FINAL REPORT

Northern Central City Corridor Study

APPRAISAL OF TRANSIT STRATEGY RESULTS

Department of Infrastructure

Melbourne, Australia

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Booz | Allen | Hamilton

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Executive Summary

1. Aims and Objectives

This is the transit appraisal review of the strategy modeling results from the Northern Central City Corridor (NCCC) Study. It is presented by Booz Allen Hamilton to Sinclair Knight Merz and the Department of Infrastructure.

This report reviews the outputs from the VLC modelling analysis of a series of strategy options for the NCCC from the perspective of public transport. It covers:

- Identification of strategy inputs
- Identification of key strategy modelling outcomes, with an emphasis on public transport issues
- A review of these outcomes.

2. Transit Strategy Modelling Review Findings

Some 8 strategies were tested of which two; involve public transport services:

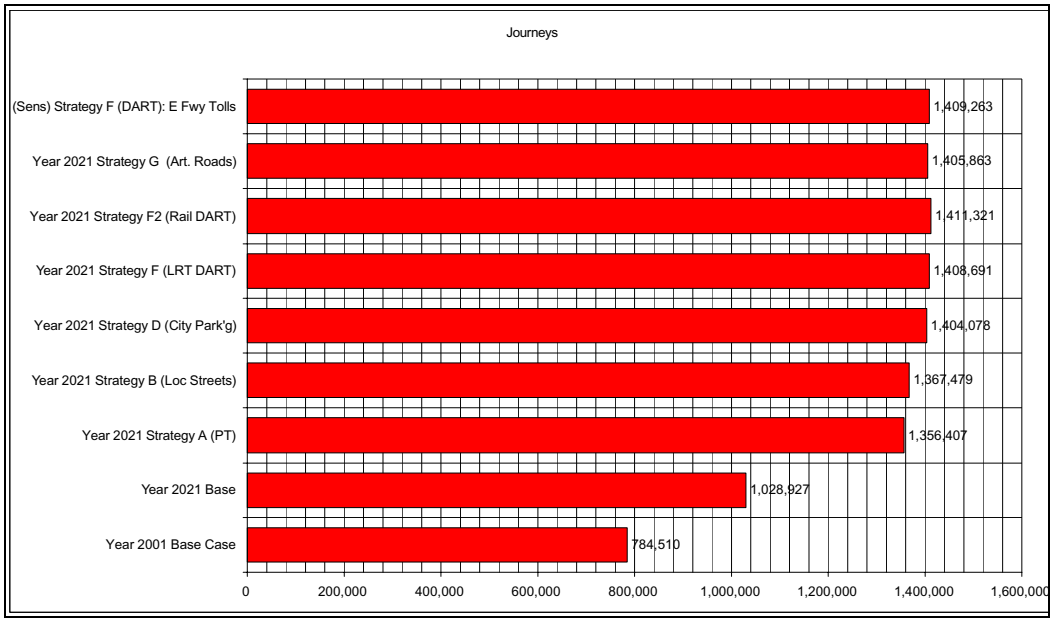
- Strategy A: Significant Upgrade of Transit Services
- Strategy F: Doncaster Area Rapid Transit (DART) service – Light Rail

All strategies are cumulative in an alphabetical sense (B includes A, C includes B and C etc). In addition an alternative strategy F option was tested (strategy F2) which examines a heavy rail version of DART. Tables 1, 2 and 3 summarises the key findings from the review in relation to Strategy A, F and F2.

3. Overall Strategy Impacts on Transit

Figure 1 illustrates the impacts of strategy option results on transit mode share.

Figure 1: Total Transit Journeys by Strategy



Note: All strategies are cumulative except strategy F2 which includes strategies A, B, and D but not F. Strategies G and E including strategy A to F but not F2. Strategy F2 is a variation of strategy F

Overall Strategy A has the most significant influence on transit usage. Of the two DART options F2, the heavy rail service has the larger effect on transit usage.

Table 1 : Summary of Major Weekday Strategy Elements and Impacts : Strategy A

Strategy Elements	
• Substantial increases in public transport service frequencies – most study area services including some services operating in the rest of Melbourne • Improves station access improvements including improvements within Melbourne CBD • Tram upgrades – reliability, stops and through routing of the Elizabeth S tram group to St Kilda • Improved bus services – improved area coverage in Doncaster and Melbourne CBD, reliability improvements better interchanges • Better study area East-West links – Eastern Freeway and Johnston Street bus route groups operate to Melbourne University plus Johnson and Elgin Street Busway	
Market	**Impact (from 2021 Base)**
NCCC Travel Impacts	
Total Travel	• Transit journeys increase by 105K sourced from car 71%, walk / cycle, 22% • Transit journey growth is from Through and External Travel markets (48% each)
Temporal Impacts	• A.M. Peak NCCC transit journey mode share increases from 32% to 41% • Most transit journey growth and car travel decline occurs inter peak
Spatial Impacts	• Almost a third of transit journey growth is external travel from the South and almost a third is through travel North to South • Theses are also the sources of equivalent car travel reductions
Metropolitan Wide Travel[1]	
Total Travel	• Transit journeys increase by 327K sourced from car (75%) and walk (25%) • Transit journey mode share increases from 7% to 9%
Temporal Impacts	• Transit journey growth at the expense of car follows through to each time period • 60% of transit journey growth occurs in the inter-peak • Transit journey mode share increases most in the a.m. peak (to 11%)
Individual Service Impacts	
Service Boarding Impacts	• Transit boardings increase by 827K (+54%) implying much transfer behaviour on new journeys. Tram boardings increase by 105%, Rail 21% and Bus 26% • Strategy A more than doubles tram patronage; high growth in the Eastern Freeway and Johnson Street buses (135% / 78%) also occurs, rail notably the Upfield line, also has considerable increased boardings (+63%) • Transit boarding growth is highest in the peak (P.M. Peak 60%) . Yarra has 150% more a.m. peak boardings and M>Tram 105%
Maximum Load Demand Impacts	• **Strategy A impacts on peak tram maximum loads are very large and will require the development of additional strategy measures to managing overloading an tram congestion if realised in practice**. Routes 19, 55, 11, 109 and 86 have forecast average maximum loads per tram in the 200-300 range with others in the high 100-200 range. • These maximum loads are not sustainable and would require either larger capacity vehicles (usually articulated tram sets) and / or increased frequency • Running trams at higher frequency or larger trams are not considered a reasonable option since trams will 'platoon' and queue slowing the service • Other possible options include grade separation of all tram operations or upgrading to a higher capacity transit mode (e.g. heavy rail). Spreading tram routes over more streets may also assist e.g. bifurcating routes on Elizabeth, William and / or Swanston Street • Strategy A runs over 60% more peak direction trains than at present. Peak trains go to 51 / hr on some groups. **Measures to enable train volumes of this size will be required** • Strategy A does not increase train overloading; rather it increases train frequencies alleviating demand on the overloaded 2021 base network. In this context it can be argued that the Strategy A service frequencies are needed for the 2021 base case

Table 2 : Summary of Major Weekday Strategy Elements and Impacts : Strategy F DART LRT

Strategy Elements	
• New high capacity light rail system operating Doncaster Shoppingtown, Eastern Freeway, NCCC, Melbourne Uni, Swanston Street to St Kilda termed DART (Doncaster Area Rapid Transit) • High frequency, high quality priority and stops (stations) • Freeway buses cut to operate at 3 Freeway station interchanges	
Market	**Impact (from 2021 Strategy D Base Case)**
Total Metropolitan travel	• Transit journeys increase by 4,613 sourced from car travel • No impact on transit journey mode share • Transit boardings increase by 3,650 implying DART reduces overall transfers between transit modes
Total NCCC Travel	• Transit journeys increase by 1,866 sourced from car • Transit journey growth is mainly from Through and some External Travel
Temporal Impacts– NCCC	• Transit boarding increases are concentrated in the a.m. peak and inter-peak • Interestingly P.M. transit boardings decline. We suggest that a group of commuters travel in by bus and out by rail but for strategy F they use DART in both directions
Spatial Impacts– NCCC	• Through travel between East and South accounts for 71% of NCCC journey growth • Car travel decline also follows this pattern
Service Boarding Impacts	• DART achieves 68,721 boardings per weekday. • Most other tram services have boarding declines • Bus have general boarding declines notably the Eastern Freeway group (-50%). Some selected NCCC bus routes have modest boarding growth. • Rail has a mixed bag of low boarding impacts
DART Loadings	• **Most DART usage is between Doncaster and the CBD. This suggests the operation should be cut back to a Doncaster-CBD service** • Key DART stations are the CBD stops, Doncaster Shoppingtown and the Freeway interchange station. NCCC stops have lower order usage to these stations
Maximum Load Demand Impacts	• DART achieves an average maximum load of 240 well within the scope of the high capacity LRT service designed. • Other tram services maintain excessively high maximum loads. Strategy F acts to slightly alleviate the tram maximum issues identified in Strategy A. However these issues are increased in the strategies implemented since strategy A. • Bus has a mixed bag of maximum load impacts. The Eastern Freeway Group are all well under-loaded and may warrant reductions in service levels as feeder bus services. Other services have no maximum load issues

Table 2 : Summary of Major Weekday Strategy Elements and Impacts : Strategy F2 DART Heavy Rail

Strategy Elements	
• New heavy rail system operating to the following stations Doncaster Shoppingtown, Bulleen Road Eastern Freeway, Chandler Highway Eastern Freeway , Victoria Park Station than all stations on the Clifton Hill group into the city loop • High frequency, slightly faster running than the LRT DART including two thirds of trains running express Victoria Park to Parliament / Flinders Street • Freeway buses cut to operate at 3 Freeway station interchanges	
Market	**Impact (from 2021 Strategy D Base Case)**
Total Metropolitan travel	• Transit journeys increase by 7.2k compared to 4.6K with DART as a light ril service • Transit boardings increase by 33.5K implying much interchanging in new transit journeys. This contrasts with the DART LRT option which reduces transfer overall
Total NCCC Travel	• Transit journeys increase by 3.7 compared to 1.9K with the DART LRT service • Transit journey growth is mainly from Through and External Travel • Transit boarding increases are spread through all time periods
Spatial Impacts– NCCC	• DART heavy rail has a wider regional impact on transit journey growth and associated car travel decline than the LRT option. LRT only really impacted on travel between East and South whilst the Heavy rail includes this effect and also impacts other through travel and external travel corridors mostly those associated with the South and North. This impact is probably caused by the easier integration with regional heavy rail services provided by DART heavy rail compared to DART LRT
Service Boarding Impacts	• DART heavy rail achieves 50.6K boardings which is 26% less than those for LRT. • However the heavy rail option has almost half the catchment of the LRT, hence the relative boardings performance is no a good indicator of overall success • With 50.6K boardings per weekday, the DART heavy rail would e carrying more than any exiting rail line in Melbourne • In general bus does better in boarding terms than with DART LRT mainly because the Johnson Street group has higher loadings. In contrast the Eastern Freeway group of bus routes, which are cut to feed DART stations, do better under LRT since it is easier to transfer to LRT than heavy rail
DART Loadings	• **DART heavy rail has a maximum inbound daily loading of just under 18,000 passengers. This is more than double the inbound daily load of the LRT.** • **Bulleen Road and Shoppingtown are the major suburban commuter stations with Victoria Park playing an important interchange role for about 20% of all DART travel.**
Maximum Load Demand Impacts	• DART heavy rail achieves an average maximum load of 244 well within the scope of a rail service and arguably very low for rail. It is suggestive that 3 car sets could be deployed on the service rather than the standard 6 car sets used elsewhere • Other loading estimates provide similar results to thise identified in option F DART light rail

1 INTRODUCTION

1.1 Aims and Objectives

This is the transit appraisal review of the strategy modeling results from the Northern Central City Corridor (NCCC) Study. It is presented by Booz Allen Hamilton to Sinclair Knight Merz and the Department of Infrastructure.

This report reviews the outputs from the VLC modelling analysis of a series of strategy options for the NCCC Area from the perspective of public transport. It covers:

- Identification of strategy inputs
- Identification of key strategy modelling outcomes, with an emphasis on public transport issues
- A review of these outcomes.

1.2 Focus of this Review

The transit strategies investigated using the VLC model involve significant change from current operations and service levels. Their impacts are substantial and complex. A key focus of this review is to explore the results from a range of perspectives to:

- Understand how travel is forecast to change
- Explain the basis and drivers for travel changes as forecast
- Explore how the strategies are performance and where improvements can be made or to identify issues to be addressed in further planning fo these strategies.

Given the expansionist and far reaching nature of the transit strategies tested, the latter point is particularly important in developing strategies further.

1.3 Report Structure

This report is divided into the following sections:

2. Strategy A – Significant Public Transport Improvements

Examines the inputs and modelled outcomes of strategy A for the year 2021

3. Strategy F – Doncaster Area Rapid Transit – Light Rail

Examines the inputs and modelled outcomes of strategy F for the year 2021

4. Strategy F2 – Doncaster Area Rapid Transit – Heavy Rail

Examines the inputs and modelled outcomes of strategy F2 for the year 2021

5. Overview of Other Strategy Impacts on Transit

Considers the transit implications of the other NCCC strategy tests

2 STRATEGY A : SIGNIFICANT PUBLIC TRANSPORT IMPROVEMENT

2.1 Strategy Inputs

The aim of this strategy is to significantly improve public transport services in order to increase public transport usage and to reduce road congestion levels.

Key elements of the strategy are illustrated in Figure 2.1. The main service upgrades include:

2.1.1 Rail

General Frequency Improvements

Upfield Line:

- frequency doubled

Ringwood, Northern, Epping & Hurstbridge groups:

- frequency increased by 50%

Craigieburn / Roxburgh VLine services:

- have been re-routed using the Upfield line, these services stop at Craigieburn, Gowrie, Coburg, Royal Park and Spencer St.

Station Access Improvements

Generic improvement to bus and tram access to stations to reflect improved bus / train and tram / train station interchange / service coordination. The following was applied in the model:

- for 'premium' stations (premium station locations are based on Melways descriptions):
  - interchange penalties reduced to 5 minutes
  - maximum walk interchange time of one minute
  - maximum wait time of 5 minutes
- for other stations:
  - rail / rail, rail / bus and rail / tram interchanges, 50% improvement in transfer penalty but with a minimum penalty of 5 minutes)

Park / ride, kiss / ride - 25% reduction in car access terminal penalties - equivalent to about 60 cents in generalised cost

CBD Intermodal Interchange Improvements

Improved rail / tram / bus interchange at Flinders Street station by reducing the transfer penalties between all modes using the interchange by 2 minutes

2.1.2 Tram

General Frequency Improvements

All study area tram services (routes 1, 11, 19, 22, 23, 42, 59, 109, 96) frequency increased by 50%

Tram Reliability Improvements

Route 109 type upgrades for study area tram routes including:

- reduce travel time by 25%,
- reducing the 'variance' (reliability factor) to 1 minute,
- reduce access terminal penalty by 5 minutes (67 cents) to reflect a constant in vehicle perception reduction.

Tram Stop Upgrades

Tram Super Stops (all CBD tram stops and the top 25% most utilised tram stops outside the CBD) including reduce access penalty by 3.5 min (50cents) at tram super stops.

Tram Route Coverage Improvements

Elizabeth Street trams (59, 57, 19) extended to St Kilda following the route of tram 55 to Domain, thence to St Kilda.

2.1.3 Bus

General Frequency Increases

Eastern Freeway, Johnston Street & Northern groups improve frequencies to 10 minutes in the peaks and double present frequencies in the off peak

Improve External Bus Catchment Coverage

Improve bus route coverage outside the study area for the Eastern Freeway / Johnston Street route groups including 7 new bus routes:

- 30A Templestowe Village to City via Lower Templestowe (Eastern Fwy),
- 30B Templestowe (Porter Road) to City via Serpells Road (Eastern Fwy),
- 30C The Pines to City via Doncaster East (Eastern Fwy),
- 30D Doncaster Shoppingtown to City via Ayr St and Bulleen (Eastern Fwy),
- 30E Doncaster Shoppingtown to City via Doncaster South (Eastern Fwy).
- 20A Doncaster Shoppingtown to City via Balwyn (Johnston St),
- 20B Doncaster Shoppingtown to City via Balwyn North / Greythorn (Johnston St).

Increase spatial coverage (city end) for Eastern Freeway & Johnston Street groups:

Pattern 1 : Johnston Street CBD Group (200,201,203 and 207) new alignment as follows:

- Lonsdale Street to Spencer Street Station then
- loop Spencer Street, Latrobe Street Extension, Docklands Esplanade, Collins Street Extension
- Spencer Street to Lonsdale Street and so on.

Pattern 2 : Eastern Freeway Group 1: 301-9 and 319;

- extension from Queens / Collins to Spencer Street Station via Collins Street then:
- loop Spencer Street, Latrobe Street Extension, Docklands Esplanade, Collins Street Extension and back

Pattern 3 : Eastern Freeway Group 2: 313, 315, 316;

- extension from Collins Street to Spencer Street Station then
- loop Spencer Street, Latrobe Street Extension, Docklands Esplanade, Collins Street Extension and back

Bus Reliability / Quality Improvements

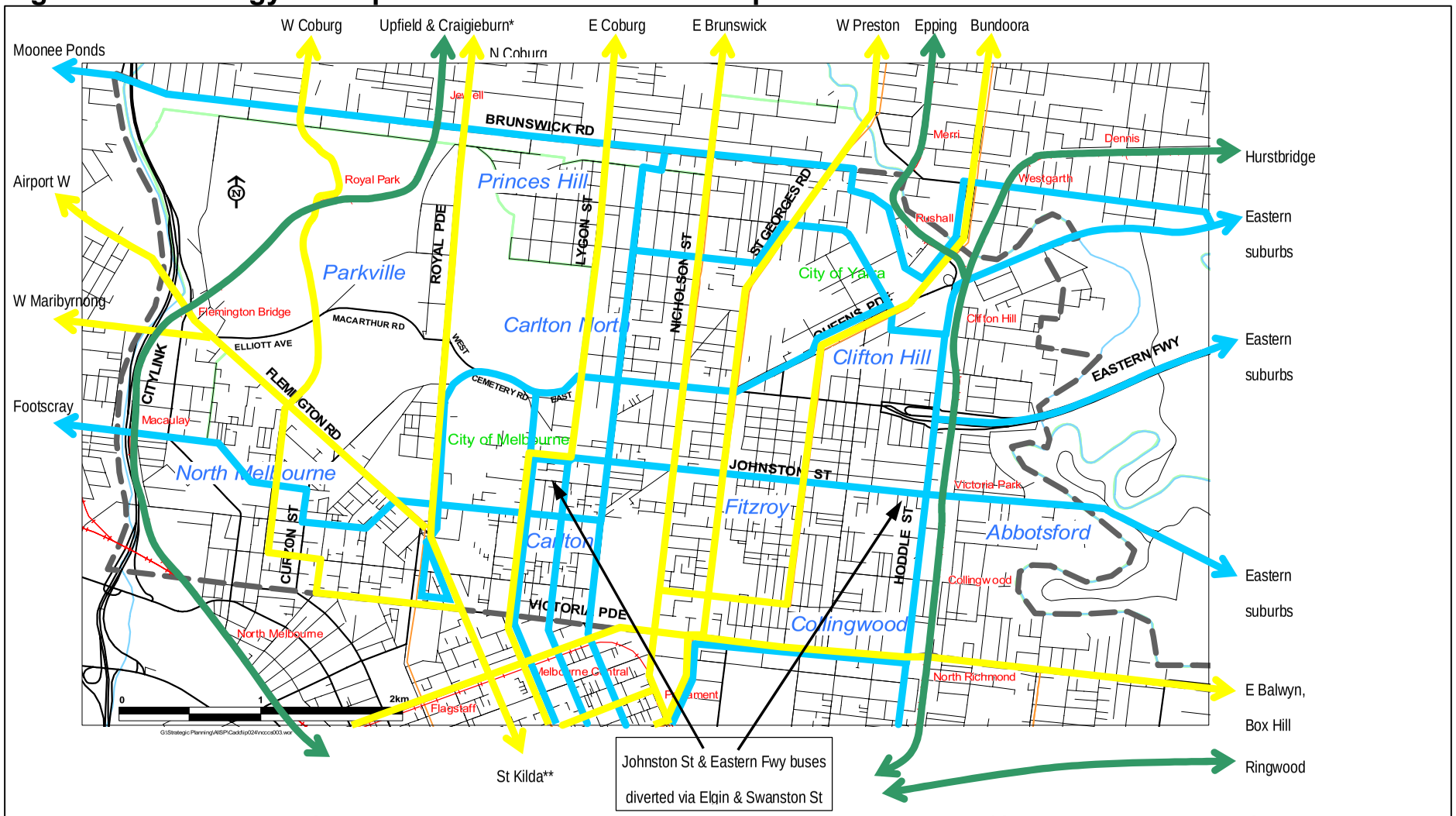
Widespread Smartbus-style improvements:

- To reflect priority measures travel times reduced by 15%
- To reflect changed bus perceptions - in vehicle travel time constant reduced access terminal penalty by 2.5 minutes (33 cents)

Better Quality Intermodal Interchanges

Tram / bus and bus / bus interchanging in the study area - reduce interchange penalties by 25%

Figure 2.1 : Strategy A : Improvements to Public Transport



Rail – increased frequency, improved bus/tram access to stations, improved park and ride, *Craigieburn services via Upfield line

Tram – increased frequency, faster travel times, improved reliability and vehicle quality, **Elizabeth St services extended to St Kilda

Bus – increased frequency, improved route coverage, faster journey times, extended evening services, Smartbus-style improvements

NOTE: Improvements apply throughout the entire lengths of relevant services

Improved Internal Study Area Linkages

East-west bus service Brunswick Road (504):

- Increase frequency to 10 mins in the peak and 15 mins in the off-peak,
- reduce 504/tram and 504/bus interchange penalties by 25%.

Johnston Street and Eastern Freeway bus groups:

- Buses were diverted to operate to the University via Johnston and Elgin Streets, University and Swanston Street to City to provide improved access into and across the study area
- One of the Doncaster Shoppingtown/Eastern Freeway bus services was retained on the existing Hoddle Street/Victoria Parade route into the City these buses use tram fairways where available.
- Includes bus way in both directions, down the median of Johnston Street and Elgin Street. Traffic impacts include:
  - reduced vehicle capacity of Johnston Street and Elgin Street to 2 lanes
  - right turn bans at Brunswick St, Smith St and Wellington St.
- Includes bus lanes in both directions on Hoddle Street between Johnston Street and Alexandra Parade. Loss of one northbound traffic lane on Hoddle Street.

2.2 Types of Travel Modelling Impacts

The forecast impacts of travel in Melbourne are considerable and complex. To assist understanding these impacts we analyse the forecasts from two main perspectives including:

1. **Direct impacts on the Northern Central City Corridor Study Area**. This is divided into three separate component markets:
   - Through Travel (trips passing through the study area)
   - External Travel (trips from and to locations outside the study are that start or finish in the study area)
   - Internal Travel (travel starting and finishing within the study area)
2. **Metropolitan Wide impacts**.

Travel impacts are also investigated in terms of :

- **journeys**, which are linked trip legs ;and
- **boardings**, which represent a single trip leg where a person boards a public transport vehicle.

2.3 Impacts on NCCC Area Travel

2.3.1 Strategic Travel Behaviour Changes

Table 2.1 presents a summary of the major weekday journey impacts suggested by the modelling on the NCCC Area.

Table 2.1 : Strategy A: Total NCCC Journey Impacts by Mode

	Base Case 2021				Strategy A: Significant Public Transport				Difference (Number)				Difference (%)			
	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total
NCCC Corridor																
Through	333,926	153,015	8,561	495,502	292,777	302,838	5,786	601,381	-41,149	49,823	-2,795	5,879	-12%	33%	-33%	1%
To/from	372,440	121,800	139,891	634,131	341,181	171,724	121,213	634,118	-31,259	49,924	-18,678	-13	-8%	41%	-13%	0%
Within	49,122	7,734	50,020	106,876	46,452	12,884	47,541	106,887	-2,670	5,160	-2,479	11	-5%	67%	-5%	0%
TOTAL	755,488	282,549	198,472	1,236,509	680,410	387,496	174,520	1,242,386	-75,078	104,907	-23,952	5,877	-10%	37%	-12%	0%
Mode Share by Market																
NCCC Corridor																
Through	67%	31%	2%		58%	40%	1%						-9%	10%	-1%	
To/from	59%	19%	22%		54%	27%	19%						-5%	8%	-3%	
Within	46%	7%	47%		43%	12%	44%						-3%	5%	-2%	
TOTAL	61%	23%	16%		55%	31%	14%						-6%	8%	-2%	

Impacts on total weekday travel

This indicates that:

- Total NCCC travel increases by 5.9K. This is entirely sourced from through travel.
- NCCC public transport use increases by 105K. This indicates diversion from other modes to public transport. Public transport journey growth is sourced (approximately) from :
  - Car travelers 71%
  - Walk / cycle 22%
  - Trip generation 6%
- Most public transport travel growth is from through and external travel markets (in roughly similar quantities).
- NCCC car travel reduces by 10%
- The biggest reductions in car travel are in through travel markets (-12%)
- Reductions in NCCC car journeys total 75K
- NCCC walk / cycle travel declines by about 24K trips / day or 12%. The bulk of reduced walk travel is external trips (19K).

2.3.2 Temporal Distribution of Impacts

Table 2.2 shows the impact on journeys by time period for NCCC area related travel. This indicates that:

- The general picture of increased transit journeys at the expense of car and walk travel follows through in all time periods
- Most transit journey growth occurs in off peak times (61K). Of reduced car travel 42K or 56% is sourced from off peak times.

- Total NCCC travel currently has a high transit share of travel (23%), this increases to 31%. Transit shares in the a.m. peak grow to 41% and remain the higher share of travel by time period.
- By time period the majority of transit growth occurs in the off peak. However the a.m. peak retains the highest market share (41% for NCCC)

Table 2.2 : Journey Impacts by Time Period – NCCC Related Trips

	Base Case 2021				Strategy A: Significant Public Transport				Difference (Number)				Difference (%)			
	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total
Total NCCC Journeys per Weekday																
A.M. Peak	131,025	75,337	25,948	232,310	115,212	96,519	21,977	233,708	-15,812	21,182	-3,971	1,399	-12%	28%	-15%	1%
P.M. Peak	141,153	67,468	32,536	241,157	124,286	90,336	28,024	242,646	-16,867	22,868	-4,512	1,489	-12%	34%	-14%	1%
Sub-Total Peak	272,178	142,805	58,484	473,467	239,498	186,855	50,001	476,354	-32,680	44,050	-8,483	2,887	-12%	31%	-15%	1%
Off Peak	483,310	139,744	139,988	763,042	440,912	200,601	124,519	766,032	-42,398	60,857	-15,469	2,990	-9%	44%	-11%	0%
Total NCCC	755,488	282,549	198,472	1,236,509	680,410	387,456	174,520	1,242,386	-75,078	104,907	-23,952	5,877	-10%	37%	-12%	0%
Mode Share																
A.M. Peak	56%	32%	11%		49%	41%	9%						-7%	9%	-2%	
P.M. Peak	59%	28%	13%		51%	37%	12%						-7%	9%	-2%	
Sub-Total Peak	57%	30%	12%		50%	39%	10%						-7%	9%	-2%	
Off Peak	63%	18%	18%		58%	26%	16%						-6%	8%	-2%	
Total NCCC	61%	23%	16%		55%	31%	14%						-6%	8%	-2%	

2.3.3 Spatial Distribution of Impacts

Table 2.3 shows an analysis of changes in modal trip patterns by sector of Melbourne between the 2021 base case and the 2021 Strategy A case. This indicates that:

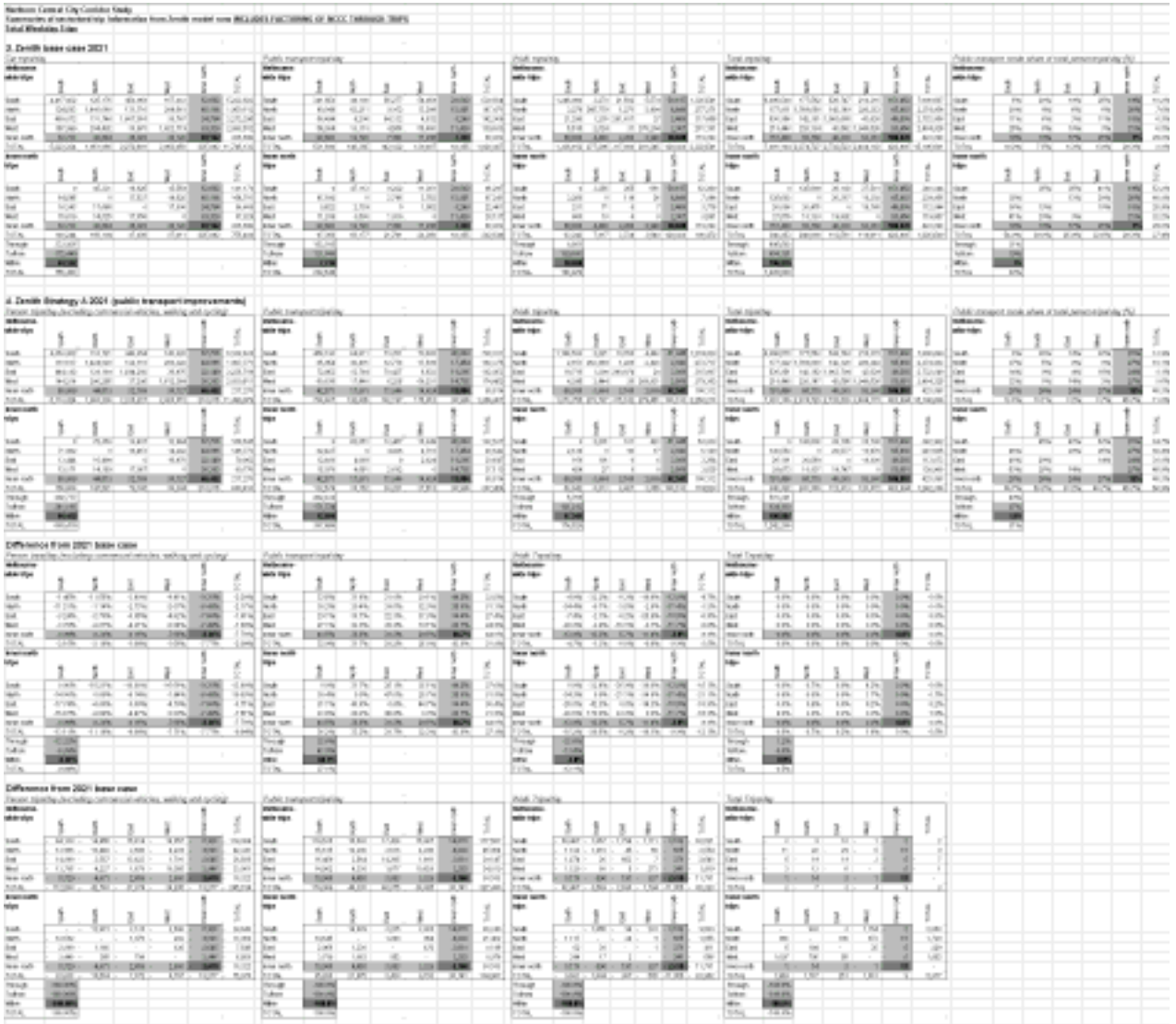
NCCC Public Transport Travel

- As noted the 105K per day (or 37%) increase in NCCC PT travel is mainly sourced from external and through travel. By individual spatial area this indicates that:
  - External travel growth has the highest proportional growth from the South (49%)
  - Through travel growth has the highest proportional growth between the East and North (48-9%) and from West-East (45-6%)
- In volume terms the additional 105K NCCC transit trips are sourced mostly from:
  - Between the North and the South (29K or 28% of transit growth)
  - Between the South and NCCC (28K or 27% of transit growth)
  - Between the North and NCCC (9K or 9%)
  - Between the South and West (8K or 7%)
  - Between the South and East (6K or 6%)

NCCC Car Travel

- As noted the 75K per day (or 10%) decrease in NCCC car travel is mainly sourced from through travel followed by external travel. By individual spatial area this indicates that:
  - External travel decline has the highest proportional growth from the South (9%)

Table 2.3 : Analysis of Spatial Changes in Modal Travel – 2021 Strategy A vs 2021 Base Case



  - Through travel growth has the highest proportional decline between the East and South (18-19%) and from West-South(16-17%)

- In volume terms the reduction of 75K NCCC car trips are sourced mostly from:
  - Between the North and the South (26K or 33% of car decline)
  - Between the South and NCCC (12K or 15% of car decline)
  - Between the North and NCCC (8K or 11%)
  - Between the South and East (6K or 8%)
  - NCCC travel to and from the South accounts for 64% of all decline in car travel.

2.4 Impacts on Metropolitan Wide Travel

Because NCCC lies next to the CBD, the changes to public transport services included in Strategy A include changes to services operating throughout Metropolitan Melbourne. As a result, NCCC travel impacts are only a sub-set of significant changes in travel throughout Metropolitan Melbourne. This section presents a summary of forecast modelled impacts on a Metropolitan Wide basis.

2.4.1 Strategic Travel Behaviour Changes

Table 2.4 presents a summary of the major weekday journey impacts suggested by the modelling.

Table 2.4 : Strategy A: Total Journey Impacts by Mode – Metropolitan Melbourne

	Base Case 2021				Strategy A: Significant Public Transport Improvement				Difference (Number)				Difference (%)			
	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total
Total Journeys per Weekday																
Total Melbourne	11,745,133	1,028,927	2,332,541	15,106,601	11,499,979	1,356,407	2,250,218	15,106,604	-245,154	327,480	-82,325	3	-2%	32%	-4%	0%
Mode Share																
Total Melbourne	78%	7%	15%		76%	9%	15%						-2%	2%	-1%	

This indicates that:

- Total travel does not change. This is to be expected, the forecast has been undertaken with a fixed travel matrix to explore shifts in total travel between modes.
- Total public transport travel increases by 327K journeys. This appears to be principally sourced from:
  - Car travelers 75%
  - Walk / Bike 25%
- Transit mode share increases from 7% to 9%. Car declines by 2% to 76%

2.4.2 Temporal Distribution of Impacts

Table 2.5 shows the impacts on journeys by mode throughout Melbourne for different times of the day.

Table 2.5 : Journey Impacts by Time Period – Total Metropolitan Area

	Base Case 2021				Strategy A: Significant Public Transport				Difference (Number)				Difference (%)			
	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total
Total Journeys per Weekday																
A.M. Peak	1,833,188	262,762	259,613	2,355,563	1,784,053	324,026	247,484	2,355,563	-49,135	61,264	-12,129	0	-3%	23%	-5%	0%
P.M. Peak	2,077,395	212,840	362,510	2,652,745	2,023,636	281,488	347,621	2,652,745	-53,759	68,648	-14,889	0	-3%	32%	-4%	0%
Sub-Total Peak	3,910,583	475,602	622,123	5,008,308	3,807,689	605,514	595,105	5,008,308	-102,894	129,912	-27,018	0	-3%	27%	-4%	0%
Off Peak	7,834,550	553,325	1,710,418	10098293	7,692,290	750,893	1,655,113	10098296	-142,260	197,568	-55,305	3	-2%	36%	-3%	0%
Total Melbourne	11,745,133	1,028,927	2,332,541	15,106,601	11,499,979	1,356,407	2,250,218	15,106,604	-245,154	327,480	-82,323	3	-2%	32%	-4%	0%
Mode Share																
A.M. Peak	78%	11%	11%		76%	14%	11%						-2%	3%	-1%	
P.M. Peak	78%	8%	14%		76%	11%	13%						-2%	3%	-1%	
Sub-Total Peak	78%	9%	12%		76%	12%	12%						-2%	3%	-1%	
Off Peak	78%	5%	17%		76%	7%	16%						-1%	2%	-1%	
Total Melbourne	78%	7%	15%		76%	9%	15%						-2%	2%	-1%	

This indicates that:

- The general picture of increased transit journeys at the expense of car and walk travel follows through in all time periods
- Most transit journey growth occurs in off peak times (60%). Of reduced car travel 58% is sourced from off peak times and 67% of walking
- The a.m. peak retains the highest share of the transit journey travel (14%)

2.5 Impacts on Transit Boardings

2.5.1 Strategic Metropolitan Wide Impacts

Metropolitan wide transit boarding impacts are illustrated in Table 2.6.

Table 2.6 : Modelled Impacts on Transit Boardings – Strategy A

	Base Case 2021		Strategy A: Significant Public Transport Upgrade		Change	
Total PT Journeys	1,028,927		1,356,407		327,480	32%
Total PT Boardings		%Total		%Total		
M> Tram	318,351	21%	648,551	27%	330,200	104%
Yarra Tram	265,983	17%	546,622	23%	280,639	106%
Sub-Total Tram	584,334	38%	1,195,173	51%	610,839	105%
M> Train	333,499	22%	419,815	18%	86,316	26%
Connex	236,680	15%	270,095	11%	33,415	14%
Sub-Total Rail	570,179	37%	689,910	29%	119,731	21%
Metro Bus	371,536	24%	466,821	20%	95,285	26%
Other	13,123	1%	14,162	1%	1,039	8%
Total	1,539,172		2,366,066		826,894	54%
Boardings per Journey	1.50		1.74		2.53	

This indicates that for Metropolitan wide travel:

- Whilst total transit journeys increase by 31%, boardings increase by 54%. This is suggestive of considerable increases in transferring behaviour
- Average boardings per transfer increase from 1.50 (base case, which is high) to 1.74 with new transit journeys have an average transfer of 2.53 per journey (an exceptionally high number)
- There are over 826K additional transit boardings per weekday.
- 611K or 74% of this growth occurs on trams which effectively double metropolitan wide usage as part of this option
- Rail boardings increase by 119K or a more modest 21% although interestingly boardings on M>Train increase by more than twice those on Connex trains
- Bus usage increases by 95K (or 26%) a similar volume to that of rail.

2.5.2 Boarding Forecasts by Time Period

Table 2.7 illustrates the change in transit boardings by time period associated with Strategy A modelling. This indicates that for <u>total Metropolitan Travel</u>:

- Whilst total boardings increase by 54%, P.M. Peak boardings increases are a higher (60%)

- By transit mode, tram has by far the highest boardings growth, although interestingly the proportional increase in boardings is higher in the peak than interpeak for both tram companies but particularly so for Yarra whos a.m. peak market increases by 150%. It will be important area to examine maximum loading points for overloading on services.

Table 2.7 : Change in Transit Boardings by Time Period – <u>Metropolitan Melbourne</u>

	Base Case 2021				Strategy A: Significant Public Transport Upgrade				Change From Base Case							
Total PT Boardings	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total
M> Train	69,961	179,091	69,309	318,361	143,138	362,571	142,852	648,561	73,177	183,480	73,543	330,200	105%	102%	106%	104%
Yarra Tram	46,643	169,825	49,705	266,983	136,468	311,211	139,968	546,822	89,803	141,386	89,263	280,639	192%	83%	179%	105%
Sub-Total Tram	116,604	348,716	119,014	584,334	279,584	673,782	281,807	1,195,173	162,980	325,066	162,793	810,839	123%	93%	120%	105%
M> Train	102,648	149,693	81,358	333,499	121,551	196,898	101,366	419,815	18,903	47,205	20,208	86,316	18%	32%	25%	26%
Connex	75,305	100,909	62,466	238,680	78,998	121,808	69,280	270,086	3,694	20,897	6,824	33,415	5%	21%	11%	14%
Sub-Total Rail	177,953	250,602	143,824	572,179	200,550	318,704	170,666	689,910	22,597	68,102	29,032	119,731	13%	27%	20%	21%
Metro Bus	96,189	215,686	59,742	371,636	121,391	262,847	82,783	466,821	24,982	47,262	23,061	95,286	26%	22%	39%	26%
Other	6,066	3,636	3,421	13,123	7,214	3,417	3,531	14,162	1,148	-219	110	1,039	19%	-6%	3%	8%
Total	396,822	818,549	323,801	1,539,172	688,529	1,268,750	619,787	2,366,066	191,707	440,201	194,986	826,894	48%	54%	60%	54%
Time Period Share	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total				
M> Train	22%	56%	22%	100%	22%	56%	22%	100%	22%	56%	22%	100%				
Yarra Tram	18%	64%	19%	100%	21%	57%	22%	100%	25%	50%	25%	100%				
Sub-Total Tram	20%	60%	20%	100%	22%	56%	23%	100%	23%	53%	23%	100%				
M> Train	31%	45%	24%	100%	29%	47%	24%	100%	22%	55%	23%	100%				
Connex	32%	43%	26%	100%	29%	45%	26%	100%	11%	53%	26%	100%				
Sub-Total Rail	31%	44%	25%	100%	29%	46%	25%	100%	19%	57%	24%	100%				
Metro Bus	26%	58%	16%	100%	26%	56%	18%	100%	26%	50%	24%	100%				
Other	46%	28%	26%	100%	51%	24%	25%	100%	110%	-21%	11%	100%				
Total	26%	53%	21%	100%	29%	53%	22%	100%	23%	53%	24%	100%				

2.5.3 Individual Service and Route Boarding Impacts

Total Daily Boardings Impacts

Table 2.8 shows the changes in transit boardings by individual route or line. NCCC related services are highlighted in this discussion. Changes are shown for two sets of forecasts:

- for travel between 2000 and 2021 base case's
- for travel between the 2021 base case and Strategy A in 2021.

The two sets of forecasts enable a better understanding of the magnitude of changes in boardings relative to current levels of service usage.

Table 2.8 indicates that by transit mode:

Rail

- Considerable growth is expected on all services by the 2021 base case. Of particular note are boardings increases on the NCCC line services; the Epping line, which increases by 70% and the Upfield Line which has boarding increases of 65%
- Strategy A results in more modest growth overall compared to the above (21%) with Bayside services realising the higher growth impacts (26%) over Hillside (14%)
- Particular services where growth is higher than average are:
  - Upfield Line (specifically upgraded as part of Strategy A)
  - Werribee and St Albans Lines

Tram

- Metro wide baordings growth of 34% is expected by 2021 for Trams with Yarra services experiencing higher growth (43%).
- Strategy A results in significantly higher boardings ; more than double for both Yarra and Swanston tram groups
- Services where the growth impacts of Strategy A are particularly significant are generally NCCC related including (in order of growth):
  - Routes 23/42/109 Mont Albert (+353% on year 2000 loads)
  - Route 11 West Preston (+260% on year 2000 loads)
  - Route 19 North Coburg (+248% on year 2000 loads)
  - Route 59 Airport West (+226% on year 2000 loads)
  - Route 86 Bundoora (+180% on year 2000 loads)

Table 2.8 : Change in Boardings by NCCC Service –Total Weekday

TRAIN			Modelled Boardings					
Line		Stations	2000	2021 Base		2021 A - PT Imps		
				No	% 2001	No	% 2001	% 2021
Bayside	Broadmeadows	Broadmeadows to Flinders St	30,278	47,292	56%	54,743	81%	16%
	Frankston	Mordialloc to Frankston	44,053	57,992	32%	62,184	41%	7%
	Pakenham	Flinders St to Pakenham	50,327	76,108	51%	82,477	64%	8%
	Sandringham	Flinders St to Sandringham	26,567	35,386	33%	39,670	49%	12%
	St Albans	St Albans to Flinders Street	25,856	48,256	87%	74,006	186%	53%
	Stony Point	Frankston to Stony Point	1,111	1,973	78%	2,204	98%	12%
	Upfield	Upfield to Flagstaff	10,839	17,884	65%	29,221	170%	63%
	Werribee	Flinders St to Werribee	19,569	39,086	100%	61,872	216%	58%
	Williamstown	Williamstown to Flinders St	6,442	9,523	48%	13,430	108%	41%
	Sub-total		215,042	333,499	55%	419,815	95%	26%
Hillside	Hillside							
	Alamein	Camberwell to Alamein	6,295	8,862	41%	11,540	83%	30%
	Belgrave	Flinders St to Blackburn	32,161	41,702	30%	39,737	24%	-5%
	Epping	Epping – Parliament	28,806	49,002	70%	50,672	76%	3%
	Glen Waverley	Flinders St – Glen Waverley	26,668	41,464	55%	51,760	94%	25%
	Hurstbridge	Greensborough – Flinders St	28,154	40,371	43%	51,037	81%	26%
	Lilydale	Parliament to Lilydale	43,730	55,279	26%	65,349	49%	18%
	Sub-total		165,813	236,680	43%	270,095	63%	14%
	All Rail		380,855	570,179	50%	689,910	81%	21%

TRAM			Modelled Boardings					
Route No		Suburbs	2000	2021 Base		2021 A - PT Imps		
				No	% 2001	No	% 2001	
Swanston	1	Sth Melbourne Beach to East Co	16,264	23,886	47%	65,587	242%	139%
	16	Melb University to St. Kilda Beach	8,603	11,321	32%	17,820	107%	57%
	19	City to North Coburg	32,516	39,466	21%	112,997	248%	186%
	22	Arts Centre to Moreland	7,853	10,527	34%	26,420	236%	151%
	3	Melb University to East Malvern	12,039	15,150	26%	28,535	137%	88%
	5	Melbourne University to Malvern	8,924	11,549	29%	18,227	104%	58%
	50	North Melbourne to City	1,596	2,186	37%	3,683	131%	68%
	55	West Coburg to Domain Rd	19,634	26,262	34%	37,509	91%	43%
	57	City to West Maribyrnong	14,097	16,397	16%	25,815	83%	57%
	59	City to Airport West	26,480	33,112	25%	86,365	226%	161%
	6	University to Glen Iris	13,710	17,413	27%	29,865	118%	72%
	64	University to East Brighton	11,846	15,117	28%	22,864	93%	51%
	67	University to Carnegie	14,141	18,990	34%	33,796	139%	78%
	69	St Kilda Beach to Kew	14,417	18,710	30%	44,046	206%	136%
	72	Melbourne University to Camber	19,591	24,681	26%	42,235	116%	72%
	78 & 79	North Richmond to Prahran	6,885	8,230	20%	13,130	91%	60%
	8	Melbourne University to Toorak	16,292	21,151	30%	42,617	162%	101%
	82	Moonee Ponds to Footscray	3,764	4,303	14%	6,930	84%	61%
	Sub-total		248,621	318,351	28%	648,551	161%	104%
Yarra	11	City to West Preston	20,602	26,843	30%	74,141	260%	176%
	12	St Kilda to City	10,049	14,425	44%	27,839	177%	93%
	23 / 42 / 109	City to Mont Albert	26,385	44,706	69%	119,628	353%	168%
	24 & 48	City to North Balwyn	18,433	23,923	30%	32,150	74%	34%
	30 & 34	City to East Melbourne	2,759	4,297	56%	8,298	201%	93%
	70	City to Wattle Park	18,764	24,457	30%	38,922	107%	59%
	75	City to East Burwood	16,488	30,380	84%	64,557	291%	80%
	86	City to Bundoora	32,444	44,550	37%	90,859	180%	104%
	96	St Kilda to East Brunswick	23,771	31,262	32%	73,869	211%	136%
	City Circle	Within CBD	13,339	17,457	31%	13,491	1%	-23%
	Sub-total		183,034	262,200	43%	533,754	192%	104%
	All Tram		431,655	580,551	34%	1,182,305	174%	104%

BUS			Modelled Boardings					
Route Name		Suburb	2000	2021 Base		2021 A - PT Imps		
				No	% 2001	No	% 2001	
Clifton Hill to Brunswick Rd	504	Moonee Ponds to Clifton Hill	449	454	1%	1,239	176%	173%
- Northern Bus Lines	Sub-total		449	454	1%	1,239	176%	173%
East Melb to Footscray	402	Footscray to East Melbourne	4,017	3,545	-12%	6,690	67%	89%
- SETA	Sub-total		4,017	3,545	-12%	6,690	67%	89%
Eastern Freeway Group	301	The Pines to City	1,656	2,033	23%	3,835	132%	89%
- National	302	Box Hill to City	932	847	-9%	2,248	141%	165%
	303	Mitcham Stn to City	32	30	-6%	884	2663%	2847%
	304	Ringwood Stn to City	1,832	1,670	-9%	3,661	100%	119%
	305	City to Warrandyte Bridge	1,650	1,765	7%	1,986	20%	13%
	306	North Ringwood to City	378	329	-13%	884	134%	169%
	307	Mitcham to City	2,627	2,638	0%	6,230	137%	136%
	308	Deep Creek to City	631	612	-3%	814	29%	33%
	309	Donvale to City	836	850	2%	1,929	130%	126%
	313	City to Templestowe	58	71	22%	792	1266%	1015%
	315	City to Box Hill	20	20	0%	477	2286%	2286%
	316	Templestowe to City	107	123	15%	614	474%	399%
	319	The Pines to City	299	319	7%	987	230%	209%
	350	City to Latrobe Uni	1,525	1,426	-6%	4,611	202%	223%
	Sub-total		12,585	12,741	1%	29,952	138%	135%
Hoddle Street – National	246	Latrobe Uni to Elsternwick	6,058	6,339	5%	5,789	-4%	-9%
	Sub-total		6,058	6,339	5%	5,789	-4%	-9%
Johnston Street Group	200	Doncaster to City	1,248	1,566	25%	2,385	91%	52%
- National	201	Doncaster to City	1,412	1,446	2%	2,751	95%	90%
	203	Doncaster to City	1,127	1,210	7%	2,237	98%	85%
	205	Doncaster to Melbourne Uni	279	320	15%	560	101%	75%
	207	Donvale to City	2,044	2,168	6%	4,028	97%	86%
	Sub-total		6,110	6,710	10%	11,961	96%	78%
Queens Pde to Melb Uni	546	Melbourne Uni to Heidelberg	936	720	-23%	564	-40%	-22%
- Dysons	Sub-total		936	720	-23%	564	-40%	-22%
Rathdowne Street Group	250	Port Melbourne to Latrobe Uni	2,068	2,761	34%	3,882	78%	39%
- National	251	Port Melbourne to Northland SC	1,620	2,088	29%	3,531	118%	69%
	253	Port Melbourne to Carlton North	275	327	19%	801	191%	145%
	Sub-total		3,963	5,176	31%	8,814	182%	55%
	All Bus		34,119	35,685	5%	64,209	88%	80%

Under strategy A the above routes will carry more demand than all of Melbourne's 2 tram groups currently carry .

Bus

- By the 2021 base case there is little change expected in bus demand.
- Strategy A results in substantial bus growth (+80%) dominated by growth in demand on the NCCC related services; the Eastern Freeway group of services (+135%) and also the Johnston Street Group (+78%)

A.M. Peak Boarding Impacts – Study Area Services

Table 2.9 shows some of the spatial changes in study area bus route loadings for the A.M. Peak. It also shows the numbers of services offered in each case. This assists in understanding how service levels as well as patronage have changed.

Table 2.9 : Changes in Key Study Area Bus Route Loadings – A.M. Peak

Group	Base 2001	Base 2021	2021 Strategy A	
	Boardings/Vehicle Trips	Boardings/Vehicle Trips	Boardings/Vehicle Trips	% Change from 2021 Base
Eastern Freeway Group	4,261 / 91	4,280 / 91	9,605 / 228	+124% / +151%
Johnson Street Group	1,043 / 29	1,153 / 29	3,788 / 96	+142% / +131%

This indicates that:

- There is not much change between the 2001 and 2021 base case
- Demand increases considerably on both route groups in Strategy A, however only in the Johnson Street group is demand growth higher than the increased number of vehicle trips offered.

Table 2.10 shows the spatial changes in study area tram route loadings for the A.M. Peak. This indicates that:

- All tram corridors have growth between 2001 and 2021 associated with frequency increases
- For Strategy A, the highest growth is on the Royal Parade and Brunswick Street Trams (over 200%)
- The largest group by volume is the University Group; this has one of the lower growth levels for Strategy A (+71%) although this is still a considerable increase in growth. However this group has no service level changes in Strategy A.
- In all cases the growth in demand for Strategy A is higher than growth in service frequencies

- All tram services with no frequency growth in Strategy A have demand growth; some e.g. route 86 (Smith Street) have considerable growth (+123%)

Table 2.10 : Changes in Key Study Area Tram Route Loadings – A.M. Peak (2 Hour)

Group	Base 2001	Base 2021	2021 Strategy A	
	Boardings/Vehicle Trips	Boardings/Vehicle Trips	Boardings/Vehicle Trips	% Change from 2021 Base
96 – Nicholson Street	4,117 / 34	5,458 / 42	14,349 / 62	+163 / +48
86 – Smith / Queens Pde	6,259 / 36	8,864 / 47	19,765 / 47	+123 / 0
11 – Brunswick St / St Georges Road	4,859 / 42	6,405 / 53	19,338 / 74	+202 / +40
109, 23, 24 & 42 – Victoria Parade Group	6,157 / 42	10,236 / 42	27,896 / 74	+169 / +76
3, 5, 6, 8, 16, 64, 67, 72 – the University group	22,524 / 188	29,169 / 238	49,979 / 238	+71 / 0
1,22 – Lygon Street	5,763 / 56	8,334 / 72	20,142 / 110	+142 / +53
19 – Royal Pde.	5,848 / 38	7,159 / 48	24,383 / 76	+236 / +58
55, 68 – Royal Park	5,152 / 47	7,850 / 58	9,508 / 58	+21 / 0
50,57 North Melbourne	2,776 / 28	3,685 / 37	5,966 / 37	+62 / 0
59 Mt Alexander Rd	5,679 / 44	6,828 / 53	18,727 / 83	+174 / +57

Note: Only a.m. peak data to this detail is available at this stage

Table 2.10 also indicates that a.m. peak tram vehicle movements on Swanston Street are likely to total around to 80-90 per hour in one direction range. This is suggestive of average headways around the 40 second range for the full 2 hours of the A.M. Peak (in practice peak of the peak headways may be in excess of this). We doubt if these headways are feasible on Swanston Street. In practice since trams do not run with even gaps between arrivals a 40 second headway will imply 'platooning' of vehicles and shunting of trams between intersections as traffic lights change. It is likely that in these circumstances, practical headways will be determined by :

- the phasing of traffic lights on Swanston Street ;and
- the distance between traffic intersections (in terms of the number of trams which can be held there) ; and
- the length of tram stop boarding and alighting areas (in terms of number of trams that can be held there); and
- methods of organising the boarding and alighting of tram vehicles and the impacts this has on dwell times (current practice includes same door boarding and alighting and ad hoc loadings to individual vehicles). There is potential for separate door or side of vehicle loading and unloading and also for coordination of loading / unloading time by groups of vehicles to match traffic light sequences).

These results indicate the need for management of tram vehicle flows within Melbourne CBD. A number of potential options for managing this are identified later in this section.

2.6 Peak Maximum Load Impacts

Peak maximum load analysis is important in establishing the feasibility of the options tested. The modelling of demand does not constrain passengers to board vehicles if they are full as happens in the 'real world'. Hence the model allows overloaded vehicles and it is necessary to check this to ensure service design is reasonable.

Earlier analysis established that with Strategy A total a.m. peak all mode transit journeys increased by 23% whilst boardings increased by 48%. Trams were particularly highly impacted since M>Tram a.m. peak boardings increase by 105% and Yarra by 150%.

Tables 2.11 to 2.13 illustrate peak maximum load point demand volumes and the number of runs by service and option for study area buses, trams and train. It also shows the average maximum load per vehicle; the key measure of overloading.

It should be noted that modelling of maximum load demands for specific routes and services is an inexact science. It stretches the capability of any model to represent demand in a specific area for a specific time period with accuracy equivalent to the real world, hence identifying maximum load demand is particularly difficult.

Tables 2.11 to 2.13 illustrates maximum load demand per vehicle trip for bus, tram and train for the 2001 base case and also for the 2021 base case and strategy A. In this way we can assess the accuracy of the model by reference to its representation of 2001 base case loads and assess the potential impacts for Strategy A within this light.

2.6.1 Bus

There is a wide range of possible bus vehicle sizes enabling maximum passenger load capacities per vehicle ranging from 45 (standard bus) up to around 120 for an articulated or stretch rigid vehicle. Key findings for Bus in Table 2.11 are:

Bus 2001 Base

- There is a wide range of maximum loads per bus including some very low values. As noted we are not overly surprised by this; achieving accurate transit maximum loading is an inexact art rather than a science.
- In general bus loadings are within achievable bus vehicle capacities

Bus 2021 Base

- There is a mixed bag of impacts on maximum loads including:
  - A general increase in Rathdowne Street group loadings; these will probably be a concern for bus capacity planning since the modelled percentage change in max load is high (up to 182%)

  - Hoddle Street, route 246 and 504 loadings are down
  - There is a mix of impacts on the important Eastern Freeway and Johnson Street services
- In general bus max loads are within capacity thresholds

Bus 2021 Strategy A

- Strategy A impacts relative to the 2021 base case are also mixed:
  - All Johnson Street service maximum loadings are down suggesting some opportunity to save peak bus resources in this corridor
  - The impact on the Eastern Freeway group is mixed; overall some balancing of capacity within the group will be needed however there are no clear indications of overloading or underloading
  - Hoddle Street route 246, the East Melbourne-Footscray route 402 and the Clifton Hill-Brunswick route 504 all have consistent growth in Strategy A. This is probably lead to overloading concerns on these routes unless higher capacity vehicles are available.
  - Rathdowne street services, already under maximum load demand pressure in the 2021 base case, have further increases in Strategy A (in the peak direction). Again peak capacity may be a concern.
  - The new bus routes in Strategy A, which increase coverage of the Eastern Freeway service catchment, have relatively light maximum loadings. Some reductions in headways would probably be warranted.
- In general bus max loads are within capacity thresholds

Our overall impression of these results is that they suggest that bus frequency and capacities are appropriate to the demands forecast. As noted peak maximum load work is an inexact science and our conclusions must be viewed in this light. In practice more detailed route and service planning will be needed to adjust bus service design appropriate to this strategy as it is developed.

Table 2.11 Modelled Bus Maximum Load Results for Strategy A

COMPARISON OF MAXIMUM A.M. PEAK LOADINGS - BUS

Route Number	Direction	2001 Base			2021 Base				2021 Strategy A			
		No. of Services	Load at Max. Load Point	Average Load per Vehicle	No. of Services	Load at Max. Load Point	Average Load per Vehicle	Change in Av. Load per Vehicle from 2001	No. of Services	Load at Max. Load Point	Average Load per Vehicle	Change in Av. Load per Vehicle from 21 base
Clifton Hill - Brunswick Rd												
Bus 304	Eastbound	5	56	11	3	31	6	-45%	12	77	6	3%
	Westbound	5	24	5	3	21	4	-13%	12	79	7	57%
East Melb - Footscray												
Bus 402	Eastbound	12	152	13	12	61	5	-60%	12	364	28	437%
	Westbound	12	489	41	12	551	46	13%	12	999	83	81%
Eastern Freeway Group												
Bus 301	Eastbound	1	18	18	1	13	12	-33%	12	209	17	46%
	Westbound	10	465	47	10	587	59	26%	12	532	44	-24%
Bus 302	Eastbound	2	18	9	2	17	9	-6%	12	138	12	55%
	Westbound	8	235	29	8	263	27	-8%	12	334	28	-28%
Bus 303	Westbound	2	15	8	2	12	6	-20%	12	368	31	411%
Bus 304	Eastbound	1	40	40	1	34	34	-16%	10	282	28	-16%
	Westbound	4	198	50	4	167	42	-16%	8	363	48	-3%
Bus 304 Variation 1	Eastbound	2	54	27	2	69	35	28%	2	73	36	4%
	Westbound	3	162	54	3	136	45	-16%	3	180	36	-21%
Bus 305	Eastbound								8	46	7	
	Westbound	1	65	65	1	52	52	16%	1	131	26	-50%
Bus 305 Variation 1	Eastbound	1	19	19	1	23	23	21%	1	12	12	-48%
	Westbound	7	258	37	7	266	38	10%	7	267	38	-28%
Bus 305 Variation 2	Eastbound	2	50	25	2	38	19	-24%	2	24	12	-37%
Bus 306	Westbound	4	139	35	4	134	34	-4%	10	358	36	7%
Bus 306 Variation	Westbound	2	88	44	2	88	40	-9%	2	74	37	-8%
Bus 307	Eastbound	2	61	31	2	48	24	-21%	12	386	31	27%
	Westbound	8	224	28	8	267	33	19%	12	312	26	-22%
Bus 308	Westbound	7	256	37	7	251	36	-2%	12	258	22	-40%
Bus 309	Westbound	5	248	48	5	253	51	5%	12	615	51	8%
Bus 313	Westbound	2	27	14	2	37	19	37%	12	320	27	48%
Bus 312	Eastbound	1	5	5	1	4	4	33%	12	122	10	154%
Bus 316	Westbound	3	63	21	3	76	25	21%	12	261	22	-14%
Bus 350	Eastbound	6	173	29	6	121	20	-30%	12	234	19	-7%
	Westbound	7	227	32	7	192	27	-16%	12	492	41	49%
Huddle Street												
Bus 246	Northbound	1	44	44	1	42	42	-5%	1	80	80	90%
Bus 246 Variation	Northbound	8	167	21	8	141	18	-16%	10	191	19	8%
	Southbound	12	860	72	12	784	66	-8%	12	952	80	25%
Johnston Street Group												
Bus 200 Variation	Eastbound	4	111	28	4	141	35	27%	12	125	10	-71%
	Westbound	5	79	16	5	84	17	6%	12	139	12	-11%
Bus 201	Eastbound	4	55	14	4	52	13	-6%	12	111	9	-29%
	Westbound	4	89	22	4	88	22	-1%	12	215	18	-19%
Bus 202	Westbound	3	71	24	3	87	29	23%	12	213	18	-39%
Bus 203	Westbound	2	31	16	2	32	16	3%	12	161	14	-14%
Bus 207	Eastbound	4	81	20	4	73	18	-10%	12	120	11	-42%
Bus 207 Variation	Westbound	3	64	21	3	71	24	11%	12	275	23	-11%
Queens Pde - Melb Uni												
Bus 546	Eastbound	4	33	8	4	21	5	-36%	4	20	5	-5%
	Westbound	4	34	9	4	28	7	-16%	4	22	6	-24%
Rathdowne Street Group												
Bus 250	Northbound	7	109	16	7	133	22	42%	12	149	12	-44%
	Southbound	6	91	15	6	188	31	107%	11	287	26	95%
Bus 250 Variation 1	Northbound	1	5	5	1	9	9	80%	1	5	5	-44%
Bus 250 Variation 2	Southbound	1	11	11	1	31	31	182%	1	36	36	95%
Bus 251	Northbound	5	88	18	5	183	21	17%	12	171	14	-31%
	Southbound	5	93	14	5	171	31	124%	12	436	36	95%
New Bus Routes												
Bus 20A	Eastbound	-	-	-	-	-	-	-	12	182	9	-
Bus 20A	Westbound	-	-	-	-	-	-	-	12	289	17	-
Bus 20B	Eastbound	-	-	-	-	-	-	-	12	147	12	-
Bus 20B	Westbound	-	-	-	-	-	-	-	12	193	16	-
Bus 30A	Eastbound	-	-	-	-	-	-	-	12	276	23	-
Bus 30A	Westbound	-	-	-	-	-	-	-	12	88	7	-
Bus 30B	Eastbound	-	-	-	-	-	-	-	12	179	13	-
Bus 30B	Westbound	-	-	-	-	-	-	-	12	286	24	-
Bus 30C	Eastbound	-	-	-	-	-	-	-	12	216	18	-
Bus 30C	Westbound	-	-	-	-	-	-	-	12	481	40	-
Bus 30D	Eastbound	-	-	-	-	-	-	-	12	56	5	-
Bus 30D	Westbound	-	-	-	-	-	-	-	12	89	7	-
Bus 30E	Eastbound	-	-	-	-	-	-	-	12	67	5	-
Bus 30E	Westbound	-	-	-	-	-	-	-	12	120	10	-
Bus Huddle St/Victor	Eastbound	-	-	-	-	-	-	-	12	4	3	-
Bus Huddle St/Victor	Westbound	-	-	-	-	-	-	-	12	57	5	-

A.M. Peak Lasts for 2 Hours between 07:00 and 09:00

2.6.2 Trams

Reasonable maximum capacities for tram and light rail range from around 50 to 150 per vehicle (excluding high capacity multiple tram sets). Maximum load demand results for Tram are shown in Table 2.12. These suggest:

Trams 2001 Base

- Modelling of the existing maximum loads on tram services is generally within feasible capacity however we suggest that estimates are generally on the high side with specific services (19, 55, 59, 67, 42, 86) being much higher than actually occurs.

Trams 2021 Base

- Despite increases in capacity of tram services between 2001 and 2026, growth in maximum loadings suggests higher capacity is required for some routes (55, 59, 8, 109).

Trams 2021 Strategy A

- Despite further increases in peak capacity in Strategy A, maximum loading generally increases some considerably beyond reasonable existing capacity bounds:
  - Routes 19, 55, 11, 109 and 86 have average peak max loads between 200 and 300 per vehicle
  - Routes 1, 3, 57, 59, 67, 8, 23, 24, 70, 75 and 96 have average peak max loads in the 100-200 per vehicle range
- Should these loading forecasts eventuate, additional strategy measures would be necessary. Possible options include either:
  - Increased vehicle capacity (articulated tram sets); and / or
  - Increased frequency (additional trams / hour); and / or
  - Suppression of demand (probably by fare increases).
- In addition to the loading issues identified, the model is also suggesting that combined vehicle movements on trams in Swanston Street will become very high making it difficult to maintain effective headways. In effect tram vehicle congestion will result in a slow service. Options worth considering to address such a problem should it eventuate include :
  - Upgrading to higher capacity transit modes e.g. Heavy rail
  - Double deck trams
  - Operation of trams in tunnels or with large amounts of traffic intersection grade separation
  - Spreading out tram operations from concentration on a single major thoroughfare (Swanston Street) to other options. Bifurcating routes to operate Swanston Street and Elizabeth Street and / or William Street would be a possible option here.

Table 2.12 Modelled Tram Maximum Load Results for Strategy A

COMPARISON OF MAXIMUM A.M. PEAK LOADINGS - TRAM

Route Number	Direction	2001 Base			2021 Base			Change in Av. Load per Vehicle from 2001	2021 Strategy A			Change in Av. Load per Vehicle from 21 base
		No. of Services	Load at Max. Load Point	Average Load per Vehicle	No. of Services	Load at Max. Load Point	Average Load per Vehicle		No. of Services	Load at Max. Load Point	Average Load per Vehicle	
New Light Rail Services												
Light Rail North B4	Eastbound	-	-		13	1,140	79	-	17	2,327	168	121%
	Westbound	-	-		13	164	11	-	15	630	41	272%
Swanston Trams												
Tram 1	Northbound	12	736	66	13	1,040	78	6%	24	2,140	89	28%
	Southbound	15	959	64	28	1,753	88	37%	30	4,188	140	60%
Tram 16	Northbound	13	726	56	17	918	54	-3%	17	946	56	3%
	Southbound	13	337	26	17	586	35	36%	17	897	53	50%
Tram 19	Northbound	15	1,960	127	28	2,519	126	-1%	30	9,827	301	139%
	Southbound	20	1,771	89	24	2,127	89	0%	40	6,844	171	72%
Tram 19 Variation 2	Northbound	2	256	85	4	351	88	3%	6	1,539	257	192%
Tram 22	Northbound	12	837	59	13	948	63	7%	24	1,664	69	10%
	Southbound	18	803	89	17	713	42	9%	24	1,788	74	76%
Tram 22 Variation 1	Northbound	4	5	1	3	4	1	7%	3	3	1	-53%
Tram 3	Northbound	10	580	58	12	683	57	-2%	12	1,270	107	87%
	Southbound	8	350	44	18	516	32	25%	10	645	65	25%
Tram 3 Variation 1	Southbound	5	50	10	6	52	9	-13%	6	43	7	-17%
Tram 3 Variation 2	Southbound	1	48	48	1	83	83	54%	1	81	81	28%
Tram 5	Northbound	10	558	56	12	658	55	-2%	12	881	73	34%
	Southbound	9	270	34	18	421	42	25%	10	592	59	38%
Tram 55	Northbound	12	1,260	108	13	1,720	132	68%	13	3,061	237	42%
	Southbound	20	1,307	66	28	2,450	92	24%	30	1,880	60	-27%
Tram 55 Variation 1	Northbound	11	800	28	13	943	26	-4%	13	663	51	90%
Tram 57	Eastbound	15	1,177	78	28	1,523	66	-16%	30	2,828	101	62%
	Westbound	15	607	47	17	1,281	75	59%	17	1,219	72	1%
Tram 58	Northbound	17	1,305	77	28	1,857	93	21%	30	5,294	130	169%
	Southbound	30	2,401	120	24	2,400	138	-17%	40	6,829	171	71%
Tram 58 Variation 1	Northbound	7	50	7	8	71	8	10%	13	220	11	122%
Tram 6	Northbound	12	670	57	13	825	53	-3%	13	1,203	87	68%
	Southbound	10	359	36	12	589	58	39%	12	881	73	47%
Tram 6 Variation 1	Northbound	2	12	6	3	13	5	-17%	3	39	13	100%
	Southbound	1	54	54	1	61	61	79%	1	79	79	30%
Tram 6 Variation 2	Northbound	2	110	55	3	126	45	-18%	3	183	61	36%
Tram 64	Northbound	11	648	59	13	797	61	4%	13	1,807	84	36%
	Southbound	7	364	52	8	384	48	13%	9	316	37	34%
Tram 64 Variation 1	Southbound	2	4	2	3	4	1	-33%	3	3	3	100%
Tram 64 Variation 2	Southbound	1	39	39	1	47	47	62%	1	69	69	47%
Tram 67	Northbound	15	1,300	85	17	1,483	93	-2%	17	1,898	111	35%
	Southbound	7	208	30	8	328	38	20%	9	360	43	78%
Tram 67 Variation 1	Southbound	4	7	2	5	8	2	5%	5	69	14	867%
Tram 67 Variation 2	Southbound	2	76	38	3	132	44	16%	3	180	60	58%
Tram 69	Northbound	12	881	73	13	1,140	76	4%	13	2,423	162	113%
	Southbound	12	572	48	15	788	52	9%	15	1,533	164	99%
Tram 69 Variation 1	Northbound	7	149	21	9	182	20	-5%	9	466	34	168%
	Southbound	5	121	24	6	147	25	1%	6	312	52	112%
Tram 69 Variation 2	Southbound	1	17	17	1	24	24	41%	1	70	70	192%
Tram 72	Eastbound	9	452	50	12	788	65	29%	12	837	70	25%
	Westbound	10	566	57	12	669	56	-2%	12	1,089	91	64%
Tram 72 Variation 1	Eastbound	1	27	27	1	38	38	41%	1	79	79	108%
Tram 78	Northbound	10	373	38	12	408	34	-4%	12	672	56	58%
	Southbound	9	258	29	12	396	33	15%	12	663	55	87%
Tram 8	Northbound	13	816	63	17	977	57	-6%	17	2,564	151	157%
	Southbound	13	767	59	17	1,074	63	37%	17	1,812	107	32%
Tram 82	Northbound	8	264	33	18	258	26	-20%	10	454	45	78%
	Southbound	9	250	28	13	256	20	-23%	12	339	28	40%
Tram 82 Variation 1	Southbound	2	11	7	3	13	4	-33%	3	24	8	086%
Swanston 24	Northbound	114	8,600	58	143	8,583	59		166	14,873	83	
	Southbound	112	4,734	40	143	7,296	51		160	12,923	81	
Yarra Trams												
Tram 11	Northbound	15	968	59	17	1,195	78	19%	24	2,188	88	24%
	Southbound	24	1,648	69	38	3,177	73	6%	40	10,884	250	246%
Tram 11 Variation 1	Northbound	1	5	5	1	4	4	33%	3	13	7	63%
Tram 11 Variation 2	Northbound	4	98	25	3	134	37	9%	8	404	51	98%
Tram 12	Northbound	15	581	39	28	978	49	25%	30	1,133	38	18%
	Southbound	13	404	33	17	684	36	8%	17	800	47	32%
Tram 23	Westbound	4	246	62	4	258	58	42%	8	1,037	130	48%
Tram 40	Eastbound	1	100	100	1	128	128	20%	2	164	82	-32%
Tram 109	Eastbound	10	958	72	13	1,553	119	66%	24	2,834	118	-1%
	Westbound	10	993	76	13	1,777	137	79%	24	6,977	291	113%
Tram 109 Variation 1	Westbound	2	301	82	2	139	70	86%	4	337	109	172%
Tram 109 Variation 2	Eastbound	3	120	40	3	267	89	123%	4	465	78	-12%
Tram 24	Eastbound	3	100	30	3	78	39	-22%	3	93	47	19%
	Westbound	4	287	72	4	281	73	1%	4	429	107	47%
Tram 24 Variation 1	Eastbound	5	79	16	3	73	13	-6%	3	340	68	353%
Tram 48	Eastbound	11	315	29	13	446	34	20%	13	846	65	98%
	Westbound	17	769	45	28	981	40	0%	30	1,207	43	48%
Tram 48 Variation	Eastbound	2	90	45	3	169	56	25%	3	131	44	-22%
Tram 58	Eastbound	11	42	4	13	78	6	57%	13	503	39	851%
	Westbound	11	72	7	13	118	9	39%	13	1,188	91	907%
Tram 78	Eastbound	10	664	66	12	863	72	8%	12	1,954	163	130%
	Westbound	10	507	64	17	1,046	62	-4%	17	2,658	156	164%
Tram 78 Variation 1	Eastbound	1	1	1	1	3	3	0%	1	7	7	132%
Tram 73	Eastbound	10	592	59	12	698	58	-1%	12	1,270	106	84%
	Westbound	15	571	44	17	833	49	12%	17	2,338	138	181%
Tram 73 Variation 1	Eastbound	1	14	14	1	33	33	136%	1	78	78	136%
Tram 86	Northbound	15	1,341	134	17	2,718	160	19%	17	3,809	224	41%
	Southbound	15	1,389	93	28	1,592	88	-34%	30	5,183	259	228%
Tram 86 Variation 1	Northbound	6	86	14	8	117	15	2%	8	213	27	82%
	Southbound	1	51	51	1	58	58	-2%	1	211	211	322%
Tram 86 Variation 2	Northbound	1	64	64	1	96	96	42%	1	132	132	67%
Tram 96	Northbound	17	1,196	70	28	1,641	86	14%	30	3,879	133	62%
	Southbound	13	927	68	17	1,036	61	-4%	24	3,473	145	137%
Tram 96 Variation 1	Northbound	1	19	19	1	26	26	37%	1	39	39	12%
	Southbound	5	15	3	4	18	5	-10%	4	44	7	69%

A.M. Peak Lasts for 2 Hours between 07:00 and 09:00

Train

Key maximum load demand results for train are shown in Table 2.12.

Table 2.13 Modelled Train Maximum Load Results for Strategy A

COMPARISON OF MAXIMUM A.M. PEAK LOADINGS - TRAIN

Route Group	Direction	2001 Base			2021 Base				2021 Strategy A			
		No. of Services	Load at Max. Load Point	Average Load per Vehicle	No. of Services	Load at Max. Load Point	Average Load per Vehicle	Change in Av. Load per Vehicle from 2001	No. of Services	Load at Max. Load Point	Average Load per Vehicle	Change in Av. Load per Vehicle from 21 base
Bayside Trains												
Caulfield Group	In	49	17,354	354	63	25,141	399	13%	63	25,400	403	1%
	Out	33	3,459	105	42	5,238	125	19%	42	6,256	149	19%
Northern Group	In	64	23,844	374	73	40,483	554	48%	102	44,179	433	-22%
	Out	47	3,598	76	35	3,401	98	29%	58	6,340	84	-15%
Hillside Trains												
Clifton Hill Group	In	24	12,382	516	30	19,625	654	27%	45	18,286	409	-38%
	Out	16	1,352	85	30	2,298	115	36%	30	2,220	74	-36%
Bumley Group	In	54	15,441	286	71	21,684	306	7%	98	21,720	222	-27%
	Out	33	4,911	149	41	7,142	174	17%	59	6,958	118	-32%

A.M. Peak Lasts for 2 Hours between 07:00 and 09:00

These suggest:

Train 2001 Base

- The highest average maximum load is 516 per train which is well within maximum 6 car set capacity (thought to be around 1,200)
- However these figures mask known existing loading problems on most rail groups; peak trains are currently very close to full capacity.
- This suggests the 2001 base values should be considered representative of existing maximum capacity per train set

Train 2021 Base

- Results suggest a considerable growth in peak train service frequencies; around 24% more inbound trains are run on all lines
- Total inbound peak rail demand increases by 55%
- Maximum loads per train also increase but not by as much as total rail demand. Nevertheless growth in rail maximum loads per train is considerable; 48% for Northern group and 27% for the Clifton Hill group
- Should growth rates of these size eventuate, additional capacity management measures will be required such as increasing train set capacities or increasing rail service frequencies.

Trains Strategy A

- Strategy A increases the inbound peak train frequencies from 191 per 2 hour peak (2001) to 308 (+61%). This results in a very large volume of train movements through the city loop in the Strategy A 2021 service:
  - Northern group has an average of 51 trains per peak hour

  - Caulfield group has over 30 an hour

- Rail track and signaling infrastructure limits the volume of trains it is possible to safety move through a rail system on a given line. Currently thinking is that 30 trains an hour is a reasonable existing limit per rail group. The design of Strategy A rail services clearly presents additional challenges with regard to future rail service capacity management.
- Strategy A does not affect total peak rail demand much relative to the 2021 base service. However the considerable increase in train frequencies associated with Strategy A means that average maximum loads per train actually decline on most lines. Hence the strategy A service level may be warranted for 2021 base case services. The implication of this finding is that heavy rail service frequencies increases in Strategy A may be overly large for strategy A alone.

2.7 Summary of Overall Impacts

See Table 2.14.

Table 2.14 : Summary of Major Weekday Strategy Elements and Impacts : Strategy A

Strategy Elements	
• Substantial increases in public transport service frequencies – most study area services including some services operating in the rest of Melbourne • Improves station access improvements including improvements within Melbourne CBD • Tram upgrades – reliability, stops and through routing of the Elizabeth S tram group to St Kilda • Improved bus services – improved area coverage in Doncaster and Melbourne CBD, reliability improvements better interchanges • Better study area East-West links – Eastern Freeway and Johnston Street bus route groups operate to Melbourne University plus Johnson and Elgin Street Busway	
Market	**Impact (from 2021 Base)**
NCCC Travel Impacts	
Total Travel	• Transit journeys increase by 105K sourced from car 71%, walk / cycle, 22% • Transit journey growth is from Through and External Travel markets (48% each)
Temporal Impacts	• A.M. Peak NCCC transit journey mode share increases from 32% to 41% • Most transit journey growth and car travel decline occurs inter peak
Spatial Impacts	• Almost a third of transit journey growth is external travel from the South and almost a third is through travel North to South • Theses are also the sources of equivalent car travel reductions
Metropolitan Wide Travel[1]	
Total Travel	• Transit journeys increase by 327K sourced from car (75%) and walk (25%) • Transit journey mode share increases from 7% to 9%
Temporal Impacts	• Transit journey growth at the expense of car follows through to each time period • 60% of transit journey growth occurs in the inter-peak • Transit journey mode share increases most in the a.m. peak (to 11%)
Individual Service Impacts	
Service Boarding Impacts	• Transit boardings increase by 827K (+54%) implying much transfer behaviour on new journeys. Tram boardings increase by 105%, Rail 21% and Bus 26% • Strategy A more than doubles tram patronage; high growth in the Eastern Freeway and Johnson Street buses (135% / 78%) also occurs, rail notably the Upfield line, also has considerable increased boardings (+63%) • Transit boarding growth is highest in the peak (P.M. Peak 60%) . Yarra has 150% more a.m. peak boardings and M>Tram 105%
Maximum Load Demand Impacts	• **Strategy A impacts on peak tram maximum loads are very large and will require the development of additional strategy measures to managing overloading an tram congestion if realised in practice**. Routes 19, 55, 11, 109 and 86 have forecast average maximum loads per tram in the 200-300 range with others in the high 100-200 range. • These maximum loads are not sustainable and would require either larger capacity vehicles (usually articulated tram sets) and / or increased frequency • Running trams at higher frequency or larger trams are not considered a reasonable option since trams will 'platoon' and queue slowing the service • Other possible options include grade separation of all tram operations or upgrading to a higher capacity transit mode (e.g. heavy rail). Spreading tram routes over more streets may also assist e.g. bifurcating routes on Elizabeth, William and / or Swanston Street • Strategy A runs over 60% more peak direction trains than at present. Peak trains go to 51 / hr on some groups. **Measures to enable train volumes of this size will be required** • Strategy A does not increase train overloading; rather it increases train frequencies alleviating demand on the overloaded 2021 base network. In this context it can be argued that the Strategy A service frequencies are needed for the 2021 base case

[1] *Strategy A service changes affect a much greater part of Metropolitan Melbourne than the NCCC area. This section examines total Melbourne travel market impacts*

3 STRATEGY F DONCASTER AREA RAPID TRANSIT - LIGHT RAIL

3.1 Strategy Inputs

Strategy F involves the addition of a new rapid transit service on the Eastern Freeway termed the Doncaster Area Rapid Transit (DART). Key features are:

- Alignment - The new transit route follows: Doncaster Shoppingtown along Doncaster Road, Eastern Freeway, Alexandra Parade, Nicholson Street, Elgin Street, Melbourne University and the CBD via Swanston Street to St Kilda Road, Fitzroy Street, the Esplanade and Acland Street. The St Kilda Road to St Kilda route segment is shared with other Melbourne trams services.
- Mode - The Eastern Freeway rapid transit system has been added as a new mode and is considered to be a high performance light rail, that is half way between a train and a tram. Hence it uses transfer penalties and run specification constants which lay half way between the train and 109 tram modes.
- Right of Way

– It has a dedicated tram alignment on Eastern Freeway with no loss of road space for other vehicles (with a free speed of 100 km / h);

– There is no delay through Hoddle Street intersection;

– It uses a dedicated facility along Alexandra Parade, Nicholson Street and Elgin Street to Melbourne University with the removal of 1 traffic lane in each direction on Alexandra Parade (free speed of 35 km / h). Note that the Elgin Street Bus Way (between Nicholson St and Melbourne University) has been replaced with a tram fairway;

- Stations / Stops

– Premium stations have been provided at Doncaster Shoppingtown, Doncaster Road / Eastern Freeway, Bulleen Road and Chandler Highway:

– these listed 'premium' stations include high-standard Park / ride, kiss / ride provisions (car access terminal penalties as for Premium stations in Strategy A)

– other rapid transit stops, also regarded as 'premium' stations, are:

: at Hoddle Street / Alexandra Pde (with access to Victoria Park Rail Station),
: Nicholson Street / Johnston Street, and
: Melbourne University.

– All of the above Premium stations reflect the standard used in Strategy A, e.g.: interchange penalties reduced to 5 minutes, maximum walk interchange time of one minute, maximum wait time of 5 minutes

– The rapid transit system then stops at all CBD stops and all stops to St Kilda using the existing tram fairway and sharing the route with other trams.

- Service Levels - Eastern Freeway Rapid Transit frequency of 4 minutes in the peaks and 5 minutes in the off peak, which relates to the tram route 109 frequencies in Strategy A.
- Bus Operating Strategy -
  - Existing (from Strategy D) Eastern Freeway buses become feeders for the rapid transit service, hence no buses actually use the freeway.
  - Buses that go to Doncaster Shoppingtown will now feed the Rapid Transit system, but still maintain their current routes unless they used the Eastern Freeway.

Strategy F like all NCCC strategy options include all the features of the strategies which precede them. This includes :

- Strategy A – Transit service developments
- Strategy B/C – Local Traffic Management and Cycling and Walking improvements within the NCCC area
- Strategy D – CBD commuter parking price increases

3.2 Modelling Impacts

Since strategy F is a composite of earlier strategies, the individual results of this strategy have been compared against those of strategy D. In this way the relative impacts of strategy F can be compared against those of the others.

3.2.1 Strategic Travel Behaviour Changes

Table 3.1 presents a summary of the major weekday journey impacts suggested by the modelling.

Table 3.1 : Strategy F: Total Journey Impacts by Mode

	Strategy D (Strategy F Base Case)				Strategy F Doncaster Rapid Transit				Difference (Number)				Difference (%)			
	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total
Total Journeys per Weekday																
Total Melbourne	11,426,413	1,404,078	2,276,119	15,106,610	11,421,687	1,408,691	2,276,224	15,106,602	-4,726	4,613	105	-8	0%	0%	0%	0%
NCCC Corridor																
Through	274,805	219,340	6,474	500,619	273,112	220,914	6,629	500,655	-1,693	1,574	155	36	-1%	1%	2%	0%
Tolfrom	336,146	171,893	126,168	634,207	335,678	172,440	126,079	634,197	-468	547	-89	-10	0%	0%	0%	0%
Within	46,085	13,199	48,311	107,575	46,182	12,944	48,452	107,578	117	-255	141	3	0%	-2%	0%	0%
TOTAL	657,076	404,432	180,953	1,242,401	654,972	406,298	181,160	1,242,430	-2,044	1,866	207	29	0%	0%	0%	0%
Mode Share by Market																
Total Melbourne	76%	9%	15%		76%	9%	15%						0%	0%	0%	
NCCC Corridor																
Through	55%	44%	1%		55%	44%	1%						0%	0%	0%	
Tolfrom	53%	27%	20%		53%	27%	20%						0%	0%	0%	
Within	43%	12%	45%		43%	12%	45%						0%	0%	0%	
TOTAL	53%	33%	15%		53%	33%	15%						0%	0%	0%	

This indicates that:

Metropolitan Melbourne

- Total travel does not change. This is to be expected, the model has been set up to explore shifts in travel between modes not trip generation.

- Total public transport travel increases by 4.6K journeys. This appears to be totally sourced from reduced car travel.
- Transit mode share does not change (on a Metropolitan wide basis)

NCCC Area Travel

- NCCC public transport use increases by 1.9K sourced entirely from car drivers. In addition there is some increase in walking (0.2K trips).
- Most public transport travel growth is from through travel (1.6K). External travel increases by .5K whilst internal transit trips decrease (by 0.3K trips).
- NCCC car travel reduces by 2K
- The biggest volume of traffic reductions are through travel
- Reductions in NCCC car journeys total 2K, however represents less than half the traffic reduced as part of Strategy F for the whole Metropolitan model
- NCCC walk / cycle travel increases marginally

Metropolitan wide transit boarding impacts are illustrated in Table 3.2.

Table 3.2 : Modelled Impacts on Transit Boardings – Strategy F

	Strategy D : Strategy F Relative Base Case - 2021		Strategy F - Doncaster Rapid Transit		Change	
Total PT Journeys	1,404,078		1,408,691		4,613	0%
Total PT Boardings		%Total		%Total		
M> Tram	676,262	28%	708,845	29%	32,583	5%
Yarra Tram	572,674	23%	562,824	23%	(9,850)	-2%
Sub-Total Tram	1,248,936	51%	1,271,669	52%	22,733	2%
M> Train	434,345	18%	435,387	18%	1,042	0%
Connex	280,550	11%	278,255	11%	(2,295)	-1%
Sub-Total Rail	714,895	29%	713,642	29%	(1,253)	0%
Metro Bus	478,098	19%	460,211	19%	(17,887)	-4%
Other	14,287	1%	14,344	1%	57	0%
Total	2,456,216		2,459,866		3,650	0%
Boardings per Journey	1.75		1.75		0.79	

This indicates that for Metropolitan wide travel:

- Whilst total transit journeys increase by 4.6K, boardings increase by only 3.6K. This is suggestive of some existing multi-transfer journeys being replaced by direct no transfer journeys as a result of DART
- There are over 3.6K additional transit boardings per weekday.
- Tram boardings increase by 22.7K at the expense of rail and mainly bus (down 18K)
- M>Tram has the largest increase mainly because this is where the DART service is operated
- Interestingly Yarra tram boardings decline by almost 10K (or 2%)

- M>Train boardings increase slightly whilst Connex loses 2.3K

3.2.2 Temporal Distribution of Impacts

Table 3.3 shows the impacts on transit boardings by time period

Table 3.3 : Change in Transit Boardings by Time Period – Metropolitan Melbourne

	Strategy D : Strategy F Relative Base Case : 2021				Strategy F : Doncaster Rapid Transit				Change From Base Case							
Total PT Boardings	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total
M> Train	152,090	385,715	150,440	670,262	163,090	381,480	164,265	708,845	10,994	15,770	5,819	32,583	7%	4%	4%	5%
Yarra Tram	127,944	312,420	132,362	572,674	124,341	300,725	129,758	562,824	-3,603	-3,703	-2,644	-9,850	-3%	-1%	-2%	-2%
Sub-Total Tram	280,042	670,146	280,740	1,249,936	287,433	680,213	294,023	1,271,668	7,391	12,067	3,276	22,733	3%	2%	1%	2%
M> Train	127,542	199,139	109,664	434,345	127,966	199,781	109,660	436,397	413	642	-13	1,042	0%	0%	0%	0%
Connex	82,001	124,558	73,991	280,550	81,533	123,557	73,166	278,256	-468	-1,001	-826	-2,295	-1%	-1%	-1%	-1%
Sub-Total Rail	209,543	322,697	182,655	714,895	209,488	322,338	181,816	713,642	-55	-359	-839	-1,253	0%	0%	0%	0%
Metro Bus	124,000	265,681	87,927	470,099	120,312	265,747	84,152	460,211	-4,610	-9,916	-3,355	-17,887	-4%	-4%	-4%	-4%
Other	7,268	3,462	3,522	14,257	7,278	3,662	3,664	14,344	-10	40	22	87	0%	1%	1%	0%
Total	621,889	1,289,986	564,442	2,498,219	624,511	1,271,660	563,656	2,459,868	2,733	1,834	-897	3,850	0%	0%	0%	0%
Time Period Share	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total				
M> Train	23%	54%	23%	100%	23%	54%	23%	100%	34%	49%	18%	100%				
Yarra Tram	22%	55%	23%	100%	22%	55%	23%	100%	37%	39%	26%	100%				
Sub-Total Tram	22%	54%	22%	100%	23%	54%	23%	100%	33%	53%	14%	100%				
M> Train	29%	46%	25%	100%	29%	46%	25%	100%	40%	52%	-1%	100%				
Connex	29%	44%	26%	100%	29%	44%	26%	100%	20%	44%	36%	100%				
Sub-Total Rail	29%	45%	26%	100%	29%	45%	25%	100%	4%	23%	87%	100%				
Metro Bus	26%	56%	19%	100%	26%	56%	19%	100%	26%	55%	19%	100%				
Other	51%	24%	25%	100%	51%	24%	25%	100%	26%	70%	56%	100%				
Total	25%	52%	23%	100%	25%	52%	23%	100%	74%	50%	-24%	100%				

This indicates that:

- Whilst total boardings increase by 3.6K most of this occurs in the a.m. peak and the remainder in the inter-peak. Overall p.m. peak boardings decline.
- Given the overall growth in transit journeys associated with DART, we suspect this means that multi-leg transit trips have declined as a result of DART in the P.M. peak
- By transit mode, tram has by far the highest boardings growth 22.7K. Most of this occurs in the a.m. and inter-peak periods
- In contrast the decline in rail (Connex) is highest in the p.m. peak.
- We hypothesize based on these results that DART attracts a.m. peak and interpeak demand from bus and mainly other trams. However in the p.m. it attracts a higher share of travel from rail mainly because there is a large group of commuters making a.m. trips by bus and p.m. return trips by rail to bus transfer trips
- By operator, M>Tram has the largest boardings growth by time period in the a.m. peak (+7% or 11K boardings)

3.2.3 Spatial Distribution of Impacts

Table 3.4 shows an analysis of changes in modal trip patterns between the Strategy D base case and the 2021 Strategy F case. This indicates that:

- As noted the 1.9K per day increase in NCCC PT journeys is mainly sourced from through travel. By individual spatial area this indicates that:
  - Through travel growth is virtually all from between the East and the South. This accounts for 71% of transit journey growth in total
  - The other major transit growth comes from West-East through travel and also travel between NCCC an the East

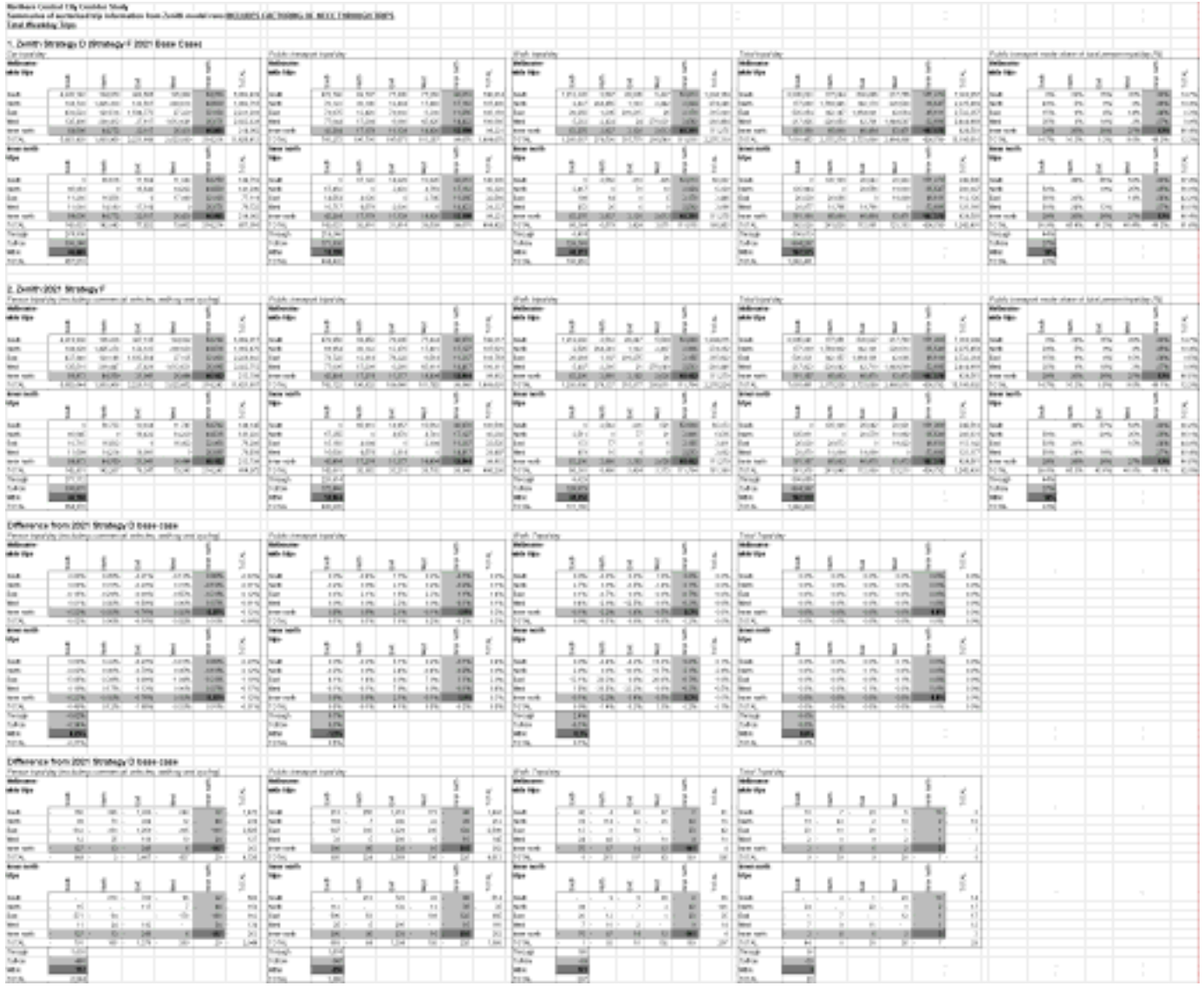
NCCC Car Travel

- Car travel decline follows the above spatial patterns for public transport growth

NCCC Walk Travel

- Walk travel growth is the result of growth in through walk/cycle travel and also internal travel plus a small decline in external travel
- Growth in through walk/cycle travel is mainly between North-South and South-West
- Decline in external walk/cycle travel is mainly between NCCC and the South and North

Table 3.4 : Analysis of Spatial Changes in Modal Travel – 2021 Strategy F vs Strategy D Base Case



3.2.4 Transit Service Boardings Impacts

Total Daily Boardings Impacts

Table 3.5 shows the changes in transit boardings by individual NCCC related service.

This indicates that:

Rail

- Hillside trains decline whilst Bayside boardings increase.
- Biggest Bayside trains growth is on the Upfield line
- Biggest declines in Hillside Boardings is on the Clifton Hill group and also the Hurstbridge line.
- These figures are illustrative of a decline in the Doncaster Catchment rail travel and a transfer to DART

Tram

- DART achieves 68,721 boardings per weekday. This is above average for Melbourne tram by route but is well below the high performing tram services in terms of daily boardings (the Mont Albert tram group achieve 78% more boardings than DART.
- Most other tram services have boardings reductions as a result of DART. The biggest impacts are on Swanston Tram services particularly Swanston Street routes 22, 16 and 5.

Bus

- Study area bus boardings are down by 19%, these passengers are using DART.
- As expected, the Eastern Freeway group of routes has a decline in boardings of over 50%. Routes 313, 315 and 303 are particularly affected (over 70% decline in boardings, these using the DART system)
- Johnston Street group buses have a boardings increase of 16%. Route 205 has a very high boardings increase (+56%)
- The Rathdowne Street group of routes and the Hoddle Street route 246 also have a modest increase in boardings as a result of DART.

Table 3.5 : Change in Boardings by NCCC Service –Total Weekday

TRAIN			Modelled Boardings					
Line		Stations	2000	2021 D (Base Case)		2021 F - DART		
				No	% 2001	No	% 2001	% 2021
Bayside	Broadmeadows	Broadmeadows to Flinders St	30,276	56,693	87%	56,844	88%	0%
	Frankston	Mordialloc to Frankston	44,053	63,752	45%	63,447	44%	0%
	Pakenham	Flinders St to Pakenham	60,327	84,114	67%	84,198	67%	0%
	Sandringham	Flinders St to Sandringham	28,567	41,473	56%	41,888	57%	1%
	St Albans	St Albans to Flinders Street	25,858	77,219	199%	77,528	200%	0%
	Stony Point	Frankston to Stony Point	1,111	2,269	104%	2,252	103%	-1%
	Upfield	Upfield to Flagstaff	10,839	29,975	177%	30,201	179%	1%
	Werribee	Flinders St to Werribee	19,568	64,161	228%	64,478	229%	0%
	Williamstown	Williamstown to Flinders St	8,442	14,689	126%	14,781	129%	1%
	Sub-total		**215,042**	**434,345**	**102%**	**435,387**	**102%**	**0%**
Hillside	**Hillside**							
	Alamein	Camberwell to Alamein	6,295	12,215	94%	12,157	93%	0%
	Belgrave	Flinders St to Blackburn	32,161	41,334	29%	40,967	27%	-1%
	Epping	Epping – Parliament	28,805	51,929	80%	51,384	78%	-1%
	Glen Waverley	Flinders St – Glen Waverley	26,668	53,643	101%	53,834	102%	1%
	Hurstbridge	Greensborough – Flinders St	26,154	53,797	91%	52,672	87%	-2%
	Lilydale	Parliament to Lilydale	43,730	67,732	55%	67,241	54%	-1%
	Sub-total		**165,813**	**280,550**	**69%**	**278,255**	**68%**	**-1%**
	All Rail		**380,855**	**714,895**	**88%**	**713,642**	**87%**	**0%**

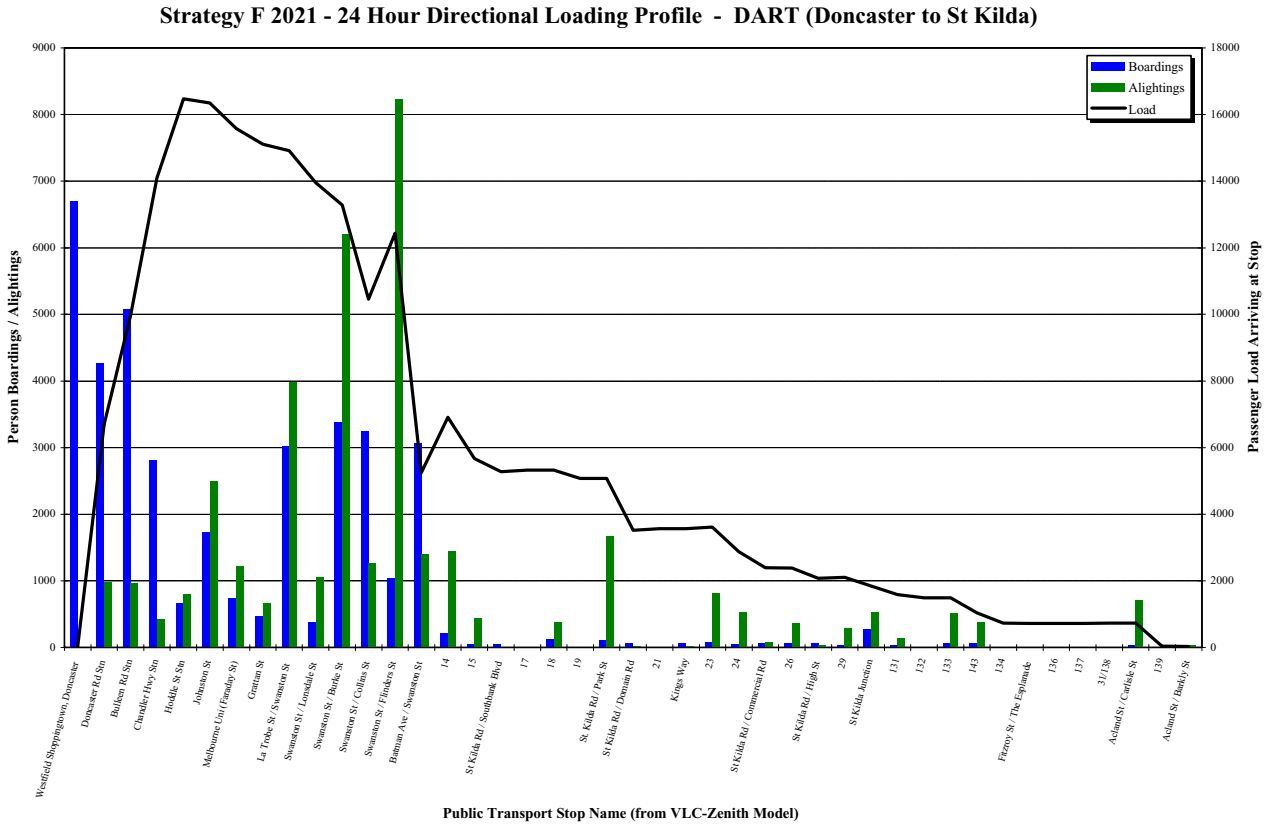
TRAM (NCCC Services)			Modelled Boardings					
Route No		Suburbs	2000	2021 D (Base Case)		2021 F - DART		
				No	% 2001	No	% 2001	
Swanston								
	Doncaster area rapid transit					68,721		
	1	Sth Melbourne Beach to East Co	16,264	68,737	261%	52,440	223%	-11%
	16	Melb University to St. Kilda Beach	8,603	19,197	123%	16,743	83%	-16%
	19	City to North Coburg	32,516	116,519	258%	114,922	253%	-1%
	22	Arts Centre to Moreland	7,853	28,841	267%	24,481	212%	-15%
	3	Melb University to East Malvern	12,039	29,838	148%	26,991	124%	-10%
	5	Melbourne University to Malvern	8,924	19,260	116%	16,894	87%	-13%
	50	North Melbourne to City	1,595	3,805	139%	3,758	136%	-1%
	55	West Coburg to Domain Rd	19,634	40,303	105%	40,136	104%	0%
	57	City to West Maribyrnong	14,097	26,948	91%	26,416	87%	-2%
	59	City to Airport West	26,480	92,292	249%	91,009	244%	-1%
	6	University to Glen Iris	13,710	31,396	129%	28,098	105%	-11%
	64	University to East Brighton	11,648	23,803	101%	21,105	78%	-11%
	67	University to Carnegie	14,141	35,098	148%	32,245	128%	-8%
	69	St Kilda Beach to Kew	14,417	44,410	208%	44,139	206%	-1%
	72	Melbourne University to Camber	19,591	43,935	124%	40,499	107%	-8%
	78 & 79	North Richmond to Prahran	6,866	13,188	92%	13,295	93%	1%
	8	Melbourne University to Toorak	16,292	44,439	173%	40,920	151%	-8%
	82	Moonee Ponds to Footscray	3,764	7,233	92%	7,255	93%	0%
	Sub-total		**248,621**	**679,262**	**173%**	**700,845**	**195%**	**4%**
Yarra	11	City to West Preston	20,602	77,466	276%	72,793	253%	-6%
	12	St Kilda to City	10,049	29,323	192%	28,718	186%	-2%
	23 / 42 / 109	City to Mont Albert	26,395	125,051	374%	123,083	366%	-2%
	24 & 48	City to North Balwyn	18,433	35,126	91%	33,527	82%	-5%
	30 & 34	City to East Melbourne	2,755	9,467	243%	9,136	231%	-3%
	70	City to Wattle Park	18,764	40,820	118%	40,530	117%	0%
	75	City to East Burwood	16,488	57,251	247%	56,772	244%	-1%
	86	City to Bundoora	32,444	93,447	188%	92,346	185%	-1%
	96	St Kilda to East Brunswick	25,771	78,268	229%	79,883	236%	2%
	City Circle	Within CBD	13,336	13,602	2%	13,124	-2%	-4%
	Sub-total		**183,034**	**559,811**	**206%**	**549,992**	**200%**	**-2%**
	All Tram		**431,655**	**1,239,073**	**187%**	**1,250,837**	**190%**	**1%**

BUS (NCCC Services)			Modelled Boardings					
Route Name		Suburb	2000	2021 Base		2021 A - PT imps		
				No	% 2001	No	% 2001	
Clifton Hill to Brunswick Rd	504	Moonee Ponds to Clifton Hill	449	1,230	174%	1,259	180%	2%
– Northern Bus Lines	**Sub-total**		**449**	**1,230**	**174%**	**1,259**	**180%**	**2%**
East Melb to Footscray	402	Footscray to East Melbourne	4,017	7,246	80%	7,197	79%	-1%
– SITA	**Sub-total**		**4,017**	**7,246**	**80%**	**7,197**	**79%**	**-1%**
Eastern Freeway Group	301	The Pines to City	1,656	4,072	146%	2,449	48%	-40%
– National	302	Box Hill to City	932	2,362	153%	875	-6%	-63%
	303	Mitcham Stn to City	32	958	2894%	886	2669%	-8%
	304	Ringwood Stn to City	1,832	3,900	113%	2,127	16%	-45%
	305	City to Warrandyte Bridge	1,660	2,115	28%	605	-63%	-71%
	306	North Ringwood to City	378	953	152%	416	10%	-56%
	307	Mitcham to City	2,627	6,451	146%	3,837	46%	-41%
	308	Deep Creek to City	631	905	43%	514	-19%	-43%
	309	Donvale to City	836	2,059	146%	1,016	21%	-51%
	313	City to Templestowe	58	852	1369%	157	188%	-80%
	315	City to Box Hill	20	497	2385%	103	416%	-79%
	316	Templestowe to City	107	660	517%	423	295%	-36%
	319	The Pines to City	299	992	232%	286	-4%	-71%
	350	City to Latrobe Uni	1,525	4,995	226%	1,815	19%	-64%
	Sub-total		**12,565**	**31,771**	**152%**	**15,518**	**23%**	**-51%**
Roddle Street – National	246	Latrobe Uni to Elsternwick	6,059	6,141	1%	6,496	7%	6%
	Sub-total		**6,059**	**6,141**	**1%**	**6,496**	**7%**	**6%**
Johnston Street Group	200	Doncaster to City	1,248	2,553	105%	3,399	172%	33%
– National	201	Doncaster to City	1,412	2,998	112%	4,024	185%	34%
	203	Doncaster to City	1,127	2,337	107%	524	-54%	-78%
	205	Doncaster to Melbourne Uni	279	586	110%	917	229%	56%
	207	Donvale to City	2,044	4,282	109%	5,934	190%	39%
	Sub-total		**6,110**	**12,756**	**109%**	**14,798**	**142%**	**16%**
Queens Pde to Melb Uni	546	Melbourne Uni to Heidelberg	936	554	-41%	526	-44%	-5%
. Dysons	**Sub-total**		**936**	**554**	**-41%**	**526**	**-44%**	**-5%**
Rathdowne Street Group	250	Port Melbourne to Latrobe Uni	2,068	3,743	81%	4,320	109%	15%
– National	251	Port Melbourne to Northland SC	1,620	3,631	124%	3,797	133%	4%
	253	Port Melbourne to Carlton North	275	828	201%	817	197%	-1%
	Sub-total		**3,963**	**8,202**	**107%**	**8,934**	**125%**	**9%**
	All Bus		**34,119**	**67,900**	**99%**	**53,698**	**60%**	**-19%**

3.2.5 DART Boardings Performance

Figure 3.1 illustrates a loading profile for all day boardings for city bound DART services.

Figure 3.1 : DART Load Profile – City Bound Services Per Day



This indicates that:

- There is a clear demarcation between the demand performance of the Doncaster to CBD and the CBD to St.Kilda route sections.
  - Most of the service has its market between Doncaster and the CBD. A daily maximum of over 16,000 passengers per day occurs as the service passes Hoddle Street towards the city
  - Between the CBD and St.Kilda, DART has broadly a quarter of the utilisation of the Doncaster section.
  - There is little through travel between the route sections; each are relatively self contained from a service design viewpoint. The St.Kilda route section is covered by many other tram routes.
- We conclude from this analysis that there would be a good basis to operate DART at between Doncaster and Flinders Street and to withdraw the St Kilda sections. Such a design modification would require substantial tram turnarounds within the CBD; a suitable location and design would be required.

- The busiest DART stops are:
  - CBD stops including Flinders Street Station, Bourke and Latrobe Streets along Swanston Street
  - Doncaster Shopping Town
  - The Doncaster Road, Bulleen Road and Chandler Highway Freeway interchange stations
- NCCC DART stops have more modest usage. Of these the Johnston Street station is busier than the University

3.2.6 Peak Maximum Load Impacts

Table 3.6 illustrates peak maximum load point demand volumes and the number of runs by service and option for study area trams.

As noted earlier, modelling of maximum load demands for specific routes and services is an inexact science. It stretches the credibility of any model to represent demand in a specific area for a specific time period with accuracy equivalent to the real world, hence identifying maximum load demand is particularly difficult.

Tables 3.6 and 3.7 illustrates maximum load demand per vehicle trip for bus and tram for the 2001 base case and also for the 2021 strategy D base case and strategy A. In this way we can assess the accuracy of the model by reference to its representation of 2001 base case loads and assess the potential impacts for Strategy F within this light.

Tram

- DART achieves an average maximum load per tram of 240. This is well within the capacity range of the high capacity vehicles proposed for the service (i.e. multi-articulated sets)
- A scan of the maximum loadings on other tram services shows a continuance of the high loadings (in the 200-300 plus range) for selected tram services as identified in strategy A. Strategy F, appears to alleviate some of this problem compared to the strategy D loadings, however the strategy D maximum loads are slightly higher than those identified in strategy A i.e. a tram overloading issues remains despite the small amount of relief being made as a result of DART.

Table 3.6 Modelled Tram Maximum Load Results for Strategy F

COMPARISON OF MAXIMUM A.M. PEAK LOADINGS - TRAM

Route Number	Direction	2001 Base			2021 Base			Change in Av. Load per Vehicle from 2001	2021 Strategy A			Change in Av. Load per Vehicle from 21 base
		No. of Services	Load at Max. Load Point	Average Load per Vehicle	No. of Services	Load at Max. Load Point	Average Load per Vehicle		No. of Services	Load at Max. Load Point	Average Load per Vehicle	
New Light Rail Services												
Dunsmuir Area	In	-	-		-	-		-	30	2,001	67	-
Rapid Transit	Out	-	-		-	-		-	30	7,197	240	-
Light Rail North Rd	Eastbound	-	-		13	2,377	172	-	13	2,506	167	-3%
	Westbound	-	-		13	614	48	-	13	566	38	-8%
Swanston Tram												
Tram 1	Northbound	12	786	66	24	2,348	98	49%	24	2,153	90	-8%
	Southbound	15	859	64	28	4,348	145	126%	30	3,776	126	-13%
Tram 16	Northbound	13	726	56	17	1,052	62	11%	17	987	53	-14%
	Southbound	13	337	26	17	992	58	123%	17	818	48	-17%
Tram 19	Northbound	15	1,383	127	38	9,284	309	144%	30	9,562	319	3%
	Southbound	20	1,771	89	48	4,754	169	51%	40	6,824	171	1%
Tram 19 Variation 2	Northbound	3	236	83	6	1,570	262	207%	6	1,622	271	3%
Tram 22	Northbound	12	707	59	24	1,592	66	13%	24	1,406	60	-10%
	Southbound	13	503	39	24	2,055	85	119%	24	1,626	68	-20%
Tram 22 Variation 1	Northbound	4	3	1	8	2	0	-67%	8	2	0	0%
Tram 3	Northbound	10	550	55	12	1,347	112	104%	12	1,361	113	1%
	Southbound	9	330	41	18	703	70	70%	10	593	59	-17%
Tram 3 Variation 1	Southbound	5	30	10	6	48	7	-32%	6	62	8	10%
Tram 3 Variation 2	Southbound	1	41	41	1	86	86	110%	1	72	72	-16%
Tram 5	Northbound	10	552	56	12	974	81	45%	12	889	75	-8%
	Southbound	9	270	34	18	632	60	87%	10	524	52	-17%
Tram 55	Northbound	12	1,293	108	13	4,102	289	169%	13	4,226	202	-3%
	Southbound	28	1,207	66	38	1,990	60	-9%	30	1,857	62	3%
Tram 55 Variation 1	Northbound	11	803	28	13	738	56	104%	13	727	56	0%
Tram 57	Eastbound	15	1,177	70	28	3,180	112	43%	20	2,293	115	2%
	Westbound	18	607	47	17	1,091	96	63%	17	1,286	76	0%
Tram 59	Northbound	17	1,383	77	38	3,843	128	67%	30	4,012	134	4%
	Southbound	20	2,481	128	48	7,754	195	61%	40	7,888	197	2%
Tram 59 Variation 1	Northbound	7	50	7	13	202	16	119%	13	228	17	9%
Tram 6	Northbound	12	678	57	13	1,470	97	71%	13	1,391	99	4%
	Southbound	10	379	38	12	968	81	126%	11	833	79	-14%
Tram 6 Variation 1	Northbound	2	12	6	3	38	15	111%	3	39	13	-9%
	Southbound	1	34	34	1	88	88	159%	1	74	74	-16%
Tram 6 Variation 2	Northbound	2	130	71	3	204	68	24%	3	188	63	-6%
Tram 64	Northbound	11	648	59	13	1,197	92	56%	13	1,118	86	-7%
	Southbound	7	364	52	8	563	65	86%	9	479	53	-19%
Tram 64 Variation 1	Southbound	2	4	2	3	6	2	0%	3	6	2	0%
Tram 64 Variation 2	Southbound	1	39	39	1	78	78	152%	1	64	64	-18%
Tram 67	Northbound	15	1,188	83	17	1,998	118	39%	17	1,988	117	-1%
	Southbound	7	208	30	8	622	89	133%	8	628	89	0%
Tram 67 Variation 1	Southbound	4	7	2	5	70	14	700%	5	77	15	10%
Tram 67 Variation 2	Southbound	2	76	38	2	139	66	75%	2	167	56	-16%
Tram 69	Northbound	12	881	73	13	2,409	161	119%	13	2,502	157	-2%
	Southbound	12	572	48	13	1,570	105	121%	13	1,570	105	-1%
Tram 69 Variation 1	Northbound	7	149	21	8	508	56	161%	9	483	54	-3%
	Southbound	5	121	24	6	344	57	137%	6	317	53	-8%
Tram 69 Variation 2	Southbound	1	17	17	1	77	77	353%	1	77	77	0%
Tram 72	Eastbound	9	452	50	13	1,015	65	88%	12	913	76	-10%
	Westbound	10	366	37	13	1,194	100	76%	12	1,134	95	-5%
Tram 72 Variation 1	Eastbound	1	27	27	1	76	76	181%	1	73	73	-4%
Tram 76	Northbound	10	375	38	12	668	55	47%	12	713	59	8%
	Southbound	9	250	28	12	644	54	87%	12	638	53	-1%
Tram 8	Northbound	10	616	62	17	2,720	160	155%	17	2,681	158	-1%
	Southbound	10	767	59	17	1,900	112	90%	17	1,771	104	-7%
Tram 82	Northbound	8	394	37	18	526	52	42%	10	523	52	1%
	Southbound	9	250	28	12	413	34	24%	12	260	21	-51%
Tram 82 Variation 1	Southbound	2	11	7	3	24	8	22%	3	23	8	-4%
Drummond 28	Northbound	114	6,604	58	146	13,040	91	65%	146	14,240	98	6%
	Southbound	112	4,334	40	140	11,071	87	114%	140	12,148	76	-13%
Nova Tram												
Tram 11	Northbound	15	768	59	24	3,172	91	53%	24	3,274	94	4%
	Southbound	24	1,648	69	48	10,093	273	300%	40	9,782	244	-11%
Tram 11 Variation 1	Northbound	1	3	3	2	12	6	100%	2	12	6	0%
Tram 11 Variation 2	Northbound	4	88	23	8	420	53	117%	8	531	65	23%
Tram 12	Northbound	15	501	39	28	1,248	62	60%	30	1,255	62	0%
	Southbound	15	454	33	17	889	55	98%	17	818	48	-10%
Tram 25	Westbound	4	346	92	8	1,569	171	178%	8	1,378	139	-7%
Tram 42	Eastbound	1	100	100	2	178	53	-15%	2	163	82	-4%
Tram 109	Eastbound	15	930	72	24	2,027	110	63%	24	2,726	114	4%
	Westbound	15	995	76	24	7,916	330	352%	24	7,648	319	-3%
Tram 109 Variation 1	Westbound	2	84	42	4	360	216	414%	4	836	214	-1%
Tram 109 Variation 2	Eastbound	3	120	40	6	488	83	108%	6	460	77	-8%
Tram 24	Eastbound	2	100	50	2	106	53	6%	2	93	47	-12%
	Westbound	4	287	72	4	493	124	72%	4	421	105	-14%
Tram 24 Variation 1	Eastbound	5	79	16	2	398	70	394%	2	288	72	-8%
Tram 48	Eastbound	11	315	29	13	864	66	132%	13	851	65	-2%
	Westbound	17	769	45	28	1,545	77	71%	20	1,444	72	-7%
Tram 48 Variation	Eastbound	2	90	45	2	134	45	-1%	2	97	32	-28%
Tram 30	Eastbound	11	42	4	13	585	45	1079%	13	551	42	-6%
	Westbound	11	72	7	13	1,546	119	1717%	13	1,355	104	-12%
Tram 70	Eastbound	10	664	66	12	2,026	169	154%	12	2,142	179	6%
	Westbound	10	633	64	17	2,906	171	168%	17	2,955	174	1%
Tram 70 Variation 1	Eastbound	1	3	3	1	6	6	100%	1	6	6	0%
Tram 75	Eastbound	10	352	35	12	1,207	101	84%	12	1,276	107	-1%
	Westbound	10	571	44	17	2,699	159	281%	17	2,758	162	2%
Tram 75 Variation 1	Eastbound	1	14	14	1	78	78	457%	1	78	78	0%
Tram 86	Northbound	10	1,741	134	17	3,159	221	65%	17	3,571	210	-5%
	Southbound	15	1,289	93	28	1,961	201	222%	20	1,736	207	-4%
Tram 86 Variation 1	Northbound	6	86	14	8	204	26	70%	8	211	26	3%
	Southbound	1	31	31	1	208	208	367%	1	208	208	-4%
Tram 86 Variation 2	Northbound	1	64	64	1	147	147	130%	1	138	138	-6%
Tram 96	Northbound	17	1,196	70	38	4,140	109	96%	30	4,000	134	-3%
	Southbound	15	827	64	24	4,058	169	166%	24	3,750	156	-9%
Tram 96 Variation 1	Northbound	1	19	19	2	63	32	68%	2	63	31	-3%
	Southbound	5	17	3	6	52	9	73%	6	52	9	0%

Bus

Maximum load demand results for Bus are shown in Table 3.7. These suggest:

- A mixed bag of impacts
- Almost all of the Eastern freeway group of routes have maximum loads below prevailing 2001 levels. This suggests that modelled frequencies are generous
- In contrast the Johnston Street group have maximum loadings above prevailing 2001 levels and which are generally above those in the 2021base
- Overall however maximum loads per vehicle are within prevailing capacity bounds for buses.

Train

Analysis of the impacts of DART on train services has identified only minor changes to total boardings.

3.3 Summary of Overall Impacts

See Table 3.8.

Table 3.7 : Modelled Bus Maximum Load Results for Strategy F

COMPARISON OF MAXIMUM A.M. PEAK LOADINGS - BUS

Route Number	Direction	2001 Base			2021 Strategy D Base				2021 Strategy F			
		No. of Services	Load at Max. Load Point	Average Load per Vehicle	No. of Services	Load at Max. Load Point	Average Load per Vehicle	Change in Av. Load per Vehicle from 2001	No. of Services	Load at Max. Load Point	Average Load per Vehicle	Change in Av. Load per Vehicle from 21 base
Clifton Hill - Brunswick Rd												
Bus 304	Eastbound	3	36	11	12	61	5	-55%	12	70	6	15%
	Westbound	3	24	7	12	85	7	48%	12	85	7	0%
East Melb - Footscray												
Bus 402	Eastbound	12	152	13	12	362	30	138%	12	279	32	5%
	Westbound	12	489	41	12	1,089	91	123%	12	1,084	91	0%
Eastern Freeway Group												
Bus 301	Eastbound	1	18	18	12	232	19	7%	12	177	15	-24%
	Westbound	10	463	47	12	569	47	2%	12	407	34	-28%
Bus 302	Eastbound	2	18	9	12	166	14	54%	12	158	13	-9%
	Westbound	8	233	29	12	265	22	-25%	12	139	10	-55%
Bus 303	Westbound	2	15	8	12	413	34	359%	12	445	37	8%
Bus 304	Eastbound	1	40	40	10	286	29	-29%	10	305	30	6%
	Westbound	4	198	50	9	399	44	-10%	9	210	24	-47%
Bus 304 Variation 1	Eastbound	2	54	27	2	71	36	31%	2	57	29	-20%
	Westbound	3	162	54	5	139	40	-27%	5	31	7	-82%
Bus 305	Eastbound				9	45	5		9	54	6	
	Westbound	1	45	45	5	140	28	-38%	5	6	1	-98%
Bus 305 Variation 1	Eastbound	1	19	19	1	15	15	-21%	1	2	2	-87%
	Westbound	7	258	37	7	229	33	-12%	7	107	15	-53%
Bus 305 Variation 2	Eastbound	3	50	25	2	28	14	-44%	2	12	6	-67%
Bus 306	Westbound	4	138	35	10	385	39	11%	10	239	24	-38%
Bus 306 Variation	Westbound	2	88	44	2	76	38	-14%	2	13	7	-83%
Bus 307	Eastbound	2	61	31	12	349	29	-5%	12	315	26	-10%
	Westbound	8	224	28	12	302	25	-10%	12	272	23	-10%
Bus 308	Westbound	7	256	37	12	289	24	-34%	12	233	19	-19%
Bus 309	Westbound	3	240	80	12	706	59	22%	12	471	39	-33%
Bus 313	Westbound	1	37	14	12	368	31	127%	12	46	4	-88%
Bus 313	Eastbound	1	3	3	12	136	11	278%	12	33	3	-76%
Bus 316	Westbound	3	63	21	12	281	23	12%	12	196	16	-30%
Bus 378	Eastbound	6	173	29	12	275	23	-20%	12	155	13	-45%
	Westbound	7	227	32	12	511	46	42%	12	336	28	-39%
Hoddle Street												
Bus 246	Northbound	1	44	44	1	74	74	68%	1	81	91	23%
Bus 246 Variation	Northbound	8	167	21	10	230	23	10%	10	302	30	31%
	Southbound	12	863	72	12	949	79	10%	12	867	72	-9%
Johnston Street Group												
Bus 200 Variation	Eastbound	4	111	28	12	138	12	-59%	12	138	10	-14%
	Westbound	3	79	26	12	190	16	0%	12	336	28	66%
Bus 201	Eastbound	4	55	14	12	125	10	-24%	12	146	12	17%
	Westbound	4	89	22	12	224	19	-16%	12	337	28	50%
Bus 203	Westbound	3	71	24	12	239	20	-16%	12	36	3	-77%
Bus 205	Westbound	2	31	16	12	175	15	-4%	12	260	22	46%
Bus 207	Eastbound	4	31	20	12	141	12	-42%	12	164	14	16%
Bus 207 Variation	Westbound	3	64	21	12	266	22	4%	12	376	31	41%
Queen Vic - Melb Uni												
Bus 546	Eastbound	4	53	13	4	24	6	-27%	4	19	5	-21%
	Westbound	4	34	9	4	20	5	-41%	4	18	5	-10%
Rathdowne Street Group												
Bus 250	Northbound	7	108	16	12	141	12	-25%	12	249	21	77%
	Southbound	8	91	12	11	381	35	126%	11	373	34	-2%
Bus 250 Variation 1	Northbound	1	5	5	1	5	5	0%	1	7	7	40%
Bus 250 Variation 2	Southbound	1	11	11	1	35	35	218%	1	34	34	-3%
Bus 251	Northbound	3	88	18	12	175	15	-17%	12	186	16	6%
	Southbound	2	70	14	12	430	36	160%	12	411	34	-2%
New Bus Routes												
Bus 20A	Eastbound	-	-	-	12	111	9		12	115	10	
Bus 20A	Westbound	-	-	-	12	217	18		12	215	18	
Bus 20B	Eastbound	-	-	-	12	161	13		12	182	15	
Bus 20B	Westbound	-	-	-	12	211	18		12	240	20	
Bus 30A	Eastbound	-	-	-	12	317	26		12	141	12	
Bus 30A	Westbound	-	-	-	12	107	9		12	46	4	
Bus 30B	Eastbound	-	-	-	12	215	18		12	133	11	
Bus 30B	Westbound	-	-	-	12	318	27		12	159	13	
Bus 30C	Eastbound	-	-	-	12	239	20		12	167	14	
Bus 30C	Westbound	-	-	-	12	527	44		12	487	41	
Bus 30D	Eastbound	-	-	-	12	55	5		12	18	2	
Bus 30D	Westbound	-	-	-	12	84	8		12	17	1	
Bus 30E	Eastbound	-	-	-	12	64	5		12	23	2	
Bus 30E	Westbound	-	-	-	12	134	11		12	21	2	
Bus Hoddle St/Victoria	Eastbound	-	-	-	12	4	0					
Bus Hoddle St/Victoria	Westbound	-	-	-	12	70	6					

Table 3.8 : Summary of Major Weekday Strategy Elements and Impacts : Strategy F

Strategy Elements	
• New high capacity light rail system operating Doncaster Shoppingtown, Eastern Freeway, NCCC, Melbourne Uni, Swanston Street to St Kilda termed DART (Doncaster Area Rapid Transit) • High frequency, high quality priority and stops (stations) • Freeway buses cut to operate at 3 Freeway station interchanges	
Market	**Impact (from 2021 Strategy D Base Case)**
Total Metropolitan travel	• Transit journeys increase by 4,613 sourced from car travel • No impact on transit journey mode share • Transit boardings increase by 3,650 implying DART reduces overall transfers between transit modes
Total NCCC Travel	• Transit journeys increase by 1,866 sourced from car • Transit journey growth is mainly from Through and some External Travel
Temporal Impacts– NCCC	• Transit boarding increases are concentrated in the a.m. peak and inter-peak • Interestingly P.M. transit boardings decline. We suggest that a group of commuters travel in by bus and out by rail but for strategy F they use DART in both directions
Spatial Impacts– NCCC	• Through travel between East and South accounts for 71% of NCCC journey growth • Car travel decline also follows this pattern
Service Boarding Impacts	• DART achieves 68,721 boardings per weekday. • Most other tram services have boarding declines • Bus have general boarding declines notably the Eastern Freeway group (-50%). Some selected NCCC bus routes have modest boarding growth. • Rail has a mixed bag of low boarding impacts
DART Loadings	• **Most DART usage is between Doncaster and the CBD. This suggests the operation should be cut back to a Doncaster-CBD service** • Key DART stations are the CBD stops, Doncaster Shoppingtown and the Freeway interchange station. NCCC stops have lower order usage to these stations
Maximum Load Demand Impacts	• DART achieves an average maximum load of 240 well within the scope of the high capacity LRT service designed. • Other tram services maintain excessively high maximum loads. Strategy F acts to slightly alleviate the tram maximum issues identified in Strategy A. However these issues are increased in the strategies implemented since strategy A. • Bus has a mixed bag of maximum load impacts. The Eastern Freeway Group are all well under-loaded and may warrant reductions in service levels as feeder bus services. Other services have no maximum load issues

4 STRATEGY F2 DONCASTER AREA RAPID TRANSIT – HEAVY RAIL

4.1 Strategy Inputs

Strategy F2 involves the addition of a new rapid transit service using heavy rail on the Eastern Freeway termed the Doncaster Area Rapid Transit (DART). Key features of the F2 heavy rail option are indicated in Table 4.1.

Table 4.1 : Option F2 Doncaster Area Rapid Transit – Heavy Rail System Specification

Design Area	Specification
Alignment	Stations as follows: 1. Doncaster Shoppingtown 2. Bulleen Road Eastern Freeway 3. Chandler Highway Eastern Freeway 4. Victoria Park then all stations on the Clifton Hill group to the City Loop
Mode	Heavy Rail
Right of Way	• Underground between stations 1 and 2 • Freeway median between stations 2, 3 and 4 • Existing rail right of way for other station sections • Free operating speed is 110 kph on the new rail sections
Stations / Stops	• All new stations are Premium stations. Victoria Park also converted to Premium Station status • Designated park and ride / kiss and ride stations (car access terminal penalties as for Premium stations in Strategy A) at: – Doncaster Shoppingtown – Bulleen Road Eastern Freeway – Chandler Highway Eastern Freeway • All of the above Premium stations and also Victoria Park reflect above the standard used in Strategy A, e.g.: interchange penalties reduced to 2 minutes, maximum walk interchange time of one minute, maximum wait time of 3 minutes
Operating Strategy	• Two thirds of trains operate all stops Doncaster to Victoria Park and then express to Parliament / Flinders Street Station. Travel time benefits of express sections are the same as existing express trains • Remaining third operate all stops
Service Levels	• LRT frequencies were 4 minutes in the peaks and 5 minutes in the off peak. The Heavy rail option is at least equivalent to this or higher if this is consistent with 2020 heavy rail frequencies on other lines
Bus Operating Strategy	• Existing (from Strategy D) Eastern Freeway buses become feeders for the rapid transit service, hence no buses actually use the freeway. • Buses that go to Doncaster Shoppingtown will now feed the Rapid Transit system, but still maintain their current routes unless they used the Eastern Freeway i.e. the Johnston Street Group still operates

4.2 Modelling Impacts

Since strategy F2 is a composite of earlier strategies, the individual results of this strategy have been compared against those of strategy D. In this way the relative impacts of strategy F2 can be compared against those of the others.

4.2.1 Strategic Travel Behaviour Changes

Table 4.2 presents a summary of the major weekday journey impacts suggested by the modelling.

Table 4.2 : Strategy F2: Total Journey Impacts by Mode

	Strategy D (Strategy F Base Case)				Strategy F2 Doncaster Rapid Transit Heavy Rail				Difference (Number)				Difference (%)			
	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total	Car	Public Transport	Walk	Total
Total Journeys per Weekday																
Total Melbourne	11,426,413	1,404,078	2,276,119	15,106,610	11,417,730	1,411,321	2,277,553	15,106,604	-8,683	7,243	1,434	-6	0%	1%	0%	0%
NCCC Corridor																
Through	274,805	219,340	6,474	500,619	272,875	221,777	6,528	501,180	-1,930	2,437	54	561	-1%	1%	1%	0%
Trans	336,146	171,893	126,160	634,207	334,086	173,266	126,668	633,920	-2,060	1,373	508	-287	-1%	1%	0%	0%
Within	46,085	13,999	48,311	107,575	45,954	13,088	48,174	107,206	-131	-131	-137	-369	0%	-1%	0%	0%
TOTAL	657,076	404,432	180,953	1,242,401	652,925	408,111	181,270	1,242,306	-4,091	3,679	317	-95	-1%	1%	0%	0%
Mode Share by Market																
Total Melbourne	76%	9%	15%		76%	9%	15%						0%	0%	0%	
NCCC Corridor																
Through	55%	44%	1%		54%	44%	1%						0%	0%	0%	
Trans	53%	27%	20%		53%	27%	20%						0%	0%	0%	
Within	43%	12%	45%		43%	12%	45%						0%	0%	0%	
TOTAL	53%	33%	15%		53%	33%	15%						0%	0%	0%	

This indicates that:

Metropolitan Melbourne

- Total travel does not change. This is to be expected, the model has been set up to explore shifts in travel between modes not trip generation.
- Total public transport travel increases by 7.2K journeys. This is 56% more total journey growth than with option F, the light rail service
- Transit mode share does not change (on a Metropolitan wide basis)

NCCC Area Travel

- NCCC public transport use increases by 3.7K a 95% increase in transit journey growth compared to option F, the light rail service.
- Most public transport travel growth is from through travel (2.4K). External travel increases by 1.4K whilst internal transit trips decrease (by 0.1K trips).
- NCCC car travel reduces by 4K double that with the light rail option
- The biggest volume of traffic reductions are through and external travel
- NCCC walk / cycle travel increases marginally

Metropolitan wide transit boarding impacts are illustrated in Table 4.3.

Table 4.3 : Modelled Impacts on Transit Boardings – Strategy F2

	Strategy D : Strategy F Relative Base Case - 2021		Strategy F2 - Doncaster Rapid Transit		Change	
Total PT Journeys	1,404,078		1,411,321		7,243	1%
Total PT Boardings		%Total		%Total		
M> Tram	676,262	28%	676,226	27%	(36)	0%
Yarra Tram	572,674	23%	564,581	23%	(8,093)	-1%
Sub-Total Tram	1,248,936	51%	1,240,807	50%	(8,129)	-1%
M> Train	434,345	18%	434,966	17%	621	0%
Connex	280,550	11%	332,328	13%	51,778	18%
Sub-Total Rail	714,895	29%	767,294	31%	52,399	7%
Metro Bus	478,098	19%	467,274	19%	(10,824)	-2%
Other	14,287	1%	14,329	1%	42	0%
Total	2,456,216		2,489,704		33,488	1%
Boardings per Journey	1.75		1.76		4.62	

This indicates that for Metropolitan wide travel:

- Whilst total transit journeys increase by 7.2K, boardings increase by 33.5K. This is suggestive of a great deal of multi-modal transit journeys being created by the Heavy Rail DART system. It contrasts strongly with the reduction in transfer behaviour apparent with the LRT design for DART which reduced transfers overall.
- There are 33.5K additional transit boardings per weekday.
- Heavy rail boardings increase by 52.4K at the expense of bus (down 10.8K) and tram (down 8.1K)
- M>Train has the largest increase mainly because this is where the DART heavy rail service is operated in the model
- Interestingly Connex also have a small increase in boardings, presumably passengers at the edge of the DART catchment who were displaced as a result of the cutting of buses associated with DART who decided to use the Ringwood line as an alternative path.

4.2.2 Temporal Distribution of Impacts

Table 4.4 shows the impacts on transit boardings by time period

Table 4.4 : Change in Transit Boardings by Time Period – Metropolitan Melbourne

	Strategy D : Strategy F Relative Base Case - 2021				Strategy F2 - Doncaster Rapid Transit				Change From Base Case					
Total PT Boardings	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak
M> Tram	152,098	365,718	158,446	676,262	152,554	365,464	158,208	676,226	456	-254	-238	-36	0%	0%
Yarra Tram	127,944	312,428	132,302	572,674	125,367	307,958	131,256	564,581	-2,577	-4,470	-1,046	-8,093	-2%	-1%
Sub-Total Tram	280,042	678,146	290,748	1,248,936	277,921	673,422	289,464	1,240,807	-2,121	-4,724	-1,284	-8,129	-1%	-1%
M> Train	127,542	198,139	108,664	434,345	127,818	198,025	109,123	434,966	276	-114	459	621	0%	0%
Connex	82,001	124,558	73,991	280,550	95,216	150,425	86,687	332,328	13,215	25,867	12,696	51,778	16%	21%
Sub-Total Rail	209,543	322,697	182,655	714,895	223,034	348,450	195,810	767,294	13,491	25,753	13,155	52,399	6%	8%
Metro Bus	124,930	265,661	87,507	478,098	122,963	258,518	85,793	467,274	-1,967	-7,143	-1,714	-10,824	-2%	-3%
Other	7,293	3,462	3,532	14,287	7,334	3,460	3,535	14,329	41	-2	3	42	1%	0%
Total	621,808	1,269,966	564,442	2,456,216	631,252	1,283,850	574,602	2,489,704	9,444	13,884	10,160	33,488	2%	1%
Time Period Share	A.M. Peak	Off Peak	P.M. Peak	Total	A.M. Peak	Off Peak	P.M. Peak	Total						
M> Tram	22%	54%	23%	100%	23%	54%	23%	100%						
Yarra Tram	22%	55%	23%	100%	22%	55%	23%	100%						
Sub-Total Tram	22%	54%	23%	100%	22%	54%	23%	100%						
M> Train	29%	46%	25%	100%	29%	46%	25%	100%						
Connex	29%	44%	26%	100%	29%	45%	26%	100%						
Sub-Total Rail	29%	45%	26%	100%	29%	45%	26%	100%						
Metro Bus	26%	56%	18%	100%	26%	55%	18%	100%						
Other	51%	24%	25%	100%	51%	24%	25%	100%						
Total	25%	52%	23%	100%	25%	52%	23%	100%						

This indicates that:

- Total boardings increase by 33.5K. This is spread across all time periods. Interestingly this contrasts with the time period pattern for the Light Rail version of DART (F2), where P.M. boardings declined. For the light rail option we hypothesized that p.m. peak DART light rail boardings were derived from rail and the other time periods bus and tram. The heavy rail version of DART is abstracting from mainly bus and tram in all time periods.
- Boardings growth is highest for rail in the inter-peak compared to the peak. This pattern is mirrored by higher declines in bus boardings at this time

4.2.3 Spatial Distribution of Impacts

Table 4.5 shows an analysis of changes in modal trip patterns between the Strategy D base case and the 2021 Strategy F2 case. This indicates that:

NCCC Public Transport Travel

- As noted the 3.7K per day increase in NCCC PT journeys is mainly sourced from through and external travel. By individual spatial area this indicates that:
  - Through transit travel growth is mainly from between the :
    - East and the South 38%
    - North and South 20%
    - East and West 19%
    - East and North 8%
  - The heavy railway option opens up more opportunities for inter-regional travel growth than the light rail option. Possibly because the heavy rail design integrates better with other heavy rail services

Table 4.5 : Analysis of Spatial Changes in Modal Travel – 2021 Strategy F2 vs Strategy D Base Case

– External transit travel growth is mainly from the South and East to and from NCCC. Again this is a wider impact than the light rail option and is due to better inter-regional connectivity provided by operating DART as heavy rail and hence better connecting with other regional rail services.

NCCC Car Travel

- Car travel decline follows the above spatial patterns for public transport growth

NCCC Walk Travel

- Modest Walk travel growth is the result of growth in external and through walk / cycle travel and also a decline in internal walk travel
- Most Walk / Cycle travel growth is from the South and North to NCCC

4.2.4 Transit Service Boardings Impacts

Total Daily Boardings Impacts

Table 4.6 shows the changes in transit boardings by individual NCCC related service. It shows the results for option F2 and also compared them with option F, the light rail version of DART.

This indicates that:

- DART heavy rail carries 50.6K boardings per weekday compared with the light rail which carries 68.7K i.e. 18.1K less boardings or 26% less carryings. This contrasts from the journey growth and boardings growth of the two schemes with the heavy rail option having a much greater impact.
- It is not appropriate to use the direct boarding performance of the LRT or heavy rail options as a measure of success. The LRT runs broadly twice the distance that the LRT does and hence has more than double the catchment potential for boarding attractions.
- With 50.6K boardings per weekday, the DART heavy rail would be carrying more than any current Melbourne rail lines does at present.
- Rail boardings are higher and tram boardings lower under option F2 compared to F due to DART being heavy rail rather than a tram service
- Interestingly bus boardings are higher under F2 than F, the Johnson Street group of bus services in particular do better under F2. In contrast the Eastern Freeway group of bus routes do worse under F2 than F; this group is cut to feed DART under both options. It appears that bus feeding to light rail has higher loadings than bus to heavy rail. This may be rationalised by the fact that walk access to LRT is likely to be better than to Heavy rail.

Table 4.6 : Change in Boardings by NCCC Service –Total Weekday

TRAIN		Modelled Boardings								
Line	Stations	2000	D - CBD park		F - DART (light)		F2 - DART (heavy)		Difference F2-F	
			No	% 2001	No	% 2001	No	% 2001	No	% 2001
Bayside										
Broadmeadows	Broadmeadows to Flinders St	34,279	50,692	47%	50,944	48%	50,643	47%	-301	0%
Frankston	Mordialloc to Frankston	44,093	63,792	45%	63,447	44%	63,671	45%	224	0%
Pakenham	Flinders St to Pakenham	58,227	84,114	47%	84,160	47%	84,496	49%	336	0%
Sandringham	Flinders St to Sandringham	26,987	41,473	56%	41,689	57%	41,413	56%	-276	-1%
St Albans	St Albans to Flinders Street	25,356	77,219	199%	77,528	200%	77,775	201%	247	0%
Stony Point	Frankston to Stony Point	1,111	2,269	104%	2,253	103%	2,224	100%	-29	-1%
Upfield	Upfield to Flagstaff	10,626	29,575	177%	29,291	175%	28,690	174%	-591	-2%
Werribee	Flinders St to Werribee	19,900	64,911	226%	64,478	225%	64,134	224%	-344	-1%
Williamstown	Williamstown to Flinders St	6,442	14,616	126%	14,791	129%	14,878	131%	87	1%
Sub-total		**271,843**	**434,341**	**102%**	**435,387**	**102%**	**434,966**	**102%**	**-421**	**0%**
Hillside										
Alamein	Camberwell to Alamein	6,298	12,215	94%	12,157	93%	12,144	93%	-13	0%
Belgrave	Flinders St to Blackburn	32,161	41,334	29%	40,967	27%	40,920	27%	-47	0%
Epping	Epping – Parliament	28,906	51,929	80%	51,394	78%	54,521	89%	3,127	6%
Glen Waverley	Flinders St – Glen Waverley	26,664	53,642	101%	53,694	102%	53,426	100%	-268	-1%
Hurstbridge	Greensborough – Flinders St	34,164	63,797	87%	62,672	83%	63,993	87%	1,321	2%
Lilydale	Parliament to Lilydale	43,730	67,722	55%	67,281	54%	66,636	53%	-645	-1%
Sub-total		**193,813**	**290,338**	**60%**	**277,255**	**60%**	**280,890**	**70%**	**3,635**	**1%**
DART										
Doncaster to City via Victoria Park							50,620		50,620	
Sub-total		**0**	**0**		**0**		**50,630**		**50,630**	
All Rail		**388,255**	**714,885**	**88%**	**713,642**	**87%**	**767,284**	**101%**	**53,642**	**8%**

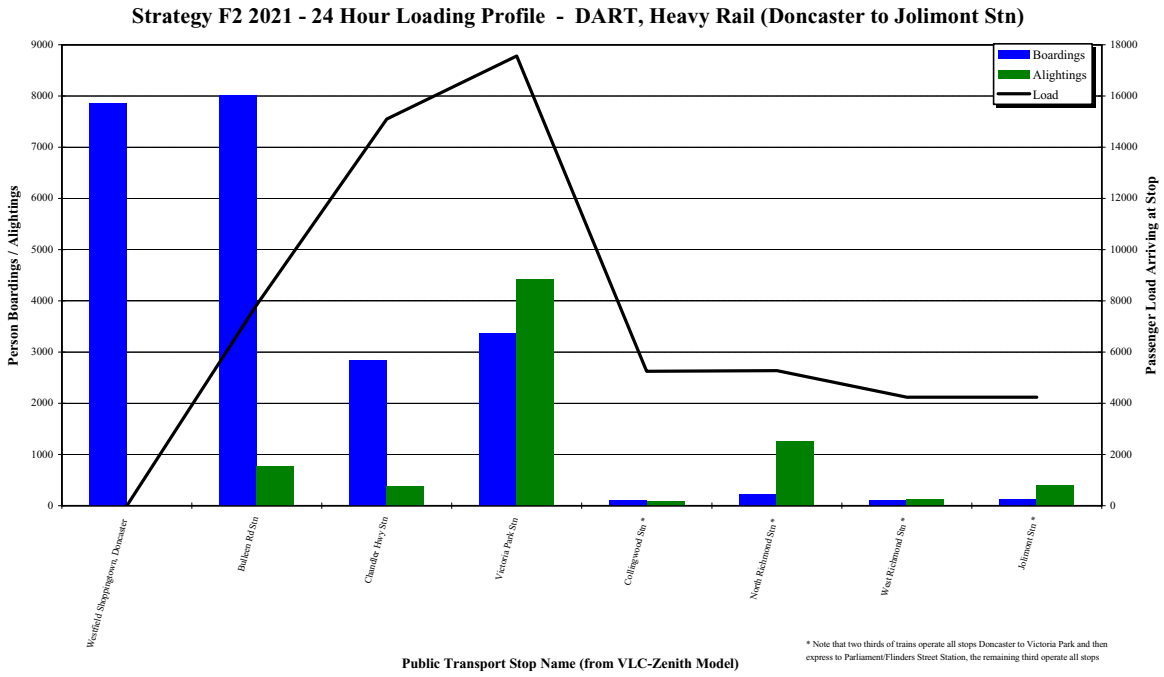
TRAM		Modelled Boardings								
Route No	Suburbs	2000	2021 B - CBD park		F - DART (light)		F2 - DART (heavy)		2021 B - arterials	
			No	% 2001	No	% 2001	No	% 2001	No	% 2001
New North Road light rail			12,982		12,032		13,006		974	1%
Doncaster area rapid transit					40,721				-40,721	-100%
Swanston										
1	Sth Melbourne Beach to East Co	16,254	54,737	261%	52,440	222%	58,411	259%	5,971	11%
16	Melb University to St. Kilda Beach	4,603	19,187	133%	15,740	10%	18,671	117%	2,931	19%
19	City to North Coburg	32,836	118,815	260%	116,922	262%	118,559	260%	1,637	1%
22	Arts Centre to Moreland	7,803	28,841	267%	26,481	212%	29,279	261%	3,098	16%
3	Melb University to East Malvern	12,029	29,131	146%	26,991	124%	29,437	140%	2,446	9%
5	Melbourne University to Malvern	9,304	19,290	116%	15,694	97%	17,984	112%	2,290	14%
59	North Melbourne to City	1,596	3,006	109%	3,704	126%	3,840	144%	136	2%
55	West Coburg to Domain Rd	19,634	46,302	186%	40,136	104%	40,757	106%	621	2%
57	City to West Maribyrnong	14,097	26,941	91%	26,416	87%	27,137	93%	721	3%
59	City to Airport West	26,430	92,280	249%	91,069	245%	93,269	253%	2,200	2%
6	University to Glen Iris	12,710	31,286	128%	28,098	108%	31,002	128%	2,904	10%
64	University to East Brighton	11,946	23,903	101%	21,105	79%	23,469	98%	2,364	11%
67	University to Carnegie	14,141	35,098	148%	32,245	128%	34,651	145%	2,406	8%
69	St Kilda Beach to Kew	14,417	44,410	208%	44,129	206%	43,902	205%	-227	0%
72	Melbourne University to Camberwell	19,555	43,595	124%	40,499	107%	43,244	121%	2,745	7%
78 & 79	North Richmond to Prahran	6,895	13,144	92%	13,298	93%	13,106	91%	-192	-1%
8	Melbourne University to Toorak	16,283	44,431	173%	40,929	151%	43,808	170%	2,879	7%
82	Moonee Ponds to Footscray	3,764	7,223	92%	7,288	94%	7,393	96%	105	1%
Sub-total		**245,621**	**679,852**	**177%**	**640,124**	**157%**	**670,226**	**172%**	**30,102**	**5%**
Yarra										
11	City to West Preston	26,002	77,466	276%	72,790	253%	73,683	255%	893	1%
12	St Kilda to City	10,049	29,322	192%	29,714	196%	30,050	199%	336	1%
23 / 42 / 109	City to Mont Albert	26,346	128,061	374%	120,860	359%	122,771	366%	763	1%
24 & 86	City to North Balwyn	18,423	38,126	81%	33,507	82%	34,222	86%	788	2%
29 & 31	City to East Melbourne	2,709	9,467	242%	9,126	231%	8,983	226%	-143	-2%
70	City to Wattle Park	18,764	40,920	119%	40,620	117%	41,221	120%	601	1%
75	City to East Burwood	16,411	57,201	247%	56,772	244%	57,309	250%	537	2%
86	City to Bundoora	32,444	93,447	186%	92,246	185%	91,247	182%	-999	-1%
96	St Kilda to East Brunswick	23,771	79,264	229%	79,440	234%	77,846	229%	-1,594	-2%
City Circle	Within CBD	13,339	13,602	2%	13,124	-2%	13,669	3%	545	4%
Sub-total		**183,834**	**559,211**	**200%**	**549,092**	**200%**	**551,075**	**201%**	**1,983**	**0%**
All Tram		**471,933**	**1,251,936**	**198%**	**1,271,669**	**195%**	**1,240,397**	**182%**	**-30,863**	**-2%**

BUS		Modelled Boardings								
Route Name	Suburb	2000	2021 B - CBD park		F - DART (light)		F2 - DART (heavy)		2021 B - arterials	
			No	% 2001	No	% 2001	No	% 2001	No	% 2001
Clifton Hill to Brunswick Rd – Northern Bus Lines										
504	Moonee Ponds to Clifton Hill	449	1,230	174%	1,259	180%	1,187	164%	-72	-6%
Sub-total		**449**	**1,230**	**174%**	**1,259**	**180%**	**1,187**	**164%**	**-72**	**-6%**
East Melb to Footscray – BTA										
402	Footscray to East Melbourne	4,017	7,248	80%	7,197	79%	7,014	75%	-183	-3%
Sub-total		**4,017**	**7,248**	**80%**	**7,197**	**79%**	**7,014**	**75%**	**-183**	**-3%**
Eastern Freeway Group – National										
201	The Pines to City	1,655	4,072	146%	2,449	48%	1,749	6%	-700	-29%
202	Box Hill to City	902	2,262	151%	875	-4%	815	-12%	-67	-7%
203	Mitcham Stn to City	32	954	2884%	886	2669%	175	447%	-711	-80%
204	Ringwood Stn to City	1,432	3,000	110%	2,127	16%	1,609	-18%	-518	-29%
205	City to Warrandyte Bridge	1,680	2,116	26%	608	-63%	1,060	-36%	448	74%
206	North Ringwood to City	375	953	152%	415	10%	33	-91%	-382	-92%
207	Mitcham to City	2,627	6,451	146%	3,937	48%	4,619	73%	682	11%
208	Deep Creek to City	631	906	43%	514	-13%	969	54%	455	89%
209	Donvale to City	418	2,059	146%	1,016	21%	170	-60%	-846	-83%
213	City to Templestowe	68	952	1309%	147	116%	144	113%	-3	-2%
215	City to Box Hill	20	487	2335%	110	451%	111	490%	18	18%
216	Templestowe to City	107	980	817%	420	298%	608	460%	178	82%
219	The Pines to City	299	992	232%	288	-4%	88	-71%	-190	-69%
250	City to Latrobe Uni	1,535	4,996	225%	1,815	19%	2,452	61%	637	29%
Sub-total		**12,585**	**31,771**	**152%**	**15,598**	**24%**	**14,415**	**15%**	**-1,183**	**-7%**
Heidelberg Street – National										
246	Latrobe Uni to Elsternwick	6,059	6,141	1%	6,486	7%	6,302	4%	-184	-3%
Sub-total		**6,059**	**6,141**	**1%**	**6,486**	**7%**	**6,302**	**4%**	**-184**	**-3%**
Johnston Street Group – National										
200	Doncaster to City	1,248	3,053	165%	3,399	172%	4,511	261%	1,112	33%
201	Doncaster to City	1,412	2,998	112%	4,604	185%	5,291	274%	1,257	31%
203	Doncaster to City	1,127	2,317	167%	524	-54%	915	-19%	391	75%
205	Doncaster to Melbourne Uni	279	596	119%	917	229%	1,475	430%	561	61%
207	Donvale to City	2,044	4,202	109%	5,304	159%	4,791	232%	487	14%
Sub-total		**6,110**	**13,156**	**109%**	**14,790**	**142%**	**16,916**	**211%**	**6,125**	**20%**
Queens Pde to Melb Uni – Dysons										
546	Melbourne Uni to Heidelberg	536	554	-41%	526	-44%	521	-44%	-5	-1%
Sub-total		**536**	**554**	**-41%**	**526**	**-44%**	**521**	**-44%**	**-5**	**-1%**
Rathdowne Street Group – National										
250	Port Melbourne to Latrobe Uni	2,064	3,740	81%	4,320	109%	4,091	97%	-229	-6%
251	Port Melbourne to Northland SC	1,620	3,621	124%	3,767	133%	3,788	134%	21	1%
253	Port Melbourne to Carlton North	278	824	261%	817	197%	853	210%	36	4%
Sub-total		**3,962**	**8,383**	**187%**	**8,904**	**125%**	**8,732**	**120%**	**-172**	**-2%**
All Bus		**34,110**	**67,900**	**99%**	**56,090**	**68%**	**57,137**	**67%**	**2,639**	**1%**
ALL PUBLIC TRANSPORT BOARDINGS		**846,620**	**2,034,771**	**140%**	**2,049,089**	**141%**	**2,065,228**	**144%**	**25,239**	**1%**

4.2.5 DART Boardings Performance

Figure 5.1 illustrates a loading profile for all day boardings for city bound DART heavy rail service.

Figure 5.1 : DART Heavy Rail Load Profile – City Bound Services Per Day



This indicates that:

- A maximum daily load of 18,000 pass Victoria Park towards the CBD. This is more than twice the loading of the LRT service (at 8,000 at the same location).
- The busiest DART stops are:
  - Bulleen Road
  - Doncaster Shopping Town
  - Victoria Park
- It is significant that Victoria Park is a major interchange point to other regional transit services. The data suggests that about a fifth of the inbound daily market is using DART to access this transfer point.

4.2.6 Peak Maximum Load Impacts

Analysis of peak maximum loadings on the DART heavy rail service indicates that the heavy rail maximum loading is at Victoria Park station. Average peak maximum loads are 244 per train which is relatively low for a heavy rail service. This is suggestive that only 3 car sets may be required even in the peak.

Maximum loading result conclusions for other services are similar to option F.

4.3 Summary of Overall Impacts

See Table 4.6.

Table 4.5 : Summary of Major Weekday Strategy Elements and Impacts : Strategy F2

Strategy Elements	
• New heavy rail system operating to the following stations Doncaster Shoppingtown, Bulleen Road Eastern Freeway, Chandler Highway Eastern Freeway , Victoria Park Station than all stations on the Clifton Hill group into the city loop • High frequency, slightly faster running than the LRT DART including two thirds of trains running express Victoria Park to Parliament / Flinders Street • Freeway buses cut to operate at 3 Freeway station interchanges	
Market	**Impact (from 2021 Strategy D Base Case)**
Total Metropolitan travel	• Transit journeys increase by 7.2k compared to 4.6K with DART as a light ril service • Transit boardings increase by 33.5K implying much interchanging in new transit journeys. This contrasts with the DART LRT option which reduces transfer overall
Total NCCC Travel	• Transit journeys increase by 3.7 compared to 1.9K with the DART LRT service • Transit journey growth is mainly from Through and External Travel • Transit boarding increases are spread through all time periods
Spatial Impacts– NCCC	• DART heavy rail has a wider regional impact on transit journey growth and associated car travel decline than the LRT option. LRT only really impacted on travel between East and South whilst the Heavy rail includes this effect and also impacts other through travel and external travel corridors mostly those associated with the South and North. This impact is probably caused by the easier integration with regional heavy rail services provided by DART heavy rail compared to DART LRT
Service Boarding Impacts	• DART heavy rail achieves 50.6K boardings which is 26% less than those for LRT. • However the heavy rail option has almost half the catchment of the LRT, hence the relative boardings performance is no a good indicator of overall success • With 50.6K boardings per weekday, the DART heavy rail would e carrying more than any exiting rail line in Melbourne • In general bus does better in boarding terms than with DART LRT mainly because the Johnson Street group has higher loadings. In contrast the Eastern Freeway group of bus routes, which are cut to feed DART stations, do better under LRT since it is easier to transfer to LRT than heavy rail
DART Loadings	• **DART heavy rail has a maximum inbound daily loading of just under 18,000 passengers. This is more than double the inbound daily load of the LRT.** • **Bulleen Road and Shoppingtown are the major suburban commuter stations with Victoria Park playing an important interchange role for about 20% of all DART travel.**
Maximum Load Demand Impacts	• DART heavy rail achieves an average maximum load of 244 well within the scope of a rail service and arguably very low for rail. It is suggestive that 3 car sets could be deployed on the service rather than the standard 6 car sets used elsewhere • Other loading estimates provide similar results to thise identified in option F DART light rail

5 OVERVIEW OF OTHER STRATEGY IMPACTS ON TRANSIT

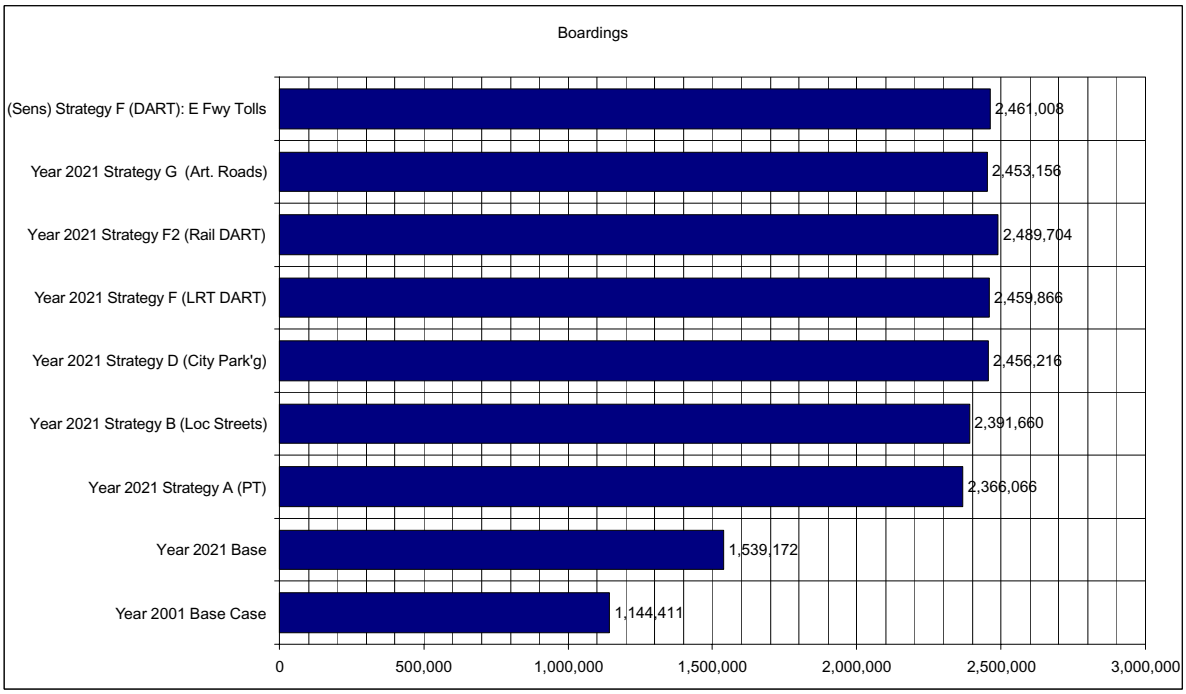
5.1 Introduction

This section summarises some of the key findings from the analysis presented.

5.2 Transit Boardings

Figure 5.1 shows the impact of the available strategy modelling results on total transit boardings.

Figure 5.1 : Transit Boardings by Strategy



Note: All strategies are cumulative except strategy F2 which includes strategies A, B, and D but not F. Strategies G and E including strategy A to F but not F2. Strategy F2 is a variation of strategy F

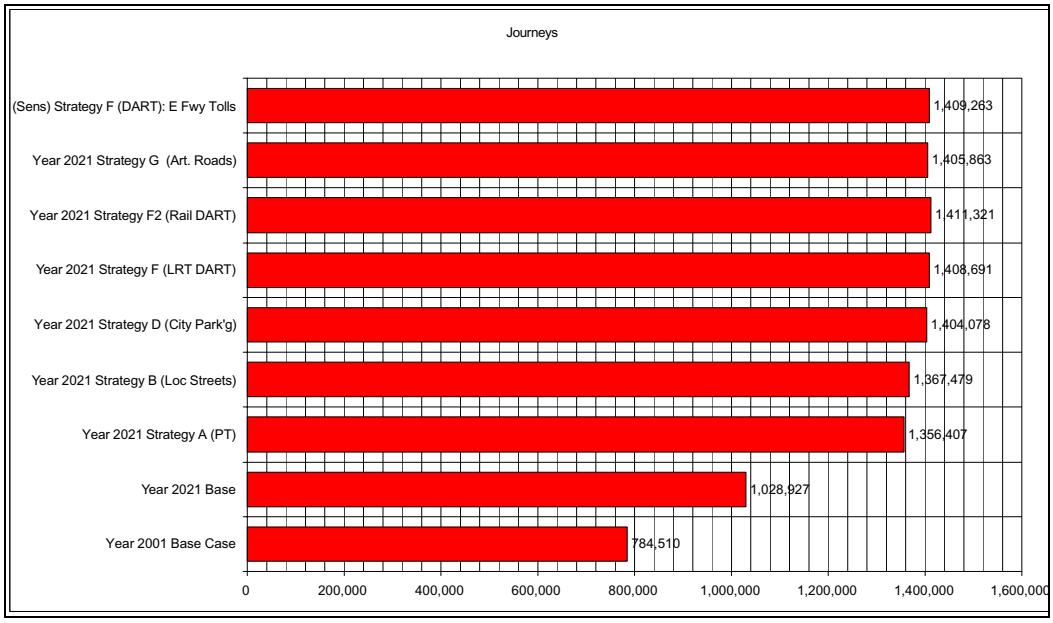
This indicates that:

- Strategy A has by far the largest impact on transit usage followed by developments between the 2001 base and the 2021 base case
- For all other strategies the impacts on boardings are generally positive, however they are marginal compared to the strategy A impacts
- Of the strategies other than strategy A, strategy D has had the largest of the very marginal positive impacts on boardings
- Strategy F2, DART Heavy rail has a bigger transit boarding growth impact than its alterntive strategy F (DART LRT).

5.3 Transit Journeys

Figure 5.2 shows the impact of the available strategy modelling results on total transit journeys. The conclusions from this analysis is exactly the same as for transit boardings.

Figure 5.2 : Transit Journeys by Strategy

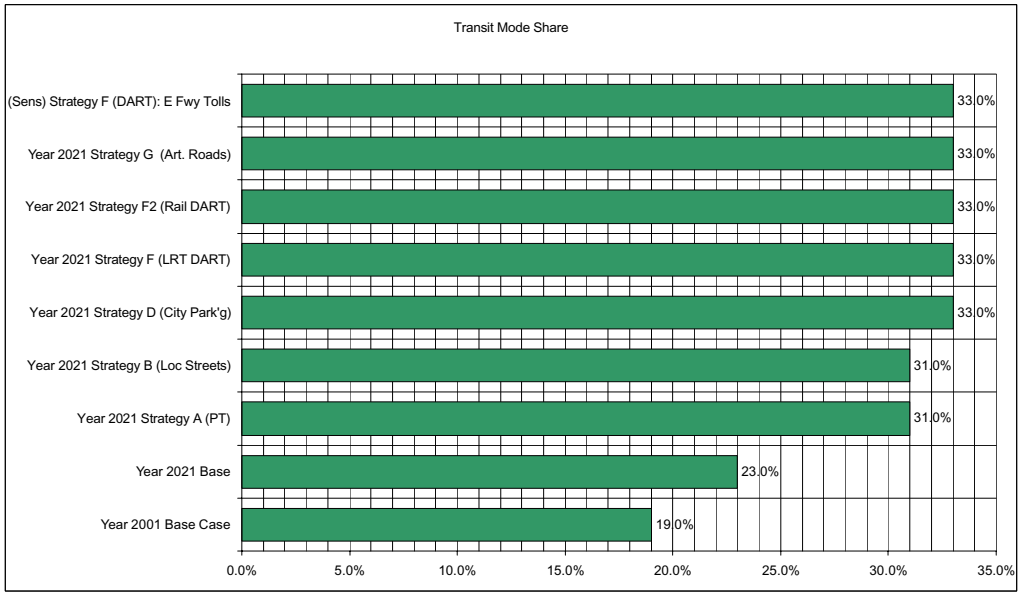


Note: All strategies are cumulative except strategy F2 which includes strategies A, B, and D but not F. Strategies G and E including strategy A to F but not F2. Strategy F2 is a variation of strategy F

5.4 NCCC Transit Mode Share

Figure 5.3 shows the impact of strategy options on NCCC transit mode share.

Figure 5.3 : NCCC Transit Mode Share by Strategy



Note: All strategies are cumulative except strategy F2 which includes strategies A, B, and D but not F. Strategies G and E including strategy A to F but not F2. Strategy F2 is a variation of strategy F

This indicates that:

- The pattern of the boarding and journey results is almost identical to NCCC transit mode share impacts
- However strategy A stands out even more as the major influence since the change in transit share between 2001 and 2021 base case is modest, whilst the strategy A improvements in mode share are relatively large (an increase of 8%)
- The heavy rail DART service has little overall mode share impact compared to its LRT counterpart (the differences are a fraction of a percent).