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Infrastructure Victoria
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AECOM

Strategic transport modelling of tram and train projects to inform Victoria's infrastructure strategy 2025-2055

Strategic Transport Modelling Report

13-Feb-2025

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Executive Summary

To support the development of *Victoria's infrastructure strategy 2025-2055*, Infrastructure Victoria has commissioned AECOM to assess a range of public transport interventions which aim to:

- **support a more compact city** by improving public transport connections in established parts of Melbourne
- **improve access in rapidly expanding growth areas** where underdeveloped road, public, and active transport corridors would otherwise contribute to long-term private vehicle reliance and associated network congestion.

Base case modelling, which is considered a "business as usual" scenario, indicates that pressures on road congestion are likely to increase, particularly for Melbourne's growth regions (see Appendix A).

From an initial Infrastructure Victoria list of almost 50 candidate rail and tram projects, a four-stage process is used to prioritise and investigate the projects most likely to deliver the desired transport network objectives:

- **Stage 1** – An extensive list of almost 50 transport projects was reviewed against the overall scope of the 2025 strategy update, generating a long-list of projects that warranted further analysis.
- **Stage 2** – Headline outcomes of all long-listed transport projects were modelled at two future time periods (2031 and 2041).
- **Stage 3** – High priority projects identified for further investigation were shortlisted using a multi-criteria analysis.
- **Stage 4** – Detailed modelling of the shortlisted projects was completed.

Shortlisted projects are packaged into the five scenarios shown below, with the tram projects grouped to maximise construction efficiencies and deliver overlapping corridor benefits.

Scenario	Projects modelled
1	Cranbourne to Clyde rail extension and Dandenong South station
2	Extend and electrify towards Kalkallo, duplication via Upfield with new stations
3	Melton to Sunshine electrification and Deer Park to Sunshine quadruplication with new stations
4	Fishermans Bend tram extensions: Route 11 – Rerouting and extension to Fishermans Bend South (Plummer Street) via Port Junction Route 67 – Rerouting and extension to Fishermans Bend North (Turner Street) via Park and Ingles Streets
5	Suburban tram bundle: Route 3 – Extension from East Malvern to Hughesdale via Chadstone Route 55 & 58 – Extension West Coburg/Pascoe Vale South to Batman Station and Sydney Road Route 64/68 – Extension from East Brighton to Moorabbin TAFE via Moorabbin station Route 70 – Extension from Wattle Park (Box Hill South) to Burwood East (Tally Ho) via Deakin University
6	Suburban tram bundle sensitivity: Same tram service assumptions as scenario 5, with the addition of redistributed land use towards tram corridors, with lower car ownership assumptions.

The outcomes of the detailed modelling process show public transport patronage improvements across all projects, relative to the Y2041 Base Case.

Scenario	Daily station boardings* (Y2041)	Daily public transport trips (Y2041)	Daily car trips (Y2041)	Daily car kilometres (Y2041)	Activity centre catchment** (Tram projects only; Y2041)
1 Clyde rail extension	+6,900 (+27%)	+4,300	-4,900	-103,800	n/a
2 Extend and electrify towards Kalkallo	+6,100 (+19%)	+5,000	-5,900	-60,900	n/a
3 Melton electrification & quadruplication	+10,100 (+31%)	+7,500	-8,900	-124,600	n/a
4 Fishermans Bend tram extensions (Routes 11, 67)	n/a	+12,600	-15,400	-138,900	+19%
5 Suburban tram bundle (Routes 3, 55, 58, 64/68, 70)	n/a	+3,800	-4,500	-54,400	+7%
6 Tram bundle sensitivity (Routes 3, 55, 58, 64/68, 70)	n/a	+21,700	-53,800	-972,600	+10%

Notes:

- All figures shown are weekday estimates of change in Y2041 (relative to the Y2041 Base case)
- * The change in boardings is only shown for the stations within the immediate project corridor
- ** Population living within a 45-minute public transport catchment of an activity centre

The results shown for Y2041 highlight a strong latent demand for public transport that is responsive to service and infrastructure improvements, and are over and above the significant increases already predicted in the Base Case relative to Y2018. For example, using detailed forecasting results contained in the report, daily boardings more than double between the Y2018 and Y2041 for Cranbourne Station (Scenario 1) and Melton Station (Scenario 3). In addition to this underlying Base Case growth, the modelled scenarios grow patronage by upwards of 27% in the target rail corridors.

Similar benefits are observable in the tram-related scenarios, with a combination of service and network coverage improvements increasing activity centre accessibility and associated patronage. The Fishermans Bend extensions exemplify this, with the public transport catchment (the number of people able to reach the precinct within 45-minutes using train, tram and bus) increasing by 19% over Base Case conditions. The suburban tram package has a slightly lower impact on this accessibility measure, noting that existing metropolitan activity centres, to varying degrees, are already connected to the public transport network. However, a 6% increase in the population catchment to activity centres is still observed, with just over 4,000 vehicle trips (and 30,000 vehicle kilometres) forecast to be removed from the network each day if the package of tram upgrades proceeds. Results from a land use and car ownership sensitivity test (Scenario 6) show significant increases in patronage relative to both the base case *and* the standard tram bundle scenario (Scenario 5), indicating that potential benefits are available should public transport investments be met with a corresponding shift towards a more compact city.

Glossary of terms

AM	AM-peak period. Defined in the VITM as between 7.00am and 9.00am inclusive
Base Infrastructure Pipeline	A standardised set of committed and potential road and public transport interventions used as the baseline for future infrastructure assumptions.
BIFT	Beveridge Intermodal Freight Terminal
Boardings	A measure of public transport utilisation. Measures the number of persons entering a public transport mode at a given stop or station on the network.
Compact City Scenario	An alternative version to the SALUP land-use projections that assumes higher growth in existing urban areas. Adopted from the Infrastructure Victoria research publication, *Choosing Victoria's Future*.
Headway	Average time between public transport services.
IP	Interpeak period. Defined in the VITM as between 9.00am and 3.00pm
LGA	Local Government Area
MAC	Metropolitan Activity Centre
MCA	Multi-Criteria Analysis
NEIC	National Employment and Innovation Clusters
Network Development Scenario	Represents reasonable assumptions about how the future transport network will develop. It comprises a combination of: • projects completed or under construction since the 2018 Base Year • funded and committed projects • non-committed projects that may play a role in meeting forecast travel demand.
OP	Off-peak period. Defined in the VITM as between 6.00pm and 7.00am.
PM	PM-peak period. Defined in the VITM as between 3.00pm and 6.00pm inclusive.
PT Trips	A trip that uses public transport for any part of a trip from an origin to destination zone.
SALUP	Small Area Land-Use Projections
SRL	Suburban Rail Loop
VC	Volume to capacity ratio. A measure of a highway or public transport link's level of saturation where '0 = essentially no congestion at all' through to '1 = the link is fully saturated'.
Vehicle trips	A trip that uses a vehicle (including personal and heavy vehicles) as the only mode of transport.
VIF	Victoria in Future
VITM	Victorian Integrated Transport Model
VHT	Vehicle Hours Travelled
VKT	Vehicle Kilometres Travelled

Introduction

Victoria's 30-year infrastructure strategy was first released in 2016 and was updated in 2021. The strategy provides a long-term (30-year) evidence-based view of Victorian infrastructure needs across a broad range of public policy areas. Infrastructure Victoria is currently developing the next update, *Victoria's infrastructure strategy 2025-2055*, with the strategy's objectives informed by community consultation.

For the 2025 strategy, the emerging themes most relevant to the transport sector are 'Doing more with less' and 'Improving social equity through access.' Targeted tram and train extensions are expected to play a critical role in supporting these outcomes, particularly in areas that complement and accelerate higher-density development.

To assess the effectiveness of these different transport infrastructure scenarios, Infrastructure Victoria engaged AECOM to provide strategic demand modelling services. This report outlines findings of the multi-stage research approach undertaken, covering the following stages:

Stage 1 comprises a high-level review of each project's scope, feasibility, and potential to support growth consistent with a compact city approach. Following this review, a preliminary shortlist of projects is developed.

Stage 2 delivers interim modelling of all selected Stage 1 projects. The projects are tested in the Victorian Integrated Transport Model (VITM) using two sets of land-use and demographic forecasts:

- the **'Network Development Scenario'**, which includes continued high levels of growth at the urban fringe, in line with the Victorian Government's 'Victoria in Future' forecasts
- an alternative **'Compact City Scenario'** that assumes a higher proportion of growth in existing urban areas relative to the urban fringe.

Summary outputs at the 2031 and 2041 forecast years are obtained.

Stage 3 applies a multi-criteria analysis to compare and interpret the outcomes of each project. Key performance measures are selected and then weighted by importance to assess the following:

- public transport utilisation
- equity of public transport access
- employment accessibility
- concurrent land-use opportunities
- reductions in vehicle-kilometres travelled
- high-level project costs.

The resulting ranked scores are used as an input to workshop discussions to confirm which projects proceed to the final modelling stage.

Stage 4 provides the detailed modelling of shortlisted projects. In total, there are 10 projects examined in this final analysis stage: three rail projects and two tram projects consisting of seven extensions.

- The rail projects selected are those most likely to improve access in rapidly expanding growth areas, where residents and businesses have already moved in, but available transport networks have remained under-developed.
- The prioritised tram projects selected are those that support a more compact city through improved public transport and activity centre accessibility in established suburbs.

The findings will inform the recommendations being developed by Infrastructure Victoria for the 2025 strategy update.

Note: The selection and analysis of projects considered in this report is specifically targeted towards the objectives of the infrastructure strategy, and broader alignment with the current land-use and planning context described below. Projects not shortlisted in this study will still have applicability to other infrastructure and development scenarios within Victoria.

Land-use context

Land-use and transport outcomes are intrinsically linked. Understandably, if new housing and activity centres develop without the provision of high-quality public transport, walking and cycling networks, private vehicle dependence is likely to remain entrenched.

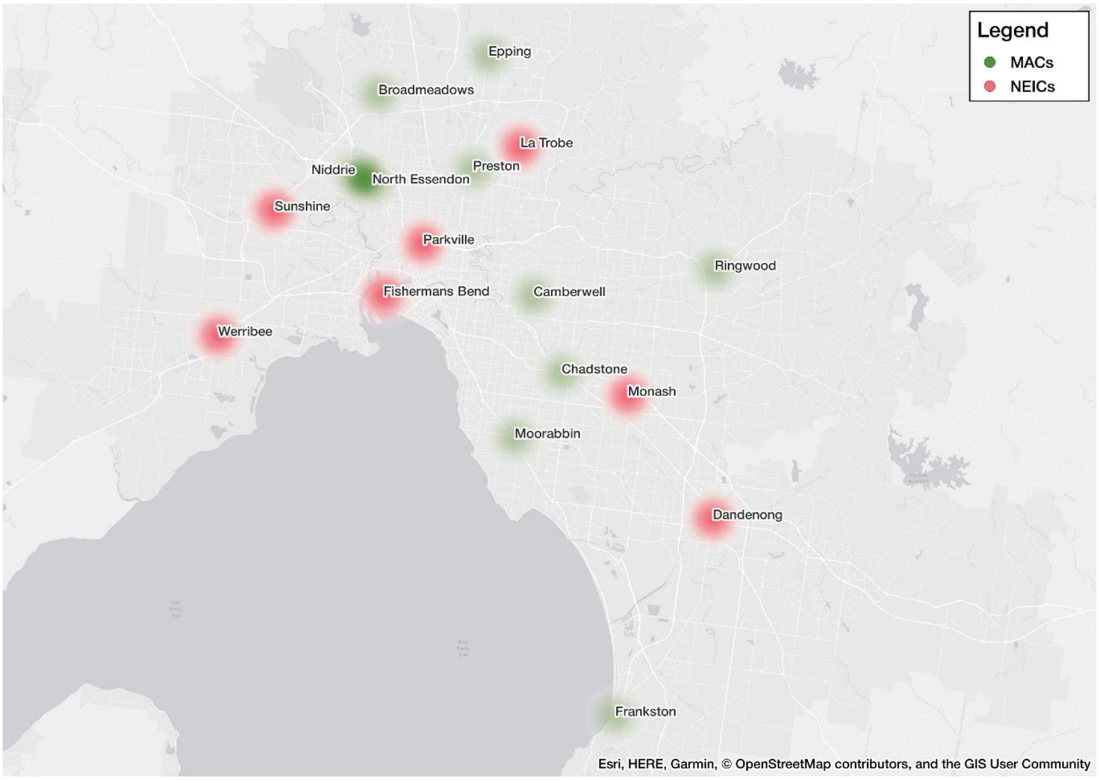
The establishment and consolidation of mixed-use activity centres remains a focus of long-term planning strategies in Melbourne. From regionally significant metropolitan activity centres, down to major and neighbourhood centres, there is widespread recognition that localised travel opportunities to employment, education, retail services, community and health services, and open space can better support sustainable and thriving communities.

In ranking the importance of transport projects in this current report, the degree to which additional benefits are unlocked at the local and regional levels is considered. For instance, the following sites and regions may warrant priority infrastructure connections due to their strategic importance:

- The recently released *Victoria's Housing Statement*[1] – a plan on how the government will improve housing availability, quality and affordability and regulatory controls over the next decade – nominates metropolitan activity centres as a focus for investment. Just over 10% of new dwellings are initially expected to be built in the 10 activity centres of Broadmeadows, Camberwell Junction, Chadstone, Epping, Frankston, Moorabbin, Niddrie (Keilor Road), North Essendon, Preston (High Street) and Ringwood. These are shown in Figure 1.
- National Employment and Innovation Clusters, proposed in Plan Melbourne[2] as specialised regional centres, support the co-location of comparable, knowledge-based businesses of national and international importance. While the focus and function of each of the seven clusters will differ, the need for high-capacity transportation links and high levels of local amenity to attract and retain specialised workforces is common to all. The clusters – in Monash, Dandenong, La Trobe, Werribee, Parkville, Fishermans Bend and Sunshine – are also mapped in Figure 1.
- The identification of designated growth areas, and an associated Urban Growth Boundary, has long been a feature of Melbourne's planning context. Over 20 years ago, *Melbourne 2030* highlighted the planning required for growth in and around Werribee, Hume, Epping North, Plenty Valley, Cranbourne, Pakenham, and Caroline Springs.[3] The Victorian Planning Authority currently uses growth corridor plans to prioritise integrated development through to Melton in the west, Sunbury and Beveridge to the north, and Clyde and Pakenham in the south-east. Notwithstanding the intent to focus development around high-capacity transport links, recent growth has been characterised by a reliance on private vehicles and increasing congestion. Remedying growth area access with appropriate transport infrastructure and improved public transport service levels therefore remains a priority.

[1] Victorian Government (2023). Victoria's Housing Statement – The decade ahead | 2024 -2034.
[2] Victorian Government (2017). Plan Melbourne 2017-2050: Metropolitan Planning Strategy.
[3] Victorian Government (2002). Melbourne 2030 – Planning for sustainable growth.

Figure 1 National Employment and Innovation Clusters (NEICs) and Metropolitan Activity Centres (MACs)[4]



Planning Context

To address the worsening traffic congestion, longer commute times, and to reduce future transport emissions, the long-term planning for Melbourne requires a shift from traditional low-density suburban growth towards a more compact city.

The Victorian Government forecasts that by 2051, the state's population will reach 10.3 million.[5] This includes approximately eight million people living in metropolitan Melbourne, a 57% increase on the 2023 population.

For Melbourne to remain as a dynamic and liveable global city, capable of addressing long-term environmental, social, and economic challenges, a transition to a more compact urban form is essential. High-density development can support the anticipated population growth by creating well-connected suburbs, ensuring employment, activities, and services remain accessible, and promoting travel behaviours that are less reliant on private vehicle ownership.

Recent work published by Infrastructure Victoria quantifies the benefits of a higher-density development ('Compact City' approach) compared to other potential growth scenarios.[6] With a more compact city, the overall size of the Melbourne metropolitan area remains largely unchanged. Most new homes are therefore built in existing suburbs, with the highest growth directed to inner city areas. Apartments and townhouses typify the new housing stock.

[4] Since the modelling work has begun, the Victorian government has announced a further 25 train and tram zone activity centres: https://www.vic.gov.au/train-and-tram-zone-activity-centres
[5] Department of Transport and Planning (2023). *Victoria in Future 2023 – Population and household projections to 2051*.
[6] Infrastructure Victoria (2023). *Choosing Victoria's Future – Five urban development scenarios.*

Through increased density, benefits and efficiencies of population scale emerge across a range of indicators (Figure 2). Relative to the existing dispersed pattern of growth, a more compact city form will:

- improve access to key destinations, such as work or study, as people are travelling shorter distances and in less congested conditions
- benefit households by providing more choices to find an affordable home in different places, more employment choices and more options to travel designs
- support a stronger economy, by offering more opportunities for businesses to hire staff and find customers
- produce fewer greenhouse gas emissions, as more people can walk, cycle or use public transport
- use less land for new housing developments, which can instead be used for industrial, agricultural, recreational or wildlife habitat opportunities.[7]

Figure 2 Benefits of a Compact City planning approach for Melbourne [reproduced from '*Choosing Victoria's Future*' (2023)]

For the benefits of a more compact city to be realised, inner city growth must be underpinned by enhanced public transport, walking, and cycling networks. Furthermore, in transitioning to a higher density urban area, it must be recognised that some growth will continue in areas with traditionally poor public transport service levels: middle and outer suburban areas, as well as urban fringe housing developments. The identified benefits of a more compact city will only materialise if infrastructure development ensures city-wide accessibility that is balanced, equitable, and efficient.

It is anticipated that the provision of lower cost and high impact infrastructure projects, identified through this project, can act as a catalyst for the desired changes across Melbourne. The prioritisation and assessment of these projects – even those with very localised effects – will maintain a view of city-shaping opportunities consistent with Infrastructure Victoria's 30-year strategy.

[7] Infrastructure Victoria (2023). *Choosing Victoria's Future – Five urban development scenarios.*

Report structure

The transport modelling presented in this report investigates potential public transport network and service improvements to support population growth in Melbourne over the next 30 years.

From an extensive list of almost 50 different train and tram projects, the analysis investigated infrastructure and service upgrades that would:

- *support a more compact city* by improving public transport connections in established parts of Melbourne
- *improve access in rapidly expanding growth areas* which suffer from under-developed transport networks.

To identify projects that have the best alignment with Victoria's 30-year infrastructure strategy update, a four-stage shortlisting and analysis approach was followed. The report structure mirrors these steps, as shown below, before final conclusions are drawn.

Stage 1 critically reviewed all projects, removing those that fell outside the scope of the analysis based on feasibility, cost, or alignment with the desired compact city objectives. **> Page 20**

Stage 2 of the research used the Victorian Integrated Transport Model (VITM) to describe the broad impacts of all projects that progressed through the Stage 1 selection phase. **> Page 23**

To create an efficient analysis design, projects were grouped together into one of six different scenarios for a first round of modelling. High level outcomes relating to highway volumes, public transport patronage, and network performance were identified.

Stage 3 applied a multi-criteria analysis (MCA) to synthesise outputs from the first round of scenario modelling. The MCA was used as an input to broader workshop discussions, and assisted in the shortlisting of projects most likely to deliver the desired urban form outcomes. **> Page 32**

Stage 4 completed a second round of detailed modelling for all individually shortlisted projects, using population and land-use scenarios for 2031 and 2041. **> Page 37**

The report conclusion summarises the key research outcomes, and highlights the effectiveness of the shortlisted projects in progressing a more compact city development pathway for Melbourne. **> Page 63**

For ease of navigation, only the main outcomes and decision-making processes are described in the body of the report. For readers interested in the technical components of the model implementation and model assumptions, further detail is provided in the following Appendices:

- **Appendix A** – Detailed Base Case assumptions and results
- **Appendix B** – Modelling assumptions applied to initial (Stage 2) projects
- **Appendix C** – Modelling assumptions applied to shortlisted (Stage 4) projects
- **Appendix D** – Multi-Criteria Analysis

Methodology

The study identifies and evaluates projects that can either support a more compact land-use development within Melbourne or improve access to growth areas. Central to these aims, and consistent with the next 30-year infrastructure strategy update, are the objectives of 'doing more with less' and 'improving social equity through access'.

Using the Victorian Integrated Transport Model (VITM), a multi-stage approach was adopted to refine and test potential projects. In the first round of modelling, high level results from all projects of interest were generated. A shortlist of priority projects was then developed using a multi-criteria analysis, and analysed in detail through a second round of modelling.

Transport-related outcomes were reported, including mode share, accessibility and network performance for all shortlisted projects.

The adopted research methodology is graphically represented in Figure 3 on the following page.

VITM overview

The strategic modelling and analysis presented in the report is undertaken using the VITM.

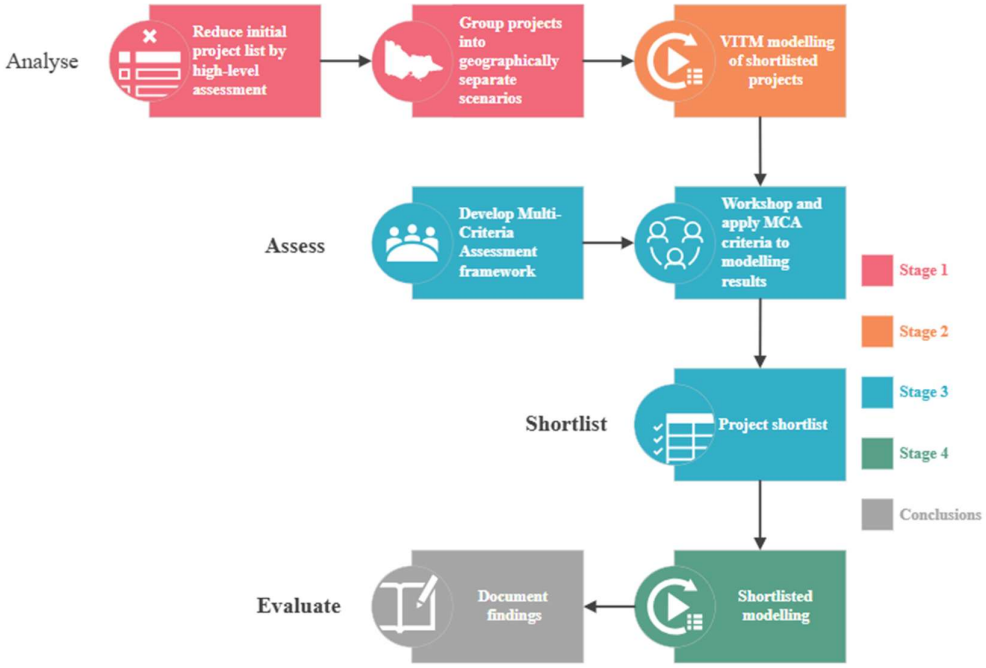
The VITM includes a set of input assumptions for a Y2018 base year, and future years including Y2031 and Y2041. The assumptions include demographic and land-use forecasts, improvements to road and public transport infrastructure, and behavioural and economic indicators such as value of time and vehicle operating costs. In this report we refer to these collective assumptions as the 'Network Development Scenario' and we refer to the model outputs using these assumptions as 'Base Case' results. In comparison, any project-based scenario tested is referred to as the 'Project case'.

Transport infrastructure projects included in the Network Development Scenario range from those that are under construction (for example, the North East Link), those that are committed and funded (such as the level crossing removal program) through to those that are long term planning ideas (E6 freeway). The inclusion of a project in the Network Development Scenario does not represent a commitment from the Victorian Government to the timing or construction of a project. However, the scenario does provide a consistent and reasonable set of assumptions from which to test and compare alternative projects. A summary of the Network Development scenario assumptions and results are provided in Appendix A.

A set of demographic and land-use forecasts were previously developed by Infrastructure Victoria in the *Choosing Victoria's future* research report.[8] These forecasts represent different development scenarios for population and jobs growth. The Compact City Scenario focuses residential development in established suburbs and consolidates employment growth in the CBD and inner Melbourne activity centres. Development of tram, cycling and walking networks are prioritised to support this higher density living. The demographic and land-use assumptions from the Compact City Scenario are used in this report as a comparison to the Network Development Scenario. The selection of projects that progress to each modelling stage also considers their applicability to objectives of a more compact city.

[8] Infrastructure Victoria (2023). *Choosing Victoria's future: five urban development scenarios*. https://www.infrastructurevictoria.com.au/resources/choosing-victorias-future

Figure 3 Research methodology



Stage 1 Review and refinement of potential projects

Potential tram and train projects were identified by Infrastructure Victoria for investigation. Projects were sourced from activity centre structure plans, state and local government strategic plans, and other advocacy channels.

Every project was reviewed by AECOM and Infrastructure Victoria to understand their potential contribution to the 30-year infrastructure strategy. The review considered the fit of each project with current urban development opportunities, including their alignment with and potential contribution to:

- Priority Precincts and National Employment and Innovation Clusters (NEICs)
- Victoria's Housing Statement
- Plan Melbourne activity centres
- Infrastructure Victoria's urban development scenarios.

AECOM and Infrastructure Victoria ensured different areas of Melbourne were serviced by projects in the first round of modelling.

Efforts were made to include a variety of project types, with tram realignments, tram extensions, rail extensions, rail electrifications, and new stations all selected for the first round of modelling. The costs and potential network benefits associated with each project depend on a variety of factors including the type, scale, and location of the project. The purpose of this stage was to identify which projects would be both effective and cost-efficient.

The full list of projects, and their categorisation against several geographic and strategic measures, is shown in Figure 4.

A note on selected projects

While 28 projects are initially highlighted in Figure 4 as progressing to the first round of modelling, 30 projects were subsequently analysed. The additional two projects were identified through the following adjustments:

- '*Arden north-south corridor'* was split into two projects at the modelling stage: '*Route 5 - Malvern East to Flemington Bridge Station'*, and '*Route 56 - St Kilda to Flemington Bridge Station'.*
- '*Fishermans Bend North'* was initially omitted from the recommended Stage 1 project list due to the complexity of required bridge works, but was reinstated at the modelling stage with an alternative alignment ('*Route 67 - Carnegie to Fishermans Bend North'*).

The projects not selected for further modelling would have likely provided network benefits. However, the land-use opportunities and accessibility improvements to jobs and services were anticipated to be lower relative to other projects on the list. Some are also currently hard to implement and require further investigation.

Figure 4 Stage 1 project review outcomes

Project	Selected for first round modelling?	Rationale
Arden east-west corridor *	✓	Strong strategic alignment to land use opportunities
New route - Highpoint to Sunshine	✓	Strong strategic alignment to land use opportunities
new - Highpoint to Rushall	✓	Strong strategic alignment to land use opportunities
Arden north-south corridor *	✓	Strong strategic alignment to land use opportunities
Route 11 (south) - South Reservoir to Fishermans Bend	✓	Lower cost project, with strong strategic alignment to land use opportunities.
Route 55 - Domain to Pascoe Vale	✓	Improved NEIC and network connectivity
Route 11 (north) - Victoria Harbour to Reservoir	✓	Transport network merits; accessibility/land use opportunities needs further exploration.
Route 5 (west) - Footscray to Malvern via Dynon Road	✓	Useful comparison to alternative Route 5 options
new - Footscray to Spotswood	✓	Strong strategic alignment to land use opportunities
Alamein rail extension to Oakleigh	✓	Good strategic alignment; alternative network alignment for Cranbourne/Pakenham lines
Route 72 - Melbourne Uni to Heidelberg	✓	Strong strategic alignment to land use opportunities.
Route 59 - Flinders Street to Melbourne Airport	✓	Strong strategic alignment, including accessibility to two Housing Statement areas
Epping rail (medium intervention) extension to Wollert	✓	Good strategic alignment to land use opportunities and PT accessibility uplift
Route 3 (east) - Melb Uni to Hughesdale via Chadstone	✓	Strategic land use alignment. Major activity centre in close proximity to tram network
Route 68 - Kew to Moorabbin	✓	Strategic alignment. Mixed use opportunities. Activity centre close to tram network
New route - Camberwell to Caulfield Station	✓	Modelling to determine network benefits, accessibility uplift & land use opportunities
Wallan electrification and Somerton link	✓	Good PT accessibility uplift given no current rail connection
Route 75 - Victoria Harbour to Ferntree Gully via Knox	✓	Good strategic alignment to land use opportunities
Route 48 - Docklands Stadium to Doncaster	✓	Good strategic alignment to land use opportunities.
New station at Altona North	✓	Good strategic alignment to land use opportunities and PT accessibility uplift
Partial duplication Altona Loop Line	✓	Modelling to determine the accessibility benefits from service uplift
Melton electrification and quadruplication	✓	Supports major activity centre and growth area planning
Melton Central extension and electrification	✓	Supports major activity centre and growth area planning

Project	Selected for first round modelling?	Rationale
Route 5 (east) - Remand Centre to Darling	✓	Improves network connectivity. Advocacy support for project.
Route 57 - Flinders Street to East Keilor	✓	Broader advocacy support for project warrants examination
Route 58 - West Coburg via Toorak Rd to Burwood East	✓	Modelling to determine the network benefits, accessibility uplift & land use opportunities
Route 70 - Docklands Stadium to Burwood East	✓	Significant land use opportunities, complementing SRL East structure planning.
Clyde extension and electrification	✓	Good PT accessibility uplift given no current rail connection and limited bus services
new - Fishermans Bend (north)	×	Technical complexity of bridge connection. Maintain as long-term opportunity.
new - Doncaster via Eastern Freeway	×	Provides limited accessibility advantages over existing BRT
Wyndham Vale electrification & extension to Werribee	×	Extension is noted for potential consideration in future model runs.
new - North Melbourne to Richmond	×	Transport network merits, but limited land use opportunities anticipated.
new - City to Footscray (2) - Footscray Road	×	Dynon Road alignment to be investigated further
new - Caulfield to Rowville	×	BRT to be investigated separately for Monash NEIC
Alamein light rail conversion & extension to Oakleigh	×	Rail extension preferred as the appropriate PT intervention
Epping rail (low intervention) - extension to North Epping	×	Priority given to testing of higher level intervention
Route 109 - Box Hill to Nunawading	×	Transport & land use merits; proximity to Ringwood rail corridor reduces likely impact.
Route 75 (north-east) - Vermont South to Bayswater	×	Ferntree Gully alignment to be investigated further.
new - Park Street missing link	×	Further exploration needed outside of this work.
Route 82 - Victoria University diversion	×	Network benefits, but limited accessibility/ land use opportunities relative to others.
Route 86 - Bundoora to South Morang		
new - Port Melbourne to St Kilda		
Route 67 - Glen Huntly to Carnegie		
Route 6 (east) - Glen Iris to Ashburton		
Route 6 (west) - Moreland to Pascoe Vale South		
Route 19 - Coburg to Gowrie		

* Project name changes in subsequent modelling phases

Stage 2 Initial project modelling

This section details the work undertaken to combine, model and assess the list of 30 projects identified in Stage 1.

To efficiently model all 30 projects, while minimising the interactions between individual projects, each project was allocated to one of six modelling scenarios according to its geographic location. For example, the Wollert extension and Wallan extension were modelled in separate scenarios due to their proximity and the difficulty of isolating project impacts (such as reduction in road congestion) had they been modelled in a single scenario.

Using this approach allowed for the impacts of each of the projects to be assessed more independence than if they were modelled alongside projects with higher proximity.

The allocation of projects to scenario groups is shown in Table 1. Maps of each project group then follow in Figure 5.

Table 1 Project scenario allocation

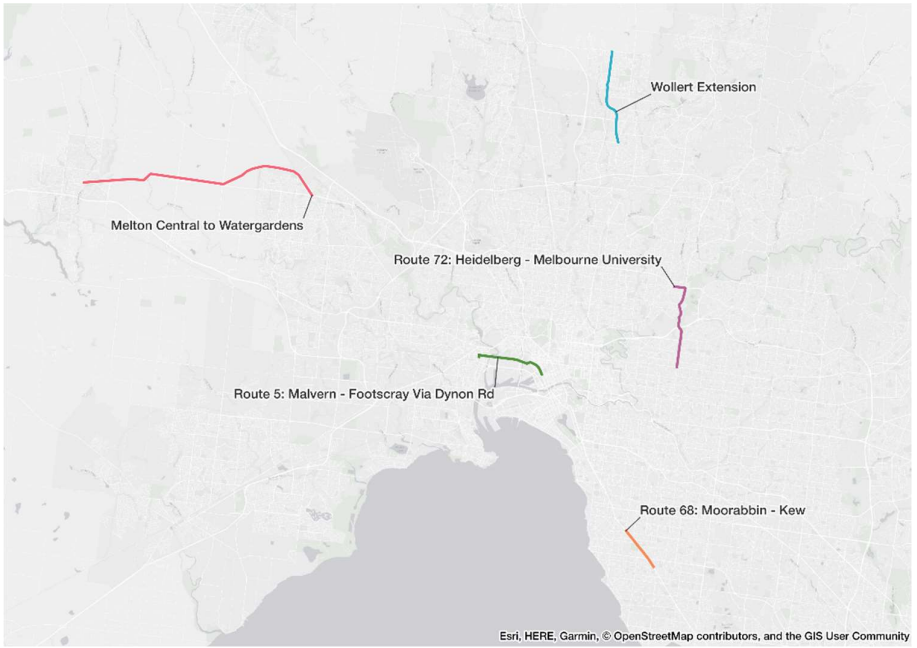
Group	Project	Mode
1	Cranbourne to Clyde rail extension	Rail
	New route - Camberwell to Caulfield Station	Tram
	New route - Highpoint to Sunshine	Tram
	Route 3 – Rerouting and extension from Victoria Street to Kensington Station	Tram
2	Partial duplication Altona Loop Line	Rail
	Wallan electrification and Somerton link	Rail
	New route - Footscray to Spotswood	Tram
	Route 5 – Extension from La Trobe Street to Flemington Bridge Station	Tram
	Route 56 – Rerouting via Spencer and Abbotsford Street	Tram
	Route 70 – Extension From Box Hill South to Burwood East (Tally Ho)	Tram
3	Melton to Sunshine electrification and Deer Park to Sunshine quadruplication	Rail
	New route - Highpoint to Rushall	Tram
	Route 11 – Rerouting and extension from King/Collins Street to Fishermans Bend	Tram
	Route 3 – Extension from East Malvern to Hughesdale via Chadstone	Tram
	Route 48 – Extension from Balwyn North to Doncaster	Tram
	Route 75 – Extension from Vermont South to Ferntree Gully via Knox	Tram
4	Watergardens to Melton Central extension	Rail
	Lalor to Wollert extension	Rail
	Route 5 – Extension from La Trobe Street to Footscray Station via Dynon Road	Tram
	Route 68 – Extension from Brighton East to Moorabbin Station	Tram
	Route 72 – Extension from Deepdene to Heidelberg Station	Tram
5	Alamein rail extension to Oakleigh	Rail
	New station at Altona North	Rail
	Route 58 – Extension from Kooyong to Burwood East (Tally Ho)	Tram
	Route 59 – Extension from Strathmore Heights to Melbourne Airport	Tram
6	Route 11 – Extension from Regent Street to Reservoir Station	Tram
	Route 5 – Extension from Burke Road to Darling Station	Tram
	Route 55 – Extension from Bell Street to Pascoe Vale Station	Tram
	Route 57 – Extension from Maribyrnong to East Keilor	Tram
	Route 67 – Rerouting and Extension from ANZAC station to Fishermans Bend North	Tram

Figure 5 Project groups (extensions/new services)

Group 1

Group 2

Group 3



Group 4

Group 5

Group 6

First round modelling results

The VITM was used to forecast future travel demand for the Base Case and six Project Case scenarios corresponding to the project groupings specified in the previous section. Model forecasts were produced for future years Y2031 and Y2041. The demographic assumptions were taken from the Network Development Scenario and Compact City Scenario for each year.

Noting that each scenario contains interactions from multiple projects, the complete project-specific demand responses are not examined in this modelling phase. As a useful proxy measure, outcomes are instead attributed by looking at the direct corridor and catchment effects around each project.

Rail projects

Table 2 summarises the change in daily boardings for each rail project compared to the Base Case. The results are presented for each model year and demographic assumptions.

All of the rail projects tested provide new public transport options to areas that are under served in the Base Case. However, the forecast impact of the projects on rail boardings varies. The Melton Line electrification and quadruplication project and the new station at Altona North are expected to attract the largest increases in rail boardings while the Wollert extension is forecast to have only a limited increase or decrease in boardings.

The variance in new boardings between model years and land-use scenarios can in some cases be attributed to the differences in population in the project catchment and in other cases be attributed to changes in road congestion (increased congestion leading to public transport becoming more attractive or alternatively, new road projects reducing congestion leading to lower public transport demand).

Table 2 Change in daily project line boardings (rail projects): Project Case vs Base Case

		Y2031		Y2041	
Group	Rail project	Network development	Compact city	Network development	Compact city
1	Clyde extension and electrification	+3,900	+4,200	+9,100	+6,300
2	Partial duplication Altona Loop Line	+5,800	+6,300	+6,100	+6,800
	Wallan electrification and Somerton link	+3,900	+2,100	+9,400	+6,100
3	Melton electrification and quadruplication	+61,300	+65,200	+12,800	+11,000
4	Melton Central extension and electrification	+9,100	+8,200	+4,500	+3,200
	Wollert extension	+2,400	+1,600	+400	-4,300
5	Alamein rail extension to Oakleigh	+8,900	+9,100	+8,300	+7,900
	New station at Altona North	+20,200	+20,700	+10,800	+11,500

Differences in population assumptions drive different outcomes in modelling results. For many of the rail projects that service growth areas, the impact on the total number of boardings is lower when using the Compact City land use assumptions due to the redistribution of persons and jobs and in the relevant project areas towards inner-Melbourne.

The relatively small impact of the Wollert extension on rail boardings is a result of the competition with the Mernda Line and the limited track capacity between Epping Station (the junction of the two lines) and the city. Many potential users of the Wollert line are forecast to use the Mernda line in the Base Case and therefore, although a Wollert service would save users travel time, a new boarding on Wollert will in many cases result in a loss of a boarding on the Mernda line.

To assess the impacts of individual projects within each group, a project catchment area was defined for each project.[9] Metrics, such as 'accessibility to employment by public transport within 60 minutes' were then extracted from the modelling results using the project catchments.

The forecasts show that accessibility to employment by public transport increased most significantly when new corridors or areas were serviced. Accessibility increased significantly for the Clyde extension and electrification, Wallan electrification and Somerton link, Melton Central extension and electrification, and the new station at Altona North.

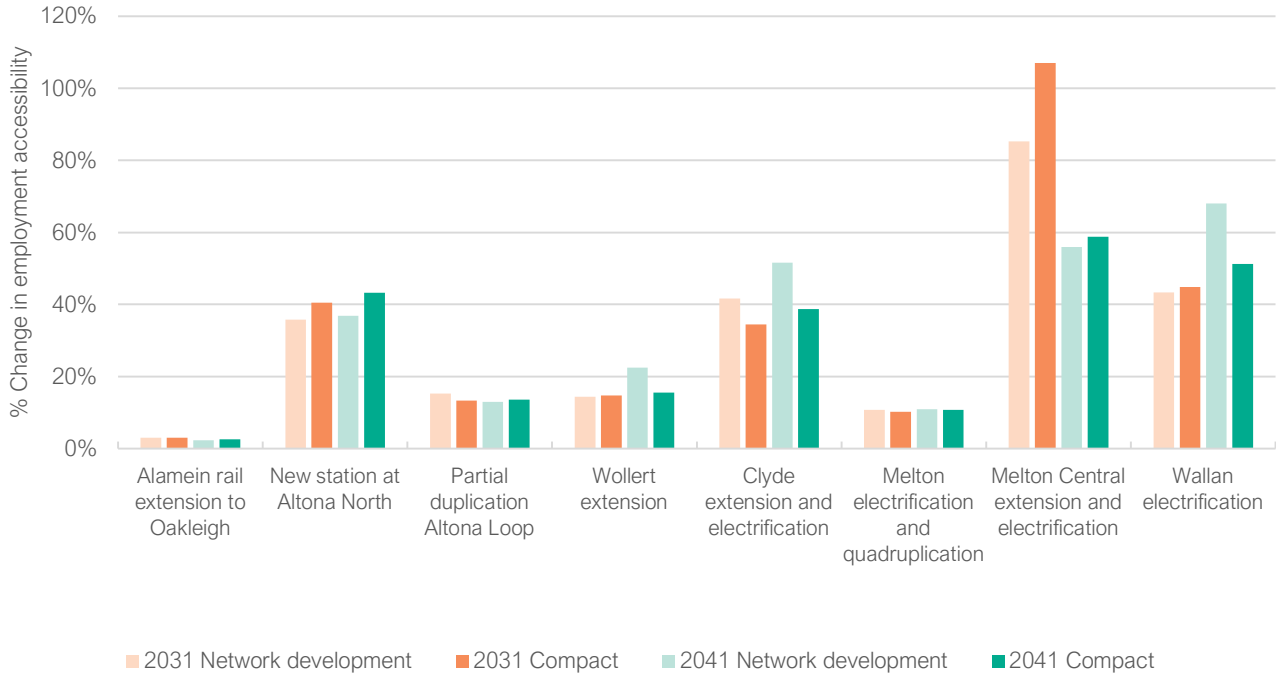
Conversely, the accessibility improvements for projects operating on existing alignments and corridors were more modest. For example, the Alamein rail extension to Oakleigh is not expected to significantly increase the number of employment opportunities accessible by public transport compared to the Base Case likely due to the high number of bus service connections to Chadstone Shopping centre that are already assumed in the Base Case. Similarly, the Altona loop duplication and Melton Electrification, which at this stage of modelling didn't include additional stations, saw lower relative increase in accessibility when compared to other projects.

The exceptions to the above patterns are the Wollert extension, and Wallan electrification. The former saw a relatively subdued increase, while the latter experienced a significant increase. This likely reflects the scale of each intervention, in addition to the fact that the Wallan electrification includes the construction of new stations in high-growth areas.

Figure 6 compares the potential change in public transport accessibility to employment within the project catchment areas following introduction of the Stage 2 rail projects.

[9] Further details on the definition of project catchment area boundaries are included in Stage 3

Figure 6 Change in accessibility to employment by public transport for zones in the project catchment (rail projects): Project Case vs Base Case



Tram projects

The changes in route-specific boardings identified for the Stage 2 tram projects are summarised in Table 3.

The proximity of grouped tram project routes must be considered when analysing the differences in route boardings from the Project Case scenarios. For example, the Group 2 project specification includes Route 5 and Route 56. These services were intentionally bundled together as a combined intervention and both share track through the Arden precinct. This likely explains the decrease in tram boardings forecast for Route 56, which when considered together with the significant increases for Route 5 show a moderate improvement in boardings.

Boardings often increased significantly for services that were extended or rerouted to employment centres. For example, in Y2041 services extending to Fishermans Bend saw some of the largest increases in daily tram route boardings, with the Route 11 (south) seeing increases of up to 26,000, and the Route 67 service experiencing an increase of up to 10,000. Similarly, the 5/56 Arden services collectively saw an increase of approximately 9,000. Other high performers connect existing population and economic centres, such as West Coburg to Burwood East (Tally Ho) (Route 58), or Footscray to Malvern (Route 5).

Table 3 Change in daily project route boardings (tram projects): Project Case vs Base Case

Group	Tram project	Y2031		Y2041	
		Network development	Compact city	Network development	Compact city
1	New route - Camberwell to Caulfield Station	+900	+600	+800	+700
	New route - Highpoint to Sunshine	+3,600	+3,800	+5,300	+5,700
	Route 3 (west) - Kensington to Malvern East	+4,900	+6,600	+5,200	+7,300
2	New route - Footscray to Spotswood	+4,100	+4,700	+5,600	+6,900
	Route 5 (north) - Malvern East to Flemington Bridge Station	+9,700	+12,500	+11,800	+15,300
	Route 56 (north) - St Kilda to Flemington Bridge Station	-5,200	-5,900	-5,300	-6,100
	Route 70 - Docklands Stadium to Burwood East (Tally Ho)	+5,200	+5,100	+5,200	+5,400
3	New route - Highpoint to Rushall	+7,500	+8,600	+8,800	+11,100
	Route 11 (south) - South Reservoir to Fishermans Bend	+15,400	+20,300	+19,800	+26,800
	Route 3 (east) - Melbourne Uni to Hughesdale via Chadstone	+4,700	+4,900	+6,000	+5,900
	Route 48 - Docklands Stadium to Doncaster	+4,900	+5,500	+6,300	+6,900
	Route 75 - Victoria Harbour to Ferntree Gully via Knox	+3,300	+3,400	+3,900	+3,700
4	Route 5 (west) - Footscray to Malvern via Dynon Road	+11,300	+13,200	+12,400	+15,000
	Route 68 - Kew to Moorabbin	+3,800	+3,900	+4,000	+4,500
	Route 72 - Melbourne Uni to Heidelberg	+4,600	+4,700	+4,000	+4,600
5	Route 58 - West Coburg via Toorak Road to Burwood East (Tally Ho)	+10,700	+9,500	+10,000	+11,200
	Route 59 - Flinders Street to Melbourne Airport	+3,000	+3,100	+3,300	+3,500
6	Route 11 (north) - Victoria Harbour to Reservoir	+1,100	+1,100	+3,200	+3,200
	Route 5 (east) - Remand Centre to Darling	+1,200	+1,400	+1,500	+2,000
	Route 55 - Domain to Pascoe Vale	+2,500	+2,200	+2,400	+2,700
	Route 57 - Flinders Street to East Keilor	+4,300	+4,100	+3,800	+3,700
	Route 67 - Carnegie to Fishermans Bend North	-2,900	-200	+6,800	+10,400

Stage 3 Project shortlisting using multi-criteria analysis

Following the first round of modelling a multi-criteria analysis (MCA) process was developed to synthesise model outputs across a wide range of measures, and help shortlist candidate projects that best align with the study objectives.

Through an AECOM and Infrastructure Victoria workshop, the key measures identified for the MCA were:

- public transport utilisation
- equity of access
- accessibility
- land-use potential
- sustainability
- project cost.

Through internal Infrastructure Victoria workshops, the relative importance of the agreed measures was determined. Weightings for each MCA component are summarised in Table 4 below. These weightings were developed by Infrastructure Victoria to align with the broader objectives of the 30-year infrastructure strategy.

Table 4 MCA criteria developed

Criterion	Descriptive data	Weight
Public transport	Change in public transport boardings	15%
Equity of access	Change in public transport costs	5%
Accessibility	Change in employment accessibility	10%
Sustainability	Change in Vehicle Kilometres Travelled (VKT) as a proxy for environmental effects	10%
Land-use potential	Qualitative assessment of adjacent land-use and VIF forecasts	10%
Cost (CAPEX)	High-level capital expenditure cost estimate based on indicative rates and implied capital works.	30%
Cost (OPEX)	High-level operating cost estimate based on changes to service kilometres.	20%

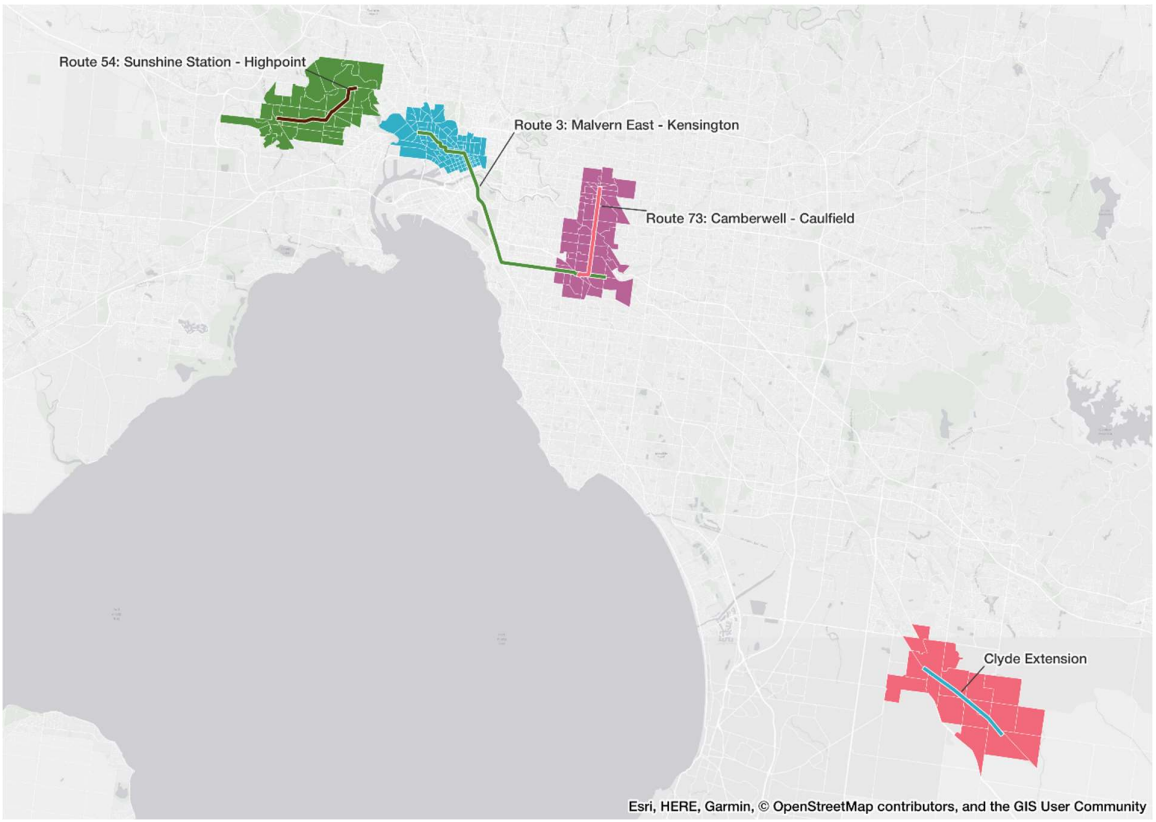
Assessments for 4 of the criteria (Public transport, Equity of access, Accessibility and Sustainability) were directly derived from transport modelling results. Land-use potential was qualitatively assessed by looking at the land-use density around project corridors, in addition to proximity to key activity centres. Capital and operational expenditure were estimated by using per-km rates and averages sourced from available cost data and applied to each project specification.

As each scenario modelled project groups, an approach was required to isolate (as far as practical) the impacts of each individual initiative. A one-kilometre buffer was therefore defined around each of the modelled interventions to identify the transport modelling zones most relevant to a localised project analysis. The intent is to provide comparable measures of project benefits - the relative scale and scope

of potential change – for consideration within the MCA. Detailed modelling investigations follow in the subsequent Stage 4 phase of work.

As an example, buffers for the Group 1 projects are shown in Figure 7. These show the VITM zones that are at least partially within one kilometre of a project location[10], providing a tangible area of influence where change can be realistically measured. Only change within the buffer zones is considered at this stage, and all change within a zone is attributed to the related project.

Figure 7 Analysis catchment zones for Group 1 projects



For the remaining criteria, the following approach was used:

- For the land-use potential, a qualitative assessment was undertaken by Infrastructure Victoria which considered the existing residential densities and potential densities based on the 'Compact City' scenario and adjacent NEICs, MACs and other precincts identified in the Housing Statement or other planning documents.
- Costs were estimated using a benchmark unit rate per kilometre of rail or tram track. Unit rates were also applied for assets such as stations. These rates were developed through a desktop review of other transport projects.

In order for each chosen MCA criteria to be comparable, the relative benefits or disbenefits were quantified with a standardised score between -3 and +3. In most categories, the (dis)benefits were scaled in proportion to the underlying metric. Projects with outlying impacts were considered separately to avoid biasing most scores down to 0.

[10] In the case of a network extensions, only the sections of new infrastructure are included in the buffer

MCA outcomes

Criteria ratings for each project was collated and assessed within the MCA. The scoring and ranking of projects are provided in Table 5, with more detailed MCA results contained in Appendix D.

Table 5 MCA outcomes

Project list	Mode	Total score	Rank
Route 11 (south) - South Reservoir to Fishermans Bend	Tram	1.05	1
New station at Altona North	Rail	0.90	2
Route 5 (north) - Malvern East to Flemington Bridge Station	Tram	0.75	3
Clyde extension and electrification	Rail	0.65	4
Route 70 - Docklands Stadium to Burwood East (Tally Ho)	Tram	0.20	5
Route 67 - Carnegie to Fishermans Bend North	Tram	0.15	6
Route 3 (west) - Kensington to Malvern East	Tram	0.15	7
Route 56 (north) - St Kilda to Flemington Bridge Station	Tram	0.15	8
Wallan electrification and Somerton link	Rail	0.10	9
Route 3 (east) - Melbourne Uni to Hughesdale via Chadstone	Tram	0.10	10
Route 11 (north) - Victoria Harbour to Reservoir	Tram	0.10	10
Route 5 (east) - Remand Centre to Darling	Tram	0.10	12
Melton electrification and quadruplication	Rail	0.05	13
Route 68 - Kew to Moorabbin	Tram	0.00	14
New route - Footscray to Spotswood	Tram	-0.10	15
Route 48 - Docklands Stadium to Doncaster	Tram	-0.10	16
Route 55 - Domain to Pascoe Vale	Tram	-0.10	16
New route - Camberwell to Caulfield Station	Tram	-0.10	16
Wollert extension	Rail	-0.15	19
Route 57 - Flinders Street to East Keilor	Tram	-0.20	20
New route - Highpoint to Sunshine	Tram	-0.20	21
Route 5 (west) - Footscray to Malvern via Dynon Road	Tram	-0.25	22
Route 58 - West Coburg via Toorak Road to Burwood East (Tally Ho)	Tram	-0.30	23
Route 59 - Flinders Street to Melbourne Airport	Tram	-0.30	24
New route - Highpoint to Rushall	Tram	-0.45	25
Route 75 - Victoria Harbour to Ferntree Gully via Knox	Tram	-0.55	26
Alamein rail extension to Oakleigh	Rail	-0.60	27
Route 72 - Melbourne Uni to Heidelberg	Tram	-0.65	28
Melton Central extension and electrification	Rail	-0.65	29
Partial duplication Altona Loop Line	Rail	-0.85	30

While the MCA process is extremely useful for synthesising a multitude of discrete inputs, caution is required when interpreting the results. Outcomes listed are not an absolute measure of 'project value', but an indicator of relative benefits observed using a subjective evaluation lens. In this view, negative scores do not necessarily mean projects do not have merit, only that the particular set of data and weights have led to the high-level cost estimates outweighing the ranked transport benefits. Appropriately, the final assessment of the projects proceeding to the detailed modelling phase used the MCA for discussion purposes, and factored in broader contextual information to understand whether the research objectives were still aligned. Below are some examples of how the MCA scores were unpacked:

- Altona North station was ranked the highest of all projects. This results from a combination of factors. First, the project had a strong impact across public transport outcomes, increasing boardings while decreasing impediments to PT access. Second, the estimated cost of construction is low relative to other rail projects.

- The two tram extensions to Fishermans Bend were also ranked highly. Both had high scores for additional boardings, improved public transport access, and a decrease in the number of kilometres travelled by car (Vehicle Kilometres Travelled, VKT). A positive qualitative assessment of land-use and relatively low costs also boosted the results.

- Most rail projects were rated relatively highly. Even though rail extensions and electrifications had high costs associated with them, their impact on boardings, equity of access, employment accessibility, and VKT typically generated a net positive score.

With the exception of the Fishermans Bend extensions, there was generally less differentiation in the overall scoring for tram projects. There are several reasons for this. First, the high weighting on cost in the MCA weighting, and similar estimated CAPEX/OPEX values for tram projects, meant half of the final scores for trams had similar values. Another reason was that many tram projects obtained similar 'moderate scoring' across several metrics, with very high scoring criterion observed as outliers. An example of this can be found in boardings, where a few high performers like Route 11 (south) 'crowded out' the scoring for projects with more moderate impacts.

Shortlisted projects

The final shortlist of 10 projects (packaged into 5 distinct scenarios) is shown in Table 6. The shortlist was determined by several factors, including:

- **Overall MCA scoring.** Positive project scores were a minimum requirement for further shortlist considerations.

- **The extent of current project advocacy**. Projects that were anticipated to proceed, were less likely to be considered for shortlisting. This reiterates the role of the study; to build a robust evidence base for new infrastructure investment that can accelerate the shift to a more compact urban form.

- **The broader strategic alignment** of projects with the study objectives.

- **Input from key stakeholders**, including Department of Transport and Planning representatives.

The shortlisting process provided opportunity to review the project assumptions in more detail. Modifications following the review include truncating the Wallan electrification project at Lockerbie as part of a shift to a potential two-staged approach to the Wallan Electrification. Further, services were realigned to use the Upfield corridor rather than the Craigieburn corridor. Route 55 was also adjusted to connect to Batman station on the Upfield line rather than the Craigieburn line. Additionally, a new tram route extension (Route 58) was added to the tram bundle to take advantage of the Route 55 extension opportunities.

The detailed modelling descriptions identify further amendments made to the shortlist projects.

Table 6 Project shortlist

Group	Project
1	Clyde rail extension
2	Extend and electrify towards Kalkallo
3	Melton electrification and quadruplication
4	Fishermans Bend tram extensions: Route 11 (south) – South Reservoir to Fishermans Bend (south) Route 67 – Carnegie to Fishermans Bend (north)
5	Tram bundle: Route 3 (east) – Melbourne Uni to Hughesdale via Chadstone Route 55 – Domain to Batman Station Route 58 – Toorak to Batman Station Route 68 – Kew to Moorabbin Route 70 – Docklands Stadium to Burwood East (Tally Ho)

Comparable with the first round modelling, shortlisted tram projects were again grouped for the detailed modelling phase. However, in this instance, the grouping aimed to understand the combined effects of a complementary network development approach.

Stage 4 Detailed modelling

This section describes the modelling outcomes of shortlisted projects across the 2031 and 2041 population and land-use scenarios.

Prior to commencing this round of modelling, the input assumptions of the shortlisted projects were reviewed and, in some cases, modified based on technical, engineering and operational considerations. Key details of the modelling assumptions are included in the result summaries, with the remainder provided in Appendix C.

This round of modelling was undertaken using only the Network Development land-use and demographic forecasts so that the results will be comparable to other forecasts that rely on the Victorian Government's 'Victoria in Future' forecasts.

Modelling results

Clyde rail extension

The Clyde rail extension project involves extending the Cranbourne rail line by approximately 5.8 kilometres along the existing rail reserve to Clyde. The project includes the construction of 4 new stations, 3 located along the extension at Casey Fields, Cranbourne East and Clyde and one at Dandenong South, located between the existing Dandenong and Lynbrook train stations. The location of the extension is shown in Figure 8.

Figure 8 Clyde rail extension

Project context

The City of Casey is one of Melbourne's fastest-growing local government areas. From a 2023 base of 390,000 people[11], population is forecast to rise to 457,000 by 2031, and to 532,000 by 2041 in SALUP forecasts. Road network congestion is an issue for residents and will likely continue despite recent road upgrades such as the Narre Warren - Cranbourne Road duplication.

Public transport services in Casey, particularly train, are well patronised. While the recent Cranbourne Line upgrade has provided additional capacity, strong train patronage growth is expected to continue.

The case for the project is further supported by the residential development that has occurred adjacent to the rail line and by the attractions located near the proposed stations. Specifically, Cranbourne East station will provide convenient access to the new Cranbourne Community Hospital and Casey Fields station will serve as the entrance to the region's top outdoor sport and recreation facility.

Project assumptions

Service frequencies for the extension were assumed to match the Base Case services that terminate at Cranbourne: 6 trains per hour in the peak and 3 trains per hour in the interpeak and off-peak periods. Each of the new stations were modelled to include a station car park, with the capacities shown in Appendix C.

The route alignments of the Base Case bus services in the Clyde rail corridor were optimised to provide access to the new stations and to avoid duplicating existing services in the area. Further details of the project assumptions are provided in Appendix C.

Base Case result summary

In the Base Case, services continue to terminate at Cranbourne Station. The Y2031 and Y2041 forecasts indicate a very high demand for public transport in Cranbourne and surrounding areas. For example, as shown in Table 7, the number of weekday boardings at Cranbourne Station are forecast to more than double between 2018 and 2041 despite the station car park being close to capacity in Y2018, with over 1,000 park and ride boardings modelled in the AM peak.

Table 7 Base Case average weekday boardings at Cranbourne station | Clyde rail extension

Access mode	Y2018	Y2031	Y2041
Walk access	1,200	1,700	2,200
Car access	1,100	1,600	1,700
Bus transfer	700	1,600	2,700
Total boardings	3,000	4,900	6,600

Modelling result summary

The Project Case forecasts high passenger demand for the rail extension to Clyde. The estimated daily boardings for the stations between Dandenong and Clyde, and the changes compared to the Base Case, are provided in Table 8. These results show that of the 4 new stations, demand is expected to be highest at Cranbourne East. When compared to the Base Case station boardings it is apparent that a portion of the Cranbourne East Station demand has shifted from Cranbourne Station.

[11] Regional Population by Age and Sex (ABS, 2024). https://www.abs.gov.au/statistics/people/population/regional-population-age-and-sex/2023

Table 8 Forecast daily station boardings (change from Base Case) | Clyde rail extension

Station	Y2031		Y2041	
Dandenong	8,700	(-100)	12,000	(-200)
Dandenong South (new)	1,000	(+1,000)	1,200	(+1,200)
Lynbrook	1,800	(-300)	2,100	(-400)
Merinda Park	2,500	(-600)	3,000	(-800)
Cranbourne	3,400	(-1,500)	5,100	(-1,400)
Cranbourne East (new)	2,300	(+2,300)	3,600	(+3,600)
Casey Fields (new)	1,800	(+1,800)	2,400	(+2,400)
Clyde(new)	1,100	(+1,100)	2,500	(+2,500)
Total	**22,600**	**(+3,700)**	**31,900**	**(+6,900)**

Statistics on the forecast mode change resulting from the project are given in Table 9. These results show the Clyde rail extension is expected to generate an additional 4,300 public transport trips per day by Y2041 over and above the Base Case, while also removing 4,800 car trips per day. A reduction in the number of daily car trips is also predicted for Y2031, falling further by Y2041. It should be noted that the total increase in public transport trips as a whole are smaller than the total change in station boardings shown in Table 8. The reason for this is that many of the increased boardings along the Clyde corridor are either switching between other corridors (e.g. Pakenham services) or other public transport modes (e.g. bus services between Clyde and Cranbourne).

Table 9 Change in mode resulting from project | Clyde rail extension

Metric	Y2031	Y2041
Change in daily public transport trips (average weekday)	+2,500	+4,300
Change in daily public transport hours travelled	+2,400	+4,900
Change in daily car trips (average weekday)	-2,800	-4,800
Change in daily car vehicle kilometres travelled	-31,100	-103,800

Extend and electrify towards Kalkallo

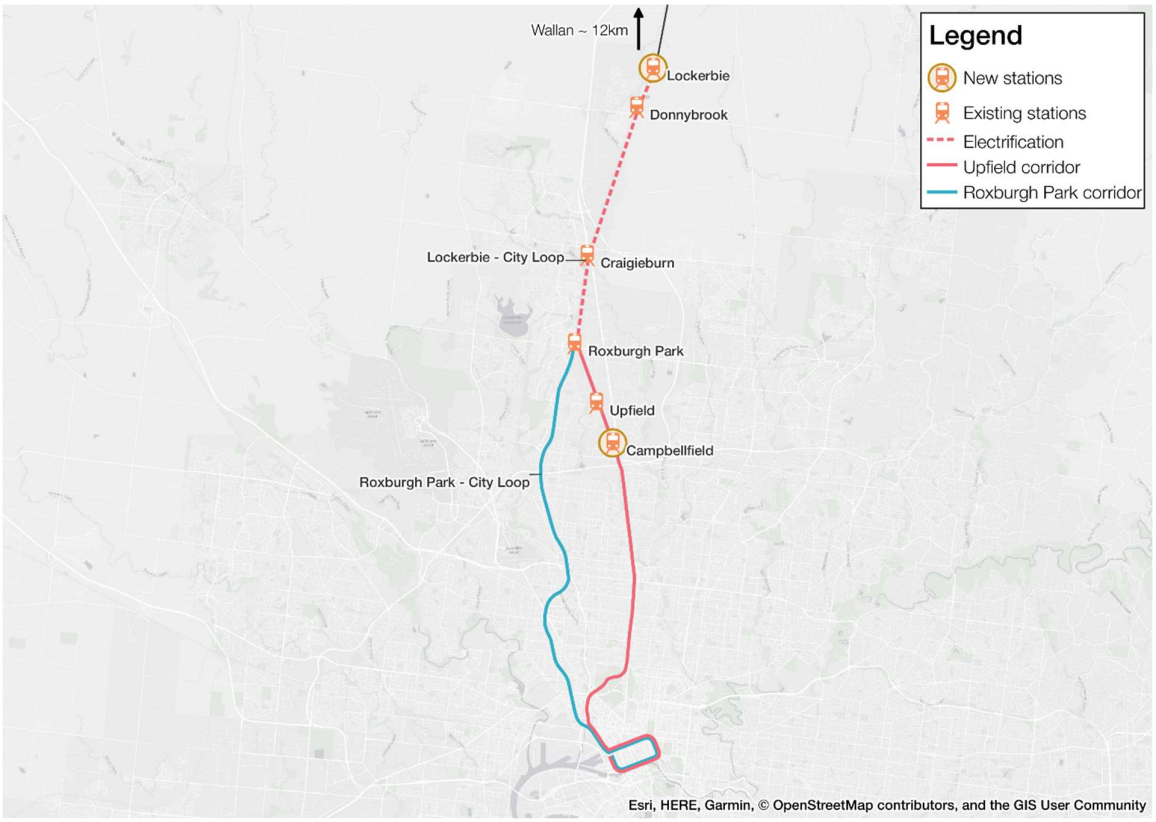
The Extend and electrify towards Kalkallo project – originally modelled as a Wallan Electrification in the initial project modelling – involves the electrification and extension of metropolitan rail services between Upfield and Lockerbie and the modification of some existing V/Line services on the Seymour line that currently service the stations north of Craigieburn.

After considering the likely outcomes, costs, and benefits of the electrification and extension project and the objectives and focus of the strategy update, Infrastructure Victoria and AECOM made the decision to truncate the project at Lockerbie Station near Kalkallo. This is in effect the first stage of this project as the full electrification to Wallan can still be completed as a second stage in the future.

Key to the updated alignment is that services previously operating on the Craigieburn corridor now terminate at Roxburgh Park Station, while Upfield services instead continue until Lockerbie Station.

The project includes the construction of new stations at Lockerbie and Campbellfield. The project corridor is illustrated in Figure 9 below.

Figure 9 Extend and electrify towards Kalkallo



Project context

Melbourne's northern growth area is expected to run into increasing pressure from expanding communities around Craigieburn, several planned precincts (including Merrifield North, Lockerbie, Donnybrook, Beveridge North East, Beveridge North West and Beveridge South West) and the Northern Freight precinct containing the Beveridge Intermodal Freight Terminal (BIFT).

With increasing residential and industrial activity planned, the Hume Freeway is likely to fall under increasing stress as southbound travel increases. To improve travel reliability and provide an alternative public transport connection to the northern growth area, improvements to the Upfield/Craigieburn corridor were modelled.

Project assumptions

Service frequencies between Lockerbie and Upfield stations were assumed to match the Base Case services that terminate at Upfield: 9 trains per hour in the peak, 6 trains per hour in the interpeak, and 3 trains per hour in the off-peak.

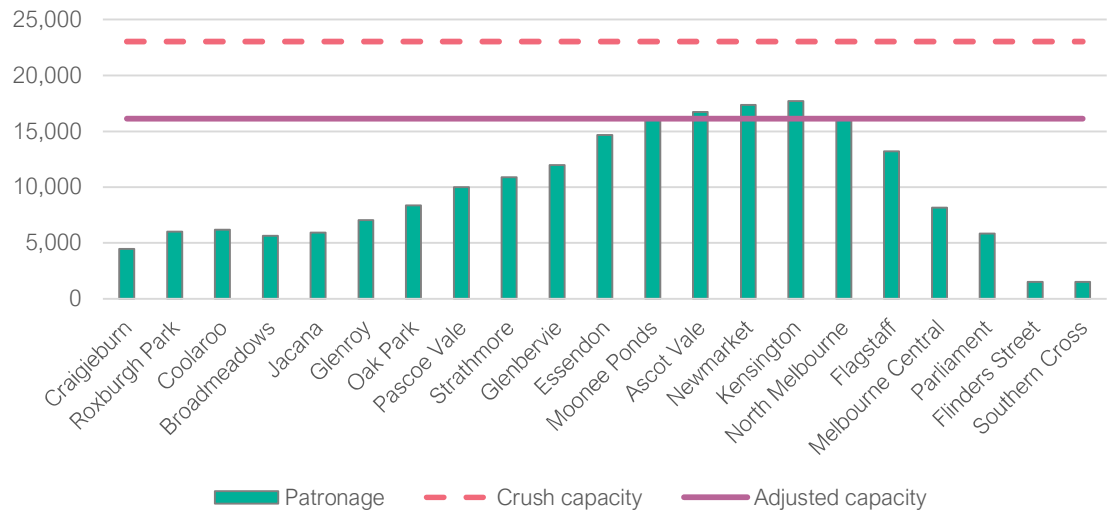
Both Lockerbie and Campbellfield stations were modelled to include a station car park, with assumed capacities of 500.

The Base Case bus services near the rail line were optimised to provide access to the new stations and to avoid duplicating existing services in the area. Details of these changes and other project assumptions are described in Appendix C.

Base Case summary

Road congestion and demand for public transport services in the region between Wallan and Craigieburn are forecast to steadily increase between Y2018 and Y2041. This is in response to high population growth without accompanying employment growth in the local area, and insufficient upgrades in transport infrastructure and services. Residents travelling by car south towards Melbourne for work, shopping, school, and recreation are expected to experience long delays, while those using public transport will face crowded peak period services.

Figure 10 Base AM Craigieburn passenger load | Extend and electrify towards Kalkallo



Modelling result summary

Modelling results indicate a strong increase in rail patronage along the corridor. Table 10 shows the effects of the electrification and extension of the Upfield line, with a significant number of additional boardings forecast for Upfield, Lockerbie, Donnybrook and Roxburgh Park stations. The increase at Roxburgh Park Station is partially linked to the decrease in patronage at Craigieburn Station, with some redistribution of passengers anticipated once the service extension past Craigieburn Station is in place.

Table 10 Forecast daily station boardings (change from Base Case) | Extend and electrify towards Kalkallo

Station	Y2031	Y2041
Lockerbie (new)	1,100 (+1,100)	2,100 (+2,100)
Donnybrook	3,100 (+400)	7,000 (+1,100)
Craigieburn	6,500 (-1,900)	7,700 (-2,600)
Roxburgh Park	7,400 (+3,400)	9,600 (+4,900)
Coolaroo	1,200 (-300)	1,800 (-500)
Broadmeadows	5,400 (-700)	6,900 (-600)
Upfield	900 (+200)	1,000 (+100)
Campbellfield (new)	1,600 (+1,600)	1,500 (+1,500)
Total	27,200 (+3,900)	37,600 (+6,100)

The improvement in rail services along the northern rail corridor is anticipated to lead to a localised reduction in daily car trips. Table 11 shows that public transport trips increase in both model years above Base Case expectations, with a slightly larger decrease in private vehicle trips. This leads to an overall decrease in vehicle kilometres travelled, particularly in Y2031, as the significant travel demand from the norther growth area to employment opportunities in Melbourne consumes the additional rail capacity introduced by the project.

Table 11 Change in mode resulting from project | Extend and electrify towards Kalkallo

Region	Y2031	Y2041
Change in daily public transport trips (average weekday)	+7,500	+5,000
Change in daily public transport hours travelled	+9,300	+5,300
Change in daily car trips (average weekday)	-8,600	-5,900
Change in daily car vehicle kilometres travelled	-113,200	-60,900

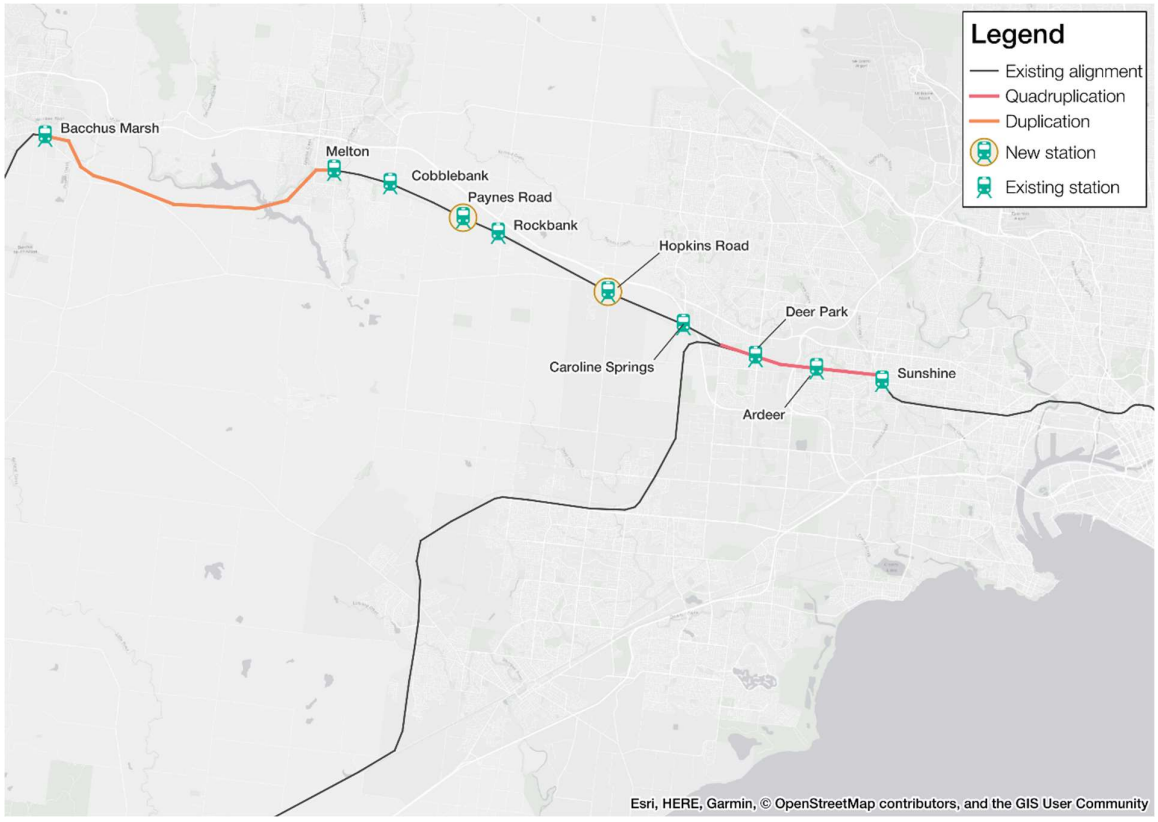
Melton electrification and quadruplication

The Melton electrification and quadruplication comprises a substantial package of network upgrades, including:

- the extension of electrified metropolitan services from Sunshine to Melton, replacing the current V/Line diesel services operating to stations in this section
- expanding the double-track section between Sunshine and Deer Park West (junction with the Geelong line) to four tracks
- constructing two new stations at Paynes Road and Hopkins Road.

Figure 11 illustrates these proposed Melton line upgrades.

Figure 11 Melton Electrification



Project context

Melbourne's west is a fast-growing area with significant development currently underway. As identified in the Western Growth Corridor Plan, rapid population increases are expected to continue, particularly in and around the Toolern, Rockbank, Melton East and Plumpton precincts.

With this population growth expected to outstrip employment growth, significant peak period traffic pressures to access external employment opportunities are anticipated. This highlights the need for improved accessibility to the Melbourne CBD and other major employment centres.

Table 12 Projected western LGA population and employment (with growth)

LGA	Demographic	Y2018	Y2031	Y2041
Melton	Population	158,000	268,000 (+110,000)	367,000 (+99,000)
	Employment	35,000	71,000 (+36,000)	97,000 (+26,000)
Wyndham	Population	256,000	399,000 (+143,000)	496,000 (+97,000)
	Employment	86,000	142,000 (+56,000)	175,000 (+33,000)
Hume	Population	224,000	313,000 (+89,000)	360,000 (+47,000)
	Employment	118,000	159,000 (+41,000)	178,000 (+19,000)

Project assumptions

The introduction of electrified services to Melton, and network upgrades through to Bacchus Marsh, involves a significant update to all services operating in the corridor. The track quadruplication to Melton allows a significant increase in service frequency with services increasing from a 20 to a 10-minute headway in all peak periods. By shifting to an electrified service up to Melton, existing V/Line rolling stock can subsequently be repurposed. This extra V/Line rolling stock available from the shift to electrified services is utilised by increasing frequency for services on the Seymour and Wyndham Vale lines. The Bacchus Marsh to Southern Cross service is also truncated to operate as a shuttle between Bacchus Marsh and Melton, freeing up capacity for higher-frequency electrified services while still providing rail access between Bacchus Marsh and Melton.

Table 13 Headway assumptions (minutes) | Melton Electrification

Station	AM peak	Interpeak	PM peak	Off peak
Bacchus Marsh – Melton (V/Line)	40	0	40	0
Melton – Bacchus Marsh (V/Line)	40	0	40	0
Melton – Pakenham East	10	10	10	10
Pakenham East – Melton	10	10	10	10
Seymour – Southern Cross (V/Line)	20	40	20	60
Southern Cross – Seymour (V/Line)	20	40	20	60
Wyndham Vale – Southern Cross (V/Line)	10	10	10	20
Southern Cross – Wyndham Vale (V/Line)	10	10	10	20
Wendouree – Southern Cross (V/Line)*	24	40	40	40
Southern Cross – Wendouree (V/Line)*	40	40	24	40
Maryborough - Southern Cross (V/Line)*	0	360	180	360
Southern Cross – Maryborough (V/Line)*	0	360	0	360
Ararat - Southern Cross (V/Line)*	120	180	180	360
Southern Cross - Ararat (V/Line)*	120	120	180	360

* No Change from Base Case

The project also includes assumptions of optimised bus services, including realigning a feeder service to Paynes Road station, an additional service to Caroline Springs, and two feeder services to Bacchus Marsh.

Base Case results

The Base Case assumes that V/Line remains as the only rail option for travel from Sunshine Station towards Melton and Ballarat.

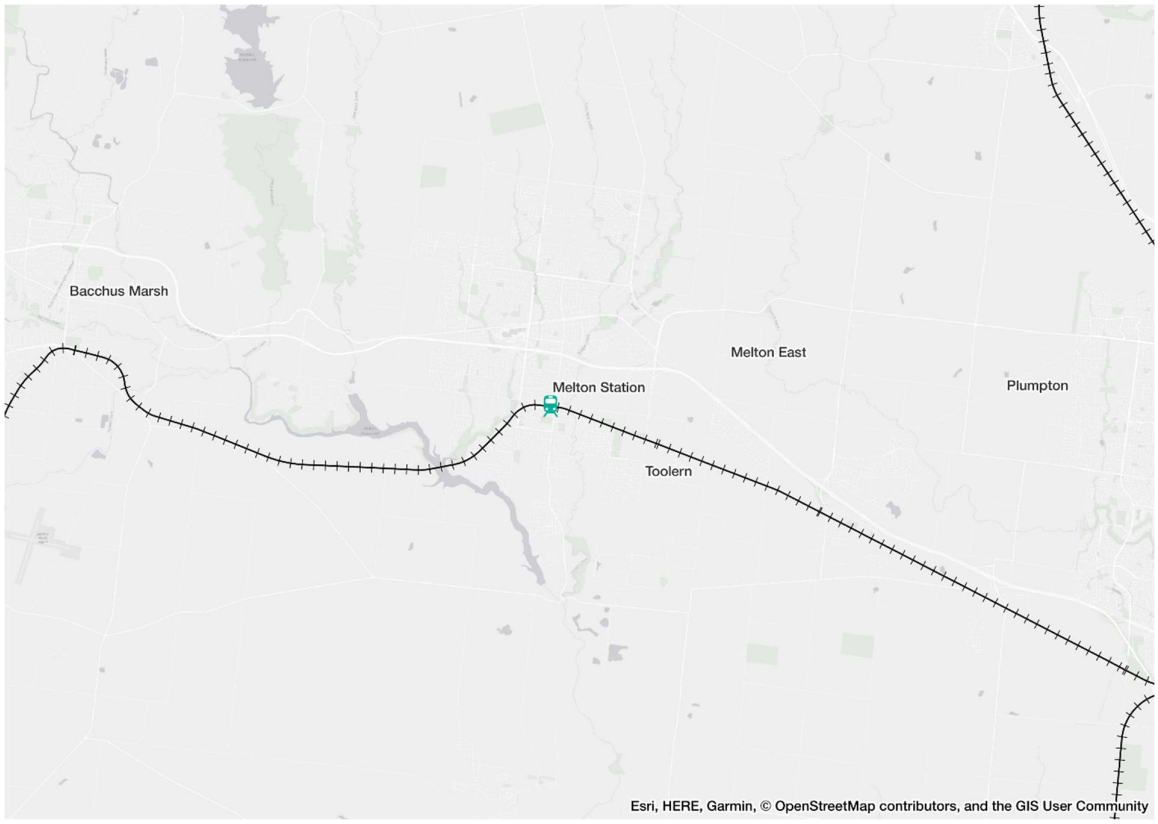
Demand for rail services at Melton Station is forecast to increase significantly in the Base Case, attracting passengers from Melton, from new developments such as Plumpton and Brookfield, and from neighbouring towns such as Bacchus Marsh (as shown in Figure 12).

Table 14 shows that boardings at Melton are expected to double by Y2041, with the net increase split relatively evenly between car and bus access. By looking at the accompanying compound annual growth rates (CAGR), we can see that bus transfers increase relatively faster than the other access modes. Ultimately, car access grows more than walk access across the modelled period, though the relative pace of growth for car starts to flatten out between Y2031 and Y2041.

Table 14 Base Case average weekday boardings (CAGR) at Melton station | Melton Electrification

Access mode	Y2018	Y2031	Y2041
Walk access	1,800	1,800 (0.0%)	2,200 (2.0%)
Car access	2,300	4,300 (4.9%)	4,600 (0.7%)
Bus transfer	800	2,400 (8.8%)	3,100 (2.6%)
Total boardings	**4,900**	**8,500 (4.3%)**	**9,900 (1.5%)**

Figure 12 Melton Station and surrounds



Modelling result summary

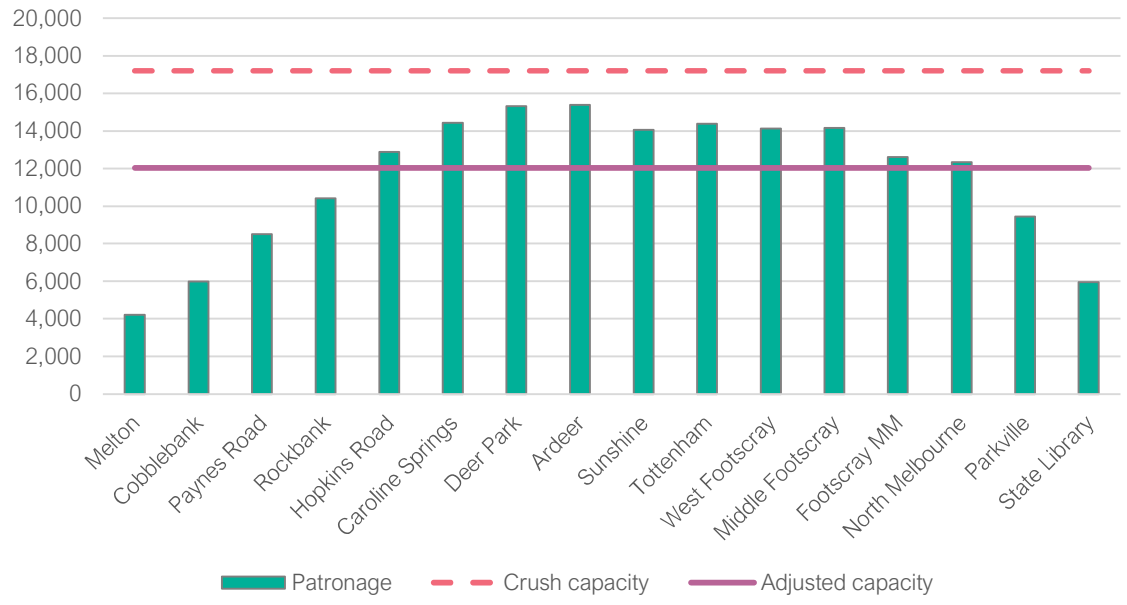
Table 15 highlights the impact of the project on station boardings across the corridor. Interestingly, boardings actually decrease at Bacchus Marsh and Melton stations as a result of the project. This can be explained by the increase in boardings at the new Paynes Road and Hopkins Road stations, with the new stations becoming a more attractive option compared to those currently making longer park and ride trips to the established stations of Melton, Cobblebank and Rockbank.

Table 15 Forecast daily station boardings (change from Base Case) | Melton Electrification

Station	Y2031		Y2041	
Bacchus Marsh	1,700	(-200)	2,200	(-800)
Melton	8,000	(-600)	10,100	(-100)
Cobblebank	3,000	(-100)	4,500	(-100)
Paynes Road (New)	3,400	(+3,400)	5,000	(+5,000)
Rockbank	2,800	(-500)	4,600	(-1,900)
Hopkins Road (New)	1,000	(+1,000)	5,400	(+5,400)
Caroline Springs	3,600	(+1,200)	5,000	(+1,500)
Deer Park	3,700	(-800)	6,100	(+1,200)
Ardeer	300	(+100)	400	(+100)
Total	**27,500**	**(+3,500)**	**43,100**	**(+10,100)**

The electrified Melton Service sees a high level of utilisation which is forecast to be overcapacity from Hopkins Road to Parkville, suggesting potential demand for an even higher service frequency than modelled.

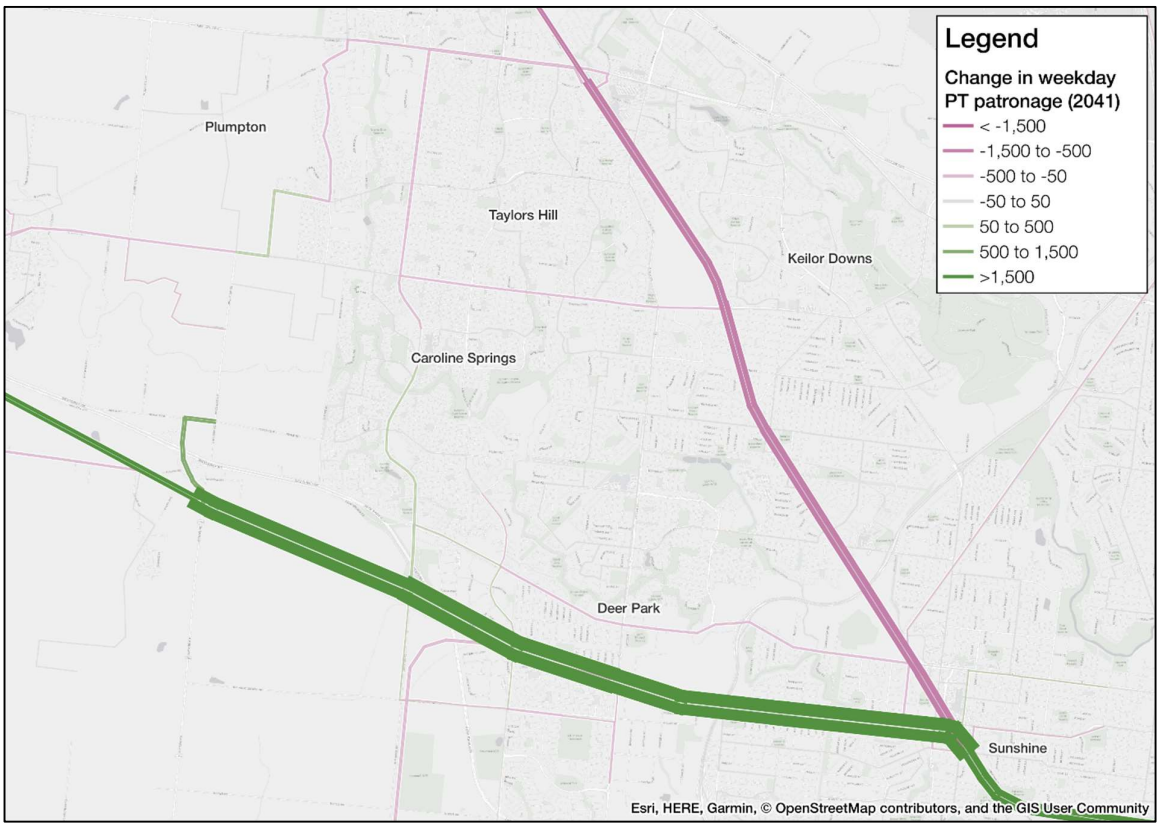
Figure 13 Melton to Pakenham East AM load | Melton Electrification



The number of boardings at Caroline Springs Station also increases. This can be attributed to several factors. Most significantly, the improved frequency of the electrified Melton services will likely draw patronage from the Sunbury Line as more residents of the suburbs between the lines choose to travel on the Melton Line take advantage of the additional capacity. This is illustrated in Figure 13 below, with a clear increase in daily patronage forecast for the Melton Line and a corresponding reduction in

patronage for the Sunbury Line. Improved bus alignments in the area will also boost patronage, which can be partially seen in segments of the network feeding into the rail corridor.

Figure 14 Shift in patronage from Sunbury services to the Melton line (Y2041)



The project has a significant effect on mode share. Table 16 details the shift away from private vehicles to public transport in comparison to the Base Case, which is most significant in Y2031.

Table 16 Change in mode resulting from project | Melton Electrification

Region	Y2031	Y2041
Change in daily public transport trips (average weekday)	+14,500	+7,500
Change in daily public transport hours travelled	+14,600	+7,000
Change in daily car trips (average weekday)	-16,800	-8,900
Change in daily car vehicle kilometres travelled	-209,700	-124,600

In the immediate project area, vehicle travel decreases on the Melton Highway and the Western Freeway, with connecting roads also seeing reductions. The largest decrease in vehicle volumes is observed for Mt Cottrel Road, likely due to its connection to both the Western Freeway and Melton Highway. Due to increased traffic accessing the new Paynes Road and Hopkins Road stations, traffic volumes increase on Paynes Road from the south, and Hopkins Road from the north. This is a particularly large relative increase for Paynes Road, where daily volumes increase by approximately 25%.

Table 17 Change in Y2041 two-way vehicle volumes | Melton Electrification

Road	Change in daily vehicle volumes
Hume Freeway South of Watson Street (Wallan)	-200
Calder Freeway East of Green Gully Road	-300
Western Freeway east of Leakes Road	-500
Hopkins Road north of Western Freeway	+900
Paynes Road south of Paynes Station	+1,400
Mt Cottrel Road south of Western Freeway	-1,500
Melton Highway east of Calder Park Drive	-1,200
Monash Freeway west of Chadstone Road	-200

Further afield, the effect of using the repurposed V/Line rolling stock to increase frequencies on the Seymour corridor can be seen through a reduction in vehicles along the Hume Freeway and parts of the Western Ring Road as the relative accessibility of rail improves. The increase in service frequency on the Melton – Pakenham line also has downstream effects in Melbourne's east by decreasing volumes on the Monash Freeway. These changes are less impactful than those in the immediate project area – representing a daily decrease of less than 1% – however they show the wide reach of the project's impact.

Fishermans Bend tram extensions

Extending tram services into Fishermans Bend will significantly improve the public transport connectivity for this important precinct. The project involves rerouting the western end of tram route 11: down Spencer Street, then west along Normandy Road and Williamstown Road into Fishermans Bend south. Additionally, the northern end of tram route 67 is rerouted: west along Park Street, then north on Ingles Street into Fishermans Bend north. The locations of the tram extensions are shown in Figure 15 and the extension particulars are shown in Table 18.

Figure 15 Fishermans Bend tram extensions

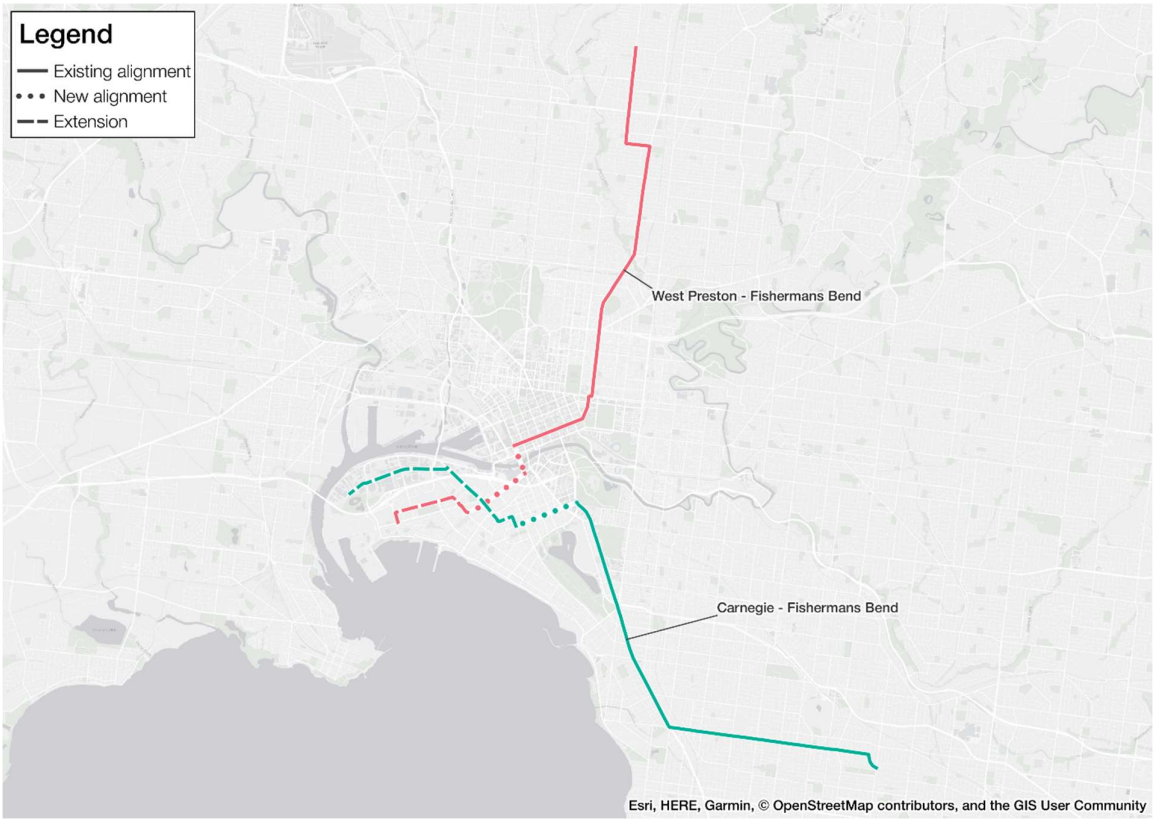


Table 18 Fishermans Bend route extensions

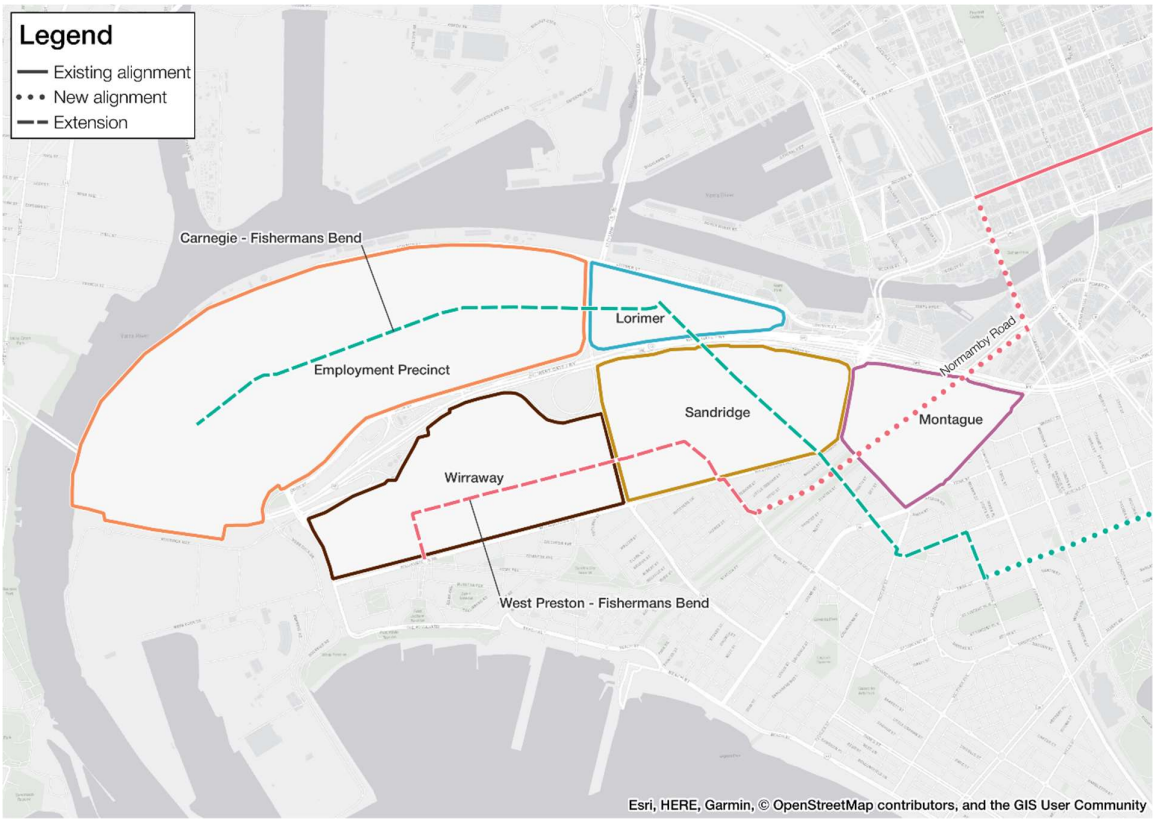
Tram route	Route name	Extension	Extension distance (kilometres)
11	West Preston to Fishermans Bend South	Bridge Street to Plummer Street, down Prohasky Street	2.6
67	Carnegie to Fishermans Bend North	Anzac station on St Kilda Road then Park Street to Ingles Street via Mountain Street, Turner Street to Wharf Road	5.3

Project context

The Fishermans Bend region is 3 times the size of the Melbourne CBD and consists of 4 mixed use precincts and an employment precinct. The employment region is identified as a National Employment and Innovation Cluster (NEIC) in Plan Melbourne.

In 2018, across all precincts, the area supported a population of just under 1,000 people and 33,000 jobs. By 2041, it is anticipated that the area will support a population of 50,000 people and approximately 80,000 jobs. As such, strong public transport connectivity between Fishermans Bend and the CBD will be essential to the success of this urban renewal project.

Figure 16 Fishermans Bend precincts



Much like the CBD itself, the high density of employment in the precinct will place significant constraints on private vehicle commuting and parking. As a result, the employment and other activities in the precinct will need to be serviced by reliable public transport.

Currently, the medium-term expectation for public transport in Fishermans Bend involves the provision of bus routes to service the precinct. The Fishermans Bend Framework[12] also sets out potential tram and metro rail routes, both of which would require new infrastructure to cross the Yarra River.

The proposed tram extensions serve to provide reliable connections between the precinct and Melbourne's north and south-east suburbs, and bring forward the expected timeline for high quality tram services for Fishermans Bend.

Project assumptions

The Fishermans Bend tram extensions involve a re-routing of two existing tram services into Fishermans Bend. In the Base Case, no tram services service Fishermans Bend, with the exception of route 86 (currently 109) passing through Montague via the Port Melbourne tram line.

Importantly, updates were made from the service assumptions in the original Stage 2 modelling. The main changes made were extending the Route 67 further west into Wharf Road, and further extending the Route 11 onto Prohasky Street to better reflect proposed alignments proposed in the Fishermans Bend Framework.

[12] https://www.fishermansbend.vic.gov.au/framework

As part of the project, the Route 235 bus was re-routed due to a similar alignment with the Route 11 tram service. The updated Route 235 bus instead runs along Lorimer Street, before returning to its previous route at Montague Street/Wurundjeri Way.

Table 19 Headway assumptions (minutes) | Fishermans Bend tram extensions

Tram route	Route name	AM peak	Interpeak	PM peak	Off peak
11	West Preston – Fishermans Bend South	8	10	8	15
67	Carnegie – Fishermans Bend North	8	10	8	15

Base Case result summary

In the Base Case, Fishermans Bend is well serviced by high frequency bus routes on Lorimer Street and Williamstown Road (5-minute headways in the peaks) that link the precinct with the CBD via the Charles Grimes Bridge. The Y2031 Base Case forecasts that over 21,000 bus trips will be made over this bridge each day. Despite the high service frequency, the demand for public transport is forecast to outstrip supply and many AM peak bus services that service Fishermans Bend are forecast to be over capacity. For example, both the Route 237 and Route 235 bus services heading to the Employment Precinct are modelled to be already above AM crush capacity in Y2041 when crossing the Yarra via Wurundjeri Way into Fishermans Bend.

Additionally, road congestion is forecast to reach extreme conditions in Y2041, with forecast AM peak speeds on Lorimer Street, Ingles Street, Salmon Street and the Docklands Highway reducing to less than 10 kilometres per hour.

Modelling result summary

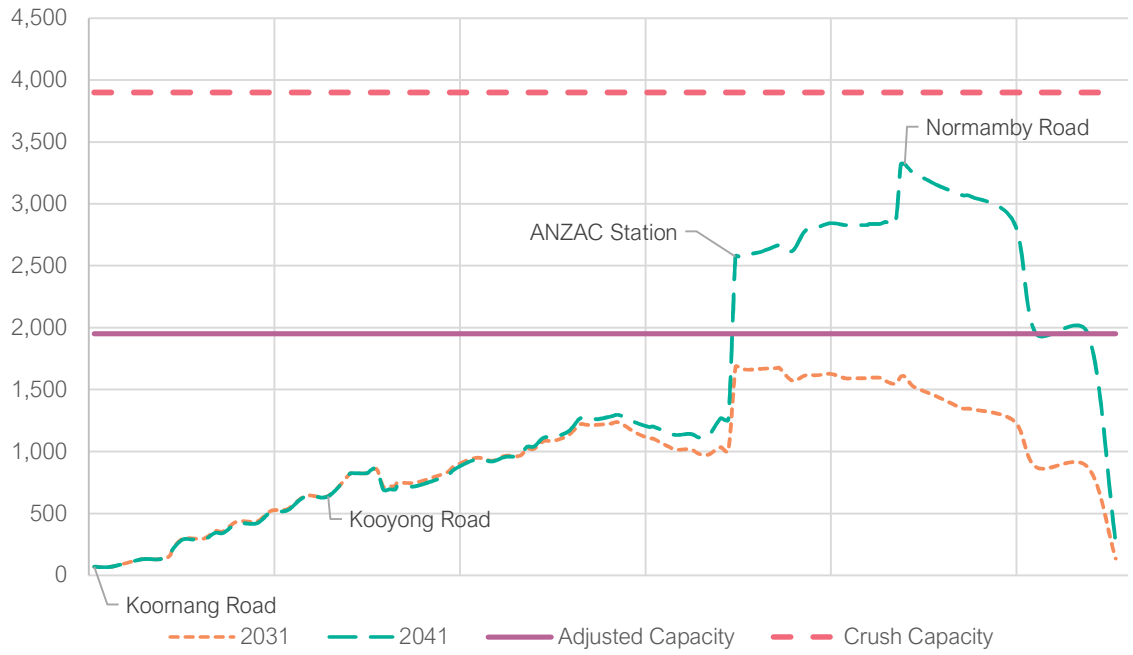
The modelling results indicate a strong demand for public transport into Fishermans Bend. Table 20 indicates a strong increase compared to the Base Case in passenger kilometres travelled in Y2041 for both services, in particular Route 67.

Table 20 Change in tram passenger kilometres travelled by route | Fishermans Bend tram extensions

Tram route	Passenger kilometres travelled (Y2041)		Increase	Percentage increase (%)
	Base	Project		
11	108,000	172,000	64,000	59.3%
67	89,000	143,000	54,000	60.7%
Total	**197,352**	**326,664**	**118,000**	**59.9%**

This increase in patronage leads to significant utilisation of both services. A significant portion of boardings for the updated Route 11 service come from Southern Cross Station, while it appears that appears much of demand for Route 67 occurs from boardings in South Melbourne and near ANZAC Station. Figure 17 shows Route 67 patronage exceeding capacity for much of the service within the precinct and South Melbourne. While encouraging from a service utilisation perspective, adjusting for such high demand at Y2041 may be difficult within the current tram network's constraints. In particular, the service runs through a network hotspot for tram services between Toorak Road and Park Street on St Kilda Road, which may struggle with additional service frequency. Further investigations may be needed to understand potential operational issues for project implementation. In the interim, through to Y2031, tram congestion remains more manageable.

Figure 17 Route 67 AM peak line load | Fishermans Bend tram extensions



The increase in public transport utilisation significantly reduces the number of private vehicle trips being taken. Table 21 shows public transport trips increasing with a corresponding – and somewhat larger – decrease in private vehicle trips. This is particularly true in Y2041.

Table 21 Change in mode resulting from project | Fishermans Bend tram extensions

Metric	Y2031	Y2041
Change in daily public transport trips (average weekday)	+6,300	+12,600
Change in daily public transport hours travelled	+5,800	+8,300
Change in daily car trips (average weekday)	-7,500	-15,400
Change in daily car vehicle kilometres travelled	-88,400	-138,900

Table 22 Access to precinct | Fishermans Bend tram extensions

Precinct	Population within 45 minutes using public transport (Y2041)		Increase	Percentage increase (%)
	Base	Project		
Employment precinct	466,000	717,000	251,000	53.9%
Lorimer	653,000	1,021,000	368,000	56.4%
Wirraway	455,000	580,000	125,000	27.5%
Sandridge	746,000	811,000	65,000	8.7%
Montague	1,197,000	1,179,000	-18,000	-1.5%
Combined				**19.0%**

Tram bundle

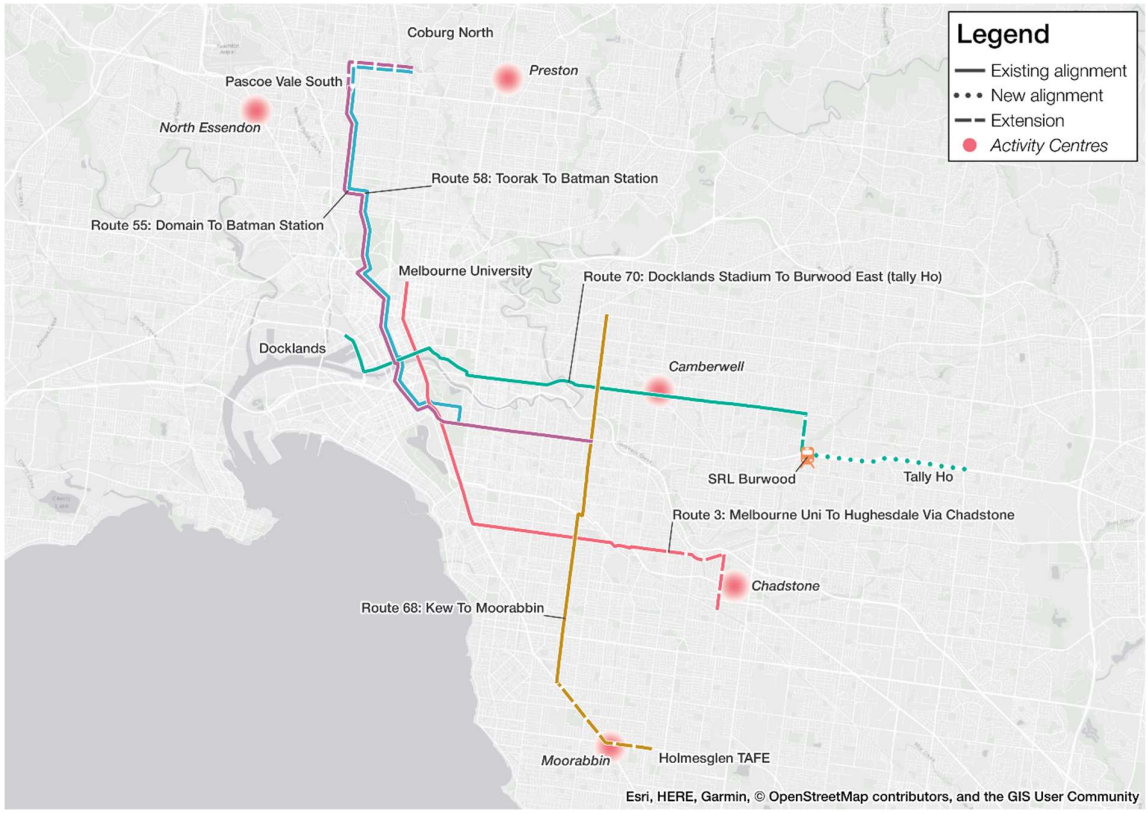
The 'Tram bundle' scenario encompasses five tram extension projects that share common characteristics and objectives. Primarily, these extensions enhance connectivity to employment centres and provide links to current and future train stations. Implementing these tram extension projects therefore supports Melbourne's transition to a more compact city. Greater access to local jobs and services from a high density inner-Melbourne population is well suited to shorter public transport trips, while the improved public transport connectivity to train services provides a competitive method of travel for longer trips.

The extensions are all relatively modest in scope, the longest (Route 68) adding approximately 4 kilometres of new track. The locations of the five tram routes are shown in Figure 18 and details of the extensions are provided in Table 23. It should be noted that a new service (Route 58) has been added to take advantage of the extension made for Route 55.

Table 23 Tram bundle route extensions

Tram route	Route name	Extension	Additional track (kilometres)	Extension distance (kilometres)
3	Melbourne Uni to Hughesdale via Chadstone	Malvern East to Hughesdale	3.7	3.7
55	Domain to Batman Station	West Coburg to Batman Station / Tram route 19	2.6	2.6
58	Toorak to Batman Station			
68	Kew to Moorabbin	Brighton East terminus along Nepean Highway then South Road to Holmesglen Tafe and Hospital	4.0	4.0
70	Docklands Stadium to Burwood East (Tally Ho)	Wattle Park at Elgar Road to Burwood Highway to Springvale Road (Tally Ho)	1.3	6.7

Figure 18 Tram bundle route map



Project context

The Tram bundle project is focused on testing relatively small changes to the tram network to improve employment accessibility and encourage increased population density within metropolitan Melbourne. Notably, each of the proposed extensions links to an existing employment and activity precinct:

- **Route 3 (Chadstone shopping centre)**

  Chadstone shopping centre in East Malvern is the largest shopping centre in Victoria and is a substantial employment and shopping destination. The shopping centre contains approximately 9,000 car parks and, while well serviced by suburban bus routes, has no direct tram or train connections. The closest train stations are Hughesdale Station (1 kilometre) on the Cranbourne / Pakenham train line and East Malvern Station (2 kilometres) on the Glen Waverley train line. There are also commercial office towers and low-rise offices nearby.

- **Routes 55 and 58 (Coburg north)**

  Many tram services, such as Routes 11, 86 and 19 in Melbourne's north, have strong interfaces with rail or other tram corridors. In contrast to this, the Route 55 and 58 tram services terminate on Bell Street, a busy arterial with little walking amenity that is only served by bus services. Modelled peak travel speeds on Bell Street are expected to fall from approximately 30 kilometres per hour in Y2018 down to 20 kilometres per hour in Y2041. With little room for priority bus lanes, average bus speeds are also expected to fall. To provide more streamlined public transport interfaces and greater connectivity in and around Coburg North, a connection between Batman Station and these services is modelled. This area is characterised by low density residential houses on large blocks south of Gaffney Street and industrial and commercial land to the north of Gaffney Street.

- **Route 68 (Moorabbin)**

  Moorabbin is one of the Metropolitan Activity Centres that is being fast-tracked for a more permissive zoning system as part of Victoria's Housing Statement. As with many centres located along existing rail corridors, public transport access to Moorabbin is largely radially-focused, with north-south connections facilitated by a variety of bus services. Currently, the Route 68 is planned to terminate at Hawthorn Road/Nepean Highway, leading to a 3 kilometre walk or multiple bus transfer to Moorabbin Station. Moorabbin has a mix of commercial, civic and residential land uses in the activity centre and its catchment. There are also anchor institutions including the Holmesglen Institute of TAFE and Holmesglen Private Hospital nearby.

- **Route 70 (Burwood East and future Suburban Rail Loop station and activity centre)**

  Burwood East is one of the planned station sites along the Suburban Rail Loop (SRL). The station is set to bring together key transport networks in addition to acting as a primary point of access to Deakin University. Further east, Tally Ho is a key major activity centre identified in the Plan Melbourne 2017-2050 strategy, that is currently served by the Route 75 tram and two bus services (Routes 732 and 902). The SRL vision for Burwood East is to renew the established neighbourhoods and create more residential diversity, amenity and provide more employment opportunities.

Project assumptions

Many of the tram extensions modelled in this phase adopt the same assumptions as those from the initial round of project modelling. A key change is the redirection of the Route 55 and Route 58 services from Pascoe Vale to Batman Station. This was in response to challenging gradients identified along the proposed route, in addition to providing additional network connectivity by providing a link to services on Sydney Road.

In addition, the alignment of the Route 68 service was updated to terminate at Holmesglen TAFE, instead of Moorabbin station as originally modelled. This further extension provides a connection to an educational cluster which, aside from Holmesglen includes Tucker Road and St Catherine's Primary Schools. In addition to changes to the high-level project specifications, further refinements were made with regard to tram stop spacing and tram speed assumptions. These assumptions are outlined in Appendix C.

The proposed tram route extensions are assumed to maintain the same service frequencies as the existing Base Case routes. The headway assumptions, shown in Table 24, are set to have a service every eight minutes in the peak periods and every ten to fifteen minutes outside of the peaks.

Table 24 Headway assumptions (minutes) | Tram bundle

Tram route	Route name	AM peak	Interpeak	PM peak	Off peak
3	Melbourne Uni to Hughesdale via Chadstone	8	10	8	15
55	Domain to Batman Station	8	10	8	15
58	Toorak to Batman Station	8	10	8	15
68	Kew to Moorabbin	8	10	8	10
70	Docklands Stadium to Burwood East (Tally Ho)	8	10	8	15

Base Case result summary

Melbourne's tram network is a popular choice for transit within the Greater Melbourne area, behind rail it is the most popular mode in terms of boardings and passenger hours travelled in the Y2018 base scenario:

Table 25 Y2018 average weekday public transport utilisation (Greater Melbourne)

Mode	Boardings	Passenger Kilometres	Passenger Hours
Rail	1,019,000 (48.5%)	17,034,000 (80.2%)	409,000 (62.9%)
Tram	671,000 (31.9%)	2,093,000 (9.9%)	143,000 (22.0%)
Bus	411,000 (19.5%)	2,104,000 (9.9%)	98,000 (15.1%)
Total	**2,101,000 (100.0%)**	**21,231,000 (100.0%)**	**650,000 (100.0%)**

One of the strengths underpinning this popularity is proximity to existing employment and population, in addition to stronger reliability and the ability for patrons to 'turn up and go'. However, the coverage of Victoria's tram network pales in comparison to the bus network. As Melbourne grows and as activity centres become more entrenched, this highlights the potential for targeted extension of the existing tram network.

Table 26 Y2018 land use accessible within 1km of public transport (Victoria)

Mode	Tram	Bus
Population	1,407,000	5,523,000
Employment	1,141,000	2,860,000

Modelling result summary

The modelling results for the Tram Bundle show all five tram route extensions being well patronised, with the largest gains in passenger kilometres occurring on the Route 3 extension to Chadstone and the Route 70 extension past the Burwood SRL station. The change in tram passenger kilometres compared to the Base Case is shown in Table 27.

Table 27 Change in tram passenger kilometres travelled by route | Tram bundle

Tram route	Passenger kilometres travelled (Y2041)		Increase	Percentage increase (%)
	Base	Project		
3	76,500	97,700	21,200	27.7%
55 / 58 (combined)	272,700	291,400	18,700	6.9%
68	45,300	65,600	20,300	44.8%
70	73,800	118,200	44,400	60.2%
Total	**468,300**	**572,900**	**104,600**	**22.3%**

This increase in patronage is accompanied by reductions private vehicle mode share. Car trips decrease roughly in line to the increase in public transport, as shown in Table 28.

Table 28 Change in mode resulting from project | Tram bundle

Metric	Y2031	Y2041
Change in daily public transport trips (average weekday)	+5,300	+3,800
Change in daily public transport hours travelled	+6,100	+3,000
Change in daily car trips (average weekday)	-6,100	-4,500
Change in daily car vehicle kilometres travelled	-57,200	-54,400

Perhaps more importantly, these interventions have also improved the accessibility to the key employment and activity centres identified on page 54. This is partially a function of land-use distribution along each corridor, in addition to the relative improvements in travel time. Most projects see a similar absolute increase in the population catchment living within a 45-minute public transport

trip of each area. The extension to Coburg North generates the largest relative increase in accessibility (20%).

Table 29 Access to employment centres | Tram bundle

Tram route	Attraction	Population within 45 minutes using public transport (2041)		Increase	Percentage increase (%)
		Base	Project		
3	Chadstone shopping centre	845,000	883,000	38,000	4.5%
55 / 58	Coburg north / Gaffney Street	214,000	256,000	42,000	19.6%
68	Holmesglen TAFE	391,000	400,000	9,000	2.3%
70	Burwood East (Tally Ho)	520,000	567,000	47,000	9.0%
Total		**1,970,000**	**2,106,000**	**136,000**	**6.9%**

Tram bundle sensitivity

Transport and land use outcomes are tightly linked in policymaking. To test potential densifying impacts of the tram extensions, a sensitivity test was conducted on the tram bundle (P4). This sensitivity altered the land use (where housing is built and people live) and car ownership assumptions in the VITM. This reflects the tendency for greater population density and lower car ownership rates in areas with improved public transport access to jobs and services. The sensitivity test assumes zoning changes in the impact areas allow and encourage higher density housing in these established areas.

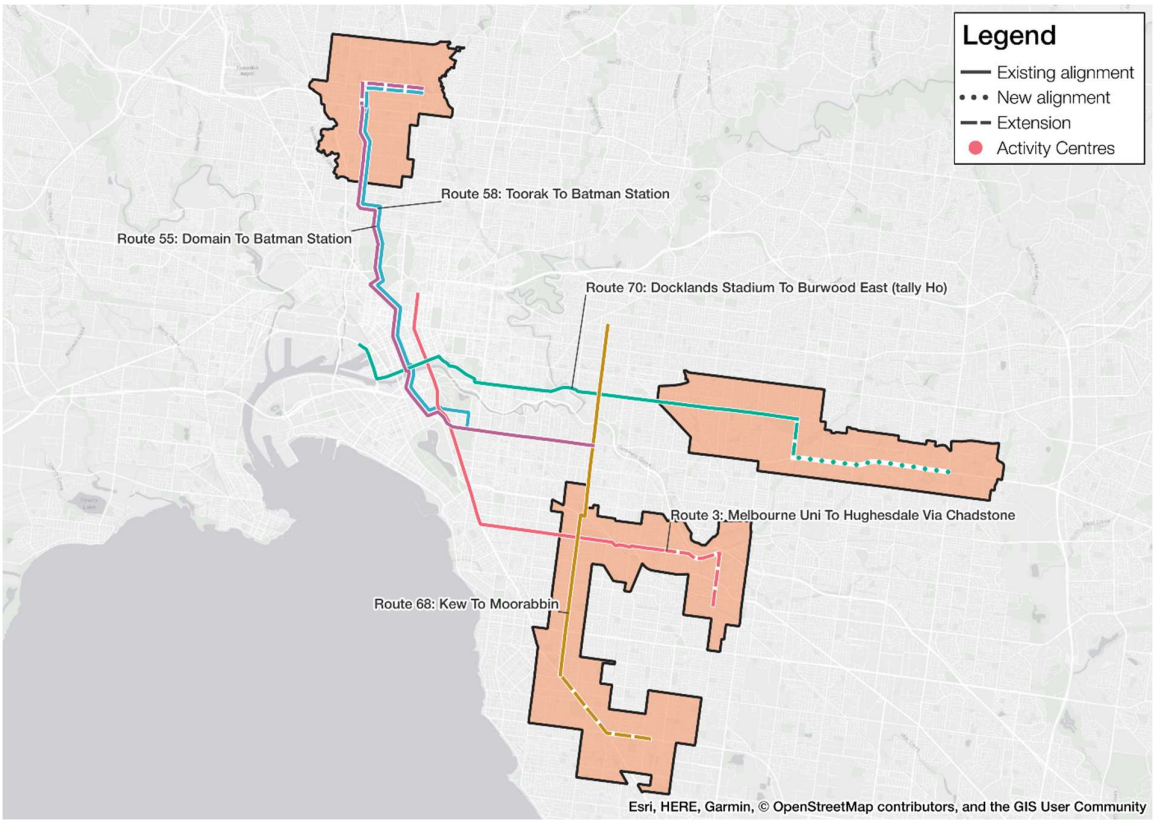
Assumptions

This sensitivity had two levers that were adjusted at a zonal level in order to test transport outcomes:

1. Land use density
2. Car ownership rates

Figure 19 shows the areas that were identified for intervention in both inputs.

Figure 19 Land use impact areas (source: Infrastructure Victoria)



In each of these areas, the population density of transport zones was increased to reflect the improved accessibility created by the tram extensions. The population was proportionally reallocated from transport zones in the northern and south-east growth areas within Hume, Whittlesea, Casey and Cardinia local government areas. This maintains a consistent total population with the other Network Development scenarios.

Table 30 Changes to population by impact corridor | Tram Bundle sensitivity

Tram corridor	Y2031 NDS Population	Y2031 Sensitivity Population	Y2041 NDS Population	Y2041 Sensitivity Population
3	54,700	57,900	62,700	74,200
55 / 58	69,500	71,000	79,100	84,600
68	78,300	88,400	84,100	120,400
70	78,300	83,300	89,200	107,300
Total	**280,800**	**300,600**	**315,100**	**386,500**

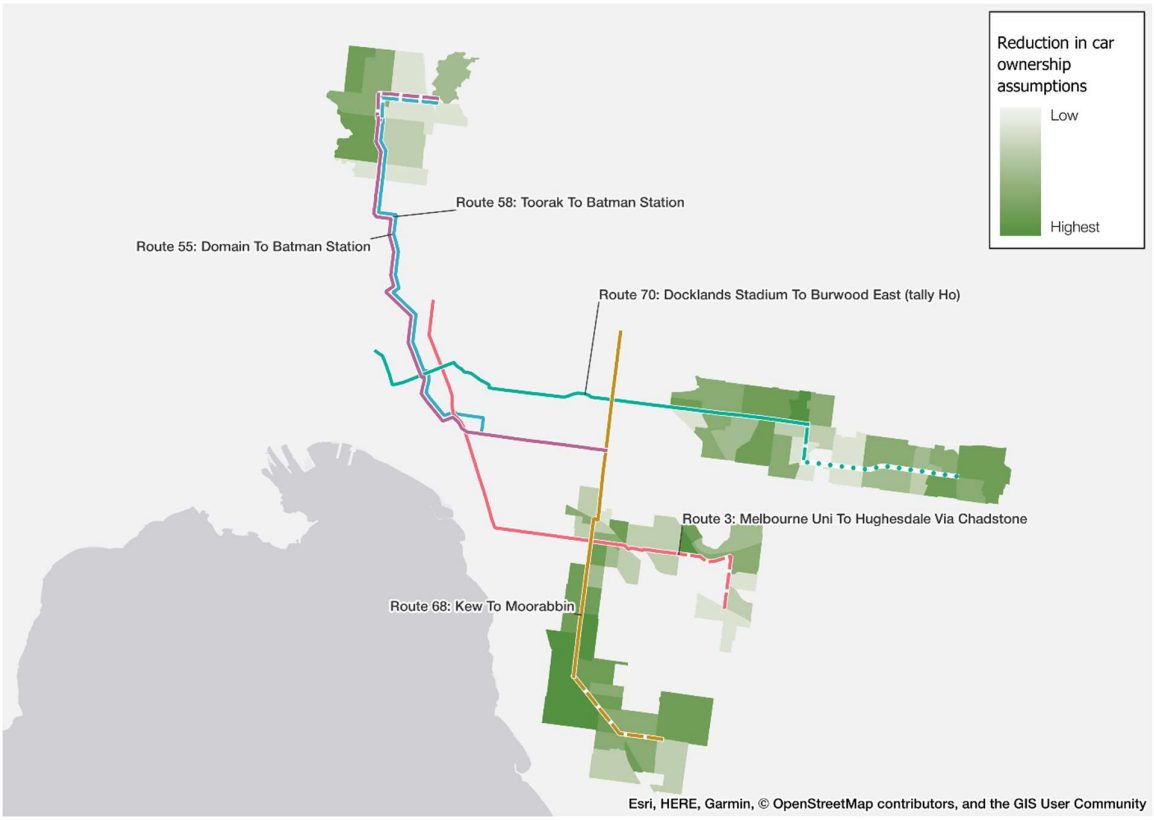
Table 31 provides an overview of the assumed changes to population in the growth area. Population does not fall in these LGAs in the sensitivity scenario, rather they grow at a slower rate than the Network Development Scenario land-use.

Table 31 Changes to growth area population assumptions

LGA	Land-use scenario	Y2018	Y2031		Y2041	
Hume	Network Development Scenario	223,529	312,586	(+89,057)	359,981	(+47,395)
	Sensitivity	223,529	311,842	(+88,313)	357,608	(+45,766)
Whittlesea	Network Development Scenario	223,319	301,499	(+78,180)	364,520	(+63,021)
	Sensitivity	223,319	300,715	(+77,396)	361,366	(+60,651)
Cardinia	Network Development Scenario	107,233	150,752	(+43,519)	179,167	(+28,415)
	Sensitivity	107,233	145,729	(+38,496)	161,101	(+15,372)
Casey	Network Development Scenario	340,413	457,250	(+116,837)	532,544	(+75,294)
	Sensitivity	340,413	444,069	(+103,656)	484,672	(+40,603)

Additionally, the assumptions on the rates of car ownership in the impact areas were adjusted to reflect the car ownership rates currently seen adjacent to existing tram lines. Within the VITM, car ownership is modelled by estimating the proportion of households where the number of adults exceeds the number of cars owned by a household. These households are deemed to be 'captive' to public transport, and as a result will be more likely to choose public transport compared to a household that is not captive. Figure 20 shows the reduced car ownership assumptions for the impacted areas.

Figure 20 Reduction in car ownership | Tram Bundle sensitivity



Modelling result summary

Table 32 details the change in tram boardings compared to both the Base Case and the Network Development Scenario Tram Bundle results. The data show a strong increase in patronage for the services, in particular for Route 68. This makes sense, given the strong increases in population and reduction in car ownership modelled for the corridor.

Table 32 Change in tram passenger kilometres travelled by route | Tram bundle sensitivity

	Compared to Base		Compared to NDS tram bundle	
Tram corridor	+ / -	%	+ / -	%
3	+28,100	+36.7%	+6,900	+7.1%
55 / 58	+32,600	+12.0%	+13,900	+4.8%
68	+38,900	+85.9%	+18,600	+28.4%
70	+57,600	+78.0%	+13,200	+11.2%
Total	**157,200**	**33.6%**	**52,600**	**9.2%**

Table 33 details the changes in mode for the sensitivity, comparing against both the Base Case and the Tram Bundle using the Network Development land-use assumptions. A key highlight here is the significant decrease in car trips. This is likely due to two factors:

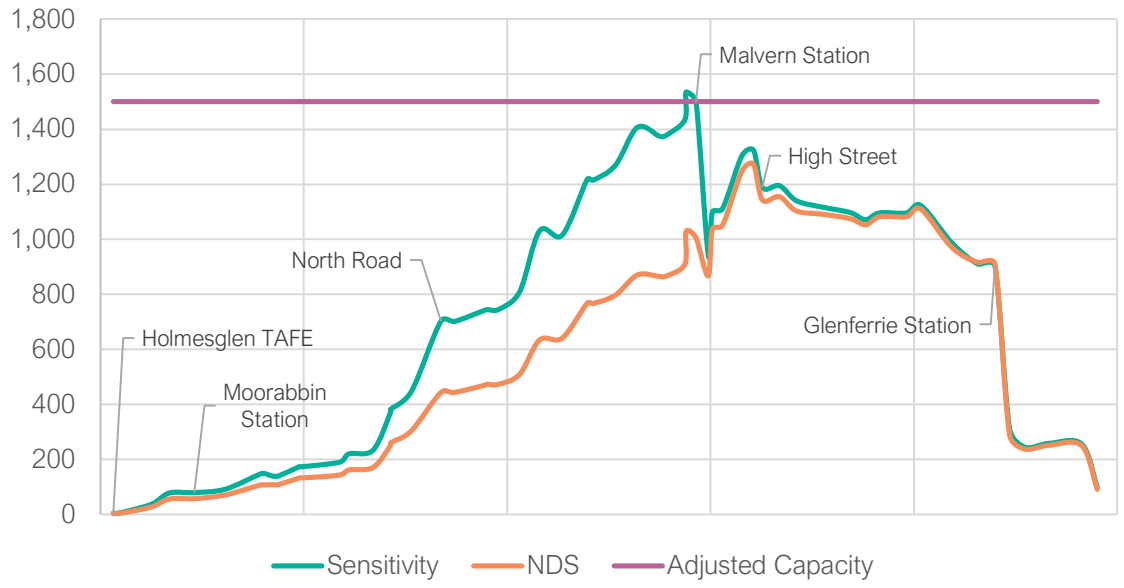
1. By increasing the density of population around the corridors *and* reducing the implied car ownership, a significant number of trips are likely to shift to public transport.
2. By shifting population away from the outer fringes, fewer trips are made in growth areas, which have a higher private vehicle mode share.

Table 33 Change in mode resulting from project | Tram bundle sensitivity

Metric	Compared to Base		Compared to NDS tram bundle	
	Y2031	Y2041	Y2031	Y2041
Change in daily public transport trips (average weekday)	+17,900	+21,700	+12,600	+17,900
Change in daily public transport hours travelled	+12,600	+7,800	+6,400	+4,700
Change in daily car trips (average weekday)	-39,900	-53,800	-33,700	-49,300
Change in daily car vehicle kilometres travelled	-385,200	-972,600	-328,000	-918,300

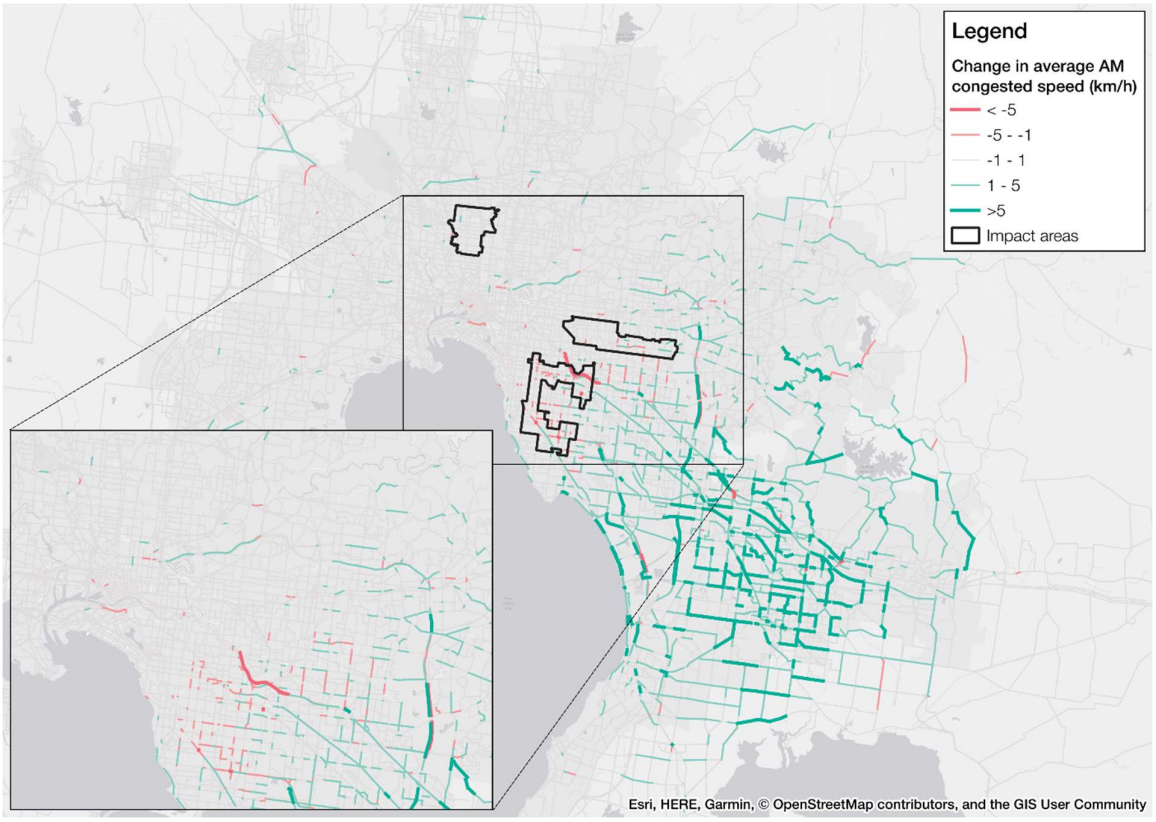
These results show a strong potential demand for extended public transport corridors should they be paired with uplifts in residential density. However, it is also clear that such increases in density require additional network planning, as loading on services will increase in step, as illustrated in Figure 21.

Figure 21 Route 68 extension loading (Y2041) | Tram bundle sensitivity



The redistribution of land use has a particularly strong impact in the south-east, as shown in Figure 22. Due to the higher levels of congestion in the base case for the south-east, changes to land use have an outsized impact on network performance. The increased activity and population density in the tram corridors causes a corresponding decrease in travel time.

Figure 22 Change in modelled AM speeds | Tram bundle sensitivity



As with the original Tram Bundle scenario, the services increase accessibility to key activity centres. In the case of an assumed increase in population density, the population within 45-minutes increases even further, as shown in Table 34.

Table 34 Access to employment centres | Tram bundle sensitivity

Tram route	Attraction	Population within 45 minutes using public transport (2041)		Increase	Percentage increase (%)
		Base	Project		
3	Chadstone shopping centre	845,000	896,000	51,000	6.0%
55 / 58	Coburg north / Gaffney Street	214,000	245,000	31,000	14.5%
68	Holmesglen TAFE	391,000	433,000	42,000	10.8%
70	Burwood East (Tally Ho)	520,000	588,000	68,000	13.1%
Total		**1,970,000**	**2,162,000**	**192,000**	**9.7%**

Summary of findings

The VITM was used to research and help assess potential options to improve public transport accessibility for the purposes of supporting a more compact city and to improve connectivity in the rapidly expanding growth areas of Melbourne. In addition to modelling of infrastructure interventions, a land use and car ownership sensitivity has been undertaken to understand the potential benefits of shifting growth from outer to inner areas of Melbourne that are better serviced by public transport.

The modelling supports the findings that:

- The level of demand for travel to inner and central Melbourne from its **growth areas** is forecast to exceed current network capacities and highlights the need for significant new public transport investments including rail extensions and electrifications.
- **Fishermans Bend** is forecast to become a substantial attraction for travel over the next two decades, and will require strong public transport connections to avoid over-crowding of services.
- A **Compact City** future where population growth is focused on areas with existing infrastructure will also require a corresponding increase in public transport services

The first round of modelling tested and assessed 30 tram and train projects. The projects were tested against two sets of land-use and demographic forecasts:

- the '**Network Development**' scenario, which includes continued high levels of growth at the urban fringe, in line with the Victorian Government's 'Victoria in Future' forecasts,
- an alternative '**Compact City**' scenario that assumes a higher proportion of growth in existing urban areas relative to the urban fringe.

The VITM modelling was used to establish a set of metrics, that were fed into a multi-criteria analysis. Modelling metrics included changes to boardings, vehicle kilometres travelled, changes in public transport access, and employment accessibility. Combined with benchmarked costs and land-use evaluations, MCA scores were produced for evaluation. Table 35 summarises the key results of the initial modelling and MCA.

Table 35 MCA outcomes

Project list	Mode	Total score	Rank
Route 11 (south) - South Reservoir to Fishermans Bend	Tram	1.05	1
New station at Altona North	Rail	0.90	2
Route 5 (north) - Malvern East to Flemington Bridge Station	Tram	0.75	3
Clyde extension and electrification	Rail	0.65	4
Route 70 - Docklands Stadium to Burwood East (Tally Ho)	Tram	0.20	5
Route 67 - Carnegie to Fishermans Bend North	Tram	0.15	6
Route 3 (west) - Kensington to Malvern East	Tram	0.15	7
Route 56 (north) - St Kilda to Flemington Bridge Station	Tram	0.15	8
Wallan electrification and Somerton link	Rail	0.10	9
Route 3 (east) - Melbourne Uni to Hughesdale via Chadstone	Tram	0.10	10
Route 11 (north) - Victoria Harbour to Reservoir	Tram	0.10	10
Route 5 (east) - Remand Centre to Darling	Tram	0.10	12
Melton electrification and quadruplication	Rail	0.05	13
Route 68 - Kew to Moorabbin	Tram	0.00	14
New route - Footscray to Spotswood	Tram	-0.10	15
Route 48 - Docklands Stadium to Doncaster	Tram	-0.10	16
Route 55 - Domain to Pascoe Vale	Tram	-0.10	16
New route - Camberwell to Caulfield Station	Tram	-0.10	16
Wollert extension	Rail	-0.15	19
Route 57 - Flinders Street to East Keilor	Tram	-0.20	20
New route - Highpoint to Sunshine	Tram	-0.20	21
Route 5 (west) - Footscray to Malvern via Dynon Road	Tram	-0.25	22
Route 58 - West Coburg via Toorak Road to Burwood East (Tally Ho)	Tram	-0.30	23
Route 59 - Flinders Street to Melbourne Airport	Tram	-0.30	24
New route - Highpoint to Rushall	Tram	-0.45	25
Route 75 - Victoria Harbour to Ferntree Gully via Knox	Tram	-0.55	26
Alamein rail extension to Oakleigh	Rail	-0.60	27
Route 72 - Melbourne Uni to Heidelberg	Tram	-0.65	28
Melton Central extension and electrification	Rail	-0.65	29
Partial duplication Altona Loop Line	Rail	-0.85	30

The second round of detailed modelling focused on 5 scenarios, shortlisted through the MCA and project review process. The scenarios included 3 rail extension projects that will service Melbourne's expanding growth areas and two tram extension packages that will enhance connectivity to employment and will support a more compact city. These scenarios were tested using the 'Network Development' land-use and demographic assumptions. The scenarios are listed in Table 36.

Table 36 Shortlisted projects selected for detailed modelling

Project	Description	Purpose
1	Clyde rail extension	To improve access in rapidly expanding growth areas where residents and businesses have already moved in, but suffer from underdeveloped transport networks.
2	Extend and electrify towards Kalkallo	
3	Melton electrification and quadruplication	To improve access in rapidly expanding growth areas where residents and businesses have already moved in, but suffer from underdeveloped transport networks.
4	Fishermans Bend tram extensions: Route 11 (south) – South Reservoir to Fishermans Bend (south) Route 67 – Carnegie to Fishermans Bend (north)	Support a more compact city through improving public transport connections in established parts of Melbourne
5	Tram bundle: Route 3 (east) – Melbourne Uni to Hughesdale via Chadstone Route 55 – Domain to Batman Station Route 58 – Toorak to Batman Station Route 68 – Kew to Moorabbin Route 70 – Docklands Stadium to Burwood East (Tally Ho)	
6	Tram bundle land use and car ownership sensitivity	

An increase in public transport boardings and public transport hours travelled is forecast for all modelled projects, as shown in Table 37. The two tram extension projects are forecast to improve accessibility to key activity and employment centres by significantly improving public transport capacity to these areas, in addition to improvements in travel time and a reduction in private vehicle travel. Each tested rail project has significant modelled impacts due to the wider scope of the projects in addition to their roles in connecting areas of strong population growth.

Table 37 Stage 4 Y2041 summary results

Project	Description	Change in daily public transport boardings	Change in daily public transport passenger hours	Change in car trips	Percentage change in 45-minute activity-centre accessibility
1	Clyde rail extension	+4,900	+4,300	-4,800	N/A
2	Extend and electrify towards Kalkallo	+5,000	+5,300	-5,900	N/A
3	Melton electrification and quadruplication	+7,500	+7,000	-8,900	N/A
4	Fishermans Bend tram extensions	+12,600	+8,300	-15,400	19.0%
5	Tram bundle	+3,800	+3,000	-4,500	6.9%
6	Tram bundle sensitivity	+21,700	+7,800	-53,800	9.7%

This report shows that there is strong demand for public transport in Melbourne's growth areas, particularly around Melton. It is also clear that Fishermans Bend requires significant public transport capacity to meet the strong demand forecast for the medium and long term.

However, the modelling results only tell part of the story for these projects. It is clear that there is demand for improved public transport connections across Victoria, but more detailed analysis of the project impacts, benefits and costs is needed to provide sufficient information for government investment decision making.

Further, the modelling and analysis in this report are strategic in nature, and do not cover operational impacts. For example, capacity in the tram network along St Kilda Road or Port Junction – both of which are expected to experience high tram throughput in the Fishermans Bend scenario – would require further detailed investigation and planning by DTP and Yarra Trams for successful implementation.

Appendix A

Detailed Base Case assumptions and results

Appendix A Detailed Base Case assumptions and results

This appendix provides a view of the Base case modelling undertaken as the reference point for the Round 1 and Round 2 modelling. The purpose of this appendix is to provide a view of the challenges facing Victoria's network in the near to medium term.

Assumptions

VITM model

The Department of Transport and Planning provided version VITM23_v2_03 of the VITM. This version of VITM uses the 2023 Reference case and includes updated assumptions on working from home rates and recent modifications to the public transport model.

Land-use

Victoria is expected to experience significant population growth over the next couple of decades. Table 38 details the population estimates between Y2018 and Y2041 for a selection of growth area LGAs. A key implication shown is that for many of these growth areas are expected to see population growth outstrip employment. This is particularly true for Mitchell, which is expected to add almost 70,000 residents with a corresponding 10,000 jobs.

Table 38 SALUP Population forecasts by LGA

	Population				Employment			
Local Government Area (LGA)	Y2018	Y2041	+ / -	%	Y2018	Y2041	+ / -	%
Melton	158,000	367,000	209,000	132%	35,000	97,000	62,000	177%
Hume	224,000	360,000	136,000	61%	118,000	178,000	60,000	51%
Mitchell	44,000	113,000	69,000	157%	13,000	23,000	10,000	77%
Whittlesea	223,000	365,000	142,000	64%	71,000	137,000	66,000	93%
Wyndham	256,000	496,000	240,000	94%	86,000	175,000	89,000	103%
Casey	340,000	533,000	193,000	57%	88,000	162,000	74,000	84%
Victoria	**6,460,000**	**8,867,000**	**2,407,000**	**37%**	**3,248,000**	**4,651,000**	**1,403,000**	**43%**

Such differentials in employment and population suggest a significant inward pressure for work-based trips in the future. The distribution of population density is shown in Figure 23, Figure 24, Figure 25 for 2018, 2031 and 2041 respectively.

Figure 23 2018 population density | SALUP

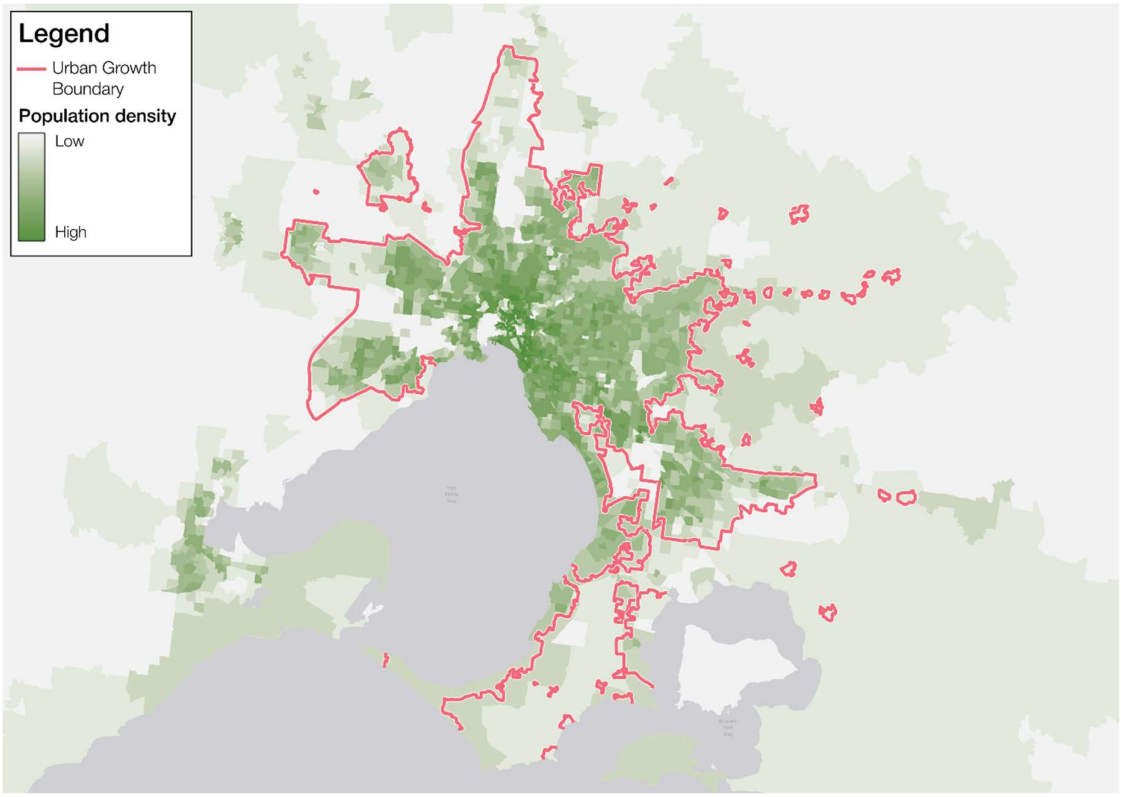


Figure 24 2031 population density | SALUP

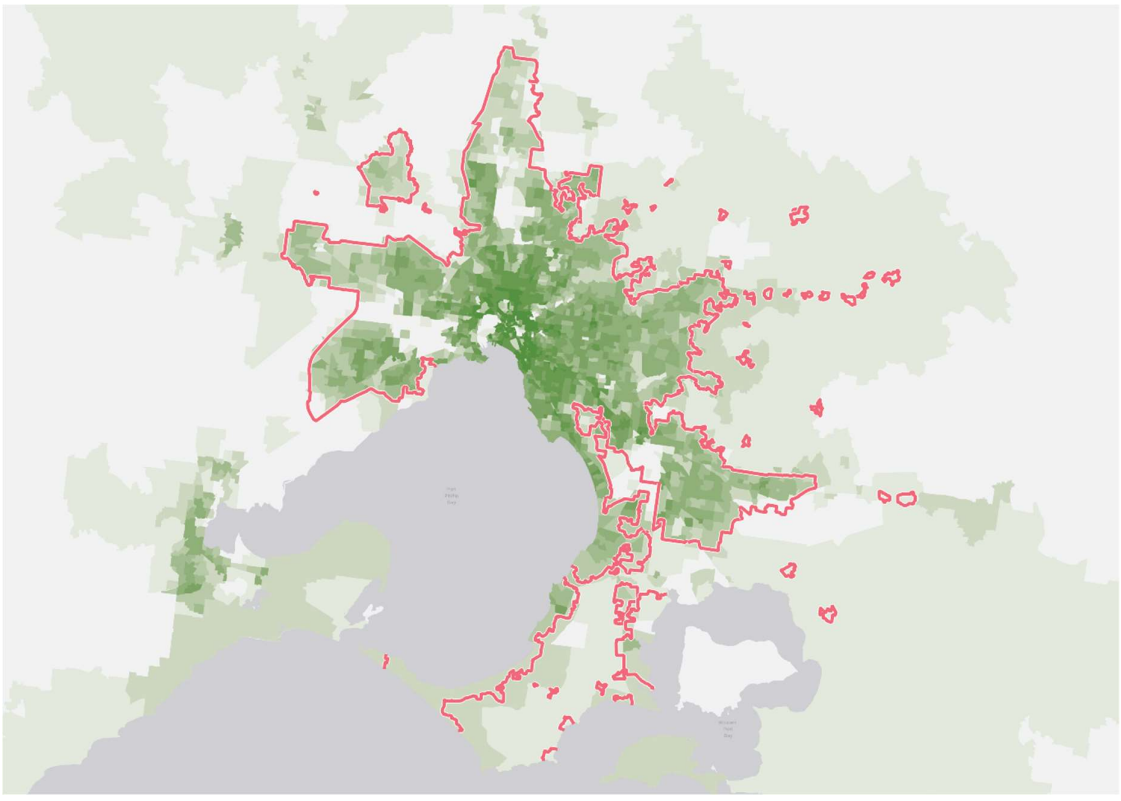
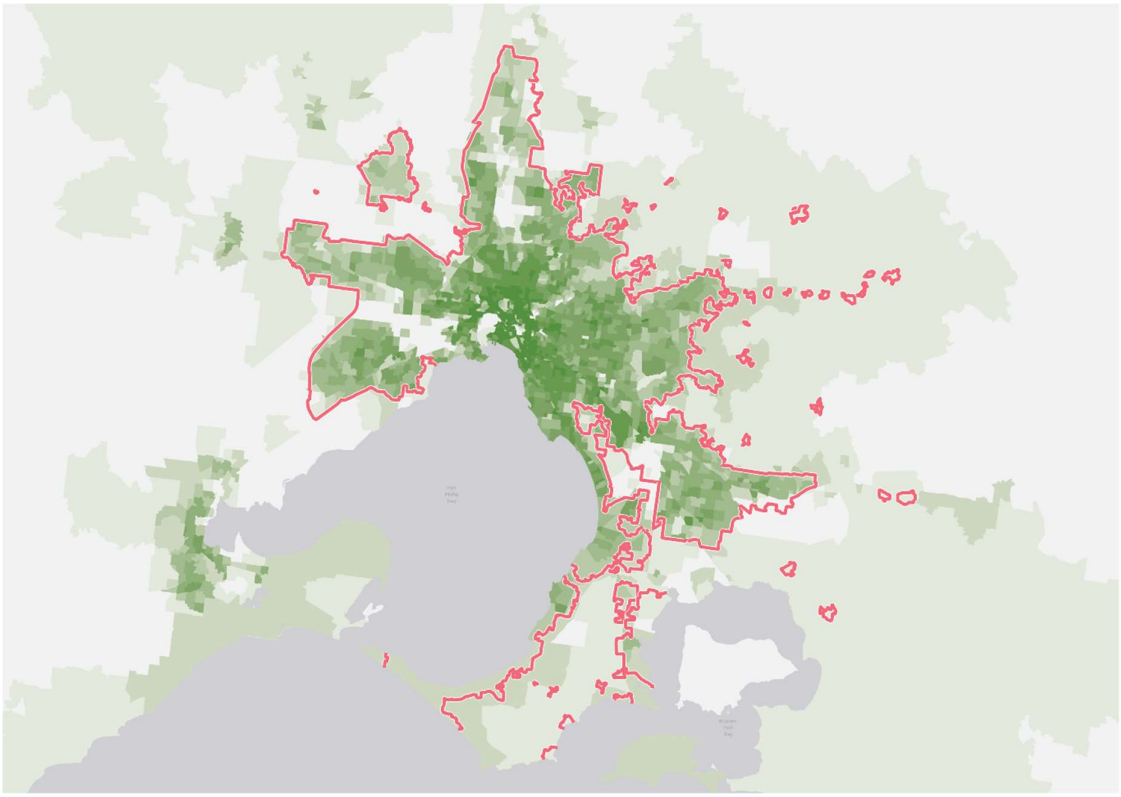


Figure 25 2041 population density | SALUP



Highway and public transport projects

Broadly, the network and public transport assumptions included in the Base case modelling did not depart from those provided by Department of Transport and Planning as part of the VITM23_v2_03 model received.

However, some modifications to the DTP's Network Development public transport assumptions were required when establishing the Base case assumptions to ensure that the Base case did not include projects that were to be scenario tested.

The timing of major highway and rail projects in the Base Case network are shown in Table 39 below.

Table 39 Key projects included in Base case by year

Active by Y2031	Active by Y2041
Westgate tunnel	SRL Southland to Reservoir
North-East Link	Melbourne Airport Rail Link
Bulla Bypass	Cross City Line (Stage 1 and 2)

Key to note is that the Y2041 network **does not** include:

- The E6
- Hume widening
- M80 widening
- Western Freeway widening

The exclusion of these projects has implications for the growth areas they connect to, in particular the Hume and Western Freeway projects, without which congestion and travel speeds will worsen in the face of increasing growth area populations.

Differences between Initial Project and Detailed Project Base Case modelling

A limited number of modifications were required to be made to the Base case assumptions prior to beginning the detailed modelling to ensure that the projects could be properly assessed. These differences are shown in Table 40.

Table 40 Modifications for initial project modelling base case

Route	Network Development assumptions	Base case assumptions
Route 3	Reroute to Arden by 2031	Continue terminating at Melbourne University. No rerouting to Arden.
Route 5	Reroute to Remand Centre (Spencer/Latrobe St) by 2026. Extend via Arden by 2031	Reroute to Remand Centre (Spencer/Latrobe St) by 2026. No further extensions.
Route 11	Extend to Fishermans Bend via new Yarra River link by 2036.	No extension.
Route 18	Extended to Fishermans Bend by 2036.	No extension.
Route 56	Rerouted via Arden corridor by 2031.	Original alignment retained (Peel St/Flemington Road)

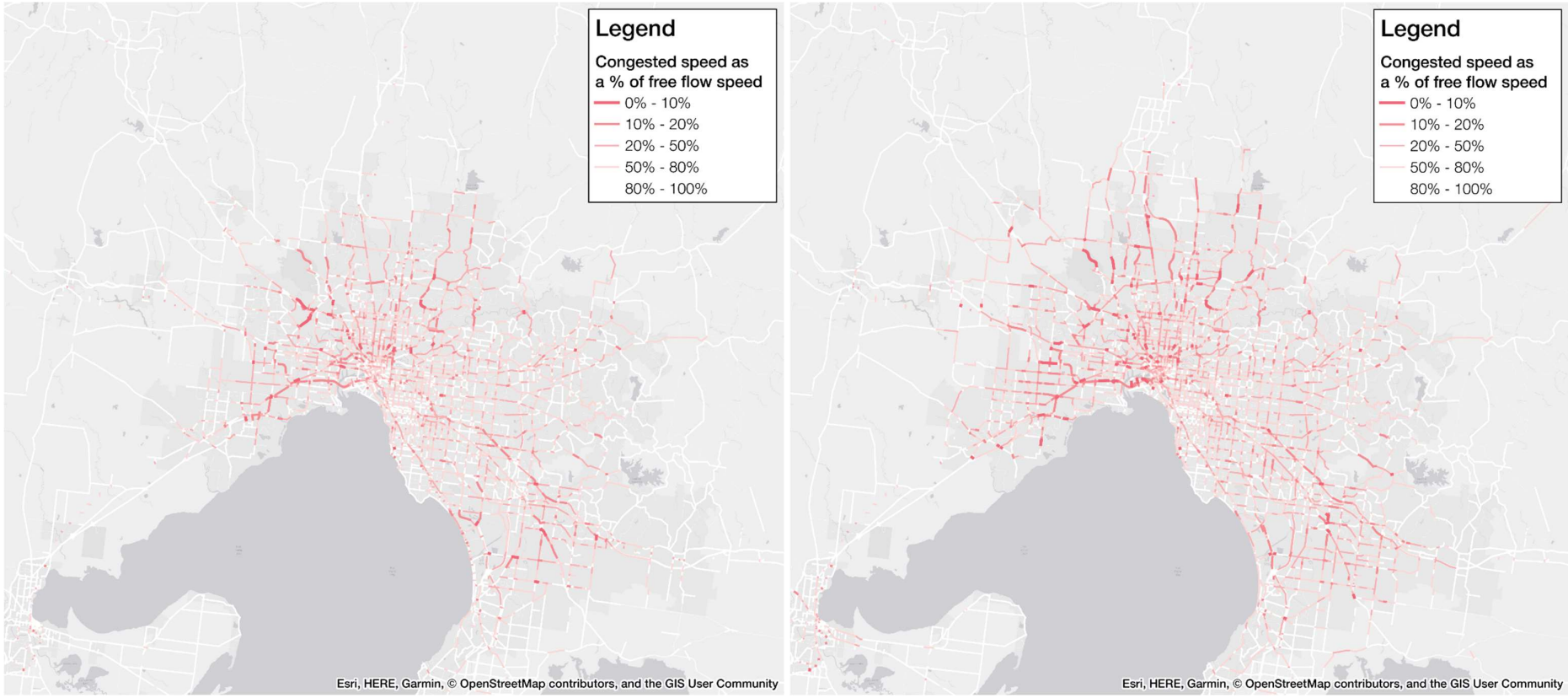
In addition to the modifications for the above tram projects, the Sunshine to Southern Cross Regional Rail Loop upgrade was disabled for the base case modelling.

Results

This section provides an overview of the Base case modelling results, with discussion on the key constraints implied by future population growth and network configuration. The results shown are taken from the Base case used for Detailed Project modelling, as that set of assumptions has fewer modifications from the standard assumptions provided by the Department of Transport and Planning.

As it currently stands, the broader network assumptions formed in the Base case do not provide enough capacity to meet the demand implied by the SALUP land-use forecasts. This is primarily due to significant inward pressure from the growth areas leading to deteriorating performance along the key connecting Freeways and public transport corridors. To investigate this, we can look at the gap between free flow speeds and modelled congested speeds over time. Figure 26 on the following page details this. Comparing between the Y2018 and Y2041 Base case, it is clear that prevailing speeds are modelled to fall over time, and impact a greater proportion of Victoria's road network.

Figure 26 Congested AM peak speed as a percentage of free-flow speeds (left: Y2018, right: Y2041)



Conversely, much of the rail network appears to see an improvement in congestion, with most corridors seeing a decrease in AM V/C values, likely due to the activation of projects like the Melbourne Metro Tunnel. The main exception to this trend is the northern rail corridor, in particular the upfield line.

Figure 27 AM rail V/C (left: Y2018, right: Y2041)

Appendix B

Initial Project Modelling Assumptions – Stage 2

Appendix B Initial project modelling assumptions

This appendix provides further detail about the modelling assumptions for the projects modelled in the initial project modelling undertaken as part of Stage 2 of the project. Additionally, further modelling results are provided.

Group 1

Group one includes the following projects:

- Cranbourne to Clyde rail extension
- New route - Camberwell to Caulfield Station
- New route - Highpoint to Sunshine
- Route 3 – Rerouting and extension from Victoria Street to Kensington Station

Figure 28 provides an overview of the Group 1 extension alignments.

Figure 28 Group 1 project alignments

Route 3 – Rerouting and extension from Victoria Street to Kensington Station

Figure 29 shows the alignment of the Route 3 extension, with the new track identified via the dotted line.

Figure 29 Route 3 Extension Alignment | Group 1

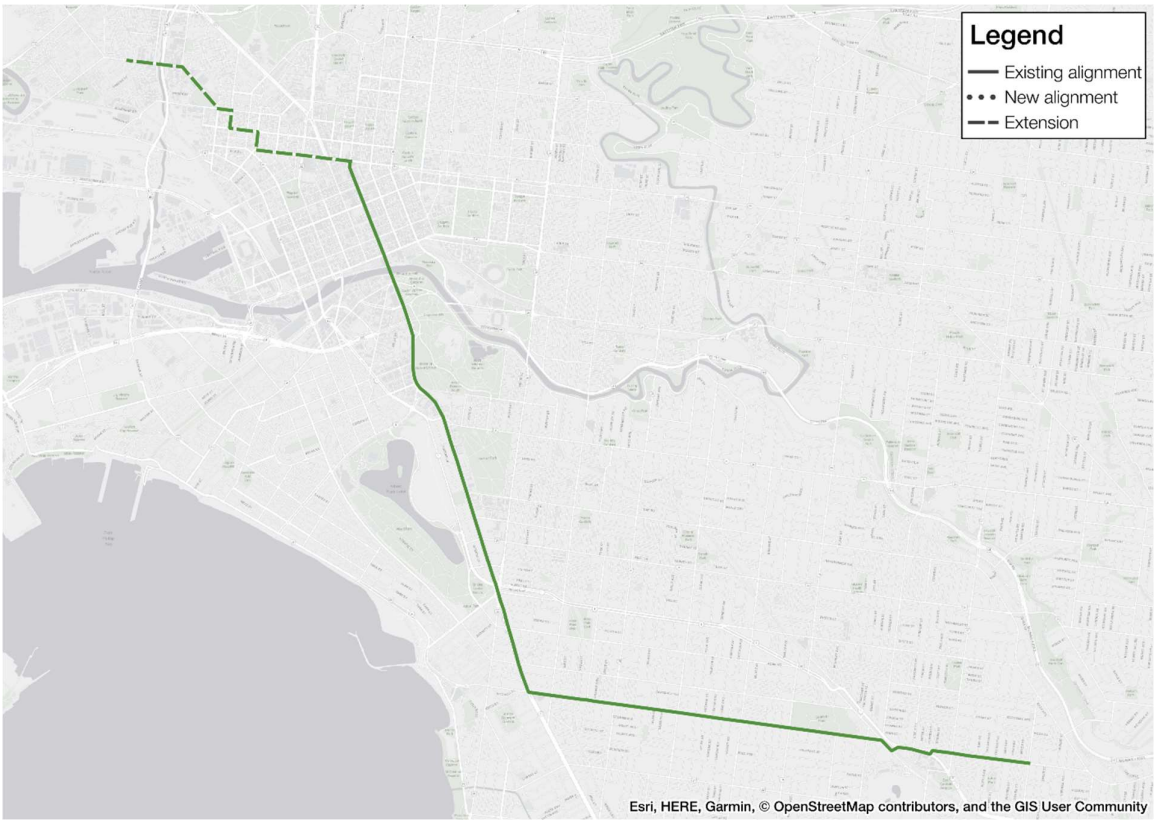


Table 41 provides an overview of the headways assumed in the modelling. These headways are per direction.

Table 41 Route 3 Extension tram service headways (minutes) | Group 1

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

New route - Highpoint to Sunshine

Figure 30 provides an overview of the assumed Highpoint to Sunshine service alignment. The service takes advantage of some existing track on Wests Road, before requiring additional track to be laid for the remainder of the service.

Figure 30 Route 54 Extension Alignment | Group 1

Table 42 outlines the headways assumed for this service in the modelling. These headways are per direction.

Table 42 Route 54 Extension tram service headways (minutes) | Group 1

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

New route - Camberwell to Caulfield Station

Figure 31 details the alignment of the Camberwell to Caulfield Station service. Much of the service is covered by existing track, with Burke Road between Malvern and Waverley Road requiring additional track.

Figure 31 Route 73 Extension Alignment | Group 1

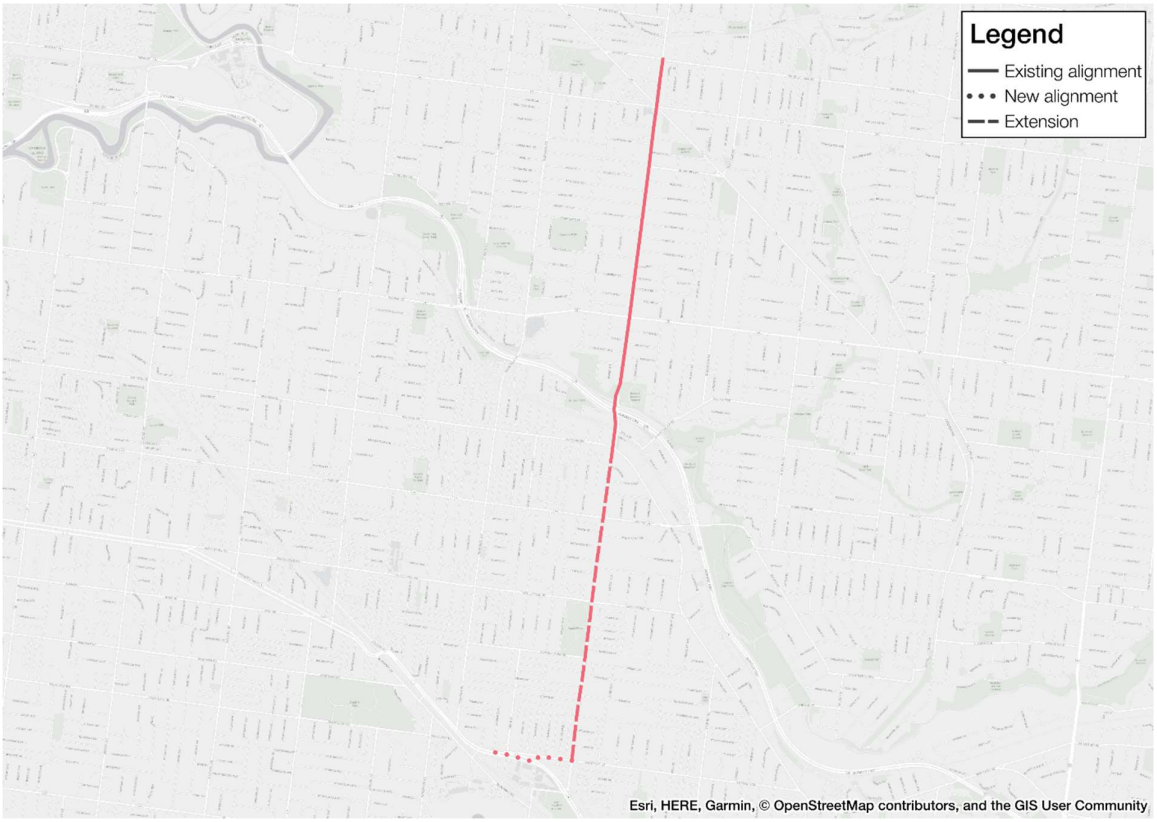


Table 43 provides an overview of the assumed headways for this service by direction.

Table 43 Route 73 Extension train service headways (minutes) | Group 1

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Cranbourne to Clyde rail extension

Figure 32 details the assumed alignment for the modelled Clyde extension, including the location of new stations.

Figure 32 Clyde Extension Alignment | Group 1

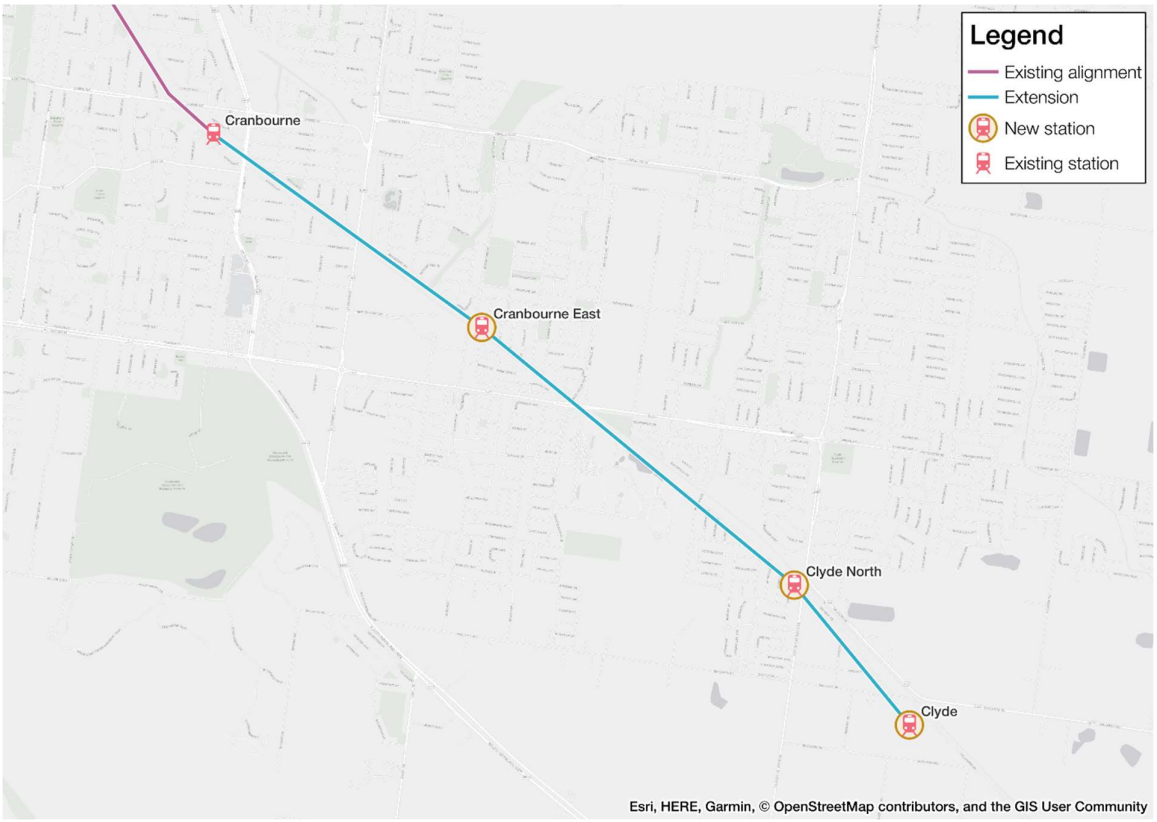


Table 44 details the headways for the two services operating from Clyde.

Table 44 Clyde Extension train service headways (minutes) | Group 1

Year	Service	AM	IP	PM	OP
2031	Clyde – Sunbury	10	20	10	20
	Sunbury – Clyde	10	20	10	20
2041	Clyde – Sunbury	10	20	10	20
	Sunbury – Clyde	10	20	10	20

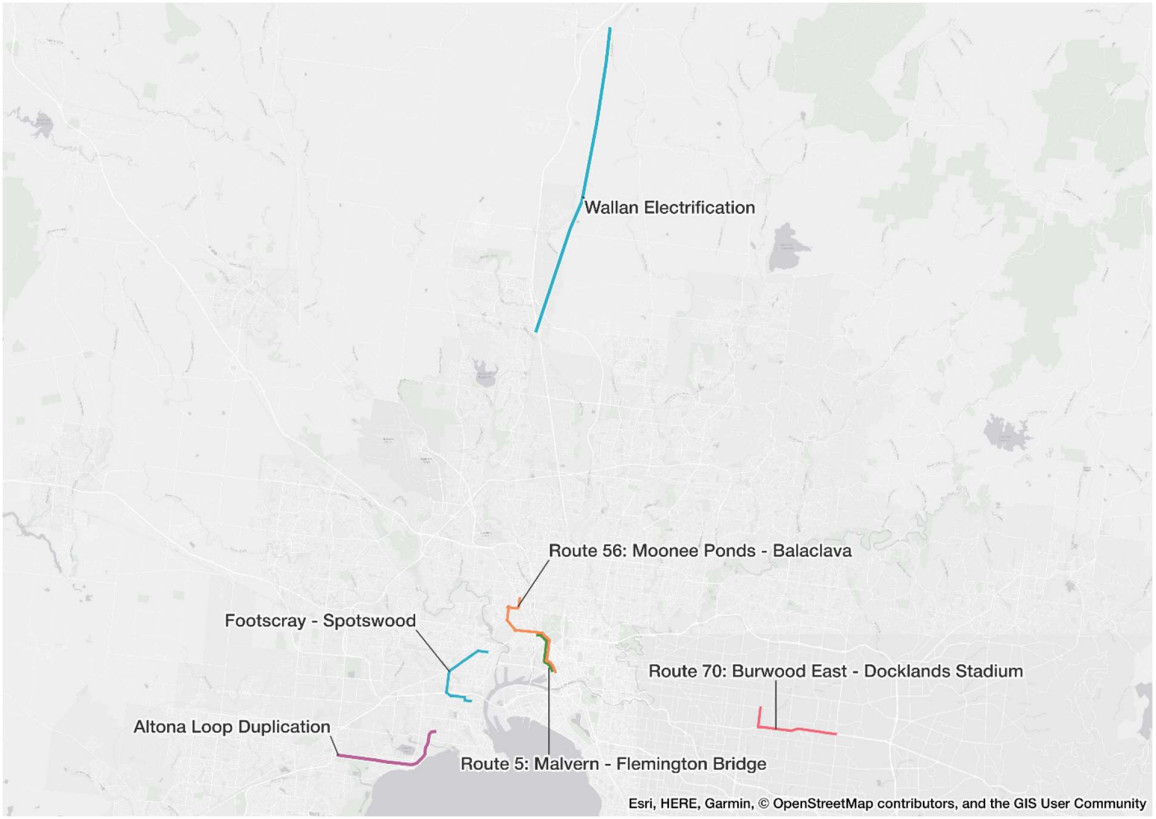
Group 2

Group 2 includes the following set of projects:

- Partial duplication Altona Loop Line
- Wallan electrification and Somerton link
- New route - Footscray to Spotswood
- Route 5 – Extension from La Trobe Street to Flemington Bridge Station
- Route 56 – Rerouting via Spencer and Abbotsford Street
- Route 70 – Extension From Box Hill South to Burwood East (Tally Ho)

The alignment of the extensions for these are shown Figure 33 below.

Figure 33 Group 2 project alignments



Partial duplication Altona Loop Line

Figure 34 shows the alignment of the Altona Loop duplication. The duplication provides for higher frequencies along the mainline and loop.

Figure 34 Partial duplication Altona Loop Alignment | Group 2

Table 45 shows the assumed headways for services in the corridor in Y2031 and Y2041

Table 45 Altona Loop duplication train service headways (minutes) | Group 2

Year	Service	AM	IP	PM	OP
2031	Laverton - Flinders St (via Altona)	10	20	10	20
	Flinders St – Laverton (via Altona)	10	20	10	20
	Werribee – Sandringham (via main line)	7.5	10	7.5	20
	Sandringham – Werribee (via main line)	7.5	10	7.5	20
2041	Laverton - Flinders St (via Altona)	10	20	10	0
	Flinders St – Laverton (via Altona)	10	20	10	0
	Werribee – Sandringham (via main line)	6	10	6	20
	Sandringham – Werribee (via main line)	6	10	6	20

Wallan electrification and Somerton link

Figure 35 shows the extent of the assumed electrification for the Wallan Electrification project.

Figure 35 Wallan electrification and Somerton link | Group 2

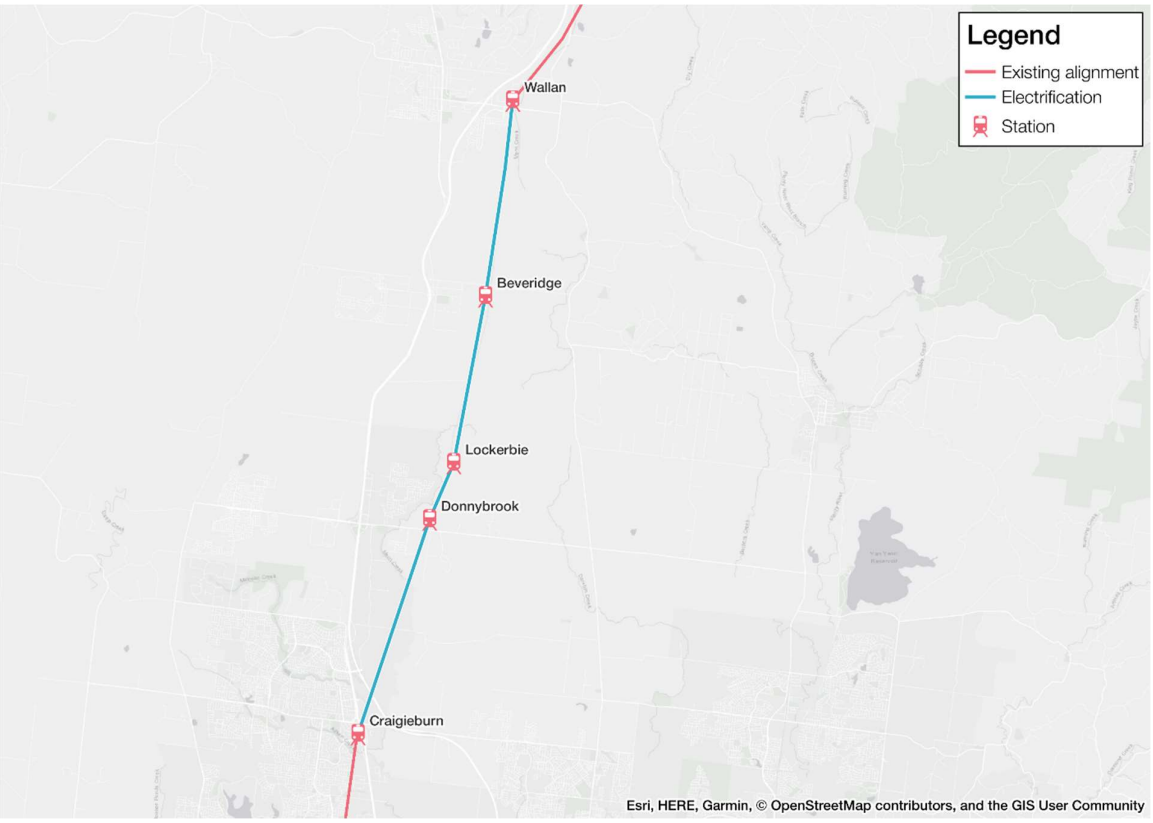


Table 46 details the assumed headways for the electrified Wallan services.

Table 46 Wallan Electrification train service headways (minutes) | Group 2

Year	Service	AM	IP	PM	OP
2031	Wallan – City Loop	6.67	10	6.67	20
	City Loop – Wallan	6.67	10	6.67	20
2041	Wallan – City Loop	6.67	10	6.67	20
	City Loop – Wallan	6.67	10	6.67	20

New route - Footscray to Spotswood

Figure 36 shows the modelled alignment of the Footscray to Spotswood service. As modelled, the entire route would require new tram tracks to be laid.

Figure 36 Footscray to Spotswood alignment | Group 2

Table 47 shows the headways for both directions of the service.

Table 47 Footscray to Spotswood tram service headways (minutes) | Group 2

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 5 – Extension from La Trobe Street to Flemington Bridge Station

Figure 37 shows the assumed alignment of the Route 5 extension. The service would require additional tracks along Spencer and Abbotsford Street, before joining up with existing tracks along Flemington Road.

Figure 37 Route 5 alignment | Group 2

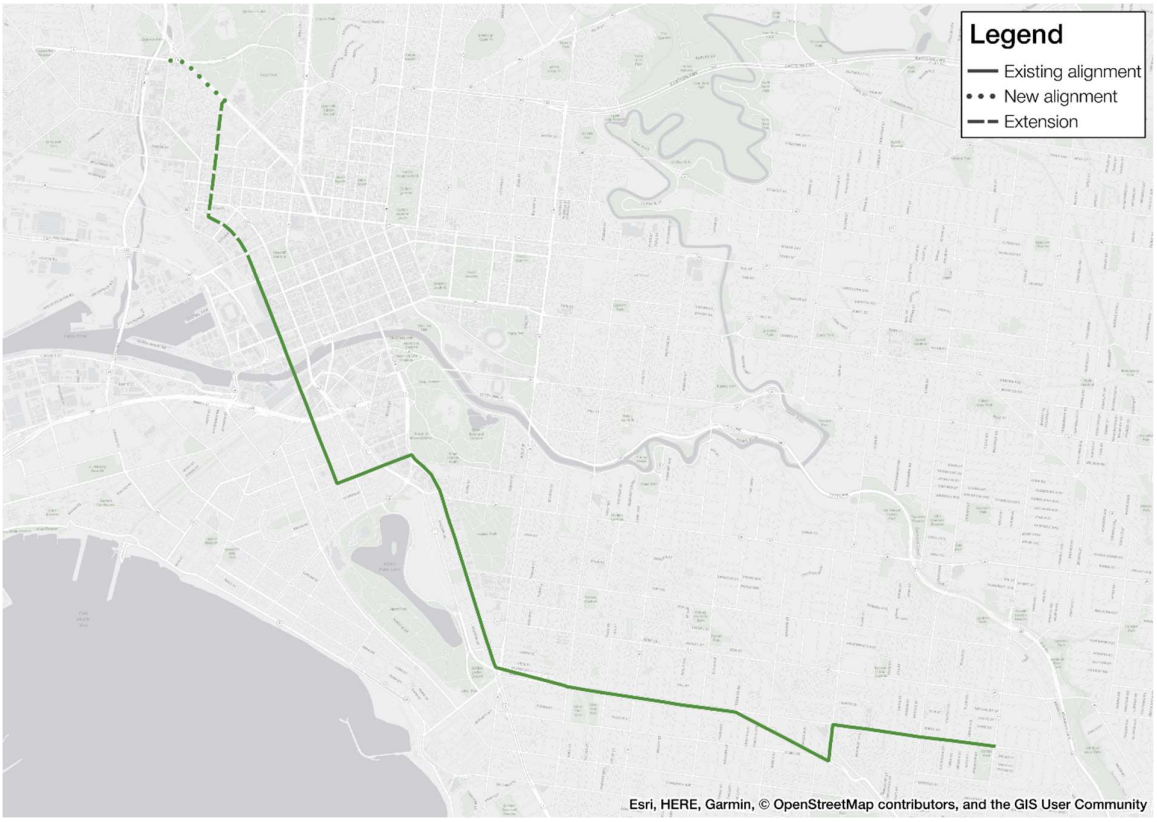


Table 48 shows the assumed headways for the service.

Table 48 Route 5 Extension tram service headways (minutes) | Group 2

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 56 – Rerouting via Spencer and Abbotsford Street

Figure 38 outlines the assumed alignment of the Route 56 extension. Similar to Route 5, the service requires additional tracks along Spencer and Abbotsford Street, before using existing infrastructure for the remainder of the extension.

Figure 38 Route 56 alignment | Group 2

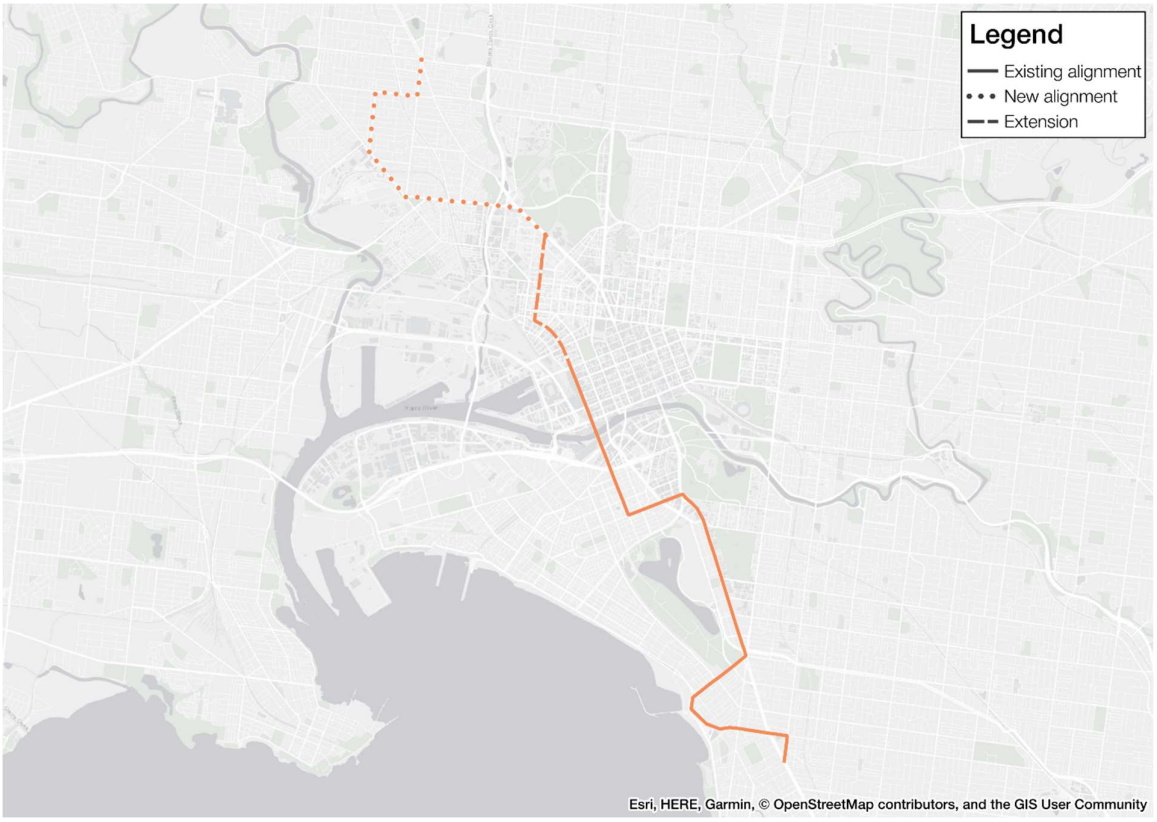


Table 49 details the assumed headways for the extended service.

Table 49 Route 56 Extension tram service headways (minutes) | Group 2

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 70 – Extension From Box Hill South to Burwood East (Tally Ho)

Figure 39 details the alignment of the extended Route 70 service, with additional tracks being required on Edgars road, before utilising the existing tracks along the Burwood Highway to feed into the Tally Ho Business Park.

Figure 39 Route 70 alignment | Group 2

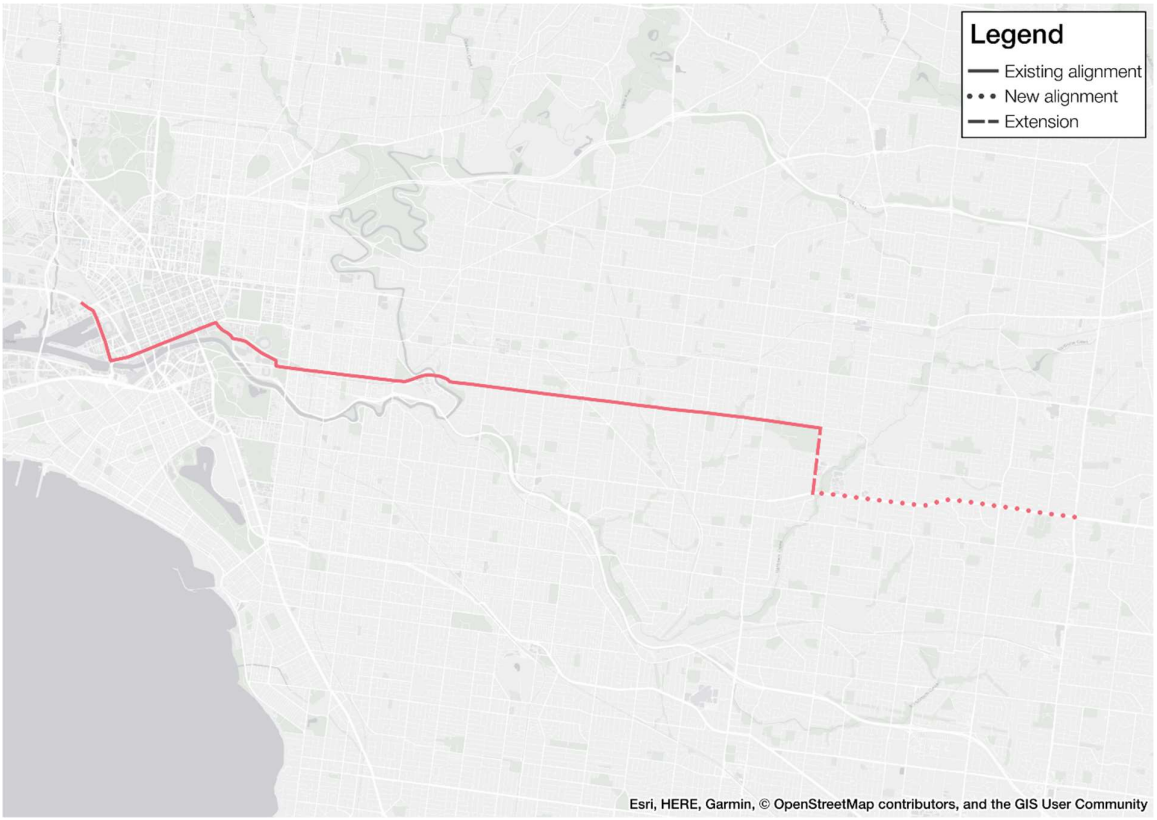


Table 50 details the headway assumptions for the service.

Table 50 Route 70 Extension tram service headways (minutes) | Group 2

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Group 3

Group 3 includes the following projects:

- Melton to Sunshine electrification and Deer Park to Sunshine quadruplication
- New route - Highpoint to Rushall
- Route 11 – Rerouting and extension from King/Collins Street to Fishermans Bend
- Route 3 – Extension from East Malvern to Hughesdale via Chadstone
- Route 48 – Extension from Balwyn North to Doncaster
- Route 75 – Extension from Vermont South to Ferntree Gully via Knox

Figure 40 details the alignment of the extension component of these projects:

Figure 40 Group 3 project alignments

Melton to Sunshine electrification and Deer Park to Sunshine quadruplication

Figure 41 details the extent of the Melton Electrification project.

Figure 41 Melton electrification alignment | Group 3

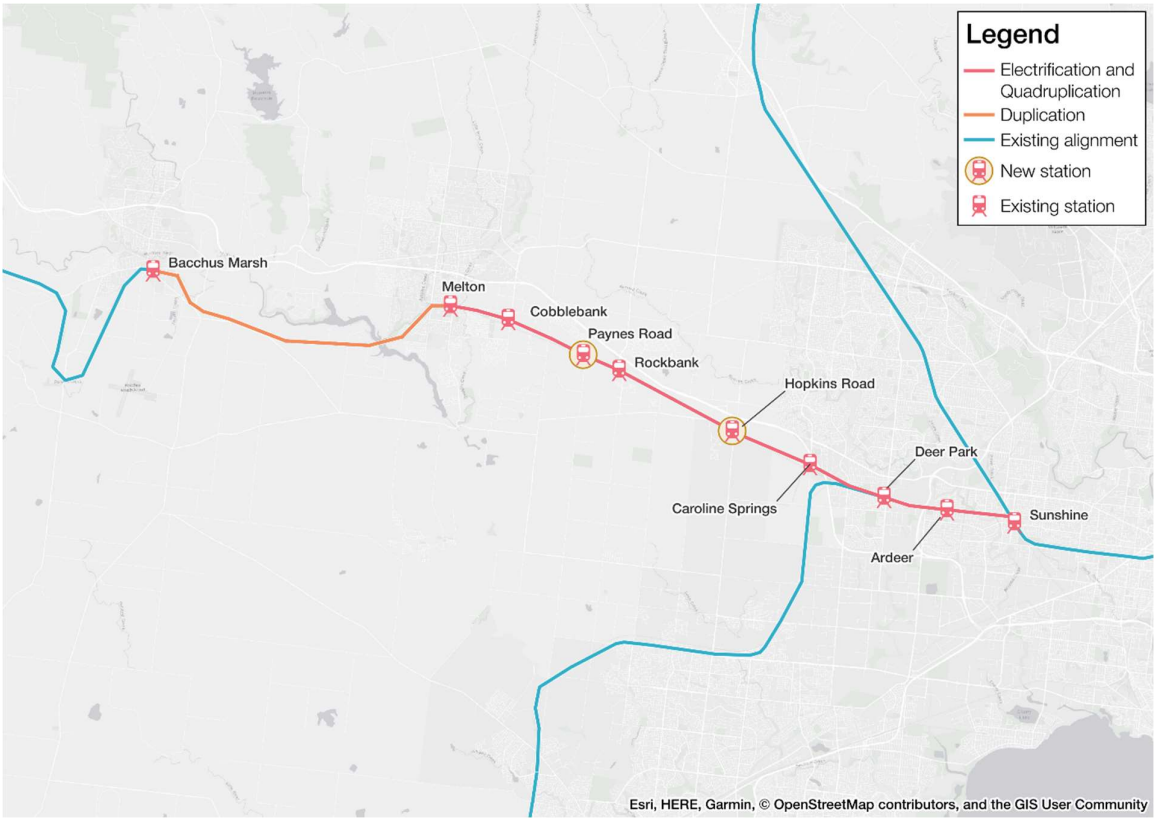


Table 51 details the assumed headways for impacted services.

Table 51 Melton Electrification train service headways (minutes) | Group 3

Year	Service	AM	IP	PM	OP
2031	Melton – Westall	10	10	10	10
	Westall – Melton	10	10	10	10
	Bacchus Marsh – Melton	40	0	40	0
	Melton – Bacchus Marsh	40	0	40	0
	Southern Cross – Wyndham Vale	13.33	20	13.33	20
	Wyndham Vale – Southern Cross	13.33	20	13.33	20
	Seymour – Southern Cross	26.67	80	80	120
	Southern Cross - Seymour	80	80	26.67	120
2041	Melton – Pakenham East	10	10	10	10
	Pakenham East – Melton	10	10	10	10
	Bacchus Marsh – Southern Cross	40	0	40	0
	Southern Cross – Bacchus Marsh	40	0	40	0
	Southern Cross – Wyndham Vale	13.33	20	13.33	20

Year	Service	AM	IP	PM	OP
2041	Wyndham Vale – Southern Cross	13.33	20	13.33	20
	Seymour – Southern Cross	26.67	80	80	120
	Southern Cross – Seymour	80	80	26.67	120

New route - Highpoint to Rushall

Figure 42 shows the alignment of the Highpoint to Rushall service. The service is able to utilise existing track from Highpoint up until Ascot Vale Road.

Figure 42 Highpoint to Rushall alignment | Group 3

Table 52 details the headways for the new service.

Table 52 Highpoint to Rushall tram service headways (minutes) | Group 3

Year	AM	IP	PM	OP
2031	10	10	10	15
2041	10	10	10	15

Route 11 – Rerouting and extension from Spencer/Collins Street to Fishermans Bend

Figure 43 details the alignment for the extended Route 11 service. In the base case route 11, continues along Collins Street into Docklands (Victoria Harbour).

Figure 43 Route 11 alignment | Group 3

Table 53 details the assumed headways for the extended service.

Table 53 Route 11 tram service headways (minutes) | Group 3

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 3 – Extension from East Malvern to Hughesdale via Chadstone

Figure 44 shows the alignment of the extended Route 3 service.

Figure 44 Route 3 alignment | Group 3

Table 54 shows the assumed headways for the service.

Table 54 Route 3 tram service headways (minutes) | Group 3

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 48 – Extension from Balwyn North to Doncaster

Figure 45 shows the alignment of the extended Route 48 service. Currently, Route 48 terminates at Balwyn Road.

Figure 45 Route 48 alignment | Group 3

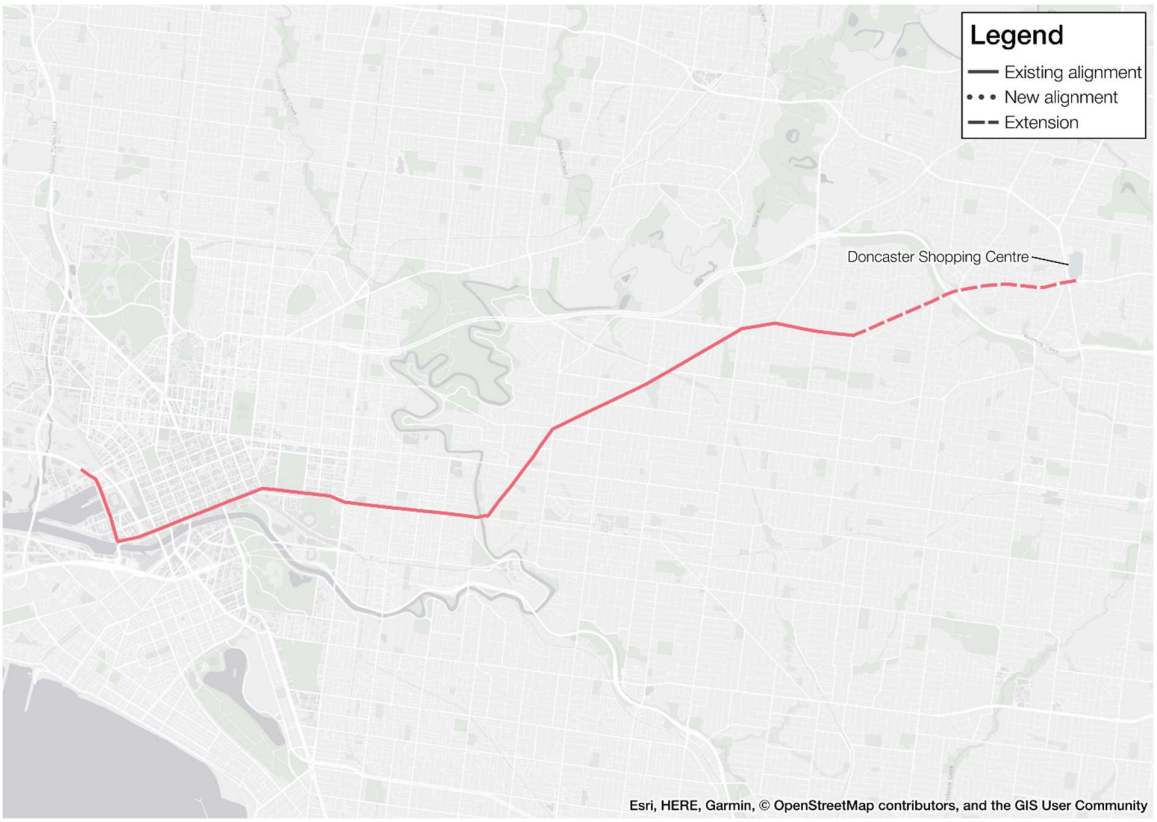


Table 55 details the modelled headways for the extended service.

Table 55 Route 48 tram service headways (minutes) | Group 3

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 75 – Extension from Vermont South to Ferntree Gully via Knox

Figure 46 shows the alignment for the Route 75 extension. This is one of the longest tram extensions modelled, with the current service terminating at Vermont South Shopping Centre.

Figure 46 Route 75 alignment | Group 3

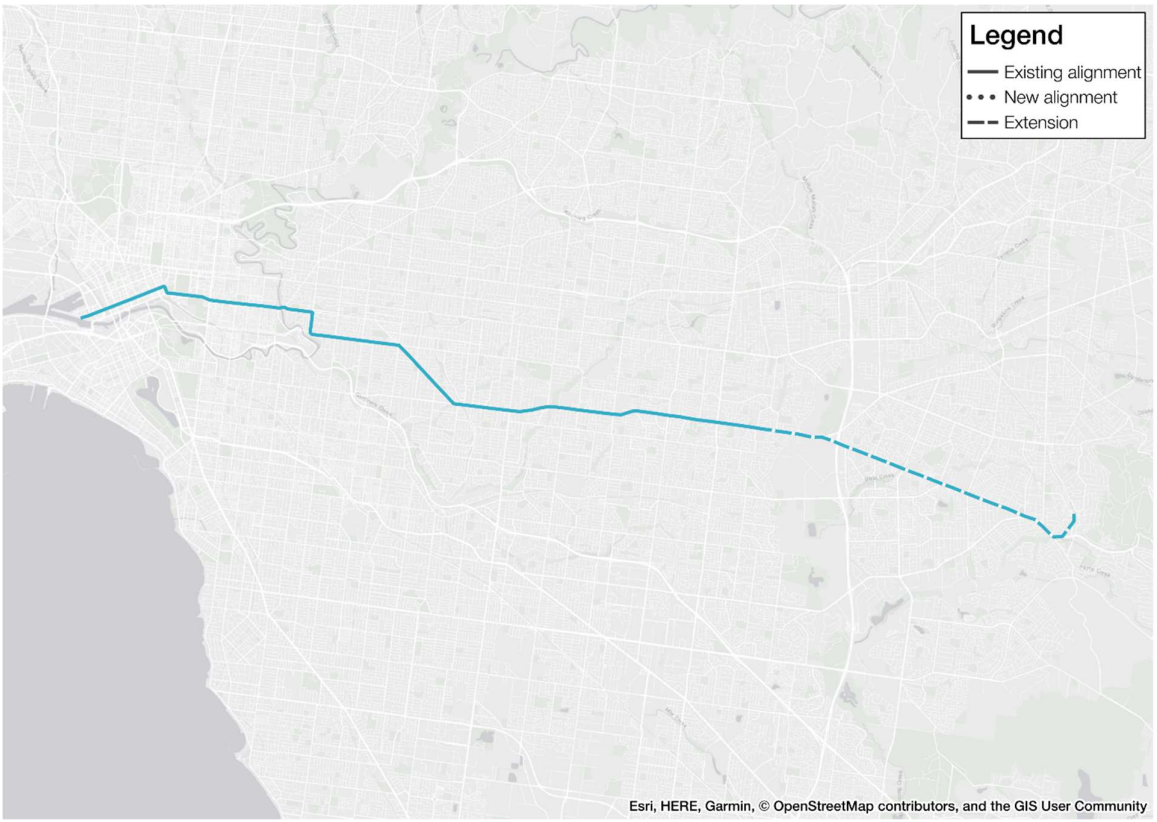


Table 56 details the assumed headways for the updated service.

Table 56 Route 75 tram service headways (minutes) | Group 3

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

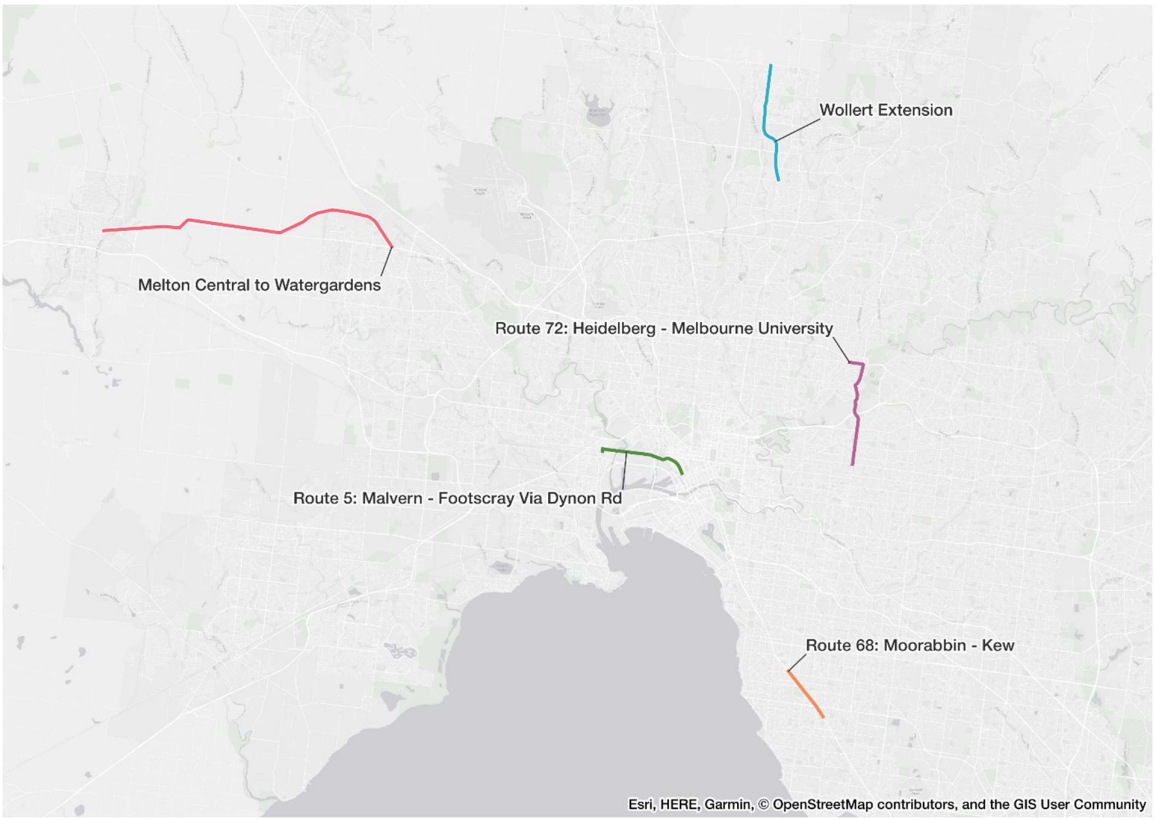
Group 4

Group 4 includes the following projects:

- Watergardens to Melton Central extension
- Lalor to Wollert extension
- Route 5 – Extension from La Trobe Street to Footscray Station via Dynon Road
- Route 68 – Extension from Brighton East to Moorabbin Station
- Route 72 – Extension from Deepdene to Heidelberg Station

Figure 47 details the location of the project extensions.

Figure 47 Group 4 project alignments



Watergardens to Melton Central extension

Figure 48 provides an overview of the assumptions for the Melton Central extension project. Aside from providing a rail service branching off the Sunbury line to Melton Central, five new stations are added:

1. Melton Central
2. Melton North
3. Plumpton Road
4. Hillside
5. Calder Park

Figure 48 Watergardens to Melton Central extension alignment | Group 4

Table 57 details the headway assumptions of the related services.

Table 57 Melton Central Extension train service headways (minutes) | Group 4

Year	Service	AM	IP	PM	OP
2031	Melton Central – Pakenham East	10	20	10	20
	Pakenham East – Melton Central	10	20	10	20
2041	Melton Central – Pakenham East	20	0	20	0
	Pakenham East – Melton Central	20	0	20	0
	Melton Central – Calder Park	20	20	20	20
	Calder Park – Melton Central	20	20	20	20

Lalor to Wollert extension

Figure 49 provides an overview of the Wollert extension alignment. The project would create four new stations:

1. Epping Plaza
2. O'Hearns Road
3. Harvest Home Road
4. Wollert

Figure 49 Lalor to Wollert extension alignment | Group 4

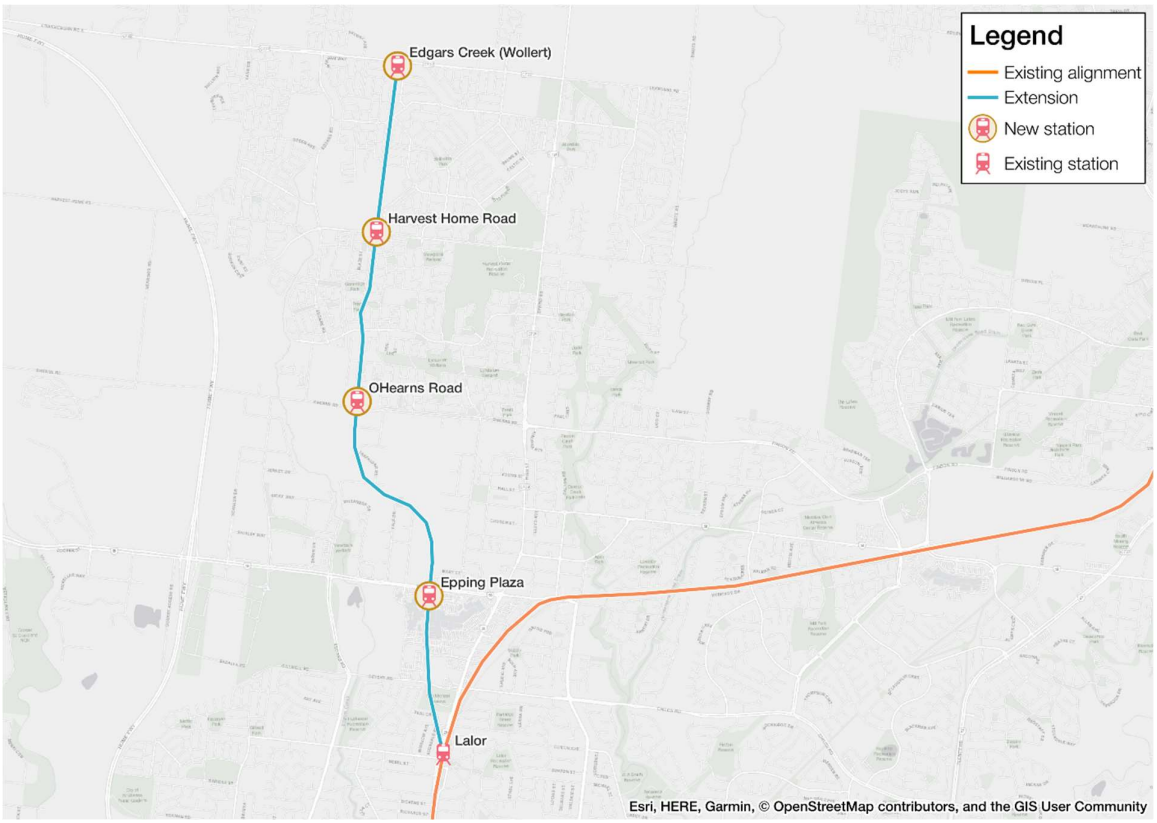


Table 58 details the headway assumptions for the new Wollert services.

Table 58 Wollert Extension train service headways (minutes) | Group 4

Year	Service	AM	IP	PM	OP
2031	Wollert – City Loop	12	20	12	0
	City Loop – Wollert	12	20	12	0
	Wollert – Lalor	0	0	0	20
	Lalor – Wollert	0	0	0	20
2041	Wollert – City Loop	10	20	10	0
	City Loop – Wollert	10	20	10	0
	Wollert – Lalor	0	0	0	20
	Lalor – Wollert	0	0	0	20

Route 5 – Extension from La Trobe Street to Footscray Station via Dynon Road

Figure 50 details the alignment of the extended Route 5 service. New tracks are required along Spencer Street and Dynon Road, with the final connection to Footscray Station able to utilise existing track on Leeds Street.

Figure 50 Route 5 alignment | Group 4

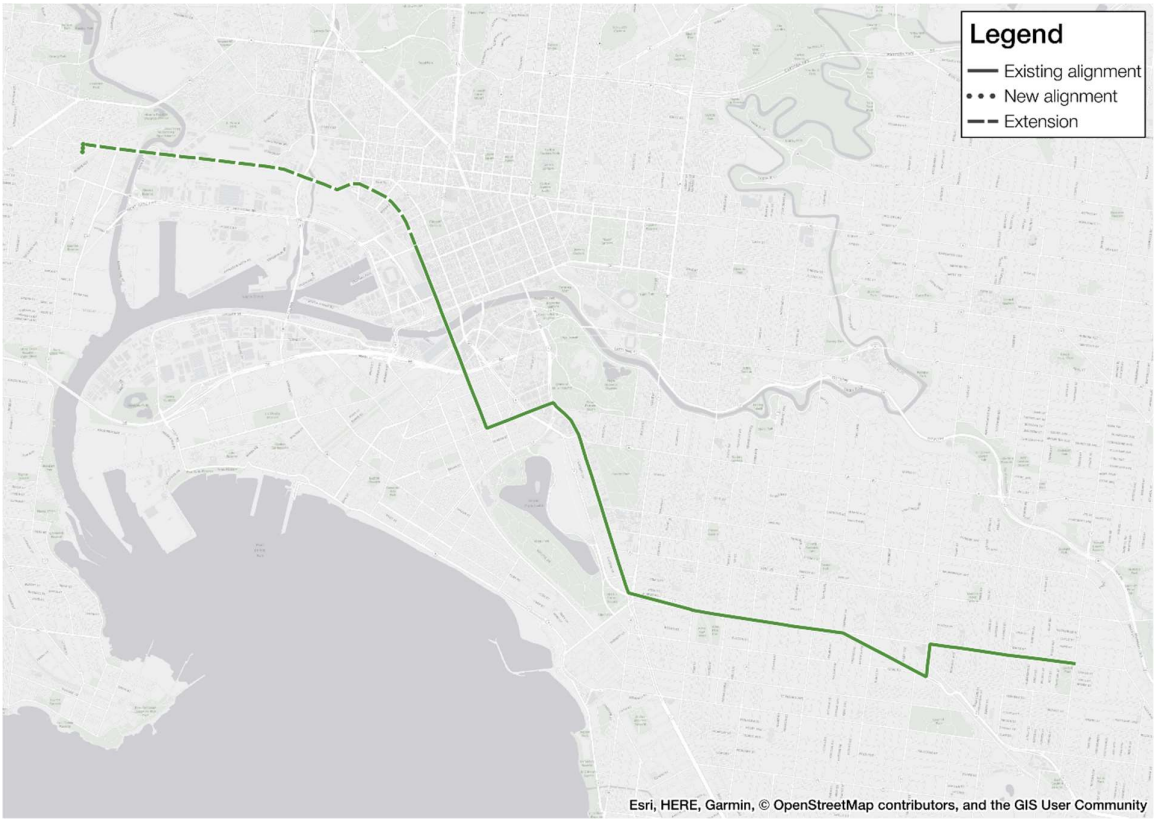


Table 59 details the assumed headways for the extended service.

Table 59 Route 5 tram service headways (minutes) | Group 4

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 68 – Extension from Brighton East to Moorabbin Station

Figure 51 shows the alignment for the Route 68 extension to Moorabbin Station. The whole extension will require additional tram tracks along the Nepean Highway.

Figure 51 Route 68 alignment | Group 4

Table 60 details the assumed headways for the service.

Table 60 Route 68 tram service headways (minutes) | Group 4

Year	AM	IP	PM	OP
2031	8	10	8	10
2041	8	10	8	10

Route 72 – Extension from Deepdene to Heidelberg Station

Figure 52 shows the alignment of the Route 72 service. This is one of the longer tram extensions modelled, with the full extension north of Whitehorse Road requiring additional tram tracks.

Figure 52 Route 72 alignment | Group 4

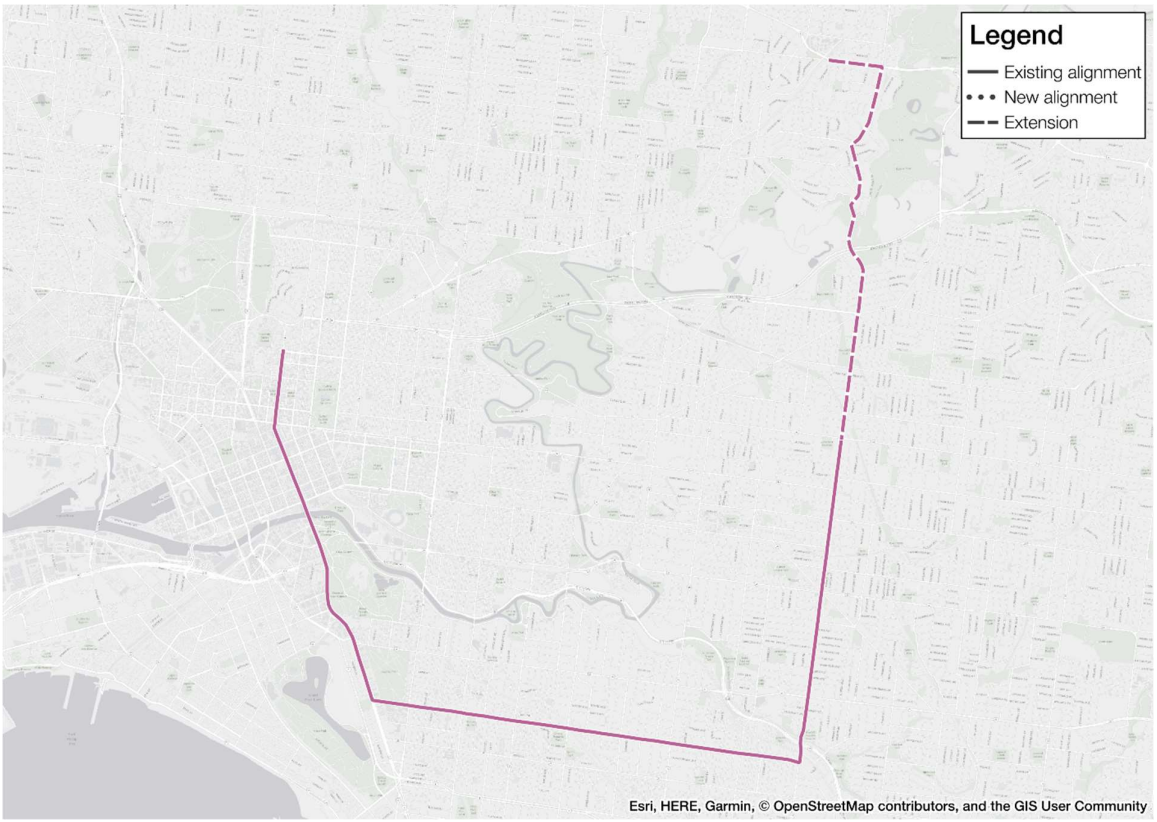


Table 61 details the assumed headways for the extended service.

Table 61 Route 72 tram service headways (minutes) | Group 4

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

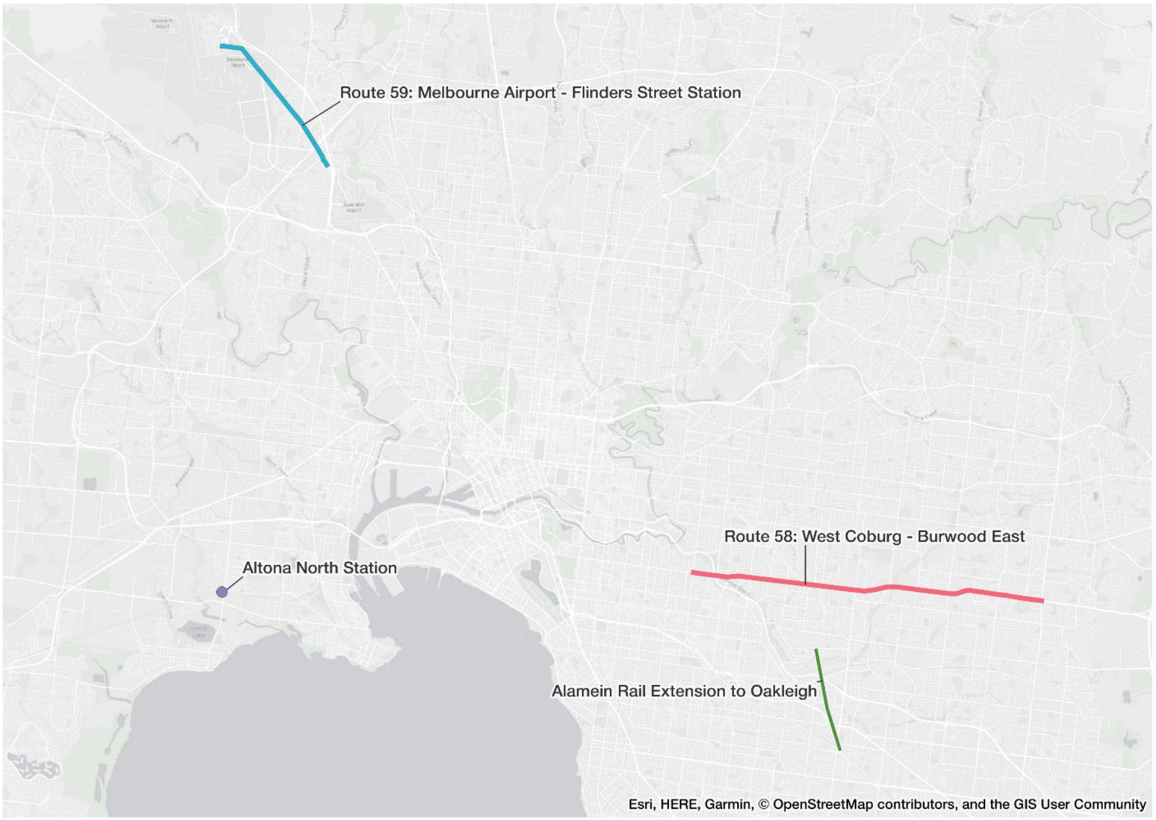
Group 5

Group 5 includes the following projects:

- Alamein rail extension to Oakleigh
- New station at Altona North
- Route 58 – Extension from Kooyong to Burwood East (Tally Ho)
- Route 59 – Extension from Strathmore Heights to Melbourne Airport

Figure 53 provides an overview of each project's extension.

Figure 53 Group 5 project alignments



Alamein rail extension to Oakleigh

Figure 54 details the alignment of the Alamein extension to Oakleigh Station. The project includes the addition of a new station adjacent to Chadstone Shopping Centre. It should be noted that the alignment of the extension in Figure 54 is for modelling purposes, and does not represent IV's or other Government views regarding the potential alignment of any potential future extension.

Figure 54 Alamein rail extension alignment | Group 5

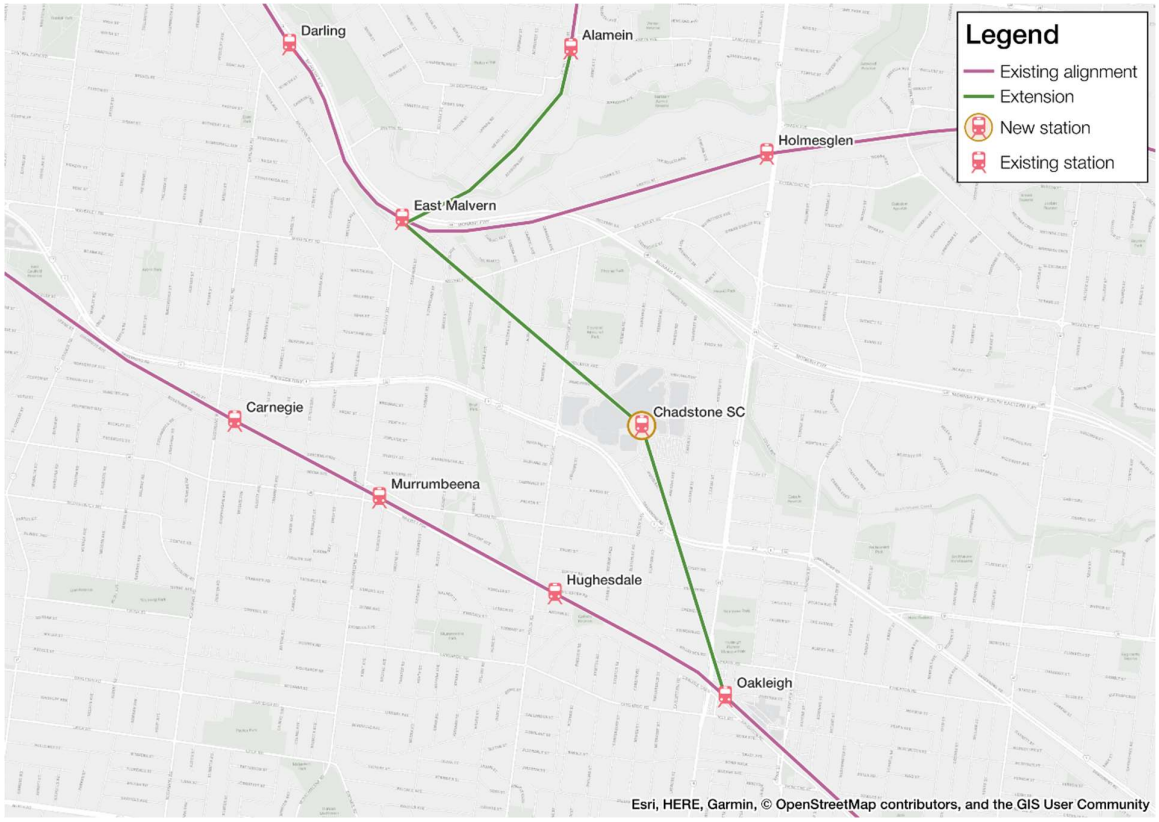


Table 62 details the headway assumptions for the extension. Off-peak services are provided via a Camberwell-Oakleigh service.

Table 62 Alamein extension train service headways (minutes) | Group 5

Year	Service	AM	IP	PM	OP
2031	Oakleigh – City Loop (via Alamein Line)	20	0	20	0
	City Loop – Oakleigh (via Alamein Line)	20	0	20	0
	Camberwell – Oakleigh (via Alamein Line)	0	20	0	20
	Oakleigh – Camberwell (via Alamein Line)	0	20	0	20
2041	Oakleigh – City Loop (via Alamein Line)	20	0	20	0
	City Loop – Oakleigh (via Alamein Line)	20	0	20	0
	Camberwell – Oakleigh (via Alamein Line)	0	20	0	20
	Oakleigh – Camberwell (via Alamein Line)	0	20	0	20

New station at Altona North

Figure 55 shows the location of the new Altona North station as modelled in the VITM.

Figure 55 Altona North station | Group 5

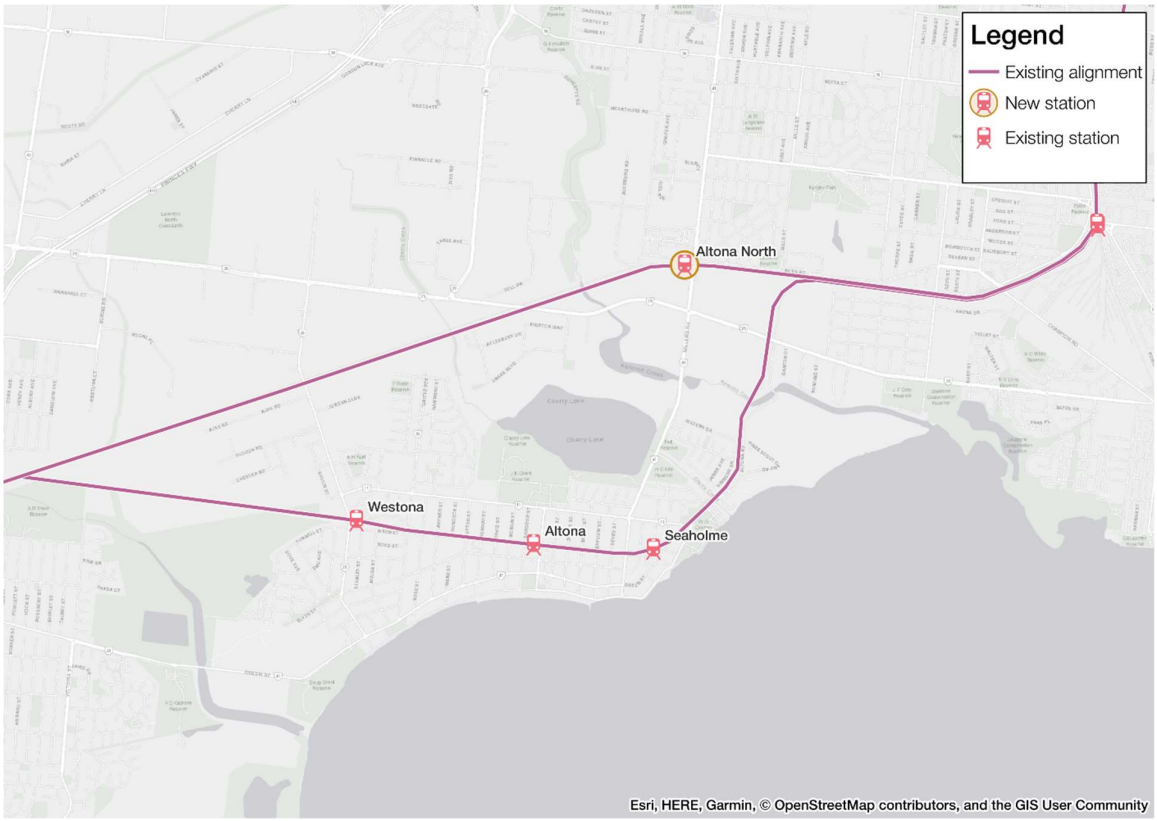


Table 63 details the headway assumptions for services using the Altona Loop and Main Line corridors. Services labelled "via Main Line" refer to those running via the northern corridor and stopping at Altona North.

Table 63 Altona Service train service headways (minutes) | Group 5

Year	Service	AM	IP	PM	OP
2031	Werribee – Sandringham (via Main Line)	7.5	10	7.5	10
	Sandringham – Werribee (via Main Line)	7.5	10	7.5	10
	Laverton – Flinders Street (via Altona Loop)	20	20	20	20
	Flinders Street – Laverton (via Altona Loop)	20	20	20	20
2041	Werribee – Sandringham (via Main Line)	6	10	6	10
	Sandringham – Werribee (via Main Line)	6	10	6	10
	Flinders Street – Werribee (via Main Line)	15	0	15	0
	Werribee – Flinders Street (via Main Line)	15	0	15	0
	Laverton – Flinders Street (via Altona Loop)	20	20	20	20
	Flinders Street – Laverton (via Altona Loop)	20	20	20	20

Route 58 – Extension from Kooyong to Burwood East (Tally Ho)

Figure 56 details the alignment of the Route 58 extension. This is one of the larger extensions modelled, though new tracks are only needed between Glenferrie Road and Camberwell Road.

Figure 56 Route 58 alignment | Group 5

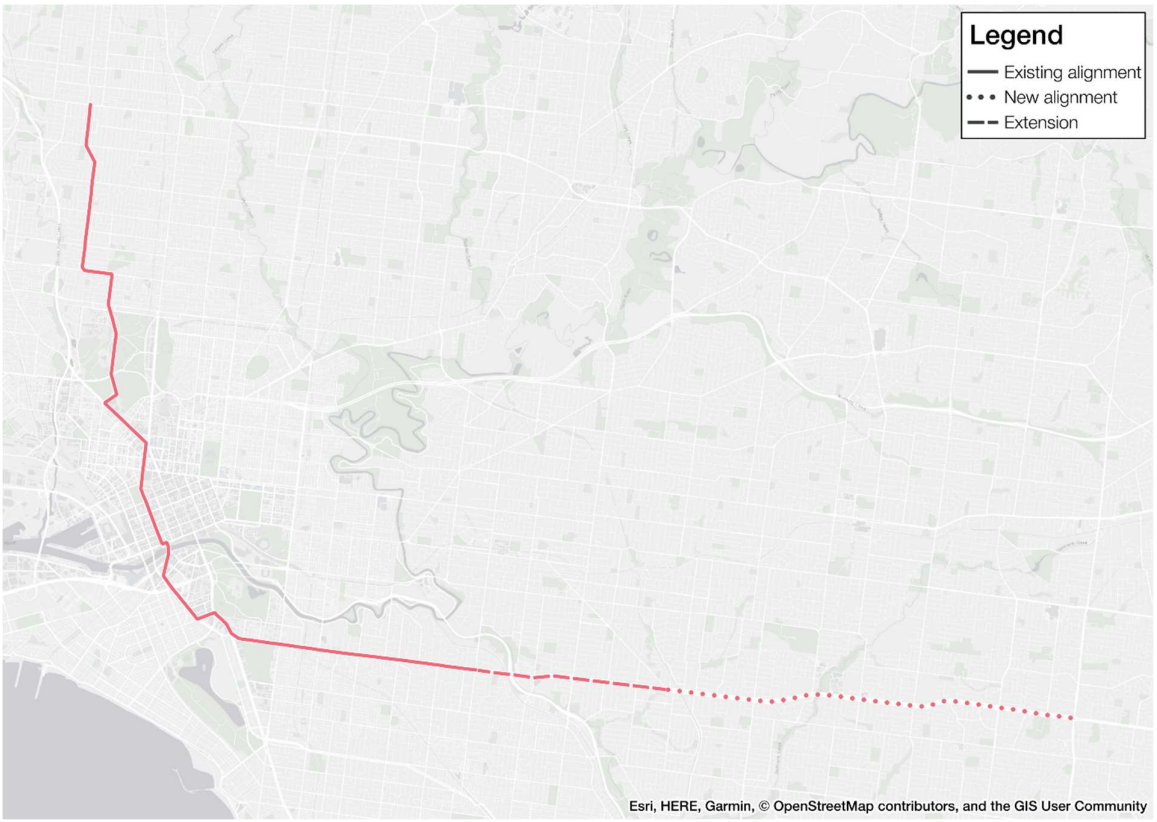


Table 64 details the headway assumptions of the extended service.

Table 64 Route 58 tram service headways (minutes) | Group 5

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 59 – Extension from Strathmore Heights to Melbourne Airport

Figure 57 shows the assumed alignment for the Route 59 extension.

Figure 57 Route 59 alignment | Group 5

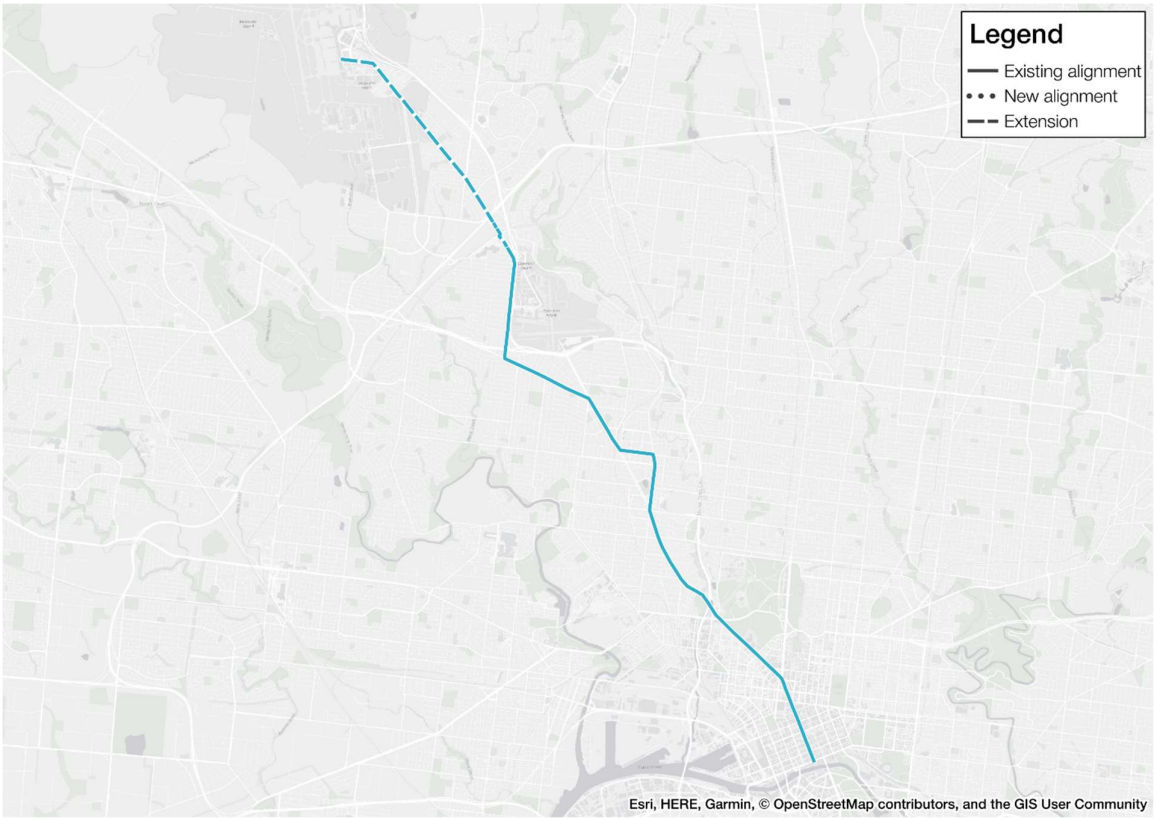


Table 65 details the assumed headways for the Route 59 extension.

Table 65 Route 59 Headways | Group 5

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Group 6

Group 6 consists of five tram projects:

- Route 11 – Extension from Regent Street to Reservoir Station
- Route 5 – Extension from Burke Road to Darling Station
- Route 55 – Extension from Bell Street to Pascoe Vale Station
- Route 57 – Extension from Maribyrnong to East Keilor
- Route 67 – Rerouting and Extension from ANZAC station to Fishermans Bend North

Figure 58 provides a high-level view of the extensions.

Figure 58 Group 6 project alignments

Route 11 – Extension from Regent Street to Reservoir Station

Figure 59 indicates the alignment of the Route 11 extension.

Figure 59 Route 11 alignment | Group 6

Table 66 shows the assumed headways for the extended service.

Table 66 Route 11 tram service headways (minutes) | Group 6

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 5 – Extension from Burke Road to Darling Station

Figure 60 indicates the alignment of the extended Route 5 service.

Figure 60 Route 5 alignment | Group 6

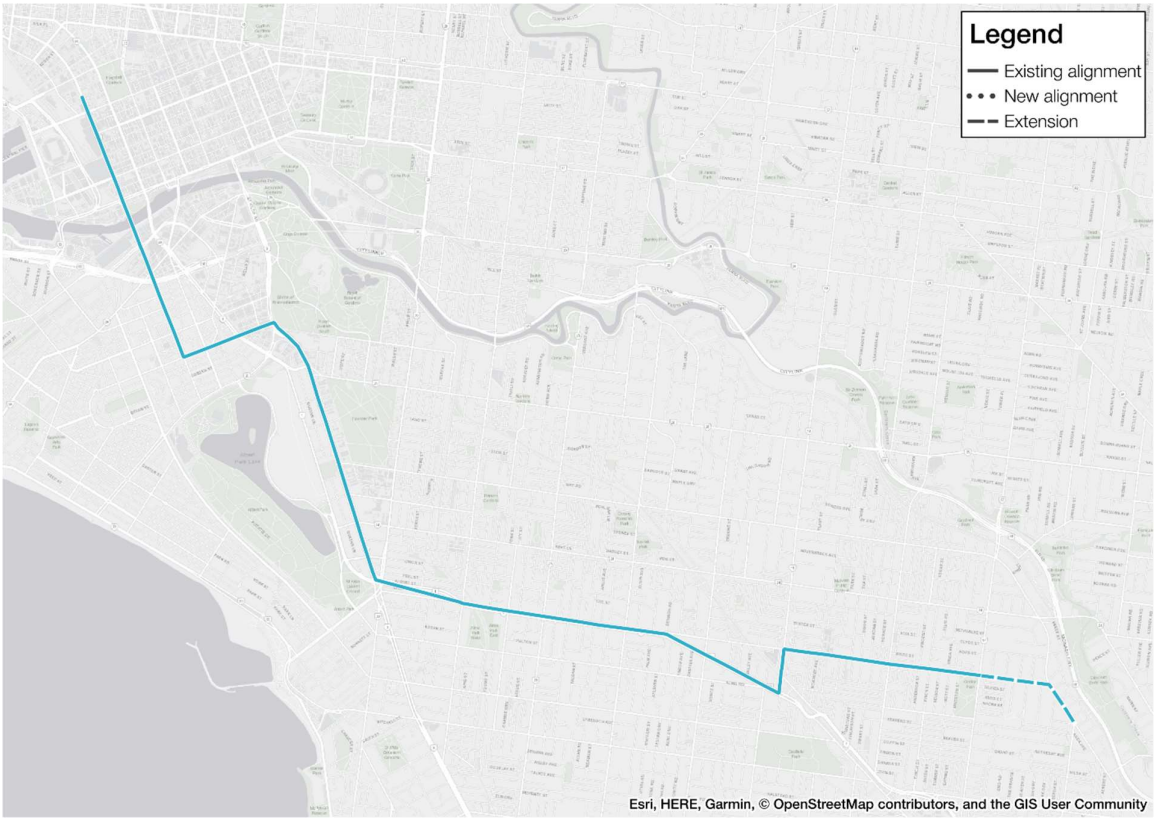


Table 67 Route 5 tram service headways (minutes) | Group 6

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 55 – Extension from Bell Street to Pascoe Vale Station

Figure 61 shows the alignment of the extended Route 55 service.

Figure 61 Route 55 alignment | Group 6

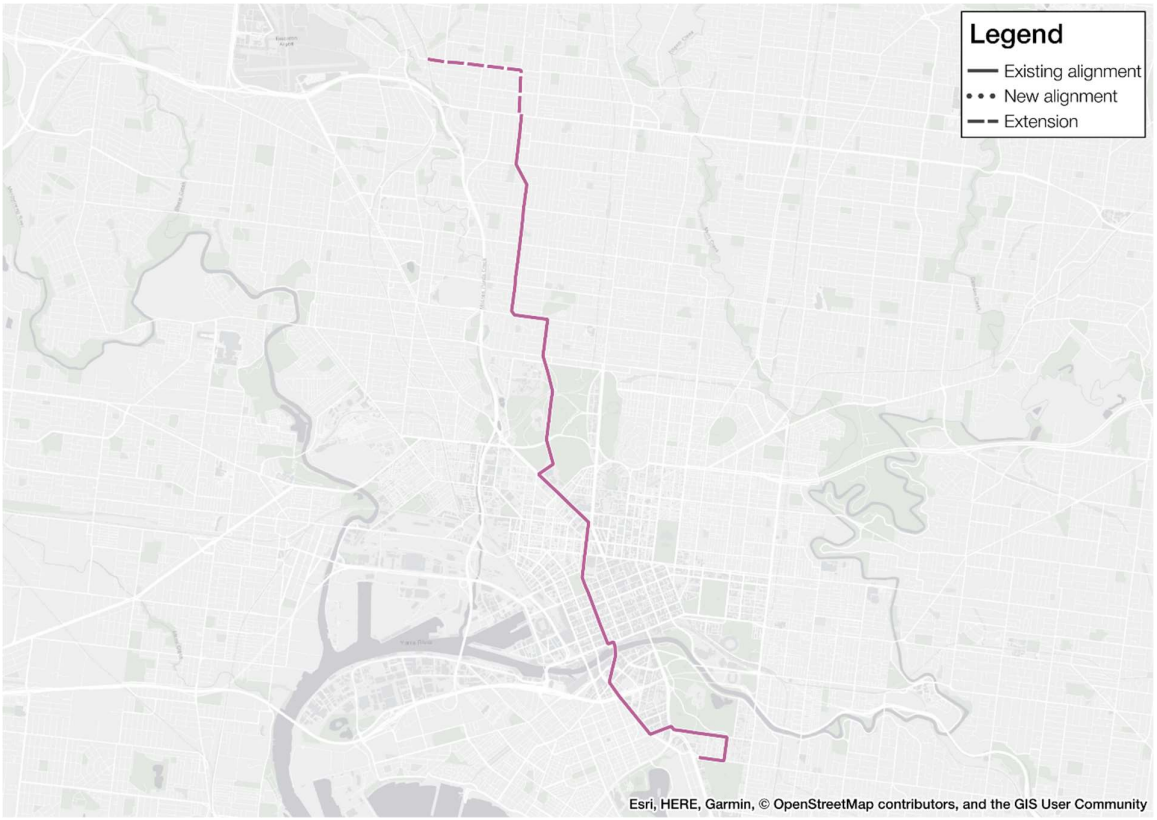


Table 68 shows the assumed headways for the extended service.

Table 68 Route 55 tram service headways (minutes) | Group 6

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 57 – Extension from Maribyrnong to East Keilor

Figure 62 shows the alignment for the Route 57 extension.

Figure 62 Route 57 alignment | Group 6

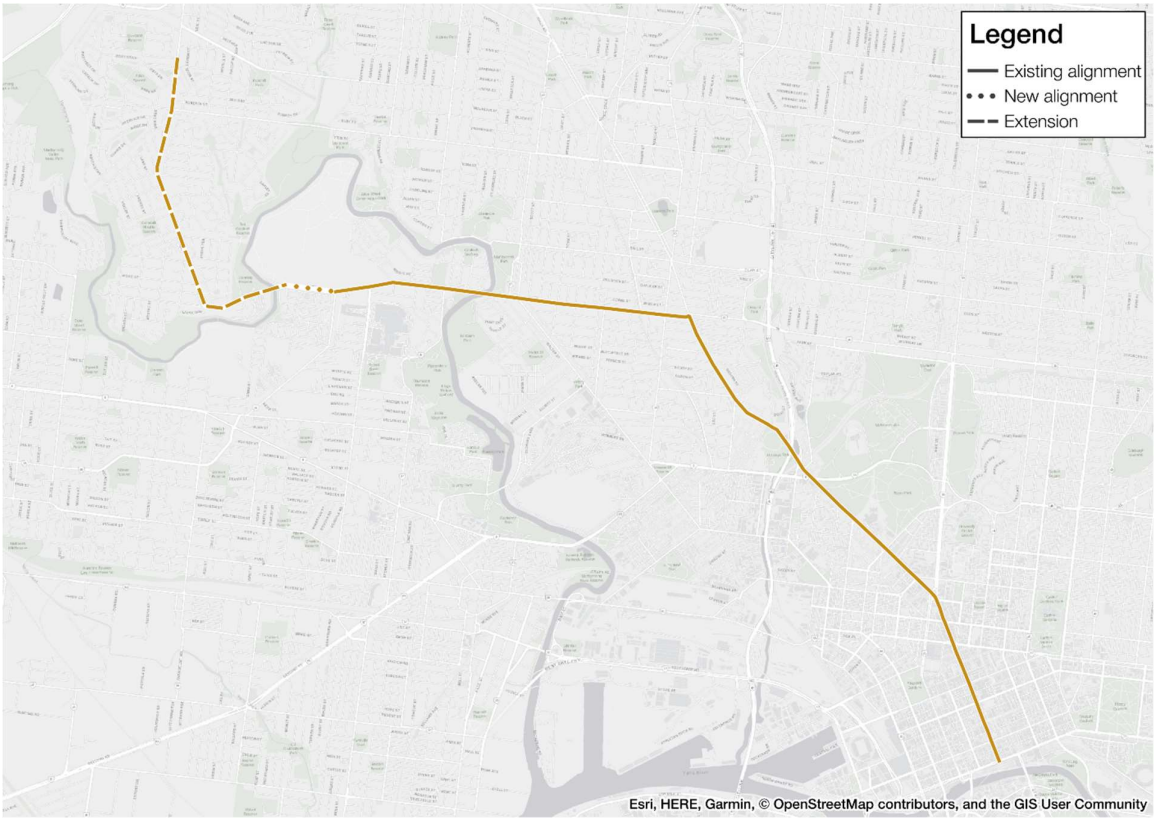


Table 69 details the headway assumptions for the updated service.

Table 69 Route 57 tram service headways (minutes) | Group 6

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Route 67 – Rerouting and Extension from ANZAC station to Fishermans Bend North

Figure 63 shows the assumed alignment of the Route 67 reroute/extension.

Figure 63 Route 67 alignment | Group 6

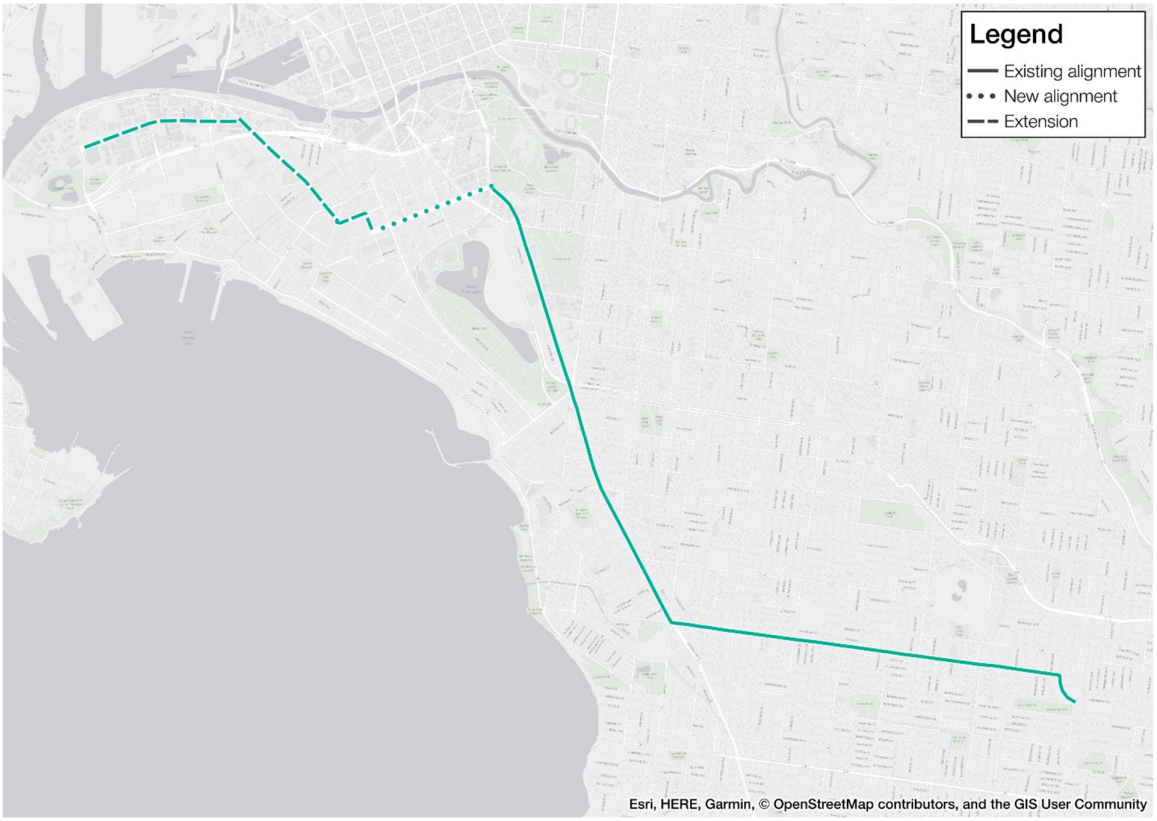


Table 70 details the assumed headways for the updated service.

Table 70 Route 67 tram service headways (minutes) | Group 6

Year	AM	IP	PM	OP
2031	8	10	8	15
2041	8	10	8	15

Appendix C

Detailed Modelling Assumptions -Stage 4

Appendix C Detailed modelling assumptions – Stage 4

This appendix provides additional details regarding the modelling assumptions for the Detailed Project modelling as part of Stage 4 of the project.

Clyde rail extension

Assumptions

The Clyde rail extension consists of the extension of track from Cranbourne out to Clyde. It includes the construction of four new stations:

1. Dandenong South
2. Cranbourne East
3. Casey Fields
4. Clyde

The latter three are enabled by the extension itself. Dandenong South station was added between modelling phases after it was identified as a potential source of . Additionally, The Clyde North station was moved to the Casey Fields site.

Figure 64 Clyde rail extension

Table 71 details the parking assumptions for the new stations.

Table 71 Car park capacities of new station car parks for Clyde extension

New station	Car park capacity
Dandenong South	1,000
Cranbourne East	700
Casey Fields	500
Clyde	1,000

The extension has not been modelled to include any additional services. Cranbourne Metro Tunnel services instead terminate at Clyde, with the additional stations added to the stopping pattern of services. By 2041, it is assumed that services to Melbourne Airport have started. Table 72 details the headway assumptions for Clyde services.

Table 72 Clyde Services train service headways (minutes)

Year	Service	AM	IP	PM	OP
2031	Clyde – Sunbury	10	20	10	20
	Sunbury – Clyde	10	20	10	20
2041	Clyde – Sunbury	10	20	10	20
	Sunbury – Clyde	10	20	10	20
	Clyde – Melbourne Airport	20	0	20	0
	Melbourne Airport – Clyde	20	0	20	0

Results

Figure 65 and Figure 66 on the following page indicate the modelled impact the project has on daily public transport patronage. Overall, there is an uplift of patronage along the Clyde/Pakenham corridor in both model years, though it is clear that the extended Clyde services draw some patronage away from Pakenham services. Prior to the extension, residents in Clyde wanting to commute towards the city could either take a bus to Cranbourne or Berwick Station. The extension removes much of this bus patronage, as evidenced in Figure 65 and Figure 66.

Figure 65 Change in patronage from Clyde extension (Y2031)

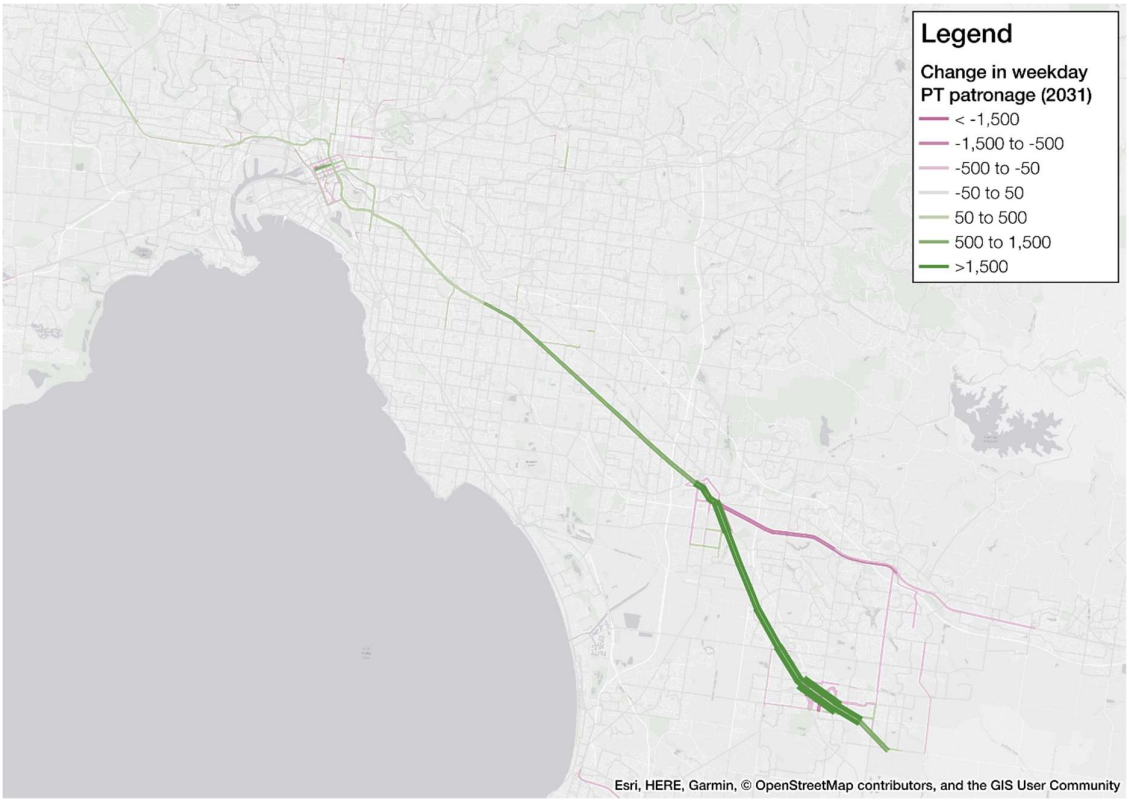
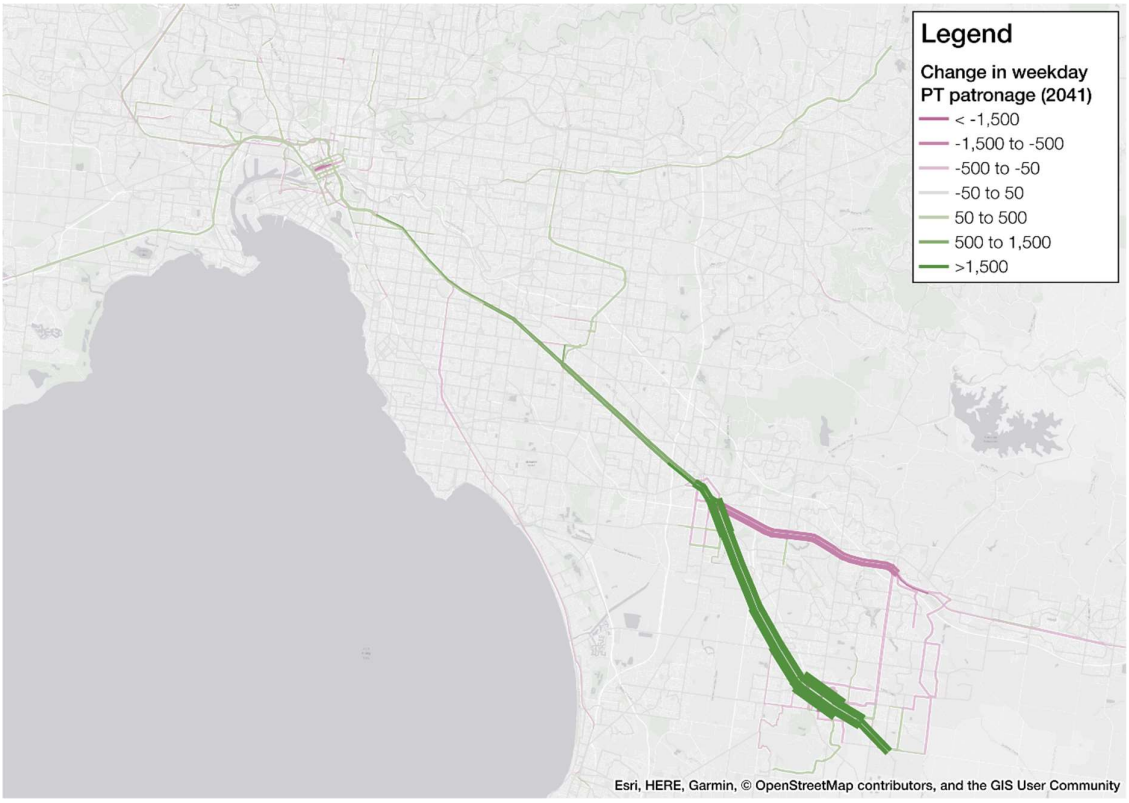


Figure 66 Change in patronage from Clyde extension (Y2041)

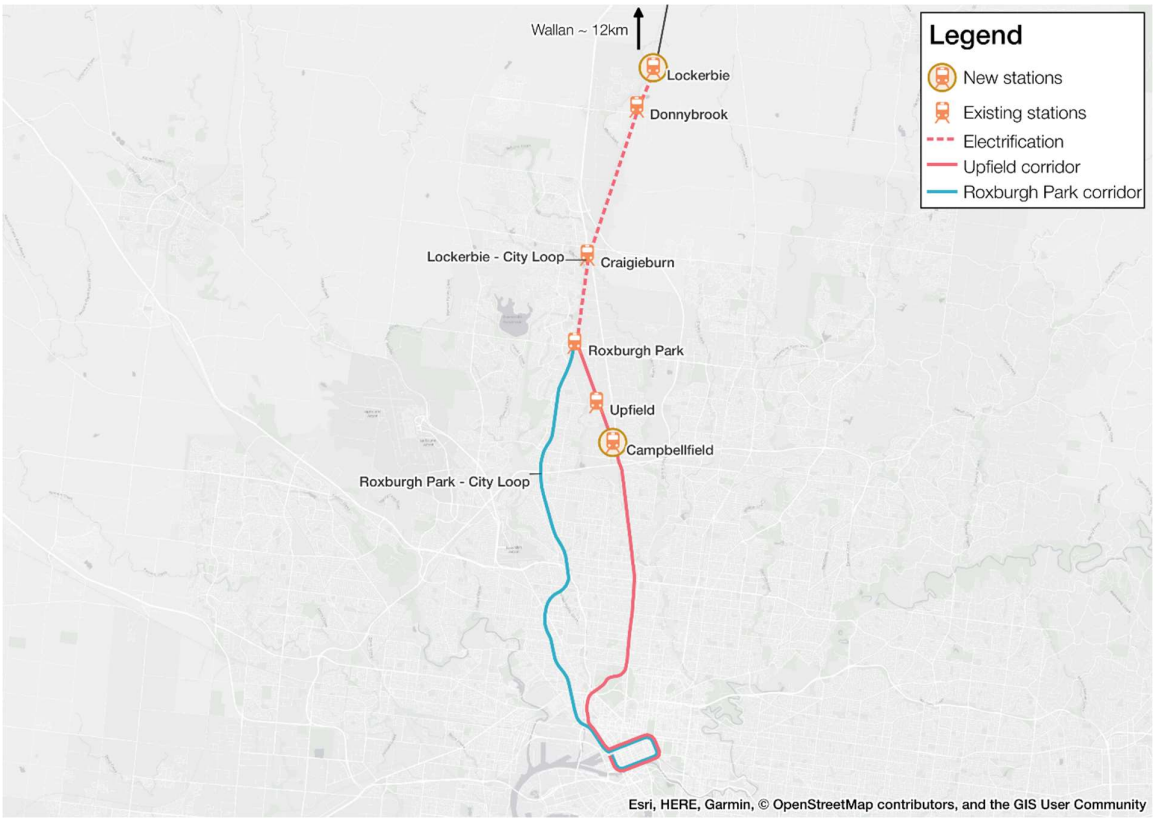


Extend and electrify towards Kalkallo

Assumptions

Figure 67 shows the project scope. The project consists of extending the electrified Upfield line up to Lockerbie Station, and truncating Craigieburn services at Roxburgh Park Station.

Figure 67 Extend and electrify towards Kalkallo



The project involves the construction of two new stations:

1. Campbellfield Station
2. Lockerbie Station

Table 73 indicates the assumed car park capacity for these new stations.

Table 73 Car park capacities of new station car parks for the Extend and electrify towards Kalkallo project

New station	Car park capacity
Campbellfield	500
Lockerbie	500

Table 74 details the headway assumptions for the impacted services.

Table 74 Extend and electrify towards Kalkallo train service headways (minutes)

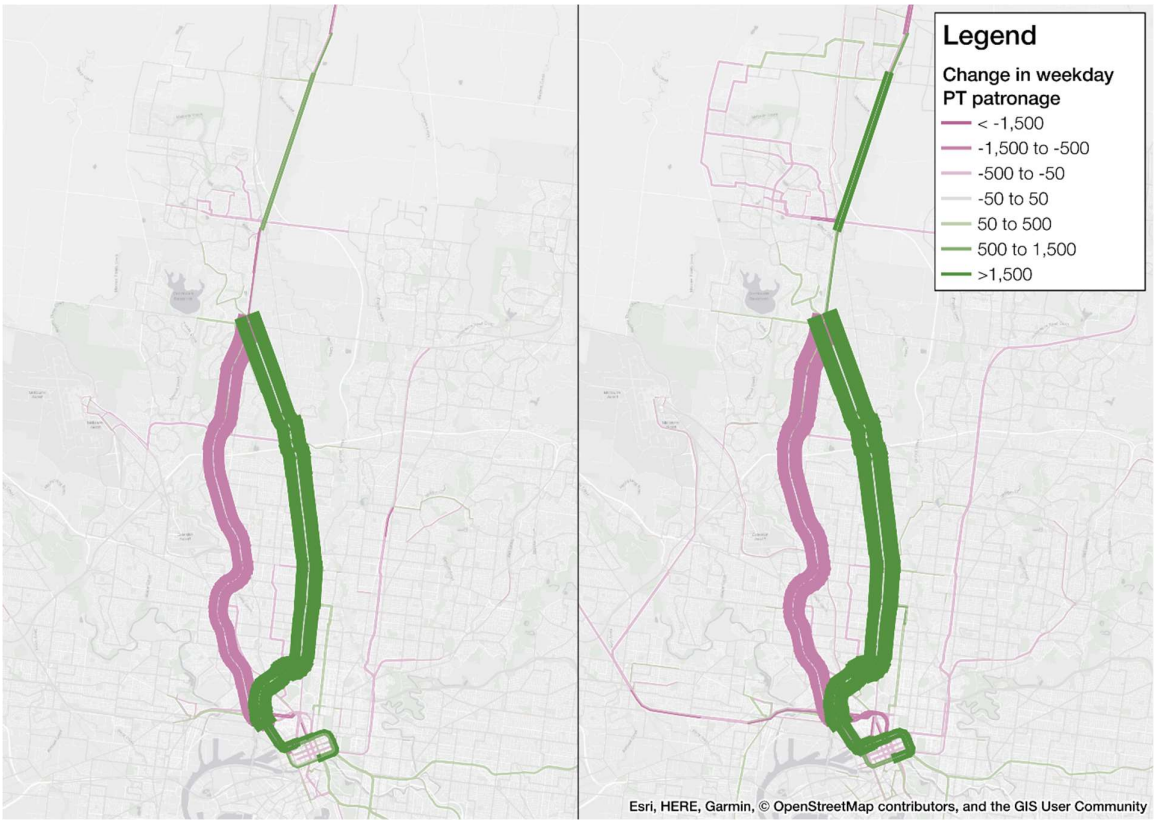
Year	Service	AM	IP	PM	OP
2031	Roxburgh Park – City Loop	6.67	10	6.67	20
	City Loop – Roxburgh Park	6.67	10	6.67	20
	Lockerbie – City Loop	6.67	10	6.67	20
	City Loop – Lockerbie	6.67	10	6.67	20
2041	Roxburgh Park – City Loop	6.67	10	6.67	20
	City Loop – Roxburgh Park	6.67	10	6.67	20
	Lockerbie – City Loop	6.67	10	6.67	20
	City Loop – Lockerbie	6.67	10	6.67	20

Results

Figure 68 below shows the impact of the project for both model years in the form of changes to patronage across the network. Interestingly, in Y2031, the truncation of Craigieburn services appears to have caused a reduction in patronage between Craigieburn and Roxburgh Park. This appears to be offset by an increase in bus patronage from the Roxburgh Park and Craigieburn suburbs down to Roxburgh Park. Conversely, bus services feeding Craigieburn stations see reduced patronage due to the updated alignment.

By Y2041 the reduction in patronage between Craigieburn and Roxburgh Park stations shifts to a slight increase. It is likely that this is partly due to the increased population in the northern growth corridor.

Figure 68 Change in patronage resulting from Extend and electrify towards Kalkallo project (left: Y2031, right: Y2041)



Melton electrification and quadruplication

Assumptions

The Melton electrification has the largest scope of the projects modelled as part of the Detailed Project modelling phase, both in terms of extent and the required works to implement. Figure 69 details the scope of the project.

Figure 69 Melton electrification

Aside from the construction of new rail tracks between Sunshine and Bacchus Marsh, the project also includes the construction of two new stations:

1. Paynes Road
2. Hopkins Road

Table 75 Car park capacities of new station car parks for Melton electrification

New station	Car park capacity
Paynes Road	1,000
Hopkins Road	1,000

The project as modelled consists of two stages for the extent of services. In Y2031, it is assumed that Westall to West Footscray Services are extended via the new electrified corridor to Melton. By Y2041, it is assumed that Melton services terminate at Pakenham East Station.

The electrification of services between Sunshine and Melton releases V/Line rolling stock to be used on other services and corridors. For the detailed project modelling, service frequency was increased on the Wyndham Vale and Seymour corridors.

In order to allow capacity for the new electrified services but also provide connectivity for Bacchus Marsh, a V/Line shuttle service was assumed between Bacchus marsh and Melton Stations. Table 76 provides the headway assumptions for these services.

Table 76 Melton Electrification train service headways (minutes)

Year	Service	AM	IP	PM	OP
2031	Melton – Westall	10	10	10	10
	Westall – Melton	10	10	10	10
	Bacchus Marsh – Melton	40	0	40	0
	Melton – Bacchus Marsh	40	0	40	0
	Wyndham Vale – Southern Cross	10	10	10	20
	Southern Cross – Wyndham Vale	10	10	10	20
	Seymour – Southern Cross	20	40	20	60
	Southern Cross – Seymour	20	40	20	60
2041	Melton – Pakenham East	10	10	10	10
	Pakenham East – Melton	10	10	10	10
	Bacchus Marsh – Melton	40	0	40	0
	Melton – Bacchus Marsh	40	0	40	0
	Wyndham Vale – Southern Cross	10	10	10	20
	Southern Cross – Wyndham Vale	10	10	10	20
	Seymour – Southern Cross	20	40	20	60
	Southern Cross – Seymour	20	40	20	60

Results

Figure 70 and Figure 71 on the following page detail the impact the project has on public transport patronage. A similar dynamic as for the Clyde extension occurs, where the improvement on the Melton corridor appears to be drawing away patronage from the Sunbury line. This can be seen by the shifting bus patronage patterns between both corridors.

It appears that patronage decreases between Bacchus Marsh and Melton. There are multiple potential reasons for this. *First*, the required transfer to connect to city-bound services likely acts as an impediment for more trips, and *second*, there is potentially a domino effect of cascading park and ride capacity, wherein capacity may be freed up at Melton station by the Paynes Road station, only to be utilised by persons proximate to Bacchus Marsh.

Further afield, the improvements to frequencies for Wyndham Vale services is apparent in Y2031, though disappears by Y2041.

Figure 70 Change in patronage from Melton electrification (Y2031)

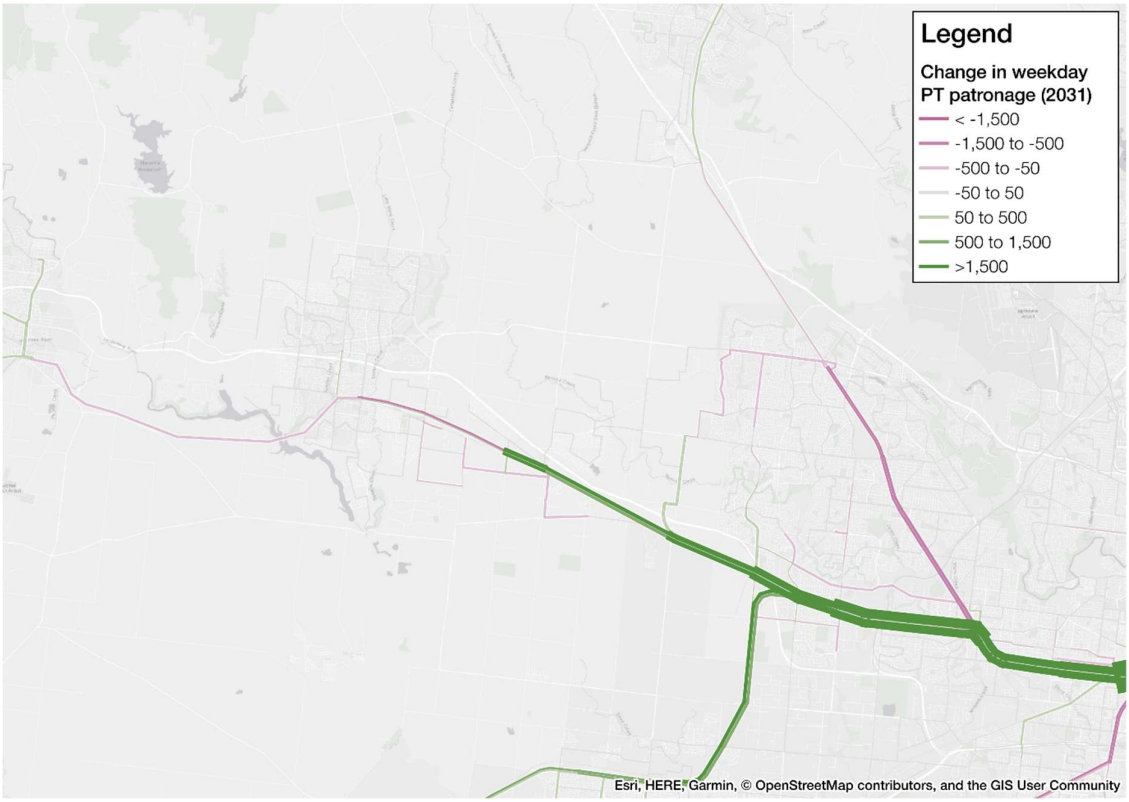
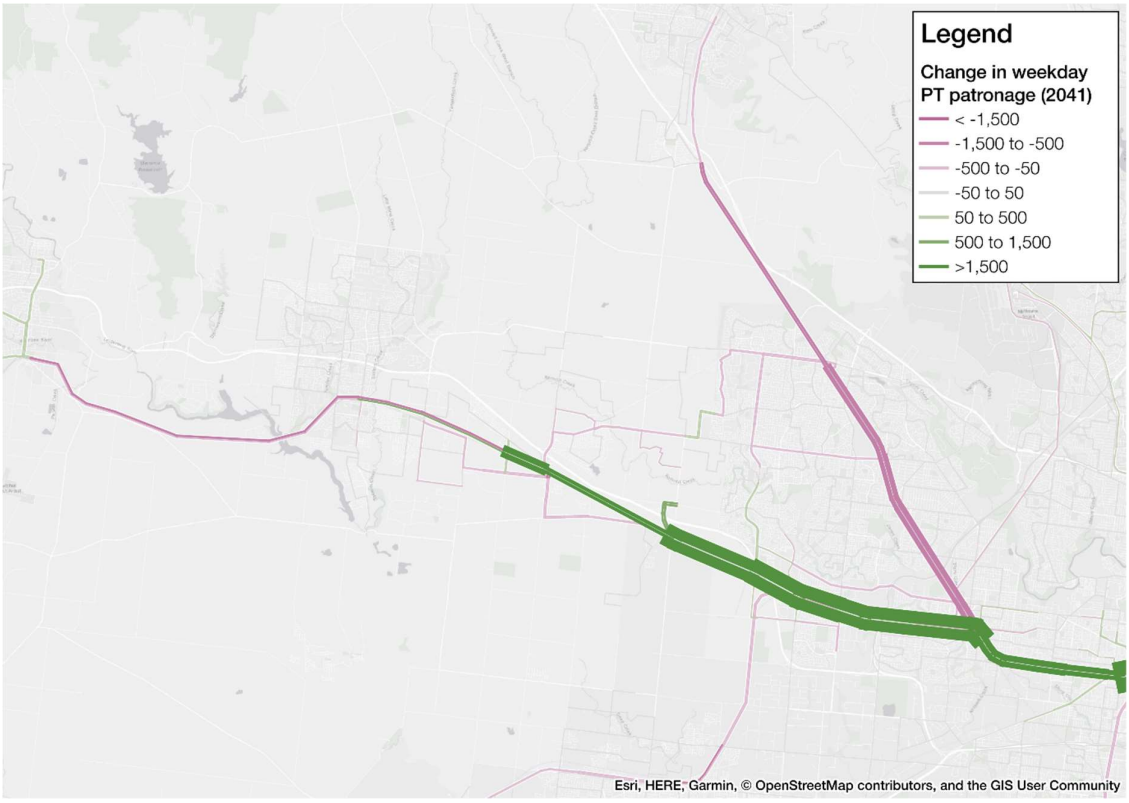


Figure 71 Change in patronage from Melton electrification (Y2041)

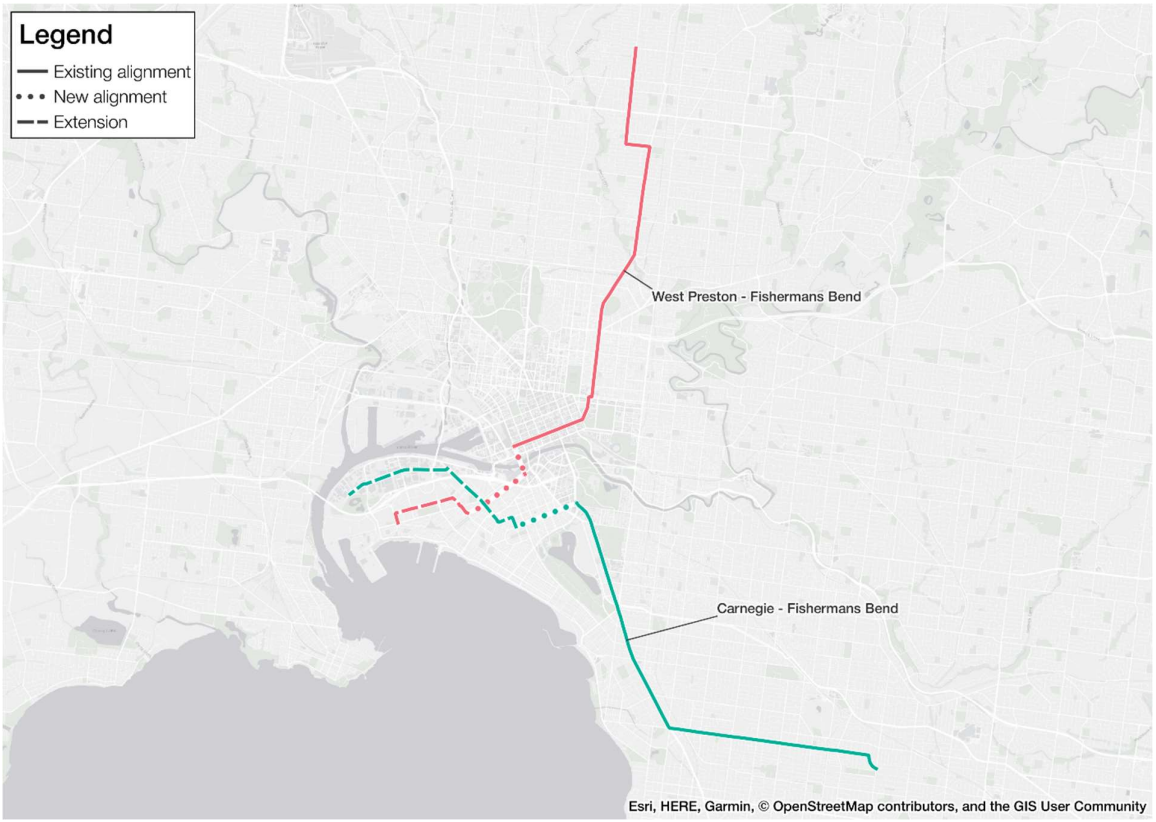


Fishermans Bend tram extensions

Assumptions

The Fishermans Bend tram extensions consist of rerouting and extending both the Route 11 and 67 tram services into the Fishermans Bend Precinct. From the north, the Route 11 service is rerouted via Spencer Street and the Sandridge Rail trail to the southern half of the Precinct. From the south, Route 67 utilises existing track on Park Street before the extension leads up Mountain Street, Ingles Street, and down Turner Street to Wharf Road. Figure 72 details the extensions, while Figure 73 and Figure 74 on the following page provide a closer view of each route's alignments.

Figure 72 Fishermans Bend Tram Extensions



Service frequencies are unchanged from the initial project modelling, as shown in Table 77.

Table 77 Fishermans Bend Extension tram service headways (minutes)

Year	Service	AM	IP	PM	OP
2031	Route 11	8	10	8	15
	Route 67	8	10	8	15
2041	Route 11	8	10	8	15
	Route 67	8	10	8	15

Figure 73 Route 11 extension

Figure 74 Route 67 extension

Results

Figure 75 and Figure 76 detail the change in modelled patronage from the tram extensions. It is clear that there is significant public transport demand to Fishermans bend. This is particularly true in Y2041, with similar but intensifying patterns of patronage, especially for Route 67, which sees a significant jump in patronage around South Melbourne.

Figure 75 Change in patronage from Fishermans Bend tram extensions (Y2031)

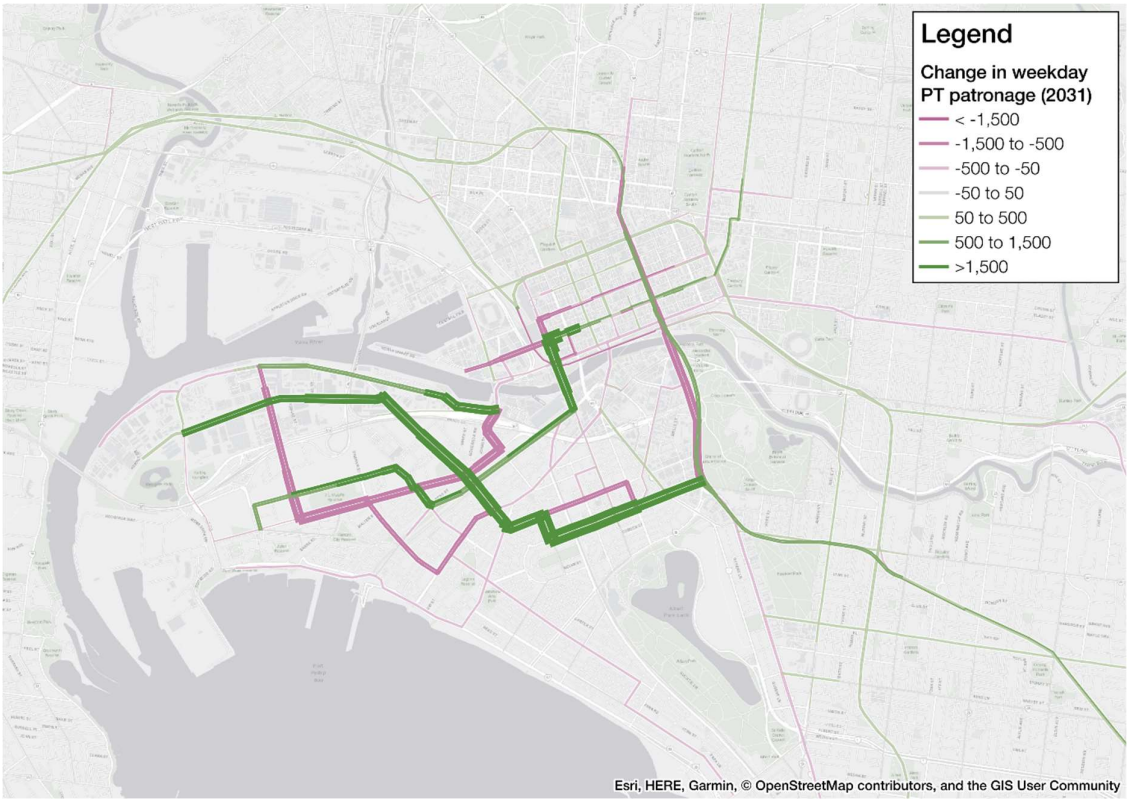
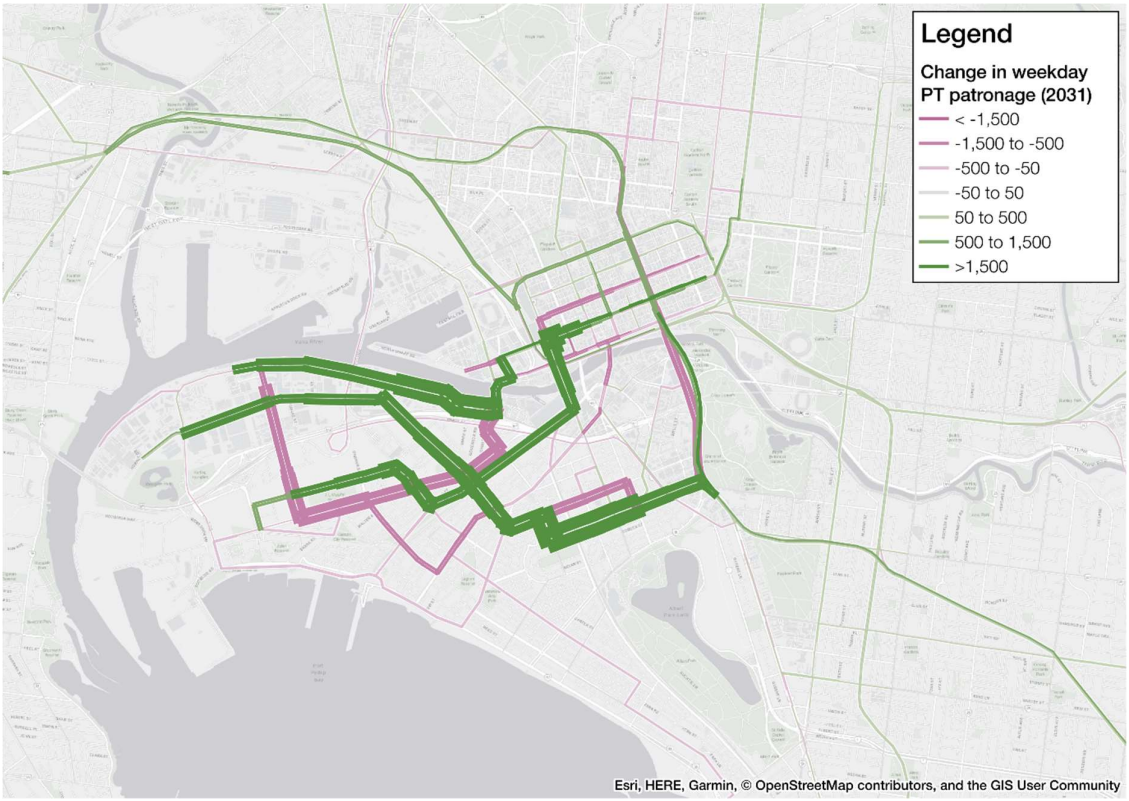


Figure 76 Change in patronage from Fishermans Bend tram extensions (Y2041)



Tram Bundle

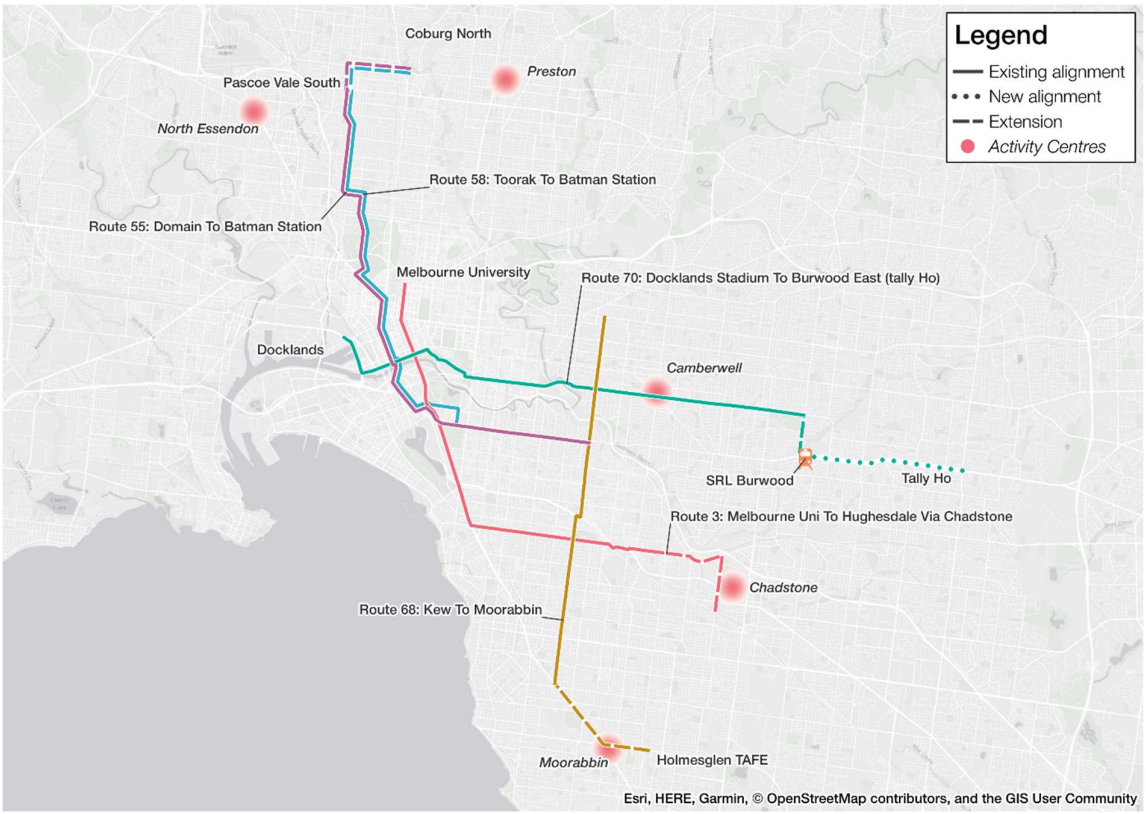
Assumptions

The Tram Bundle project is a collection of tram extensions that are designed to provide enhance connectivity to activity centres in addition to other tram and rail corridors. The bundle consists of five tram extensions:

1. Route 3 (Melbourne Uni to Hughesdale via Chadstone)
2. Route 55 (Domain to Batman Station)
3. Route 58 (Toorak to Batman Station)
4. Route 68 (Kew to Moorabbin)
5. Route 70 (Docklands Stadium to Burwood East (Tally Ho))

The broader scope of the project is shown in Figure 77 below. Detailed alignments are shown in Figure 78 to Figure 82.

Figure 77 Tram extension bundle



In between the initial project modelling and detailed modelling phases of the project, some key changes were made to the project specifications:

- A new service (Route 58) was added to take advantage of the capital works to extend the Route 55 service.
- The Route 55 extension was altered to terminate at Batman Station. The alignment was shifted from due to unfavourable track gradients identified after a site visit by Infrastructure Victoria.
- Route 68 was further extended down South Road to terminate at Holmesglen TAFE, to provide greater access to it and other nearby schools.

Headway assumptions were unchanged between modelling stages. Service headways are summarised in Table 78 below.

Table 78 Tram Extension Bundle service headways (minutes)

Year	Service	AM	IP	PM	OP
2031	Route 3	8	10	8	15
	Route 55	8	10	8	15
	Route 58	8	10	8	15
	Route 68	8	10	8	10
	Route 70	8	10	8	15
2041	Route 3	8	10	8	15
	Route 55	8	10	8	15
	Route 58	8	10	8	15
	Route 68	8	10	8	10
	Route 70	8	10	8	15

Figure 78 Route 3 extension alignment

Figure 79 Route 55 extension alignment

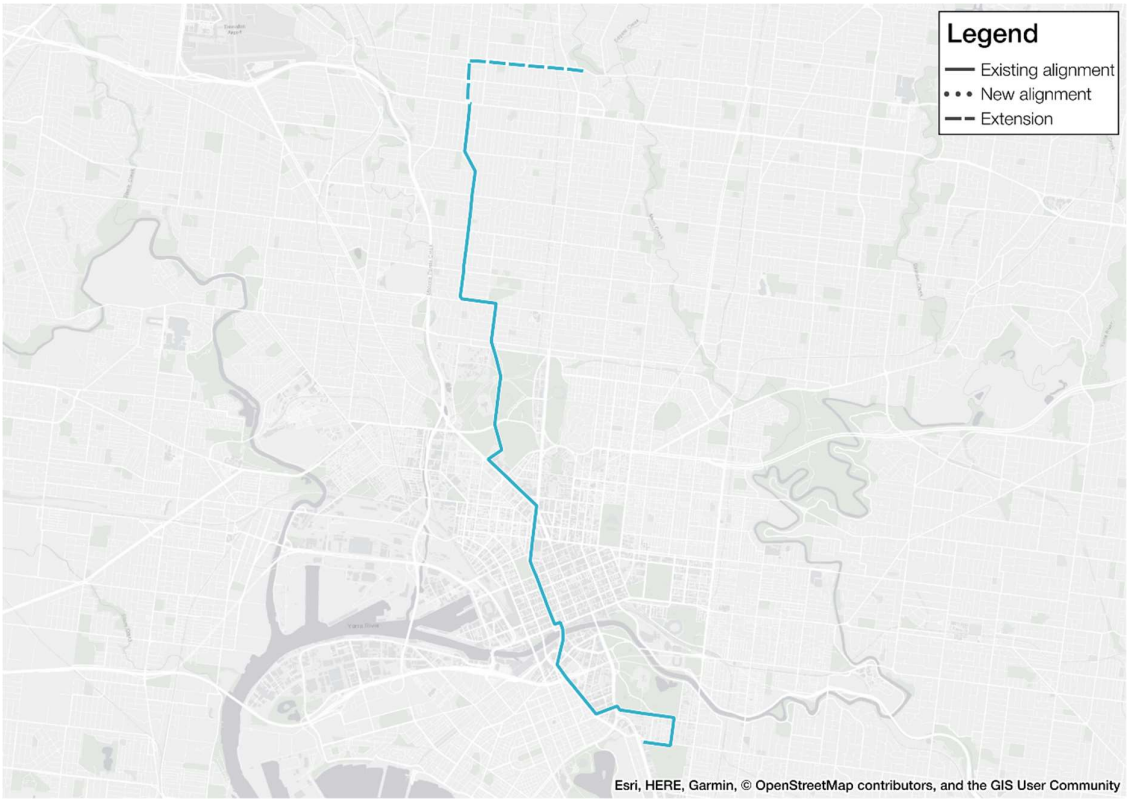


Figure 80 Route 58 extension alignment

Figure 81 Route 68 extension alignment

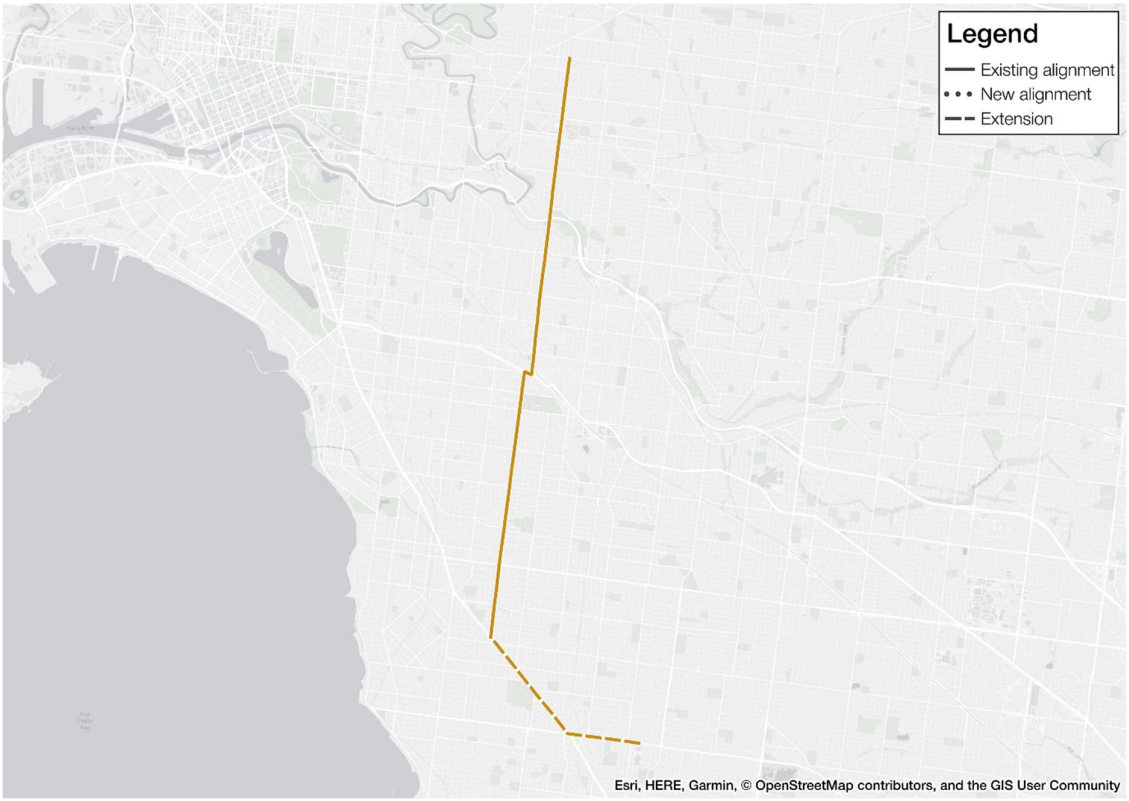
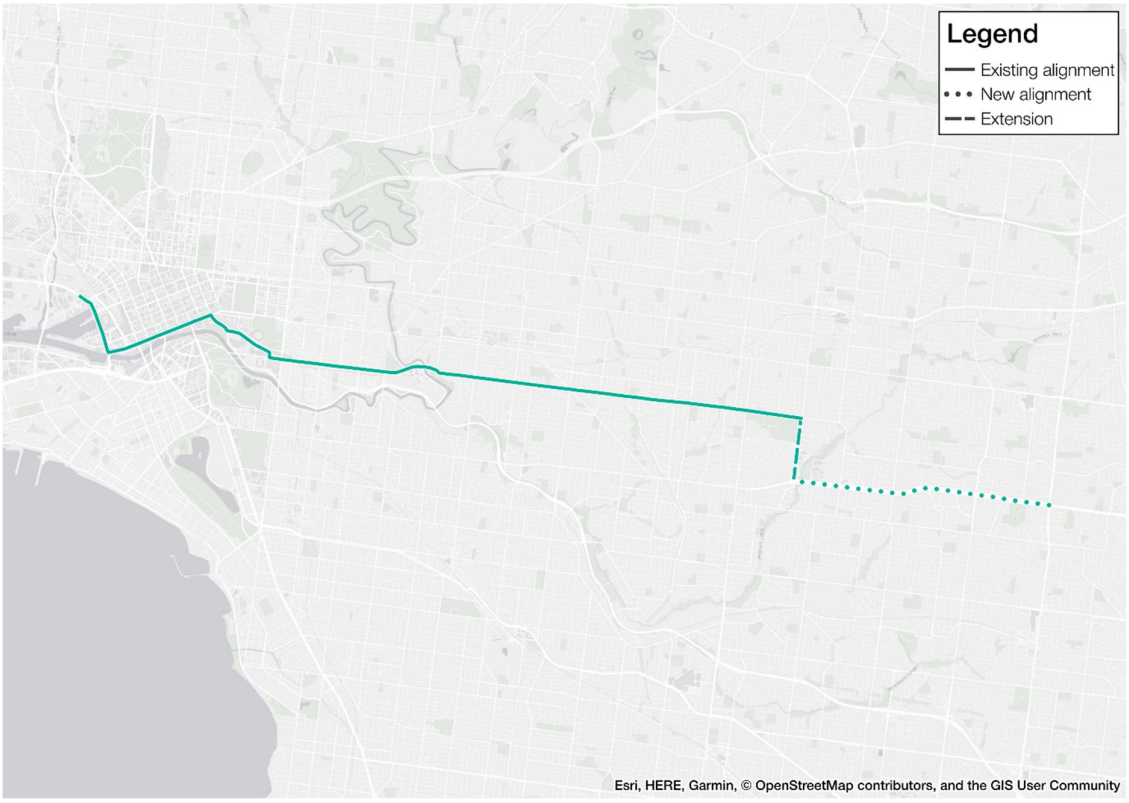


Figure 82 Route 70 extension alignment



Results

Figure 83 and Figure 84 detail the changes to modelled patronage produced by the project in Y2031 and Y2041 respectively. The impacts of the projects are clear, as each extension can be identified by the uptick in patronage produced by it. As with other projects, the extensions induce a shift from other public transport services that run parallel to the extended corridors.

Figure 83 Change in patronage from Tram Extension Bundle (Y2031)

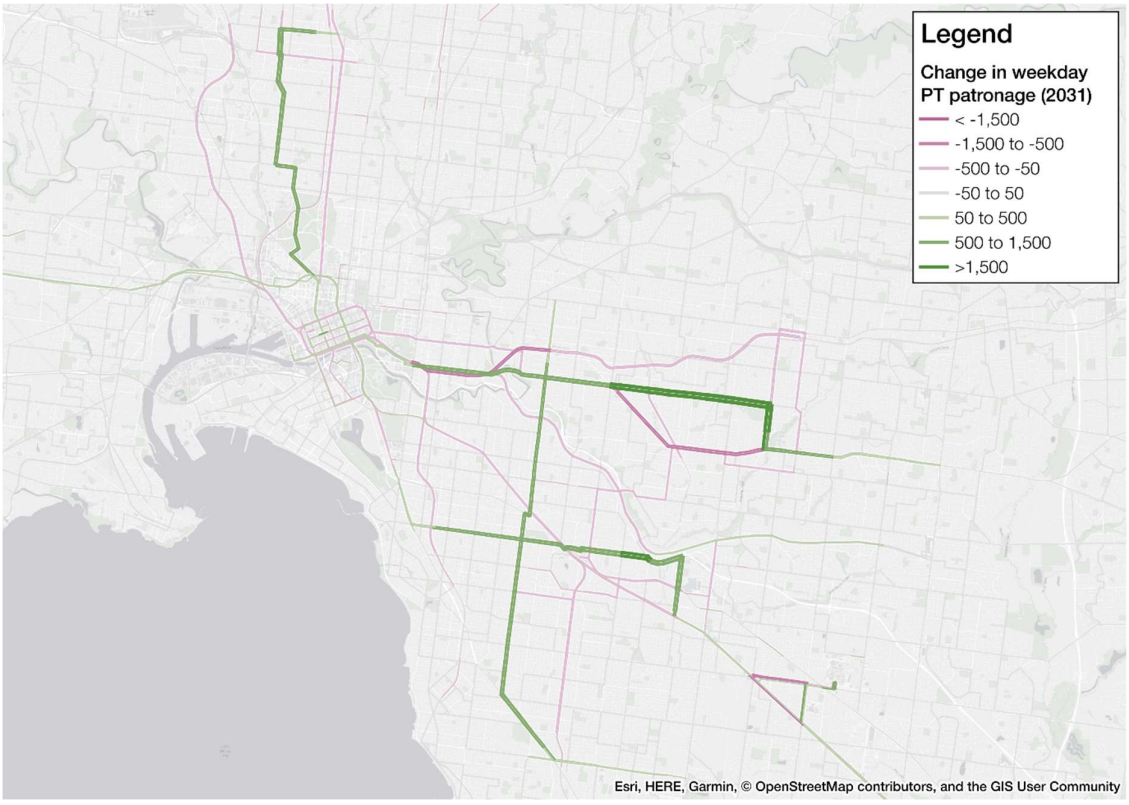
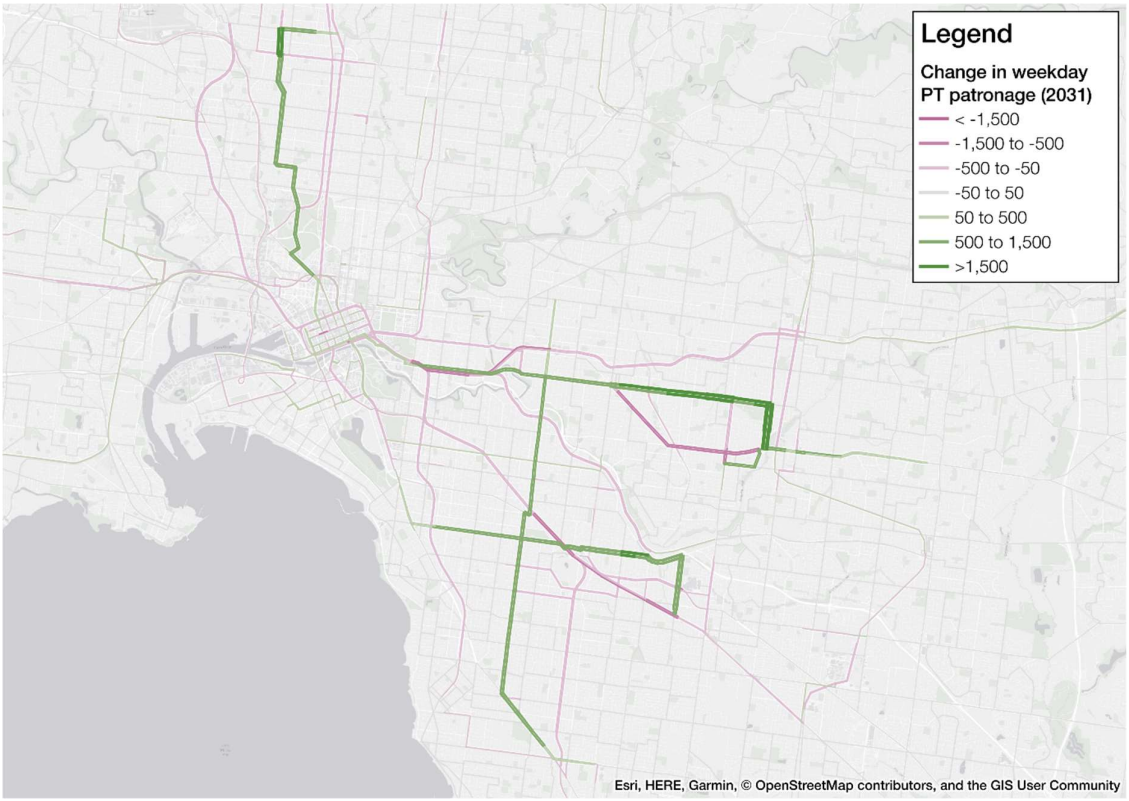


Figure 84 Change in patronage from Tram Extension Bundle (Y2041)



Appendix D

Multi-Criteria Analysis

Appendix D Multi-Criteria Analysis

This appendix provides further details regarding the Multi-Criteria Analysis undertaken as part of the shortlisting process in Stage 3 of the project.

Figure 85 to Figure 90 on the following pages details the 1km zone catchments defined for project intervention areas to extract the VITM modelling results for the initial project modelling as part of the shortlisting process.

Separately, Table 79 on page D-5 provides the full scoring for all projects as part of the MCA process.

Figure 85 Group 1 Catchments

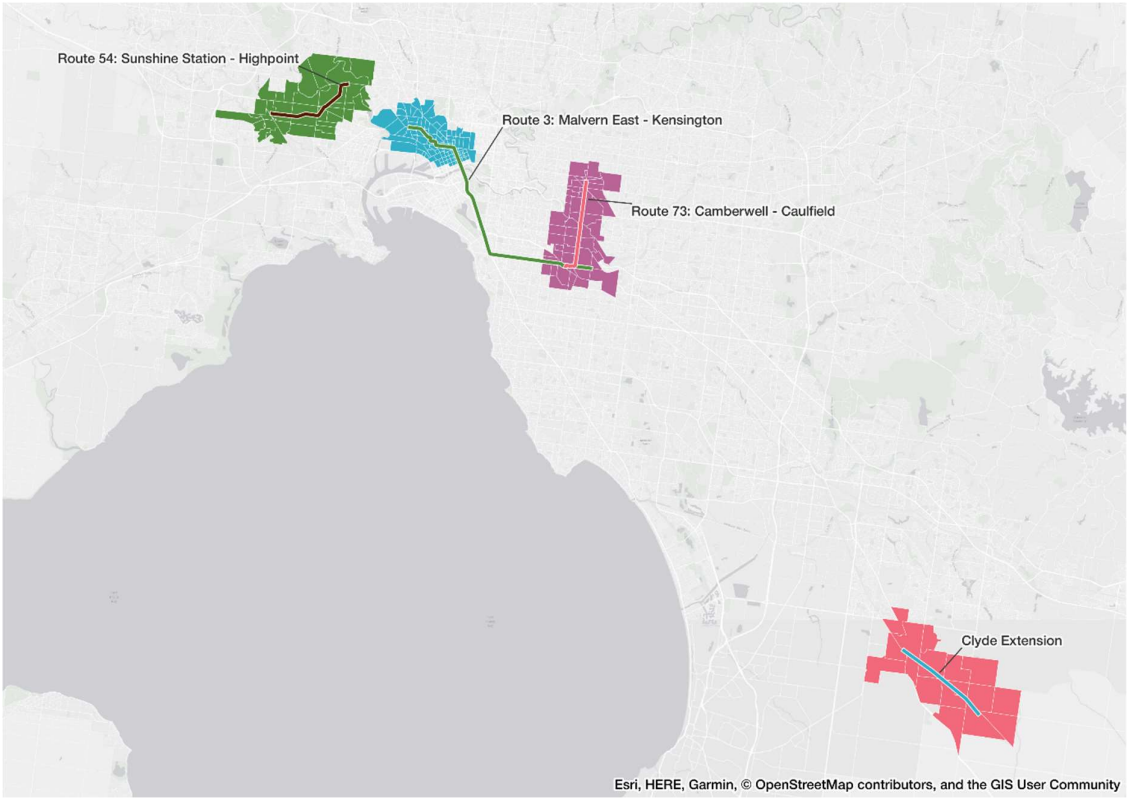


Figure 86 Group 2 Catchments

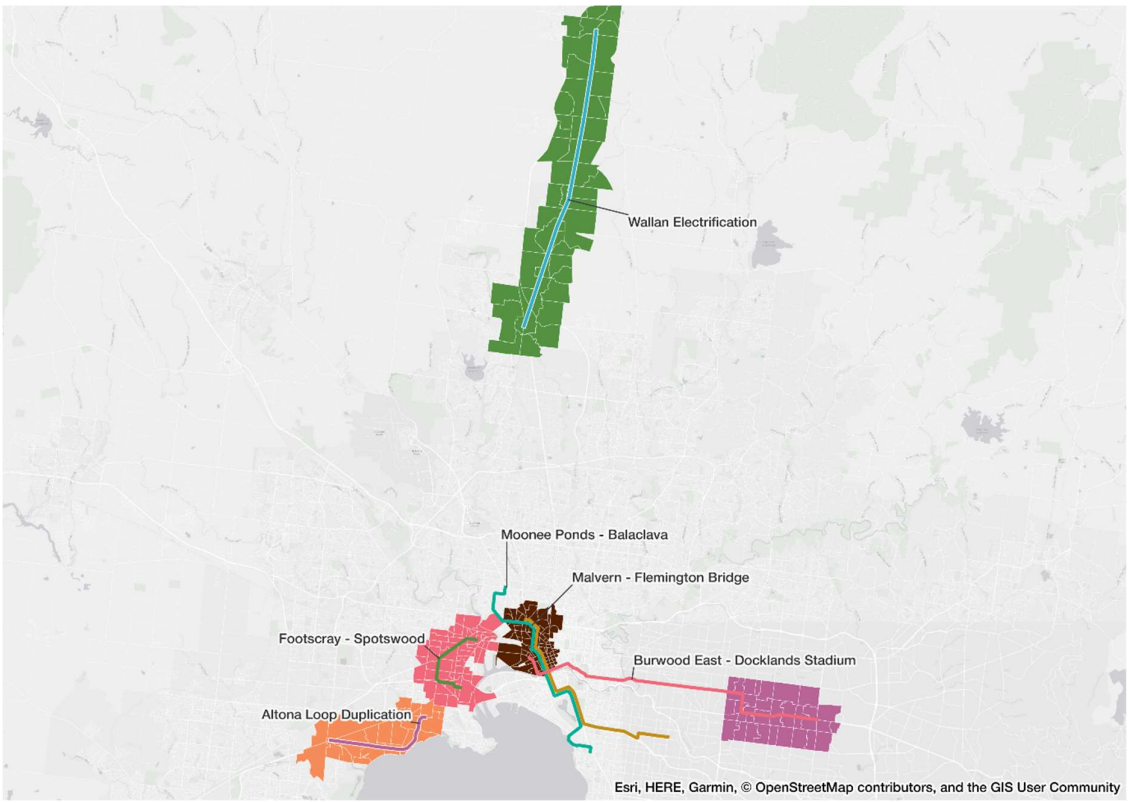


Figure 87 Group 3 Catchments

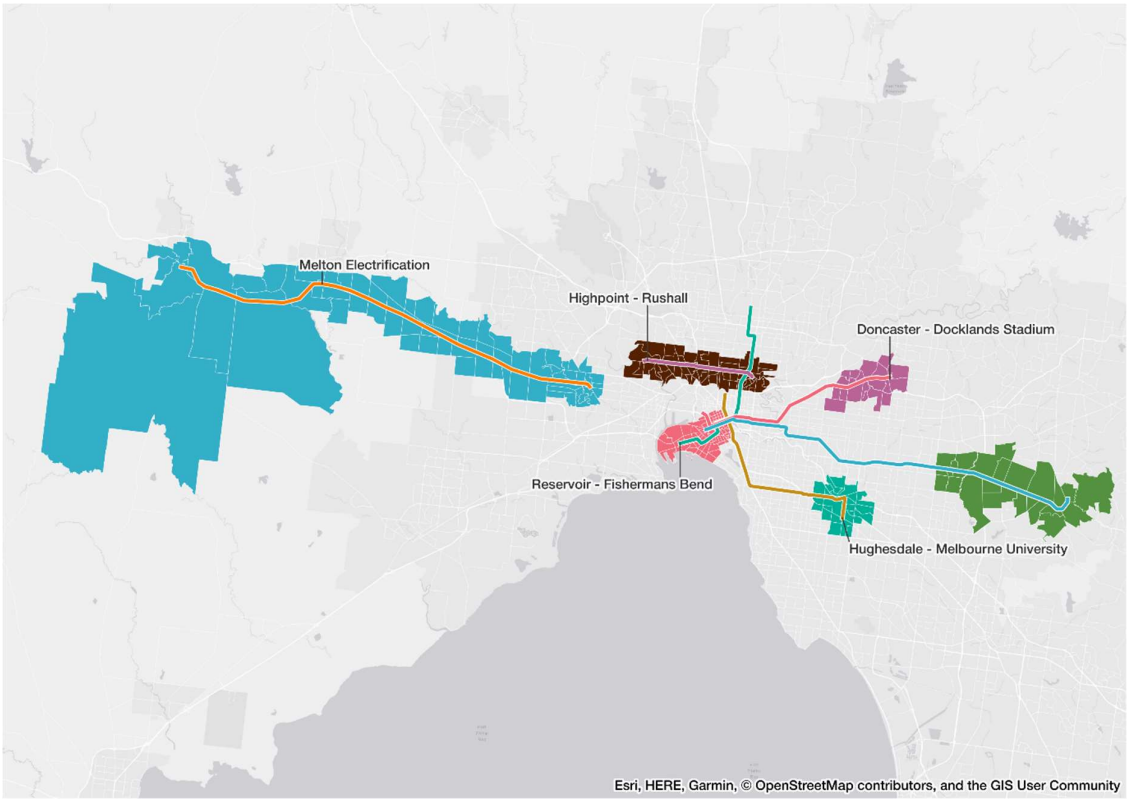


Figure 88 Group 4 Catchments

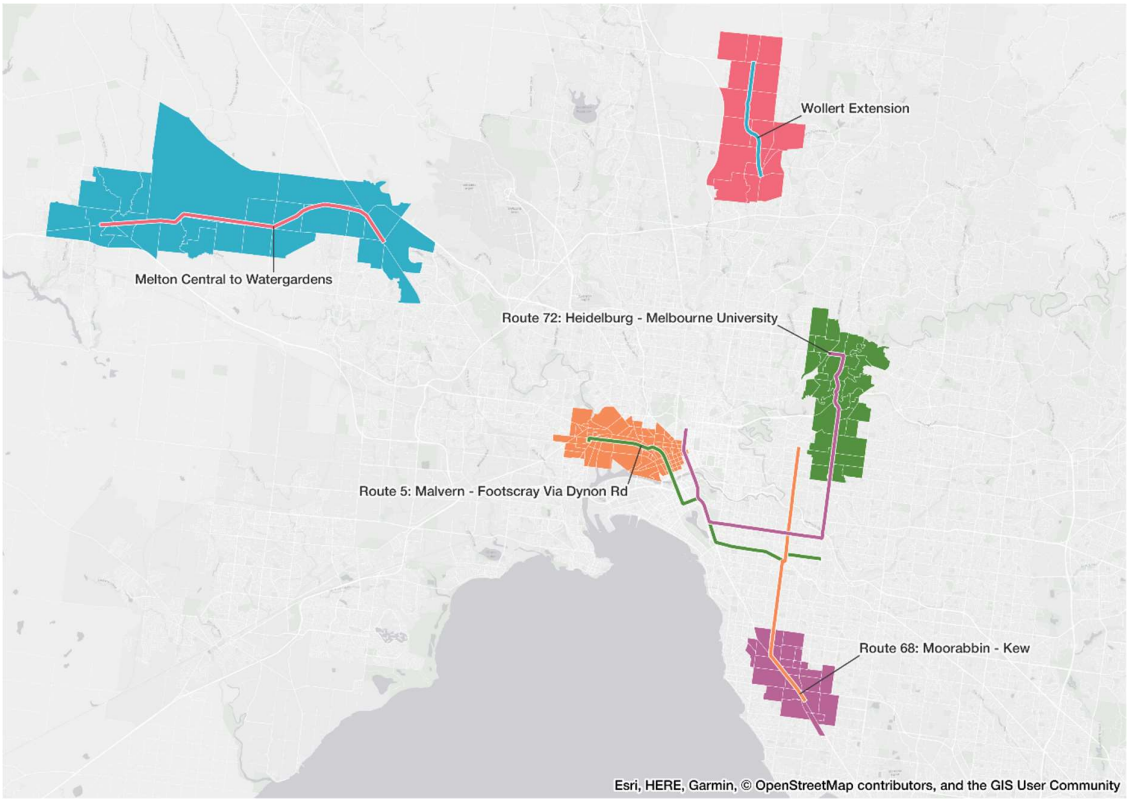


Figure 89 Group 5 Catchments

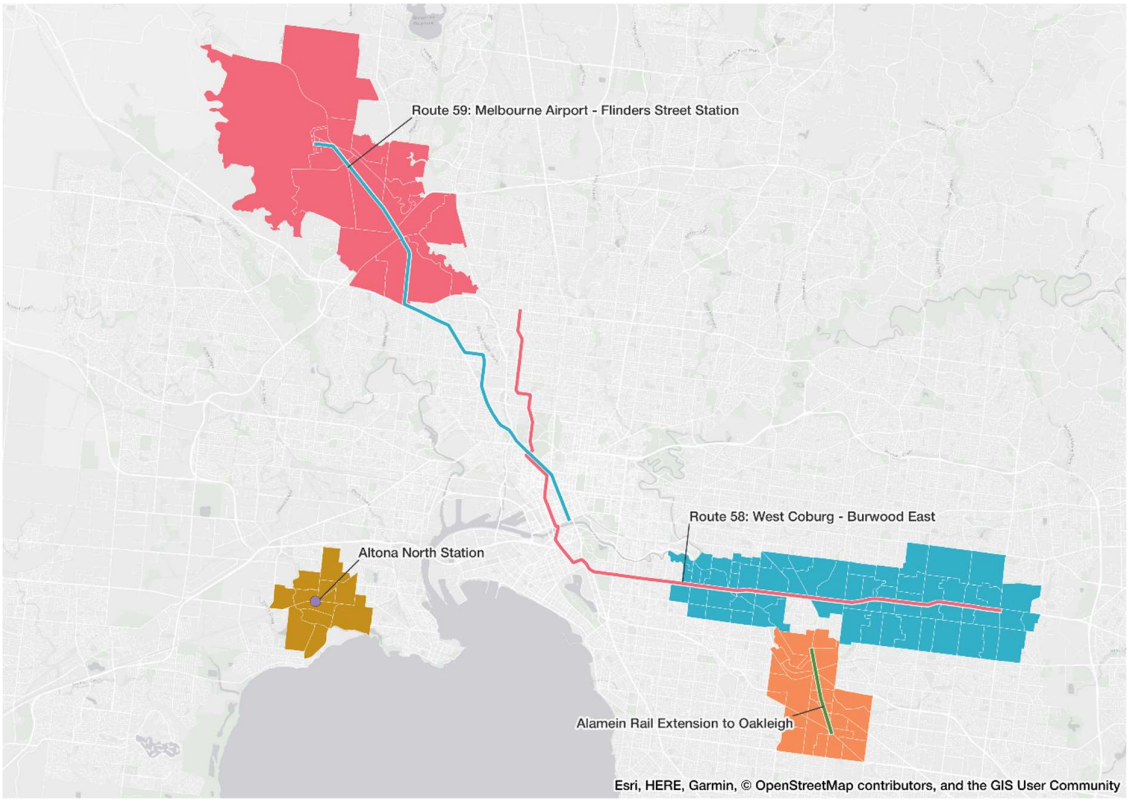


Figure 90 Group 6 Catchments

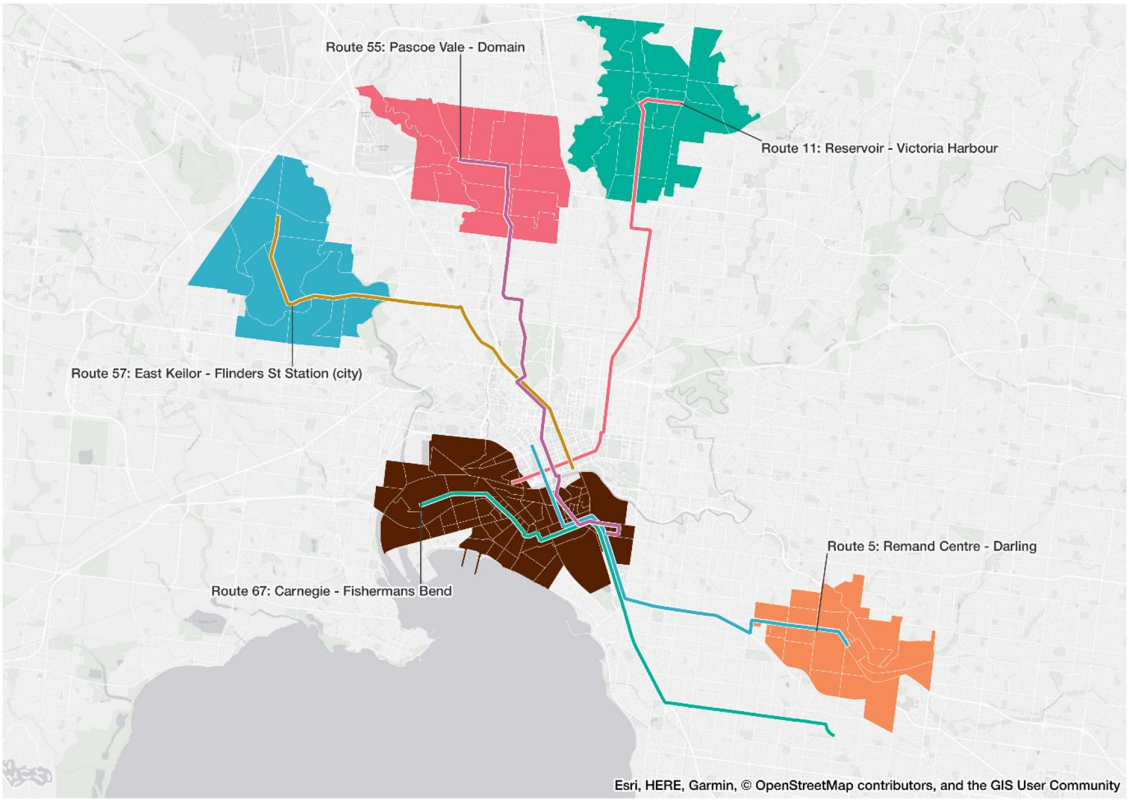


Table 79 Full MCA Results

Group	Project	Mode	Boardings	PT Equity	Employment accessibility	Density potential	CAPEX	OPEX	VKT[13]	Total Score	Rank
1	Cranbourne to Clyde rail extension	Rail	2	3	4	2	-2	-1	4	0.65	4
	New route - Camberwell to Caulfield Station	Tram	0	0	0	2	-1	0	0	-0.1	16
	New route - Highpoint to Sunshine	Tram	1	1	0	3	-2	-1	1	-0.2	21
	Route 3 – Rerouting and extension from Victoria Street to Kensington Station	Tram	1	0	0	3	-1	0	0	0.15	7
2	Partial duplication Altona Loop Line	Rail	1	2	3	0	-4	-1	0	-0.85	30
	Wallan electrification and Somerton link	Rail	2	4	4	2	-2	-4	4	0.1	9
	New route - Footscray to Spotswood	Tram	1	1	1	3	-2	-1	1	-0.1	15
	Route 5 – Extension from La Trobe Street to Flemington Bridge Station	Tram	3	0	0	3	0	0	0	0.75	3
	Route 56 – Rerouting via Spencer and Abbotsford Street	Tram	-1	0	0	3	0	0	0	0.15	8
	Route 70 – Extension From Box Hill South to Burwood East (Tally Ho)	Tram	1	1	0	2	0	-1	0	0.2	5
3	Melton to Sunshine electrification and Deer Park to Sunshine quadruplication	Rail	3	4	3	3	-4	-2	4	0.05	13
	New route - Highpoint to Rushall	Tram	2	1	0	3	-3	-1	0	-0.45	25
	Route 11 – Rerouting and extension from King/Collins Street to Fishermans Bend	Tram	4	3	0	3	-1	0	3	1.05	1
	Route 3 – Extension from East Malvern to Hughesdale via Chadstone	Tram	1	1	0	2	-1	0	0	0.1	10
	Route 48 – Extension from Balwyn North to Doncaster	Tram	1	1	1	2	-2	0	0	-0.1	16
	Route 75 – Extension from Vermont South to Ferntree Gully via Knox	Tram	0	1	3	2	-3	-2	2	-0.55	26
4	Watergardens to Melton Central extension	Rail	1	4	4	1	-4	-3	3	-0.65	29
	Lalor to Wollert extension	Rail	0	3	3	2	-4	2	0	-0.15	19
	Route 5 – Extension from La Trobe Street to Footscray Station via Dynon Road	Tram	3	0	0	2	-3	0	0	-0.25	22
	Route 68 – Extension from Brighton East to Moorabbin Station	Tram	1	1	0	3	-1	-1	0	0	14
	Route 72 – Extension from Deepdene to Heidelberg Station	Tram	1	2	0	2	-3	-1	0	-0.65	28

[13] As a proxy for environmental effects

Group	Project	Mode	Boardings	PT Equity	Employment accessibility	Density potential	CAPEX	OPEX	VKT[13]	Total Score	Rank
5	Alamein rail extension to Oakleigh	Rail	2	0	1	2	-4	0	0	-0.6	27
	New station at Altona North	Rail	3	3	4	1	-1	0	1	0.9	2
	Route 58 – Extension from Kooyong to Burwood East (Tally Ho)	Tram	2	0	1	2	-2	-2	1	-0.3	23
	Route 59 – Extension from Strathmore Heights to Melbourne Airport	Tram	0	0	3	2	-2	-1	0	-0.3	24
6	Route 11 – Extension from Regent Street to Reservoir Station	Tram	0	0	2	2	-1	0	0	0.1	10
	Route 5 – Extension from Burke Road to Darling Station	Tram	0	0	0	1	0	0	0	0.1	12
	Route 55 – Extension from Bell Street to Pascoe Vale Station	Tram	0	0	0	2	-1	0	0	-0.1	16
	Route 57 – Extension from Maribyrnong to East Keilor	Tram	0	0	1	2	-2	0	1	-0.2	20
	Route 67 – Rerouting and Extension from ANZAC station to Fishermans Bend North	Tram	2	3	0	3	-3	0	3	0.15	6