of interactions that land use models may take into account when seeking to understand the interaction between land use, transport and other factors. The figure below sets out the way in which these factors interact.

Figure 2 – Interaction of land use, transport and other factors



Source: WebTAG, Department for Transport (2014)

Australia's Transport Assessment and Planning guidelines distinguish between different approaches to land use transport interaction analysis. The guidance outlines four possible approaches to analysis, representing different levels of interaction between land use and transport models, and different factors forecast to impact location decisions. These different approaches are shown in Table 1.

Table 1 – Land use transport interaction frameworks

Structure \ Mode	Static	Dynamic
Linked	Separate Land use and transport model, run iteratively to convergence representing single forecast year	Separate land use and transport models, run sequentially, say in 1 or 5 year increments, representing dynamic evolution over time
Integrated	Interaction of land use / activity patterns directly mapped to transport needs, run iteratively or through simulation if disaggregate, to equilibrium	E.g. using system dynamics software, directly linking land use / activities to transport, and representing lags in rate of response

Source: ATAP 2016

The guidelines set out that "static equilibrium LUTI models provide a tried and tested method of modelling the interaction between transport and land use" and are appropriate to be used in the appraisal of major transport infrastructure projects.[1]

Further guidance from ATAP relates to model specification and validation, noting that the regression analysis should look at the "the correlation between planning data (residential intensity, employment intensity) and accessibility (as derived from the transport model)" and provide

[1] ibid

"evidence to establish suitable functional relationships with outputs available from the transport model".

Guidance also notes that linked static models do not fully represent supply side conditions and suggests that consideration of "constraints of the planning system (and) the extent of land available for development" would provide another level of sophistication to the LUTI framework.

ATAP suggests that land use and transport models are run together iteratively, with land use model outputs informing the trip generation stage of the transport model, and that the models should be run until convergence is achieved between models.

In using a LUTI framework for North East Link to estimate land use benefits and the Project's impact on Melbourne's urban form, there are a number of criteria required achieve functionality, including:

- Timeliness of modelled results
- Simplicity in interpretation of results

However, it is important that this functionality is not be achieved at the expense of robustness of results.

2.3.2 Our approach

This section provides an overview of EY's land use model and LUTI approach.

2.3.2.1 EY's land use model

The land use model used for North East Link reflects guidance set out by ATAP and seeks to address relevant concerns of guidelines in a way that preserves both the functionality required for business case evaluation, as well as robustness desired from land use models.

Our land use model represents a 'linked static' approach and uses the change in access to jobs, workers and firms as forecast by the transport model to estimate the impact North East Link will have on population and employment density. This approach recognises that land use changes will occur through shifting demand by encouraging:

- Residents to choose to locate in areas with greater accessibility to jobs.
- Businesses to choose to locate in areas with greater accessibility to potential employees and to other firms.

There are also a range of other aspects driving location preferences that need to be controlled for within the analysis including:

- Attractiveness factors (distance to: education; health services; amenities; shopping)
- Control variables (distance to train station; access to parks, etc.).

In order to measure the effect of accessibility on land use, observed population and employment densities are used in econometric regression models. The models comprise:

- Model 1: Population density – which builds a causal relationship between observed differences in population density across travel zones (TZs) and differences in amenities and accessibility to jobs. The model estimates the extent to which accessibility drives residential density. It does this by isolating accessibility to jobs from a number of other factors determining attractiveness, such as distance or accessibility to other attractions or the physical characteristics of the area.

- Model 2: Employment density – which builds a causal relationship between observed differences in employment density across TZs and differences in accessibility to workforce, other firms and key infrastructure that firms depend on. The model estimates the extent to which accessibility drives employment density. It does this by isolating accessibility to people and firms from a

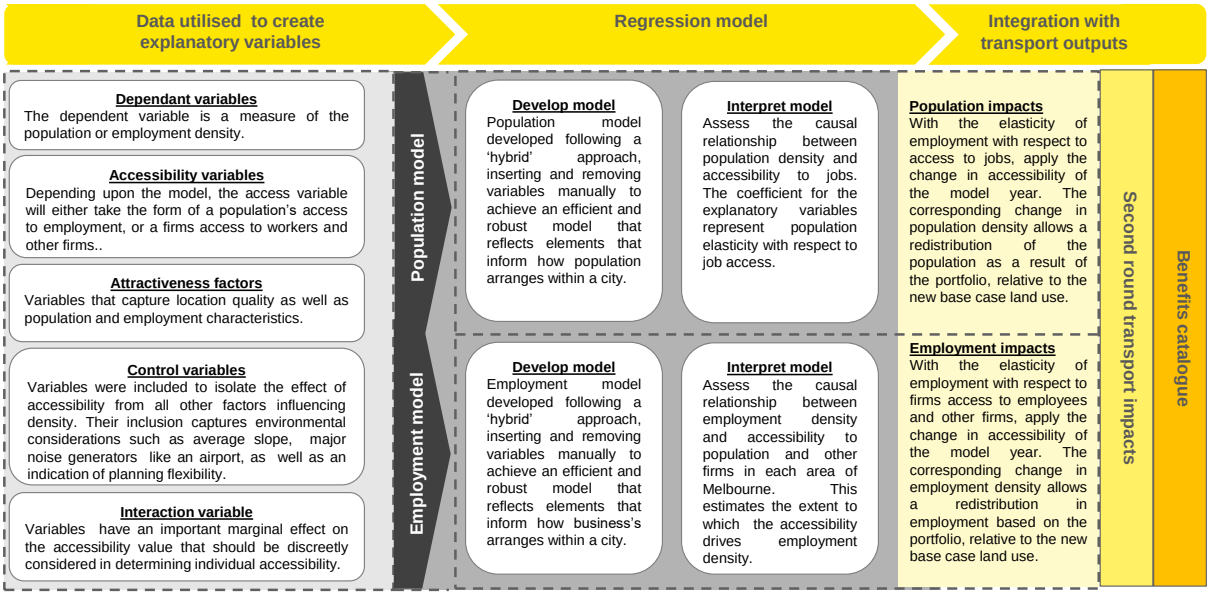
number of other factors, such as proximity to other enabling pieces of infrastructure such as a port or an airport.

- Outputs from the population density model (Model 1) are used as an input for population accessibility in Model 2. In this way, Model 1 and Model 2 are iterative. These results are then used in the modelling approach discussed below.

Econometric techniques are used to correct for a number of confounding relationships that often prevents robust causal relationships from being identified. One such relationship is 'reverse causality'. Reverse causality occurs if we estimate the impact of accessibility on density and there is a simultaneous causal impact of density on accessibility – which would be the case if transport investment and services tend to be provided in locations where population or employment density is already high (which is the case).

The models developed explicitly account and correct for reverse causality using techniques that are discussed the methodology below.

Figure 3 Summary of land use model



In order to translate the results of the land use model components into a Melbourne-wide land use profile, the results of the land use models are input into another model to generate the land use file that can be used in transport modelling and economic analysis.

When doing this, the approach is redistribute land use so that overall population and employment do not change and are kept in line with Government forecasts as per the DEDJTR Reference Case.

Key variables in the land use file that is an input to that strategic model include:

- Household size
- Population by age
- Dependents by age
- Primary, secondary and tertiary enrolments
- Industry composition
- Blue and white collar employment.

A number of assumptions have been made in order to govern our approach to the redistribution of population and employment at the travel zone level informed by the land use modelling results. Generally it is assumed that induced population and employment to a particular travel zone take on

the characteristics of that attraction zone. Further information about these assumptions is included in Appendix A.

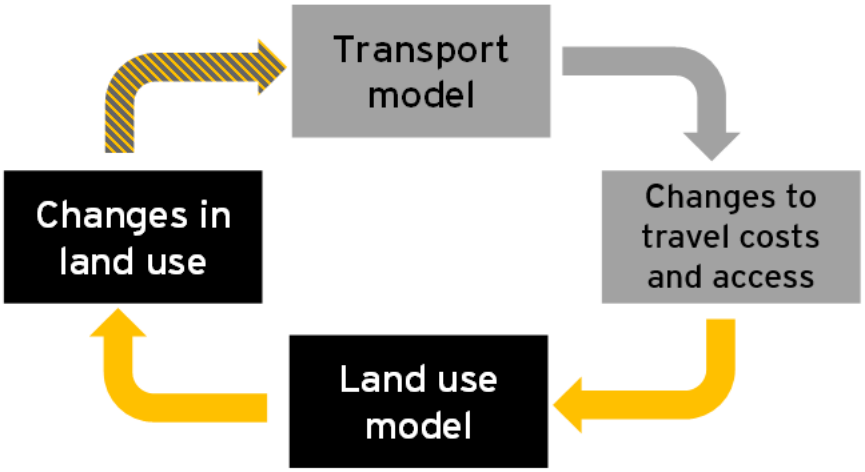
2.3.2.2 LUTI process

Over the last three years, our land use transport interaction (LUTI) modelling and benefits frameworks have been used to measure 'city shaping' effects of infrastructure and urban renewal projects in Victoria, New South Wales and the ACT. This includes modelling the potential for transport investments to influence the location of future industries and jobs, and changes in population density for whole cities linked to the accessibility changes estimated by strategic transport models.

The interaction between the transport and land use models is summarised in Figure 4 and occurs in the following steps:

1. The transport model uses Reference Case land use assumptions to determine the change in travel times due to the construction of North East Link. This data is used to calculate change in accessibility.[2]
2. Accessibility results are input to the land use model which calculates the change in population and employment density.
3. The change in population densities are translated to changes in population and employment for each travel zone, to produce a new land use profile.[3]
4. This new land use profile becomes the project case land use, which is used to estimate the dynamic (second/third round) impacts on the transport network. For example the redistribution of population and employment may result in cost efficiency from a denser urban form for households or greater economies of agglomeration for businesses.

Figure 4 – Summary of Land Use and Transport Interaction framework



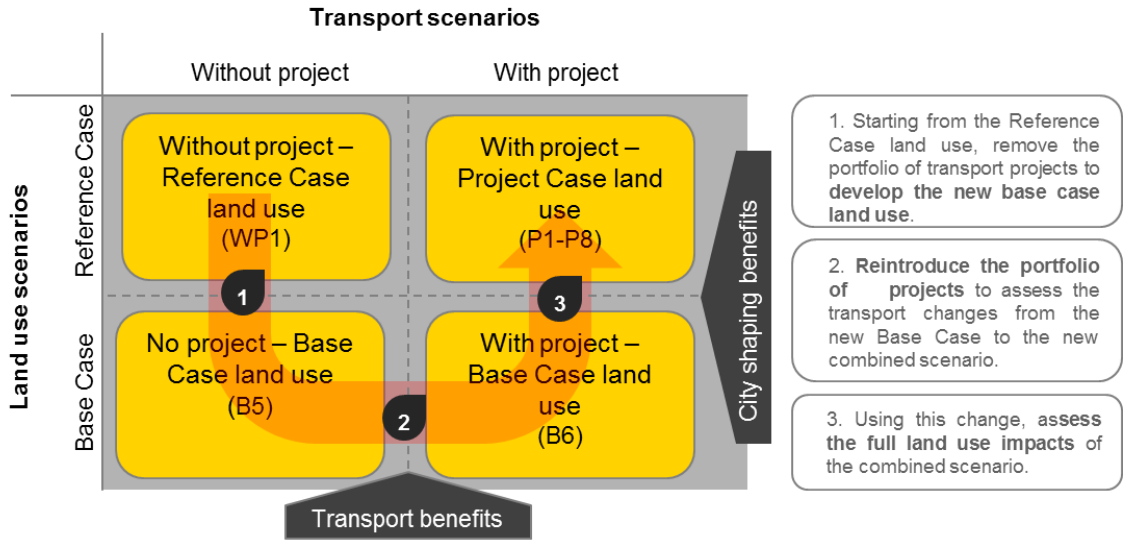
Our land use model effectively forms a fifth step to the traditional four step transport model, with generalised cost of travel informing land use redistribution, which then seeds the next transport model run at the trip generation step (first step). In theory (and suggested by ATAP), this loop through of the transport and land use model (Figure 4), should be repeated until convergence is achieved with the previous result. However, it is generally considered that a reasonable level of convergence can be achieved with one iteration.

The figure below provides a high level summary of the approach to modelling the transport and land use impacts in an 'interactive' way as an input to the calculation of the city shaping and transport benefits of the program of major projects (i.e. using the LUTI approach).

[2] The Reference Case refers to the DEDJTR 'Transport Modelling Reference Case' which defines key input parameters and network assumptions used in the transport model.

[3] Travel zone refers to the areas which produce trips within the transport model.

Figure 5 Disaggregating the transport and city shaping benefits



A key part of this approach relates to building a traditional CBA at the lower half of the diagram using a base case land use scenario. The next step involves estimating the land use changes that can be attributed to the project and the benefits that result from those changes. In this way, it is only the redistribution of land use that is driving the additional benefits, and by starting with a base case land use scenario, any issues around double counting benefits are removed (i.e. as opposed to calculating transport benefits using the project case land use scenario).

By carefully constructing a series of 'with' and 'without' project scenarios under different land use settings ('base' or 'Reference Case'), it is possible to determine the first round transport impacts and associated benefits and costs (using the transport model runs with the base land use scenario), and then the second round land use impacts (using the land use model) and transport changes (using the 'with project' run with the Reference Case land use scenario), and additional benefits and costs they provide.

3. Spatial definition and context

This section provides the spatial definition and context relevant to the assessment of the potential land use impacts of North East Link.

3.1 Geography of Analysis

In understanding the land use context relevant to North East Link and the potential impacts of the project we have examined the following areas:

- North East Link Project Catchment;
- NEICs and MACs[4]; and,
- Key residential locations.

It should be noted that the assessment in this paper has not considered areas outside of the Urban Growth Boundary as it does not aligned with the key policy direction in Plan Melbourne 2017-2050 Strategy[5] that specified growth will be contained within the UGB to promote *more consolidated city of 20-minute neighbourhoods with good access to public transport and services*.

3.1.1 North East Link Project Catchment

As identified in the ILM, the North East Link project is expected to provide benefits for residents and businesses in Melbourne's north, east and south east regions.

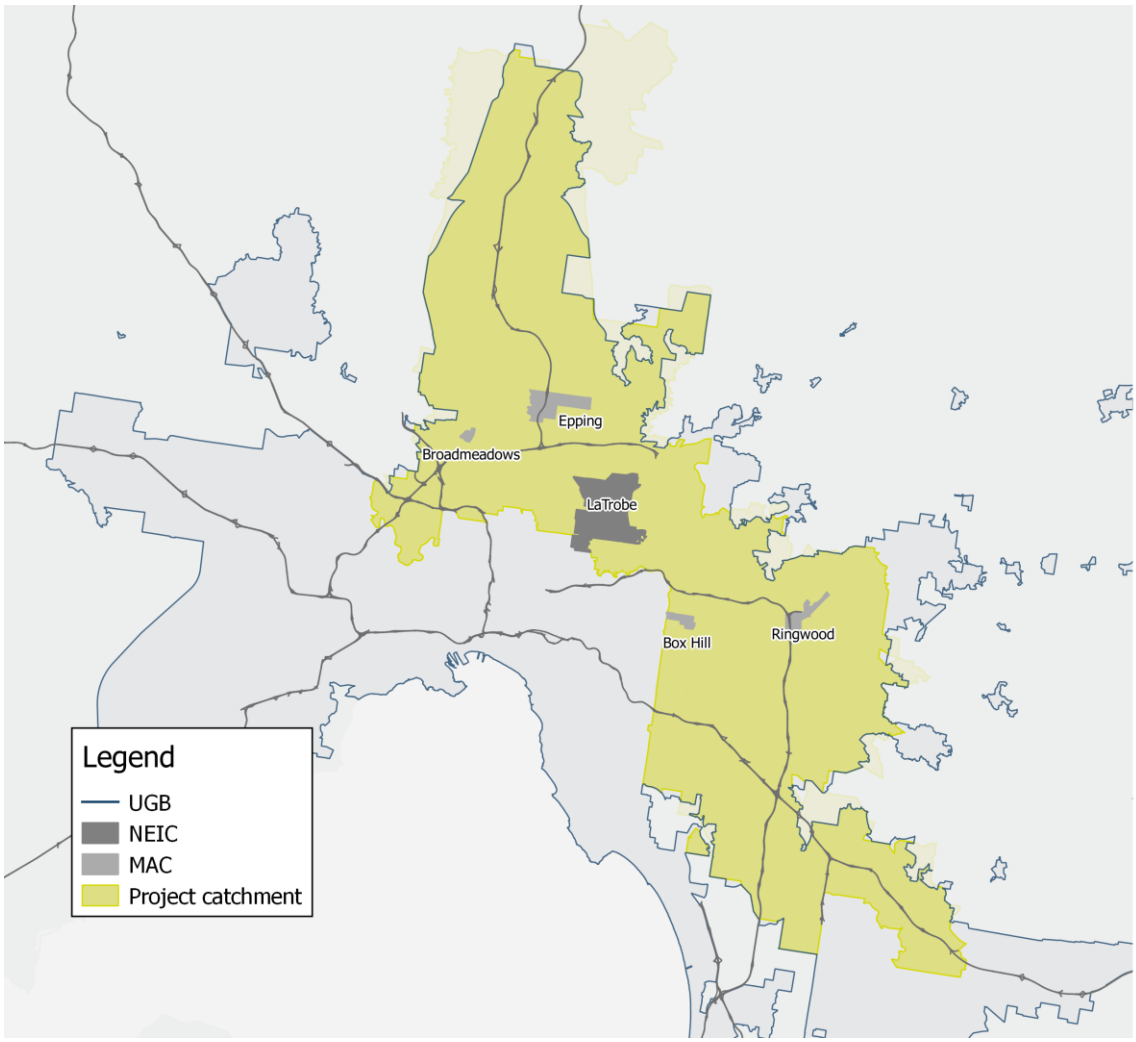
As a starting point for considering the potential impacts of the project on land use, a broad catchment area was defined with reference to the Australian Bureau of Statistics (ABS) Statistical Area 3 (SA3) geography to approximate the areas targeted for the project. This geography represents areas serviced by the same major transport or commercial hubs.[6]

[4] Plan Melbourne (2017), Department of Land, Water and Planning

[5] 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

[6] ABS (2016), Australian Statistical Geography Standard (ASGS): Volume 1 - Main Structure and Greater Capital City Statistical Areas, ABS Cat no. 1270.0.55.001 - July 2016

Figure 6 –North East Link Project Catchment



Source: EY

The position of North East Link in the network and its links with other significant freeways and arterials suggests that it could create far-reaching impacts on land use in areas of Melbourne that have vastly different characteristics. For example, this could include residential: growth areas and industrial zones in the north; established residential and employment areas in the north-east that are on the fringe of Melbourne and close to green wedge areas; and established residential, business and industrial areas in the east and south-east.

A challenge for this study has been to determine the areas to focus the analysis in recognition that some areas in the north-east and north in particular are expected to experience more significant changes in accessibility compared to other areas across the project catchment that are already well connected to existing freeways and arterials.

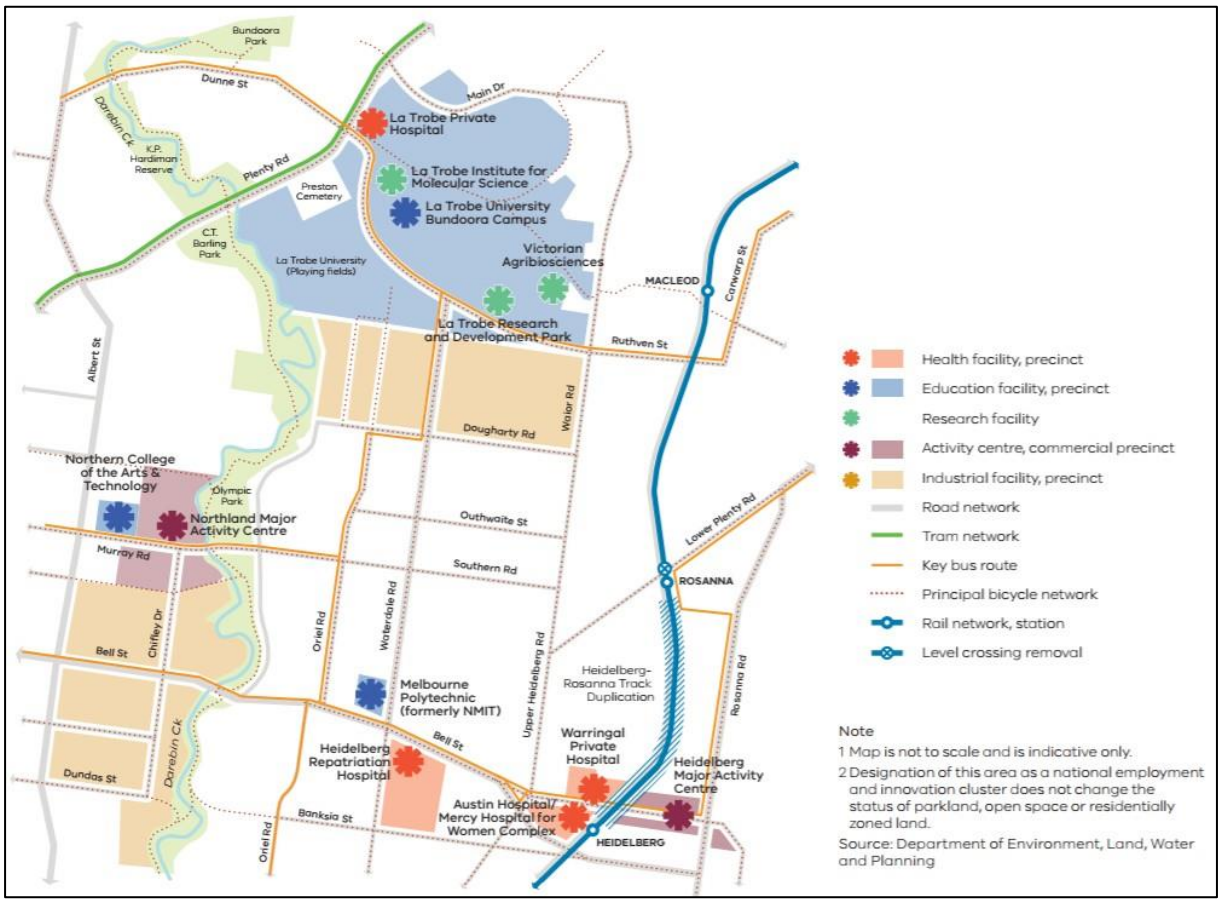
3.1.2 National Employment and Innovation Clusters

Seven NEICs are identified in Plan Melbourne. The Victorian Government has identified these areas as the focus for jobs growth and strategic infrastructure investment to help expand employment opportunities in the future.

As set out in the ILM, a key objective of the project is to support employment growth in the north east. For the project to achieve this objective, it must be able to deliver benefits to businesses located in the north east. Accordingly, the La Trobe NEIC is particularly relevant for the project.

The La Trobe NEIC is formed around three key sites, La Trobe University (education precinct), the Northland Major Activity Centre (retail precinct) and the Heidelberg Activity Centre (health precinct). Figure 7 below shows a map of the La Trobe NEIC and key areas of activity.

Figure 7 – La Trobe NEIC (Plan Melbourne)



Source: Department of Environment, Land, Water and Planning (2017)

La Trobe University is a growing education precinct, both in research efforts and student population. The university plans to grow its' biosciences sector and support teaming between researchers and surrounding health care practises in the nearby Heidelberg Major Activity Centre to encourage commercialisation and development. Furthermore, the Northland shopping centre provides a retail precinct to support population and also has significant capacity to accommodate new jobs and housing.

The project is expected deliver significant improvements in accessibility for some key parts of the cluster and surrounding areas and has the potential to support aspirations for the development of the cluster and the creation of employment opportunities in the north-east.

3.1.3 Metropolitan Activity Centres and other activity centres

Plan Melbourne outlines MACs as important to Melbourne in supporting higher density living and providing an array of services to the wider regional population. This includes providing communities with access to a range of major retail, community, government, entertainment, cultural and transport services, as well as employment opportunities. MACs identified as important to the north east are:

- Broadmeadows
- Epping
- Box Hill
- Ringwood.

In particular, the Broadmeadows and Epping MACs are expected to experience significant accessibility improvements with North East Link, potentially enabling greater employment and population density in those areas. While Box Hill and Ringwood are also forecast accessibility improvements, these areas already experience good accessibility to jobs and workers and are therefore less likely to be impacted by North East Link in terms of land use change.

The Broadmeadows MAC, supports a mix of industrial and retail employment. Good existing arterial connections to the freeway system will enable residents and businesses to benefit from the construction of North East Link. Accordingly, improved travel times are expected to reduce transport costs for industrial businesses and encourage increased activity in the centre.

Furthermore, there is a growing emergence of town houses in Broadmeadows and the area has the potential to accommodate higher density residential development. Increased activity, as well as better access to jobs due to North East Link will increase the attractiveness of Broadmeadows to households.

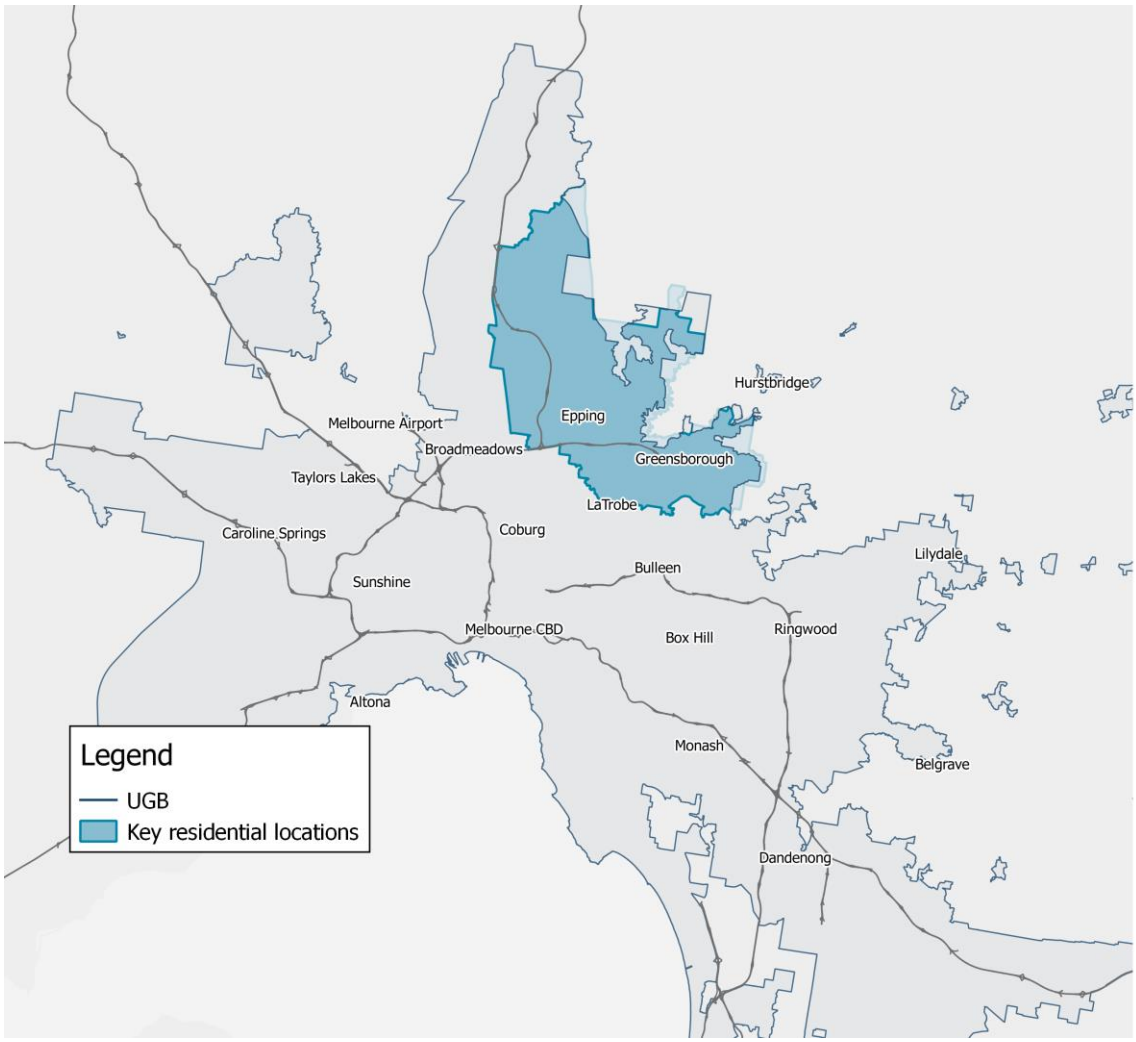
The Epping MAC is similar in nature to Broadmeadows, supporting both industrial and commercial employment and is expected to benefit from the construction of North East Link through better access to labour and cheaper transport costs. Employment opportunities in the Broadmeadows and Epping MACs may encourage households to locate near the activity centres, further driving the establishment of higher density development and aligning development with the direction set out by Plan Melbourne.

The Greensborough activity centre is also relevant to North East Link, with the area providing commercial, retail and civic land uses. With close proximity to the La Trobe NEIC, there is potential for North East Link to complement increased business and household development by providing better access to both workers and jobs.

3.1.4 Key residential locations

Key residential locations were identified for areas where accessibility is significantly impacted by conflicting local and strategic orbital movements between the M80 Freeway and Eastern Freeway/EastLink. These areas are currently under serviced by the transport system, experiencing poor accessibility to jobs and stand to become significantly more attractive to households due to the construction on North East Link. These locations are broadly shown Figure 8 and include suburbs such as Rosanna, Eltham, Heidelberg, Bundoora, Greensborough and Bulleen. Key residential locations and their potential to support increased population density are explored in greater detail in section 5.1.

Figure 8 – Key residential locations



Source: EY

3.2 Projected land use

Undertaking an assessment of potential and use impacts of a project like North East Link requires understanding planned population and employment growth that is expected for the corridor, as well as the high level planning policies that are in place to support those plans.

3.2.1 Population and households

The historic and forecast density of population as well as the rate of growth in catchment areas to North East Link provides a high level indication of the ability of the area to accommodate growth within existing constraints and the potential relevance of additional infrastructure. This is particularly relevant for parts of the North East Link catchment where population in the key residential locations is expected to grow more quickly than the rest of Melbourne and also currently experience relatively poor transport access to jobs.

According to Victoria in Future 2015 estimates, the project catchment has a population of 1,773,300 in 2016 and is projected to grow by 562,700 to 2036 and a further 428,900 to 2051, totalling 2,765,000. This represents a compound annual growth rate (CAGR) of 1.4 per cent per annum between 2016 and 2036, with more moderate growth of 1.1 per cent per annum expected between 2036 and 2051.

The Melbourne UGB is expected to grow more quickly (1.7% p.a. 2016-2036 and 1.3% p.a. 2036-2051) than the project catchment, this is due to a high proportion of the project catchment being

existing residential areas. However, areas identified as 'key residential locations' are expected to grow most quickly between 2016 and 2036 (2.2% p.a.). These 'key residential locations' include growth areas to the north of Melbourne including: Epping; Mernda; South Morang and Wollert in the Whittlesea LGA which are expected to accommodate new residential development in the near future. Growth in these 'key residential locations' is expected to return to 1.1 per cent per annum between 2036 and 2051.

Table 2 – Population forecasts for Project catchment

				2016-2036		2036 - 2051	
Study area	2016	2036	2051	Change	CAGR	Change	CAGR
Key residential locations	310,807	476,477	562,195	165,669	2.2%	85,718	1.1%
Project catchment	1,773,337	2,336,023	2,764,932	562,686	1.4%	428,908	1.1%
Melbourne UGB	4,379,804	6,090,175	7,406,967	1,710,371	1.7%	1,316,793	1.3%

Source: TfV Reference Case land use v.1.08 based on VIF 2015

Table 3 shows forecast household growth in the north east being largely in line with that of population. However, it should be noted that the number of households is forecast to grow more quickly than population, representing a fall in the average number of persons per dwelling in the future.

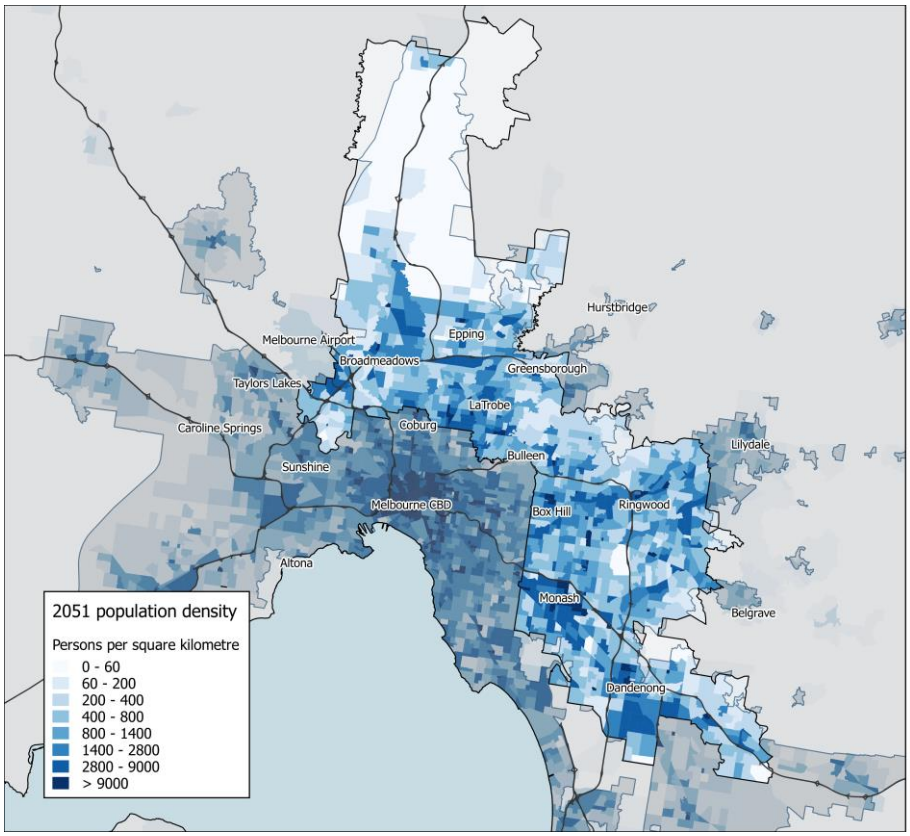
Table 3 - Household forecasts for North East Study Area

				2016-2036		2036 - 2051	
Study area	2016	2036	2051	Change	CAGR	Change	CAGR
Key residential locations	110,646	172,299	207,956	61,653	2.2%	35,657	1.3%
Project catchment	653,006	879,576	1,059,138	226,570	1.5%	179,563	1.2%
Melbourne UGB	1,699,067	2,414,045	2,994,646	714,978	1.8%	580,601	1.4%

Source: TfV Reference Case land use v.1.08 based on VIF 2015

Figure 9 shows forecast population density in 2051 within the project catchment. Population is expected to be relatively well distributed within the project catchment with greater density around the NEICs and MACs (i.e. Broadmeadows, Epping, La Trobe, Ringwood, Monash, Dandenong).

Figure 9 – 2051 population density



Source: TfV Reference Case land use v.1.08 based on VIF 2015

3.2.2 Employment

Access to labour markets is a key driver of employment and productivity growth.[7] Understanding where employment is forecast to grow is essential in catering for transit oriented development and enabling increased accessibility and productivity in areas with the greatest forecast employment change. It is also important in understanding the destinations of household trips in the future.

Table 4 shows VIF 15 employment forecasts for the north east between 2016 and 2051. Notably, employment is forecast to grow at 1.7 per cent per annum in the total catchment between 2016 and 2036, before growing more conservatively at 1.3 per cent per annum between 2036 and 2051.

The NEICs and MACs identified as important to the north east are forecast to grow by 2.0 per cent per annum between 2016 and 2036, with more modest growth of 1.4 per cent per annum expected between 2036 and 2051. Overall, employment growth is forecast to be faster in the NEICs and MACs suggesting that these areas should be a focus of increased accessibility, to promote productivity gains.

Table 4 – Employment forecasts for the NEICs and MACs, Project catchment and rest of Melbourne

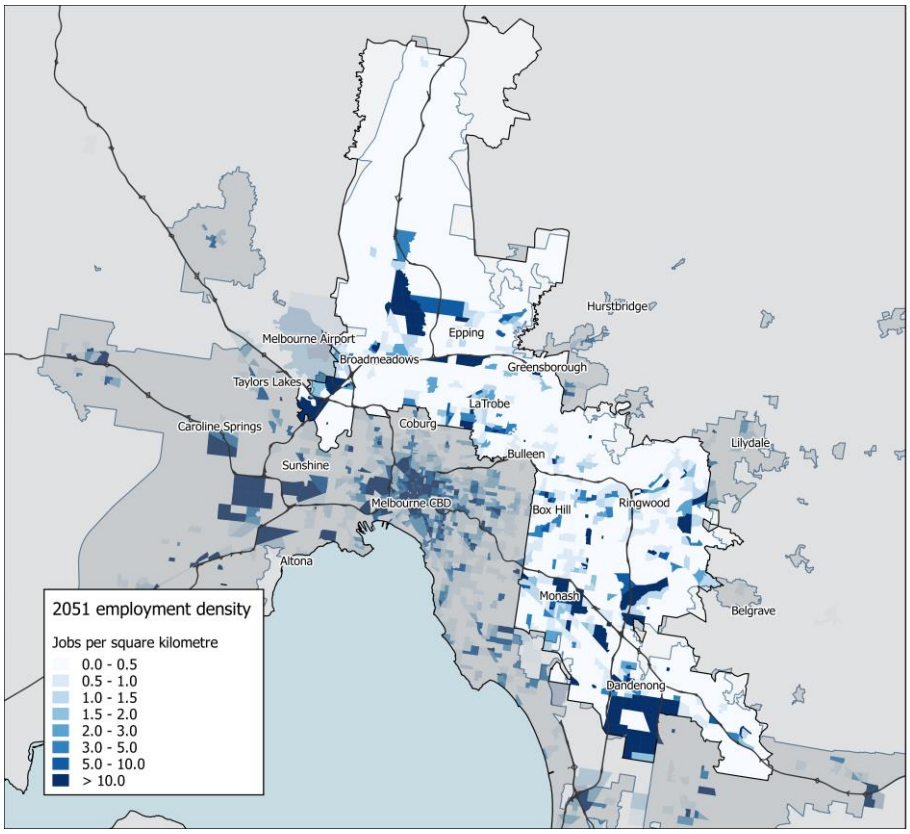
				2016-2036		2036 - 2051	
Study area	2016	2036	2051	Change	CAGR	Change	CAGR
NEICs and MACs	88,051	131,442	163,078	43,392	2.0%	31,635	1.4%
Project catchment	774,463	1,093,668	1,337,165	319,204	1.7%	243,497	1.3%
Melbourne UGB	2,248,013	3,223,377	4,017,136	975,364	1.8%	793,759	1.5%

Source: TfV Reference Case Land use v.1.08 based on VIF 2015

[7] North East Link Business Case – Chapter 1

Figure 10 shows the employment density in 2051. Note, future employment within the project catchment is expected to be clustered around NEICs and MACs (i.e. Broadmeadows, Epping, La Trobe, Ringwood, Monash, Dandenong).

Figure 10 – 2051 Employment density



Source: TfV Reference Case land use v.1.08 based on VIF 2015

3.2.3 Zoning and policy

Planning system considerations are important in understanding the feasibility of forecast population and employment densities.

Table 5 shows the percentage of land use for the North East, Metropolitan Melbourne and Melbourne LGA. The project catchment is characterised by residential land and to a lesser extent mixed use zones, with some commercial and industrial land (approx. 6 per cent). This is very similar to other areas in Metropolitan Melbourne. However, in comparison with the Melbourne LGA, the north east has much a smaller percentage of commercial and industrial land and a much higher percentage of residential land.

The ability of areas in the north east to accommodate increased density subject to planning constraints is explored in more detail in section 5.1.

Table 5 – Land use in the north east catchment

Area	Residential	Commercial and Retail	Industrial	Other
Project catchment (%)	65.1	1.9	4.7	28.3
Metropolitan Melbourne (%)	66.0	2.4	6.2	25.4
Melbourne LGA (%)	17.7	6.1	9.7	66.4

Source: Vicmap, DELWP

3.2.4 Plan Melbourne

Plan Melbourne was established to help achieve the Victorian Governments vision for Melbourne to become a 'global city of opportunity and choice.' It is estimated that between 2015 and 2051 Melbourne is projected to grow by 3.4 million people, from a population of 4.5 million to almost 8 million. This will require additional housing across Melbourne to accommodate this growth.

A key policy direction of Plan Melbourne is that *"population and housing growth will be kept within the existing urban growth boundary by the careful development of growth areas and the selective redevelopment of underutilised areas within existing communities."* It also seeks to create a more globally connected and competitive Melbourne by increasing the number and diversity of jobs closer to where people live, facilitate social and economic participation, and establish liveable communities and the creation of 20-minute neighbourhoods so that people can access a range of local services and facilities, ideally within 20 minutes of home. Therefore any future housing supply be located in areas that can capitalise on existing infrastructure and also in proximity to jobs, services and public transport.

Plan Melbourne also identified that by targeting development and infrastructure investment in key employment areas this will maximise the city's productivity. National Employment and Innovation Clusters such as La Trobe have been designated as key precincts to promote and grow knowledge-based and high-productivity industries. Together with key industrial precincts, transport gateways, health and education precincts and metropolitan activity centres, these clusters will attract investment and stimulate employment.

Table 6 outlines the NEICs and MACs in the Project Catchment as set out by Plan Melbourne and identified as important to the north east.

Table 6 – NEICs and MACs within the Project Catchment

NEIC	MACs
La Trobe	Broadmeadows
	Epping
	Box Hill
	Ringwood

Source: Plan Melbourne, DELWP

Figure 11 - Plan Melbourne summary

Source: Plan Melbourne, DELWP

The precinct analysis and refinement of land use scenarios will draw on these strategic visions to develop some key assumptions on the allocation of future population and employment growth.

3.3 Initial modelling results

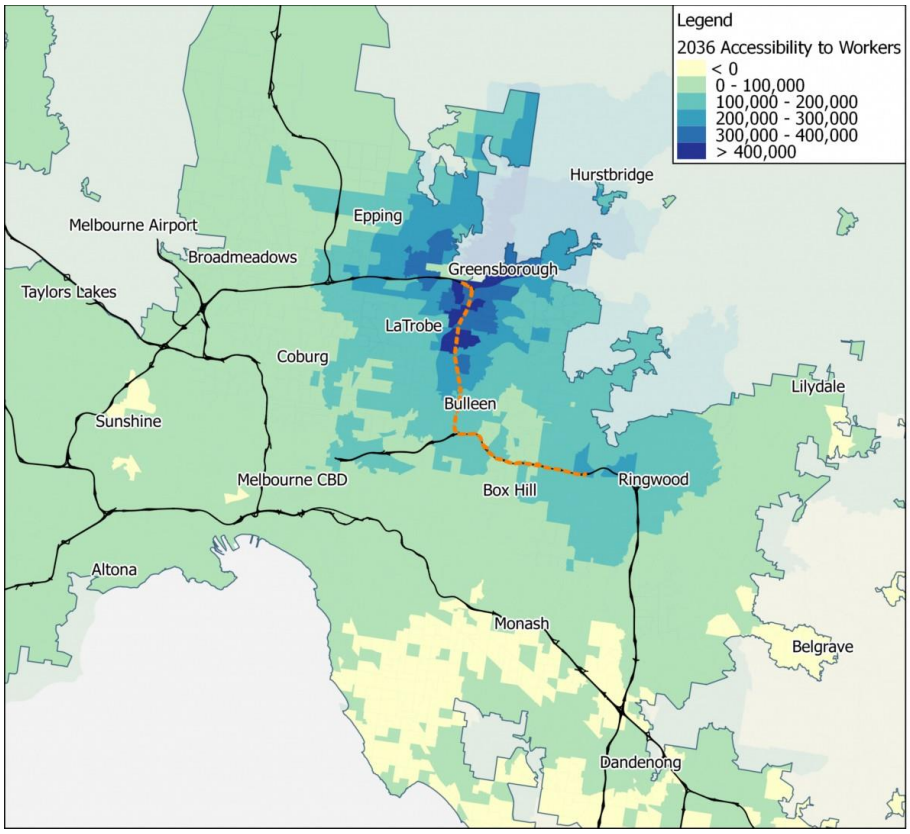
Preliminary transport modelling results were used to identify the areas of Melbourne that could be expected to experience the most significant changes in accessibility and therefore changes in land use demand. This information was used to define the key areas of interest for understanding potential supply constraints and market factors that could influence land use outcomes.

Figure 12 and Source: VLC, EY analysis

Figure 13 below show accessibility change to workers and jobs respectively for 2036 with construction of North East Link. Accessibility to workers is expected to improve for areas along the alignment, as well as north of the M80 Freeway and east of the Hume Freeway, including: La Trobe; Epping, and Broadmeadows. Accessibility to employment is expected to improve for areas along the alignment Rosanna, Bundoora, Greensborough and Reservoir. Improved access to jobs is also expected in areas south of the Eastern Freeway, including Blackburn and Box Hill. However, these areas to the south of the Eastern Freeway already experience good connection to jobs and local services and are therefore not expected to experience significant increased accessibility due to the construction of North East Link.

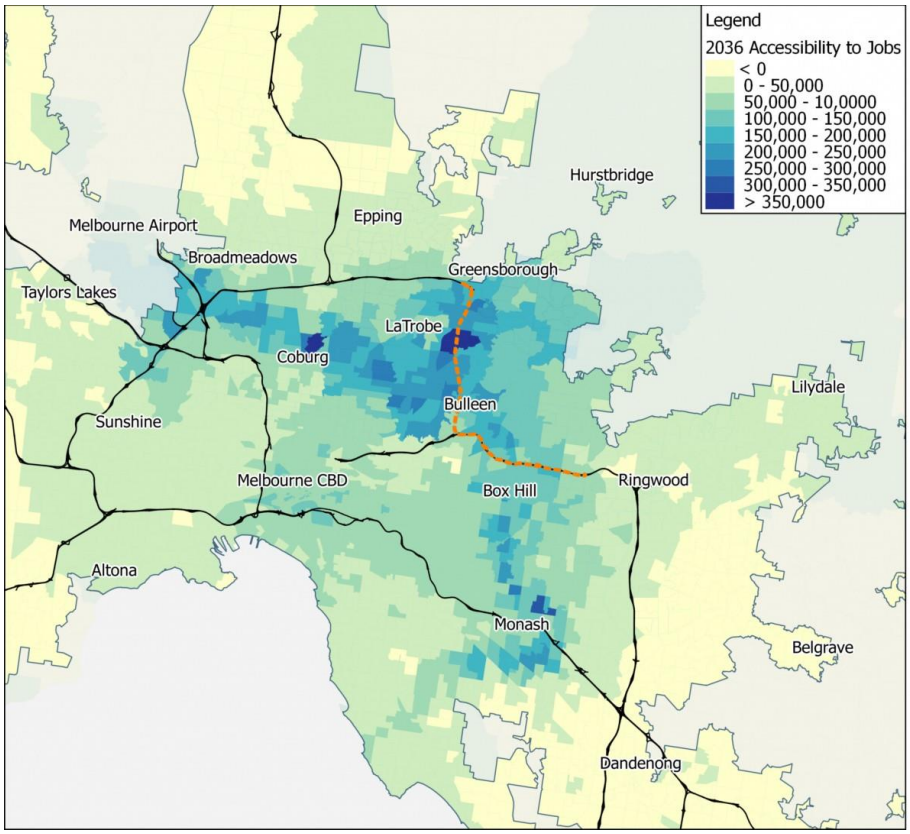
Accordingly, the definition of precincts is focused on areas along the alignment, as well as industrial centres including Broadmeadows and Epping.

Figure 12 – Accessibility to workers within 45 minutes



Source: VLC, EY analysis

Figure 13 – Accessibility to jobs within 45 minutes



Source: VLC, EY analysis

3.4 Identification of precincts impacted by North East Link

Precincts have been identified on the basis of their potential to experience an uplift in value and attractiveness due to the construction of North East Link, as per Figure 12 and Source: VLC, EY analysis

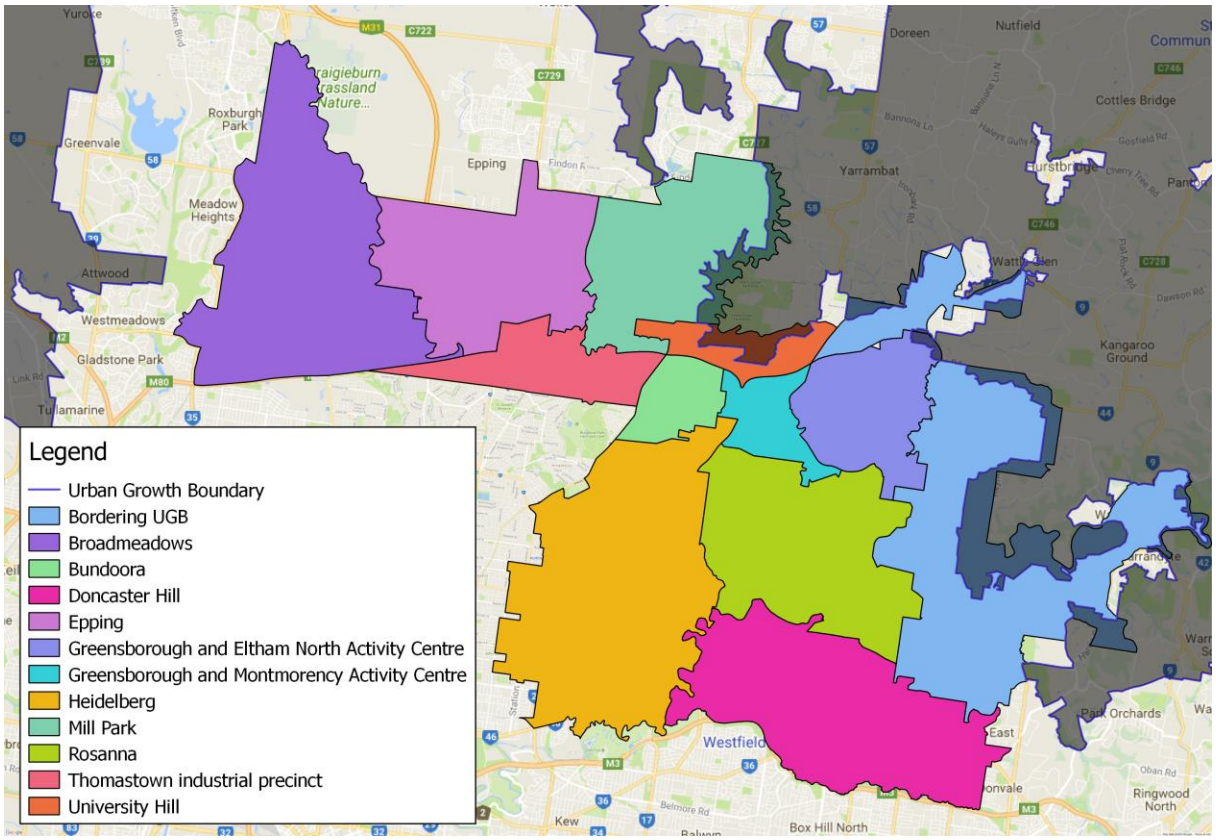
Figure 13. Precincts will be classified on their land use classification and features (i.e. commercial and residential precincts).

Figure 14 below depicts precincts defined by EY based on the location of key population and employment nodes that are within proximity to the project and are expected to benefit from the project. These precincts will be subject to further analysis outlining the constraints and opportunities for development.

Each precinct has a combination of land uses and planning controls that will allow for ongoing population and employment growth. Additional growth would be expected with the delivery of the potential project.

The assessment in this document considers the growth trajectory without the project based on opportunities and constraints and historical trends.

Figure 14 – North East Link Precincts



Source: EY Analysis

4. Case Studies

This section explores historic land use changes following the construction of Melbourne toll roads, including the M80 Ring Road, EastLink and the Mornington Peninsula Freeway. These case studies have helped to validate the project case land use scenario as well to understand potential implications for land use policy.

In undertaking review of the ability of road construction to induce a population and employment change in the vicinity of the project, the EY Real Estate Advisory Services ("REAS") and Infrastructure Advisory ("IA") teams have undertaken the following stepped approach:

1. **Key constraint definition** – we have considered the constraints to dwelling growth and employment growth around both existing case studies by reviewing the planning environment and significant changes to planning policy over the assessment period.
2. **Study area identification and characterisation** – Three study areas have been utilised in each assessment as follows:

   a. case study transport zones that represent key employment precincts / drivers in the case study.
   b. wider study area data for surrounding LGA's
   c. observed averages for the Melbourne Statistical Division.

   These comparison areas allow for consideration of relative changes in trends for input variables post-delivery of case study project.

3. **Timeline of assessed data –** the assessment period has been confined to a window pre- and post-project delivery of ten years. It should be noted however that in the case of EastLink data for 2016 is only a forecast. Actual employment data for 2016 is not yet available.

4. **Data inputs utilised** – The following variables have been utilised, population, annual average population growth, employment (total), employment (industrial), employment (retail / commercial).

This analysis is not definitive due to data constraints but can act as an input to future forecasts of how the project may influence development in the residential and commercial market post-delivery.

The comparison with broader trends in Melbourne allows for some isolation of market impacts. In situations where employment has declined in grown significantly this may have limited relevance to the case study if this trend is consistent with Melbourne averages.

4.1 EastLink

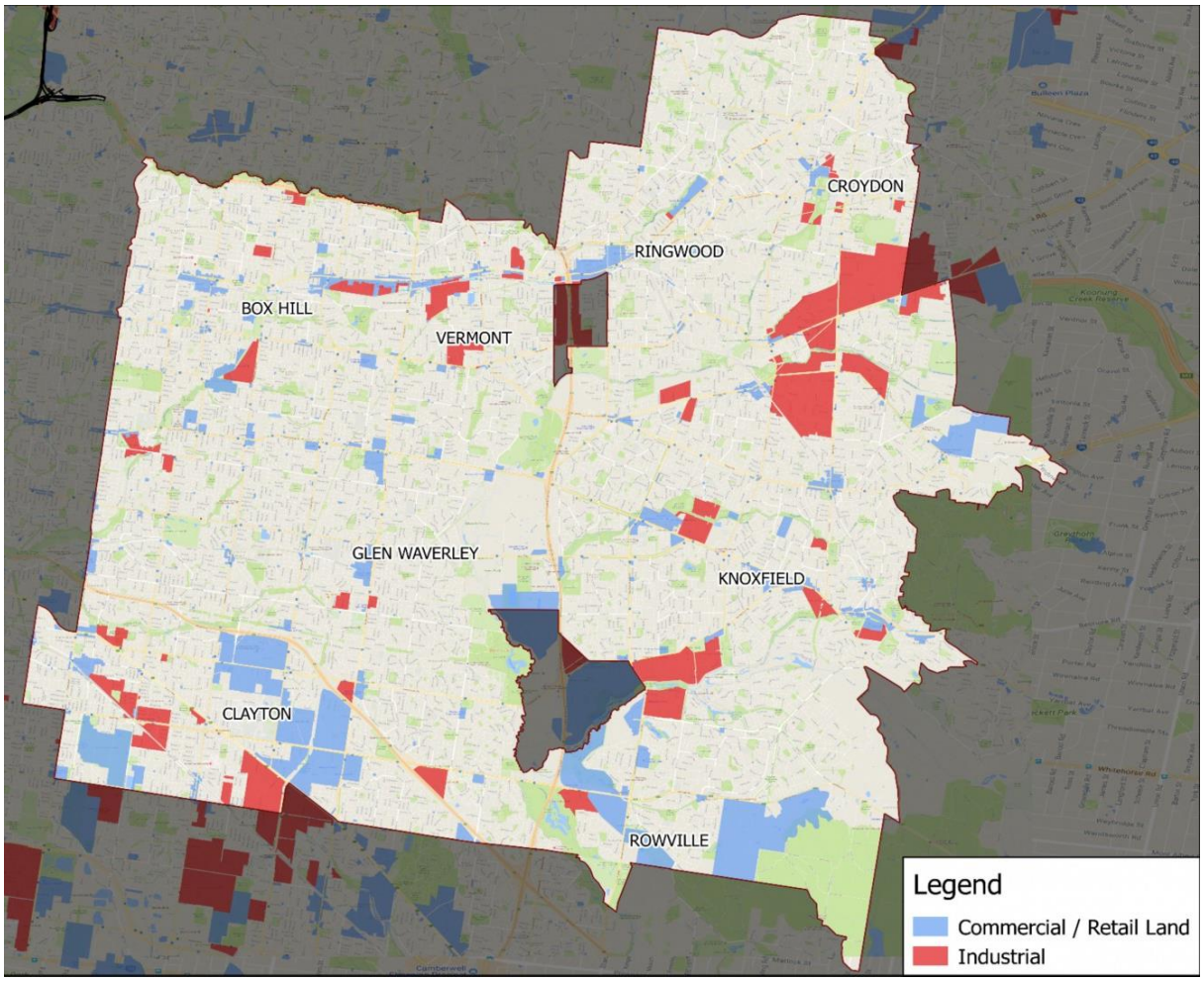
Prior to construction the EastLink corridor reservation was largely undeveloped open space with some residential dwellings to the south of the Monash Freeway. Construction commenced March 2005 and the project opened June 2008.

We have completed analysis based on a pre-project timeframe of 2006-08 and compared this to post-project 2009-16. This case study examines the land use change in the following areas:

- EastLink North
- Caribbean Gardens
- Key residential areas adjacent to EastLink (Ringwood, Mitcham, Rowville, Wantirna South)
- Eastern LGAs (Maroondah, Whitehorse, Monash, Knox)
- Rest of Melbourne (excluding Melbourne LGA)

The figure below shows the total study area identified for EastLink. Note, the two dark regions within the study area represent EastLink North industrial precinct and Caribbean Gardens.

Figure 15 – EastLink study area

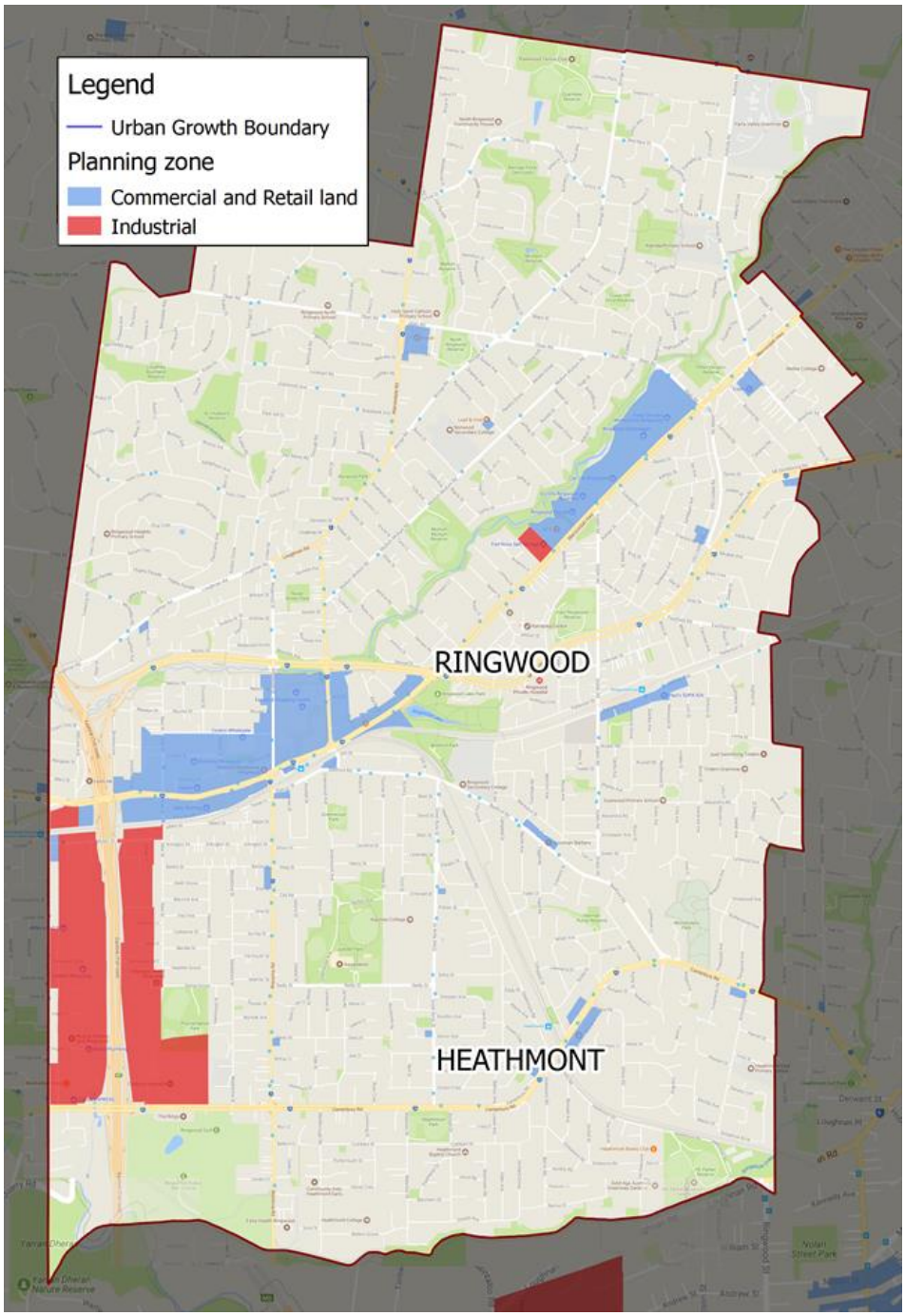


Source: DELWP, Google Maps, EY Analysis

4.1.1 Employment

EastLink North is an established industrial precinct that was primarily developed before the delivery of the EastLink project. The precinct is shown in the figure below.

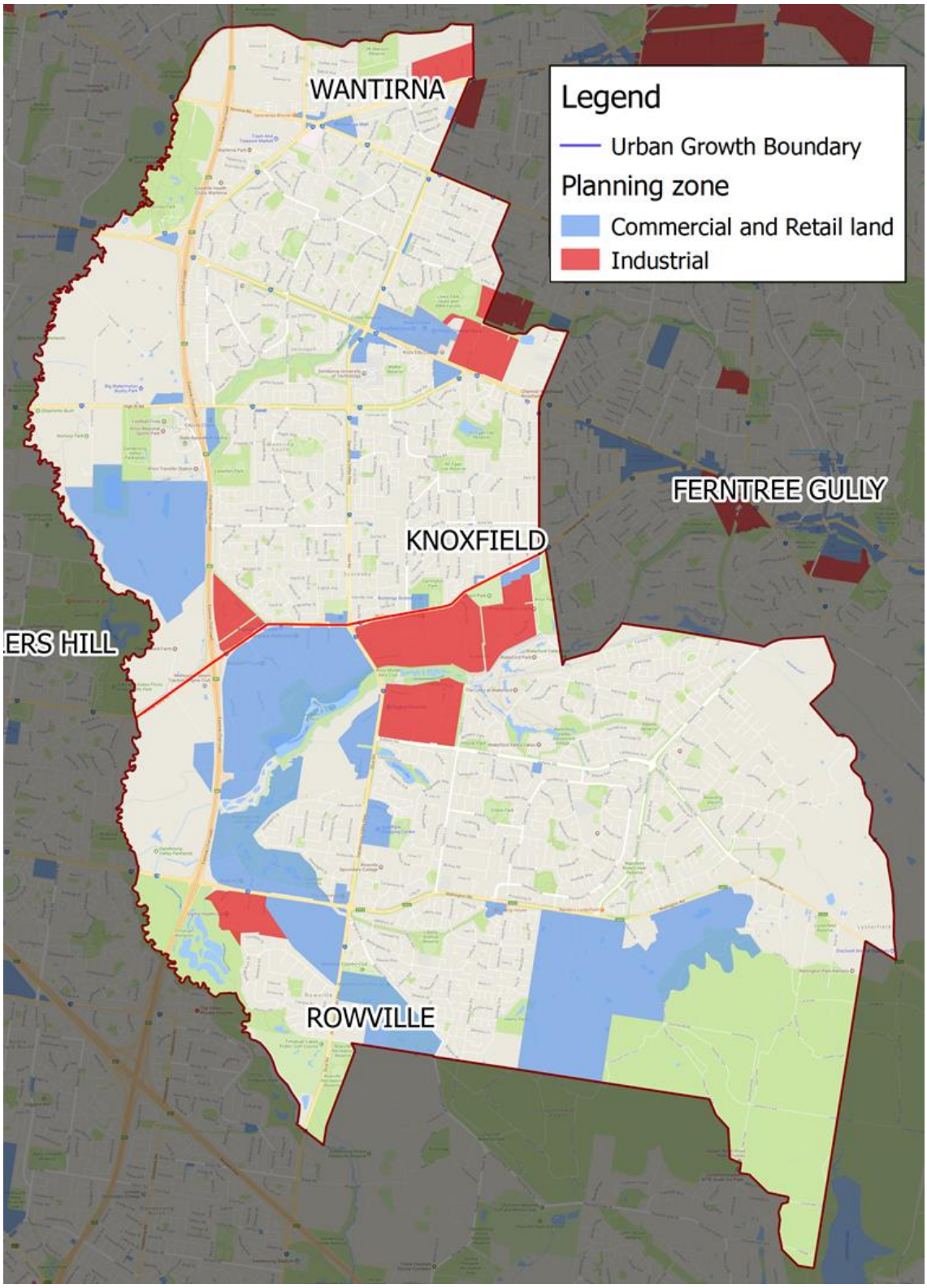
Figure 16 – EastLink North industrial precinct



Source: DELWP, Google Maps, EY Analysis

Caribbean Gardens is a more recently established precinct that was delivered in unison with the opening of EastLink from 2016. While the area including some older industrial sites a number of new employment precincts with vacant land have been delivered to the market over the last 10 to 15 years. The precinct is shown in the figure below.

Figure 17 – Caribbean Gardens



Source: DELWP, Google Maps, EY Analysis

4.1.1.1 Key constraints summary

Table 7 – Key constraints summary

Constraint	Comments
Statutory Planning	► EastLink North. Planning controls in the EastLink north industrial precinct are composed of primarily Industrial 1 with a small area of Industrial 3 zone. There are no limits on office floor space in the schedule to the Industrial 1 zone and built form is not constrained by detailed design and development overlay (DDO). The Ringwood Activity Centre includes predominantly Commercial 1 (C1) zoned land where residential and commercial uses are allowable. Height limit controls allow for high density development. ► Caribbean Gardens. Precinct composed of a mix of zones including Special Use, Commercial 2 Zone and Industrial 1 zone.
Land Fragmentation	► EastLink North. At least 50% of the precinct includes large un-fragmented sites which allows for employment growth and transformation of activity. ► Caribbean Gardens. Most of the Commercial 2 zone land sits on large sites with several vacancies available post project delivery. Industrial 1 zone is more fragmented however this is only around 20% of precinct. The SUZ land is largely undeveloped and includes a service station.
Surrounding Features	► Both precincts have access to the EastLink project ► The Caribbean Gardens precinct has limited residential encroachment on immediate boundaries and had significant opportunity for strong employment growth between 2006 and 2011. Some vacant sites remain. ► The EastLink north precinct was developed in the 1980s and 1990s with opportunities post project more focussed on re-development. Sites are fully occupied.

The opportunities for industrial and commercial development provided by the planning system land fragmentation ability enabled Caribbean Gardens and EastLink North areas to increase in employment density following the construction of EastLink.

4.1.1.2 Employment change

Table 8 below shows the historic population in EastLink North and Caribbean Gardens pre and post construction of EastLink. Industrial employment in Caribbean Gardens increased from approximately 3,800 in 2006 to 4,400 in 2016, while commercial and retail employment grew from 800 in 2006 to 1,400 in 2016. Employment throughout the broader east and established Melbourne also increased significantly during the period. However, employment in the EastLink North precinct declined over the same period.

Table 8 – EastLink employment change before and after construction

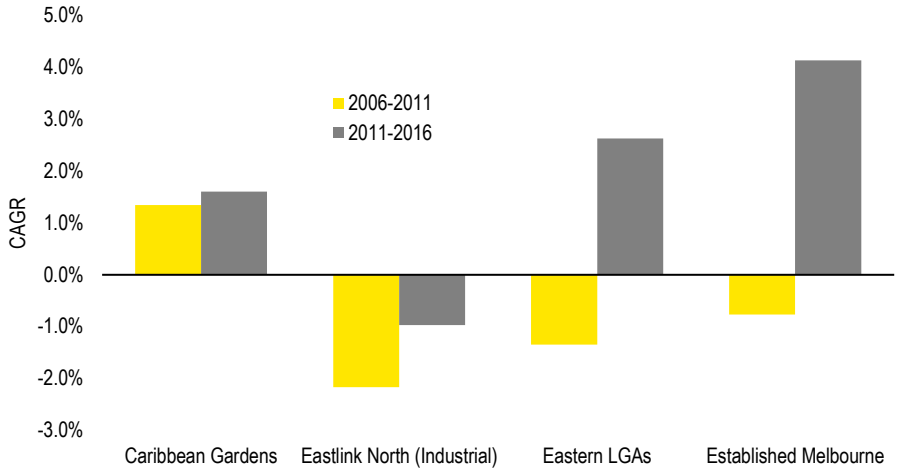
	Industrial			Commercial / retail		
Location	2006	2011	2016 forecast	2006	2011	2016 forecast
Caribbean Gardens	3,792	4,054	4,390	747	909	1,443
EastLink North (Industrial)	2,306	2,067	1,969	1,179	1,346	965
Eastern LGAs	71,764	67,059	76,358	162,073	186,382	213,975
Established Melbourne	295,742	284,625	348,533	705,487	812,478	979,529

Source: Victoria in Future 2015, ABS, EY analysis

Figure 18 and Figure 19 below show a comparison of employment growth across all employment study areas before and after the construction of EastLink.

Following the construction of EastLink, industrial employment growth rate increased in both Caribbean Gardens and EastLink North. However, during the same period, industrial employment growth also grew in the broader east and established Melbourne.

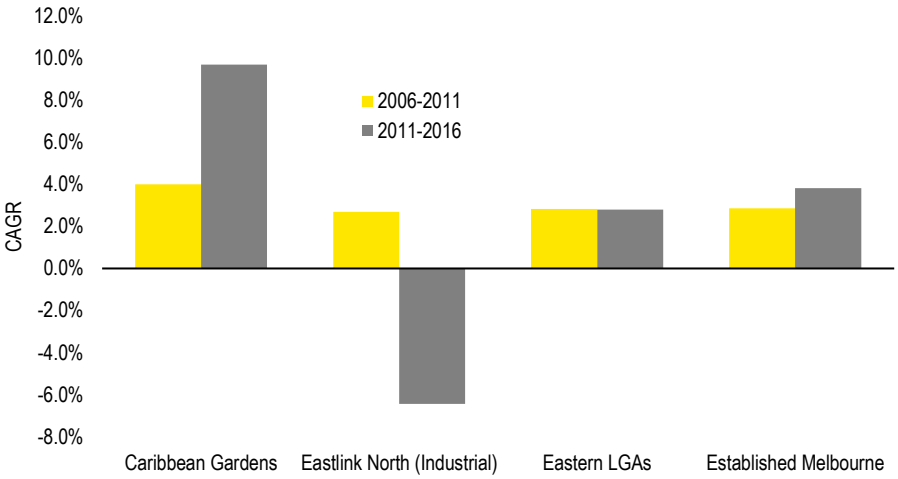
Figure 18 – Pre and post EastLink opening industrial employment growth



Source: Victoria in Future 2015, ABS, EY analysis

The figure below shows that following the construction of EastLink (2011 to 2016), commercial and retail employment in Caribbean Gardens grew considerably (9.7%), albeit from a low base, while employment in EastLink North declined. Over the same period, commercial and retail employment growth in the east remained relatively consistent when compared with 2006 – 2011 levels, while the rate of employment growth in established Melbourne increased.

Figure 19 – Pre and post EastLink opening commercial / retail employment growth



Source: Victoria in Future 2015, ABS, EY analysis

There is no evidence to suggest that EastLink has led to any significant transformation in employment or increase in density in the EastLink North precinct between 2006 and 2011 particularly in relation to employment in the industrial sector. The trends in industrial employment are similar to those in LGA's across the broader study area.

The data reveals that the Caribbean Gardens precinct has experienced growth in industrial employment that has outperformed the averages for LGA's within Melbourne's east. There has also been particular strong employment growth in white collar jobs many of which are likely to be located in the precinct. The data suggests that the EastLink project did lead to an acceleration in employment that outperformed established parts of East Melbourne.

4.1.2 Population

Key residential areas adjacent to EastLink that have been analysed for impact include:

1. Ringwood – located toward the northern end of the new infrastructure
2. Mitcham – located toward the northern end of the new infrastructure
3. Rowville – Central, North and South – located toward the southern end of the new infrastructure
4. Wantirna South – located toward the southern end of the new infrastructure

4.1.2.1 Key constraints summary

Table 9 – Key constraints summary

Constraint	Comments
Statutory Planning	► Around the date of the road opening (June 2008) residential land within Ringwood was subject to R1Z zoning which allowed development to support additional dwellings. Commercial zoning to activity centre also allows for mixed use residential dwellings. ► Mitcham comprises R1Z zoning to residential land which allows development to support additional dwellings. ► Rowville and Wantirna South were zoned R3Z at the date of the road opening which allows some development, though limits density and height.
Land Fragmentation	► All residential areas comprise predominantly subdivided land which can be subdivided further to units, however there are few larger un-subdivided sites
Surrounding Features	► Ringwood and Mitcham have strong fundamentals with access to public transport which appealed to younger buyers and CBD workers. ► Rowville and Wantirna South have little access to public transport and during this period was not considered an appealing residential location.

Planning controls in Mitcham and Ringwood enabled development to support additional dwellings following the construction of EastLink. Furthermore, access to public transport provided incentive for prospective residents to locate in these areas.

Planning controls and access to public transport in Rowville and Wantirna South were less favourable to accommodate residential growth.

4.1.2.2 Population change

Figure 20 shows the historic population in key residential areas pre and post construction of EastLink. As a baseline to compare local areas influenced by the project, we have analysed population change over three broader areas which are summarised as follows:

► Total Melbourne - Outer East (less analysed areas) comprises areas within Knox, Manningham, Maroondah, Whitehorse and Yarra Ranges LGA's.

► Total Melbourne – Inner East comprises areas within Port Phillip, Melbourne City, Stonnington – West and Yarra LGA's and inner northern suburbs.

► Established Melbourne is analysed as total metropolitan Melbourne less growth area LGA's.

These areas showed a slight drop in CAGR in the analysed period pre project (2006-08) compared to post project (2009-16) being a drop in CAGR of between 0.05% and 0.16%.

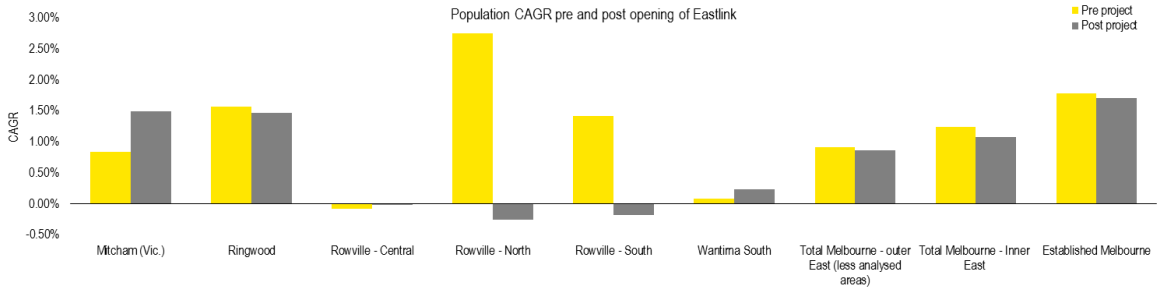
Mitcham SA2 ABS-defined area showed increase in CAGR post project opening (an increase in CAGR of 0.65%), whilst Ringwood dropped slightly coming off a high base.

Rowville SA2 areas showed no change, in fact dropping significantly in CAGR. This may be explained by more restrictive residential zoning compared to Mitcham and Ringwood.

Wantirna South SA2 area showed an increase of 0.16% CAGR over the two analysed periods pre and post project, albeit coming off a low base.

Overall the residential areas immediately adjacent to the EastLink project showed modest CAGR growth post project compared to larger statistical areas and the total of established Melbourne.

Figure 20 – Observed population trends before and after the construction of EastLink



	Annual Growth Rate										2006-08 CAGR	2009-16 CAGR
Statistical Area - CAGR	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Pre project	Post project
Mitcham (Vic.)	0.83%	0.84%	0.70%	0.37%	0.53%	3.02%	2.54%	1.76%	1.28%	0.95%	0.84%	1.49%
Ringwood	1.24%	1.88%	3.02%	1.45%	1.12%	1.74%	1.58%	1.53%	1.42%	1.46%	1.56%	1.47%
Rowville - Central	-0.67%	0.52%	0.23%	0.04%	-0.99%	0.11%	0.15%	0.20%	0.14%	0.21%	-0.08%	-0.02%
Rowville - North	4.11%	1.41%	1.17%	-0.19%	-1.66%	0.06%	-0.01%	0.01%	-0.01%	0.04%	2.75%	-0.25%
Rowville - South	1.10%	1.73%	1.71%	0.45%	-0.21%	-0.28%	-0.22%	-0.30%	-0.33%	-0.36%	1.42%	-0.18%
Wantirna South	-0.22%	0.39%	-0.03%	-0.19%	-0.51%	0.05%	0.40%	0.53%	0.68%	0.71%	0.08%	0.24%
Total Melbourne - outer East (less analysed areas)	0.87%	0.95%	1.30%	0.47%	0.31%	0.81%	0.91%	1.05%	1.17%	1.30%	0.91%	0.86%
Total Melbourne - Inner East	1.14%	1.33%	1.26%	0.62%	0.36%	0.98%	1.23%	1.36%	1.41%	1.57%	1.23%	1.08%
Established Melbourne	1.71%	1.86%	2.03%	1.20%	0.90%	1.79%	1.96%	2.01%	1.96%	2.10%	1.78%	1.70%

Source: ABS, EY Analysis

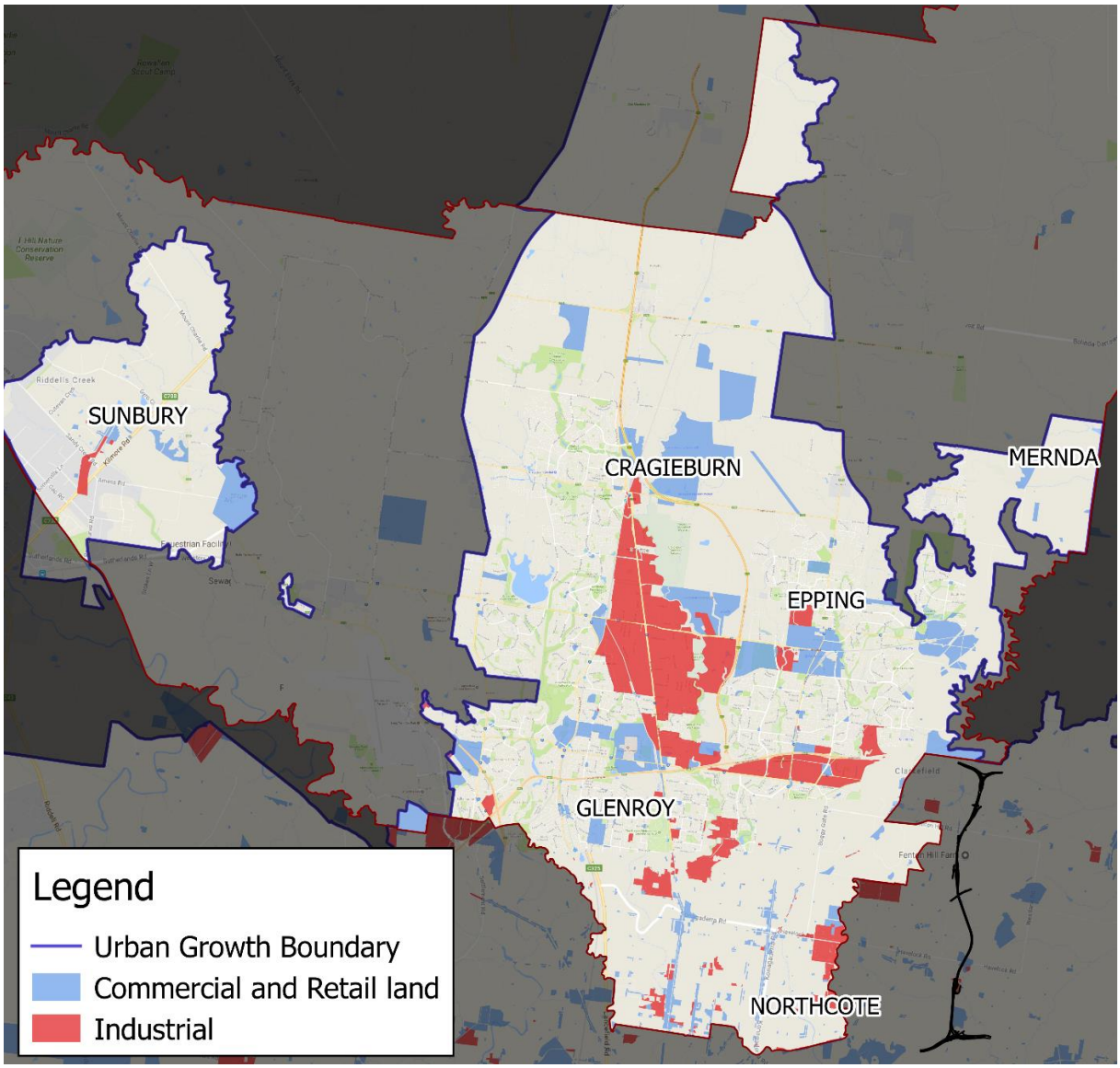
4.2 M80 Western Ring Road

The M80 Western Ring Road was constructed in sections with construction beginning in 1992 and ending in 1999. We have completed analysis based on the timing of the final, eastern stages of the project being pre project timeframe of 1996-99 and compared this to post project timeframe of 2000-06. The areas of analysis for the M80 case study include:

- Thomastown industrial precinct
- University Hill precinct and town centre
- Cooper Street industrial precinct
- Key residential areas adjacent to M80 (Coburg, Moreland, Whittlesea)
- Northern LGAs (Darebin, Moreland, Hume, Whittlesea)
- Rest of Melbourne (excluding Melbourne LGA)

The figure below shows the total study area identified for the M80 Western Ring Road.

Figure 21 – M80 Ring Road study area

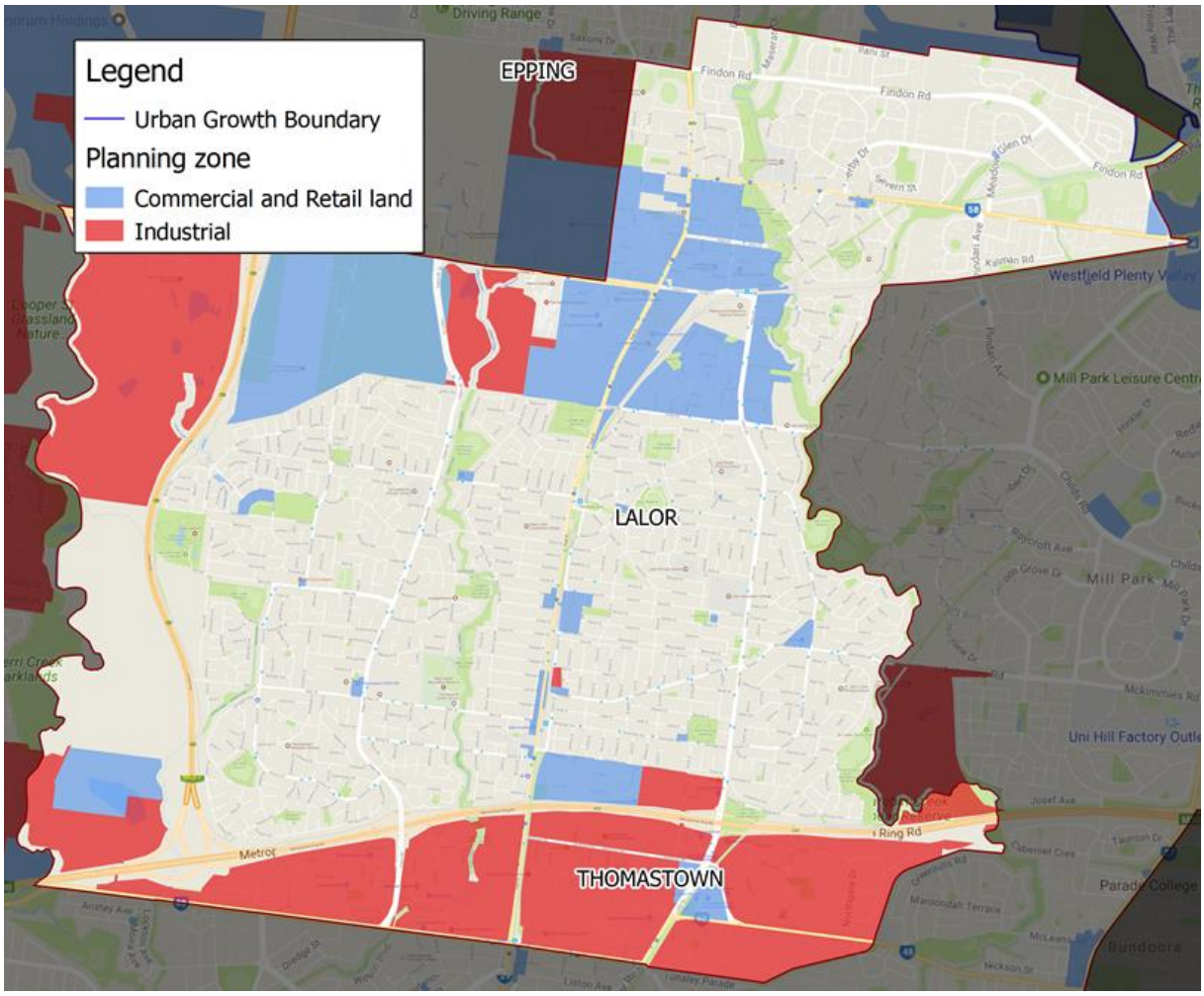


Source: DELWP, Google Maps, EY analysis

4.2.1 Employment

The precincts assessed around the M80 corridor include established areas and new industrial estates and business parks that have enjoyed ongoing access to the M80 / Northern Ring Rd and the more recently completed Craigieburn bypass.

Figure 22 – M80 industrial precinct



Source: DELWP, Google Maps, EY analysis

4.2.1.1 Key constraints summary

Table 10 – Key constraints summary

Constraint	Comments
Statutory Planning	► **Thomastown Industrial Precinct.** The Thomastown Industrial Precinct is dominated by IN1 zone with constraints for most land uses. While office is an allowable use the location is not attractive given surrounding land uses. ► **University Hill Precinct.** Zoning is Special Use zone 3 allowing for a number of uses including manufacturing, light industrial, commercial and residential. ► **Cooper St Industrial precinct.** This precinct includes a mix of IN1, and Priority Development Zone (PDZ) which encourages manufacturing and industrial uses.
Land Fragmentation	► Land in most precincts offers a mix of sizes with a number of vacant parcels in Cooper St precinct and recently developed parcels in University Hill. ► The established Thomastown Industrial precinct directly adjacent to the M80 offers a range of lot sizes that would be attractive to the market with a suitable adjustment in planning controls.
Surrounding Features	► The Thomastown industrial precinct and Coopers St precinct both have direct access to the M80 via either existing connections or the Craigieburn bypass. ► Campus style office development is not currently feasible in most of the study area with the exception of University Hill where a high amenity environment has been created close to a new mixed use activity centre. ► Commercial development and employment densification could occur over time (10-20 years) with appropriate re-zoning of parts of the Thomastown Industrial precinct near the existing.

Planning system controls in the Thomastown industrial precinct provide a constraint to development, while zoning in the University Hill precinct facilitates industrial, commercial and residential development. Developers within the M80 industrial precinct have the ability fragment parcels of land to enable higher density development.

The construction of the M80 Ring Road connected the Thomastown industrial and Coopers St precinct to the freeway network, enabling more efficient connection to suppliers and key freight nodes across Melbourne.

4.2.1.2 Employment change

Table 11 below shows the historic population in the M80 industrial precinct pre and post construction of the M80 Western Ring Road. Industrial employment in the M80 industrial precinct increased significantly over the period from approximately 2,600 in 1996 to 6,300 in 2006. Over the same period, there was a decline in industrial employment in the north and the rest of established Melbourne.

Commercial and retail employment in the M80 industrial precinct declined from 2,200 in 2001 to 2,100 in 2011. Significant growth in commercial and retail employment occurred in Melbourne's north and the rest of established Melbourne during the same period.

Table 11 – M80 Ring Road employment change before and after construction

	Industrial			Commercial / retail		
Location	1996	2001	2006	1996	2001	2006
M80 Industrial	2,583	2,667	6,348	2,227	2,267	2,142
Northern LGAs	74,566	78,820	64,881	80,093	91,780	107,155
Established Melbourne	345,583	364,373	302,376	614,186	662,960	891,818

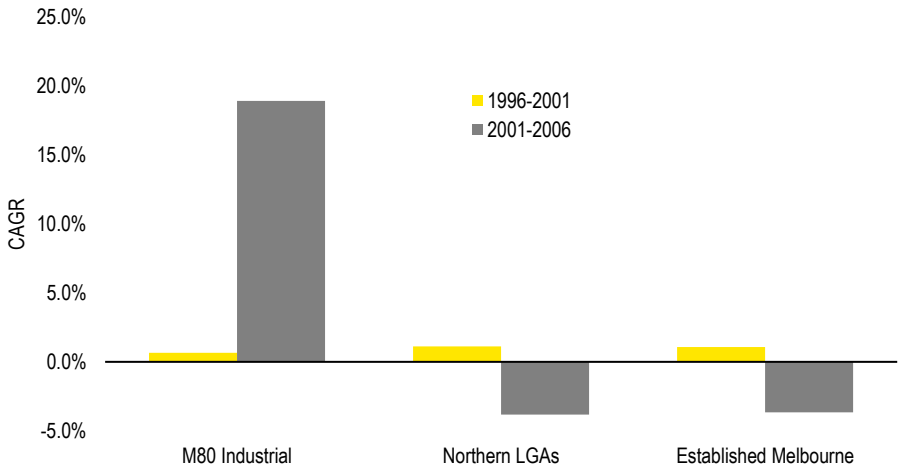
Source: Victoria in Future 2015, ABS, EY analysis

Figure 23 and Figure 24 below show a comparison of employment growth across all employment study areas before and after the construction of the M80 Ring Road.

In regard to industrial employment, the precincts in the study area have outperformed trends in industrial employment across northern Melbourne LGA's and industrial employment more broadly in Melbourne SD. This outcome is particular evident in the period between 2001 and 2006, following the opening of the M80 Ring Road. During the period, industrial employment grew from 2,700 jobs to 6,400 at a rate of 18.9 per cent per annum.

The study area includes a large volume of vacant land around Cooper St in Epping adjacent to the Craigieburn bypass as well as the University Hill precinct near Thomastown which has been delivered to industrial and commercial developers over the last ten years.

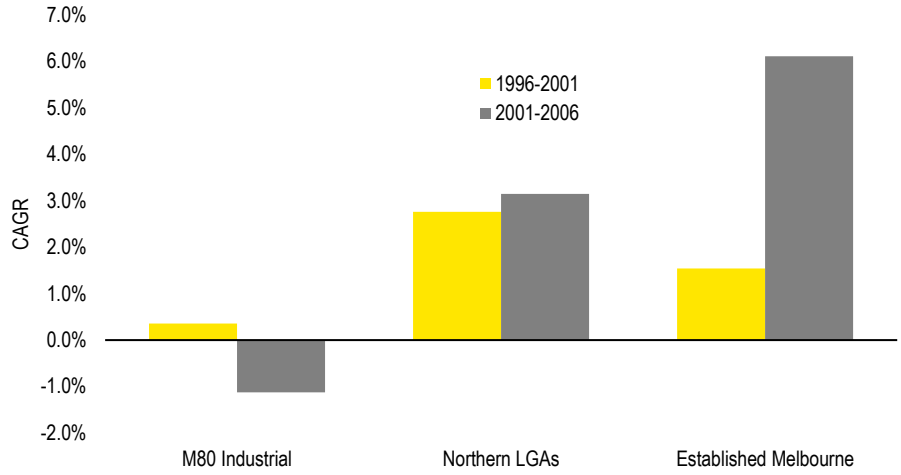
Figure 23 – Pre and post M80 Ring Road opening industrial employment growth



Source: Victoria in Future 2015, ABS, EY analysis

The figure below shows the change in the rate of commercial and retail development before and after the opening of the M80 Ring Road. There is no evidence that project construction assisted an increased rate of commercial development within the study area.

Figure 24 – Pre and post M80 Ring Road opening commercial / retail employment growth



Source: Victoria in Future 2015, ABS, EY analysis

4.2.2 Population

Key residential areas adjacent to the Northern Ring Road that have been analysed for impact include:

1. Coburg – suburb south of the latter stages of the project
2. Moreland (north) – broader northern portion of the Moreland LGA
3. Whittlesea (south east and south west) - broader southern portion of the Whittlesea LGA

4.2.2.1 Key constraints summary

Table 12 – Key constraints summary

Constraint	Comments
Statutory Planning	► Around the date of the opening of the last section (1999) residential land within all the reviewed areas was R1Z which allowed development to support additional dwellings.
Land Fragmentation	► All residential areas comprise predominantly subdivided land which can be subdivided further to units, however there are few larger un-subdivided sites.
Surrounding Features	► Coburg / Moreland have strong fundamentals with access to public transport which appealed to younger buyers and CBD workers, albeit this analysis is based around the timeframe of the mid to late 1990's. ► Southern Whittlesea was further from the CBD compared to Coburg / Moreland and more affordable during this time but established as a residential area that has grown in value since the early 2000's as buyers looking for affordable housing have been pushed out to these areas since this time.

Planning controls in key residential areas in the vicinity of the project provided capacity to support additional dwellings following the construction of the project. Furthermore, good public transport access and affordable housing provided incentive for prospective residents to locate in these areas.

4.2.2.2 Population change

Figure 25 below shows historic population growth in key residential areas in the vicinity of the M80 Ring Road project pre and post construction.

As a baseline to compare local areas influenced by the project, we have analysed population change over three broader areas which are summarised as follows:

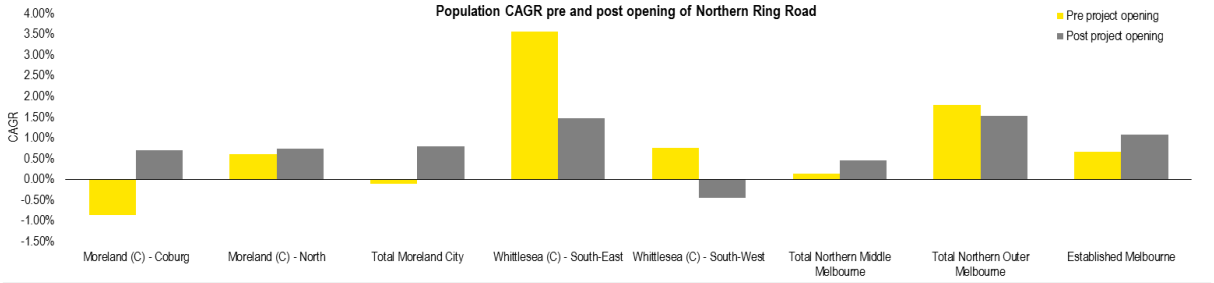
- Total Northern Middle Melbourne comprises the areas Banyule (C) – Heidelberg, Banyule (C) – North, Darebin (C) – Northcote and Darebin (C) – Preston.
- Total Northern Outer Melbourne comprises the areas Nillumbik (S) – South, Nillumbik (S) - South-West, Nillumbik (S) Bal, Whittlesea (C) – North, Whittlesea (C) - South-East and Whittlesea (C) - South-West.
- Established Melbourne is analysed as total metropolitan Melbourne less growth area LGA's.

The broader areas provided mixed pre and post project population change results; Total Northern Middle Melbourne showed an increase in CAGR of 0.32% over the analysed pre and post project timeframe, Total Northern Outer Melbourne dropped in CAGR by 0.27% over the analysed periods and Established Melbourne showed an increase in CAGR of 0.40%.

Analysed areas surrounding the new infrastructure showed varied results, for example Moreland showing a significant increase (1.57% additional CAGR) compared to Whittlesea (C) - South-East an increase in CAGR of 2.09%.

Overall our analysis did not show any clear increase in population growth in statistical areas surrounding the new infrastructure.

Figure 25 – Observed population trends before and after the construction of the M80 Ring Road



	Annual Growth Rate										1996-99 CAGR	2000-06 CAGR
Statistical Area - CAGR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	*Pre project*	*Post project*
Moreland (C) - Coburg	-0.63%	-1.36%	-0.62%	-1.12%	-0.06%	0.59%	0.42%	0.75%	1.20%	1.28%	*-0.87%*	*0.70%*
Moreland (C) - North	0.48%	0.92%	0.43%	0.42%	0.77%	0.35%	0.43%	0.70%	0.70%	1.47%	*0.61%*	*0.74%*
Total Moreland City	-0.07%	-0.23%	-0.03%	-0.37%	0.45%	0.56%	0.49%	0.82%	1.01%	1.39%	*-0.11%*	*0.79%*
Whittlesea (C) - South-East	3.02%	4.75%	2.91%	2.25%	2.99%	1.84%	1.03%	0.05%	2.31%	0.61%	*3.56%*	*1.47%*
Whittlesea (C) - South-West	0.20%	0.59%	1.46%	1.19%	0.32%	-0.04%	-0.48%	-1.19%	-0.94%	-0.42%	*0.75%*	*-0.46%*
Total Northern Middle Melbourne	0.36%	0.05%	-0.01%	-0.15%	0.24%	0.13%	0.21%	0.14%	0.84%	1.20%	*0.14%*	*0.46%*
Total Northern Outer Melbourne	1.28%	2.07%	2.01%	1.73%	2.06%	1.38%	1.40%	1.11%	1.69%	1.48%	*1.79%*	*1.52%*
Established Melbourne	0.56%	0.65%	0.81%	0.91%	1.07%	1.10%	0.96%	0.86%	1.08%	1.38%	*0.67%*	*1.08%*

Source: ABS, EY analysis

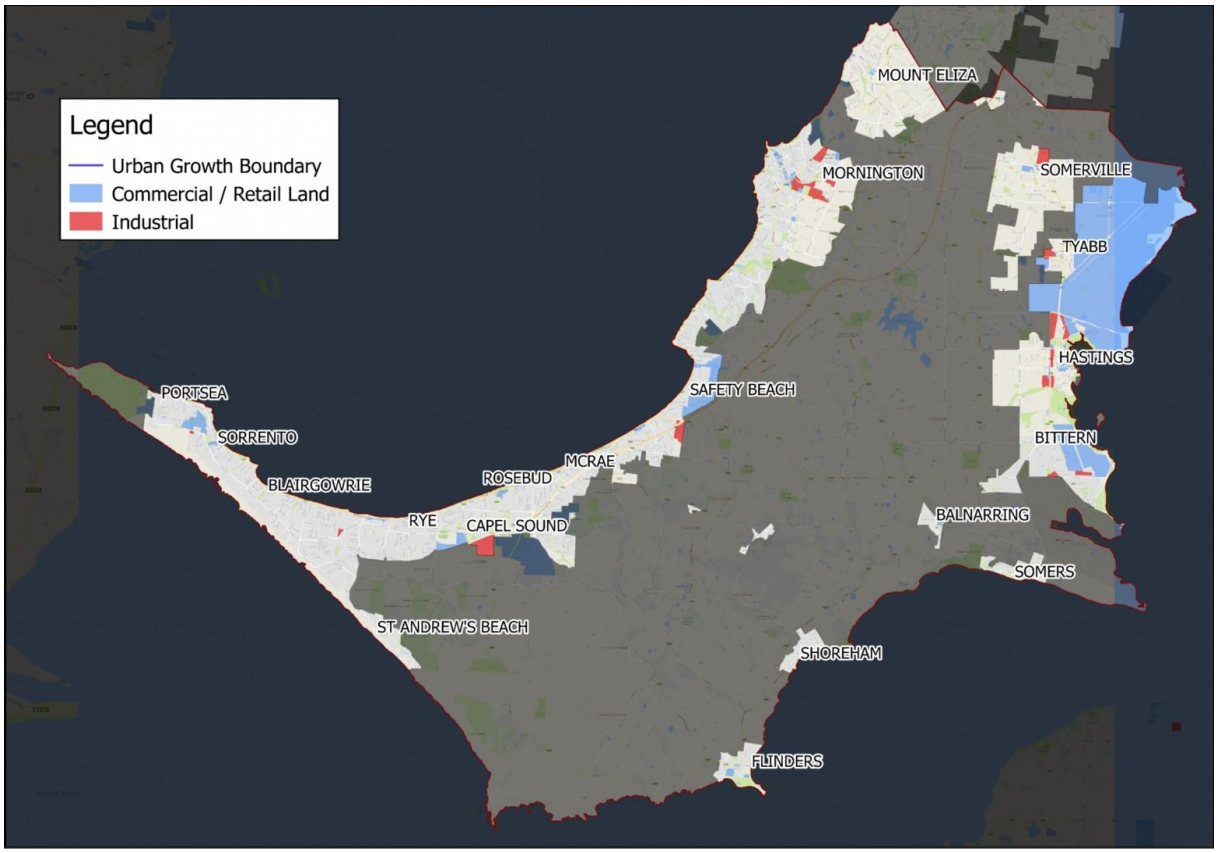
4.3 Peninsula Link

Peninsula Link opened in January 2013 and therefore we have completed analysis based on the pre project timeframe of 2006-12 and compared this to post project timeframe of 2013-16. The study area for the Peninsula Link comprises areas within the Mornington Peninsula LGA. Residential areas adjacent to the Peninsula Link that have been analysed for impact include:

- Rosebud - McCrae – suburbs adjacent to the western most portion of the road project
- Point Nepean – statistical area generally west of the road project
- Mornington Peninsula – LGA

The figure below shows the study area investigated for the Peninsula Link Freeway case study.

Figure 26 – Peninsula Link study area



Source: DELWP, Google Maps, EY Analysis

4.3.1 Population

Residential areas adjacent to the Peninsula Link that have been analysed for impact include:

1. Rosebud – McCrae – suburbs adjacent to the western most portion of the road project
2. Point Nepean – statistical area generally west of the road project
3. Mornington Peninsula – LGA

Point Nepean (left) and Rosebud-McCrae (right) are shown in the figure below.

Figure 27 – Key residential areas in the vicinity of Peninsula Link

4.3.1.1 Key constraints summary

Table 13 – Key constraints summary

Constraint	Comments
Statutory Planning	► Predominantly residential land within these areas is zoned R1Z, which allows for development beyond conventional density dwellings, however there are design and development overlays (DDOs) that exist over most of these areas. These DDOs prescribe types of development allowed, which in some locations is potentially constraining development activity.
Land Fragmentation	► There are examples of large, un-subdivided portions of residential land around Rosebud and McCrae ► Residential areas in the balance of the study area comprise predominantly subdivided land which can be subdivided further to units, however there are few larger un-subdivided sites
Surrounding Features	► Strong development activity around Rosebud where land is available, and unit development in the balance of the study area where planning allows. ► Broader area constrained by the geography of the area (i.e. Port Phillip Bay to the north and Bass Straight south)

While planning controls in the Mornington Peninsula allow for higher density residential development, DDOs may have provided constraint to development following the opening Peninsula Link.

4.3.1.2 Population change

Figure 28 below shows population growth in Rosebud-McCrae and Point Nepean relative to the broader Mornington Peninsula study area and the rest of established Melbourne before and after the construction of Peninsula Link.

As a baseline to compare local areas influenced by the project, we have analysed population change of Established Melbourne, which is analysed as total metropolitan Melbourne less growth area LGA's.

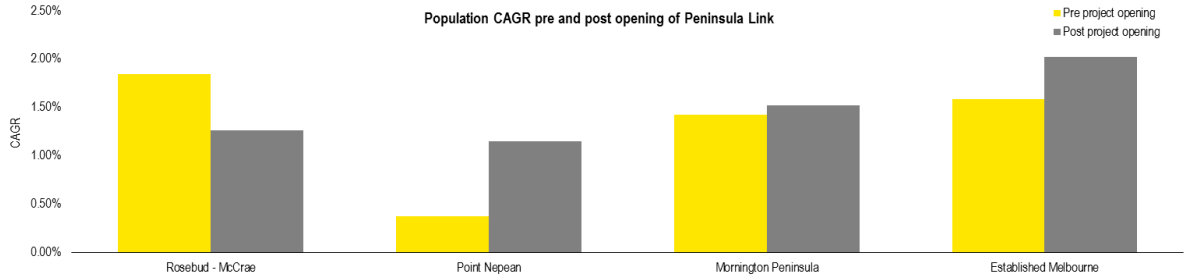
Population growth in established Melbourne from pre project (2006-12) compared to post project (2013-16) showed an increase in CAGR of 0.44 per cent.

Rosebud – McCrae showed a decrease in CAGR when comparing the pre and post construction period; whilst this area would be directly impacted by the new infrastructure, restrictive zoning may have attributed to slower average growth in the latter period.

Point Nepean (increase in CAGR of 0.78%) and Mornington Peninsula LGA (increase in CAGR of 0.10%) both showed increases over the period, though the latter is less than the analysed established Melbourne.

Overall our analysis generally showed an increase in CAGR for areas that would otherwise be expected to show subdued population growth, however it was considered moderate given the growth in established Melbourne over the period.

Figure 28 – Observed population trends before and after the construction of Peninsula Link



	Annual Growth Rate										2006-12 CAGR	2013-16 CAGR
Statistical Area - CAGR	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	*Pre project opening*	*Post project opening*
Rosebud - McCrae	2.64%	2.39%	2.60%	1.04%	0.93%	1.45%	1.29%	1.29%	1.35%	1.14%	*1.84%*	*1.26%*
Point Nepean	0.25%	0.27%	0.13%	0.08%	0.05%	1.46%	1.27%	1.30%	1.04%	1.12%	*0.37%*	*1.15%*
Mornington Peninsula	1.74%	1.88%	1.80%	1.05%	0.49%	1.56%	1.42%	1.58%	1.45%	1.52%	*1.42%*	*1.52%*
Established Melbourne	1.71%	1.86%	2.03%	1.20%	0.90%	1.79%	1.96%	2.01%	1.96%	2.10%	*1.58%*	*2.02%*

Source: ABS, EY Analysis

4.4 Key findings

4.4.1 Implications for employment forecasts

Case study 1 – EastLink

The analysis of employment trends between 2006, 2011 and 2016 confirmed that the EastLink project may have contributed to a moderate increase in employment across the project study area particularly in the Caribbean Gardens industrial and commercial precinct and in the Ringwood Activity Centre.

Employment growth for industrial sector jobs in Caribbean Gardens outperformed growth in the same sector in a wider study area of Eastern Melbourne LGA's and the balance of Melbourne between 2006 and 2011. However it is likely that much of the growth was due to the absorption of land by new businesses on vacant land serviced by the road, not a re-generation of existing tenants / businesses into new jobs.

In contrast the volume of industrial employment in the 'EastLink north' precinct (which is principally concentrated adjacent to EastLink near Ringwood) fell between 2006 and 2011.

This indicates that the EastLink project is a driver of land absorption and new jobs in precincts where vacant sites are available, however it has not in general led to employment densification in the industrial sector in already established precincts.

Employment in the retail and commercial sectors both grew strongly in the sub-precincts analysed with average annual growth of 4% (Caribbean Gardens) and 2.9% (EastLink North) respectively between 2006 and 2011.

Case study 2 – M80 Western Ring Road

The analysis of employment trends between 1996, 2001 and 2006 confirmed that this project has continued to support ongoing employment growth in the sub-precinct included in the case study.

The sub-precinct includes a number of industrial estates that have been progressively developed in unison with new road infrastructure. The metropolitan ring road was opened in 1999 and supported the early development of a number of new estates along the corridor. In turn the Craigieburn bypass was opened in 2004 which has also been a driver of new development in industrial estates including the Cooper St precinct.

The case study also includes 'University Hill' which is a mixed use manufacturing, commercial retail and residential precinct adjacent to the M80 Ring Road. This precinct supports industrial and commercial employment.

This indicates that the M80 project in unison with the Craigieburn bypass has been a significant driver of land absorption and new jobs in precincts where vacant sites are available, however it is also unlikely to have led to any significant employment densification in already established industrial precincts such as the Thomastown industrial area.

Data assessed in this case study confirmed industrial and commercial employment growth between 2001 and 2006 that significantly outperformed averages for northern LGA's and the rest of established Melbourne.

Conclusion

The outcomes highlighted in the case studies show correlation between new road infrastructure and industrial employment growth. However, it should be noted that most industrial precincts within the vicinity of the project have already been developed prior to likely construction timing of the project.

Without a supporting re-zoning to land use, a significant level of growth in industrial employment would be unlikely. Commercial jobs that may be driven by improved access can however be supported by more flexible planning controls, particularly in activity centres.

4.4.2 Implications for population forecasts

Case Study 1 – EastLink

The analysis of population trends pre and post project identified that the EastLink project may have contributed to a modest increase in population within the precinct study area, though results were varied.

In terms of study area comparisons, Ringwood and Mitcham outperformed the 'Outer East' and 'Inner East' statistical areas. It should also be noted that growth in these areas came off a high base through the pre-project timeframe. However, the rest of established Melbourne grew more quickly over the period following construction.

At a high level those areas with statutory planning controls that allow for development (i.e. Ringwood and Mitcham) experienced strong growth post project where those areas with more restrictive planning controls (i.e. Rowville and Wantirna) experienced less or no population growth.

Case Study 2 – M80 Western Ring Road

Analysis of population change in residential areas around the M80 Ring Road revealed there were varied changes in the level of population growth to the area impacted by the project.

Study areas compared comprised areas within Moreland and southern Whittlesea to statistical areas of 'Total Northern Outer Melbourne', 'Total Northern Middle Melbourne' and 'Established Melbourne'. Varied results could be explained by the project progressively being completed between 1992 and 1999 and therefore the impact on population in surrounding areas was diluted.

Overall, there was no clear increase to population growth due to construction of the project.

Case Study 3 – Peninsula Link

The analysis of population trends pre and post project revealed that Peninsula Link may have contributed to an increase in population within the study areas.

The analysis compared the suburbs of Rosebud and McCrae and larger areas of Point Nepean, the Mornington Peninsula and Established Melbourne.

For the analysis of Rosebud and McCrae, suburbs located immediately adjacent to the western end of the road, population growth declined following the project construction. However, the larger areas of Point Nepean and Mornington Peninsula LGA showed increases in population CAGR.

Overall analysis of population change in the study areas showed the project may have contributed to increased population growth.

Conclusion

The analysis presented above demonstrates that new toll roads may lead to a change in population and employment growth in surrounding areas. However, the analysis also demonstrates that the level of change depends on the nature of the project and local constraints and opportunities for land development. There's no simple picture across each of the case studies analysed, suggesting that the analysis of future projects like North East Link needs to take into account a range of factors to set against transport access changes that the project is estimated to provide.

The analysis shows that there may be some large increases in areas that are suitable for rapid change, particularly in the case of former agricultural and industrial sites where large landholdings are possible. When those opportunities don't exist, we observe the potential for projects to reinforce longer term growth trends and bring forward densification and development.

In general, at the LGA level, the analysis suggests that major toll roads and freeways can increase the rate of development at a precinct level. This is consistent with growth above baseline estimates in the thousands, rather than in the tens of thousands that is experienced with major urban rail upgrades, particularly in central city areas.

5. Precinct analysis and review of baseline

This analysis characterises the precincts of interest defined in section 3.

In the first instance we have reviewed the VIF model outputs for population numbers against recent ABS population projections and our understanding of recent trends in the residential markets in the study area. We have separately compared VIF employment outputs to our understanding of industrial and commercial markets in the defined precincts.

In undertaking the Land Impact assessment the EY Real Estate Advisory Services ("REAS") and Infrastructure Advisory ("IA") teams have undertaken the following sequential approach.

1. **Key constraint definition** – we have defined our key constraints based on our understanding of land use impacts from other infrastructure implementation.
2. **Precinct identification and characterisation** – Precincts have been defined with reference to accessibility metrics generated in EY's LUTI model. Each precinct identified has been characterised based on current land use, what is expected under Base Case (i.e. no infrastructure implementation) scenarios and how land use and corresponding value may change under the VIF Scenario (i.e. implementation of North East Link).
3. **Review VIF outputs against precinct constraints** – compare population and employment model outputs against expected trends and constraints of the precinct.

The results from this analysis have been used as a basis to refine land use model outputs, as well as consider alternative land use scenarios for testing.

Our analysis considers the constraints and opportunities that each precincts offers. The precinct constraints provide limits to potential development based on the following attributes:

- **Statutory planning** (what the zoning and overlay controls offer to use, yield and density)
- **Land fragmentation** (how land is split up and how this impacts development centred around the idea that the market is less likely to amalgamate smaller lots in order to developer rather than subdivide larger lots in order to develop)
- **Surrounding features** (i.e. how physical constraints will impact development)
- **Market readiness** (based on historic analysis of change the area and expected trends based on broad market understanding)

The above factors influence the development opportunity that each precinct offers and act as an input to our consideration of the appropriateness of population and employment forecasts and model outputs.

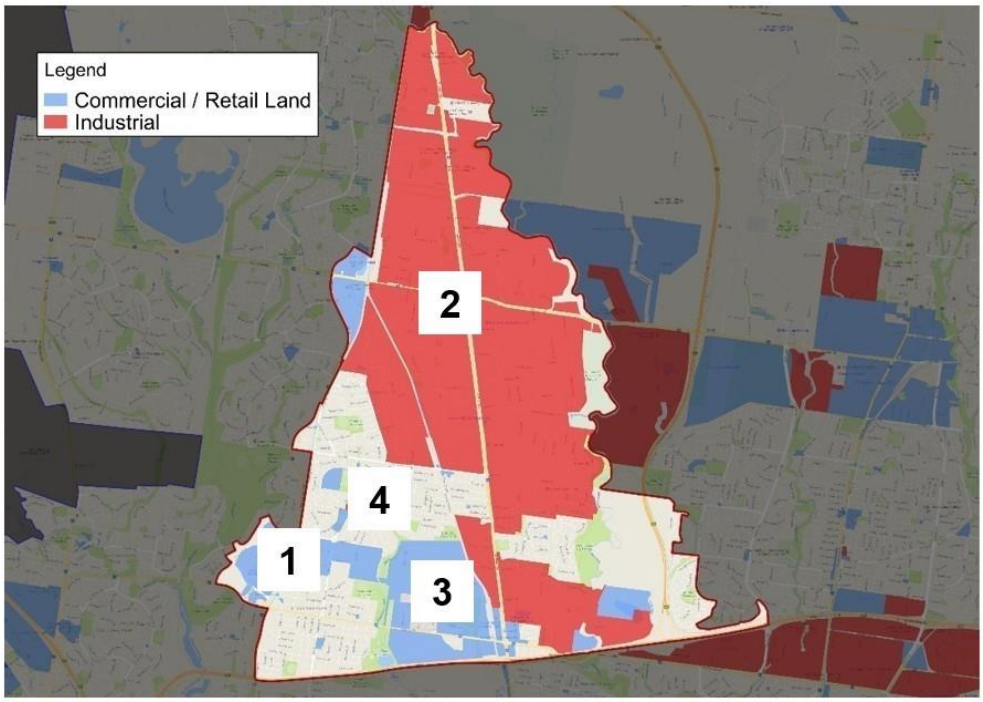
5.1 Precincts

5.1.1 Broadmeadows

5.1.1.1 Characterisation

The image below in Figure 29 show the Broadmeadows precinct boundaries, as well as its constraints and opportunities.

Figure 29 – Broadmeadows precinct geography



Source: DELWP, Google Maps, EY analysis

Table 14 below provides a characterisation of important areas within the identified Broadmeadows precinct, contextualising land use in the area.

Table 14 – Broadmeadows precinct characterisation

Area	Characterisation
1. Broadmeadows activity centre	► Includes the Broadmeadows Regional Shopping Centre, with this centre and surrounding retail and commercial properties appearing to be performing well with relatively low vacancy levels. ► Large future commercial area east of the core activity centre with strategic planning documents identifying this area for future commercial development (see sub-precinct 3) ► A growing residential population within this precinct will continue to drive demand for commercial and retail space.
2. Core Industrial precinct	► Predominantly comprises industrial showroom / large format warehouse properties which are accessible via the Hume Highway or Cooper Street, Campbellfield. Balance of the industrial precinct comprises light industrial warehouses uses. ► Covers a large footprint with the local market varied as older stock with inferior efficiency poorly received by the market however new, more modern and efficient stock well received due to proximity of the Western Ring Road and Hume Freeway. ► Melbourne Airport is located within proximity of this precinct; in late 2016 Melbourne Airport received approval to develop the remaining 146 hectares of vacant land within the Melbourne Airport Business Park for predominantly industrial warehouses and distribution centres.
3. Secondary industrial / commercial area	► Comprises a mix of land uses such as commonwealth land (Department of Defence Maygar Barracks, currently vacant), The Meadows greyhound racing track, Melbourne Immigration Transit Accommodation and conventional industrial and large format retail uses. ► There is surplus and vacant land within this precinct; whole area identified for future commercial, retail uses under strategic planning documents.
4. Residential	► Growing number of townhouse developments in the area, apartments are expected in the future around the activity centre.

The Broadmeadows precinct is bordered by the Hume Freeway in the east and the M80 Ring Road in the south and contains the Broadmeadows Metropolitan Activity Centre. Good existing connections to the freeway system will enable residents and businesses to benefit from the construction of North East Link. The precinct is characterised largely by industrial land, with the core industrial precinct, other industrial uses, as well as vacant land covering a large proportion of the area. Commercial and retail zoning is significant in the precinct, with the Broadmeadows shopping centre performing well with low retail vacancy rates. While existing residential is largely low density development, there is a growing emergence of town houses and indications of movement towards higher density residential development.

5.1.1.2 Key constraints summary

Table 15 below details constraints and opportunities to development within the Broadmeadows precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 15 – Key constraints summary

Constraint	Comments
Statutory Planning	► Currently low density development within retail / commercial precincts. Planning controls support significant commercial development. ► Greater Broadmeadows Draft Framework Plan details future development for the retail / commercial and industrial properties. Outcomes within the Draft Plan include a new town centre, the facilitation of a range of diverse housing opportunities and improved transport links between Broadmeadows, Campbellfield and the Northern Industrial Employment Precinct.
Land Fragmentation	► Broadmeadows activity centre offers significant land holding which is partially subdivided, however allows further subdivision/development. ► Otherwise commercial and industrial precincts offers significant opportunities for subdivision (fragmentation). ► Residential land predominantly conventional dwelling lots.
Surrounding Features	► Broadmeadows Shopping Centre fronts Pascoe Vale Road and is bound by residential properties and Hume Central Secondary College. ► Industrial land to the south of the precinct generally abuts railway infrastructure (train lines) or parkland. Vacant industrial land development possible in properties along Sydney Road, leading north of Campbellfield to Somerton.
Market Readiness	► Precinct largely characterised by low to medium density development. ► Commercial and industrial development highly possible within the precinct but currently subject to a lack of demand.

While development is currently predominantly low to medium density, planning controls, potential for land fragmentation and vacant land would facilitate consolidated higher density development.

This is supported by the Greater Broadmeadows Framework plan, existing planning controls, as well as vacant industrial land which allow for significant commercial/retail and industrial development. Furthermore, existing lot sizes in Broadmeadows allow for subdivision and the emergence of town house residential development.

5.1.1.3 Baseline population and employment forecasts

Table 16 below shows the forecast population in the Broadmeadows precinct from 2016 to 2051 according to the Victoria in Future 2015 (VIF15) forecasts. In total, population is expected to grow from 28,800 in 2016 to 42,100 in 2051. Note, population growth is forecast to slow considerably between 2036 and 2051.

Total employment in the Broadmeadows precinct is expected to grow from 46,100 in 2016 to 74,400 by 2051, with strong growth expected between 2016 and 2026 (1.95%), before more modest growth is expected in the longer term (0.80% per annum between 2026 and 2036, 1.39% per annum between 2036 and 2051). Commercial and retail employment is expected to grow faster

than industrial employment to 2036, with industrial employment growing marginally quicker between 2036 and 2051. Note, the forecast floor space ratios for industrial and commercial and retail employment are low, highlighting the potential for further development.

Table 16 – Broadmeadows population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	28,784	33,982	39,215	42,126
CAGR		1.67%	1.44%	0.48%
Person per dwelling	3.06	3.00	2.88	2.74
Industrial Employment - VIF (Base Case)	26,544	31,230	33,322	40,875
CAGR		1.64%	0.65%	1.37%
Floor Space Ratio	0.11	0.13	0.14	0.17
Commercial & Retail Employment- VIF (Base Case)	14,009	17,699	20,082	24,141
CAGR		2.37%	1.27%	1.23%
Floor Space Ratio	0.14	0.18	0.21	0.25
Total Employment	46,083	55,877	60,535	74,448
CAGR		1.95%	0.80%	1.39%

Source: Victoria in Future 2015, DELWP, EY analysis

With a large availability of General Residential Zone (GRZ) land and the ability for further subdivision facilitating the ongoing emergence of the apartment and townhouse market in the longer term, current planning controls are expected to accommodate forecast growth.

This is supported by the Greater Broadmeadows Framework plan, existing planning controls, as well as vacant industrial land which allow for significant commercial/retail and industrial development. Provided the Greater Broadmeadows Framework plan, existing vacant industrial land and the very low forecast floor space ratios, all forecast employment growth can be accommodated in the existing planning schemes.[8]

Review of precinct constraints suggest that the Broadmeadows precinct is able to accommodate forecast development and has capacity for additional development above levels forecast by VIF.

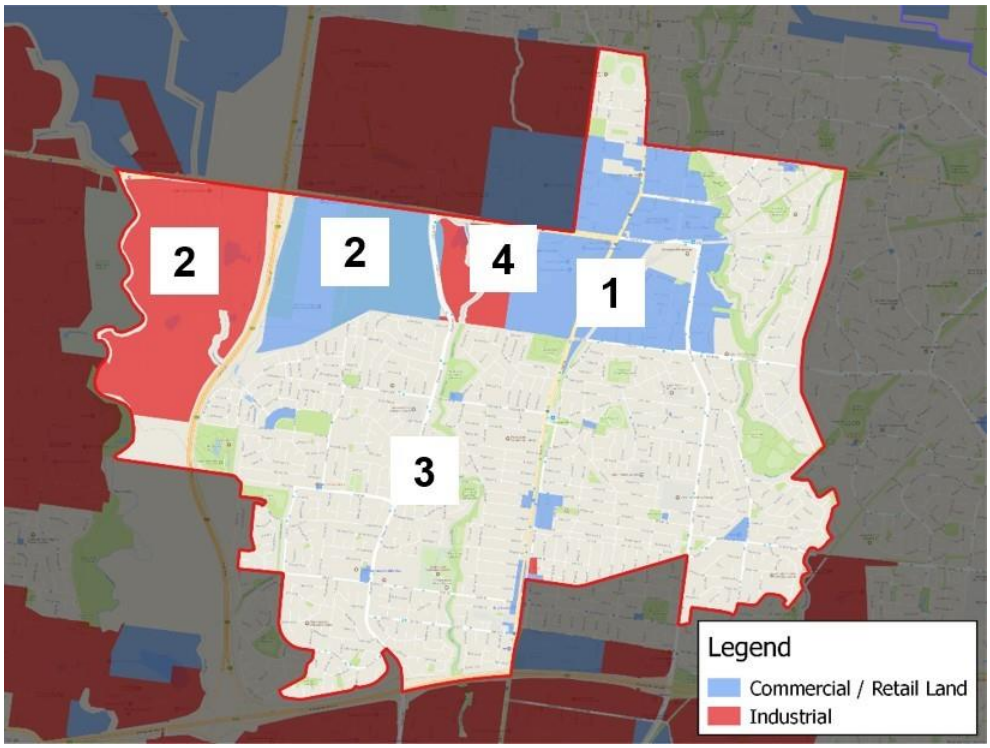
5.1.2 Epping

5.1.2.1 Characterisation

The image below show the Epping precinct boundaries, as well as its constraints and opportunities.

[8] Floor space ratio refers to ratio between Gross Floor Area (GFA) on a site (i.e. the area used for business purposes), relative to the total area of the site.

Figure 30 – Epping precinct geography



Source: DELWP, Google Maps, EY analysis

Table 17 below provides a characterisation of important areas within the identified Epping precinct, contextualising land use in the area.

Table 17 – Epping precinct characterisation

Area	Characterisation
1. Epping activity centre	► Areas within the activity centre have the potential to accommodate developments up to 25 metres (circa 8 levels). Expansion of this activity centre has already been approved by council via strategic planning documents. ► Retail and commercial properties appear to be performing well within the activity centre with relatively low vacancy levels. ► A growing population within the activity centre will continue to drive demand.
2. Epping industrial precinct	► The northern industrial precinct predominantly comprises industrial showroom / large format retail properties which are accessible via O'Herns Road and Hume Hwy. ► Industrial properties appear to be performing well and the area under developed (i.e. vacant land available). Development occurring to the west of this area in the CDZ zoning adjacent to the Hume Freeway, with the recently completed Melbourne Markets located on the south side of Cooper Street.
3. Residential	► The precinct's residential land comprise a mix of 20-30 year old stock to the south (suburbs of Thomastown and Lalor), with some newly developed residential estates as northern Epping is a growth area. ► There are a growing number of townhouse developments in the area with the emergence of high density apartment development around the Epping activity centre. ► This precinct also includes a significant volume of Residential Growth Zone (RGZ) which allows significant increases in density. ► An apartment market is not currently mature, however it is expected this type of housing would commence post 2026.
4. The Northern Hospital	► Large hospital, the only major public facility in Melbourne's outer northern suburbs. ► A recognised need to expand the hospital due to growing population in the area.

Similar to the Broadmeadows precinct, good existing connection freeway system will enable the Epping precinct to benefit from the construction of North East Link. The precinct is characterised by a mix of industrial and commercial land with commercial and industrial development, including the Epping MAC and industrial precinct, occupying the north of the precinct.

Residential development characterises the southern part of the precinct. Current housing stock is largely traditional low density development in the precinct's south with town house and apartment development beginning to develop closer to the activity in the precinct's north. Furthermore, the precinct is zoned as Residential Growth Zone (RGZ) which allows significant increases in density.

5.1.2.2 Key constraints summary

Table 18 below details constraints and opportunities to development within the Epping precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 18 – Key constraints summary

Constraint	Comments
Statutory Planning	► Epping Activity Centre is well serviced by public transport networks and planning currently supports higher density development – up to 25 metres (circa 8 levels). ► There are limited open spaces in the precinct however the Epping Central Structure Plan intends to increase the level of community services and facilities that responds to the needs of existing and future residents. ► Precinct 8 (land along Miller Street) within the Epping Central Structure Plan focuses on industry based employment and includes modern industrial development.
Land Fragmentation	► Land within Epping Activity Centre comprises larger allotments that could be subdivided in the future. ► The Epping Central Structure Plan supports and promotes consolidation of smaller lots into larger parcels that will enable high density integrated development.
Surrounding Features	► Epping Central is bound by Memorial Avenue to the north and Deny Road to the south with the western boundary adjoining Epping Waste Disposal site and the eastern boundary abuts Darebin Creek. Surrounding development predominately comprises low to medium density residential housing. ► O'Herns Industrial Precinct adjoins vacant land zoned comprehensive development – schedule 2 (Cooper Street Employment Area) and is surrounded by recently developed medium density residential housing.
Market Readiness	► High active development market being part of a growth area.

Given larger land allotments within the Epping activity centre, there is opportunity for the subdivision of land, as well as potential for the development of apartments supported by the Epping Central Structure Plan. Planning controls in the Epping activity centre accommodate development up to 25m, signalling the ability for comprehensive commercial development. Furthermore, vacant land adjacent to O'Herns industrial precinct allows for future industrial development.

5.1.2.3 Baseline population and employment forecasts

Table 19 below shows population and employment growth forecasts in the Epping precinct from 2016 to 2051 according to VIF15 forecasts. Population is expected to grow from 47,000 in 2016 to 70,100 in 2051. Following a period of significant growth between 2016 and 2026 (1.90% per annum) population growth is forecast to slow between 2026 and 2036, before accelerating again between 2036 and 2051 (1.24% per annum).

Total employment in the Epping precinct is expected to grow from 14,100 in 2016 to 26,000 by 2051, with strong growth expected between 2016 and 2026 (2.6% per annum).

Industrial employment is forecast to grow from 1,400 jobs in 2016 to 2,600 by 2051. Growth is forecast most quickly between 2016 and 2051 (1.77% per annum). Commercial employment is expected to grow from 11,600 in 2016 to 21,300 jobs by 2051. Note, the forecast floor space

ratios for industrial and commercial / retail employment are very low, highlighting the potential for further development.[9]

Table 19 – Epping population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	46,960	55,950	58,204	70,063
CAGR		1.77%	0.40%	1.24%
Person per dwelling	2.85	2.91	2.90	2.82
Industrial Employment - VIF (Base Case)	1,361	1,806	2,195	2,596
CAGR		2.87%	1.97%	1.12%
Floor Space Ratio	0.04	0.05	0.07	0.08
Commercial & Retail Employment- VIF (Base Case)	11,591	14,404	17,733	21,276
CAGR		2.20%	2.10%	1.22%
Floor Space Ratio	0.10	0.12	0.15	0.18
Total Employment	14,068	17,684	21,726	26,001
CAGR		2.6%	2.3%	1.3%

Source: Victoria in Future 2015, DELWP, EY analysis

Activity Zone (ACZ) land near the Epping activity centre provides development potential and opportunities for densification, as well as Residential Growth Zone (RGZ) and General Residential Zone (GRZ) land in Thomastown and Lalor provides multi-unit development opportunity. Accordingly, the Epping precinct is expected to be able to accommodate forecast population growth under current planning controls.

The ability of the Epping activity centre to support commercial and retail development, in line with the Epping Central Structure Plan, current planning controls, as well as very low forecast floor space ratios suggest that the precinct will accommodate forecast employment growth. The presence of vacant industrial land, as well as the very low forecast floor space ratios, suggest that all forecast employment growth can be accommodated in the existing planning schemes.

Review of precinct constraints suggest that the Epping precinct is able to accommodate all forecast development. Furthermore, our analysis suggests the precinct has capacity for additional development above that forecast by VIF.

5.1.3 Thomastown industrial precinct

5.1.3.1 Characterisation

The image below show the Thomastown industrial precinct boundaries, as well as its constraints and opportunities.

[9] Floor space ratio refers to ratio between Gross Floor Area (GFA) on a site (i.e. the area used for business purposes), relative to the total area of the site.

Figure 31 – Thomastown industrial precinct geography

Source: DELWP, Google Maps, EY analysis

Table 20 below provides a characterisation of important areas within the Thomastown industrial precinct, contextualising land use in the area.

Table 20 – Thomastown industrial precinct characterisation

Area	Characterisation
1. Thomastown activity centre	► Local activity centre to the north of the precinct and larger, light industrial uses to the southern end abutting the M80. ► Local activity centre offers little development with predominantly localised tenants interspersed with some national tenants (banks, food retail), services the local Thomastown area only.
2. Thomastown primary industrial precinct	► Eastern area of industrial precinct comprises a mix of historic manufacturing interspersed with showroom, large format retail and more recently constructed industrial warehouses and smaller units. ► Accessible via a network of local and major roads including Settlement Road, High Street and the M80 Freeway ► Industrial property in the area performs well in terms of vacancy and rents achieved, with a relatively low vacancy level in spite of a large number of older stock in the area. Newly developed business parks and industrial estates that are modern and efficient, are beginning to emerge in the area.
3. Thomastown secondary industrial precinct	► Western industrial precinct comprises large format heavy industrial warehouses, older stock compared to the eastern area. ► However, industrial properties are well tenanted and have a relatively low vacancy rate.
4. Residential	► Land in the east of the precinct within the suburb of Bundoora, land in the north is Thomastown ► Predominantly characterised by detached dwelling with some examples of townhouse development. ► Area features an older demographic though this will change as housing affordability pushes buyers further north. ► In proximity to La Trobe University and Melbourne Polytechnic (TAFE and higher education institute).

The Thomastown industrial precinct is largely industrial zoned land, with warehousing and manufacturing activity occurring in the primary and secondary industrial precincts. Residential dwellings in the east of the precinct are characterised largely by detached dwellings.

5.1.3.2 Key constraints summary

Table 21 below details constraints and opportunities to development within the Thomastown industrial precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 21 – Key constraints summary

Constraint	Comments
Statutory Planning	► Generally medium density development within commercial precincts. Planning controls over these properties generally do not support an increase in density. ► Thomastown Industrial Strategy Plan outlines objective to become increasingly attractive for potential investment and provide more employment opportunities for residents. The strategy defines specific locations and their development potential, with regard to their current and surrounding use.
Land Fragmentation	► Bundoora Square Shopping Centre offers a significant land holding which is partially subdivided. ► Opportunities available to further subdivide industrial and commercial properties along Settlement and Dalton Road. Additionally, multiple pockets of industrial land identified in the Strategic Plan to facilitate potential industrial estates and business parks. ► Residential land predominantly conventional dwelling lots with opportunities for subdivision available but a lack of demand for townhouse/apartment style housing in the area.
Surrounding Features	► Industrial areas bound by residential land uses and the M80 freeway. ► Commercial areas bound by residential land uses, footprint unlikely to increase.
Market Readiness	► Majority of development in the area comprises industrial development, through subdivision and the construction of more modern industrial warehouses and business parks. ► Industrial and residential development in the area.

Existing planning controls and dwelling characteristics allow for subdivision of lots to facilitate in-fill residential development. While there exist opportunities for industrial land subdivision to support development, the medium density development within the commercial precincts does not generally support an increase in density.

5.1.3.3 Baseline population and employment forecasts

Table 22 below shows the forecast population and employment in the Thomastown industrial precinct from 2016 to 2051 according to VIF15 forecasts. Population is expected to grow from 11,700 in 2016 to 22,600 in 2051. Population growth is expected to be strong in the near term, 2.02 per cent per annum between 2016 and 2026, slowing to 0.73 per cent per annum between 2026 and 2036, before increasing again in 2036 to 2.59 per cent per annum until 2051.

Total employment in the Thomastown industrial precinct is expected to grow from 20,100 in 2016 to 27,100 by 2051. Growth is expected to decline in the future, from 2.09 per cent per annum between 2016 and 2026, to 1.64 per cent per annum between 2026 and 2036, then 0.92 per cent per annum until 2051. The precinct is has a greater number of industrial jobs than commercial/retail jobs, with this trend expected to continue into the future. Industrial and commercial / retail employment are expected to grow at similar rates in the future in absolute terms. While industrial employment has low forecast floor space ratios (FSR), commercial and retail employment is expected to have a FSR of 1.52 in 2051.[10]

[10] Floor space ratio refers to ratio between Gross Floor Area (GFA) on a site (i.e. the area used for business purposes), relative to the total area of the site.

Table 22 – Thomastown population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	11,711	14,303	15,389	22,591
CAGR		2.02%	0.73%	2.59%
Person per dwelling	2.71	2.75	2.74	2.61
Industrial Employment - VIF (Base Case)	8,268	9,739	11,305	12,779
CAGR		1.65%	1.50%	0.82%
Floor Space Ratio	0.15	0.17	0.20	0.23
Commercial & Retail Employment- VIF (Base Case)	5,620	7,377	8,851	10,362
CAGR		2.76%	1.84%	1.06%
Floor Space Ratio	0.82	1.08	1.29	1.52
Total Employment	16,342	20,088	23,634	27,102
CAGR		2.09%	1.64%	0.92%

Source: Victoria in Future 2015, DELWP, EY analysis

With the potential for subdivision to facilitate in-fill residential development, the Thomastown industrial precinct is expected to be accommodate forecast population growth. Low FSR and the potential for subdivision is expected to allow for future industrial development. However, the high forecast FSR for commercial and retail employment along with constraints to high density development on the current commercial zones suggest that forecast commercial and retail employment growth may place pressure on the existing commercial and retail zoned land.

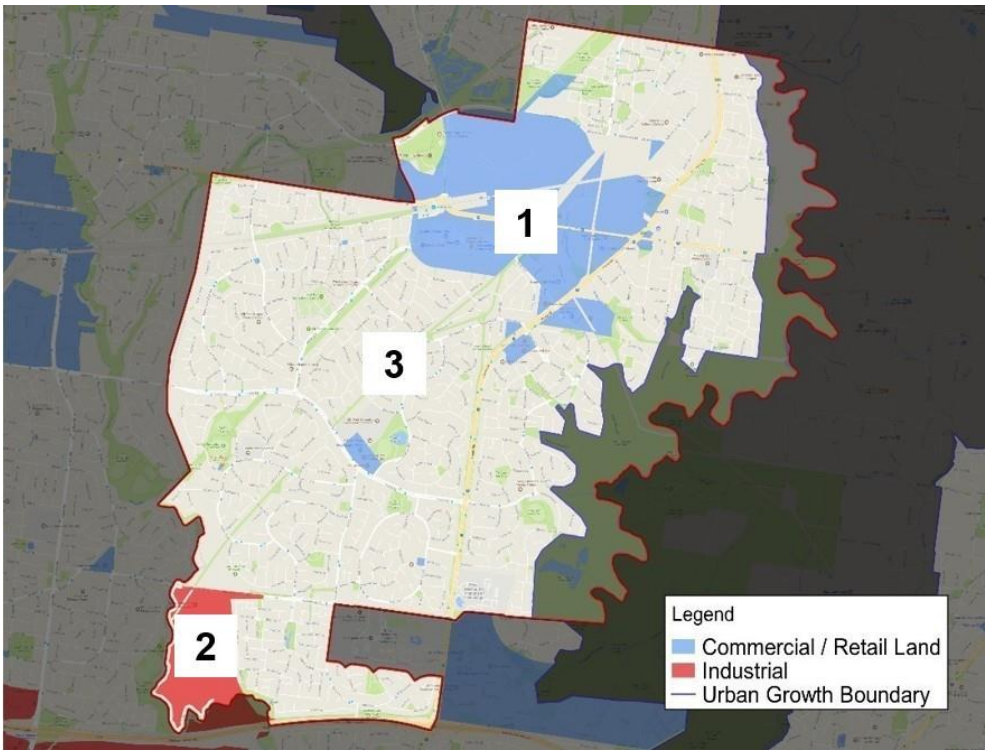
Our review of precinct constraints suggest that while the Thomastown industrial can accommodate all forecast housing development, growth in commercial and retail employment, along with constraints to land development under the current planning scheme may place pressure on existing commercial and retail zoned land.

5.1.4 Mill Park

5.1.4.1 Characterisation

The image below show the Mill Park precinct boundaries, as well as its constraints and opportunities.

Figure 32 – Mill Park precinct geography



Source: DELWP, Google Maps, EY analysis

Table 23 below provides a characterisation of important areas within the Mill Park industrial precinct, contextualising land use in the area.

Table 23 – Mill Park industrial precinct characterisation

Area	Characterisation
1. Mill Park activity centre	► The commercial / retail land is largely concentrated around Westfield Plenty Valley and South Morang Train Station; accessible via a number of major roads including McDonalds Road and Plenty Road. ► Westfield Plenty Valley will undergo significant redevelopment, increasing the total retail footprint. ► Large vacant parcels within commercial precinct which could be developed as the catchment area grows.
2. Mill Park industrial zoned land	► Industrial zoned land is located to the south of McKimmies Road; this land falls within the suburb of Bundoora. ► Industrial zoned land predominantly comprises a landfill, with a bus depot being an associated use.
3. Residential	► Predominantly detached dwellings. ► Few townhouse developments in the area but presumed to commence over time within proximity to South Morang train station, located in the eastern portion of the activity centre. ► Development of the Leisure Centre to include 3 swimming pools, café, outdoor play and BBQ areas in response to the growing population and residential needs of the area.

Mill Park is largely a residential precinct, characterised predominantly by detached dwellings with little development of town house estates. The precinct has some commercial / retail land around Westfield Plenty Valley and South Morang train station, with this activity centre expected to undergo significant redevelopment in the future. The Industrial land in the south west corner of the precinct is predominantly land fill.

5.1.4.2 Key constraints summary

Table 24 below details constraints and opportunities to development within the Mill Park precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 24 – Key constraints summary

Constraint	Comments
Statutory Planning	► Currently medium density development within commercial precinct with a number of undeveloped vacant parcels. Planning controls generally do not oppose an increase in density, however development must be complementary to the current scale. ► A large parcel to the north of South Morang Station is zoned Special Use 6 and is for the future use and development of the South Morang Train Station. This site may achieve higher density development. ► Development potential within the 'industrial' precinct considered limited given current land uses i.e. landfill.
Land Fragmentation	► Westfield Plenty Valley offers a significant land holding with future development potential, however subdivision of the centre is unlikely. ► Commercial land located to the east of the Westfield has potential for land subdivision and significant development. ► Residential land predominantly conventional dwelling lots.
Surrounding Features	► The Quarry Hills PSP which covers circa 280 hectares is located north of this precinct. This PSP is projected to accommodate 2,300 new dwellings and an ultimate resident population of approximately 6,600. ► The commercial and core activity area of the precinct are bordered by residential zoning to the south.
Market Readiness	► Majority of development in the area is commercial and residential with the emergence of townhouse developments. However not a great deal of development occurring overall. Suburb is relatively small, with council prioritising the development of surrounding suburbs over Mill Park. ► A number of vacant commercial parcels present opportunities for future development / subdivision.

Existing conventional detached dwellings allow for future subdivision of properties and the establishment of town houses. In particular, town house development is expected around South Morang station. Furthermore, the development of Quarry Hills is expected accommodate an additional population of 6,600 people.

Commercial and retail development in the precinct is limited by planning controls associated with medium density, while planning controls generally do not oppose an increase in density, development must be complementary to the current scale. Furthermore, development potential within the 'industrial' precinct is considered limited given current land fill use.

5.1.4.3 Baseline population and employment forecasts

Table 25 below shows the forecast population and employment in the Mill Park precinct from 2016 to 2051 according to VIF15 forecasts. Population is expected to grow from 44,900 in 2016 to 55,600 in 2051. Population is expected to grow at 1.21 per cent per annum between 2016 and 2026, then increase more slowly in the future (0.25% per annum 2026 – 2036, 0.45% per annum 2036 – 2051).

Total employment in the precinct is expected grow rapidly between 2016 and 2026 (3.85% per annum) before slowing in the future (1.91% per annum 2026 – 2036, 1.07% per annum 2036 – 2051). Employment in the precinct is largely commercial and retail with some industrial. Both categories of employment are expected to grow at similar speeds in the future. FSRs for both commercial / retail and industrial land uses are forecast to remain well below 1.0.[11]

[11] Floor space ratio refers to ratio between Gross Floor Area (GFA) on a site (i.e. the area used for business purposes), relative to the total area of the site.

Table 25 – Mill Park population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	44,853	50,588	51,873	55,521
CAGR		1.21%	0.25%	0.45%
Person per dwelling	3.05	3.08	3.07	3.01
Industrial Employment - VIF (Base Case)	1,518	2,322	2,773	3,200
CAGR		4.34%	1.79%	0.96%
Floor Space Ratio	0.21	0.33	0.39	0.45
Commercial & Retail Employment- VIF (Base Case)	7,931	11,541	13,966	16,433
CAGR		3.82%	1.93%	1.09%
Floor Space Ratio	0.20	0.30	0.36	0.42
Total Employment	10,986	16,031	19,365	22,722
CAGR		3.85%	1.91%	1.07%

Source: Victoria in Future 2015, DELWP, EY analysis

Opportunities for subdivision, particularly near South Morang station, as well as the Quarry Hills residential development are expected to accommodate forecast population growth within the Mill Park precinct.

Despite constraints to the development of additional commercial / retail and industrial land, low forecast FSRs (0.45 for industrial and 0.42 for commercial / retail in 2051) signal that future employment growth can be accommodated within the existing planning schemes.

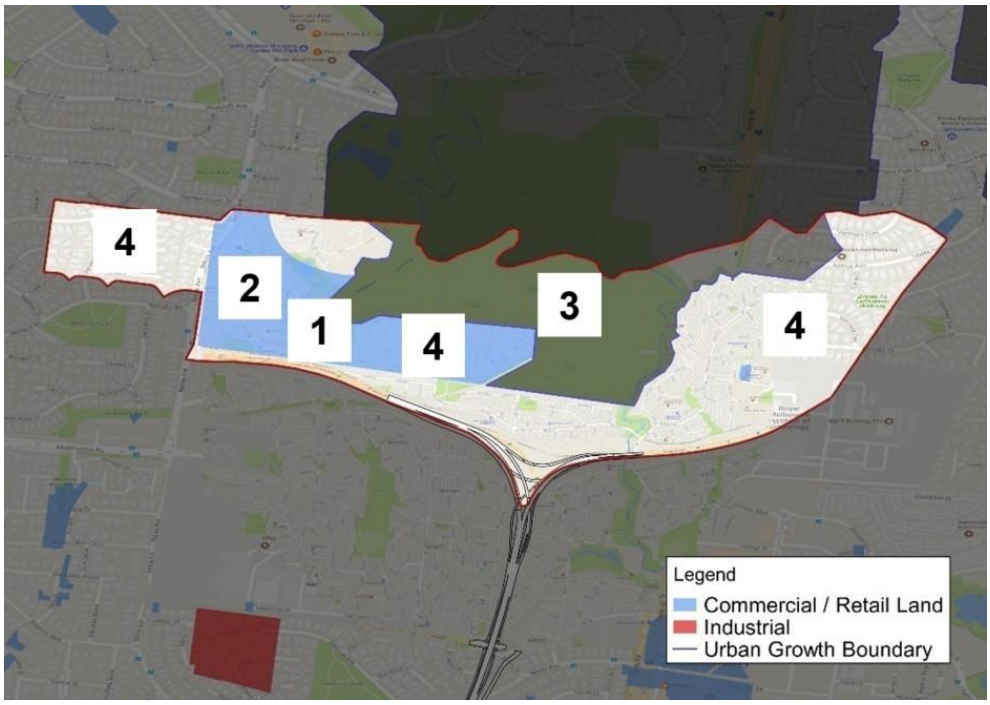
Our review of precinct constraints and opportunities suggest that the Mill Park precinct can accommodate growth forecast by VIF under the current planning controls. It is also able to accommodate increased development on top of that forecast by VIF.

5.1.5 University Hill

5.1.5.1 Characterisation

The image below show the University Hill precinct boundaries, as well as its constraints and opportunities.

Figure 33 – University Hill precinct geography



Source: DELWP, Google Maps, EY analysis

Table 26 below provides a characterisation of important areas within the University Hill precinct, contextualising land use in the area.

Table 26 – University Hill precinct characterisation

Area	Characterisation
1. University Hill retail area	► 'University Hill' has been developed by MAB (private property developer) since 2005. ► University Hill activity centre and discount retail precinct make up a majority of the retail space. The area appears to be performing well with relatively low vacancy levels. ► A growing residential population within this precinct will continue to underwrite demand.
2. Mill Park industrial zoned land	► MAB's development saw the introduction of University Hill Business Park and more recently Ormond Square providing commercial office development.
3. Passive open space	► Large passive open spaces located to the north and east of the commercial / retail area including Plenty Gorge Parklands, Jane field Wetland and Yellow Gum Park.
4. Residential	► Recently developed detached housing adjoins the commercial / retail area of the precinct while older style housing positioned in the eastern portion of the precinct towards Diamond Creek Road. ► Development of townhouses and apartments close to the main retail precinct has been well received in the area. ► Far eastern portion of the precinct features a majority of detached residential housing that has seen limited development. Eastern residential area falls within the suburb of Greensborough.

University Hill land use comprises of both residential zones and commercial / retail areas. The University Hill retail and commercial areas have been developed by MAB Corporation since 2005 and include the University Hill Business Park and retail space. Dwellings are predominantly detached houses, with some townhouses and apartments beginning to come onto the market closer to the main retail precinct. A large proportion of the precinct is open space, with the UGB overlay in the middle of the precinct.

5.1.5.2 Key constraints summary

Table 27 below details constraints and opportunities to development within the University Hill precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 27 – Key constraints summary

Constraint	Comments
Statutory Planning	► Commercial precinct currently subject to Special Use Zone – Schedule 3 which is designated for integrated mixed use high technology, commercial and residential development. This zoning allows for an array of developments to occur simultaneously, spurring on the growth of this northern area. ► Special Use Zone – Schedule 3 encourage a diverse range of housing types and an increase in density.
Land Fragmentation	► Opportunities available for future subdivision within the commercial precinct. ► Opportunities for future residential subdivision of conventional dwelling lots in the eastern portion of the precinct, relatively untouched and underutilised space.
Surrounding Features	► Precinct noticeably bordered by passive open space, limiting development to the north of the area. ► Commercial precinct bordered by the M80 freeway and residential use land to other sides limiting expansion.
Market Readiness	► Precinct largely characterised by low to medium density development. ► Emerging commercial and residential development within precinct in particular of properties within the western portion of the precinct near University Hill.

The planning schemes for the University Hill retail and commercial areas encourage a diverse range of uses including residential, commercial and retail, as well as promoting higher density development. There is potential for future subdivision of existing commercial, as well as residential land providing capacity to employment and population growth.

5.1.5.3 Baseline population and employment forecasts

Table 28 below shows the forecast population and employment in the University Hill precinct from 2016 to 2051 according to VIF15 forecasts. University Hill has the smallest population of any of the identified precincts, with population is expected to grow from 6,800 in 2016 to 9,900 in 2051. Population is expected to grow modestly in the future, 1.30 per cent per annum between 2016 and 2026, then at approximately 1 per cent to 2051.

Total employment in the precinct is expected grow rapidly between 2016 and 2026 (5.38% per annum) before slowing in the future (1.76% per annum 2026 – 2036, 1.03% per annum 2036 – 2051). Employment in the precinct is largely commercial and retail with some industrial. Commercial and retail zoned land is expected to have an overall FSR of 0.45 by 2051, while industrial employment is forecast an FSR of 1.02.[12]

[12] Floor space ratio refers to ratio between Gross Floor Area (GFA) on a site (i.e. the area used for business purposes), relative to the total area of the site.

Table 28 – University Hill population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	6,762	7,697	8,474	9,827
CAGR		1.30%	0.97%	0.99%
Person per dwelling	2.48	2.34	2.32	2.31
Industrial Employment - VIF (Base Case)	844	1,512	1,809	2,100
CAGR		6.00%	1.81%	1.00%
Floor Space Ratio	0.41	0.73	0.88	1.02
Commercial & Retail Employment- VIF (Base Case)	3,041	5,019	5,972	6,978
CAGR		5.14%	1.75%	1.04%
Floor Space Ratio	0.19	0.32	0.38	0.45
Total Employment	4,248	7,177	8,548	9,966
CAGR		5.38%	1.76%	1.03%

Source: Victoria in Future 2015, DELWP, EY analysis

University Hill's opportunity for subdivision as well the planning system allowing for higher density commercial, retail and residential are expected to accommodate future development in the precinct. This is supported by the low FSR forecast commercial and retail land, signalling capacity for further development. The industrial land FSR of 1.02 suggests industrial employment growth will be accommodated within the current planning constraints.

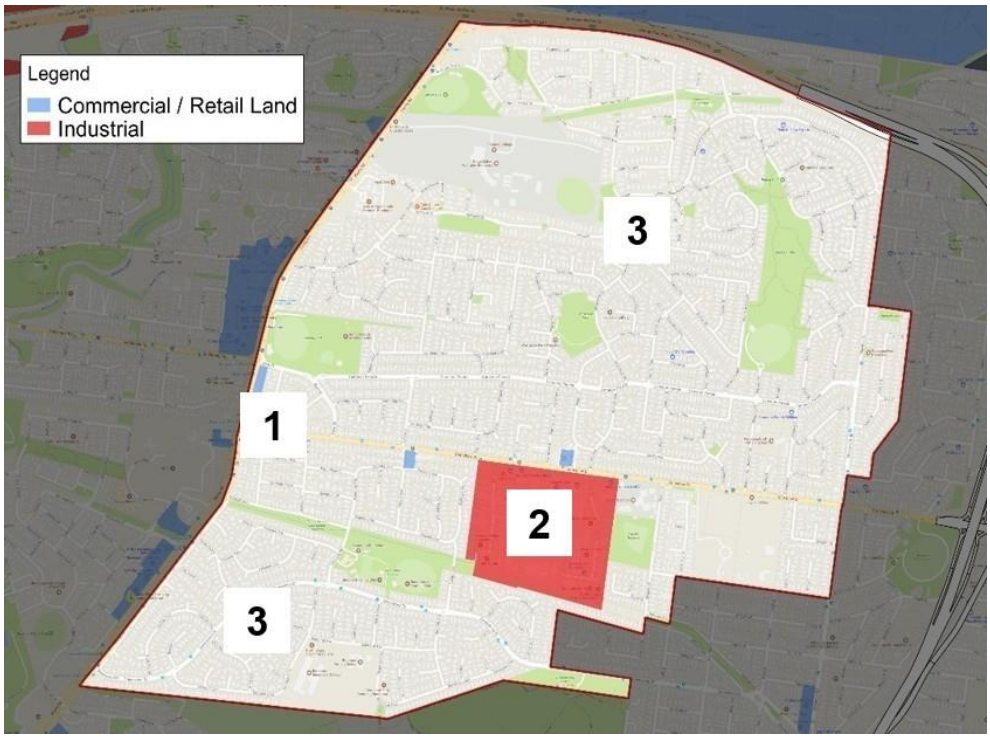
Our review of constraints and opportunities suggest that University Hill can accommodate growth forecast by VIF under the current planning controls, as well as having capacity for additional development.

5.1.6 Bundoora

5.1.6.1 Characterisation

The image below show the Bundoora precinct boundaries, as well as its constraints and opportunities.

Figure 34 – Bundoora precinct geography



Source: DELWP, Google Maps, EY analysis

Table 29 below provides a characterisation of important areas within the Bundoora precinct, contextualising land use in the area.

Table 29 – Bundoora precinct characterisation

Area	Characterisation
1. Bundoora commercial area	► The commercial area is a relatively small are positioned within western portion of the precinct. ► Close proximity to La Trobe University and the University Hill residential, commercial and retail developments, as University Hill falls within the suburb of Bundoora.
2. Bundoora industrial precinct	► Relatively small pocket of industrial use land that comprises predominantly manufacturing and storage use properties. ► Majority of development is 20-30 years old, however the area remains well tenanted, with little vacancy. ► Majority of industrial tenants currently have no intention to relocate in the near future (Banyule Business Monitor, 2017).
3. Residential	► Predominantly detached dwellings with a number of examples of unit (townhouse) developments. ► A number of apartment developments in the area, potential a response to the increased student population form being in proximity to La Trobe University.

The precinct is largely residential land use, with small pockets of industrial and commercial land use. Residential dwellings are predominantly detached, with some townhouse developments in the area, as well as apartments. Industrial zoned land is predominantly warehousing or light manufacturing.

5.1.6.2 Key constraints summary

Table 30 below details constraints and opportunities to development within the Bundoora precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 30 – Key constraints summary

Constraint	Comments
Statutory Planning	► Industrial Zone 3 is to act as a buffer between Industrial Zone 1 and the surrounding residential land. Preventing heavy industrial development from impeding on residential areas. Heavy industrial use is restricted to Industrial zone 1. ► Controls over the balance of the precinct currently don't hinder higher density or change in use. ► Majority of the residential use land is GRZ which allows for increased density development from detached dwellings to units and townhouses.
Land Fragmentation	► No significant land holdings in the area. Industrial land can be subdivided and further developed. ► Otherwise land in commercial precincts subdivided (fragmented). ► Residential land predominantly conventional dwelling lots.
Surrounding Features	► Bundoora industrial precinct footprint bound by a school site to the east and low density residential surrounding to the balance.
Market Readiness	► Majority of development in the area is residential townhouse and apartment developments. Apartments in excess of 7 storeys suggests limited planning control on future development. ► Otherwise commercial and industrial development subdued due to limited available land.

Residential development is largely unconstrained in Bundoora with the majority of the residential use land being GRZ which allows for increased density development from detached dwellings to units and townhouses. Furthermore, the construction of apartments in excess of 7 storeys suggests limited planning control on future development. However, commercial and industrial land development may be subdued due to limited available land.

5.1.6.3 Baseline population and employment forecasts

Table 31 below shows the forecast population and employment in the Bundoora precinct from 2016 to 2051 according to VIF15 forecasts. Population is expected to grow from 12,900 in 2016 to 17,100 by 2051. Population is expected to grow more slowly relative to the rest of Melbourne with population growth below 1.0 per cent per annum during all periods between 2016 and 2051, compared to the rest of Melbourne CAGR of 1.6 per cent per annum between 2016 and 2051.

Employment in the precinct is also expected grow slowly, from 2,400 jobs in 2026 to 3,500 by 2051. The FSR forecast for commercial and retail employment is 1.12 in 2051.[13]

[13] Floor space ratio refers to ratio between Gross Floor Area (GFA) on a site (i.e. the area used for business purposes), relative to the total area of the site.

Table 31 – Bundoora population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	12,889	13,558	14,737	17,085
CAGR		0.51%	0.84%	0.99%
Person per dwelling	2.68	2.64	2.58	2.57
Industrial Employment - VIF (Base Case)	401	419	475	570
CAGR		0.43%	1.27%	1.22%
Floor Space Ratio	0.16	0.17	0.19	0.23
Commercial & Retail Employment- VIF (Base Case)	1,751	1,798	2,070	2,515
CAGR		0.26%	1.42%	1.31%
Floor Space Ratio	0.78	0.80	0.92	1.12
Total Employment	2,445	2,517	2,892	3,506
CAGR		0.29%	1.40%	1.29%

Source: Victoria in Future 2015, DELWP, EY analysis

The availability of GRZ land allows for increase residential density in the zone, suggesting that population growth forecast by VIF can be accommodated within the current planning controls.

Despite limited development opportunities for commercial and retail land due to existing zoning, a forecast FSR of 1.12 with the opportunity for development over seven stories suggests that the precinct can accommodate forecast employment growth. This is also true for industrial development provided its low FSR.

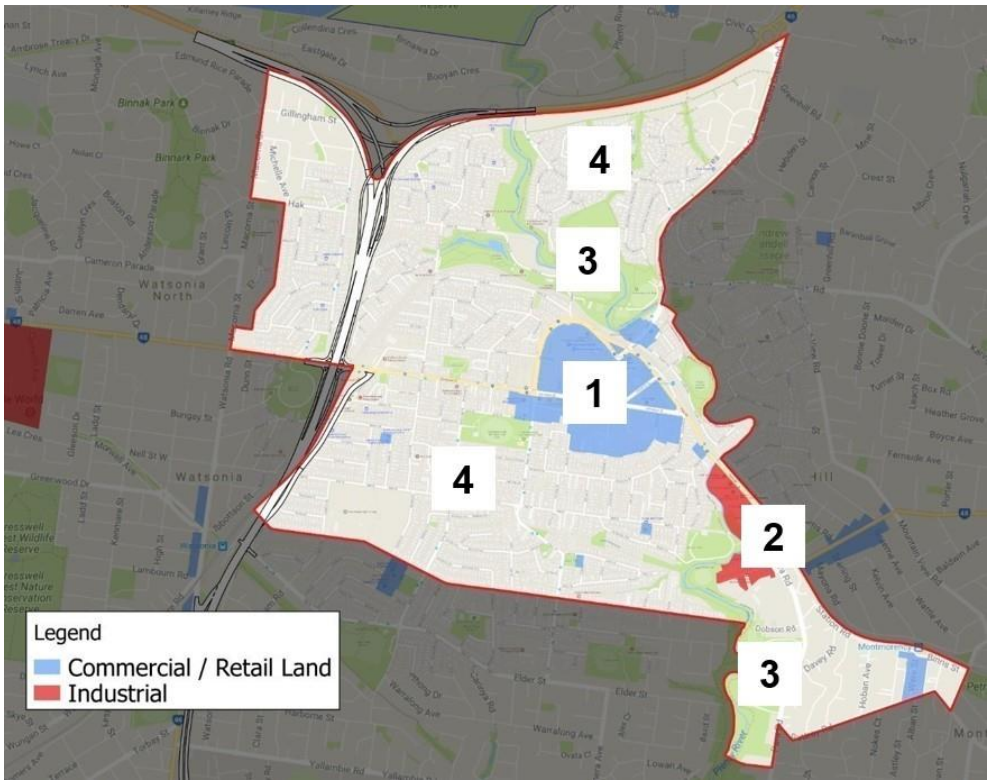
Our review of constraints and opportunities suggest that Bundoora can accommodate growth forecast by VIF under the current planning controls. Furthermore, our analysis suggests the precinct has capacity for additional development above that forecast by VIF.

5.1.7 Greensborough and Montmorency Activity Centre

5.1.7.1 Characterisation

The image below show the Greensborough and Montmorency Activity Centre precinct boundaries, as well as its constraints and opportunities.

Figure 35 – Greensborough and Montmorency Activity Centre geography



Source: DELWP, Google Maps, EY analysis

Table 32 below provides a characterisation of important areas within the Greensborough and Montmorency precinct, contextualising land use in the area.

Table 32 – Greensborough and Montmorency Activity Centre precinct characterisation

Area	Characterisation
1. Greensborough activity centre	► Positioned the middle of the area directly accessible from the new infrastructure. ► Provides commercial, retail and civic land uses, good performing local centre in terms of vacant etc. however not considered a major commercial location. ► Within proximity to La Trobe National Employment and Innovation Cluster (NEIC) (Plan Melbourne).
2. Greensborough / Montmorency industrial precinct	► Predominantly showroom and large format retail use properties along Sherbourne Road. ► The balance comprises light industrial warehouses uses. ► The area appears well tenanted, with little vacancy.
3. Passive open space	► Large tracts of open space located north of the Greensborough activity centre and west of the Montmorency industrial and retail area.
4. Residential	► Predominantly detached dwellings with some examples of unit (townhouse) development. ► Townhouse and unit development expected to continue, as well as higher density development around the Greensborough activity centre in the ACZ zoning.

The precinct is bordered by the North East Link footprint to the west and the Greensborough Bypass to the north. While the majority of the precinct is detached residential dwellings, with a number of parks and ovals in the north and south of the precinct. The precinct also has an activity centre, along with an industrial precinct, which is predominantly showroom and large format retail use.

5.1.7.2 Key constraints summary

Table 33 below details constraints and opportunities to development within the Greensborough and Montmorency precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 33 – Key constraints summary

Constraint	Comments
Statutory Planning	► Planning controls in the Greensborough activity centre allow for increased density development, up to 10 storeys. ► Controls over the balance of the precinct currently don't support higher density or change in use.
Land Fragmentation	► Major regional shopping centre Greensborough Plaza offers significant land holding. ► Otherwise land in commercial precincts subdivided (fragmented). ► Residential land predominantly conventional dwelling lots.
Surrounding Features	► Greensborough activity centre footprint bound by parkland to the north and low density residential surrounding to the balance. ► Montmorency industrial precinct bound by Plenty River and residential uses.
Market Readiness	► Majority of development in the area is residential, townhouse developments. ► One new major commercial office development in the area with major tenant being Banyule City Council. ► Otherwise commercial development subdued.

Residential land is predominantly conventional detached dwellings, providing the opportunity for subdivision. This is consistent with existing trends, with the majority of new development being townhouse dwellings. While the Greensborough activity centre provides opportunity for high density development (up to 10 stories), currently planning controls for the remainder of the precinct do not support higher density development.

5.1.7.3 Baseline population and employment forecasts

Table 34 below shows the forecast population and employment in the Greensborough and Montmorency Activity Centre precinct from 2016 to 2051 according to VIF15 forecasts. Population is expected to grow from 11,400 in 2016 to 16,100 by 2051. Growth is expected to relatively slow (0.81% per annum 2016-2026, 0.70% per annum 2026-2036 and 1.32% per annum 2036-2051), compared to the rest of Melbourne which is expected to grow at 1.6 per cent per annum between 2016 and 2051.

Total employment in the precinct is expected to grow from 5,500 in 2016 to 8,200 by 2051, with slower growth between 2016 and 2026, expected to accelerate in the future. There is little industrial employment in the area, with 340 industrial jobs in 2016. The FSR for commercial and retail employment is expected to be 1.22 by 2051.[14]

[14] Floor space ratio refers to ratio between Gross Floor Area (GFA) on a site (i.e. the area used for business purposes), relative to the total area of the site.

Table 34 – Greensborough and Montmorency population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	11,392	12,352	13,247	16,116
CAGR		0.81%	0.70%	1.32%
Person per dwelling	2.44	2.39	2.34	2.32
Industrial Employment - VIF (Base Case)	343	363	417	510
CAGR		0.56%	1.41%	1.35%
Floor Space Ratio	0.29	0.30	0.35	0.43
Commercial & Retail Employment- VIF (Base Case)	4,655	4,858	5,633	6,984
CAGR		0.43%	1.49%	1.44%
Floor Space Ratio	0.82	0.85	0.99	1.22
Total Employment	5,452	5,694	6,596	8,163
CAGR		0.44%	1.48%	1.43%

Source: Victoria in Future 2015, DELWP, EY analysis

Population and household growth is expected to be accommodated through subdivision and the ongoing emergence of townhouse development.

The very low growth in industrial jobs is expected to be accommodated within the existing planning controls, while the potential for increased density around the Greensborough activity centre can accommodate the growth forecast for commercial and retail employment and an FSR of 1.22.

Our review of constraints and opportunities suggest that Greensborough and Montmorency Activity Centre can accommodate growth forecast by VIF under the current planning controls. Furthermore, our analysis suggests land capacity is able to accommodate additional development to that forecast by VIF.

5.1.8 Greensborough and Eltham North Activity Centre

5.1.8.1 Characterisation

The image below show the Greensborough and Eltham North Activity Centre boundaries, as well as its constraints and opportunities.

Figure 36 – Greensborough and Eltham North Activity Centre geography

Source: DELWP, Google Maps, EY analysis

Table 35 below provides a characterisation of important areas within the Greensborough and Eltham North Activity Centre, contextualising land use in the area.

Table 35 – Greensborough and Eltham North Activity Centre precinct characterisation

Area	Characterisation
1. Greensborough and Eltham Activity zone	► The activity centre is a small area positioned within the southern portion of the precinct. ► The activity centre resides in the suburb of Eltham, the area is well tenanted with low vacancy and some potential for development. ► Located directly adjacent to Eltham Station. Catholic Ladies College is also located in close proximity to the north west of the activity zone.
2. Greensborough and Eltham Industrial precinct	► Located at the south of the precinct, development is a mix of older industrial buildings with newer more commercial and retail uses. ► Commercial and retail use land in this area comprise a mix of showroom, bulky goods and other retail uses.
3. Residential	► Predominantly detached dwellings, majority detached dwellings on relatively large allotments. ► Majority of the precinct is NRZ which precludes development beyond detached dwellings.

The precinct is located on the fringe of the UGB, mainly supporting residential dwellings with large block sizes on Neighbourhood Residential Zone (NRZ) land. This schedule precludes development other than detached dwellings.

The activity centre is a small area in the south of the precinct and is located directly adjacent to Eltham station and consists largely of retail sites, with some commercial businesses.

5.1.8.2 Key constraints summary

Table 36 below details constraints and opportunities to development within the Greensborough and Eltham North precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 36 – Key constraints summary

Constraint	Comments

Statutory Planning	► Planning controls in the Eltham activity centre allow for increased density development. ► Nillumbik Planning Scheme outline residential dwellings must contain no more than 2 storeys. ► Controls over the balance of the precinct currently don't support higher density or change in use.
Land Fragmentation	► Industrial land in the precinct subdivided (fragmented), unlikely to be subdivided further however, redevelopment is possible for more modern dwellings ► Residential land predominantly conventional dwelling lots.
Surrounding Features	► Eltham activity centre footprint bound by parkland zoning, preventing footprint extension. ► Industrial precinct bound by Parkland and residential zoning, preventing footprint extension.
Market Readiness	► Majority of development in the area is residential, townhouse developments and Eltham activity centre. ► Otherwise commercial development subdued.

The schedule for the dominant NRZ planning zone prevents residential development greater than 2 storeys, it also precludes development other than detached dwellings. However, the precincts large block sizes creates potential for development through subdivision. Nonetheless, the precinct has constraints to further residential development.

While there is potential for increased development in the vicinity of the Eltham activity centre, planning controls over the balance of the precinct don't support higher density or change in use.

5.1.8.3 Baseline population and employment forecasts

Table 37 below shows the forecast population and employment in the Greensborough and Eltham North Activity Centre precinct from 2016 to 2051 according to VIF15 forecasts. Population is expected to grow from 24,200 in 2016 to 33,300 by 2051, with the rate of growth increasing into the future (0.69% per annum 2016-2026, 0.82% per annum 2026-2036 and 1.12% per annum 2036-2051).

Employment in the precinct is expected to grow at a relatively steady rate between 2016 and 2051, from 5,400 to 8,900 at a rate of 1.4 per cent per annum. The majority of employment in the precinct is in commercial and retail categories, with the balance in categories other than industrial (social and health, entertainment, etc.).

Table 37 – Greensborough and Eltham North population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	24,245	25,963	28,177	33,314
CAGR		0.69%	0.82%	1.12%
Person per dwelling	2.77	2.68	2.62	2.60
Industrial Employment - VIF (Base Case)	581	674	788	975
CAGR		1.50%	1.58%	1.43%
Floor Space Ratio	0.16	0.19	0.22	0.28
Commercial & Retail Employment- VIF (Base Case)	3,807	4,332	5,075	6,287
CAGR		1.30%	1.59%	1.44%
Floor Space Ratio	0.57	0.64	0.75	0.93
Total Employment	5,412	6,148	7,195	8,904
CAGR		1.28%	1.59%	1.43%

Source: Victoria in Future 2015, DELWP, EY analysis

Residential development is somewhat constrained in the Greensborough and the Eltham North precinct due to existing planning controls. Accordingly, forecast development in the precinct may be

limited by existing planning controls. FSR for both industrial and commercial / retail land is forecast below 1 suggesting that growth in employment can be accommodated under the existing planning controls.[15]

Employment growth forecast by VIF should be accommodated under the current planning controls and precinct characteristics. However, forecast residential development in the Greensborough and Eltham North Activity Centre may be limited by the existing planning system in the precinct.

5.1.9 Rosanna

5.1.9.1 Characterisation

The image below show the Rosanna precinct boundaries, as well as its constraints and opportunities.

Figure 37 – Rosanna precinct geography

Source: DELWP, Google Maps, EY analysis

Table 38 below provides a characterisation of important areas within the Rosanna precinct, contextualising land use in the area.

Table 38 – Rosanna precinct characterisation

Area	Characterisation
1. Residential	► Residential use land is the predominant use within the precinct. ► Predominately detached dwellings with some examples of more recently developed townhouses and units. ► No apartment market in this area due to planning controls precluding development.
2. Simpsons Barracks – Commonwealth Land	► Department of Defence site utilised for training, administration and service areas. ► Approximately 1,500 personnel on the base at any one time. ► Research did not reveal any intention to divest the land.
3. Active open space	► Large tracts of open space located in the south of the area, made up predominately of the Rosanna and Heidelberg Golf Courses.

[15] Floor space ratio refers to ratio between Gross Floor Area (GFA) on a site (i.e. the area used for business purposes), relative to the total area of the site.

4. Retail / commercial	► Small commercial and retail footprint, local supermarket and several speciality shops only.

Rosanna is predominantly a residential area made up of detached dwellings with some townhouse and unit developments more recently. The precinct also has a number of parks, golf courses and open space. There are significant commonwealth land holdings in the precinct, with Simpsons Barracks in the north east of the precinct. Retail and commercial activity in limited mainly to supermarkets and speciality shops.

5.1.9.2 Key constraints summary

Table 39 below details constraints and opportunities to development within the Rosanna precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 39 – Key constraints summary

Constraint	Comments
Statutory Planning	► GRZ land to a portion of residential areas allows increased density development.
Land Fragmentation	► Residential land has the potential to be subdivided and developed. Currently predominantly conventional dwelling lots. ► Land in commercial precincts subdivided (fragmented)
Surrounding Features	► Extensive amount of passive and active open space comprising multiple gold courses, reserves and parklands. ► Simpsons Barracks (Commonwealth Department of Defence owned land) surround by residential zonings.
Market Readiness	► Majority of development in the area is residential, townhouse developments. ► Very little commercial or industrial use land to develop.

Most of the residential area is zoned as GRZ, allowing for increased density of development. Furthermore, existing residential land the potential to be subdivided and developed. Accordingly, there is significant opportunity for residential development. However, industrial and commercial/retail development is largely constrained due to the low availability of appropriate land.

5.1.9.3 Baseline population and employment forecasts

Table 40 below shows the forecast population and employment in the Rosanna precinct from 2016 to 2051 according to VIF15 forecasts. Population is expected to grow from 33,800 in 2016 to 42,800 by 2051 at a rate of 0.7 per cent per annum. Note, despite significant opportunities for residential development, this rate of population growth is particularly low relative to the rest of Melbourne, which is forecast to grow at 1.6 per cent per annum.

Employment in the precinct is largely commercial / retail (82.7% of employment in 2016), while total employment is expected to increase from 6,100 in 2016 to 9,500 by 2051. Notably, absolute population growth is expected to eclipse absolute employment growth resulting in a net negative change in labour self-sufficiency.

Table 40 – Rosanna population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	33,804	35,116	37,603	42,847
CAGR		0.38%	0.69%	0.87%
Person per dwelling	2.58	2.55	2.52	2.53
Industrial Employment - VIF (Base Case)	297	332	388	479
CAGR		1.11%	1.56%	1.41%
Floor Space Ratio	0.94	1.05	1.23	1.52
Commercial & Retail Employment- VIF (Base Case)	5,059	5,559	6,405	7,777
CAGR		0.95%	1.43%	1.30%
Floor Space Ratio	0.11	0.12	0.14	0.16
Total Employment	6,115	6,725	7,764	9,451
CAGR		0.96%	1.45%	1.32%

Source: Victoria in Future 2015, DELWP (2015), EY Analysis (2017)

Currently planning controls provide the opportunity for increased density of residential development as well as subdivision. Accordingly, there is plenty of opportunity for residential development and the precinct is expected to accommodate population growth forecast by VIF.

Despite an FSR of 1.52, industrial employment growth is relatively small, with approximately 300 additional jobs created between 2016 and 2051. This growth is expected to be accommodated within the existing planning controls. The small forecast FSR (0.16 in 2051) for Commercial and Retail land suggests that development can be accommodated by the precinct.[16]

Our review of the constraints and opportunities to development in the Rosanna precinct, suggest that the precinct will accommodate population and employment growth forecast by VIF.

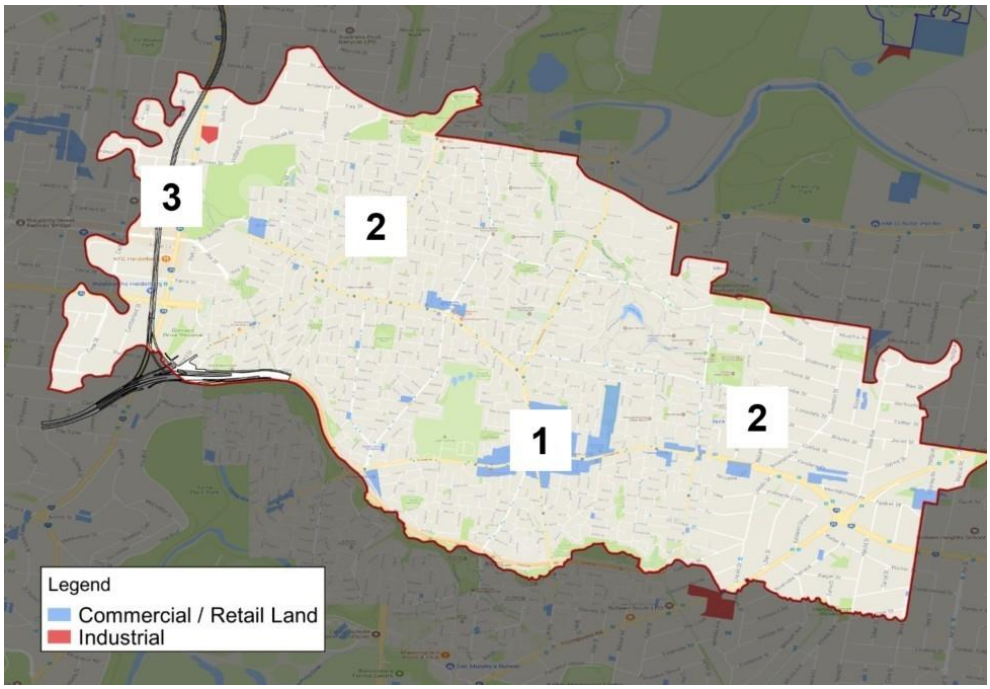
5.1.10 Doncaster Hill

5.1.10.1 Characterisation

The image below show the Doncaster Hill precinct boundaries, as well as its constraints and opportunities.

[16] Floor space ratio refers to ratio between Gross Floor Area (GFA) on a site (i.e. the area used for business purposes), relative to the total area of the site.

Figure 38 – Doncaster Hill precinct geography



Source: DELWP, Google Maps, EY Analysis

Table 41 below provides a characterisation of important areas within the Doncaster Hill precinct, contextualising land use in the area.

Table 41 – Doncaster Hill precinct characterisation

Area	Characterisation
1. Doncaster Hill activity centre	► Provides commercial, retail and civic land uses, good performing local centre in terms of vacancy. Considered a major retail location in Melbourne. ► This area includes Westfield Doncaster, a super-regional classified centre. ► A permit has been granted for a Bunnings to be developed adjacent to the Westfield Doncaster Shopping Centre indicating the underlying retail strength of the area.
2. Residential	► Predominantly detached dwellings throughout the broader precinct, development obvious in recent years. ► Unit, townhouse and apartment developments throughout the precinct have been completed, particularly around the activity centre with densities up to 30 levels.
3. Bulleen industrial precinct	► Predominantly showroom and large format retail use properties along Bulleen and Manningham Road. The balance comprises light industrial warehouses uses. ► The area appears fairly well tenanted, with varied vacancy due the detached location, however overall this is considered a secondary, localised industrial precinct.

Doncaster Hill is largely a residential area to the north of the Eastern Freeway. While residential use is predominantly made up of detached dwellings, more recent development has a greater density, particularly around the activity centre with apartments up to 30 levels.

The Doncaster Hill activity centre is formed around the Westfield Doncaster Shopping Centre, which has a significant number of retail sites. The Bulleen industrial precinct in the north west of the precinct is mainly large format retail use. Furthermore, the Heide Museum of Modern Art is located just to the north of the industrial area, providing cultural and amenity value.

5.1.10.2 Key constraints summary

Table 42 below details constraints and opportunities to development within the Doncaster Hill precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 42 – Key constraints summary

Constraint	Comments
Statutory Planning	► Industrial area may subject to change due future development of new infrastructure. ► Planning controls encourage housing growth and increased density in residential zones, hence the many apartment and unit developments currently under way and planned for the future.
Land Fragmentation	► Major regional shopping centre, Westfield Doncaster comprises a large land holding but is unlikely to be subdivided (fragmented) further. ► Residential land predominantly conventional dwelling lots, that are likely to be fragmented, based on land size.
Surrounding Features	► Doncaster Hill activity centre footprint bound by mix of medium to high density residential. ► Doncaster Hill industrial precinct bound park lands and residential zoning.
Market Readiness	► Majority of development in the area is residential, apartments and townhouse developments. ► Commercial development plausible with commercial zoning along Doncaster Road. ► Industrial development subdued and likely to move further north or west to more traditional industrial areas.

Planning controls in the precinct allow for increased density of development. Accordingly, there is opportunity for further residential development.

The Bulleen industrial precinct is very close to the footprint of North East Link and may be subject to change due to the construction of the road. This would have implications for industrial employment growth in the precinct.

5.1.10.3 Baseline population and employment forecasts

Table 43 below shows forecast population and employment in the Doncaster Hill precinct from 2016 to 2051 according to VIF15 forecasts. Population is expected to grow from 69,100 in 2016 to 104,900 by 2051 at a rate of 1.2 per cent per annum. Growth is expected to be relatively constant between years (1.30% per annum 2016-2026, 1.03% per annum 2026-2036 and 1.24% per annum 2036-2051).

Total employment in the precinct is expected to grow from 23,600 in 2016 to 33,200 by 2051, with the majority of growth being attributed to commercial and retail employment (82.9% of job growth).

Table 43 – Doncaster Hill population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	69,100	78,621	87,146	104,895
CAGR		1.30%	1.03%	1.24%
Person per dwelling	2.58	2.54	2.55	2.57
Industrial Employment - VIF (Base Case)	2,290	2,731	3,121	3,760
CAGR		1.77%	1.34%	1.25%
Floor Space Ratio	0.93	1.10	1.26	1.52
Commercial & Retail Employment- VIF (Base Case)	19,495	23,417	27,083	33,182
CAGR		1.85%	1.47%	1.36%
Floor Space Ratio	1.07	1.29	1.49	1.83
Total Employment	23,638	28,431	32,838	40,148
CAGR		1.86%	1.45%	1.35%

Source: Victoria in Future 2015, DELWP, EY analysis

The currently planning system in the Doncaster Hill precinct provides opportunities for increased residential development. Accordingly, forecast population growth is expected to be accommodated under the current planning system.

Although Commercial and Retail employment is forecast an FSR of 1.83, existing commercial developments are commonly greater than two floors (Westfield Doncaster has four floors). Thus, the precinct is expected to be able to accommodate forecast employment growth despite the high FSR. [17]

However, with the construction of North East Link industrial land may be subject to change, particularly in the Bulleen industrial precinct. Depending on the construction approach, there is a question whether the balance of industrial land within the precinct could accommodate forecast industrial employment.

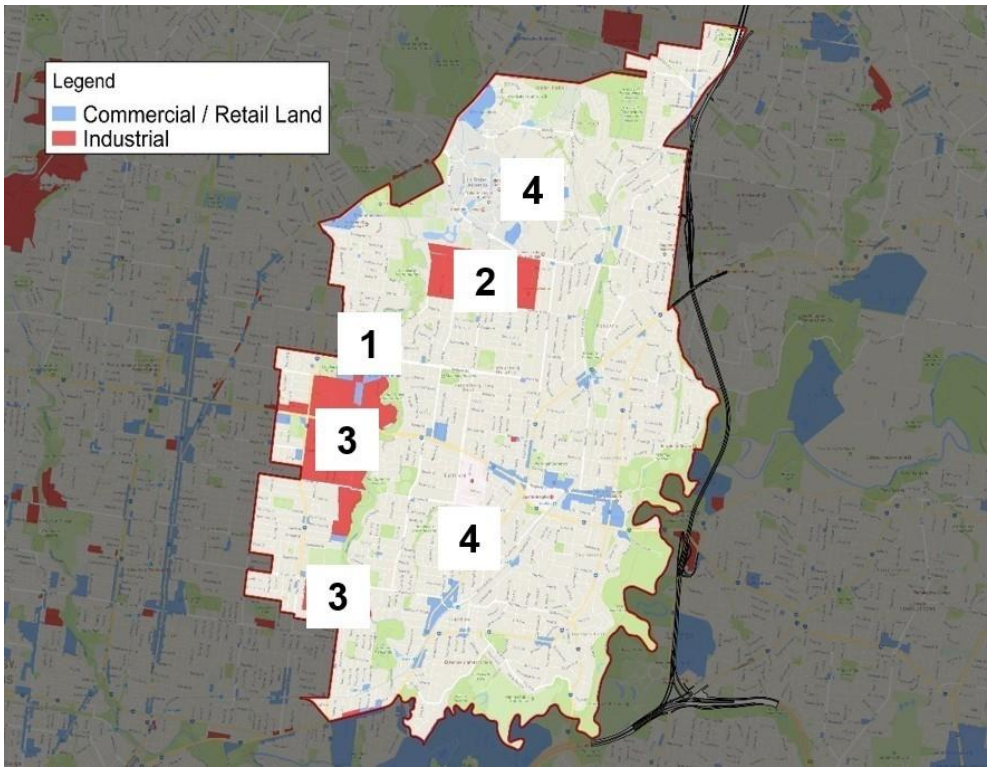
Our review of the constraints and opportunities to development in the Doncaster Hill precinct, suggests that the precinct can accommodate forecast population and commercial / retail employment growth. However, depending on the construction of North East Link, there is a question whether the precinct will accommodate forecast industrial employment.

5.1.11 Heidelberg

5.1.11.1 Characterisation

The image below show the Heidelberg precinct boundaries, as well as its constraints and opportunities.

Figure 39 – Heidelberg precinct geography



Source: DELWP, Google Maps, EY analysis

[17] Floor space ratio refers to ratio between Gross Floor Area (GFA) on a site (i.e. the area used for business purposes), relative to the total area of the site.

Table 44 below provides a characterisation of important areas within the Heidelberg precinct, contextualising land use in the area.

Table 44 – Doncaster Hill precinct characterisation

Area	Characterisation
1. 'Northland' retail precinct	► Northland Shopping Centre is a super-regional shopping centre, major precinct in metropolitan Melbourne's retail market. ► Within proximity to La Trobe University.
2. Heidelberg West Industrial Estate	► Majority of properties comprises older and relatively small light industrial uses with a large amount of businesses being of a manufacturing nature. ► Tightly held market local industrial market.
3. Preston Industrial Precincts	► Predominantly large format retail use along Bell Street, the balance of the space comprises a mix of larger format industrial warehouses and smaller manufacturing and light industrial uses. ► Industrial property through this area comprises several different pockets with different characteristics.
4. Residential	► Predominantly detached dwellings, with higher density development around activity centres and transport nodes ► A number of examples of units, townhouse and apartment developments being constructed in the area and in the pipeline for the future.

The Heidelberg precinct is predominantly residential land, with a number of activity features, including the La Trobe National Employment and Innovation Cluster planning overlay as set out in Plan Melbourne.

Detached dwellings are the most common form of residence, with some higher density development (townhouse and apartments) around the activity centres. The precinct includes La Trobe University, as well as Northland retail precinct which is designated as a major activity centre in Plan Melbourne. There is also significant industrial land in the precinct, including the Preston industrial precinct along Bell Street which is predominantly used for large format retail.

5.1.11.2 Key constraints summary

Table 42 above details constraints and opportunities to development within the Doncaster Hill precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 45 – Key constraints summary

Constraint	Comments
Statutory Planning	► Planning controls in the Heidelberg commercial zone allow for densities that complement their surroundings. ► Controls over the balance of the residential zones within the precinct currently support higher density development. ► Planning controls to ensure a buffer between residential and industrial properties, restricting industrial development. Potentially contributing to the tenants desire to relocate.
Land Fragmentation	► Major regional shopping Northland offers significant land holding. ► Otherwise land in commercial precincts subdivided (fragmented). ► Residential land predominantly conventional dwelling lots.
Surrounding Features	► Northland footprint bound by parkland to the east, low density residential surrounding the north west and Public Use zone to the west. ► Montmorency industrial precinct bound by Plenty River and residential uses.
Market Readiness	► Majority of development in the area is residential, townhouse and apartment developments, likely to continue as value of area increase. ► Examples of commercial development in local activity centres and around Northland.

Planning controls for residential land in the Heidelberg precinct support higher density development, thus providing opportunity for residential development in the precinct. Further, planning schedules for commercially zoned land in the precinct allow for higher density development providing opportunity for commercial development in the precinct. However, planning

controls on industrial land, as well as physical barriers to development are expected to constrain the development of industrial land.

5.1.11.3 Baseline population and employment forecasts

Table 46 below shows forecast population and employment in the Heidelberg precinct from 2016 to 2051 according to VIF15 forecasts. Population is expected to grow from 80,000 in 2016 to 142,200 by 2051. The rate of growth is expected to increase in the medium to long term (1.99% per annum 2026-2036, 1.77% per annum 2036-2051) from relatively slow growth between 2016 and 2026 (1.16% per annum).

Total employment in the precinct is expected to grow from 56,200 in 2016 to 105,300 by 2051, with commercial and retail employment expected to grow significantly more quickly that industrial employment.

Table 46 – Heidelberg population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	79,972	89,765	109,361	142,202
CAGR		1.16%	1.99%	1.77%
Person per dwelling	2.44	2.42	2.42	2.43
Industrial Employment - VIF (Base Case)	10,166	11,609	12,893	15,152
CAGR		1.34%	1.05%	1.08%
Floor Space Ratio	0.27	0.30	0.34	0.40
Commercial & Retail Employment- VIF (Base Case)	41,558	53,101	65,051	82,590
CAGR		2.48%	2.05%	1.60%
Floor Space Ratio	1.36	1.73	2.12	2.70
Total Employment	56,163	69,968	84,128	105,315
CAGR		2.22%	1.86%	1.51%

Source: Victoria in Future 2015, DELWP, EY analysis

The Heidelberg precinct's ability to support increased residential density (as outlined above), suggest that it will accommodate an increase in population as forecast by VIF. Despite constraints to industrial land development, the low FSR forecast (0.40 in 2051) suggest that industrial employment forecast can fit inside the existing planning controls.

While commercial and retail employment is forecast a high FSR (2.70 by 2051), opportunities for higher density commercial development, as well as significant land holdings for Northland indicate that forecast employment will be accommodated by the planning system. It should also be noted that a future shift to telecommuting and working from home would result in a lower FSR, with less space required for workers.

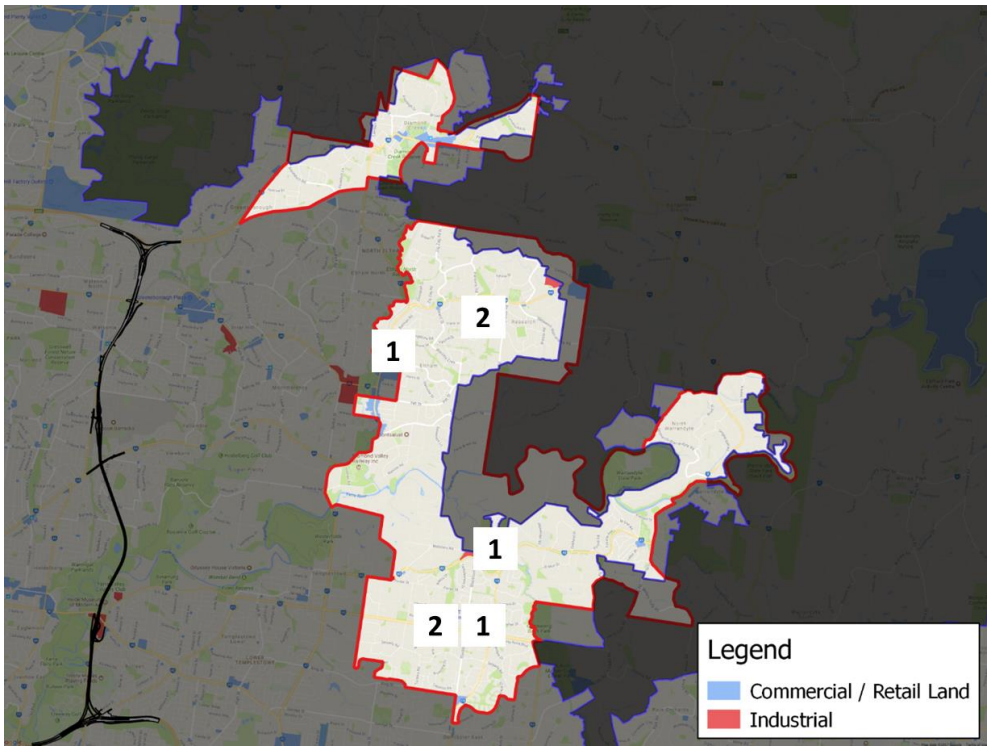
Our review of the constraints and opportunities to development in the Heidelberg precinct, suggests that the population and employment forecast by VIF can be accommodated within the current planning controls. Furthermore, our analysis suggests the precinct has capacity for additional development above that forecast by VIF.

5.1.12 Bordering UGB

5.1.12.1 Characterisation

The image below show the Bordering UGB precinct boundaries, as well as its constraints and opportunities.

Figure 40 – Bordering UGB precinct geography



Source: DELWP, Google Maps, EY analysis

Table 44 above provides a characterisation of important areas within the Bordering UGB precinct, contextualising land use in the area.

Table 47 – Bordering UGB precinct characterisation

Area	Characterisation
1. Localised retail / commercial areas	► Mostly neighbourhood shopping centres and strip retail ► The largest precinct is Stockland's The Pines, a sub-regional shopping centre
2. Residential	► Predominantly detached dwellings with some townhouse and unit development

The Bordering UGB precinct is predominantly residential land with localised retail and commercial areas and large open space areas.

Detached dwellings are the most common form of residence, with some higher density development (townhouse and apartments) around the activity centres, though zoning is generally restrictive for development (see comments in next section).

5.1.12.2 Key constraints summary

Table 42 above details constraints and opportunities to development within the Bordering UGB precinct with reference to current planning controls, precinct characteristics and historic growth.

Table 48 – Key constraints summary

Constraint	Comments
Statutory Planning	► Residential land mostly zoned General Residential – Schedule 3 and Low Density Residential which restricts residential development. ► Some zoning immediately surrounding commercial areas offers more density however the land coverage of these zonings is limited.
Land Fragmentation	► Sub-regional shopping The Pines offers significant land holding. ► Otherwise land in commercial precincts subdivided (fragmented).

	► Residential land predominantly conventional dwelling lots.
Surrounding Features	► Urban Growth Boundary provides the eastern boundary of this precinct, therefore land available generally not developable. ► Balance of the precinct comprises conventional density residential with local retail areas, built out and not conducive to extensive development.
Market Readiness	► Market appetite for these areas is strong as buyers look further away from the Melbourne CBD for value, though lack of public transport in these areas restricts younger buyers who work in the city. ► Strong capital growth in the last ten years would underpin demand for new product in these areas.

Planning controls for residential land in the precinct are generally restrictive in development potential, being predominantly general residential and low density residential zones. Planning schedules for commercially zoned land in the precinct allow for higher density development providing opportunity for commercial development in the precinct, however the area of land subject to this zoning is relatively small.

5.1.12.3 Baseline population and employment forecasts

Table 46 above shows forecast population and employment in the Heidelberg precinct from 2016 to 2051 according to VIF15 forecasts. Population is expected to grow from 53,600 in 2016 to 67,500 by 2051 at a rate of 0.6 per cent per annum.

Total employment in the precinct is expected to grow from 20,900 in 2016 to 12,100 by 2051, with commercial and retail employment expected to grow more (in absolute terms) than industrial employment.

Table 49 – Bordering UGB population and employment forecasts

Metric	2016	2026	2036	2051
Population – VIF Base case	53,648	55,580	59,220	67,497
CAGR		0.35%	0.64%	0.88%
Person per dwelling	2.97	2.84	2.80	2.83
Industrial Employment - VIF (Base Case)	1,139	1,374	1,597	1,960
CAGR		1.89%	1.51%	1.37%
Floor Space Ratio	1.03	1.25	1.45	1.78
Commercial & Retail Employment- VIF (Base Case)	9,098	10,898	12,730	15,727
CAGR		1.82%	1.57%	1.42%
Floor Space Ratio	0.41	0.49	0.57	0.70
Total Employment	12,051	14,485	16,917	20,885
CAGR		2.1%	1.7%	1.5%

Source: VIF 2015, DELWP, EY Analysis

The Bordering UGB precinct's ability to support increased residential density is limited due to planning and land constraints. The VIF forecasts are moderate and are considered reasonable given our analysis.

Industrial employment numbers and FSR's are too small to analyse as the land mass isn't available and data generally isn't consistent with the expected FSR's these types of land uses provide. Commercial and retail CAGR's are strong and the FSR the VIF numbers provide generally support this growth.

Our review of the constraints and opportunities to development in the Bordering UGB precinct suggests that the population and employment forecast by VIF can be accommodated within the current planning controls, though no further growth is expected to be appropriate for this precinct given the constraints.

5.2 Key findings

Our precinct analysis selected key areas in the north east which are expected to experience the most significant increase in attractiveness due to the project. Accordingly, this analysis focused on the ability of each precinct to absorb growth in population and employment, including consideration of a number of constraints and opportunities to development:

- Statutory planning
- Land fragmentation
- Surrounding features
- Market readiness

Overall, development forecast by VIF in the precincts identified should largely be supported under the current planning system, with a few considerations for further analysis:

- Commercial and retail development in the Thomastown industrial precinct may be limited due planning system constraints.
- Residential development in the Greensborough and Eltham North Activity Centre may be limited by the existing planning system, in particular constraints on the Neighbourhood Residential Zoned land.
- If the Bulleen industrial precinct is subject to a change in land use due to North East Link, there is a question whether the balance of industrial zoned land will be able to accommodate the precincts forecast industrial employment.

6. Scenario development

This section will focus on the refinement of preliminary LUTI model outputs based on the constraints of each precinct so as to better reflect the supply of land in each precinct. This analysis (for each precinct) will inform the overall refined project case scenario which will be used to calculate the second round land use benefits (Economic Appendix K).

6.1 Land use project case scenario

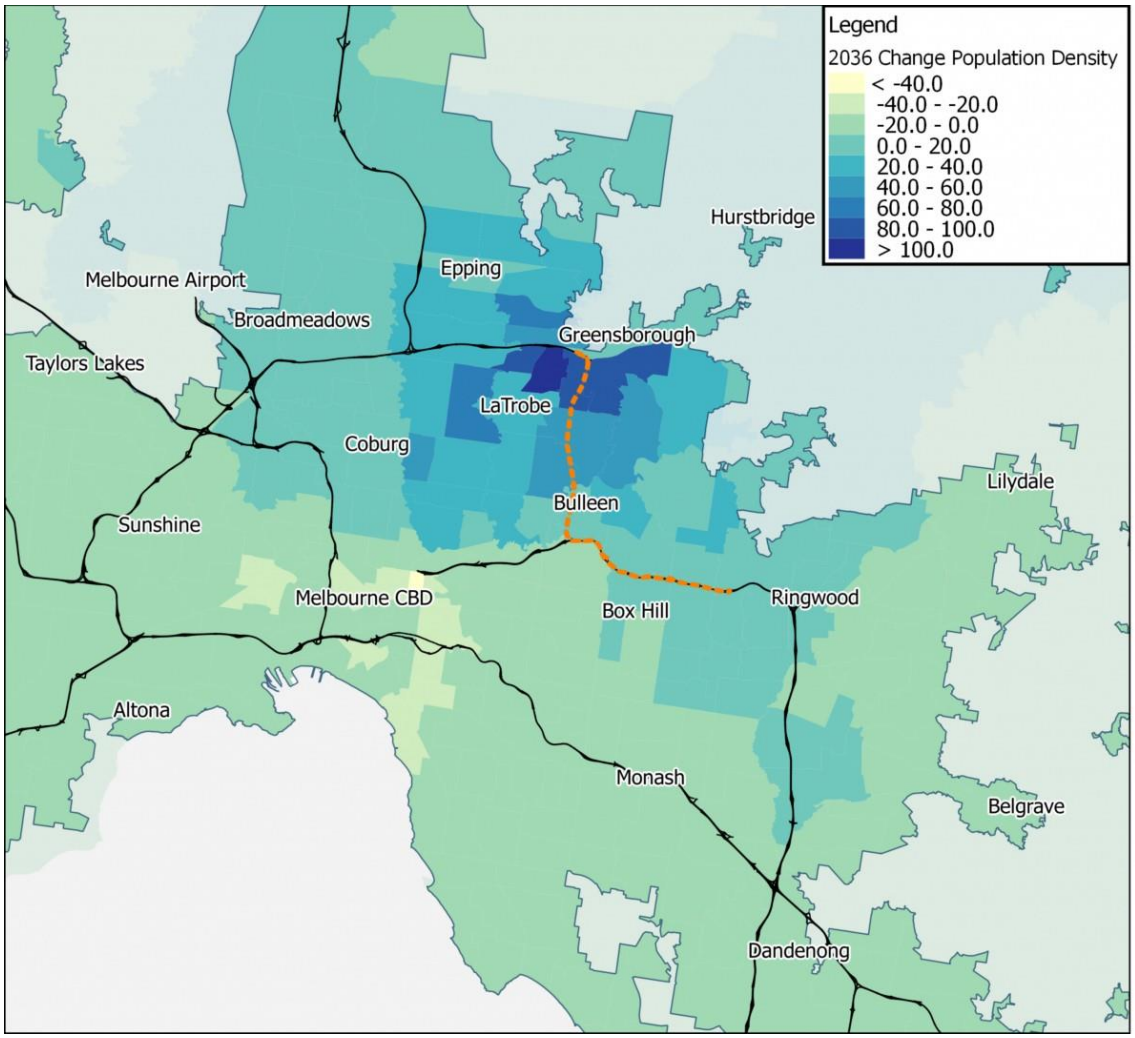
To identify areas likely to be impacted by changes in demand arising from improved accessibility, a land use and transport interaction (LUTI) modelling approach was used to estimate the potential redistribution of population and employment.

6.1.1 Population change due to North East Link

The North East Link Project has been developed in anticipation of projected population increases in the city's urban growth corridors. The project's connectivity and accessibility improvements will also contribute to attracting more residents to these areas and to the north east, which has been experiencing relatively low growth.

Figure 41 outlines the potential changes to population density resulting from North East Link. North East Link is expected to redistribute approximately 12,000 residents to Melbourne's north eastern Local Government Areas as outlined in the table below. This represents an additional 5% growth in addition to the existing forecast growth in population for these areas by Victoria In Future (VIF 2016). Furthermore, construction of North East Link is expected to result in the redistribution of approximately 9,700 residents to the north east project catchment. See Attachment B for a full list of potential induced population changes due to North East Link.

Figure 41 Potential location of population change resulting from North East Link (persons per square kilometre)



Source: VIF 2015, VLC, EY analysis

Table 50 - Additional population growth redistributed using LUTI (2036)

LGA	VIF forecast population growth (2016 – 2036)	Additional population growth redistributed using LUTI	LUTI population growth uplift proportion
Banyule	22,530	3,720	17%
Whittlesea	144,420	3,580	2%
Darebin	49,290	2,050	4%
Nillumbik	4,960	1,510	30%
Manningham	24,010	1,090	5%
North and north east LGAs	245,210	11,950	5%

Source: VIF 2015, VLC, EY analysis

6.1.2 Employment change due to North East Link

The redistribution of employment is used as a proxy to represent the potential impacts of the project in attracting additional commercial or industrial activities due to improved accessibility.

Figure 42 shows the potential locations of employment density change arising from the construction of North East Link, based on a preliminary land use analysis.[18] It indicates increased demand for employment and development in key commercial and industrial precincts such as the La Trobe NEIC, Epping, Campbellfield, Thomastown and Bundoora.

North East Link is expected to redistribute approximately 7,420 jobs to Melbourne's north eastern Local Government Areas as outlined in the table below. This represents an 8 per cent uplift to the existing forecast growth in employment for these areas by Victoria In Future (VIF 2015). Furthermore construction of the project is expected to redistribute approximately 5,500 jobs to the north east project catchment.

Additional provision of employment opportunities to areas of high growth (especially to regions like Whittlesea, where population growth is forecast to increase by over 140,000 between 2016 and 2036) is a beneficial and necessary phenomena that will help local workers in these regions to avoid having to travel long distances to employment opportunities. See Attachment B for a full list of potential induced employment changes due to North East Link.

Table 5 - Additional employment growth redistributed using LUTI approach

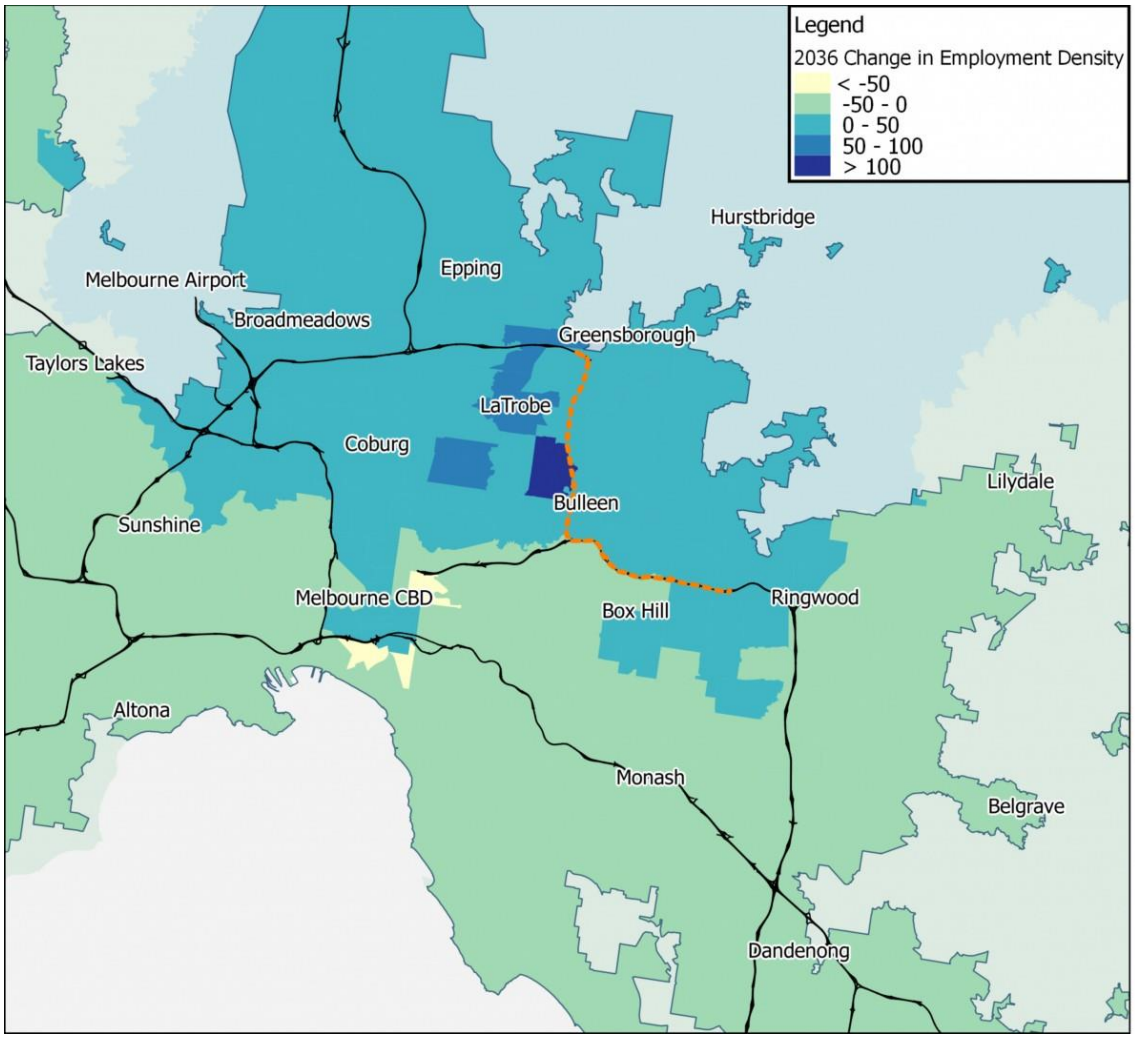
LGA	VIF forecast employment growth (2016 – 2036)	Additional employment growth redistributed using LUTI	LUTI employment growth uplift proportion
Banyule	21,860	2,240	10%
Whittlesea	32,560	1,990	6%
Darebin	21,820	1,630	7%
Manningham	6,260	820	13%
Nillumbik	13,390	740	6%
North east LGAs	95,890	7,420	8%

Source: VIF 2015, VLC, EY analysis

The land-use analysis for North East Link business case has considered the potential for North East Link to place development demand pressures on areas where there is no capacity for growth or development. Accordingly, the analysis of future land use scenarios were developed having considered planning and capacity constraints for development.

[18] While possible demand pressures have been analysed, a constrained or opportunity scenario that considers development capacity and constraints using supply factors such as planning controls and land availability has not been assessed; therefore, the results should be treated as indicative only.

Figure 42 Increased potential for job density in the north and north east (jobs per square kilometre)



Source: VIF 2015, VLC, EY analysis

6.2 Review of induced population and employment change

6.2.1 Precinct review

To provide validation to our land use model forecasts we have reviewed the redistribution of population and employment forecast due to North East Link for each of the precincts identified in section 5 against their constraints and opportunities. This review has also been informed by the case studies presented in section 4 which highlight the potential for road construction to induce population and employment change.

Table 51 and Table 52 below present the uplift in industrial and commercial / retail employment categories due to the construction of North East Link.

Table 51 – Review of industrial employment change due to North East Link

Precinct	2016 Base	2051 Base	Growth CAGR (%)	2051 Uplift	2051 Project	Project CAGR	CAGR Change
Heidelberg	10,166	15,152	1.1%	341	15,493	1.2%	0.0%
Bundoora	401	570	1.0%	28	598	1.1%	0.1%
Greensborough and Montmorency Activity Centre	343	510	1.1%	26	536	1.2%	0.1%
Rosanna	297	479	1.4%	20	499	1.4%	0.1%

Precinct	2016 Base	2051 Base	Growth CAGR (%)	2051 Uplift	2051 Project	Project CAGR	CAGR Change
Greensborough and Eltham North Activity Centre	581	975	1.5%	51	1,026	1.6%	0.1%
Doncaster Hill	2,290	3,760	1.4%	58	3,819	1.4%	0.0%
University Hill	844	2,100	2.6%	59	2,159	2.6%	0.0%
Epping	1,361	2,596	1.9%	43	2,639	1.9%	0.0%
Mill Park	1,518	3,200	2.2%	107	3,308	2.2%	0.0%
Thomastown industrial precinct	8,268	12,779	1.3%	230	13,009	1.3%	0.0%
Broadmeadows	26,544	40,875	1.2%	183	41,058	1.2%	0.0%
Bordering UGB	1,139	1,960	1.6%	68	2,028	1.6%	0.1%

Source: VIF 2015, VLC, EY analysis

Our analysis suggests that the Heidelberg precinct will have the largest absolute uplift in industrial employment due to North East Link (341 jobs by 2051). Improvements to accessibility are not expected to significantly redistribute industrial employment with the change in compound annual average growth (CAGR) rate being equal to or smaller than 0.1 per cent per annum for all precincts. Accordingly, the redistribution of industrial employment due to change in accessibility with North East Link is expected to be accommodated under the existing planning system and reflects a level of change that is broadly in line with the case studies presented in this report.

Table 52 – Review of commercial and retail employment change due to North East Link

Precinct	2016 Base	2051 Base	Growth CAGR	2051 Uplift	2051 Project	Project CAGR	CAGR change
Heidelberg	41,558	82,590	2.0%	2,658	85,248	2.0%	0.0%
Bundoora	1,751	2,515	1.0%	135	2,650	1.2%	0.1%
Greensborough and Montmorency Activity Centre	4,655	6,984	1.2%	402	7,386	1.3%	0.1%
Rosanna	5,059	7,777	1.2%	332	8,109	1.3%	0.1%
Greensborough and Eltham North Activity Centre	3,807	6,287	1.4%	310	6,597	1.5%	0.1%
Doncaster Hill	19,495	33,182	1.5%	556	33,738	1.5%	0.0%
University Hill	3,041	6,978	2.4%	247	7,225	2.4%	0.0%
Epping	11,591	21,276	1.8%	383	21,659	1.8%	0.0%
Mill Park	7,931	16,433	2.1%	455	16,888	2.1%	0.0%
Thomastown industrial precinct	5,620	10,362	1.8%	348	10,710	1.8%	0.0%
Broadmeadows	14,009	24,141	1.6%	161	24,302	1.5%	0.0%
Bordering UGB	9,098	15,727	1.6%	574	16,301	1.6%	0.1%

Source: VIF 2015, VLC, EY analysis

Table 52 above shows the forecast change in commercial and retail employment due to the construction of North East Link. The forecast change in employment is very small and does not result in movement to the forecast employment growth rate for the precincts identified. Thus, it is expected that the current planning system will accommodate a redistribution of commercial and retail employment to the north east (albeit a small one).

Table 53 below shows the potential change in population due to the construction of North East Link. The largest increases in population are expected to be in Heidelberg (2,200), Greensborough and

Eltham North Activity Centre (1,200) and the Bordering UGB precinct (1,400). However, this induced population growth is small very small relative to growth forecast between 2016 and 2051 and is expected to be accommodated by the planning system and reflects a level of change that is broadly in line with the case studies presented in this report.

Table 53 – Review of commercial and retail employment change due to North East Link

Precinct	2016 Base	2051 Base	Base CAGR (%)	2051 Uplift	2051 Project	Project CAGR	CAGR Change
Heidelberg	79,972	142,202	1.7%	2,194	144,396	1.7%	0.0%
Bundoora	12,889	17,085	0.8%	640	17,725	0.9%	0.1%
Greensborough and Montmorency Activity Centre	11,392	16,116	1.0%	636	16,753	1.1%	0.1%
Rosanna	33,804	42,847	0.7%	1,241	44,087	0.7%	0.1%
Greensborough and Eltham North Activity Centre	24,245	33,314	0.9%	1,232	34,546	1.0%	0.1%
Doncaster Hill	69,100	104,895	1.2%	849	105,744	1.2%	0.0%
University Hill	6,762	9,827	1.1%	240	10,067	1.1%	0.0%
Epping	46,960	70,063	1.1%	873	70,936	1.2%	0.0%
Mill Park	44,853	55,521	0.6%	932	56,453	0.6%	0.0%
Thomastown industrial precinct	11,711	22,591	1.9%	433	23,024	1.9%	0.0%
Broadmeadows	28,784	42,126	1.1%	140	42,266	1.1%	0.0%
Bordering UGB	53,648	67,497	0.7%	1,393	68,889	0.7%	0.0%

Source: VIF 2015, VLC, EY analysis

6.2.2 Overall findings

The analysis presented above demonstrates that the level of change due to North East Link at the precinct level that has been estimate using EY's land use model is broadly in line with the results of the case studies presented in chapter 4. It is also considered that the changes can be accommodated within existing planning controls and align with general market directions.

6.3 Review of induced change to freight and supply chain networks

While our land use model describes the movement of people and jobs due to the construction of North East Link, it does not explicitly model the change in operating costs for the supply chain. As described in Chapter 8, the construction of North East Link is expected to deliver significant benefits to the freight and supply chain network, including:

- Increased use of HPFVs to transport goods
- Reduction in travel times facilitated by less congestion
- Lower vehicle operating costs

These benefits are expected to reduce costs for suppliers and distribution centres in the south east and in particular, the north. Accordingly, the construction of North East Link is expected to promote a shift in industrial and supply chain activity to Melbourne's north.

Analysis conducted be XAct solutions, suggests that by 2036 the construction of North East Link may result in a redistribution of 1,400 jobs located in the Western State Significant Industrial precinct to the Northern State Significant Industrial precinct.[19]

[19] North East Link Phase 2 Assessment, XAct Solutions (2017)

Attachment A – Land use model

In order to measure the effect of accessibility on land use, observed population and employment densities are used in econometric regression models as shown in Figure 43. The models comprise:

- Model 1: Population density – which builds a causal relationship between observed differences in population density across travel zones (TZs) and differences in amenities and accessibility to jobs. The model estimates the extent to which accessibility drives residential density. It does this by isolating accessibility to jobs from a number of other factors determining attractiveness, such as distance or accessibility to other attractions or the physical characteristics of the area.

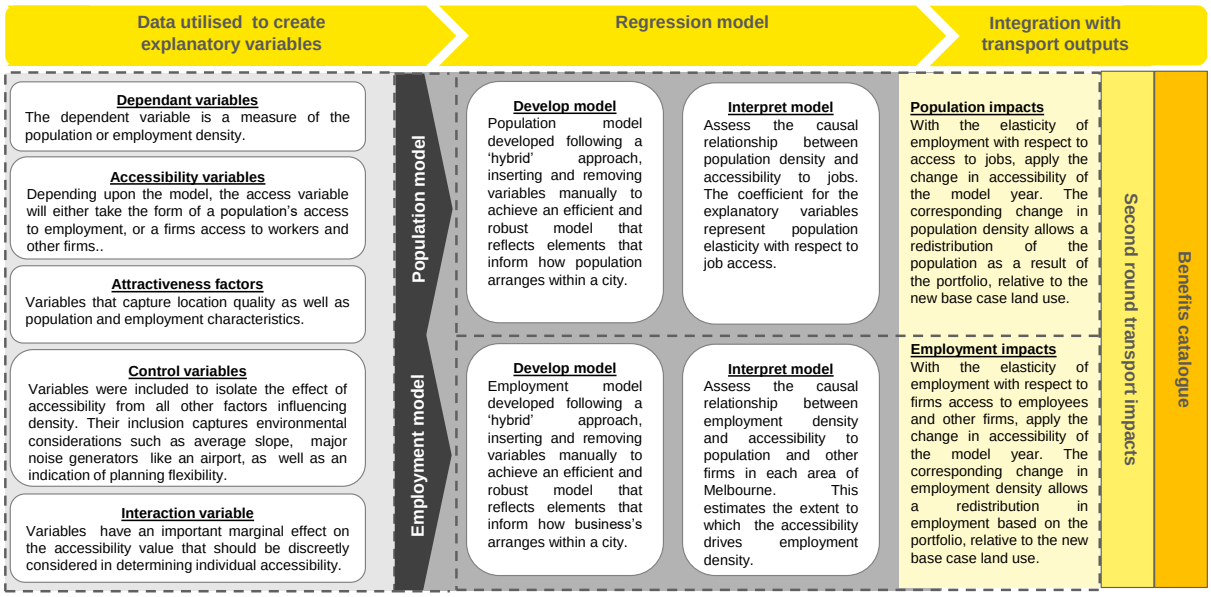
- Model 2: Employment density – which builds a causal relationship between observed differences in employment density across TZs and differences in accessibility to workforce, other firms and key infrastructure that firms depend on. The model estimates the extent to which accessibility drives employment density. It does this by isolating accessibility to people and firms from a number of other factors, such as proximity to other enabling pieces of infrastructure such as a port or an airport.

- Outputs from the population density model (Model 1) are used as an input for population accessibility in Model 2. In this way, Model 1 and Model 2 are iterative. These results are then used in the modelling approach discussed below.

Econometric techniques are used to correct for a number of confounding relationships that often prevents robust causal relationships from being identified. One such relationship is 'reverse causality'. Reverse causality occurs if we estimate the impact of accessibility on density and there is a simultaneous causal impact of density on accessibility – which would be the case if transport investment and services tend to be provided in locations where population or employment density is already high (which is the case).

The models developed explicitly account and correct for reverse causality using techniques that are discussed the methodology below.

Figure 43 Summary of land use model



Data sources

The data was sourced in cooperation with the Department of Economic Development, Jobs, Transport and Resources and from DATA.Vic. Features and corresponding data sources are set out in Table 54.

Table 54 Relevant features and data sources

Features to inform variable(s)	Data source
Public transport stops (rail stations, ferry stops, tram/ light rail stops, bus stops, interchanges, etc.)	DATA.VIC PTV Train Station PTV Bus Stop (Metro and Regional) PTV Tram Stop
Transport corridors (freeways, roads, streets, rail lines, tram/ light rail lines, bus routes)	DATA.VIC Vicmap Transport - Arterial Roads Vicmap Transport - Road Network PTV Train Track Centreline PTV Tram Route
Education facilities (primary, secondary, tertiary)	DATA.VIC DEDJTR supply: VicMap FOI (point)
Emergency services (police stations, fire stations, emergency units)	DEDJTR supply: VicMap FOI (point)
Health facilities (clinics, small hospitals, large hospitals)	DEDJTR supply: VicMap FOI (point)
Public facilities (libraries, community centres, museums)	DEDJTR supply: VicMap FOI (point)
Local amenities (parks, playgrounds, public amenities, beaches, waterbodies (sea, river, lakes))	DEDJTR supply: VicMap FOI (poly)
Airports	DEDJTR supply: VicMap Transport
Entertainment and leisure facilities (cinemas, shopping centres, theatres, cafes, restaurants, hotels)	DEDJTR supply: VicMap FOI (point)
Business facilities (major business districts, ports, intermodal terminals)	DEDJTR supply: Ports Intermodal terminals
Elevation, topography	DATA.VIC
Development approvals, dwelling completions, commercial/ retail office completions by small area	DEDJTR Supply based on WorkCover data
Business counts/information by small area	DEDJTR Supply

Dependent Variable

Population density

The dependent variable in the population model is population density. Population density is defined as the number of residents per hectare in each TZ, i:

$$Pop\ density_i = Total\ pop_i / ha_i$$

Employment model - Employment density

The dependent variable in the employment density model is work-place based employment density. Employment density is defined as the number of jobs per hectare in each TZ.

$$Emp\ density_i = Total\ emp_i / ha_i$$

Accessibility Variable

Population model - Resident accessibility to employment

Accessibility for residents to jobs is measured by car, bus and rail. Job accessibility for residents in each TZ is the number of jobs in that TZ plus the number of jobs in every other TZ divided by the average cost of getting to these TZs:

$Access_i^J = \sum_{i=1}^{N} \frac{jobs_i}{avg\ cost_i^J}$

The average cost of accessing jobs in the TZ, $avg\ cost_i^J$, is across all available modes (i.e. car and public transport).

Employment model – Employers accessibility to workers and firms

Firms' access to workers and to other firms are measured in a similar way. Worker accessibility for each TZ is the number of workers living in that TZ plus the sum of the workers in every other of the TZs divided by the cost of access to these TZ. The same logic applies to firms:

$Access_i^W = \sum_{i=1}^{N} \frac{workers_i}{avg\ cost_i^W}$

$Access_i^F = \sum_{i=1}^{N} \frac{firms_i}{avg\ cost_i^F}$

Where the average cost of accessing workers, $avg\ cost_i^W$, uses average journey costs across public transport modes. The average cost of accessing firms, $avg\ cost_i^F$, uses car journey costs. The reason for using different modes as a basis for the two different access calculations is to avoid multicollinearity – that two explanatory variables that both have causal impact will have too similar variability which means that they both should not be included in the model. The cost of accessing workers and firms in the TZ where employers are located is zero.

Explanatory variables

In addition to the access variables, a number of other explanatory variables were created for potential use in the population and employment models. These included attractiveness factors, location quality, population and employment characteristics and 'control variables'. A qualified selection of variables isolates the effect accessibility has upon population or employment. A broad overview of the package of variables is listed below.

- Attractiveness factors
  - Distance to nearest education facilities
  - Distance to the nearest emergency service
  - Distance to nearest health facilities
  - Distance to passenger Airports
  - Distance to nearest waterfront
  - Distance to nearest shopping precinct
  - Distance to the nearest recreation area
  - Distance to the nearest sport and recreation facility
- Control variables
  - Average slope/elevation
  - Distance to the nearest rail station
  - Percent of a travel zone covered by green and open space
  - Measure of flexibility of urban planning system
- Indicator (dummy) and interaction variables
  - Airport – tested airport variable where within 4km and 10km to examine the impact
  - Rail Station – tested proximity to rail station at 0.4km and 1km to examine the impact
  - Interaction variables assessing the marginal impact upon the respective accessibility variable for features such as distance to a rail station, planning flexibility, percent employment in relevant sectors.

Spatial lag

The character of the cross-sectional data, representing a zonal geography leads to first order autocorrelation. In this instance, economic intuition indicates that accessibility from a specific travel zone will be related to the corresponding accessibility in the contiguous travel zone.

Autocorrelation results in an inefficient model and presents within the disturbance term violating the ordinary least squares assumption that the error terms are uncorrelated. This inefficiency is observed via incorrect standard errors leading to incorrect confidence intervals.

To control for this, the population density of a TZ that is explained by the population density of surrounding TZs can be accounted for within a spatial lag variable. If there are factors that influence densities across adjacent TZs that have not been controlled for, and adjacent TZ also tends to feature similar accessibility, the model would assign this affect to the accessibility variable rather than to the underlying drivers. This source of distortion has been eliminated through the use of spatial lags.

Omission of variables

Through the manual stepwise process of building a strong estimation, a range of variables were omitted. The variables were tested within various iterations of the population and employment models and found to be statistically insignificant, highly correlated to other variables or problematic to the model.

Representation of supply

The land use model is designed to principally account for demand factors affecting densities. It does not have a detailed understanding of supply constraints (e.g. height/ density limits) and how these could affect the results. Supply constraints are represented through interaction variables that effectively dampen the rate of change caused by improved access in locations that historically have seen low approval rates. Given the long term focus of the analysis, it is reasonable to expect planning controls will at some point respond to higher residential or commercial demand.

It should also be noted that the land use modelling is applied 'in reverse'. Starting with forecast land use with all projects in place, the approach removes individual projects and models the reduction in future growth as a consequence.

To this end, accounting for demand is a valid approach to approximating the on average land use change in response to changes in accessibility for each respective travel zone.

Other limitations and assumptions

Because the design of travel zones follow certain rules, there is likely to be a correlation between zoning size and area characteristics. Such correlation could cause bias to the results of the regression analyses. However, since the dependent variables are normalised for zone size (e.g. population per ha, not total population), and because the role of the travel zones is to assign a geographic location to the containing population and employment (which is used to calculate proximity to amenities), the issue of biasing would therefore be limited to the greater inaccuracies in determining location and proximity to amenities for residents and jobs within larger travel zones. This is a second order issue, which could be investigated in future work.

Each travel zone is treated as an individual observation in the regression analysis. This means that each travel zone carries equal 'weight' in the analysis independently of the number of jobs or residents located there. An alternative approach could be to apply weights to each travel zone in the regression analysis, to allow dense zones to have a stronger influence on the results (i.e. effectively treating each resident and job as individual observation). Doing so would require further investigation into the implications for the validity of other variables (e.g. it may affect how the spatial lag variables are calculated). This study has chosen the former approach, but would recommend that the use of weighted observations is investigated as part of future work.

It was suggested by the peer reviewer to undertake principal components analysis of the explanatory variables in order to increase the efficiency of the model. This was not pursued as part of the study as it would risk compromising the clear link between the transport model outputs and calculation of the main policy variables (job and worker access). As noted within section 6.2,

principal components analysis for non-policy variables could be explored as part of future work and model development.

Distance explanatory variables

A key component of the LUTI model is the regression analysis that measures the relationship between population and employment density and the proximity to a broad array of urban features.

In order to calculate these distance coefficients, the distances between all urban features within the study area and the travel zone geography were measured. Specifically, this process involved measuring the distance between the feature point and the centroid, which is the most central point of a shape, of each travel zone. Two separate methods were used to determine this regression input and these are described in detail below.

Method 1: Straight line distance

Calculating the straight line distance of each travel zone to the nearest urban feature is the simplest method and is the easiest to calculate. However it possesses some obvious limitations. In reality, residents and workers will need to navigate around impermeable sections of the urban structure and geographical features, meaning that the straight line method over-exaggerates the accessibility of residents and workers to urban features to varying extents.

Method 2: BTM distance matrix

Method 2 accounts for the extended distance to urban features that result from following the road network. Using a travel distance matrix for all travel zones in the model geography, it was then determined whether a TZ contained at least one feature of each type and then the corresponding distance to that feature was recorded for each travel zone to the closest feature. This approach worked well in the central areas where travel zones were densely packed and small in area.

Specification testing

To suitably demonstrate the robust and efficient estimation of both the population and employment land use models, a series of tests were undertaken during their incremental construction.

1. **Multicollinearity** – Potential bias of the regression occurring when two or more of our explanatory variables are very highly correlated.

    - Analysis of the control and attractiveness variables via a correlation matrix was undertaken to assess the strength of the core specification and stepwise introduction of multiple variables without leading to multi-collinearity that may bias the estimate.

2. **Endogeneity** – Inconsistent and biased estimators occur if the explanatory variables are correlated with the error term. Given the comprehensive list of variables included, endogeneity in the form of reverse causality was tested for.

    - Restrictions were imposed upon the estimation through a Hausman Test to determine if the explanatory power of the accessibility variables might be co-determined by the dependant variable or otherwise correlated with the error term.

3. **Instrumental variables**

    - To satisfactorily address the issue of reverse causality found to exist in step 2, a two stage least squares estimation using instrumental variables was utilised. Two pre-conditions were imposed for the selection of instrumental variables.

        - The instrument must not be correlated with the regression error term.

- The instrument must be strongly, or at least not weakly correlated with endogenous accessibility variable(s).

Violation of these two assumptions may lead to an imprecise or biased estimation. To aid the validity and strength of the specification, a Hansen-Sargan test and Cragg-Donald test were undertaken.

4. **Statistical significance**

- Using the p-value and F-stat to demonstrate the model is comprised of variables that are individually and jointly statistically significant and different from zero.

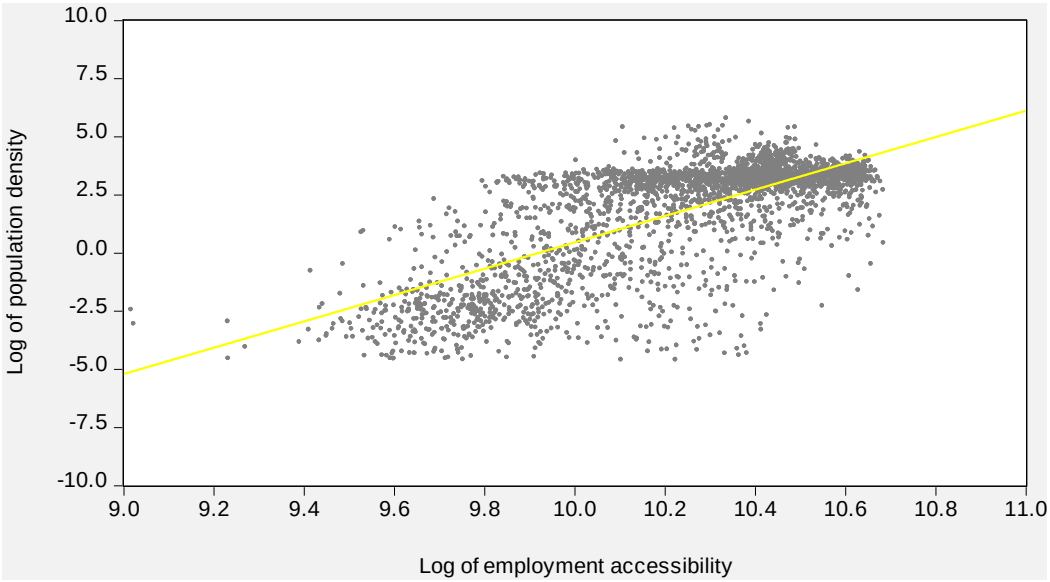
The above steps are described in detail below though the stepwise construction of both the population and employment models.

Population model

Regression model

The population model follows a log-log model specification to achieve a strong linear relationship while allowing for elasticity of the dependant variable to be easily interpreted. The relationship between accessibility and density for each respective TZ can be seen below in Figure 44. As the graph illustrates there is a clear log relationship between access to jobs and population density. This relationship helps determine the specification for the regression model.

Figure 44 Relationship between population density and access to jobs



Source: EY analysis

Core model specification

The core model includes the relevant access variable only and excludes the other explanatory variables that are subsequently defined through a two-stage OLS methodology (see below).

$$Log(PopDensity) = \beta + \beta_1 \, Log(EmpAccess) + \epsilon$$

SE	0.83	0.085	r-squared 0.479

The core model explains 47% of the variation in population density. We would expect population density to be explained by a number of other features, many of which may be highly correlated with

employment access. Accordingly, the population model was built up through the logical insertion and removal of variables.

Full OLS model specification

The population model takes into account the core relationship between employment accessibility and population density while also considering all of the other explanatory factors included within an ordinary least squares specification. By including these additional explanatory variables, the population model performs well at estimating actual population density as highlighted by the improved adjusted R-squared value and F-statistic in Table 55.

Table 55 Critical statistics for OLS specification

R-squared	0.734292	Mean dependent var	1.804035
Adjusted R-squared	0.732380	S.D. dependent var	2.357721
S.E. of regression	1.219697	Akaike info criterion	3.242554
Sum squared resid	4134.211	Schwarz criterion	3.287085
Log likelihood	-4518.576	Hannan-Quinn criter.	3.258628
F-statistic	383.9921	Durbin-Watson stat	1.711156
Prob(F-statistic)	0.000000		

The inclusion of additional explanatory variables increases the explanatory power of the model and improves a number of key statistics as seen in the table above.

Multicollinearity - A correlation matrix of the attractiveness and control variables demonstrates no two independent variables are excessively co-determinant. The largest value expressed (0.72) is comfortably below the critical value of 0.8. Nonetheless, this value and several others suggest there is a degree of co-linearity.

This in itself does not bias the estimation. It is also highlighted that the presence of the accessibility variable will have a small but entirely expected correlation with other variables that are constructed from distance calculations. Through accepting and managing the small amount of co-linearity inherent within such a model we are able to remove the detrimental bias that would result from omitting variables that serve to balance the extent to which our accessibility variable impacts population. Further, the stepwise estimation involved the exclusion of a number of variables that introduced significant covariance into the model.

Overall, the potential presence of multicollinearity does not invalidate the model.

Two stage least squares regression

There is the potential for reverse causality when estimating the impact of accessibility on density as there can be the tendency for population and employment density to also cause higher accessibility (e.g. if we invest more in transport provision to and from locations that are already dense). This was proven through the use of a Hausman Test to reject the null hypothesis that access to jobs was free from reverse causality with population density.

To overcome the issue of reverse causality, a two-stage least squares model specification was chosen to model population. Instrumental variables are regressed on employment accessibility in a 'first stage' regression in order to eliminate from the model the reverse causality. The output of the first stage is a 'corrected' set of accessibility variables, which are used in a second stage regression that is free from endogeneity.

Valid instrumental variables must meet these two key criteria:

1. The instrument must not be correlated with the regression error term.

    - The instruments used are only considered valid if uncorrelated with the error term. To confirm our model does not violate this assumption, Hansen-Sargan test has been

undertaken. The test accepted the null hypothesis that the collective use of the instruments is valid with the test statistic be less than the critical value (6.85 < 7.4) thus, the null hypothesis was accepted.

2. The instrument must be strongly, or at least not weakly correlated with employment accessibility.

    - To test that the instruments used are not weakly correlated to the endogenous variables we assess the Cragg-Donald F-Statistic for weak instruments. The test concludes the instrumental variables used are strongly or at least not weakly correlated to the endogenous variables.

Full 2SLS model specification

As observed in Table 56, the population model regression has an F-stat of 379.9 (associated p-value of 0) indicating the explanatory variables in the specification are, jointly, statistically significant in explaining population density. Individually a number of variables, including the accessibility variable, are significant at the 1%, 5% and 10% statistical significance levels, making them useful explanatory variables for describing population density.

An R-squared adjusted value of 0.73 is associated with the specification indicating that 73% of the variation in population density can be explained by the model.

Table 56 Critical statistics for 2SLS specification

R-squared	0.733743	Mean dependent var	1.804035
Adjusted R-squared	0.731827	S.D. dependent var	2.357721
S.E. of regression	1.220956	Sum squared resid	4142.749
F-statistic	379.9643	Durbin-Watson stat	1.716318
Prob(F-statistic)	0.000000	Second-Stage SSR	4230.707
J-statistic	28.76087	Instrument rank	24
Prob(J-statistic)	0.000003		

Employment model

Regression model

The employment model follows a log-log model specification to achieve a strong linear relationship while allowing for elasticity of the dependant variable to be easily interpreted. The relationship between accessibility and density can be seen below in Figure 45 and Figure 46, for each TZ. There appears to be a clear log relationship between both accessibility variables and employment density. This relationship helps determine the specification for the regression model.

Figure 45: Relationship between employment density and accessibility to workers

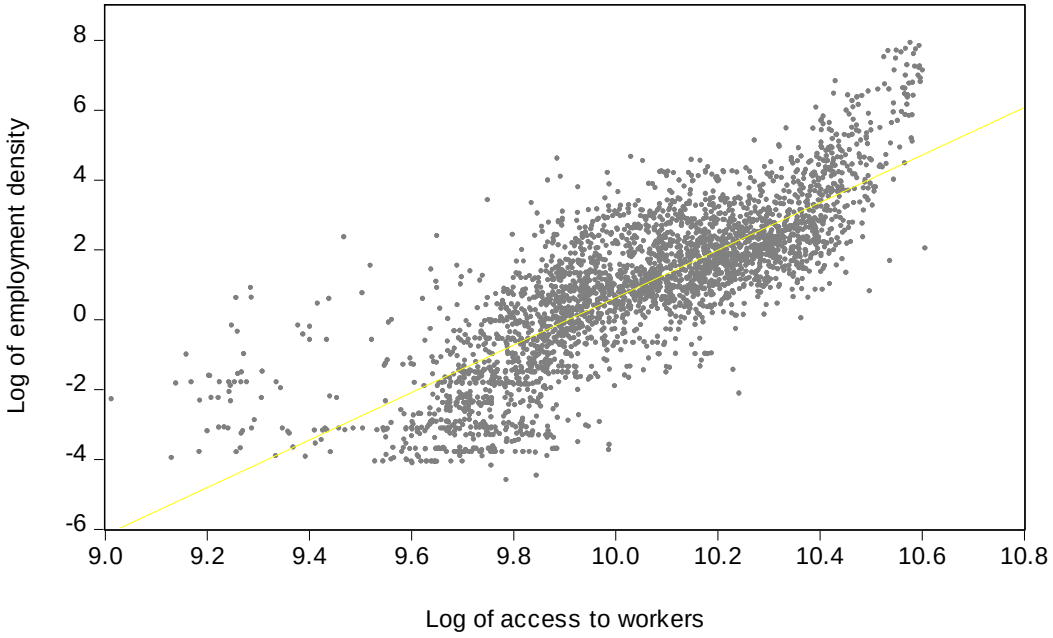
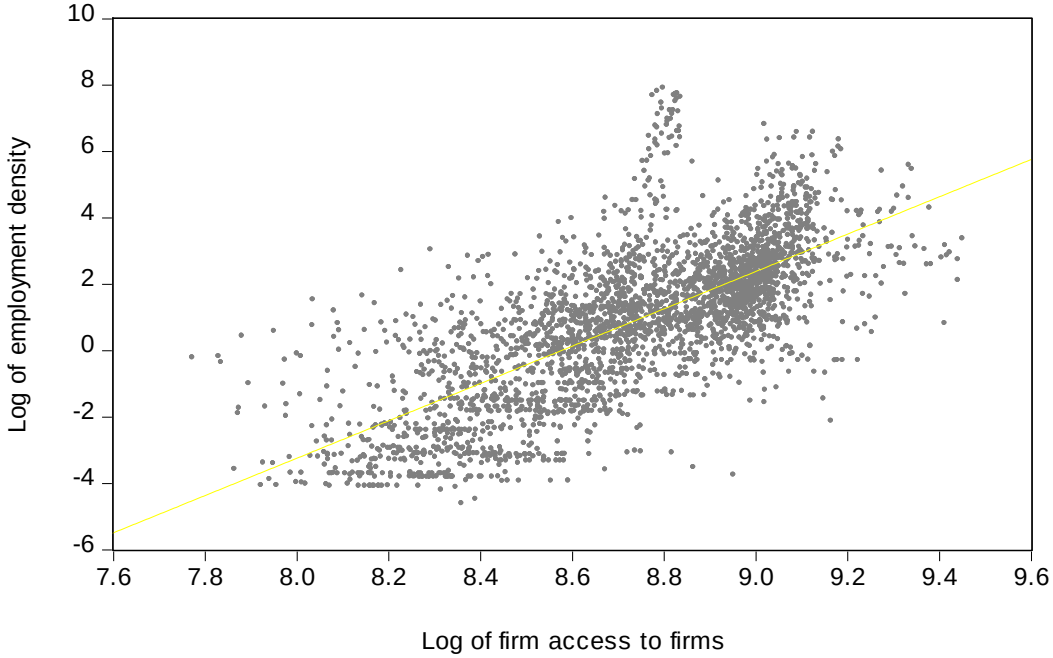


Figure 46: Log relationship between employment density and firm to firm access



Source: EY analysis

Core model specification

The core model includes the relevant access variables only and excludes the other explanatory variables that are subsequently defined through a two-stage OLS methodology (see below).

$$Log(EmpDensity) = \beta + \beta_1 Log(AccessWorkers) + \beta_2 Log(FirmAccess) + \epsilon$$

SE *0.88* *0.14* *0.13* *r-squared 0.664*

The core model explains 66% of the variation in employment density. We would reasonably expect that employment density is explained by a host of other features other than just accessibility. Accordingly the population model was built up through the logical insertion and removal of variables.

Full OLS model specification

The employment model takes into account the core relationships between employer access to workers and firms with respect to employment density while also considering a range of other explanatory factors. With the inclusion of these additional explanatory variables, the employment model performs well at estimating actual population density

Table 57: Critical statistics for OLS specification

R-squared	0.781429	Mean dependent var	0.942119
Adjusted R-squared	0.780278	S.D. dependent var	2.241306
S.E. of regression	1.050600	Akaike info criterion	2.942146
Sum squared resid	3355.435	Schwarz criterion	2.975652
Log likelihood	-4480.071	Hannan-Quinn criter.	2.954187
F-statistic	679.2818	Durbin-Watson stat	1.287436
Prob(F-statistic)	0.000000		

Source: EY analysis

The inclusion of additional explanatory variables increases the explanatory power of the model and improves a number of key statistics as seen in the table above.

Multicollinearity – As with the population model, a correlation matrix of the attractiveness and control variables demonstrates no two independent variables are co-determinant. The largest value expressed (0.79) is below the critical value of 0.8. This suggests potential co-linearity between variables and the accessibility variables.

This in itself does not bias the estimation. The presence of the accessibility variable will have a small but entirely expected correlation with other variables that are constructed from distance calculations. Through accepting and managing the small amount of co-linearity inherent within such a model we are able to remove the detrimental bias that would result from omitting variables that serve to balance the extent to which our accessibility variable impacts the dependent variable. It is noted the stepwise estimation involved the isolation and exclusion of a number of variables that introduced significant covariance into the model.

Overall, the potential presence of multicollinearity does not invalidate the model.

Two stage least squares regression

There is the potential for reverse causality when estimating the impact of accessibility on density, as there can be the tendency for employment density to also cause higher accessibility (e.g. if the Government invests more in transport provision to and from locations that are already dense there is reverse causality as the people come to transport links, and transport links are built to address demand).This was proven through the use of a Hausman test to reject the null hypothesis that access to jobs was free from reverse causality with employment density.

To overcome the issue of reverse causality, a two-stage least squares model specification was chosen to model population. Instrumental variables are regressed on employment accessibility in a 'first stage' regression in order to eliminate from the model the reverse causality. The output of the first stage is a 'corrected' set of accessibility variables, which are used in a second stage regression that is free from endogeneity.

The selection of instrumental variables was undertaken on the premise that they not violate two key criteria:

1. The instrument must not be correlated with the regression error term.

    - The instruments used are only considered valid if uncorrelated with the error term. To confirm our model does not violate this assumption, Hansen-Sargan test has been undertaken. The test accepted the null hypothesis that the collective use of the

instruments is valid with the test statistic be less than the critical value (5.5 < 7.4) thus, the null hypothesis was accepted.

2. The instrument must be strongly, or at least not weakly correlated with employment accessibility.

    - To test that the instruments used are not weakly correlated to the endogenous variables we assess the Cragg-Donald F-Statistic for weak instruments. The test concludes the instrumental variables used are strongly or at least not weakly correlated to the endogenous variables.

Full 2SLS regression

In light of the above testing, the full OLS model has been estimated using the 2 stage least squares approach with instruments deemed to be correlated to the endogenous variables and uncorrelated with the error term. The inclusion of valid and strong instruments has improved the statistical significance of the endogenous variables, especially firm access which is not statistically significant at the 5% level of significance in the OLS estimation. Overall, a number of variables are significant at the 5% and 10% statistical significance level in the employment density model, making them useful explanatory variables for describing employment density.

As shown in Table 58, the model has an F-stat of 656.7 (associated p-value of 0) which indicates that the explanatory variables included in the specification are, jointly, statistically significant in explaining employment density.

Table 58: Critical statistics for 2SLS specification

R-squared	0.773389	Mean dependent var	0.942119
Adjusted R-squared	0.772197	S.D. dependent var	2.241306
S.E. of regression	1.069748	Sum squared resid	3478.855
F-statistic	656.6716	Durbin-Watson stat	1.222031
Prob(F-statistic)	0.000000	Second-Stage SSR	3328.175
J-statistic	7.376901	Instrument rank	18
Prob(J-statistic)	0.006607		

Source: EY analysis

Redistribution model

Interaction of land use model with transport model

The econometric land use model provides an elasticity value from which population or employment will change in response to changes in the respective accessibility metric(s).

The elasticity of population or employment with respect to accessibility informs the creation of the 2031 Base Case land use scenario through inputting the accessibility variables as calculated from the 2031 Base Case transport model output. The outputs are treated so the total population and employment in 2031 do not change. Similarly, reduction factors are applied to a range of travel zones to buffer the response where demand side constraints exist, or population and employment are unlikely to respond as strongly to accessibility changes.

The resulting change in population and employment is then converted into a land use file that is compatible with the strategic model.

Approach to land use redistribution – accounting for socio-economic and industry factors

The land use model uses changes in access modelled in a strategic transport model to estimate induced changes in population and employment at the aggregate level for each travel zone (i.e. using a LUTI process). When doing this, the approach is redistribute land use so that overall

population and employment do not change and are kept in line with Government forecasts as per the DEDJTR Reference Case.

When redistributing land use, there is a requirement to consider the distribution of population and employment at a more detailed level to account for the way different socio-economic and industry factors influence travel demand, which is an important element of strategic transport models.

Key variables in the land use file that is an input to the strategic model include:

- Household size
- Population by age
- Dependents by age
- Primary, secondary and tertiary enrolments
- Industry composition
- Blue and white collar employment.

As shown in Table 59, a number of assumptions have been made in order to govern our approach to the redistribution of population and employment at the travel zone level. Generally it is assumed that induced population and employment to a particular travel zone take on the characteristics of that attraction zone.

Table 59: Land use component assumptions

Land Use Component	Assumption
Households	It is assumed that the average household size remains constant for each travel zone (i.e. in line with the Reference Case). Therefore, the change in the number of households for each travel zone is proportional to the change in population for that zone. This implies that if the general population relocation trend is, say, away from fringe areas towards inner urban areas, average city-wide household sizes would shrink. This is consistent with observed trends of lower household sizes and lower dwelling occupancies in inner city areas.
Population by age cohort	It is initially assumed that the age composition (i.e. the share of each age cohort of the total population) by travel zone remains constant as the population for that travel zone changes. In effect, the induced population takes on the characteristics of the attraction zone, reflecting the tendency for people to locate close to others with a similar socio-economic profile. The distribution between travel zones within each age cohort is also normalised to control the city-wide total number of individuals within each cohort.
Dependents by age cohort	It is assumed that the proportion of dependents relative to the population in each age cohort for each travel zone remains unchanged, which is the same as the treatment for age cohorts. Therefore the number of dependents in each cohort change in proportion to the change in population for their respective age cohort for that travel zone. The distribution between travel zones within each age cohort is also normalised to control the city-wide total number of dependents within each cohort.
Enrolments	Changes in the number of primary and secondary enrolments are assumed to be proportionate to the relative change in population in that travel zone and adjoining (catchment) zones for their appropriate age cohort (i.e. Ages 5-11 for primary enrolments, ages 12-17 for secondary enrolments). Tertiary enrolments are less likely to be impacted by redistribution of population at the levels being modelled in this study and therefore it has been assumed that tertiary enrolments will remain unchanged under each land use scenario.
Employment by industry	It is assumed that the composition of induced employment changes by industry in each travel zone reflects the composition of employment change that is anticipated to occur over time in the attraction zone as per the Reference Case (i.e. between 2021 and 2031). This implies that an increase in employment at the travel zone level will reflect observed and expected trends over time for those zones. In effect, the induced employment takes on the characteristics of the attraction zone, but more so in industries that are expected to change/grow over the horizon of the Reference Case. It is considered that this could better reflect broader trends and relative mobility of different employment categories.
Blue Collar workers by industry	The split between blue collar and white collar workers for each industry is assumed to remain unchanged within each travel zone. This is consistent with the approach used by the Reference Case land use scenarios which assumes that there is no shift in blue collar workers over time, keeping it in line with Government projections.

Attachment B – Induced population and employment growth

The North East Link Project has been developed in anticipation of projected population increases in the city's urban growth corridors. The project's connectivity and accessibility improvements will also contribute to attracting more residents to these areas and to the north east, which has been experiencing relatively low growth.

The tables below show the expected induced population and employment change due to the construction of North East Link across Melbourne's Local Government Areas.

Table 60 – Additional population growth redistributed using LUTI (2036)

LGA	VIF forecast population growth (2016-2036)	Additional population growth redistributed using LUTI
Melbourne (C)	109,530	-210
Port Phillip (C)	51,040	-450
Yarra (C)	35,970	-350
Moonee Valley (C)	34,670	-40
Maribyrnong (C)	44,490	-420
Hobsons Bay (C)	19,910	-550
Brimbank (C)	30,610	-810
Moreland (C)	57,930	630
Darebin (C)	49,280	2,050
Banyule (C)	22,530	3,720
Boroondara (C)	24,190	-360
Stonnington (C)	28,840	-360
Glen Eira (C)	23,090	-540
Bayside (C)	14,790	-400
Kingston (C)	34,490	-750
Monash (C)	29,660	-290
Whitehorse (C)	30,230	120
Manningham (C)	24,010	1,090
Maroondah (C)	25,590	-30
Knox (C)	29,220	-130
Greater Dandenong (C)	46,860	-500
Frankston (C)	24,400	-580
Mornington Peninsula (S)	41,550	-740
Casey (C)	167,840	-1,600
Cardinia (S)	76,350	-660
Bass Coast (S)	16,270	0
Unincorporated Vic	-650	0
South Gippsland (S)	370	0
Baw Baw (S)	27,400	0
Yarra Ranges (S)	27,210	-230
Nillumbik (S)	4,960	1,510
Whittlesea (C)	144,420	3,580
Hume (C)	122,020	350
Melton (S)	167,090	-1,270
Wyndham (C)	184,170	-1,780

LGA	VIF forecast population growth (2016-2036)	Additional population growth redistributed using LUTI
Greater Geelong (C)	79,930	0
Queenscliffe (B)	590	0
Surf Coast (S)	13,620	0
Moorabool (S)	16,300	0
Macedon Ranges (S)	14,580	0
Mitchell (S)	47,540	-10
Golden Plains (S)	9,290	0
Hepburn (S)	4,110	0
Murrindindi (S)	4,830	0
Ballarat (C)	45,960	0
Mount Alexander (S)	5,170	0
Greater Bendigo (C)	51,050	0
Latrobe (C)	13,770	0

Source: VIF 2015, VLC, EY analysis

Table 61 – Additional employment growth redistributed using LUTI (2036)

LGA	VIF forecast employment growth (2016-2036)	Additional employment growth redistributed using LUTI
Melbourne (C)	280,290	-120
Port Phillip (C)	27,740	-420
Yarra (C)	39,400	-420
Moonee Valley (C)	9,560	20
Maribyrnong (C)	19,380	-250
Hobsons Bay (C)	7,510	-280
Brimbank (C)	37,180	-440
Moreland (C)	19,700	280
Darebin (C)	21,820	1,630
Banyule (C)	21,860	2,240
Boroondara (C)	28,310	-420
Stonnington (C)	21,650	-310
Glen Eira (C)	13,130	-290
Bayside (C)	11,430	-270
Kingston (C)	32,790	-750
Monash (C)	48,600	-480
Whitehorse (C)	35,760	90
Manningham (C)	13,390	820
Maroondah (C)	23,260	-110
Knox (C)	17,600	-280
Greater Dandenong (C)	42,880	-650
Frankston (C)	25,460	-500
Mornington Peninsula (S)	16,470	-480
Casey (C)	32,490	-610
Cardinia (S)	12,930	-250
Bass Coast (S)	7,930	0
Unincorporated Vic	10	0

LGA	VIF forecast employment growth (2016-2036)	Additional employment growth redistributed using LUTI
South Gippsland (S)	2,800	0
Baw Baw (S)	11,440	0
Yarra Ranges (S)	15,320	-160
Nillumbik (S)	6,250	740
Whittlesea (C)	32,560	1,990
Hume (C)	40,640	560
Melton (S)	17,520	-270
Wyndham (C)	31,990	-640
Greater Geelong (C)	29,480	0
Queenscliffe (B)	230	0
Surf Coast (S)	4,560	0
Moorabool (S)	4,530	0
Macedon Ranges (S)	4,730	0
Mitchell (S)	14,020	0
Golden Plains (S)	1,760	0
Hepburn (S)	1,400	0
Murrindindi (S)	1,860	0
Ballarat (C)	23,070	0
Mount Alexander (S)	2,400	0
Greater Bendigo (C)	22,750	0
Latrobe (C)	6,200	0

Source: VIF 2015, VLC, EY analysis

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