

Zenith Model Recalibration and
Validation Version 3.0.0

Paper 9 – Model Validation

July 2014

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Paper 9 – Model Validation

Draft Report

Project No. ZML-VIC-Year4

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1 Introduction

1.1 Background

The Zenith Model of Victoria is one of a family of models developed by Veitch Lister Consulting (VLC) for transport planning in Australian cities and regions. This document is one in a series of working papers that collectively describe the calibration and validation of the Zenith Model of Victoria.

The primary focus of this document is the validation of the Zenith Model of Victoria, that is, the ability of the model to replicate a preceding year (in this case, 2011) for which a database of observed public transport, traffic and household travel survey data exists and can be compared to.

1.2 Report Structure

The balance of this report is structured as follows:

Section 2: A summary of the observed public transport, traffic and household travel survey data (VISTA07/09) used for model validation

Section 3: Compares model's estimates of public transport patronage for 2011 against a database of observed public transport data from the same year

Section 4: Compares model's estimates of traffic volumes for 2011 against a database of observed traffic count data from the same year



2 Data Used for Model Validation

In this section, the data collected for the validation of 2011 Zenith model will be discussed.

2.1 Metropolitan Public Transport Patronage Data

2.1.1 Train Station Entries

The estimated average weekday station entries at metropolitan stations for 2010-11 (by time period) have been processed and provided by Public Transport Victoria (PTV) using the following data sources:

- Automatic Ticketing System (ATS) Datastore Cube
- Metlink Origin Destination (OD) Survey
- Metlink Validation Rate Survey
- Metropolitan Train Patronage Model

Table 2.1 shows the 2011 estimates of total train station entries. The individual train station entries can be found in Table A.1 in Appendix A – Public Transport Observed Data. Note that in order to allow for a more direct comparison with the modelled results, this data is provided to VLC by PTV excluding the standard 5% allowance for linked trips.

Period	Observed
AM Peak	183,618
PM Peak	176,246
Daily	749,576

Table 2.1- Total Train Station Entries by Period (2011) – excluding transfers (Average Weekday)

2.1.2 AM Inbound CBD Cordon Train Loads

AM peak inbound train loads at the CBD cordon (departing North Melbourne, Richmond and Jolimont Stations) were collected during the annual train cordon surveys in May for the years between 2008 and 2011. This data has been made available and shown in Table A.2 in Appendix A. The 2011 cordon loading data has been used for model validation in a later section of this report.



2.1.3 Tram Boardings

Total tram boarding estimates by route were sourced from the Tram Origin Destination report – 2011, and can be seen in Table 2.2. This data is available for the AM and PM peak, as well as across the entire day and can be seen in Table C.8 as “observed” boardings in Appendix C. Unfortunately the tram boarding estimates are not separately reported by direction (i.e. up or down) in the Tram Origin Destination report.

Daily tram boardings by SLA can be seen in Table C.10 as “observed” boardings in Appendix C.

Period	Observed
AM Peak	100,409
PM Peak	113,023
Daily	585,823

Table 2.2 - Total Tram Boardings (2011) - Average Weekday



2.1.4 CBD Cordon Tram Loads

AM peak inbound tram loads at the CBD cordon and several other key locations were sourced from the October 2011 Yarra Trams Load Survey and can be seen in Table 2.3. Detailed tram loads can be seen in Table C.9 as “observed” boardings in Appendix C.

Cordon Location	Tram Routes	Count Type	Direction	Observed
Bourke St / Spring St	86, 96	Arrival	West Bound	2,890
Clarendon St (Crown Casino)	96, 109, 112	Arrival	North Bound	3,686
Elgin St / Lygon St	1, 8	Arrival	South Bound	2,005
Errol St / Victoria St	57	Arrival	South Bound	703
Flinders St / Russell St	35, 70	Arrival	West Bound	406
Haymarket (Elizabeth St)	19, 59	Arrival	South Bound	3,047
Peel St / Victoria St	55	Arrival	South Bound	1,687
Queensbridge St (Casino East)	55	Arrival	North Bound	891
St Vincents Plaza	24, 30, 109, 112	Arrival	West Bound	3,500
Swanston St / Flinders St (Federation Sq)	1,3,5,6,8,16,64,67,72	Arrival	North Bound	4,296
Wellington Pde / Jolimont Rd	48, 75	Arrival	West Bound	2,190
Other Locations				
Swanston St / Flinders St (Federation Sq)	1,3,5,6,8,16,64,67,72	Departure	South Bound	6,706
Domain Interchange (St Kilda Rd)	1,3,5,6,8,16,64,67,72	Departure	North Bound	3,881
Domain Interchange (St Kilda Rd)	1,3,5,6,8,16,64,67,72	Arrival	South Bound	5,010
Swanston St / Latrobe St	1,3,5,6,8,16,64,67,72	Departure	North Bound	2,773
Swanston St / Latrobe St	1,3,5,6,8,16,64,67,72	Arrival	South Bound	2,419

Table 2.3 – Total Tram Loads at the CBD cordon and other key locations - Average Weekday



2.1.5 Bus Boardings

In earlier validation reports produced by VLC, a majority of the observed bus boardings for 2011 were estimated by taking the 2008 total bus boardings estimates and factoring them up using growth rates in the Victorian Official Patronage Series (December 2011).

Total bus boardings for 2011-12 have since become available through the PTV bus origin-destination survey, and are used for model validation purposes in this report. A comparison of the total weekday bus boarding estimates derived from the process described above with the observed 2011 boardings are summarised in Table 2.4. AM peak boardings were lower than estimated, PM peak was slightly higher than estimated and Daily total boardings were substantially higher than estimated.

Period	2011 Estimates	2011 Observed
AM Peak	86,000	78,849
PM Peak	71,000	73,282
Daily	395,000	420,080

Table 2.4 - Total Bus Boardings - Average Weekday



2.1.6 SmartBus Boardings

Total SmartBus boardings by route were sourced from the PTV bus origin-destination survey for 2011-12. A summary can be seen in Table 2.5, while details of the SmartBus boardings by route are shown in Table 3.11 as “observed” boarding number in a later section of this report.

Observed SmartBus Boardings by Time Period			
	AM Peak	PM Peak	Daily
Total SmartBus Boardings	12,072	13,112	71,935

Table 2.5 - Total SmartBus (900 series) Boardings (2011-12) - Average Weekday

VLC understands that SmartBus routes are still experiencing rapid growth (or ramp-up) due to continuous improvements in frequency, route coverage, bus priority, marketing, real time information etc.

2.2 Regional Public Transport Patronage Data

2.2.1 V/Line Station Boardings

V/Line estimated average weekday station boardings in 2010-11 can be seen in Table 2.6. It is based upon data collected during the V/Line conductor surveys and PTV market analysis. It includes train boardings at each given station during the AM and PM peaks as well as across the entire day.

	Observed
AM Peak	8,924
PM Peak	10,087
Daily	39,415

Table 2.6 - V/Line Train Boardings by Time Periods, in the Zenith Modelled Area - Average Weekday - May 2011



2.3 Road Traffic Data

2.3.1 VicRoads 2011 Screenline Data – Model Wide

A total of 791 traffic counts make up the 22 VicRoads traffic screenlines across the entire Melbourne Statistical District (MSD). The locations of the screenline can be seen in Figure 2.1 while the total traffic passing each screenline, by direction and time of day, can be seen in Table B.11 of Appendix D. Commercial vehicle counts are also included for these screenlines.

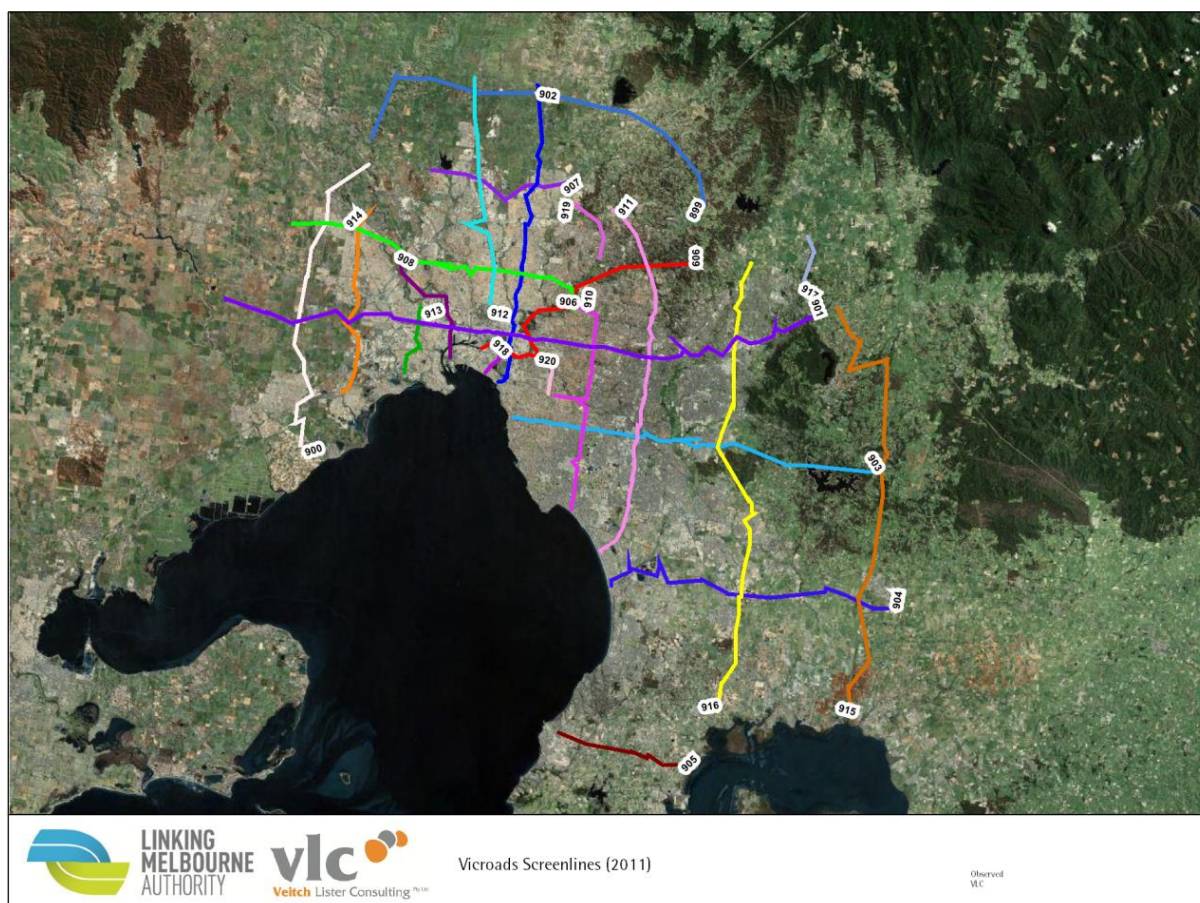


Figure 2.1 - Model Wide Screenlines (2010-11)



3 Validation of Public Transport Assignment

In this section, the validation of modelled public transport forecasts will be discussed with respect to the observed data that is available for different public transport modes in Melbourne.

3.1 Train

3.1.1 Train Station Entries Summary

Table 3.1 presents the total modelled train station entries (excluding rail to rail interchanges) in comparison to the estimated station entries for 2011, by time of day.

Compared with these estimates, the model performs well; it is close but slightly low in the AM and PM peaks and across the day.

Total Train Boardings by Period				
Period	Observed	Model	Difference	% Difference
AM Peak	183,618	177,016	- 6,602	-4%
PM Peak	176,246	169,604	- 6,643	-4%
Daily	749,576	729,333	- 20,243	-3%

Table 3.1 - Total Train Entries by Period

The following sections present more detailed line station entry comparisons by time of day.

3.1.2 Daily Train Station Entries by Line Group

At the most aggregated level, there are 4 key line groups (along with 2 inner groups). Table 3.2 presents the total number of daily station entries by each of the line groups.

The modelled estimates are lower in the inner city but higher in Northern and Clifton Hill groups. The largest percentage difference occurs on inner city interchange stations (including North Melbourne, Richmond and South Yarra stations). This could be due to the fact that the modelled totals exclude all rail to rail interchanges, however some of these rail to rail interchanges are included in the observed data, as some people are forced to exit and re-enter the station to change platforms.



Daily Train Boardings by Line Group				
Line Groups	Observed	Model	Difference	% Difference
Burnley	118,129	108,937	- 9,192	-8%
Caulfield	166,913	163,129	- 3,784	-2%
Clifton Hill	66,727	69,701	2,974	4%
Northern	109,889	123,214	13,325	12%
Sub total	461,659	464,981	3,322	1%
City Loop	254,575	240,754	- 13,822	-5%
Inner City Interchange Stations	33,342	23,599	- 9,743	-29%
Sub total	287,917	264,352	- 23,565	-8%
TOTAL	749,576	729,333	- 20,243	-3%

Table 3.2 - Daily Train Entries by Group

A detailed summary of train entries by line group, line corridor and line segment can be found in Table C.5 of Appendix C.

Figure 3.1 shows the observed station entries and modelled entries (excluding rail to rail interchanges) by line corridor.

Overall the observed and modelled results are close.

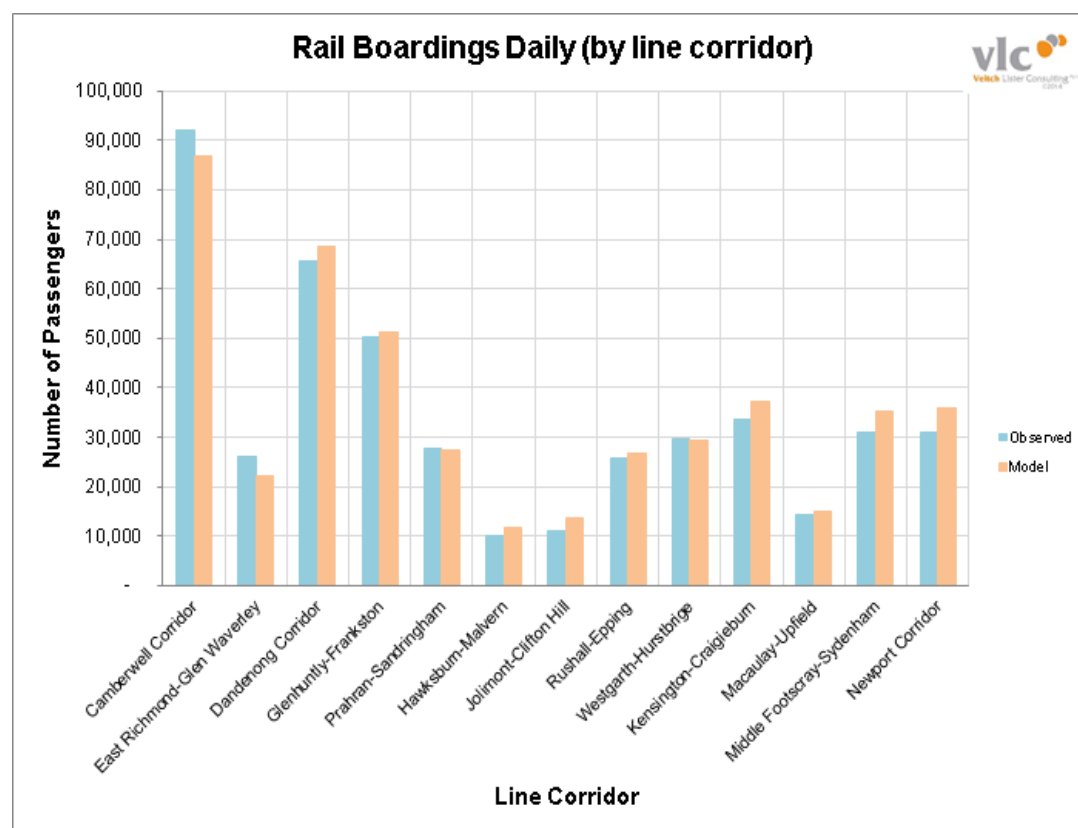


Figure 3.1 – Average Weekday Train Station Entries by Line Corridor



The comparisons between modelled and observed estimates of each line segment daily station entries are presented in Table C.5 of Appendix C. Figure 3.2 and Figure 3.3 present the scatter plots with and without the City Loop numbers respectively.

Inclusion of the City Loop (small chart on top left) results in an R-Squared of 0.99, though this measure is heavily biased by the City Loop. Excluding the City Loop an R-Squared of 0.79 is achieved. The gradient (around 0.95) again suggests that modelled rail boardings are slightly lower than observed estimates.

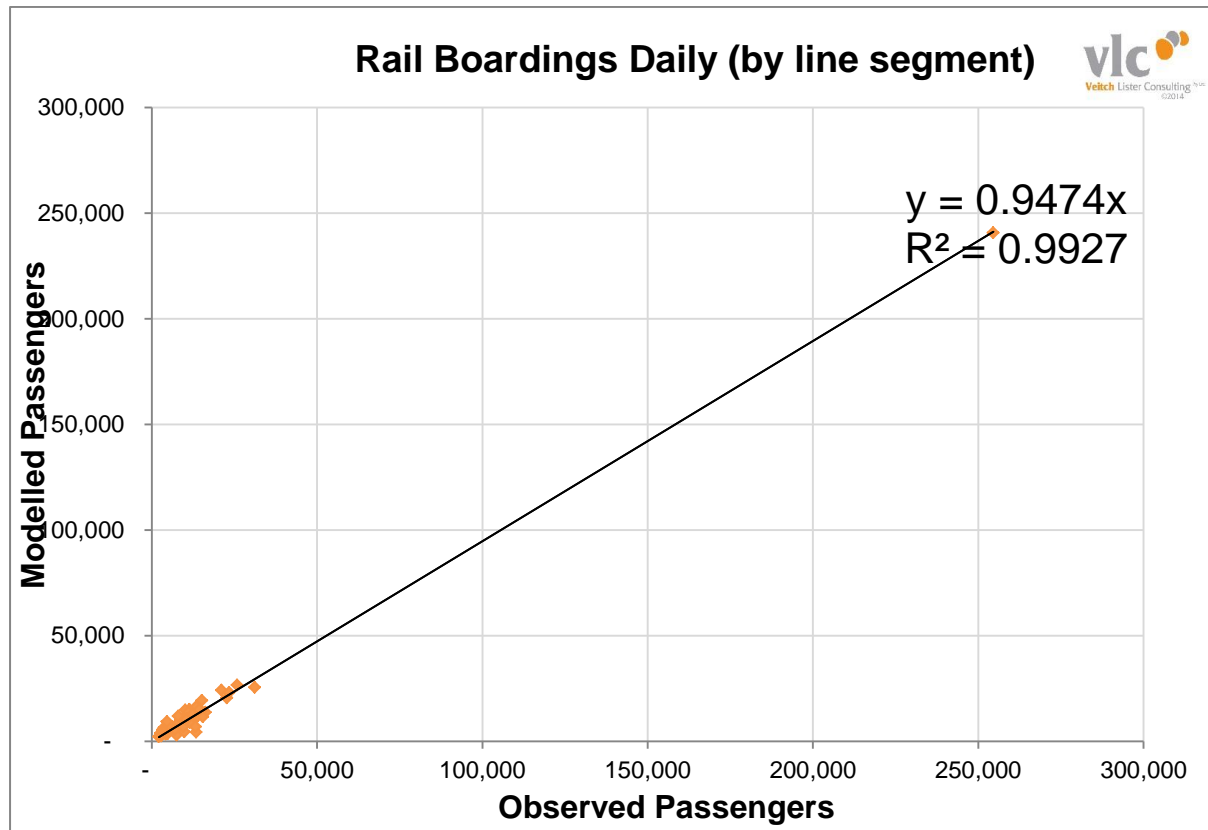


Figure 3.2 - Daily Train Entries by Line Segment (including city loop)

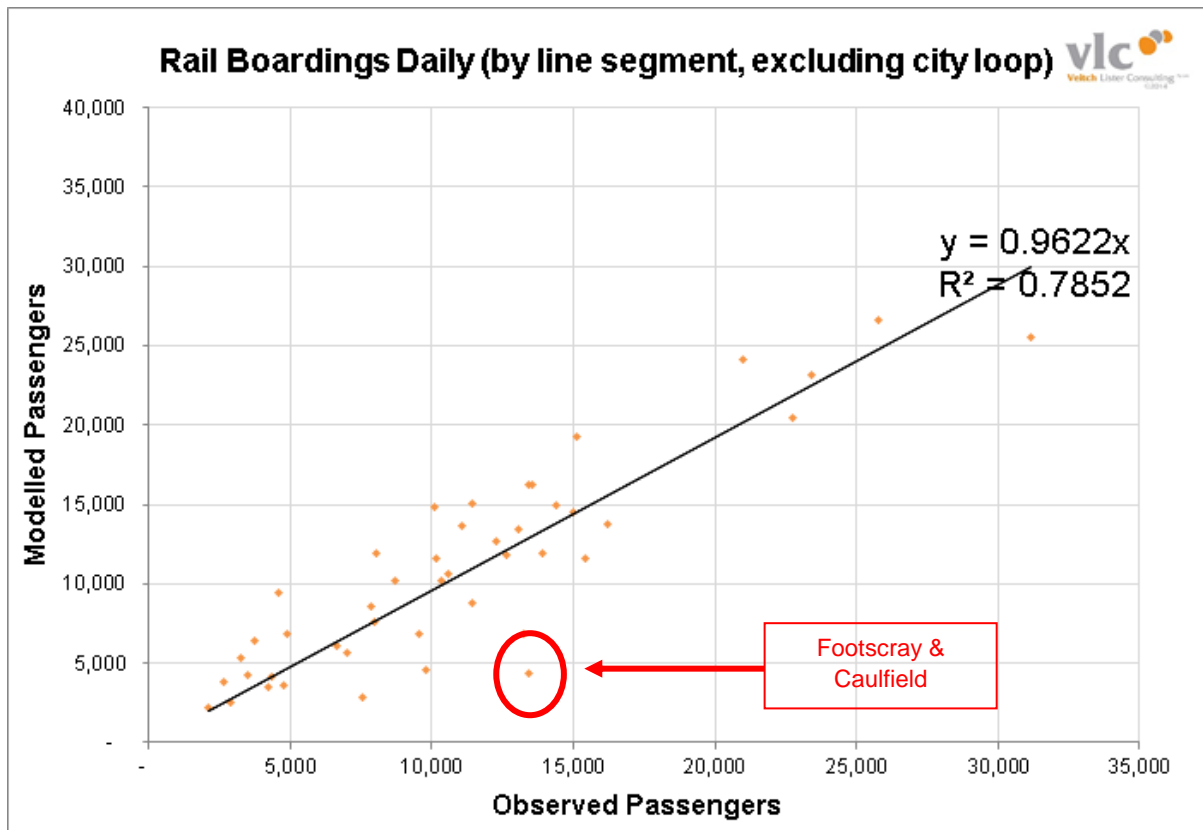


Figure 3.3 - Daily Train Entries by Line Segment (excluding city loop)

The same comparisons (i.e. modelled train station entries - excluding rail to rail interchanges - in comparison to the estimated station entries for 2011) were also undertaken at a station level. Figure 3.4 and Figure 3.5 present the comparison with and without the City Loop stations. The largest differences occur at stations that are believed to include significant numbers of rail to rail interchanges, which are in the observed data if people are forced to exit and re-enter the station to change platforms, but are not included in the modelled station entries. These locations are highlighted in the red circles.

Both R-Squared and gradient are lower (further away from 1) than those at the line segment level, which suggests that modelled rail entries are less accurate at a more disaggregated level. This is expected, as the model is designed to capture travel patterns of the whole of Melbourne and therefore it is more representative at the line segment level than the station level. The latter however can be improved if the model is customised for studies of specific geographical areas.

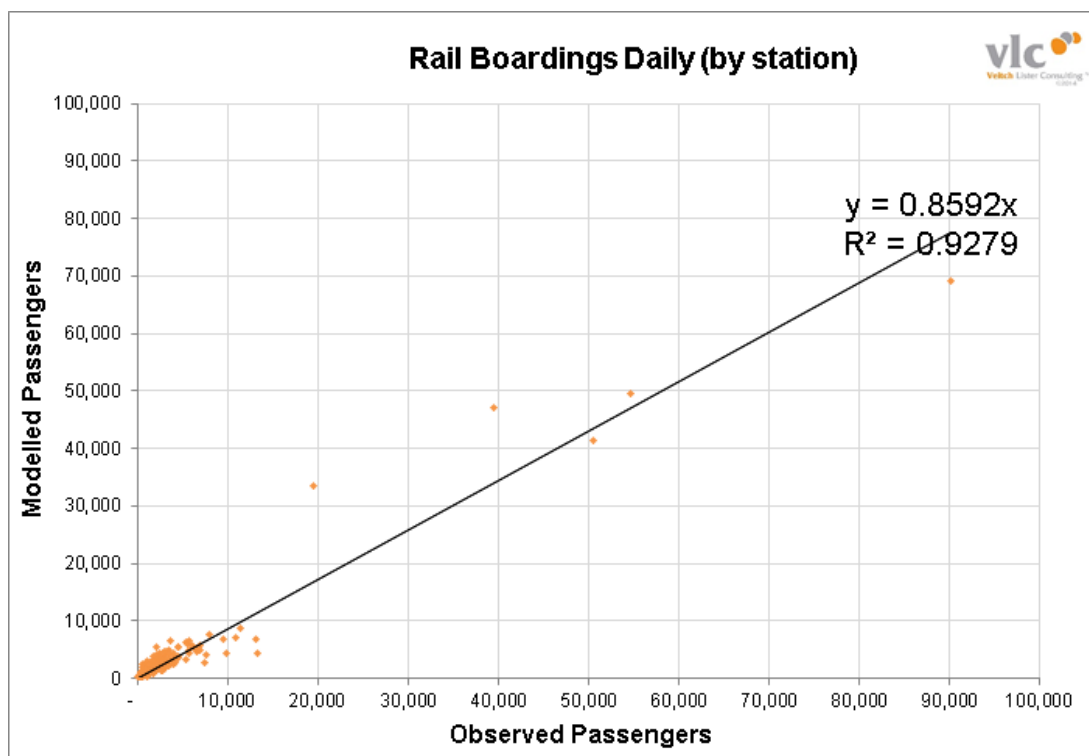


Figure 3.4 - Daily Train Entries by Stations (including city loop)

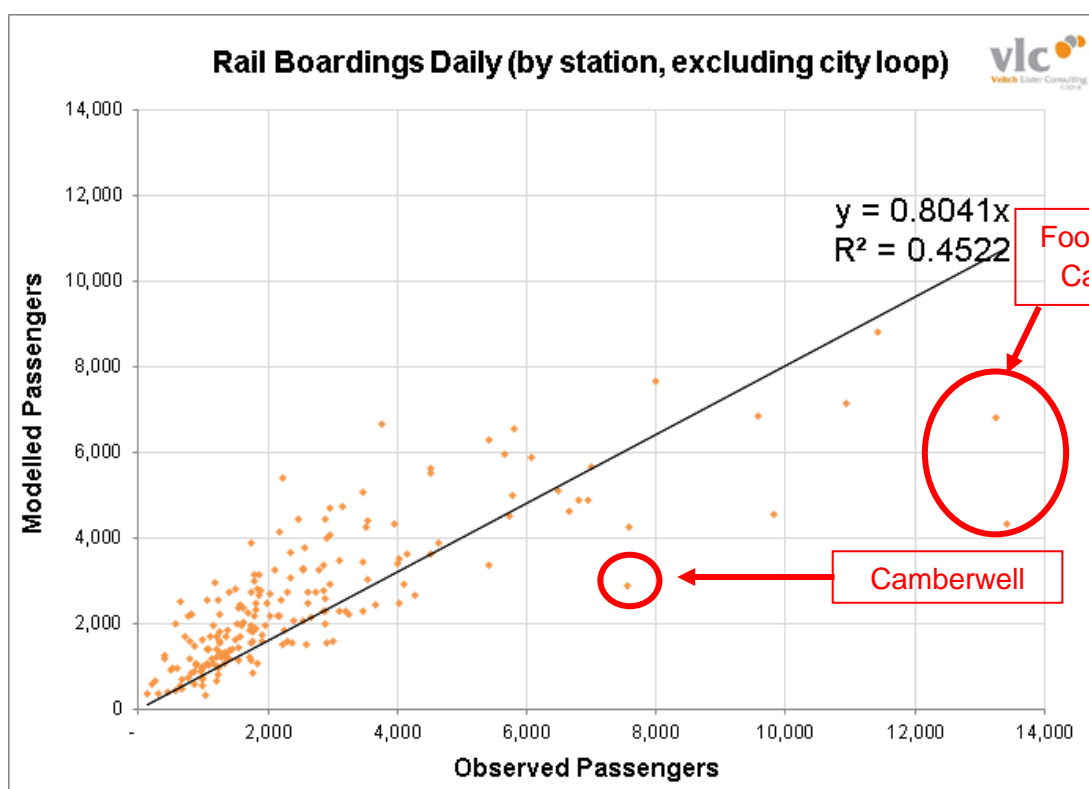


Figure 3.5 - Daily Train Entries by Stations (excluding city loop)



3.1.3 AM Peak (7-9am) Station Entries by Line Groups

Table 3.3 presents the number of AM Peak entries on each of the 4 key line groups (along with 2 inner groups).

The model represents observed major line groups reasonably well. The exceptions are the City Loop and Inner City Interchange Stations, however there are relatively small numbers of station entries in the AM peak at these stations. In the PM peak (i.e. when these stations are their busiest) these stations validate well to observed data (see Table 3.4).

AM Train Boardings by Line Group					
Line Groups	Observed	Model	Difference	% Difference	
Burnley	43,668	38,654	-	5,014	-11%
Caulfield	57,639	54,120	-	3,519	-6%
Clifton Hill	25,566	23,827	-	1,739	-7%
Northern	42,782	46,181		3,398	8%
Sub total	169,656	162,782	-	6,874	-4%
City Loop	7,618	9,768		2,151	28%
Inner City Interchange Stations	6,345	4,466	-	1,879	-30%
Sub total	13,963	14,235		272	2%
TOTAL	183,618	177,016	-	6,602	-4%

Table 3.3 - AM Peak Train Entries by Line Group

Detailed comparisons of line corridor entries and line segment entries in the AM peak are presented in Figure 3.6 and Table C.6 of Appendix C respectively.

This highlights good correlation between observed and modelled rail boarding for each line corridor.

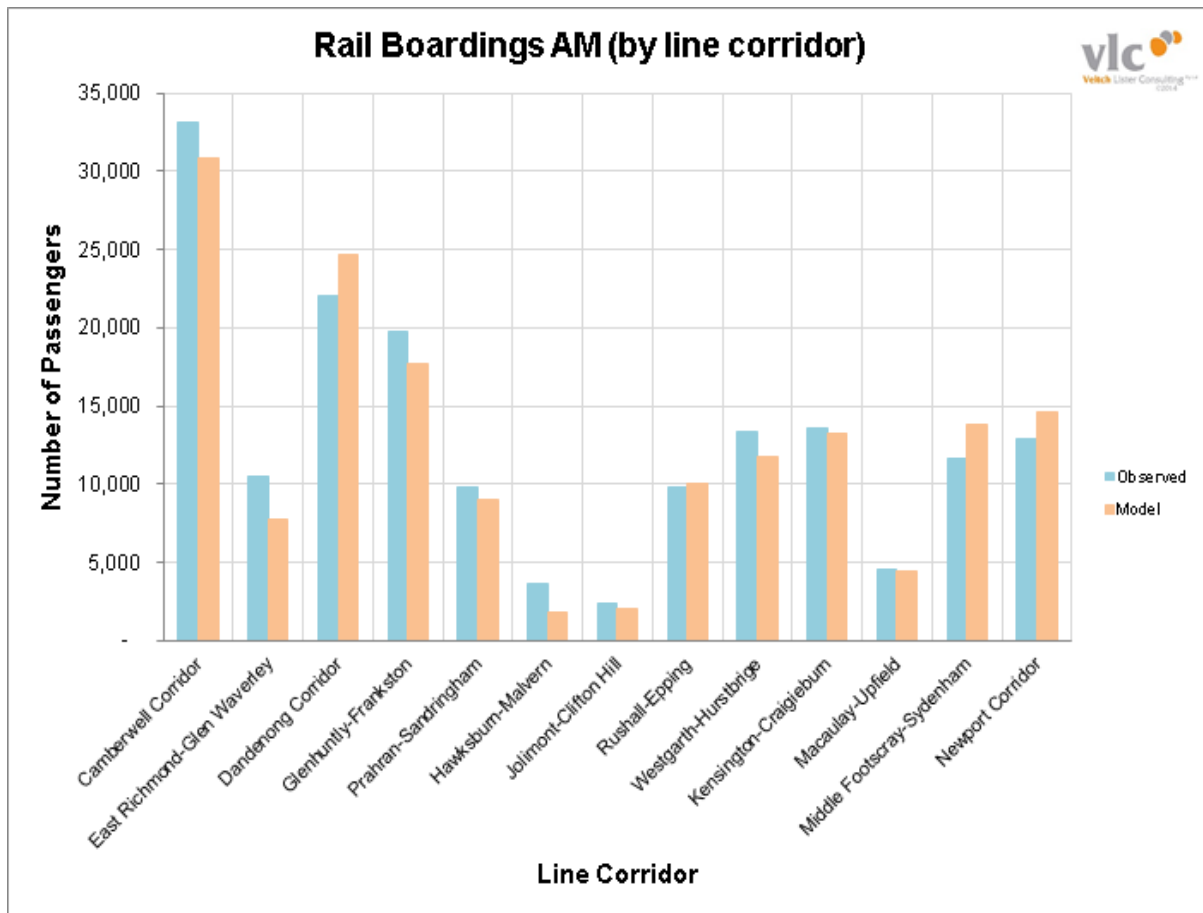


Figure 3.6 - AM Peak Train Entries by Line Corridor

Figure 3.7 to Figure 3.8 present modelled and observed estimates of AM Peak station entries by line segment and by station respectively.

An R-Squared of 0.80 is achieved, with a gradient of 0.94 at the line segment level but validation is not as good at the individual station level. This again suggests the model is performing well in the AM peak, at an aggregated line segment level. At the individual station level, the results are more scattered, again suggesting that the model is more representative at the line segment level than the station level (for example, the model over predicts station entries in the AM peak at Southern Cross station, although these numbers are small in comparison to the number of station entries in the PM peak).

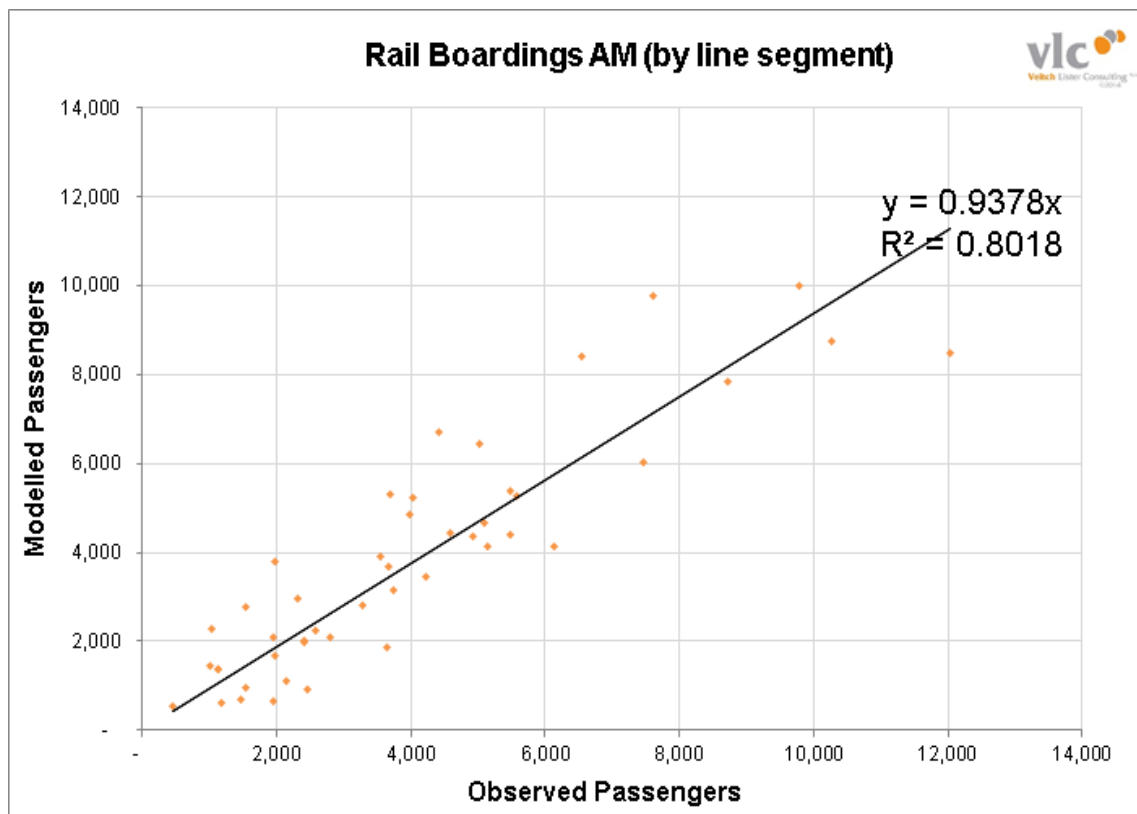


Figure 3.7 - AM Peak Train Entries by Line Segment

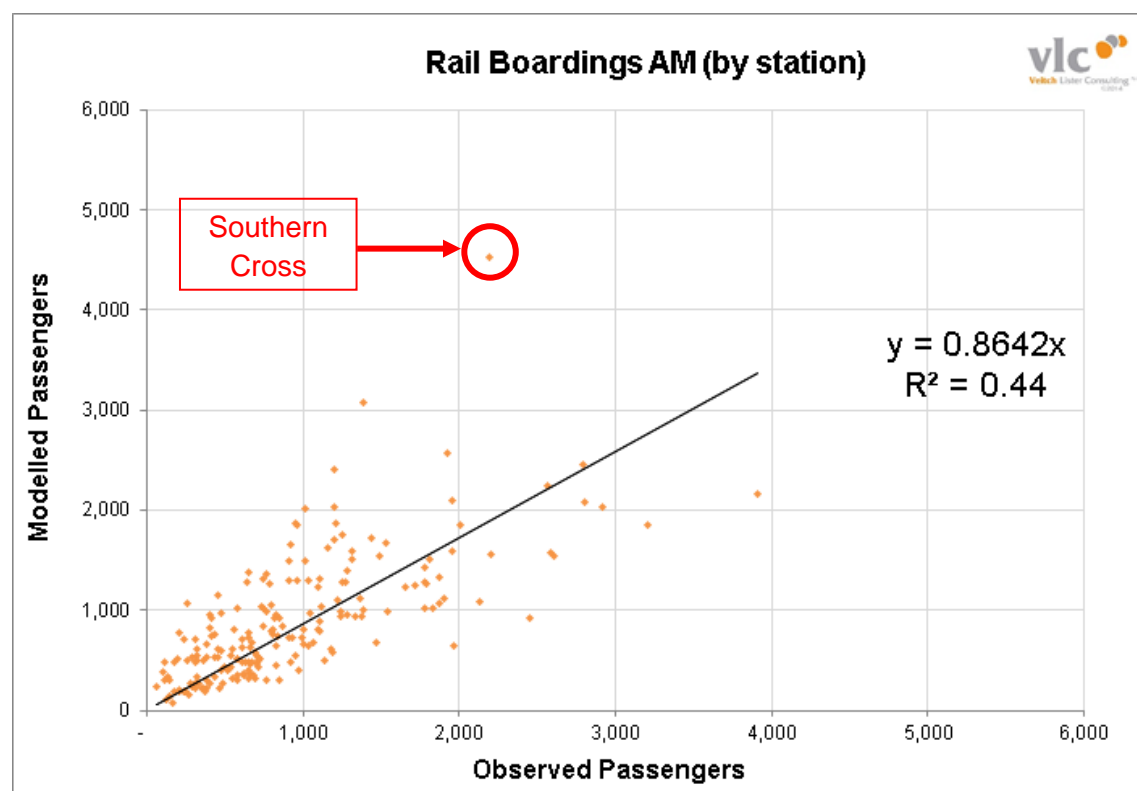


Figure 3.8 - AM Peak Train Entries by Station (including city loop)

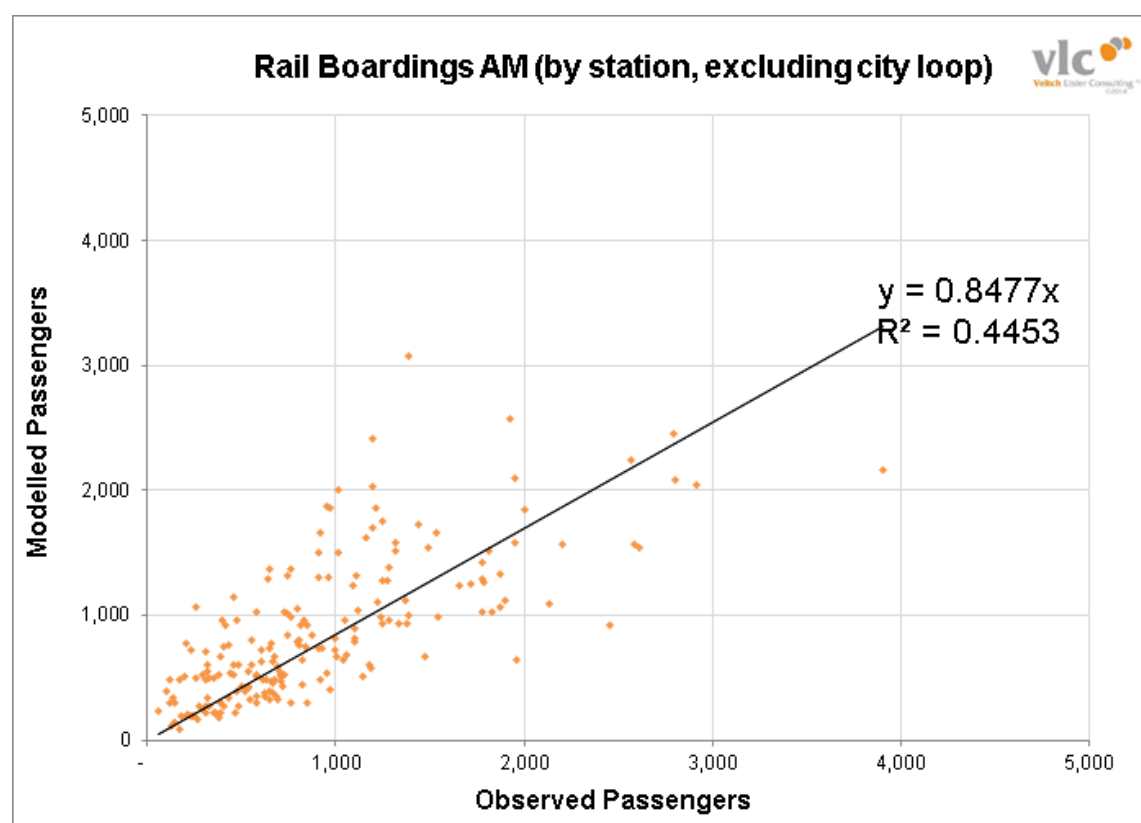


Figure 3.9 - AM Peak Train Entries by Station (excluding city loop)



3.1.4 PM Peak (4-6pm) Station Boardings by Line Groups

Table 3.4 presents a summary of PM Peak (4-6pm) entries by each of the 6 major line groups. The City Loop is the dominant boarding group in PM and the model replicates the boarding behaviour in city loop group very well.

Line Groups	Observed	Model	Difference	% Difference
Burnley	16,859	12,558	- 4,301	-26%
Caulfield	22,133	19,160	- 2,973	-13%
Clifton Hill	8,218	9,053	835	10%
Northern	11,221	9,889	- 1,332	-12%
Sub total	58,431	50,660	- 7,771	-13%
City Loop	109,784	113,256	3,472	3%
Inner City Interchange Stations	8,031	5,688	- 2,343	-29%
Sub total	117,815	118,943	1,128	1%
TOTAL	176,246	169,604	- 6,643	-4%

Table 3.4 - PM Peak Train Entries by Line Group

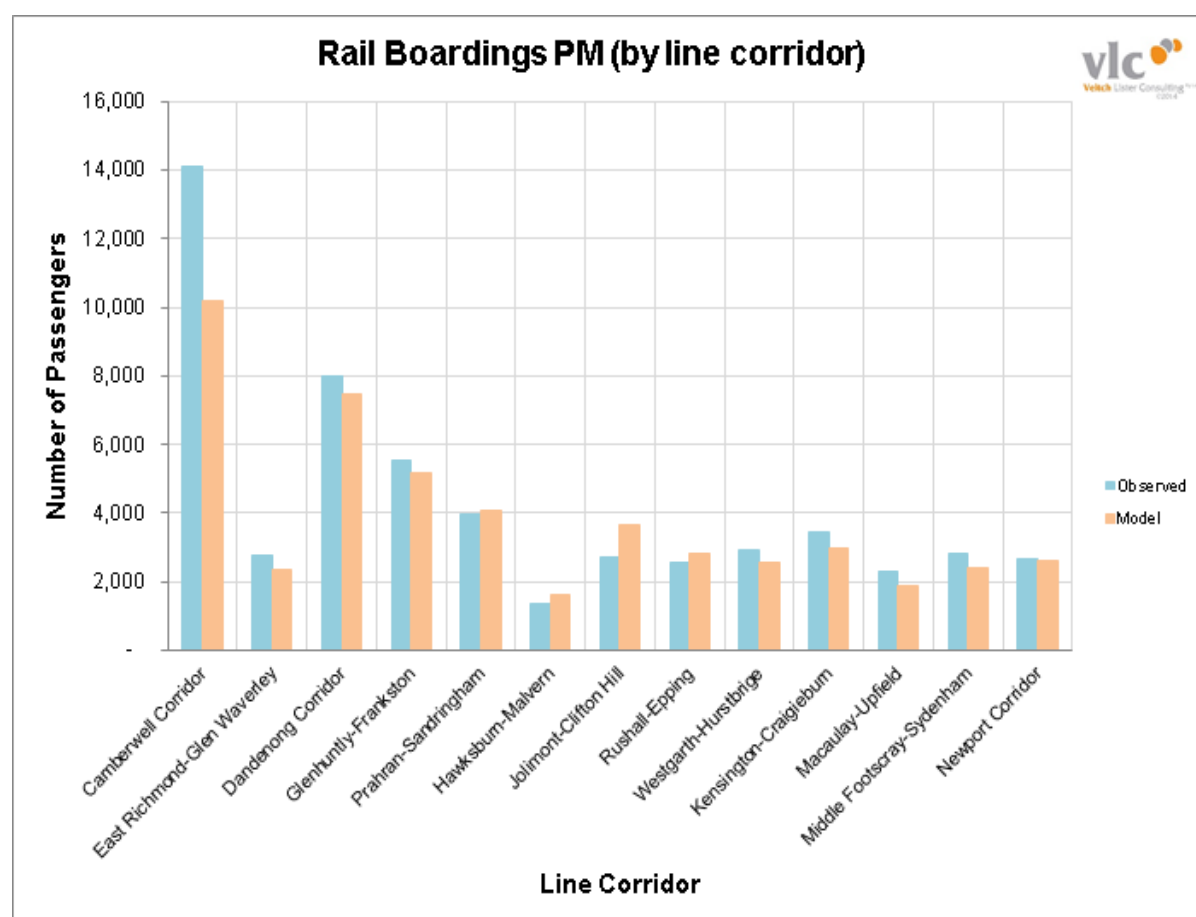


Figure 3.10 - PM Peak Train Entries Daily Train Entries by Line Corridor



The more detailed comparisons of PM line corridor entries and line segment entries are presented in Figure 3.10 and Table C.7 of Appendix C respectively.

Figure 3.11 and Figure 3.12 present modelled and observed PM Peak station entries by line segment for comparisons with and without the City Loop respectively.

The City Loop stations are very important in the PM peak, and when they are included in the line segment analysis, an R-Squared and gradient of 1.0 are achieved.

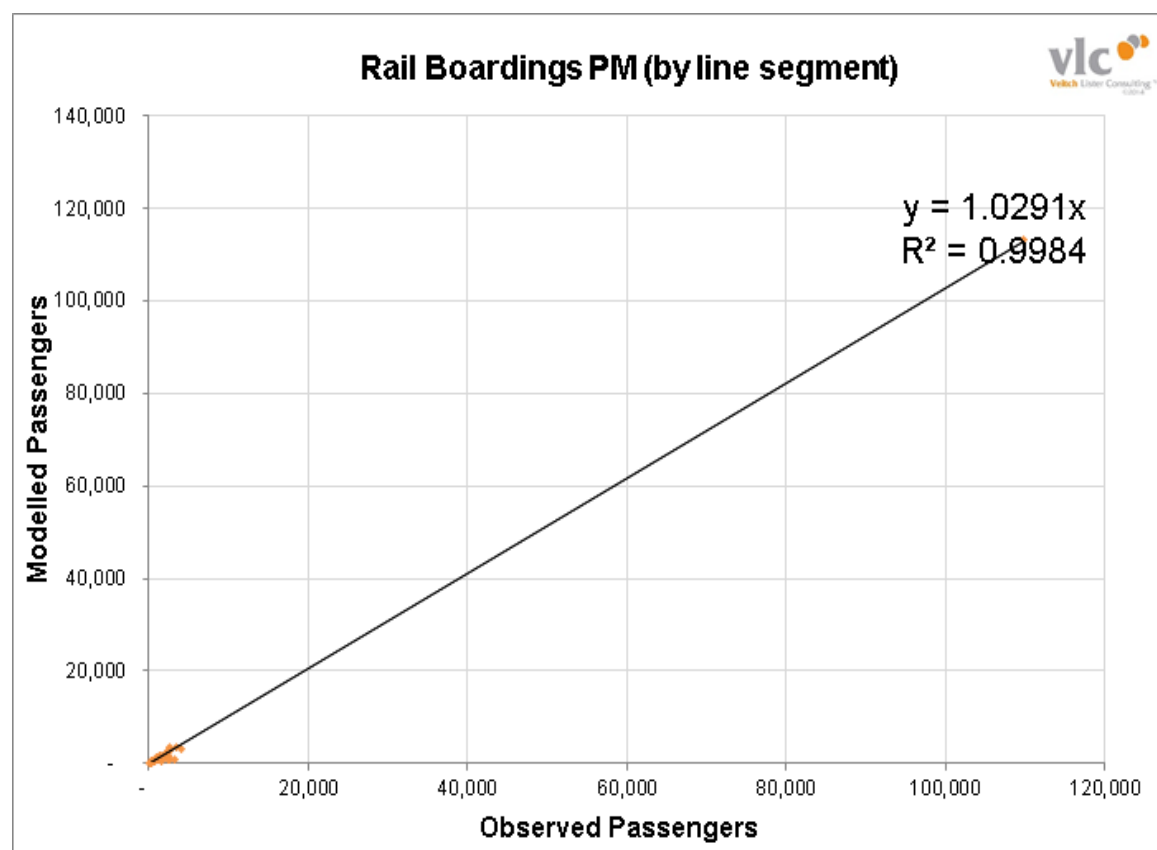


Figure 3.11 - PM Peak Train Entries by Line Segment (including city loop)

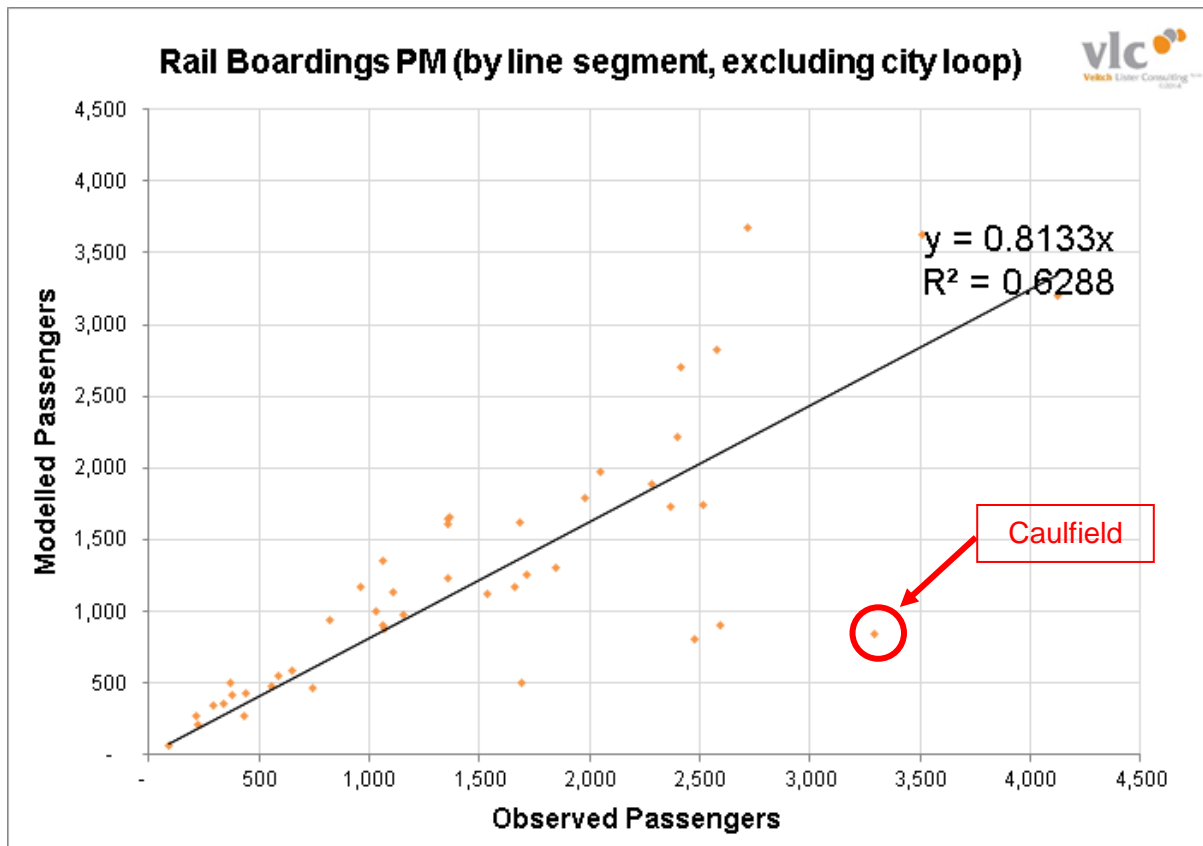


Figure 3.12 - PM Peak Train Entries by Line Segment (excluding city loop)

The same comparisons were also undertaken at a station level. Figure 3.13 and Figure 3.14 present the comparisons with and without the City Loop stations.

In this case an R-Squared of 0.97 and a gradient of 0.96 are achieved. However, when the City Loop stations are excluded, both the R-Squared and gradient are lower than those that include City Loop stations, noting that these values are a much smaller proportion of station entries in the PM peak.

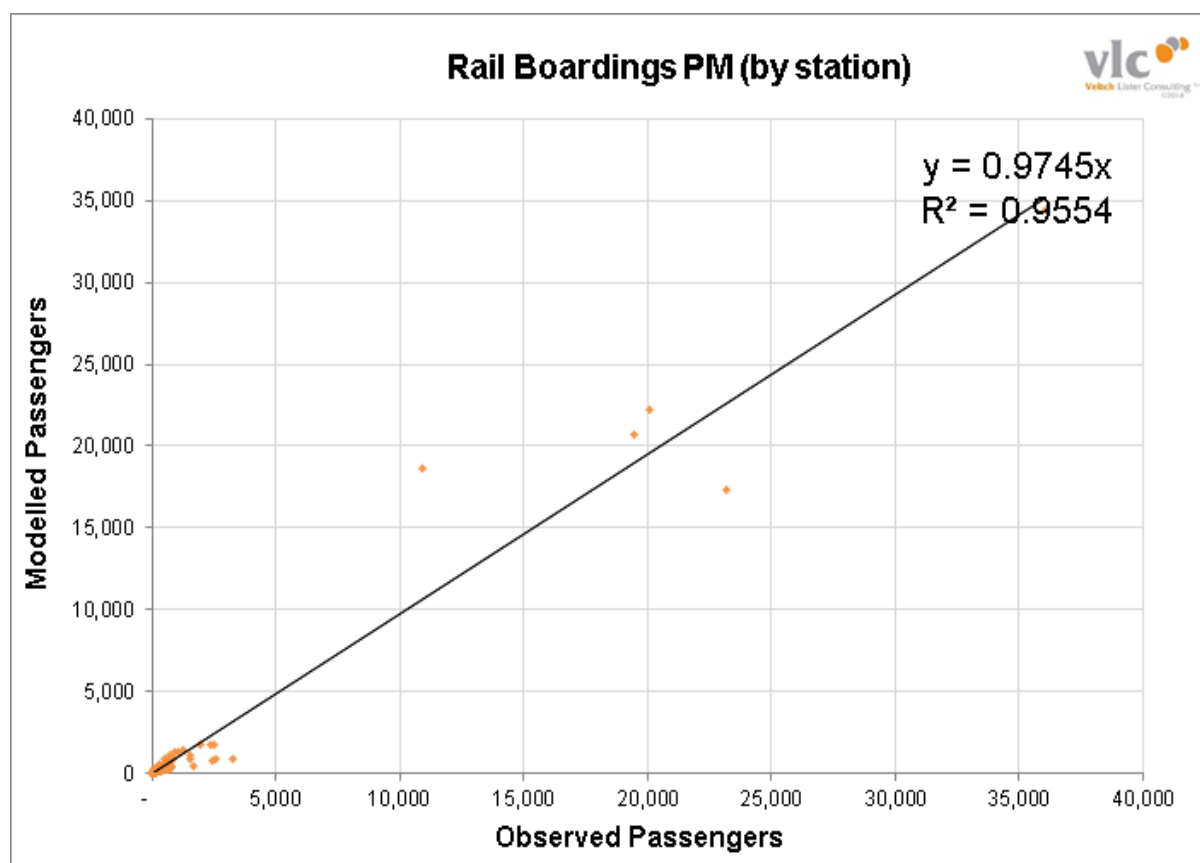


Figure 3.13 - PM Peak Train Entries by Station (including city loop)

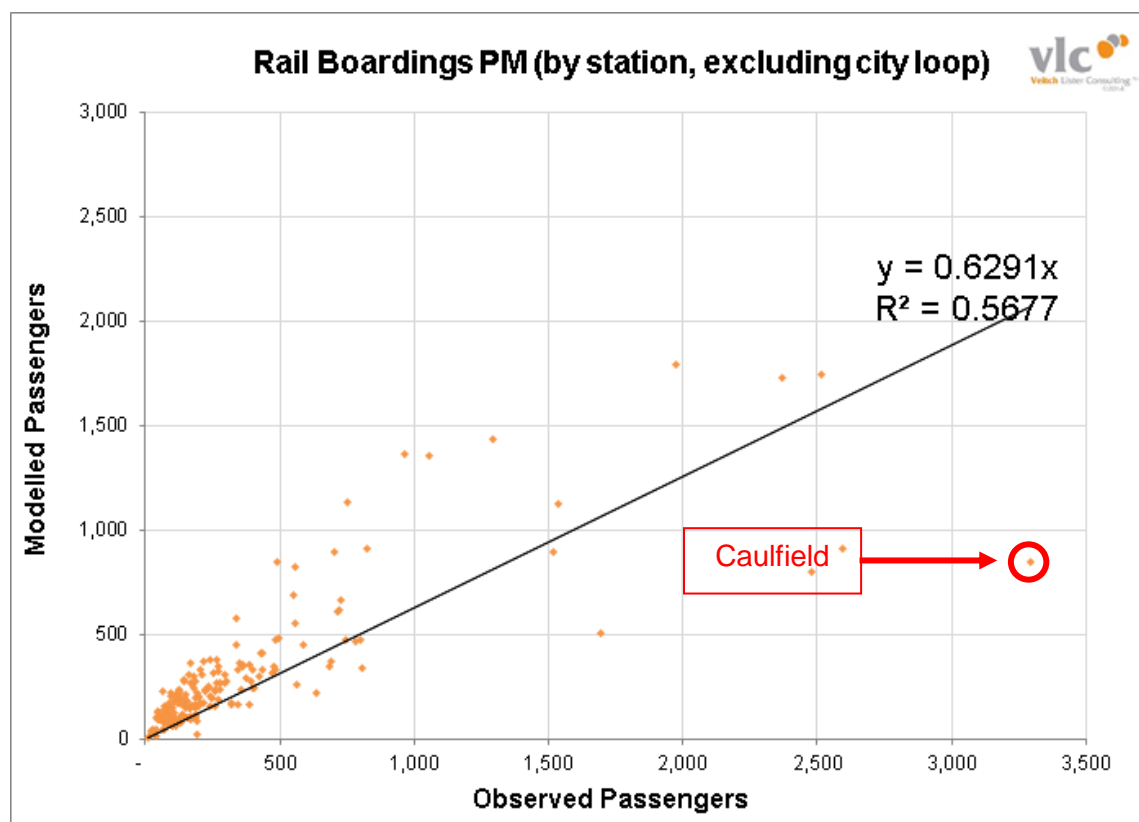


Figure 3.14 - PM Peak Train Entries by Station (excluding city loop)



3.1.5 Rail Loads at the CBD Cordon

Modelled AM peak, inbound rail line loads have been compared with PTV (observed) estimates at a cordon surrounding the CBD. The various lines have been grouped according to the four major suburban line groups.

Overall, modelled demand is 2% lower than the observed estimates. The modelled estimates on the Northern and Clifton Hill groups are very similar to the observed results, however the largest percentage difference is on Burnley group (where the Camberwell line is good, but the Glen Waverley line is underestimated).

Load at CBD Cordon by Line (AM Peak Only)				
Line Groups	Observed	Model	Difference	% Difference
Northern Group	39,985	40,375	390	1%
Williamstown	2,727	3,065	338	12%
Werribee	11,129	11,111	- 17	0%
Sydenham	10,303	12,551	2,248	22%
Craigieburn	12,279	10,230	- 2,049	-17%
Upfield	3,547	3,418	- 130	-4%
Clifton Hill Group	17,281	17,382	101	1%
Epping	6,935	7,853	918	13%
Hurstbridge	10,346	9,529	- 816	-8%
Burnley Group	30,540	28,468	- 2,072	-7%
Camberwell	22,752	22,847	95	0%
Glen Waverley	7,788	5,620	- 2,168	-28%
Caulfield Group	38,150	36,766	- 1,384	-4%
Dandenong	16,471	16,613	142	1%
Frankston	13,559	13,184	- 375	-3%
Sandringham	8,120	6,969	- 1,151	-14%
Total	125,956	122,991	- 2,965	-2%

Table 3.5 - Load at CBD Cordon by Line (AM Peak Only)



3.1.6 V/Line Boardings

The V/Line train boardings by station for each V/Line corridor are presented in Table 3.6. Overall, the model performs well across the day. Differences in the peak periods can be explained due to a difference in the definition of the peak periods in the observed data, where the observed data relates to train boardings at the given station in the peak, while the model relates to train boardings to access/egress in Melbourne in the given peak period.

V/Line Corridor	AM Observed	AM Modelled	PM Observed	PM Modelled	Daily Observed	Daily Modelled
Geelong	1,990	2,741	556	140	5,597	5,694
Ballarat	2,180	2,506	201	13	5,023	4,715
Bendigo	2,341	2,862	632	202	5,948	5,666
Seymour	738	911	216	73	2,178	2,311
Traralgon	1,132	1,436	1,015	1,309	4,530	6,242
Shared Stations	537	90	7,467	8,685	16,132	15,130
TOTAL	8,918	10,545	10,085	10,421	39,408	39,759

Table 3.6 - V/Line Boardings by Corridor and Time of Day

3.1.7 Rail Validation Summary

Table 3.7 shows how the model performs against PTV's validation criteria. It should be noted that this criteria is intended to be used for a study area for a specific project. Any weaknesses in this data should be improved within the study area for project modelling. The model performs well against many of the assessed criteria. It is weakest when compared to individual station boardings where the city loop is excluded.

While it is not included in PTV's guidelines, the table also shows how the model performs on a line segment level. This shows that the model accurately represents strategic level movements from one small area to another despite its weaknesses at a station level.



Check	Segmentation	Criteria	Assessed	Location	Daily	AM	PM
Study Area Train boardings and alightings by time of day	By Group,	$\pm 10\%$ (percentage of groups that fall within target)	Yes	All	75%	75%	0%
	By Line	$\pm 15\%$ (percentage of lines that fall within target)	Yes	All	85%	69%	69%
	By Station (>500 daily boardings)	$\pm 20\%$ (percentage of lines that fall within target)	Yes	All	83%	67%	75%
	By Station Line Segment - No Cityloop	$R^2 \geq 0.85$	Yes	All	0.79	0.80	0.81
		X coefficient > 0.9 and < 1.1	Yes	All	0.96	0.94	0.63
	By Station Line Segment - Including Cityloop	$R^2 \geq 0.85$	Yes	All	0.99	0.80	1.03
		X coefficient > 0.9 and < 1.1	Yes	All	0.95	0.94	0.99
	By Station - No Cityloop	$R^2 \geq 0.85$	Yes	All	0.45	0.45	0.57
		X coefficient > 0.9 and < 1.1	Yes	All	0.80	0.85	0.63
Study Area Train loads at CBD cordon and screenlines by time of day	By Group,	$\pm 15\%$ (percentage of groups that fall within target)	Yes	AM Only	NA	1.00	NA
		$R^2 \geq 0.85$	Yes	AM Only	NA	0.95	NA
	By Line	X coefficient > 0.9 and < 1.1	Yes	AM only	NA	0.98	NA
Study Area Access modes at train stations by time of day, (% park & ride, kiss & ride, Walk, Bus, Tram)	By Group,	$\pm 10\%$	No	NA	NA	NA	NA
	By Line	$\pm 15\%$	No	NA	NA	NA	NA
	By Station	$\pm 20\%$, and >0%	No	NA	NA	NA	NA
Travel times compared to timetables	Route or group of routes	$\pm 10\%$	No	NA	NA	NA	NA

Table 3.7 - Train Validation Summary against PTV Validation Criteria



3.2 Tram

3.2.1 Tram Boardings Summary

Table 3.8 presents total tram boardings by time of day.

In the AM peak, the model is within 2% of the tram boarding estimates obtained from the Tram OD survey. Over the entire day, the model's estimates are 8% lower.

Period	Observed	Model	Difference	%Difference
AM Peak	100,409	102,482	2,073	2%
PM Peak	113,023	106,011	- 7,011	-6%
Daily	585,823	541,500	- 44,323	-8%

Table 3.8 – Total Tram Boardings by Time of Day

3.2.2 Tram Boardings by Route

Figure 3.15, Figure 3.16 and Figure 3.17 present scatter plots of the AM Peak, PM Peak and Daily tram boardings by route. Detailed tram route boarding information can be found in Table C.8 in Appendix C.

In the AM Peak, an R-Squared of 0.76 and gradient of 0.94 is achieved. In the PM Peak an R-Squared of only 0.49 is achieved. Across the entire day an R-Squared of 0.74 indicates that the model is performing well, even though a gradient (0.90) suggests it is slightly under predicting tram travel.

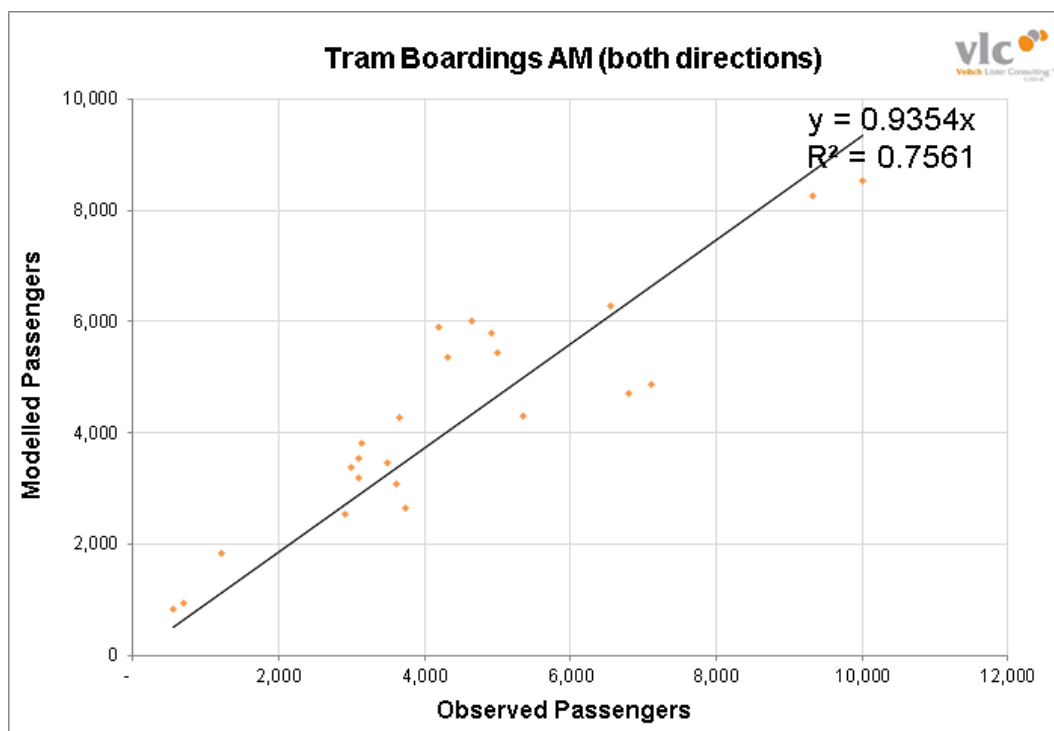


Figure 3.15 - AM Peak Tram Boardings by Route

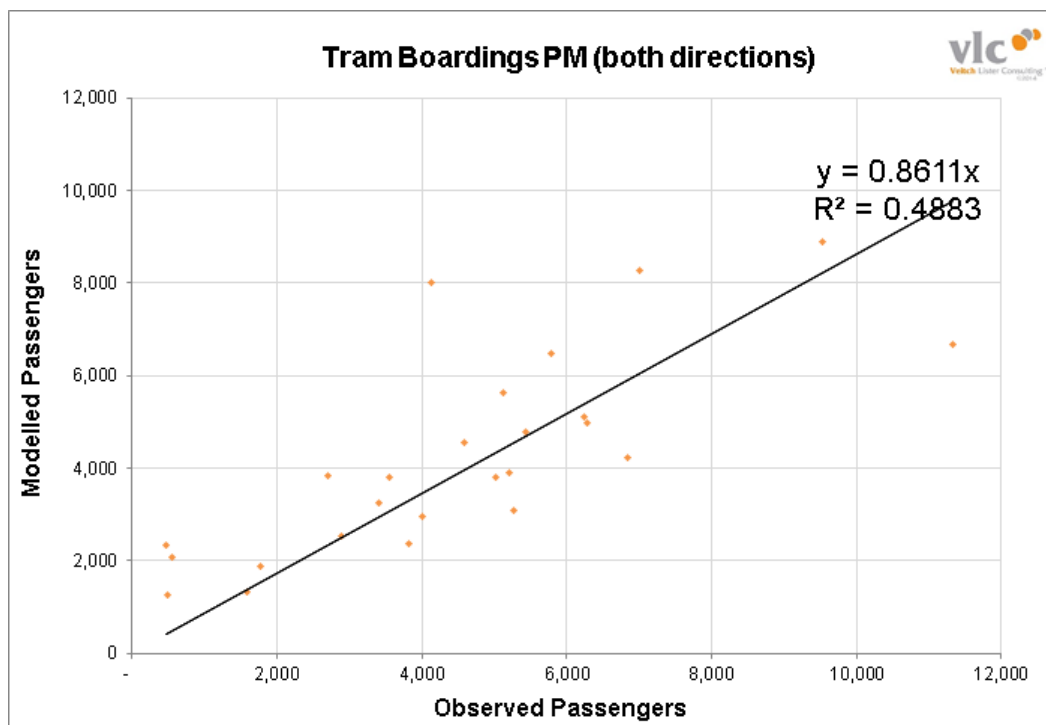


Figure 3.16 - PM Peak Tram Boardings by Route

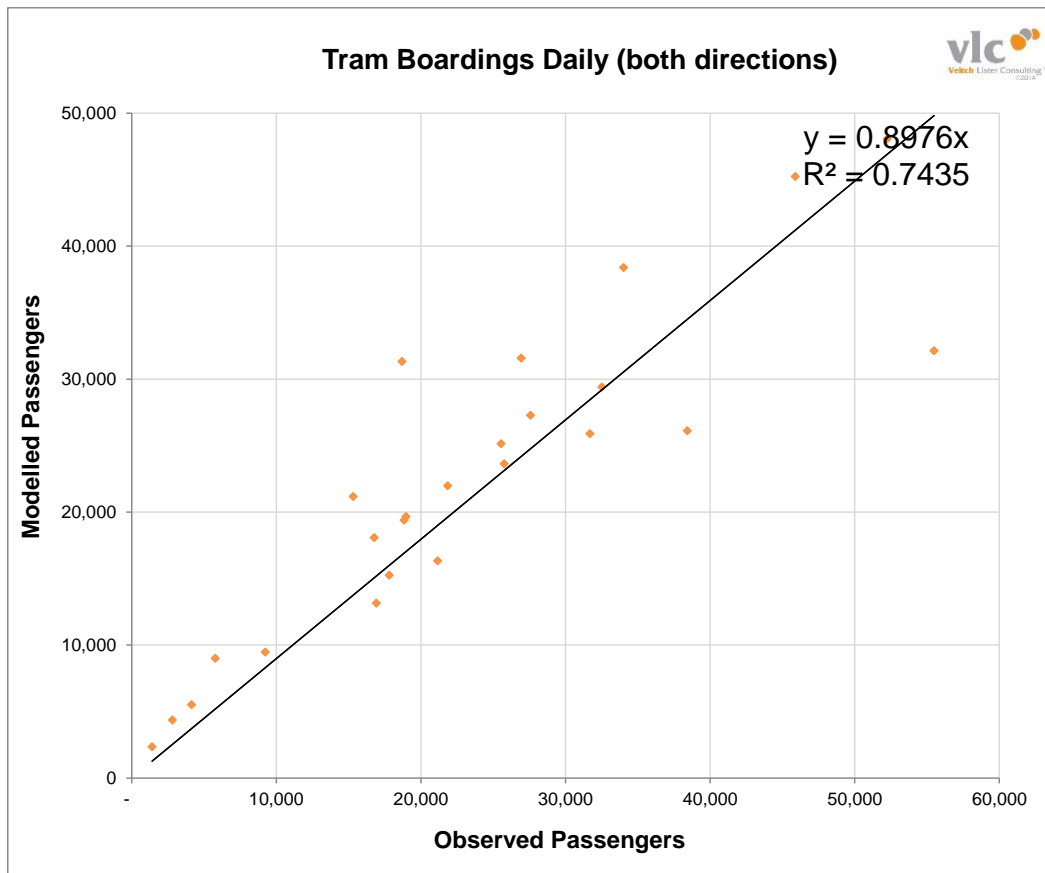


Figure 3.17 - Daily Tram Boardings by Route

3.2.3 Tram Boarding by SLA

Figure 3.18 presents a scatter plot of the daily tram boardings by SLA. Detailed tram route boarding information can be found in Table C.10 of Appendix C.

From this data we can see that the tram boardings for the Melbourne (C) – Inner SLA account for most of the difference between the model and observed tram boardings. This implies that the model is significantly underestimating small tram trips within the Melbourne CBD grid, while performing very well in all other SLAs. If the Melbourne (C) – Inner SLA is removed from the analysis, an R-Squared of 0.95 and gradient of 0.94 are achieved.



Figure 3.18 - Daily Tram Boardings by SLA (excluding the CBD)



3.2.4 Tram Loads at the CBD Cordon

Figure 3.19 presents a scatter plot of the AM Peak tram loads at the CBD cordon. Detailed tram route boarding information can be found in of Appendix C. In the AM Peak, an R-squared of 0.5 and gradient of 1.0 is achieved.

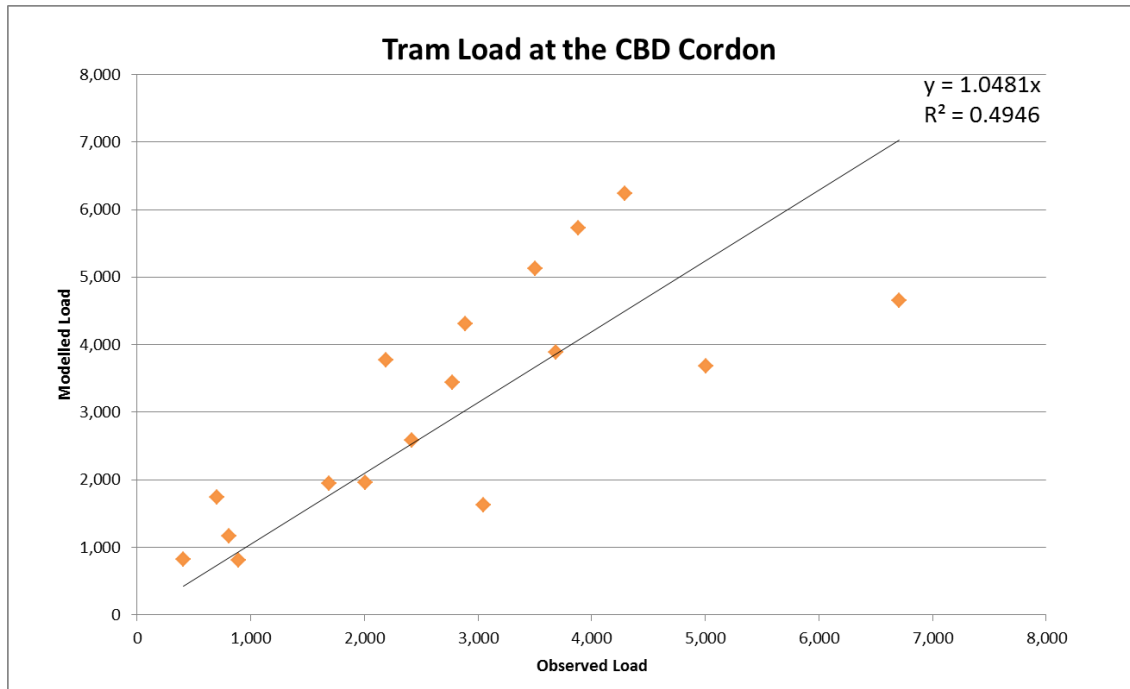


Figure 3.19 - AM Peak Tram Loads at the CBD cordon

3.2.5 Tram Validation Summary

Table 3.9 shows the model performance against PTV's validation criteria. It should be noted that this criteria is intended to be used for a study area for a specific project. Any weaknesses in this data should be improved within the study area for project modelling.

Check	Segmentation	Criteria	Assessed Location		Daily	AM	PM
Tram boardings by time of day	Total	$\pm 15\%$	Yes	All	-8%	2%	-6%
	By Route	$R^2 \geq 0.85$	Yes	All	0.79	0.76	0.49
		X coefficient > 0.9 and < 1.1	Yes	All	0.87	0.94	0.86
Tram loads at CBD cordon and screenline by time of day	By Direction	$\pm 15\%$ (percentage of locations that fall within target)	AM only	All	NA	24%	NA

Table 3.9 - Tram Validation Summary against PTV Validation Criteria



3.3 Bus

3.3.1 Bus Boardings Summary

Modelled bus demands have been compared with 2011 observed boardings.

Table 3.10 presents a summary of observed and modelled bus boardings by time of day. In the AM Peak the modelled estimates are 12% higher than observed. In the PM Peak, modelled estimates are approximately 17% lower, but across the day, the modelled estimates are only 2% low.

Total Bus Boardings by Period				
Period	Observed	Model	Difference	% Difference
AM Peak	78,849	88,423	9,574	12%
PM Peak	73,282	60,698	- 12,585	-17%
Daily	420,080	410,781	- 9,300	-2%

Table 3.10 – Total Bus Boardings by Time of Day

3.3.2 SmartBus Boardings by Route

Table 3.11, Table 3.12 and Table 3.13 present a comparison of modelled and observed daily, AM peak and PM peak SmartBus boardings by route.

Overall the model over-estimates the boarding of SmartBuses. It should be noted that the model assumes post-ramp-up (or steady state) conditions; as SmartBus is a relatively recent initiative, we would expect its demand to grow rapidly in the next few years, and therefore the modelled results are expected to be higher than the observed.

Route	Observed	Model	Difference	% Difference
703	7,942	7,280	- 662	-8%
900	6,127	4,081	- 2,046	-33%
901	15,173	21,451	6,277	41%
902	14,624	19,488	4,864	33%
903	23,426	20,850	- 2,576	-11%
905	2,982	4,717	1,735	58%
906	3,324	5,189	1,865	56%
907	4,046	5,307	1,261	31%
908	2,232	3,056	824	37%
Total	79,877	91,419	11,542	14%

Table 3.11 – Daily Smart Bus Route Boardings



Route	Observed	Model	Difference	%Difference
703	1,449	1,415	- 34	-2%
900	868	692	- 176	-20%
901	2,344	4,572	2,228	95%
902	2,396	3,761	1,365	57%
903	3,530	4,211	681	19%
905	726	833	107	15%
906	805	804	- 0	0%
907	967	908	- 60	-6%
908	436	424	- 12	-3%
Total	13,521	17,620	4,098	30%

Table 3.12- AM Peak Smart Bus Route Boardings

Route	Observed	Model	Difference	%Difference
703	1,423	1,103	- 320	-22%
900	1,188	558	- 629	-53%
901	2,544	2,812	268	11%
902	2,483	2,279	- 204	-8%
903	4,327	2,542	- 1,785	-41%
905	588	1,004	416	71%
906	662	1,006	344	52%
907	854	945	91	11%
908	466	736	270	58%
Total	14,534	12,984	- 1,550	-11%

Table 3.13 - PM Peak Smart Bus Route Boardings

3.3.3 Bus Boardings by PTV Validation Group

Table 3.14 shows how the model performs for Bus Boardings by PTV Validation group. This shows that when grouped by these regions the model generally performs well. It is low in the Central Melbourne category and high in the South East. All other regions perform well.



PTV Validation Group	Observed Daily	Model Daily	Observed AM	Model AM	Observed PM	Model PM
Central Melbourne	55,760	46,894	12,238	7,647	10,481	10,131
Inner East	2,200	1,806	283	298	405	287
Middle West	34,471	27,397	6,156	6,075	5,828	4,385
Doncaster/Whitehorse	29,251	27,385	5,388	5,616	5,286	4,410
SmartBus	62,190	67,544	9,700	13,566	11,025	8,410
Outer East	41,251	47,887	8,405	10,604	7,797	7,250
Brimbank	14,483	13,813	2,947	3,334	2,396	1,939
Wyndham	16,435	10,564	2,795	2,561	2,697	1,460
InterTown	26,813	25,359	4,729	5,771	4,523	3,354
Melton	3,535	5,472	726	1,441	578	722
Hume	17,632	17,391	3,224	4,055	3,001	2,453
Sunbury	8,193	7,603	1,584	1,857	1,362	1,087
Middle North	19,675	16,841	3,795	4,000	3,086	2,344
Whittlesea	12,608	11,251	2,279	2,642	2,032	1,600
South East	34,125	45,933	6,255	10,435	5,874	6,277
Frankston	19,781	15,350	3,844	3,581	3,659	2,365
Mornington	8,957	8,224	1,642	1,957	1,688	1,197
Outer South East	25,943	23,331	4,800	4,981	4,414	2,933

Table 3.14 – Bus Boardings by PTV Validation Group

3.3.4 Bus Validation Summary

Table 3.15 shows the model's performance against PTV's validation criteria. It should be noted that this criteria is intended to be used for a study area for a specific project. Any weaknesses in this data should be improved within the study area for project modelling.

Check	Segmentation	Criteria	Assessed	Location	Daily	AM	PM
Bus boardings by time of day	By Bus Region	± 25% (percentage of regions that fall within target)	Yes	All	83%	67%	67%
	By Route	$R^2 \geq 0.75$	Yes	All	0.83	0.64	0.74
		X coefficient > 0.9 and < 1.1	Yes	All	0.99	1.02	0.74

Table 3.15 – Bus Validation Summary against PTV Validation Criteria



4 Validation of Traffic Assignment

In this section the traffic assignment validation results will be presented. Modelled traffic volumes will be validated against observed screenline totals and individual traffic counts by time of day. The commercial vehicle assignment results will also be validated.

4.1 Traffic Volumes - Screenlines

Figure 4.1 to Figure 4.6 show the scatter plots for the modelled and observed AM peak, PM peak and daily directional screenline totals.

Across the day, there is excellent correlation between observed and modelled screenline flows, as demonstrated by R-squared and gradients very close to 1.0. Correlation is also very strong in both the AM and PM Peaks (with R-squared values close to or equal to 1.0) and gradients in the AM and PM Peak at approximately 1.0 also.

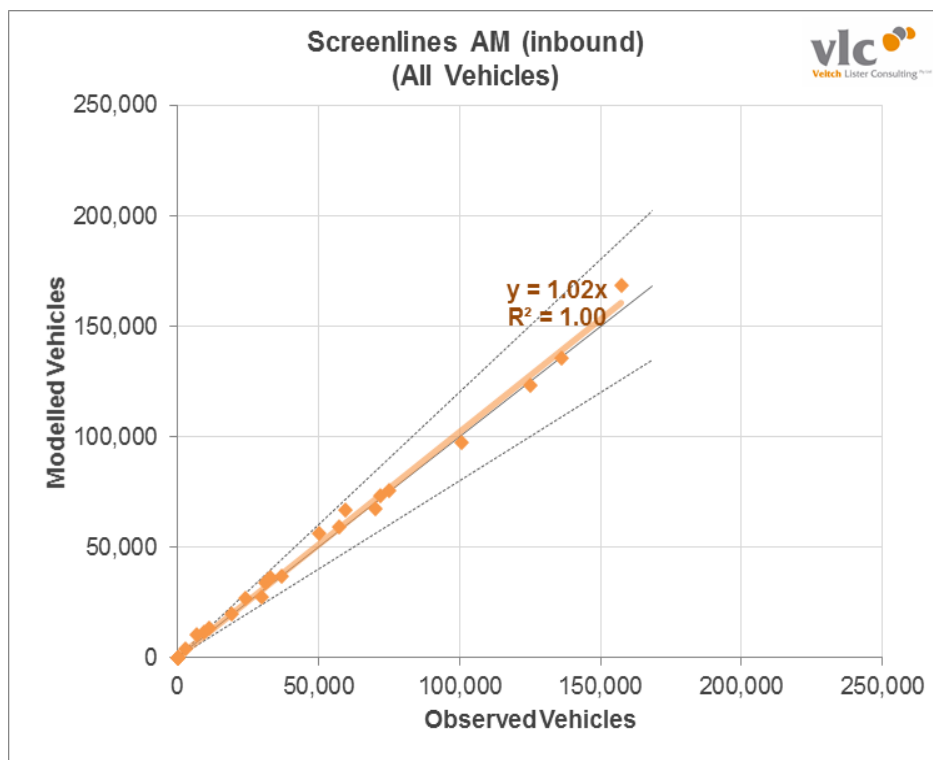


Figure 4.1 - AM Peak Inbound Traffic Volumes - Screenline Total (Observed Vs Modelled)

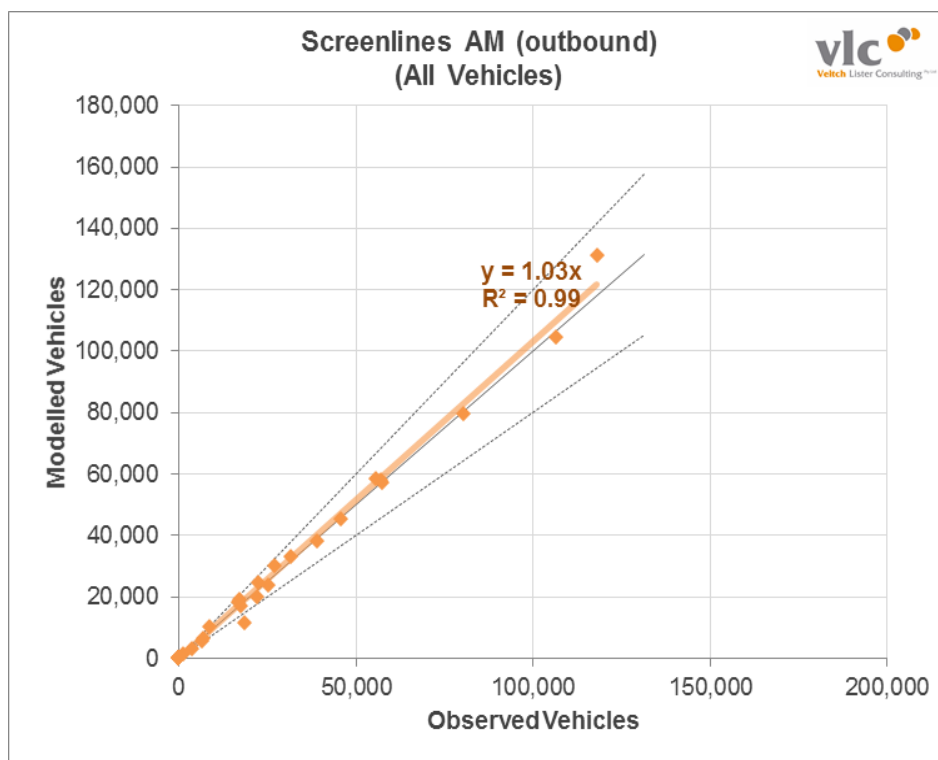


Figure 4.2 - AM Peak Outbound Traffic Volumes - Screenline Total (Observed Vs Modelled)

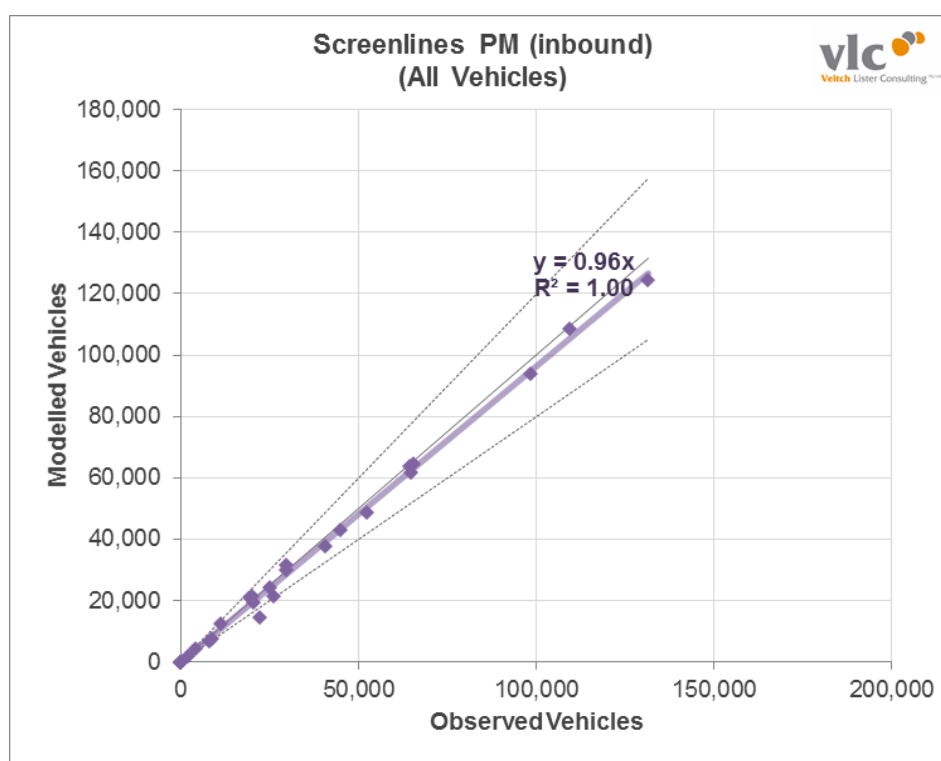


Figure 4.3 - PM Peak Inbound Traffic Volumes - Screenline Total (Observed Vs Modelled)

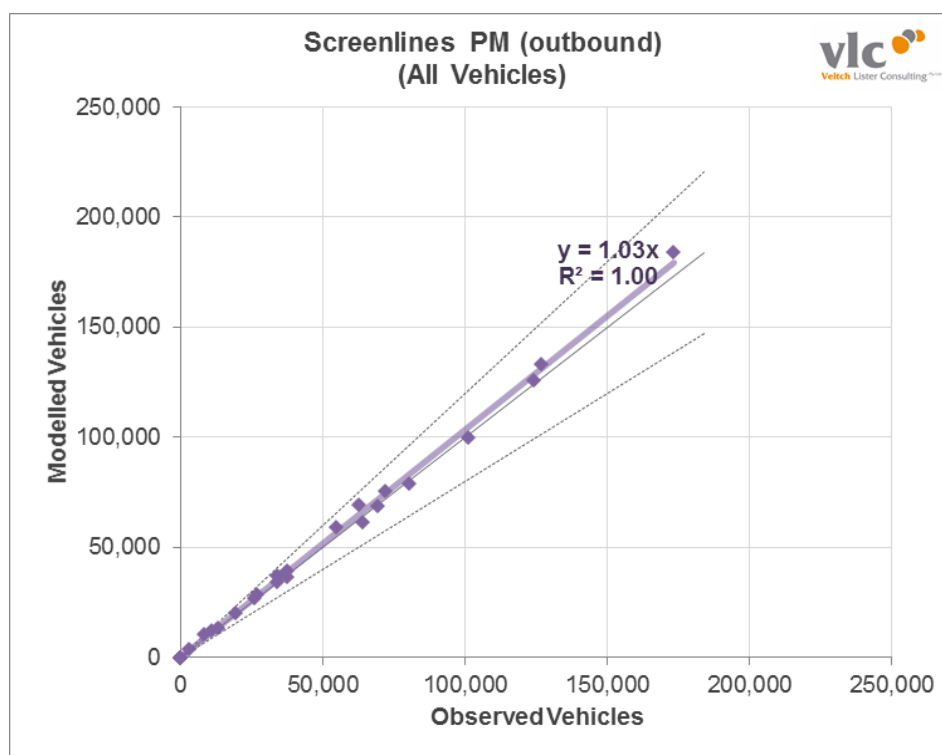


Figure 4.4 - PM Peak Outbound Traffic Volumes - Screenline Total (Observed Vs Modelled)

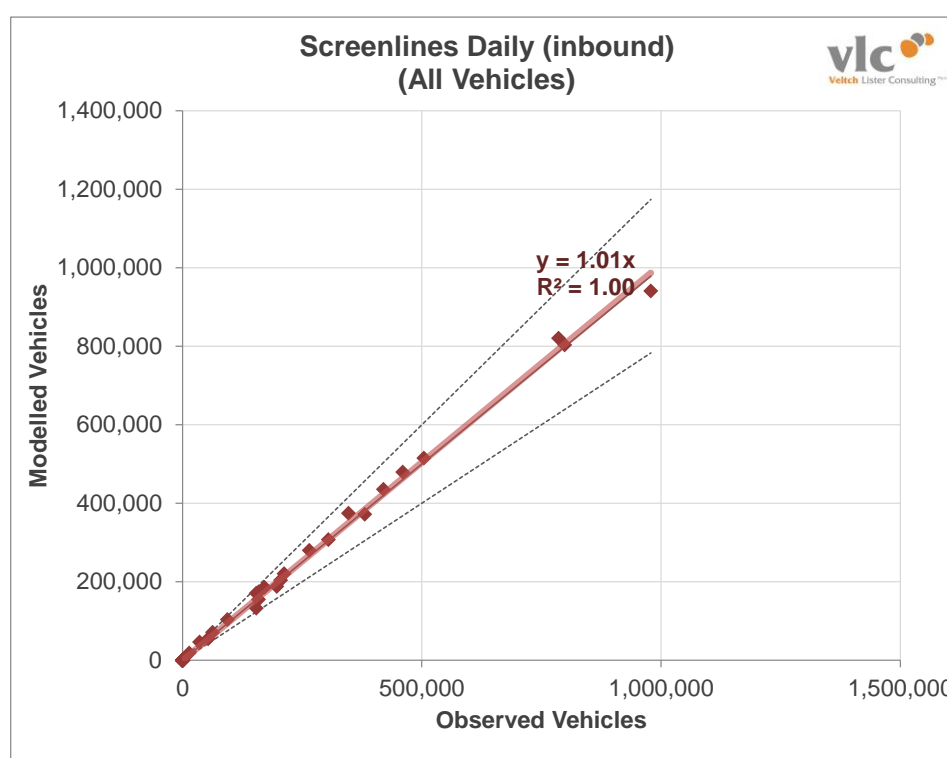


Figure 4.5 - Daily Inbound Traffic Volumes - Screenline Total (Observed Vs Modelled)

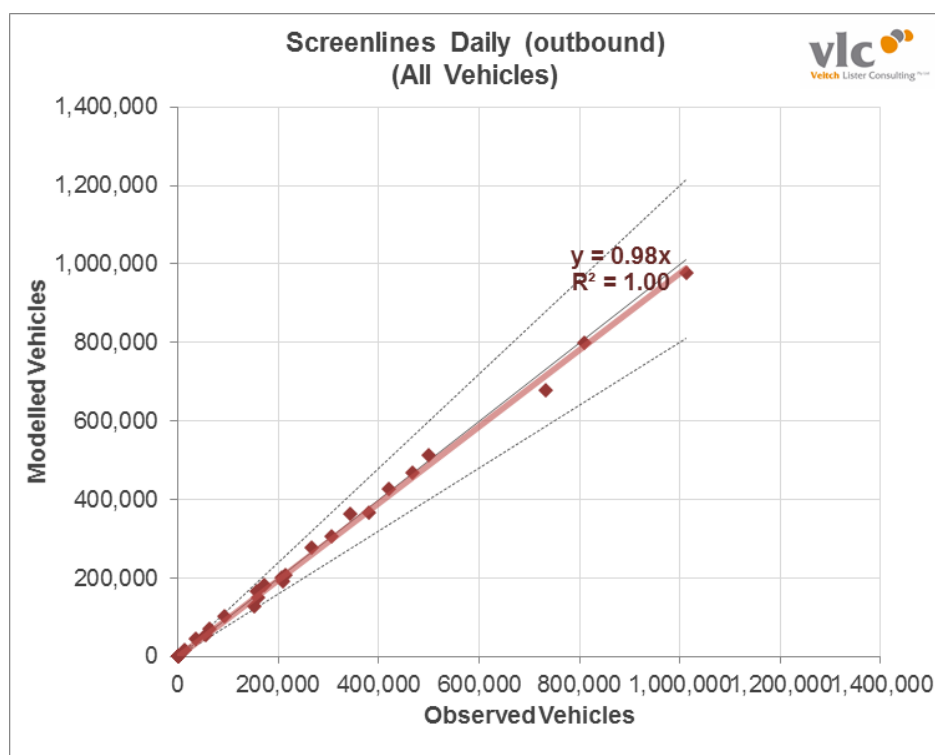


Figure 4.6 - Daily Outbound Screenlines Scatter Chart (Observed Vs Modelled)

The difference between observed and modelled screenline totals was also plotted against the maximum desirable deviation derived from NCHRP255 (VicRoads, 2012), for each time period.

Figure 4.7, Figure 4.8 and Figure 4.9 show the results of the screenline totals for the AM peak, PM peak and daily.

The vast majority of the screenline totals (by direction) are within the bounds of the curves presented for the AM Peak, PM Peak and daily flows.

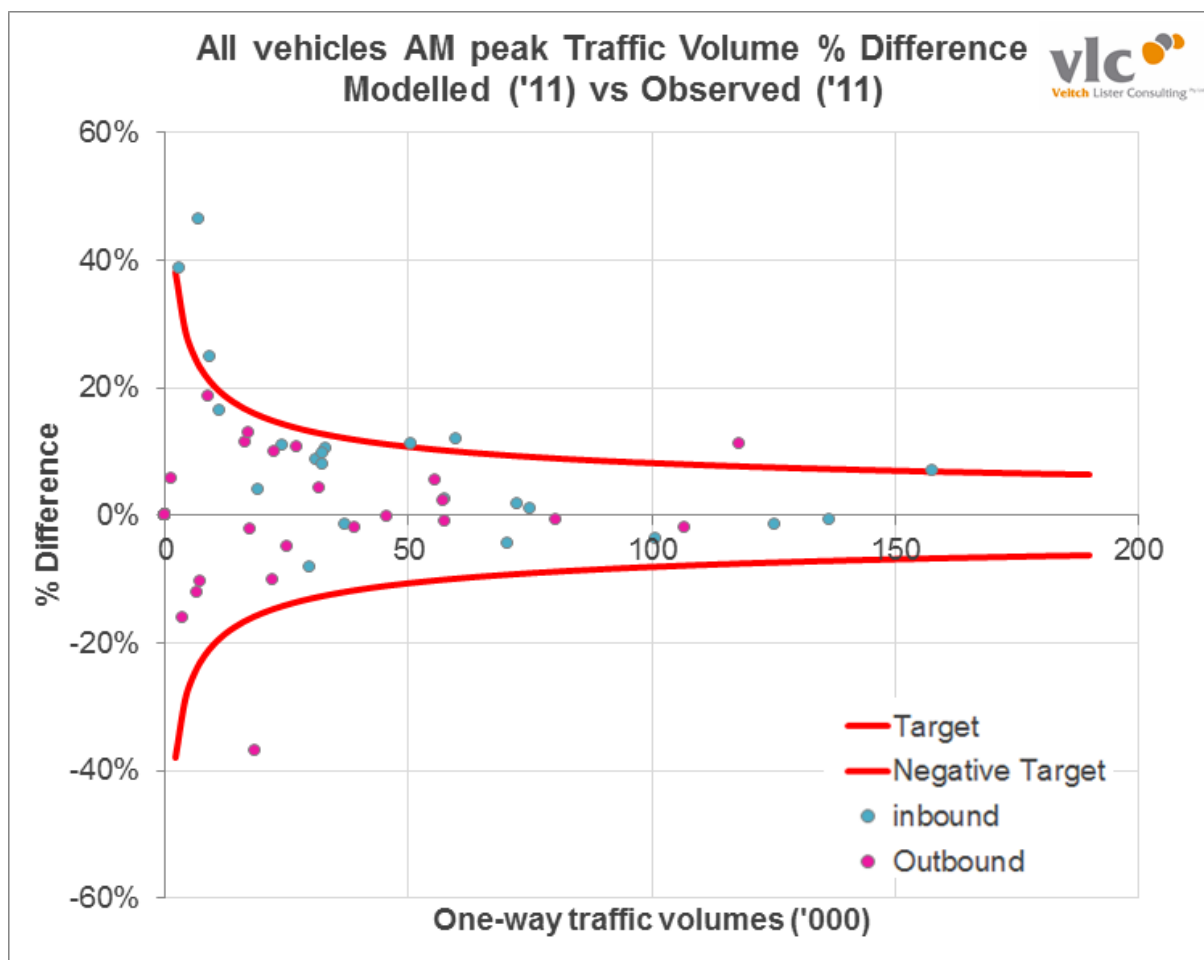


Figure 4.7 - AM Peak Screenline Maximum Desirable Deviation Comparison

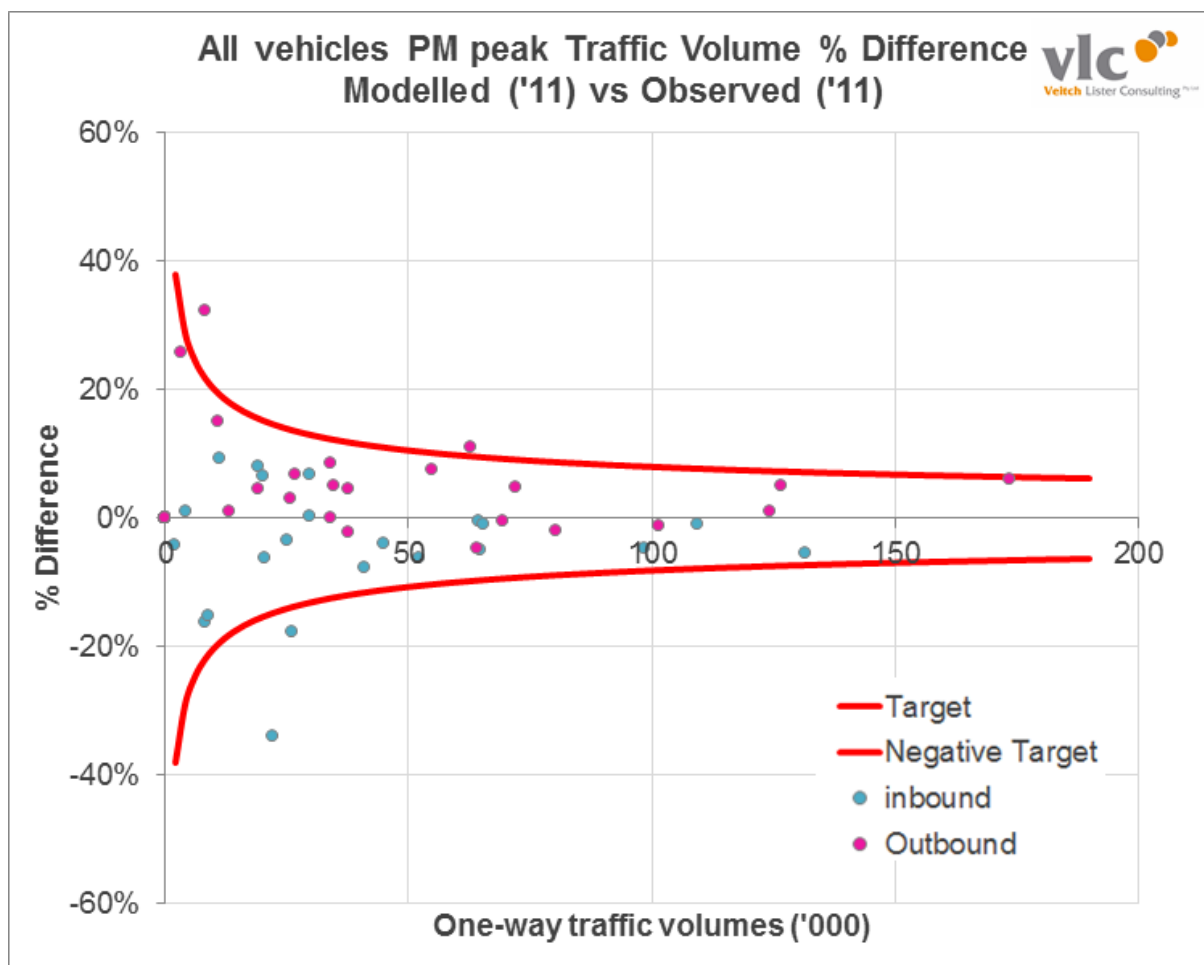


Figure 4.8 - PM Peak Screenline Max Desirable Deviation Comparison

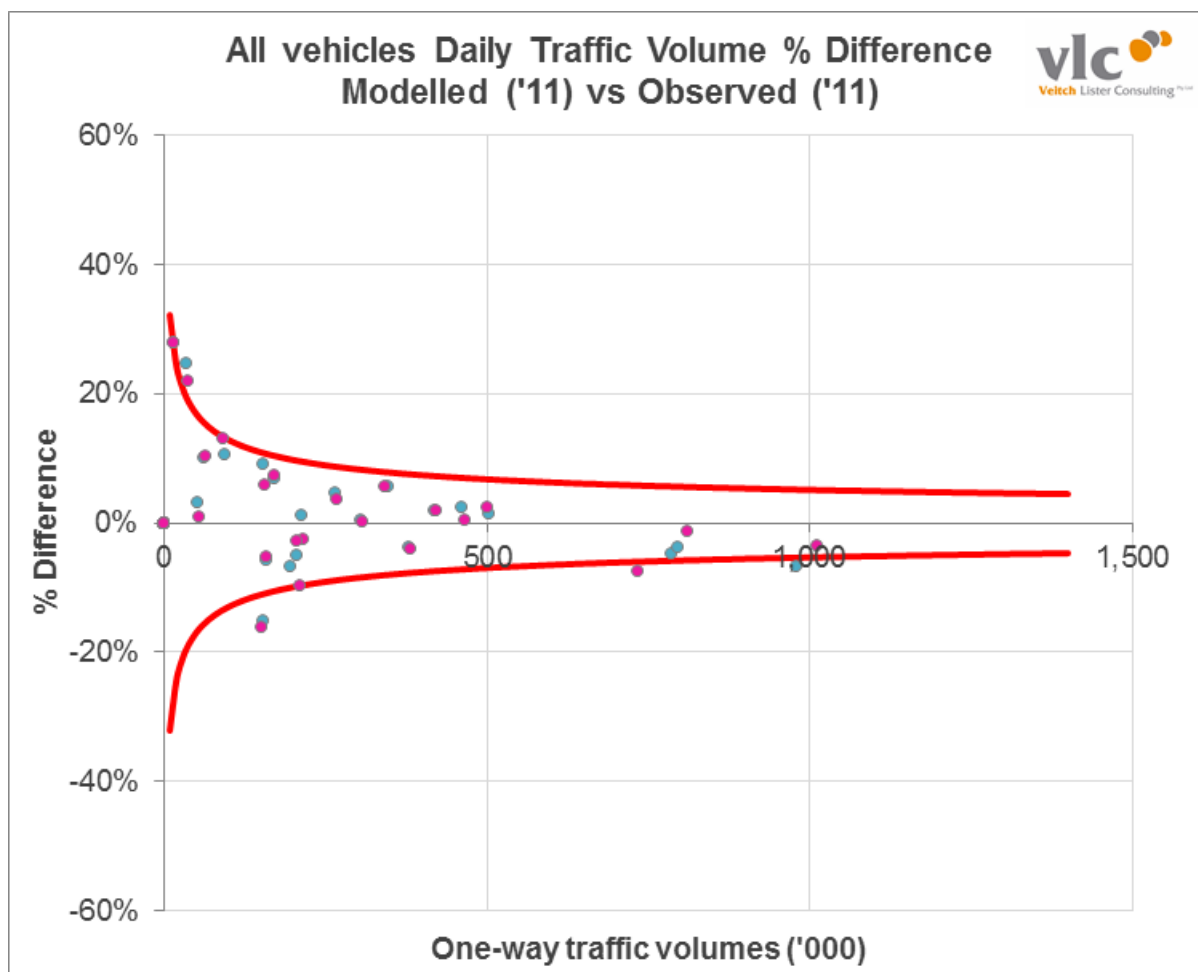


Figure 4.9 - Daily Screenline Maximum Desirable Deviation Comparison



4.1.1 Traffic Volumes - Individual Traffic Counts

Summary statistics in relation to the performance of the 2011 model against the individual 2011 screenline traffic counts are presented in Table 4.1.

They show that the model is performing well as it is in the order of 4% low in comparison to the observed counts across the day.

Summary (All Counts)	AM	PM	Daily
Number of Counts	1,689	1,689	1,701
Total Count Volume	1,838,253	2,041,477	13,108,458
Total Modelled Volume	1,860,220	1,976,942	12,534,946
Difference (Abs)	21,967	-64,535	-573,512
Difference (%)	1%	-3%	-4%

Table 4.1– Summary of Validation to Individual Counts

Table 4.2, Table 4.3 and Table 4.4 show the modelled validation results against the individual 2011 screenline traffic counts in terms of the %RMSE statistic and GEH statistic.

The %RMSE for traffic counts is around 30% across AM and PM Peaks, and around 26% across the day. Around 95% of traffic count locations have a GEH of less than 20. Note that this has been achieved without the use of matrix estimation (also known as k-factoring). The definition of the %RMSE and GEH statistics can be found in Appendix F.



Volume Bins	AM	PM
0 - 999	63	116
1,000 - 1,999	35	49
2,000 - 4,999	23	29
5,000 - 10,000	17	16
10,000 +	12	13
All	30	29

Table 4.2 - Validation to Individual Counts – Peak Periods (%RMSE)

Volume Bins	Daily
0 - 4,999	66
5,000 - 9,999	33
10,000 - 24,999	27
25,000 - 49,999	21
50,000 +	9
All	26

Table 4.3 - Validation to Individual Counts – Across the Day (%RMSE)



Validation Criteria	AM	PM	Daily
GEH < 5	40%	40%	45%
GEH < 10	72%	71%	69%
GEH < 15	89%	88%	85%
GEH < 20	97%	95%	94%
GEH < 25	99%	99%	97%
GEH < 30	100%	100%	99%
GEH < 35	100%	100%	100%
GEH < 40	100%	100%	100%

Table 4.4 - Validation to Individual Counts (GEH)

The scatter plots of AM, PM and Daily for the individual 2011 screenline traffic counts comparison are shown in Figure 4.10, Figure 4.11 and Figure 4.12.

The R-squares are generally around 0.92 and gradients are generally close to 1.0.

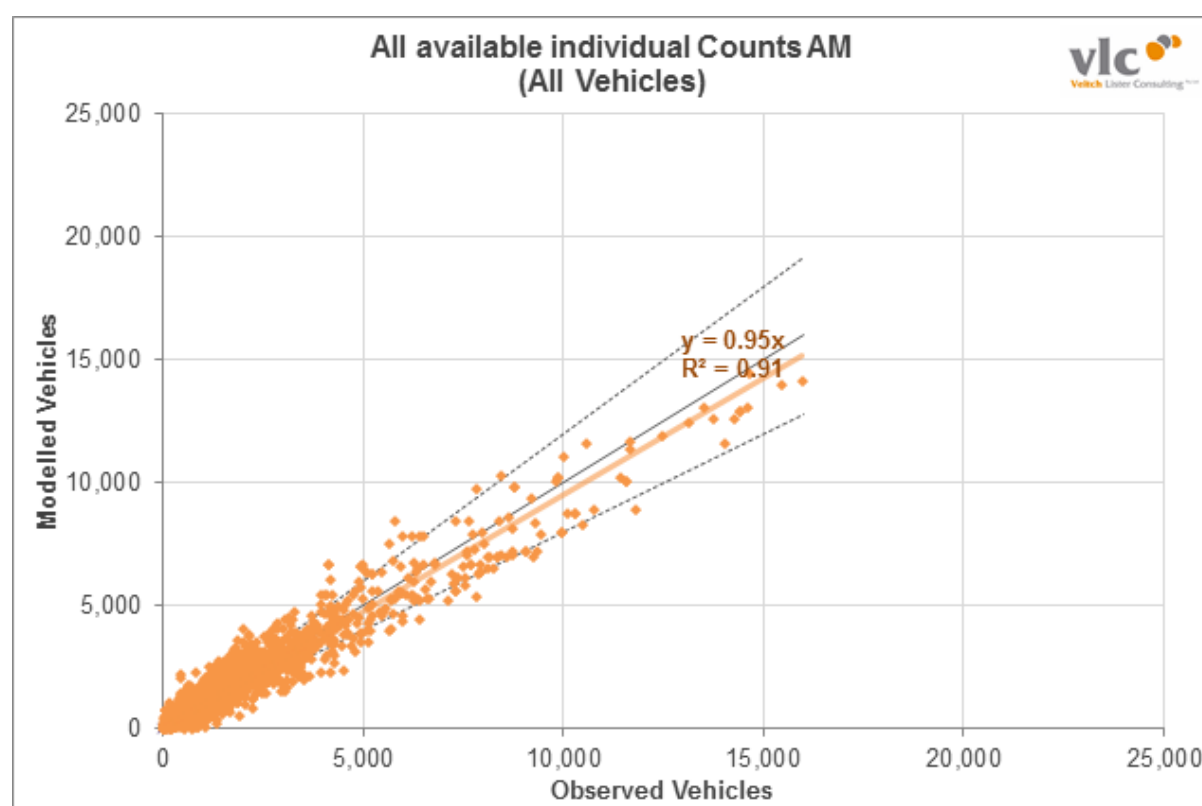


Figure 4.10 - AM Peak Individual Counts Scatter Chart (Observed Vs Modelled)

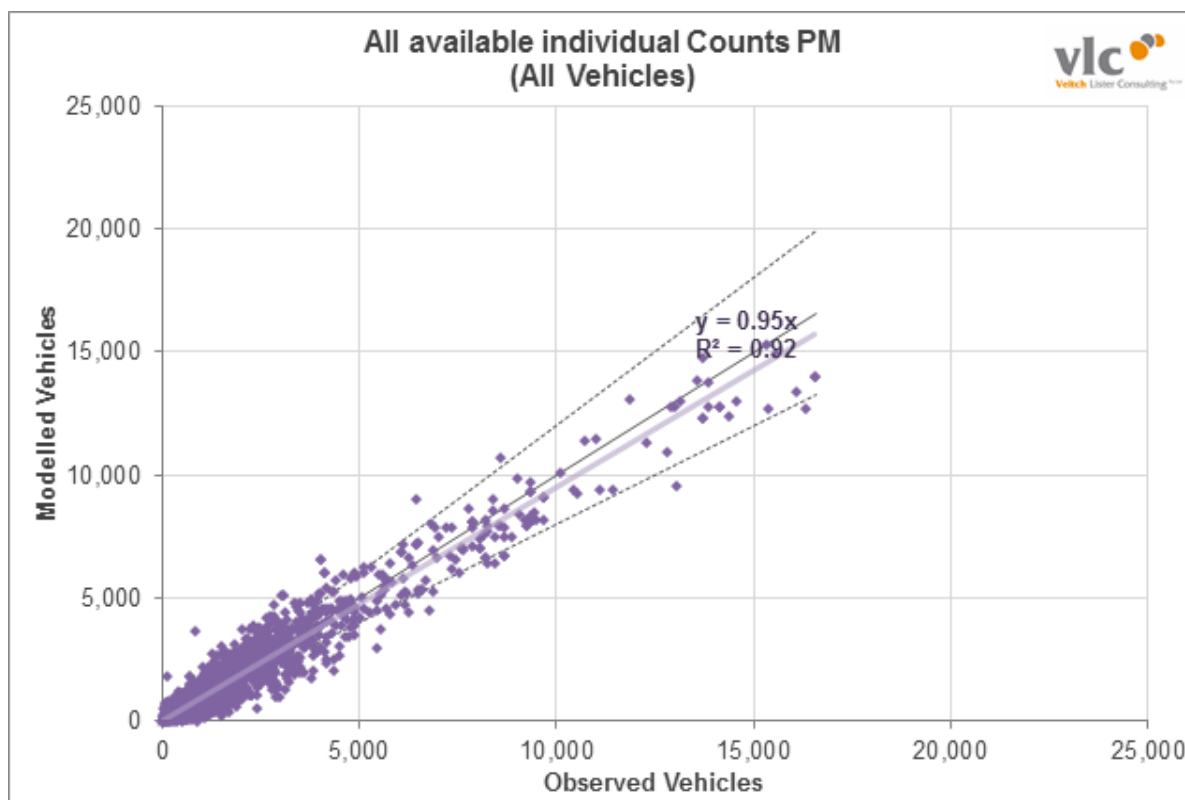


Figure 4.11 - PM Peak Individual Counts Scatter Chart (Observed Vs Modelled)

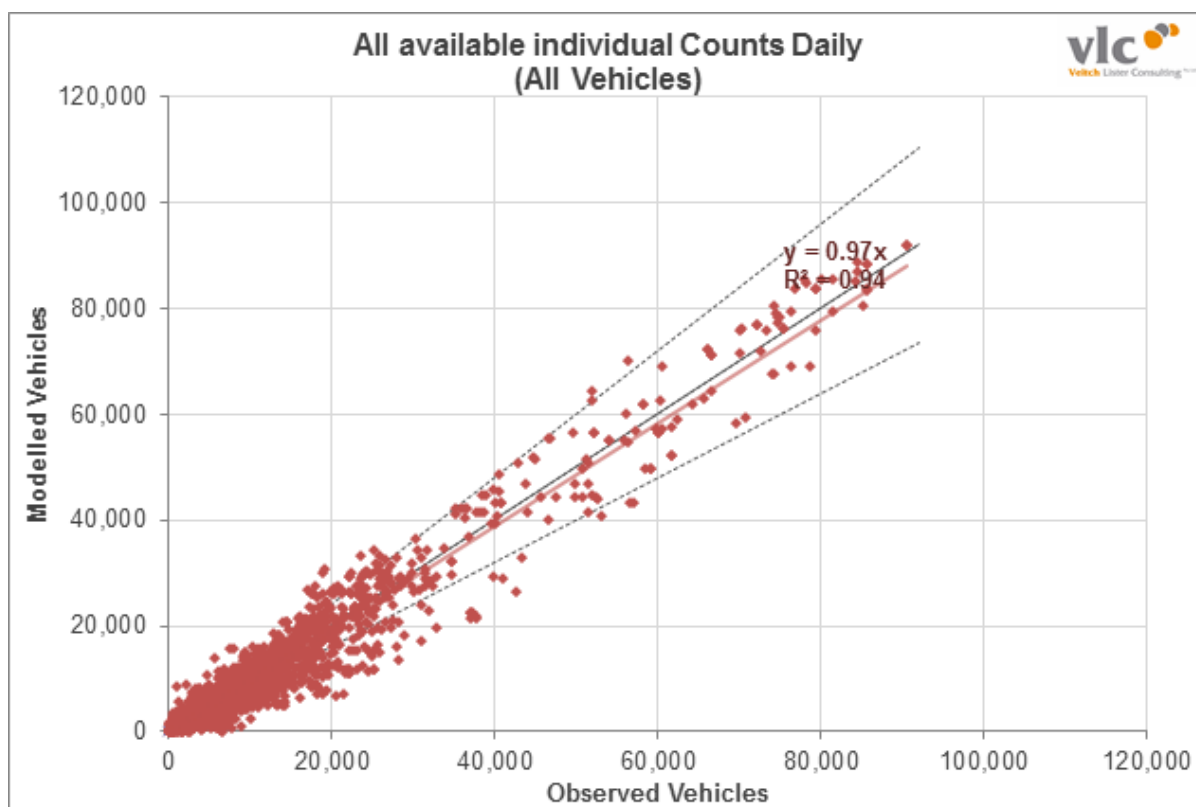


Figure 4.12 - Daily Individual Counts Scatter Chart (Observed Vs Modelled)



4.1.2 Traffic Volumes Summary

A summary of individual count validation results is shown in Table 4.5, against the acceptance targets currently specified by VicRoads in their report titled “Transport Modelling Guidelines, Volume 2: Strategic Modelling, Version: Draft 3” dated 26/04/2012. The 2011 model achieves the VicRoads targets for Global differences, R-squared and gradient. VLC considers the GEH targets to be overly stringent for a model that does not include matrix estimation or k-factoring. The screenlines that do not meet the VicRoads targets for maximum desirable deviation generally fall just outside for the PM Peak and across the day, and are considered adequate.

Statistics	VicRoadsTargets	AM	PM	Daily
Max Desireable Deviation	1	82%	91%	86%
Global Difference	< 10%	2%	-1%	-4%
R-square	>0.9	0.92	0.93	0.94
Gradient	Between 0.9 and 1.1	0.95	0.95	0.97
GEH	<=5 >60% of case	40%	40%	45%
	<=10 >85% of case	72%	71%	69%
% RMSE	<30	29.8	28.8	26.0

Table 4.5 - Traffic Volume Validation Results

4.1.3 Commercial Vehicle Volumes - Screenlines

The scatter plots of aggregated directional screenline commercial vehicle flows across the day are presented in Figure 4.13 and Figure 4.14.

The R-squareds and gradients range from 0.96 to 0.98 which indicates that the model has good correlation to observed commercial vehicle data across the day.

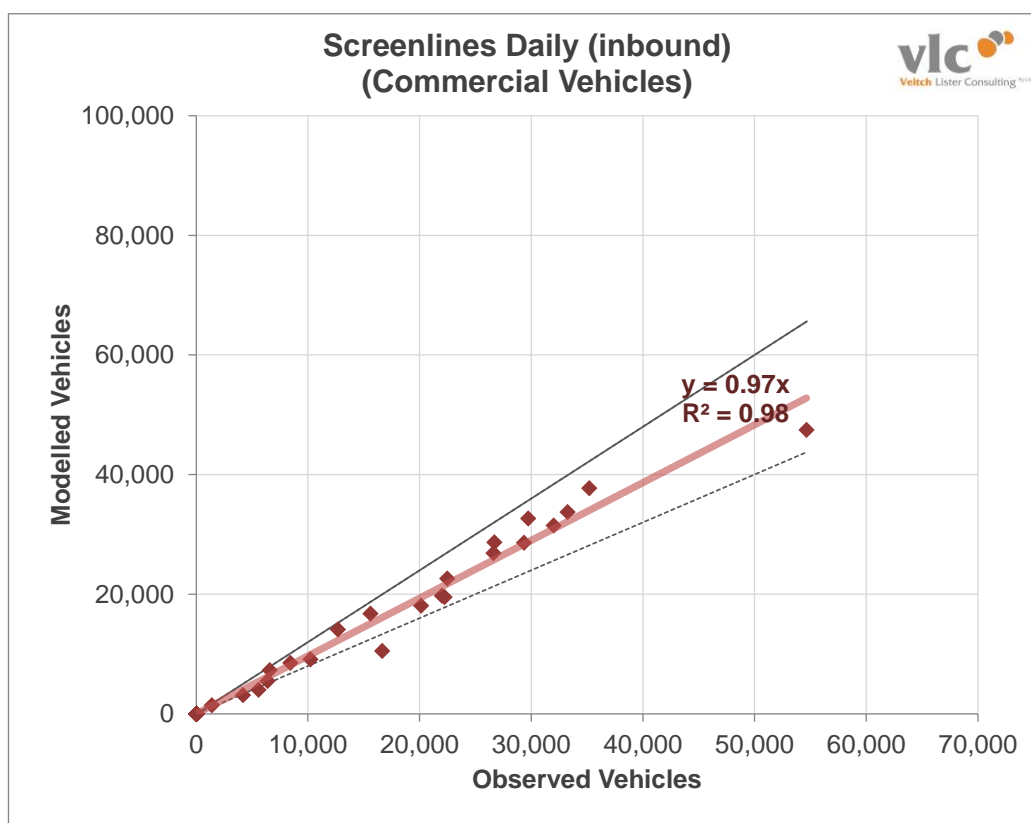


Figure 4.13 - Daily Inbound CV Screenlines Scatter Chart (Observed Vs Modelled)

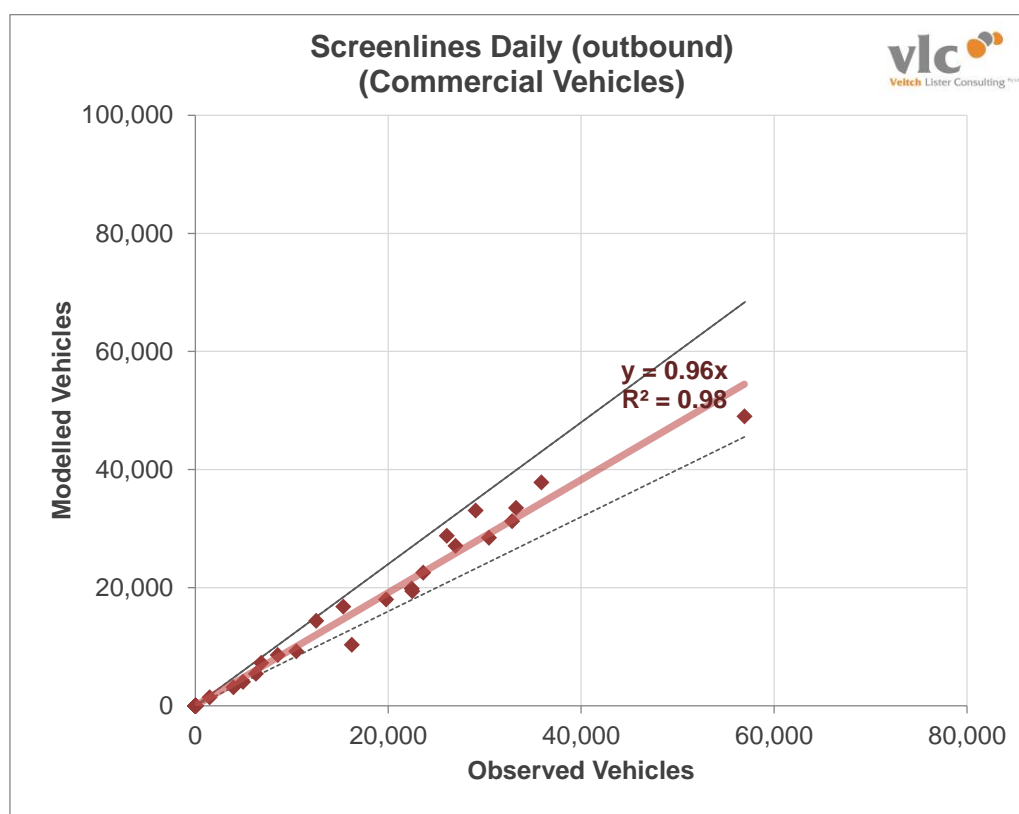


Figure 4.14 - Daily Outbound CV Screenlines Scatter Chart (Observed Vs Modelled)



4.1.4 Commercial Vehicle Volumes - Individual Traffic Counts

Scatter plots illustrating the individual count locations for commercial vehicles across the day are presented in Figure 4.15.

Good correlation is shown between modelled and observed commercial vehicle flow as the R-squared is around 0.90 and gradient around 0.88.

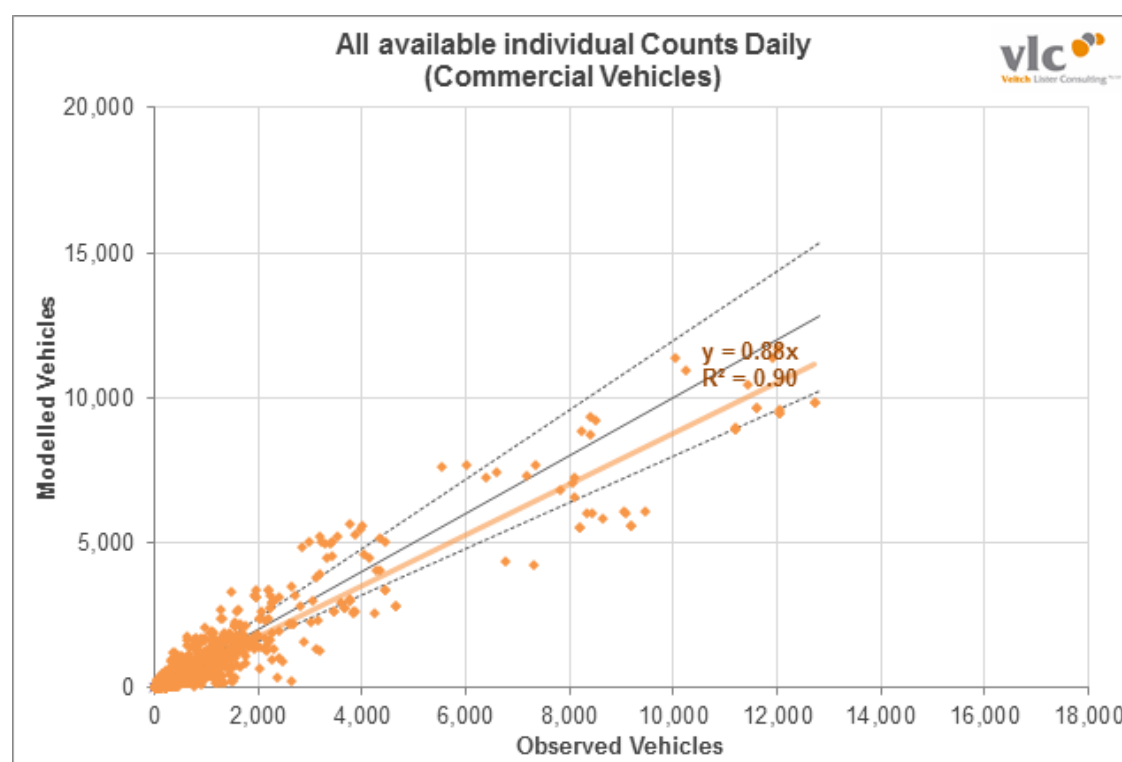


Figure 4.15 - Daily Individual Commercial Vehicle Counts Scatter Chart (Observed Vs Modelled)



5 Model Convergence

5.1.1 Assignment Convergence

Traffic assignment convergence was measured using the relative changes of link costs between consecutive iterations (RGAP) as the main indicator. The RGAP values of last iteration for each time period are listed in Table 5.1.

Model Scenario	RGAP Target	RGAP (Final Iteration)	PT Assignment RGAP (Final Iteration)
AM	<0.01	0.00428	-0.00152
MD	<0.01	0.00085	0.00114
PM	<0.01	0.00341	0.00150
OP	<0.01	0.00011	0.00177

Table 5.1 – Assignment Convergence Results



6 Appendices

Appendix A – Public Transport Observed Data

Station	Line Group	Line	Segment	Inner / Outer LGA	Zone	7am - 8am	8am - 4pm	4pm - 6pm	6pm - 7am	Total Normal Weekday
Aircraft	Northern	Newport Corridor	Laverton-Werrbee	Inner	Zone 2	313	334	169	255	1,071
Alamein	Burnley	Camberwell Corridor	Riversdale-Alamein	Inner	Zone 1	232	175	29	88	584
Albion	Northern	Middle Footscray-Sydenham	Albion-St Albans	Inner	Zone 1-2 overlap	1,492	708	182	540	2,923
Alphington	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 1	515	355	101	121	1,092
Altona	Northern	Newport Corridor	Seaholme-Westona	Inner	Zone 1-2 overlap	431	447	112	223	1,213
Anstey	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 1	487	387	141	211	1,226
Armada	Cauffield	Hawkeburn-Malvern	Hawkeburn-Malvern	Inner	Zone 1	761	706	242	323	2,032
Ascot Vale	Northern	Kensington-Craigieburn	Kensington-Essendon	Inner	Zone 1	907	542	119	242	1,810
Ashburton	Burnley	Camberwell Corridor	Riversdale-Alamein	Inner	Zone 1	480	298	83	136	997
Aspendale	Cauffield	Glenhuntly-Franston	Aspendale-Carrum	Inner	Zone 2	616	351	109	172	1,248
Auburn	Burnley	Camberwell Corridor	Auburn & Hawthorn	Inner	Zone 1	826	730	323	346	2,226
Balaclava	Cauffield	Prahran-Sandringham	Prahran-Middle Brighton	Inner	Zone 1	1,285	1,207	432	611	3,534
Batman	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 1-2 overlap	388	363	159	145	1,055
Bayswater	Burnley	Camberwell Corridor	Heathmont-Belgrave	Inner	Zone 2 (Previously Zone 3)	845	520	277	355	1,997
Beaconsfield	Cauffield	Dandenong Corridor	Beaconsfield-Pakenham	Inner	Zone 2 (Previously Zone 3)	236	259	74	243	812
Belgrave	Burnley	Camberwell Corridor	Heathmont-Belgrave	Inner	Zone 2 (Previously Zone 3)	607	561	54	343	1,565
Bell	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 1	546	682	203	284	1,715
Bentleigh	Cauffield	Glenhuntly-Franston	Glenhuntly-Moorabbin	Inner	Zone 1-2 overlap	1,188	1,104	384	531	3,208
Berwick	Cauffield	Dandenong Corridor	Hallam-Berwick	Inner	Zone 2 (Previously Zone 3)	1,196	866	270	629	2,962
Blackburn	Burnley	Camberwell Corridor	Laburnum-Ringwood	Inner	Zone 2	1,654	1,284	587	639	4,164
Bonbeach	Cauffield	Glenhuntly-Franston	Aspendale-Carrum	Inner	Zone 2 (Previously Zone 2-3 overlap)	743	368	65	195	1,372
Boronia	Burnley	Camberwell Corridor	Heathmont-Belgrave	Inner	Zone 2 (Previously Zone 3)	1,317	655	127	441	2,541
Box Hill	Burnley	Camberwell Corridor	Box Hill	Inner	Zone 2	2,804	4,419	2,369	1,840	11,433
Brighton Beach	Cauffield	Prahran-Sandringham	Brighton Beach-Sandringham	Inner	Zone 1-2 overlap	607	362	116	240	1,325
Broadmeadows	Northern	Kensington-Craigieburn	Glenbervie-Broadmeadows	Inner	Zone 2	460	1,203	497	317	2,476
Brunswick	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 1	269	343	187	172	971
Burnley	Burnley	Camberwell Corridor	East Richmond-Glen Waverley	Inner	Zone 1	972	836	635	463	2,907
Burwood	Burnley	Camberwell Corridor	Riversdale-Alamein	Inner	Zone 1	687	305	110	126	1,208
Camberwell	Burnley	Camberwell Corridor	Camberwell	Inner	Zone 1	1,962	2,350	1,692	1,543	7,546
Canterbury	Burnley	Camberwell Corridor	East Camberwell-Mont Albert	Inner	Zone 1-2 overlap	550	417	152	143	1,263
Carnegie	Cauffield	Dandenong Corridor	Carnegie-Oakleigh	Inner	Zone 1	1,118	1,048	262	432	2,861
Carrum	Cauffield	Aspendale-Carrum	Aspendale-Carrum	Inner	Zone 2 (Previously Zone 2-3 overlap)	731	542	141	329	1,742
Cauffield	Cauffield	Cauffield	Cauffield	Inner	Zone 1	2,452	4,504	3,295	3,158	13,408
Chatham	Burnley	Camberwell Corridor	East Camberwell-Mont Albert	Inner	Zone 1-2 overlap	387	230	68	93	777
Chelsea	Cauffield	Glenhuntly-Franston	Aspendale-Carrum	Inner	Zone 2 (Previously Zone 2-3 overlap)	814	776	224	337	2,150
Cheltenham	Cauffield	Glenhuntly-Franston	Highton-Mordialloc	Inner	Zone 2	1,777	1,085	485	687	4,033
Clayton	Cauffield	Dandenong Corridor	Huntingdale-Westall	Inner	Zone 2	1,318	2,195	962	939	5,414
Clifton Hill	Clifton Hill	Jolimont-Clifton Hill	Jolimont-Clifton Hill	Inner	Zone 1	1,140	954	388	530	3,011
Coburg	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 1	823	863	261	365	2,312
Collingwood	Clifton Hill	Jolimont-Clifton Hill	Jolimont-Clifton Hill	Inner	Zone 1	236	473	363	218	1,290
Coolaroo	Northern	Kensington-Craigieburn	Coolaroo-Craigieburn	Inner	Zone 2	255	251	50	92	649
Craigieburn	Northern	Kensington-Craigieburn	Coolaroo-Craigieburn	Inner	Zone 2	920	563	148	547	2,177
Cranbourne	Cauffield	Dandenong Corridor	Merinda Park-Cranbourne	Inner	Zone 2 (Previously Zone 3)	907	647	149	645	2,348
Croxton	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 1	405	318	107	171	1,000
Croydon	Burnley	Camberwell Corridor	Ringwood-East-Lilydale	Inner	Zone 2 (Previously Zone 3)	1,439	834	351	520	3,144
Dandenong	Cauffield	Dandenong Corridor	Dandenong	Inner	Zone 2 (Previously Zone 3)	1,951	3,000	1,536	1,513	8,001
Darebin	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 1	250	195	38	52	535
Darling	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 1-2 overlap	662	278	81	135	1,156
Dennis	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 1	619	353	107	158	1,237
Diamond Creek	Clifton Hill	Westgarth-Hurstbridge	Diamond Creek-Hurstbridge	Inner	Zone 2	438	222	39	191	890
Eaglemont	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 1-2 overlap	381	202	43	91	718
East Camberwell	Burnley	Camberwell Corridor	East Camberwell-Mont Albert	Inner	Zone 1	258	476	77	87	898
East Malvern	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 1-2 overlap	1,061	422	81	181	1,746
East Richmond	Burnley	Camberwell Corridor	East Richmond-Glen Waverley	Inner	Zone 1	580	474	724	477	2,254
Edithvale	Cauffield	Glenhuntly-Franston	Aspendale-Carrum	Inner	Zone 1	655	373	114	212	1,354
Elsternwick	Cauffield	Prahran-Sandringham	Prahran-Middle Brighton	Inner	Zone 1	1,390	1,176	472	624	3,663
Eltham	Clifton Hill	Westgarth-Hurstbridge	Montmorency-Eltham	Inner	Zone 2	1,334	1,033	347	390	3,104
Epping	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 2	1,161	923	264	605	2,953
Essendon	Northern	Kensington-Craigieburn	Kensington-Essendon	Inner	Zone 1	2,612	1,966	745	1,339	6,661
Fairfield	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 1	957	835	244	346	2,382
Fawkner	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 1-2 overlap	280	228	64	91	662
Ferntree Gully	Burnley	Camberwell Corridor	Heathmont-Belgrave	Inner	Zone 2 (Previously Zone 3)	965	516	96	286	1,863
Flagstaff	City Loop	City Loop	City Loop	Inner	City Loop	400	4,024	10,946	4,145	19,515
Flemington Bridge	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 1	145	234	106	106	591
Flinders Street	City Loop	City Loop	City Loop	Inner	City Loop	3,202	26,050	36,099	24,894	90,244
Footscray	Inner City Interchange Stations	Footscray	Footscray	Inner	Zone 1	2,558	6,239	2,479	1,964	13,250
Frankston	Cauffield	Glenhuntly-Franston	Seaford-Frankston	Inner	Zone 2 (Previously Zone 3)	3,908	3,637	1,520	1,869	10,934
Gardenvale	Cauffield	Prahran-Sandringham	Prahran-Middle Brighton	Inner	Zone 1	628	522	186	209	1,545
Gardiner	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 1	705	427	146	224	1,502
Ginifer	Northern	Middle Footscray-Sydenham	Albion-St Albans	Inner	Zone 2	1,016	983	200	383	2,583
Glen Iris	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 1	476	485	167	205	1,333
Glen Waverley	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 2	2,584	1,806	558	1,547	6,496
Glenbervie	Northern	Kensington-Craigieburn	Glenbervie-Broadmeadows	Inner	Zone 1	715	314	68	165	1,262
Glenferrie	Burnley	Camberwell Corridor	Glenferrie	Inner	Zone 1	1,471	3,759	2,597	1,995	9,822
Glenhuntly	Cauffield	Glenhuntly-Franston	Glenhuntly-Moorabbin	Inner	Zone 1	1,369	1,621	376	747	4,113
Glenroy	Northern	Kensington-Craigieburn	Glenbervie-Broadmeadows	Inner	Zone 1-2 overlap	1,781	1,643	408	686	4,518
Gowrie	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 2	203	342	87	141	773
Greensborough	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 2	1,270	789	344	701	3,104
Hallam	Cauffield	Dandenong Corridor	Hallam-Berwick	Inner	Zone 2 (Previously Zone 3)	1,211	591	298	693	2,793
Hampton	Cauffield	Prahran-Sandringham	Brighton Beach-Sandringham	Inner	Zone 2	650	471	184	208	1,513
Hartwell	Burnley	Camberwell Corridor	Riversdale-Alamein	Inner	Zone 1	356	185	51	79	671
Hawkeburn	Cauffield	Hawkeburn-Malvern	Hawkeburn-Malvern	Inner	Zone 1	848	608	174	278	1,908
Hawthorn	Burnley	Camberwell Corridor	Auburn & Hawthorn	Inner	Zone 1	713	578	421	259	1,971
Heatherdale	Burnley	Camberwell Corridor	Laburnum-Ringwood	Inner	Zone 2 (Previously Zone 2-3 overlap)	953	381	126	293	1,752
Heathmont	Burnley	Camberwell Corridor	Heathmont-Belgrave	Inner	Zone 2 (Previously Zone 3)	457	412	125	158	1,153
Heidelberg	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 1-2 overlap	1,039	1,469	799	719	4,026
Heyington	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 1	169	582	193	89	1,033
Highbett	Cauffield	Glenhuntly-Franston	Highbett-Mordialloc	Inner	Zone 2	827	491	205	265	1,787
Holmesglen	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 1-2 overlap	840	1,020	484	545	2,889
Hoppers Crossing	Northern	Newport Corridor	Laverton-Werrbee	Inner	Zone 2	1,924	1,183	272	1,148	4,528
Hughesdale	Cauffield	Dandenong Corridor	Carnegie-Oakleigh	Inner	Zone 1-2 overlap	727	588	215	277	1,807
Huntingdale	Cauffield	Dandenong Corridor	Huntingdale-Westall	Inner	Zone 1-2 overlap	1,875	1,597	805	1,131	5,408
Hurstbridge	Clifton Hill	Westgarth-Hurstbridge	Diamond Creek-Hurstbridge	Inner	Zone 2	577	204	40	165	987
Ivanhoe	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 1-2 overlap	1,630	918	274	439	3,460
Jacana	Northern	Kensington-Craigieburn	Glenbervie-Broadmeadows	Inner	Zone 2	101	166	45	101	413
Jewell	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 1	312	524	279	232	1,347
Jolimont	Clifton Hill	Jolimont-Clifton Hill	Jolimont-Clifton Hill	Inner	Zone 1	143	535	752	689	2,119
Jordanville	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 2	554	325	71	166	1,116
Kanook	Cauffield	Glenhuntly-Franston	Seaford-Frankston	Inner	Zone 2 (Previously Zone 3)	472	329	160	230	1,191
Keilor Plains	Northern	Middle Footscray-Sydenham	Keilor Plains-Sydenham	Inner	Zone 2	1,196	518	111	396	2,220
Kensington	Northern	Kensington-Craigieburn	Kensington-Essendon	Inner	Zone 1	691	659	185	230	1,765

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Station	Line Group	Line	Segment	Inner / Outer LGA	Zone	7am - 9am	9am - 4pm	4pm - 6pm	6pm - 7am	Total Normal Weekday
Keon Park	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 2	400	399	234	217	1,251
Kooyong	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 1	330	413	189	152	1,085
Laburnum	Burnley	Camberwell Corridor	Laburnum-Ringwood	Inner	Zone 2	664	578	130	147	1,519
Lalor	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 2	910	431	128	396	1,865
Laverton	Northern	Newport Corridor	Laverton-Werribee	Inner	Zone 1-2 overlap	2,918	1,541	305	980	5,744
Lilydale	Burnley	Camberwell Corridor	Ringwood-East-Lydale	Inner	Zone 2 (Previously Zone 3)	967	1,010	393	510	2,880
Macaulay	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 1	128	246	190	95	660
Macleod	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 2	807	618	142	257	1,824
Malvern	Cauffield	Hawkesburn-Malvern	Hawkesburn-Malvern	Inner	Zone 1	1,381	1,583	729	831	4,524
McKinnon	Cauffield	Glenhuntly-Franston	Glenhuntly-Moorabbin	Inner	Zone 1-2 overlap	797	438	119	223	1,576
Melbourne Central	City Loop	City Loop	City Loop	Inner	City Loop	1,037	16,802	19,469	17,465	54,773
Mentone	Cauffield	Glenhuntly-Franston	Hghett-Mordialloc	Inner	Zone 2	1,218	1,493	337	419	3,468
Merinda Park	Cauffield	Dandenong Corridor	Merinda Park-Cranbourne	Inner	Zone 2 (Previously Zone 3)	640	294	68	396	1,398
Merlynston	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 1-2 overlap	580	481	134	209	1,403
Merri	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 1	207	415	96	107	825
Middle Brighton	Cauffield	Prahran-Sandringham	Prahran-Middle Brighton	Inner	Zone 1-2 overlap	654	627	192	253	1,727
Middle Footscray	Northern	Middle Footscray-Sydenham	Middle Footscray-Sunshine	Inner	Zone 1	200	206	68	100	574
Mitcham	Burnley	Camberwell Corridor	Laburnum-Ringwood	Inner	Zone 2 (Previously Zone 2-3 overlap)	1,952	1,001	402	613	3,968
Mont Albert	Burnley	Camberwell Corridor	East Camberwell-Mont Albert	Inner	Zone 1-2 overlap	533	364	89	141	1,127
Montmorency	Clifton Hill	Westgarth-Hurstbridge	Montmorency-Btham	Inner	Zone 2	649	335	85	193	1,262
Moonee Ponds	Northern	Kensington-Craigieburn	Kensington-Essendon	Inner	Zone 1	1,000	862	401	413	2,677
Moorabbin	Cauffield	Glenhuntly-Franston	Glenhuntly-Moorabbin	Inner	Zone 2	711	842	434	414	2,401
Mooroolbark	Burnley	Camberwell Corridor	Ringwood-East-Lydale	Inner	Zone 2 (Previously Zone 3)	1,251	638	174	495	2,559
Mordialloc	Cauffield	Glenhuntly-Franston	Hghett-Mordialloc	Inner	Zone 2	1,093	718	187	305	2,349
Moreland	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 1	501	416	170	247	1,334
Mount Waverley	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 2	1,244	1,363	249	408	3,264
Murumbidgee	Cauffield	Dandenong Corridor	Carnegie-Oakleigh	Inner	Zone 1	1,252	927	188	371	2,737
Narre Warren	Cauffield	Dandenong Corridor	Hallam-Berwick	Inner	Zone 2 (Previously Zone 3)	1,286	681	255	732	2,955
Newmarket	Northern	Kensington-Craigieburn	Kensington-Essendon	Inner	Zone 1	928	951	265	394	2,538
Newport	Northern	Newport Corridor	South Kensington-Newport	Inner	Zone 1	1,874	1,538	562	661	4,635
Noble Park	Cauffield	Dandenong Corridor	Springvale-Yarraman	Inner	Zone 2 (Previously Zone 3)	1,903	3,300	686	1,695	7,584
North Brighton	Cauffield	Prahran-Sandringham	Prahran-Middle Brighton	Inner	Zone 1-2 overlap	1,100	886	184	445	2,614
North Melbourne	Inner City Interchange Stations	North Melbourne	North Melbourne	Inner	Inner City Interchange Stations	460	1,208	1,059	786	3,513
North Richmond	Clifton Hill	Jolimont-Clifton Hill	Jolimont-Clifton Hill	Inner	Zone 1	319	628	492	455	1,895
North Williamstown	Northern	Newport Corridor	North Williamstown-Williamstown	Inner	Zone 1	648	424	160	183	1,415
Northcote	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 1	367	626	219	185	1,398
Nunawading	Burnley	Camberwell Corridor	Laburnum-Ringwood	Inner	Zone 2 (Previously Zone 2-3 overlap)	1,790	954	339	453	3,537
Oak Park	Northern	Kensington-Craigieburn	Glenbervie-Broadmeadows	Inner	Zone 1-2 overlap	747	579	102	204	1,632
Oakleigh	Cauffield	Dandenong Corridor	Carnegie-Oakleigh	Inner	Zone 1-2 overlap	2,006	2,010	703	940	5,658
Officer	Cauffield	Dandenong Corridor	Beaconsfield-Pakenham	Inner	Zone 2 (Previously Zone 3)	61	31	18	40	151
Ormond	Cauffield	Glenhuntly-Franston	Glenhuntly-Moorabbin	Inner	Zone 1-2 overlap	1,103	929	298	551	2,881
Pakenham	Cauffield	Dandenong Corridor	Beaconsfield-Pakenham	Inner	Zone 2 (Previously Zone 3)	744	670	248	636	2,297
Parkdale	Cauffield	Glenhuntly-Franston	Hghett-Mordialloc	Inner	Zone 2	671	755	141	201	1,768
Parliament	City Loop	City Loop	City Loop	Inner	City Loop	785	8,989	20,061	9,716	39,551
Pascoe Vale	Northern	Kensington-Craigieburn	Glenbervie-Broadmeadows	Inner	Zone 1-2 overlap	1,006	515	133	253	1,906
Patterson	Cauffield	Glenhuntly-Franston	Glenhuntly-Moorabbin	Inner	Zone 2	317	328	69	108	823
Prahran	Cauffield	Prahran-Sandringham	Prahran-Middle Brighton	Inner	Zone 1	540	1,309	1,293	865	4,006
Preston	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 1-2 overlap	701	1,280	438	470	2,888
Regent	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 1-2 overlap	917	532	119	269	1,837
Reservoir	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 1-2 overlap	1,778	1,404	358	731	4,271
Richmond	Inner City Interchange Stations	Richmond	Richmond	Inner	Inner City Interchange Stations	1,182	1,978	1,977	1,868	7,004
Ringwood East	Burnley	Camberwell Corridor	Laburnum-Ringwood	Inner	Zone 2 (Previously Zone 3)	1,717	2,472	828	1,059	6,076
Ripponlea	Cauffield	Prahran-Sandringham	Prahran-Middle Brighton	Inner	Zone 1	763	453	111	211	1,539
Riversdale	Burnley	Camberwell Corridor	Riversdale-Alamein	Inner	Zone 1	874	764	201	335	2,174
Rosanna	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 2	434	401	87	78	1,000
Roxburgh Park	Northern	Kensington-Craigieburn	Coolaroo-Craigieburn	Inner	Zone 2	1,011	462	97	262	1,832
Royal Park	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 1	800	471	174	291	1,736
Rushall	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 1	141	394	242	85	862
Ruthven	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 2	138	194	77	82	492
Sandown Park	Cauffield	Dandenong Corridor	Springvale-Yarraman	Inner	Zone 2 (Previously Zone 2-3 overlap)	385	289	46	161	881
Sandringham	Cauffield	Prahran-Sandringham	Brighton Beach-Sandringham	Inner	Zone 1	807	456	88	245	1,596
Seaford	Cauffield	Glenhuntly-Franston	Seaford-Frankston	Inner	Zone 2 (Previously Zone 3)	1,046	543	139	299	2,026
Seaholme	Northern	Newport Corridor	Seaholme-Westona	Inner	Zone 1	765	464	171	379	1,779
Seddon	Northern	Newport Corridor	South Kensington-Newport	Inner	Zone 1	211	146	22	77	456
South Kensington	Northern	Newport Corridor	South Kensington-Newport	Inner	Zone 1	579	360	91	177	1,207
South Yarra	Inner City Interchange Stations	South Yarra	South Yarra	Inner	Inner City Interchange Stations	377	299	84	114	874
Southern Cross (Spencer St.)	City Loop	City Loop	City Loop	Inner	City Loop	2,135	3,109	2,517	1,814	9,574
Spotswood	Northern	Newport Corridor	South Kensington-Newport	Inner	Zone 1	2,193	13,021	23,210	12,070	50,493
Springvale	Cauffield	Dandenong Corridor	Springvale-Yarraman	Inner	Zone 2 (Previously Zone 2-3 overlap)	294	291	90	114	789
St Albans	Northern	Middle Footscray-Sydenham	Albion-St Albans	Inner	Zone 2	1,811	2,399	713	856	5,779
Stony Point (Onboard)	Cauffield	Leawarra-Stony Point	Leawarra-Stony Point	Inner	Zone 2 (Previously Zone 3)	1,532	3,319	690	1,251	6,793
Strathmore	Northern	Kensington-Craigieburn	Glenbervie-Broadmeadows	Inner	Zone 1	-	-	-	-	860
Sunshine	Northern	Middle Footscray-Sydenham	Middle Footscray-Sunshine	Inner	Zone 1-2 overlap	671	403	103	175	1,351
Surrey Hills	Burnley	Camberwell Corridor	East Camberwell-Mont Albert	Inner	Zone 1-2 overlap	2,208	2,912	783	1,046	6,948
Sydney	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 2	1,542	551	168	337	2,598
Tecoma	Burnley	Camberwell Corridor	Heathmont-Belgrave	Inner	Zone 2 (Previously Zone 3)	1,238	682	223	471	2,614
Thomastown	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 2	115	72	20	52	259
Thornbury	Clifton Hill	Rushall-Epping	Rushall-Epping	Inner	Zone 1	1,196	958	171	548	2,872
Toorak	Cauffield	Hawkesburn-Malvern	Hawkesburn-Malvern	Inner	Zone 1	681	509	122	230	1,542
Tooronga	Burnley	East Richmond-Glen Waverley	East Richmond-Glen Waverley	Inner	Zone 1	652	579	211	241	1,684
Tottenham	Northern	Middle Footscray-Sydenham	Middle Footscray-Sunshine	Inner	Zone 1	624	521	321	281	1,746
Upfield	Northern	Macaulay-Upfield	Macaulay-Upfield	Inner	Zone 2	576	611	196	228	1,611
Upper Ferntree Gully	Burnley	Camberwell Corridor	Heathmont-Belgrave	Inner	Zone 2 (Previously Zone 3)	319	439	262	200	1,220
Upwey	Burnley	Camberwell Corridor	Heathmont-Belgrave	Inner	Zone 2 (Previously Zone 3)	409	284	159	200	1,052
Victoria Park	Clifton Hill	Jolimont-Clifton Hill	Jolimont-Clifton Hill	Inner	Zone 1	307	422	99	155	983
Watergardens (Sydenham)	Northern	Middle Footscray-Sydenham	Keilor Plains-Sydenham	Inner	Zone 2	324	569	556	335	1,784
Watsonia	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 2	2,795	1,557	476	967	5,795
Wattle Glen	Clifton Hill	Westgarth-Hurstbridge	Diamond Creek-Hurstbridge	Inner	Zone 2	1,108	545	141	410	2,204
Werribee	Northern	Newport Corridor	Laverton-Werribee	Inner	Zone 2	117	45	8	33	203
West Footscray	Northern	Middle Footscray-Sydenham	Middle Footscray-Sunshine	Inner	Zone 1	1,390	1,062	365	952	3,769
West Richmond	Clifton Hill	Jolimont-Clifton Hill	Jolimont-Clifton Hill	Inner	Zone 1	692	483	107	164	1,446
Westall	Cauffield	Dandenong Corridor	Huntingdale-Westall	Inner	Zone 2 (Previously Zone 2-3 overlap)	241	334	166	241	981
Westgarth	Clifton Hill	Westgarth-Hurstbridge	Westgarth-Greensborough	Inner	Zone 1	538	697	278	278	1,792
Westona	Northern	Newport Corridor	Seaholme-Westona	Inner	Zone 1-2 overlap	468	319	72	141	1,000
Williamstown	Northern	Newport Corridor	North Williamstown-Williamstown	Inner	Zone 1	358	555	87	224	1,223
Williamstown Beach	Northern	Newport Corridor	North Williamstown-Williamstown	Inner	Zone 1	174	139	52	53	418
Willson	Burnley	Camberwell Corridor	Riversdale-Alamein	Inner	Zone 1	308	323	82	90	804
Windsor	Cauffield	Prahran-Sandringham	Prahran-Middle Brighton	Inner	Zone 1	180	82	22	37	320
Yarraman	Cauffield	Dandenong Corridor	Springvale-Yarraman	Inner	Zone 2 (Previously Zone 3)	995	1,281	554	636	3,466
Yarraville	Northern	Newport Corridor	South Kensington-Newport	Inner	Zone 1	414	430	176	214	1,235
						1,105	947	235	575	2,862

Table A.1 - Estimated Station Entries at Metropolitan Stations 2010-11



Segment Description	Timeband	Average Loads			
		May-2008	May-2009	May-2010	May-2011
Burnley					
<i>Belgrave-Lilydale Corridor</i>		17,626	16,921	17,344	15,836
Alamein - Riversdale Service Group	AM Peak Up (07:00 to 09:00)	2,533	2,709	2,664	3,034
Glen Waverley - Heyington Service Group	AM Peak Up (07:00 to 09:00)	8,011	7,442	7,579	7,788
Ringwood - Camberwell Service Group	AM Peak Up (07:00 to 09:00)	3,204	2,864	3,214	3,882
<i>Burnley Group Total</i>		31,374	29,936	30,801	30,540
Caulfield					
<i>Dandenong Corridor</i>		15,889	16,545	16,111	16,471
Frankston - Glenhuntly Service Group	AM Peak Up (07:00 to 09:00)	12,595	12,104	12,417	13,559
Sandringham - Prahran Service Group	AM Peak Up (07:00 to 09:00)	8,257	8,009	7,821	8,120
<i>Caulfield Group Total</i>		36,741	36,658	36,348	38,150
Clifton Hill					
Epping - Rushall Service Group	AM Peak Up (07:00 to 09:00)	6,799	6,541	6,950	6,935
Greensborough - Westgarth Service Group	AM Peak Up (07:00 to 09:00)	4,385	4,090	4,129	4,365
Hurstbridge - Montmorency Service Group	AM Peak Up (07:00 to 09:00)	6,086	5,781	5,990	5,981
<i>Clifton Hill Group Total</i>		17,270	16,412	17,069	17,281
Northern					
<i>Newport Corridor</i>		11,104	11,138	12,389	13,856
Craigieburn - Kensington Service Group	AM Peak Up (07:00 to 09:00)	11,805	11,416	11,472	12,279
Sydenham - Middle Footscray Service Group	AM Peak Up (07:00 to 09:00)	9,306	9,793	10,137	10,303
Upfield - Macaulay Service Group	AM Peak Up (07:00 to 09:00)	3,344	3,388	3,587	3,547
<i>Northern Group Total</i>		35,558	35,735	37,585	39,985
TOTAL		120,942	118,741	121,802	125,956

Table A.2 - Metro AM Inbound Observed Load at CBD Cordon



	Estimated Weekday Patronage FY2010 - 2011 AM Peak Patronage 7:00 am to 9:00 am (8:59 am)	Estimated Weekday Patronage FY2010 - 2011 PM Peak Patronage 4:00 pm to 6:00 pm (5:59 pm)	Estimated Weekday Patronage FY2010 - 2011 Average Weekday Patronage 4:00 am to 4:00 am (3:59 am)			Estimated Weekday Patronage FY2010 - 2011 AM Peak Patronage 7:00 am to 9:00 am (8:59 am)	Estimated Weekday Patronage FY2010 - 2011 PM Peak Patronage 4:00 pm to 6:00 pm (5:59 pm)	Estimated Weekday Patronage FY2010 - 2011 Average Weekday Patronage 4:00 am to 4:00 am (3:59 am)
Station				Station				
ARARAT	46	29	115	MALMSBURY	10	4	45	
ARDEER	41	3	76	MARSHALL	149	13	452	
BACCHUS MARSH	315	26	770	MELTON	993	74	1,845	
BAIRNSDALE	-	35	202	MOE	145	58	441	
BALLAN	83	10	231	MOOROOPNA	8	4	16	
BALLARAT	526	75	1,630	MORWELL	130	69	461	
BEAUFORT	16	2	27	MURCHISON EAST	20	12	38	
BENDIGO	187	277	1,185	NAGAMBIE	7	2	13	
BERWICK	0	11	11	NAR NAR GOON	27	4	47	
BIRREGURRA	5	-	8	NEWPORT	7	16	52	
BROADFORD	65	19	229	NORTH GEELONG	345	54	862	
BROADMEADOWS	17	38	180	NORTH MELBOURNE	3	1,102	1,736	
BUNYIP	18	5	47	NORTH SHORE	23	14	83	
CAMPERDOWN	-	2	52	PAKENHAM	243	55	532	
CASTLEMAINE	161	64	669	PYRAMID	5	-	10	
CAULFIELD	21	30	102	RICHMOND	1	54	101	
CLARKEFIELD	42	1	76	RIDDELLS CREEK	114	6	209	
CLAYTON	9	25	78	ROCHESTER	13	-	14	
COLAC	27	-	79	ROCKBANK	13	1	21	
CORIO	14	11	56	ROSEDALE	5	-	16	
CRAIGIEBURN	43	0	53	SALE	54	7	128	
CRESWICK	-	0	0	SEYMOUR	226	39	782	
DANDENONG	33	56	208	SHEPPARTON	18	-	173	
DEER PARK	153	8	300	SHERWOOD PARK	-	6	7	
DIGGERS REST	63	6	110	SOUTH GEELONG	640	111	1,504	
DINGEE	1	-	2	Southern Cross	439	6,078	13,526	
DONNY BROOK	46	3	74	ST ALBANS	8	23	37	
DROUIN	113	95	398	STRATFORD	-	1	17	
EAGLEHAWK	-	3	13	SUNBURY	988	129	1,864	
ECHUCA	44	-	44	SUNSHINE	34	116	350	
ELMORE	6	1	7	SWAN HILL	66	-	129	
ESSENDON	0	4	7	TALLAROOK	7	1	26	
FLINDERS STREET	25	257	637	TERANG	-	5	26	
FOOTSCRAY	61	170	520	TRAFALGAR	28	148	249	
GEELONG	521	305	1,896	TRARALGON	125	77	534	
GINIFER	2	0	2	TYNONG	14	2	40	
GISBORNE	236	31	441	WALLAN	190	33	373	
HEATHCOTE JUNCTION	25	2	46	WANDONG	35	5	88	
KANGAROO FLAT	41	10	116	WARRAGUL	168	56	550	
KERANG	15	-	27	WARRNAMBOOL	-	73	227	
KILMORE EAST	85	72	320	Watergardens	42	24	216	
KYNETON	140	23	409	WENDOUREE	55	4	150	
LARA	272	46	694	WERRIBEE	85	45	242	
LITTLE RIVER	26	3	49	WINCHELSEA	8	-	16	
LONGWARRY	19	6	53	WOODEND	254	26	455	
MACEDON	54	5	100	YARRAGON	12	6	41	

Table A.3 - Estimated V/Line Train Boardings at V/Line Stations 2010-11



Appendix B – Road Traffic Data

Paper 9 – Model Validation
Zenith Model Recalibration and Validation Version 3.0.0

Location	AM	PM	Daily	Location	AM	PM	Daily	Location	AM	PM	Daily	Location	AM	PM	Daily	Location	AM	PM	Daily
Ormond Rd W of Clyntik L.Miss	1,986	1,362	9,950	Grattan St E of Swanton St Ail.Moves	1,423	1,434	8,613	WILLIAMSTOWN RD N BD BTW BLACKWOOD ST & HIGH ST Ail.Moves	1,326	1,808	12,279	CHURCH ST N OF HOWARD ST Ail.Moves	1,132	1,714	10,780	BRUNSWICK ST S OF GERTRUDE ST Ail.Moves	302	793	4,994
Queens Pde SW of Wellington St Ail.Moves	798	2,005	10,808	Princes St E of Lyon St Ail.Moves	3,638	3,007	26,485	SOMERVILLE RD W BD 50M SW OF STEPHEN ST Ail.Moves	576	1,246	5,985	GLYNCHURCH ST E OF LYON ST Ail.Moves	634	691	4,513	BARCLAY ST W OF GEELONG RD Ail.Moves	1,400	1,119	8,489
Conestry Rd East of Swanton St Ail.Moves	2,853	2,813	22,794	Elizabeth St E of Queensberry Rd Ail.Moves	2,629	1,609	13,515	FULFORD RD E BD BTWN STOCKTON DR & WOOLSHED AV Ail.Moves	412	582	4,369	CHURCH ST E OF ROBERTSON ST Ail.Moves	1,015	1,247	8,151	WESTS RD W OF HAMILTON RD Ail.Moves	1,269	1,590	7,507
Victoria St W of Chewpake St Ail.Moves	1,124	884	6,979	Wellington St S of Queens Pde L.Miss	210	461	2,672	ST HWY N BD BTW FRANCIS ST & SIMCOCK AV Ail.Moves	1,941	867	6,567	WUNDURNEY WAY W OF BATMAN DR Ail.Moves	2,601	3,254	20,315	CLARENDON ST S OF ALBERT ST Ail.Moves	548	816	4,889
Hoddle St N of Eastern Fwy Ail.Moves	1,650	3,594	20,724	Princes St W of Nicholson St Ail.Moves	3,635	4,140	31,709	SOMERVILLE RD W BD 10 E OF PARAMOUNT RD Ail.Moves	1,523	370	3,275	WUNDURNEY RD W OF SREDA ST Ail.Moves	1,905	1,158	9,544	ALBERT ST E OF CLARENDON ST Ail.Moves	2,105	960	4,860
Roadhouse Rd NW of Raccourse Rd Ail.Moves	6,132	2,861	30,269	Alexandra Pde E of Nicholson St Ail.Moves	5,702	4,438	38,277	FAIRBANK RD S BD BTW SOMERVILLE RD & INDUSTRIAL DR Ail.Moves	1,405	2,900	13,261	ST GEORGES RD N OF CHARLES ST Ail.Moves	2,595	2,318	19,108	RALIGH RD W OF VAN NESS AV Ail.Moves	1,998	1,562	11,740
Hodder St SW of Flemington Rd Ail.Moves	988	1,929	6,098	Grattan St E of Alexandra Pde Ail.Moves	1,258	1,566	9,062	SOMERVILLE RD E BD 10 E OF PARAMOUNT RD Ail.Moves	1,366	1,488	9,062	CHURCH ST E OF ARCADE ST Ail.Moves	433	1,203	6,222	ALBERT ST E OF WHITEHALL ST Ail.Moves	433	1,203	6,222
Tin Alley W of Raccourse St L.Miss	76	100	573	Spencer St SE of Dryburgh St Ail.Moves	1,132	3,650	10,013	SOMERVILLE ST NW BD NW OF FRANKLIN ST Ail.Moves	423	1,181	7,551	ST GEORGES RD NW OF DUDLEY ST Ail.Moves	2,383	2,035	19,299	NICHOLSON ST S OF PIGDON ST Ail.Moves	1,976	1,843	13,792
Dryburgh St S of Spencer St Ail.Moves	202	312	1,632	Brunswick Rd E of Clyntik Ail.Moves	1,549	2,750	14,176	BARCLAY STREET E BD NW ASHLEY STREET & NEEL ST Ail.Moves	407	950	5,098	CHURCH ST N OF HOWARD ST Ail.Moves	2,318	1,899	12,674	SWAN ST W OF PUNT RD Ail.Moves	1,448	2,173	15,173
Queens Pde S of Grattan St Ail.Moves	347	1,952	4,873	BOUNDARY RD N OF SWANSEA RD Ail.Moves	2,471	1,852	14,234	BOUNDARY RD N OF FAIRVIEW RD & INDUSTRIAL DR Ail.Moves	1,948	1,665	13,897	HODKINS ST W OF WHITEHALL ST Ail.Moves	1,760	1,743	16,777	GEELONG RD SW OF SOMERVILLE RD Left Missing	3,400	1,751	9,388
Queens Pde W of Spencer St Ail.Moves	2,790	2,973	18,902	Queensberry St W of Abbotsford Rd Ail.Moves	383	2,490	13,483	GELONG RD NE BD E OF CEMETERY RD Ail.Moves	4135	1,225	6,238	WERN PDE S OF CHARLES ST Ail.Moves	1,285	8,408	31,283	LYON ST N OF GLENNYUN RD Ail.Moves	2,130	1,575	13,122
Queens Pde W of Heidelberg Rd Ail.Moves	1,029	2,885	15,065	Oberbridge St NW of Queens Pde Ail.Moves	416	369	2,152	WILLIAMSTOWN RD N BD BTW STONE ST & LORNE ST Ail.Moves	1,972	2,775	20,249	LYON ST N OF BRUNSWICK RD Ail.Moves	2,158	1,170	10,780	LABRETH ST W OF ELIZABETH ST Ail.Moves	1,981	1,555	10,652
Princes St of Victoria St Ail.Moves	1,460	1,222	11,532	Sydney Rd W of Brunswick Rd L.Miss	1,526	678	7,978	WILLIAMSTOWN RD NBD BTW WESTERN HWY & FITZGERALD RD Ail.Moves	7,968	7,861	52,230	WEST GATE FWW BTWN PRINCES HWY & GREIVE PDE OUTBOUND Ail.Moves	2,230	13,726	72,186	LANGWATNE ST S OF ALBERT Ail.Moves	910	2,000	4,683
Roadhouse St S of Princes St Ail.Moves	717	2,132	11,314	Wellington St S of Alexandra Pde Ail.Moves	456	5,125	25,416	SOMERVILLE RD E BD 10 E OF PARAMOUNT RD Ail.Moves	1,366	1,488	9,062	CONRTE AVE W OF CENTRAL PARK AV Ail.Moves	2,421	1,566	12,999	VICTORIA PDE S OF GEORGES RD Ail.Moves	558	617	3,753
Dymon Rd E of Clyntik Off Ramp Ail.Moves	1,238	3,755	17,738	Lyon St N of Princes St Ail.Moves	2,359	1,129	11,921	DOMAIN RD W BD W OF PUNT RD Ail.Moves	676	403	3,889	BRUNSWICK RD W OF LYON ST Ail.Moves	2,626	2,139	12,669	BRUNSWICK ST S OF JOHNSON ST Ail.Moves	361	879	8,184
South Bank Interchange	7,523	6,349	33,047	Flemington Rd Interchange	7,842	5,631	30,754	BARCLAY STREET E BD NW ASHLEY STREET & NEEL ST Ail.Moves	770	611	4,390	YORK ST SW OF CLARENDON ST Ail.Moves	1,255	380	2,418	ELIZABETH ST N OF LABRETH ST Ail.Moves	1,065	967	4,653
Victoria St E of Elizabeth St Ail.Moves	1,894	2,891	18,187	Queens Pde E of Hoddle St L.Miss	1,407	331	5,547	WILLIAMSTOWN RD S BD BTW BURNS ST & CHATHILL ST Ail.Moves	1,320	1,780	9,784	BURLEY ST E OF SHOPPING CENTRE ACCESS Ail.Moves	1,133	1,106	7,532	LONGSAIL ST W OF NICHOLSON ST Ail.Moves	1,158	1,400	12,625
Hoddle St S of Eastern Fwy Ail.Moves	6,274	4,511	40,875	Hoddle St S of Princes St Ail.Moves	486	1,275	8,791	FRANCIS ST W BD W OF RICHARDS ST Ail.Moves	532	670	3,540	HIGH ST N OF CLARE ST Ail.Moves	2,013	1,116	10,690	BALLARAT RD NW OF SUMMERHILL RD Ail.Moves	2,862	1,975	14,057
Ormond Rd W of Pattison St Ail.Moves	1,897	1,610	10,946	Pattison St N of Ormond Rd Ail.Moves	334	146	1,114	WESTERN HWY EB BTW PERTH AV & HULET ST Ail.Moves	4,033	2,406	21,661	HIGH ST W OF KING ST Ail.Moves	1,118	862	6,573	ST GEORGES RD SW OF CHARLES ST Ail.Moves	1,076	2,522	13,550
South Bank Interchange	2,448	1,399	9,527	Flemington Rd SE of Abbotsford Rd Ail.Moves	4,924	2,359	21,214	HODDLE ST S BD S OF VICTORIA ST Ail.Moves	5,159	4,349	37,682	MOORE ST S OF DONALD ST Left Missing	841	2,057	11,353	TOORAK RD SW OF PARK ST Ail.Moves	2,126	1,416	12,263
Boundary Rd E of Macaulay Rd Ail.Moves	1,151	136	5,390	Raccourse Rd W of Flemington Rd Ail.Moves	2,096	16,857	10,013	CHURCHILL AV SWING OF HOLLAND CT Ail.Moves	860	1,048	4,429	BALLARAT RD E OF SUMMERHILL RD Ail.Moves	1,294	3,004	17,197	SCOTCHMER ST E OF ST GEORGES RD Ail.Moves	558	617	3,753
Princes St NW of Royal Pde Ail.Moves	1,282	1,285	7,046	Cheynay Rd W of Victoria St Ail.Moves	240	171	1,191	MOREHEAD ST N BD BTW VINCH ST & NEWELL ST Ail.Moves	889	2,146	11,933	FRANCIS ST W OF WILLIAMSTOWN RD Ail.Moves	1,350	888	6,695	COPPIN ST S OF BRIDGE RD Ail.Moves	364	474	3,738
Flemington Rd SE of Grattan St Ail.Moves	880	1,888	12,997	South Bank Interchange	1,101	1,953	10,333	FULFORD RD W BD BTWN STOCKTON DR & WOOLSHED AV Ail.Moves	381	924	4,845	ST GEORGES RD SW OF HOLDSIN ST Ail.Moves	669	1,668	9,434	HAWKST STE OF KING ST Ail.Moves	694	1,295	6,435
ROYAL PDE S OF PAINT ST Ail.Moves	3,320	2,614	23,350	Cemetery Rd East of Swanton St Ail.Moves	1,407	331	5,547	PEEL ST S BD W OF DUDLEY ST Ail.Moves	2,198	2,011	17,548	ST GEORGES RD SW OF SCOTCHMER ST Ail.Moves	633	1,508	8,598	ALBERT ST W OF GEORSDNE ST Ail.Moves	1,470	2,652	14,281
Flemington Rd SE of Raccourse Rd Ail.Moves	1,867	5,641	27,316	Cemetery Rd East of Collage Cres Ail.Moves	438	3,619	31,571	FULFORD RD W BD BTW STONE ST & LORNE ST Ail.Moves	2,063	2,349	20,731	KOSAMOND RD N OF GALLABERT RD Ail.Moves	932	1,071	7,263	ALBERT ST E OF SIMPSON ST Ail.Moves	1,392	1,590	7,696
Grattan St W of Swanton St Ail.Moves	1,289	1,908	11,948	RACCOURSE RD E OF BOUNDARY RD Ail.Moves	2,042	2,369	17,915	DOMAIN RD E BD W OF PUNT RD Ail.Moves	412	495	3,330	BRUNSWICK RD W OF LORNSDALE ST Ail.Moves	1,098	2,394	12,034	FRANCIS ST W OF HYDE ST Ail.Moves	1,364	923	8,995
Flemington Rd NW of Elizabeth St Ail.Moves	2,534	1,432	14,308	Grattan St W of Royal Pde Ail.Moves	1,539	1,517	10,537	MOUNT DERRIMUT RD N BD BTW TILBURN RD & FOLEYS RD Ail.Moves	1,832	1,877	13,738	LANGS RD SW OF LORNSDALE ST Ail.Moves	1,125	2,073	5,801	PAIK ST N OF TOORAK RD Ail.Moves	2,63	278	2,150
Elliot Ave E of Bruns St Ail.Moves	1,289	1,432	14,308	Grattan St W of Royal Pde Ail.Moves	1,539	1,517	10,537	FRATON ST E BD BTW WINDLEY AV & CLAREM ST Ail.Moves	1,361	991	5,318	WINDLEY ST S OF ARCADE ST Ail.Moves	419	5,556	29,818	WINDLEY ST S OF ARCADE ST Ail.Moves	419	5,556	29,818
Princes St E of Rathdowne St Ail.Moves	4,559	3,574	30,978	Flemington St SE of Gatehouse St L.Miss	1,071	1,314	6,472	CHURCH ST N BD W OF DUDLEY ST Ail.Moves	1,824	1,272	5,943	VICTORIA PDE E OF CLARENDON ST Ail.Moves	3,820	2,998	24,537	NICHOLSON ST N OF BRUNSWICK RD Ail.Moves	1,859	1,270	10,396
Abbotsford St N of Queensberry St Ail.Moves	1,077	991	4,712	Dryburgh St N of Spencer St L.Miss	201	420	2,383	CHURCHILL AV NEBD N OF HOLLAND CT Ail.Moves	734	1,076	5,797	GLENLYON RD W OF LYON ST Ail.Moves	843	991	6,470	HIGH ST S OF WESTGARTH ST Left Missing	602	1,517	10,073
Franklin Interchange	4,651	2,891	18,861	Cemetery Rd E of Royal Pde Ail.Moves	2,471	1,852	14,234	FRANCIS ST W BD W OF RICHARDS ST Ail.Moves	532	670	3,540	FRANCIS ST W BD W OF RICHARDS ST Ail.Moves	532	670	3,540	FRANCIS ST W BD W OF RICHARDS ST Ail.Moves	532	670	3,540
Nicholson St W of Alexandra Pde L.Miss	1,258	904	8,286	Macarthur Rd W of Royal Pde Ail.Moves	1,930	1,383	14,807	PRINCES HWY SWBD BTW CONFIER AV & CYPRESS AV Ail.Moves	2,476	4,091	22,689	BUNSHINE RD E OF ROBERTS ST Ail.Moves	1,904	2,291	11,808	LABRETH ST W OF RUSSELL ST Ail.Moves	1,055	1,681	11,325
Arden St W of Dryburgh St L.Miss	1,495	797	6,568	Abbotsford St S of Victoria St Ail.Moves	1,188	775	5,562	FRANCIS ST E BD BTW HAWTHURST & VERNER ST Ail.Moves	1,305	1,415	9,091	ST GEORGES ST OF HIGHT ST Ail.Moves	1,305	1,415	9,091	BARCLAY ST E OF GORDON ST Ail.Moves	1,075	1,495	8,880
Collage Cres NW of Cemetery Rd East Ail.Moves	760	1,225	6,455	Alexandra Pde W of George St Ail.Moves	4,298	4336	34,757	WESTERN RIDG NBD BTW WESTERN HWY & FITZGERALD RD Ail.Moves	7,942	7,888	55,800	NICHOLSON ST N OF VICTORIA PDE Ail.Moves	1,377	1,082	9,903	SOMERVILLE RD W OF WILLIAMSTOWN RD Ail.Moves	1,340	793	6,414
Macaulay Rd W of Flemington Rd Ail.Moves	2,267	1,673	16,844	Macaulay Rd W of Flemington Rd Ail.Moves	2,267	1,673	16,844	SOMERVILLE RD E BD 10 E OF PARAMOUNT RD Ail.Moves	1,366	1,488	9,062	CONRTE AVE W OF CENTRAL PARK AV Ail.Moves	2,421	1,566	12,999	VICTORIA PDE S OF GEORGES RD Ail.Moves	558	617	3,753
Macaulay Rd NE of Flemington Rd Ail.Moves	969	777	4,681	Alexandra Pde W of Wellington St Ail.Moves	4,298	4336	34,757	PRINCES HWY SWBD BTW CONFIER AV & CYPRESS AV Ail.Moves	2,476	4,091	22,689	LABRETH ST W OF RUSSELL ST Ail.Moves	1,055	1,681	11,325	LABRETH ST W OF RUSSELL ST Ail.Moves	1,055	1,681	11,325
East Pde of Royal Pde Ail.Moves	1,216	1,134	6,642	Swanton St N of Eglon St Ail.Moves	1,288	514	5,840	BOUNDARY RD W BD E OF MOUNT DERRIMUT RD Ail.Moves	1,231	1,072	11,420	ASHLEY ST W OF BARCLAY ST Ail.Moves	2,258	1,887	13,882	LYON ST N OF VICTORIA ST Ail.Moves	1,610	914	8,527
Elizabeth St N of Victoria St Ail.Moves	1,216	1,134	6,642	Swanton St N of Eglon St Ail.Moves	1,288	514	5,840	WESTERN RIDG NBD BTW WESTERN HWY & FITZGERALD RD Ail.Moves	7,942	7,888	55,800	NICHOLSON ST N OF VICTORIA PDE Ail.Moves	1,377	1,082	9,903	SOMERVILLE RD W OF WILLIAMSTOWN RD Ail.Moves	1,340	793	6,414
Parson Fwy Offramp of Hoddle St Ail.Moves	4,261	2,869	25,966	Hoddle St S of Eastern Fwy Ail.Moves	3,014	863	4,342	ALOXANDRA RD E BD E OF SWAN ST Ail.Moves	1,214	2,772	14,841	ASHLEY ST W OF BARCLAY ST Ail.Moves	2,258	1,887	13,882	LYON ST N OF VICTORIA ST Ail.Moves	1,610	914	8,527
Queensberry St SE of Abbotsford St Ail.Moves	330	783	3,819	Wellington St E of Peel St Ail.Moves	1,326	1,938	12,242	QUEENSBURGE RD S OF SOUTHBANK RD Ail.Moves	2,604	1,674	14,192	BALLARAT RD E OF ASHLEY ST Ail.Moves	1,494	3,892	22,727	KING RD W OF HOWE ST Ail.Moves	2,845	1,276	11,874
Elizabeth St SE of Victoria St Ail.Moves	464	1,098	7,100	Flemington St NW of Gatehouse St L.Miss	4,495	2,279	10,340	GLENLYON RD E OF NICHOSON ST Ail.Moves	2,167	2,077	14,193	SPRING ST NW OF HOLMES ST Ail.Moves	1,270	815	7,201	BRIDGE RD W OF COPPIN ST Ail.Moves	1,093	1,595	11,066
Macaulay Rd SE of Boundary Rd Ail.Moves	1,273	1,473	8,175	Abbotsford St S of Victoria St Ail.Moves	1,188	775	5,562	VICTORIA PDE W OF NICHOLSON ST Left Missing	1,365	2,468	13,127	HIGH ST S OF CLAREM ST Ail.Moves	416	1,205	6,147	ALBERT ST E OF CHARLES ST Ail.Moves	1,392	1,590	7,696
Clyntik Offramp N of Brunswick Rd Ail.Moves	1,169	1,437	7,817	Stubs St S of Raccourse Rd Ail.Moves	255	742	3,266	ANDERSON ST E OF WATSON ST Ail.Moves	1,269	1,131	9,219	BALLARAT RD E OF ASHLEY ST Ail.Moves	1,494	3,892	22,727	KING RD W OF HOWE ST Ail.Moves	2,845	1,276	11,874
Royal Pde NW of Macarthur Rd Ail.Moves	933	1,886	12,372	Alexandra Pde W of Hoddle St Ail.Moves	273	177	1,050	GERTRUDE ST E OF BRUNSWICK ST Ail.Moves	1,183	681	6,142	HODKINS ST E OF ST GEORGES RD Ail.Moves	304	407	2,566	BARCLAY ST W OF GORDON ST Ail.Moves	1,693	1,510	10,273
Elliot Ave E of Bruns St Ail.Moves	1,273	1,473	8,175	Queens Pde W of Heidelberg Rd Ail.Moves	1,029	2,885	15,065	VICTORIA PDE W OF CLARENDON ST Ail.Moves	2,389	2,622	26,016	WIRGHT ST W OF HAMPSHIRE RD Ail.Moves	2,389	1,415	11,957	ALBERT ST E OF LANGSDOWNE ST Ail.Moves	2,140	1,108	7,798
Macaulay Rd W of Boundary Rd Ail.Moves	1,166	988	7,649	Elizabeth St SE of Flemington Rd Ail.Moves	969	1,906	12,924	SYDNEY RD E OF WATSON ST Ail.Moves	1,269	1,131	9,219	BALLARAT RD E OF ASHLEY ST Ail.Moves	1,494	3,892	22,727	KING RD W OF HOWE ST Ail.Moves	2,845	1,276	11,874
Flemington Rd Interchange	1,867	1,423	20,767	Dymon Rd W of Clyntik Off Ramp Ail.Moves	2,670	1,438	13,435	BRUNSWICK RD E OF WESTON ST Ail.Moves	1,505	1,193	10,334	ALEXANDRA AV NW of SWAN ST Ail.Moves	1,273	3,929	25,678	ST GEORGES RD NE OF SCOTCHMER ST Ail.Moves	1,968	1,181	11,033
Royal Pde N of Macarthur Rd L.Miss	2,734	1,273	13,628	Flemington St W of Curzon St Ail.Moves	1,766	689	6,668	CHABLES ST S OF ST GEORGES RD Ail.Moves	304	215	1,548	SPRING ST S OF ROBERT ST Ail.Moves	884	1,083	8,542	PUNT RD N OF TOORAK RD Ail.Moves	2,475	1,617	13,904
Queens Pde W of Heidelberg Rd Ail.Moves	1,029	2,885	15,065	Flemington Rd NW of Abbotsford Rd Ail.Moves	6,037	3,017	30,012	VICTORIA PDE W OF CLARENDON ST Ail.Moves	2,389	2,622	26,016	WIRGHT ST W OF HAMPSHIRE RD Ail.Moves	2,389	1,415	11,957	ALBERT ST E OF LANGSDOWNE ST Ail.Moves	2,140	1,108	7,798
Nicholson St S of Alexandra Pde Ail.Moves	939	1,292	12,975	Dryburgh St S of Arden St Ail.Moves	798	1,513	9,013	CLARENDON ST E OF YORK ST Ail.Moves	1,080										

Appendix C - Validation of Public Transport

Daily Train Boardings by Line Segment							
Group	Line Corridor	Line Segment	Observed	Modelled	Difference	% Difference	
Burnley	Camberwell Corridor	Auburn & Hawthorn	4,197	3,472	-	724	-17%
		Box Hill	11,433	8,809	-	2,624	-23%
		Camberwell	7,546	2,890	-	4,657	-62%
		East Camberwell-Mont Albert	6,663	6,065	-	598	-9%
		Glenferrie	9,822	4,532	-	5,290	-54%
		Heathmont-Belgrave	11,413	15,084		3,671	32%
		Laburnum-Ringwood	21,016	24,139		3,123	15%
		Ringwood East-Lilydale	10,121	14,788		4,667	46%
		Riversdale-Alamein	4,779	3,608	-	1,171	-25%
	East Richmond-Glen Waverley	East Richmond-Glen Waverley	31,140	25,550	-	5,589	-18%
Caulfield	Dandenong Corridor	Beaconsfield-Pakenham	3,260	5,323		2,063	63%
		Carnegie-Oakleigh	13,062	13,486		424	3%
		Dandenong	8,001	7,651	-	350	-4%
		Hallam-Berwick	8,710	10,227		1,517	17%
		Huntingdale-Westall	12,614	11,825	-	788	-6%
		Merinda Park-Cranbourne	3,745	6,373		2,627	70%
		Springvale-Yarraman	16,194	13,751	-	2,443	-15%
	Glenhuntly-Franston	Aspendale-Carrum	7,867	8,519		652	8%
		Glenhuntly-Moorabbin	15,002	14,504	-	498	-3%
		Highett-Mordialloc	13,405	16,269		2,863	21%
		Seaford-Frankston	13,904	11,922	-	1,982	-14%
	Prahran-Sandringham	Brighton Beach-Sandringham	4,863	6,840		1,977	41%
		Prahran-Middle Brighton	22,730	20,492	-	2,238	-10%
	Hawksburn-Malvern	Hawksburn-Malvern	10,148	11,634		1,486	15%
Caulfield	Caulfield	13,408	4,314	-	9,095	-68%	
Clifton Hill	Jolimont-Clifton Hill	Jolimont-Clifton Hill	11,079	13,655		2,575	23%
	Rushall-Epping	Rushall-Epping	25,787	26,653		866	3%
	Westgarth-Hurstbrige	Diamond Creek-Hurstbridge	2,080	2,169		89	4%
		Montmorency-Eltham	4,366	4,107	-	259	-6%
		Westgarth-Greensborough	23,415	23,117	-	298	-1%
City Loop	City Loop	City Loop	254,575	240,754	-	13,822	-5%
Inner City Interchange	North Melbourne	North Melbourne	3,513	4,259		747	21%
	Richmond	Richmond	7,004	5,673	-	1,332	-19%
	South Yarra	South Yarra	9,574	6,852	-	2,722	-28%
Northern	Footscray	Footscray	13,250	6,815	-	6,435	-49%
	Kensington-Craigieburn	Coolaroo-Craigieburn	4,562	9,388		4,825	106%
		Glenbervie-Broadmeadows	13,559	16,222		2,664	20%
		Kensington-Essendon	15,451	11,577	-	3,874	-25%
	Macaulay-Upfield	Macaulay-Upfield	14,417	14,991		573	4%
	Middle Footscray-Sydenham	Albion-St Albans	12,298	12,680		382	3%
		Keilor Plains-Sydenham	8,016	11,941		3,925	49%
		Middle Footscray-Sunshine	10,579	10,613		34	0%
	Newport Corridor	Laverton-Werribee	15,112	19,242		4,130	27%
		North Williamstown-Williamstown	2,637	3,788		1,151	44%
		South Kensington-Newport	10,367	10,207	-	160	-2%
		Seaholme-Westona	2,892	2,566	-	326	-11%

Table C.5 - Daily Train Boardings by Line Segment

AM Train Boardings by Line Segment							
Group	Line Corridor	Line Segment	Observed	Modelled	Difference	% Difference	
Burnley	Camberwell Corridor	Auburn & Hawthorn	1,539	974	-	566	-37%
		Box Hill	2,804	2,085	-	718	-26%
		Camberwell	1,962	648	-	1,314	-67%
		East Camberwell-Mont Albert	3,269	2,817	-	453	-14%
		Glenferrie	1,471	674	-	797	-54%
		Heathmont-Belgrave	5,022	6,457		1,435	29%
		Laburnum-Ringwood	8,730	7,836	-	894	-10%
		Ringwood East-Lilydale	4,421	6,706		2,285	52%
	Riversdale-Alamein	2,409	1,969	-	440	-18%	
	East Richmond-Glen Waverley	East Richmond-Glen Waverley	12,040	8,488	-	3,552	-30%
Caulfield	Dandenong Corridor	Beaconsfield-Pakenham	1,042	2,275		1,233	118%
		Carnegie-Oakleigh	5,103	4,681	-	421	-8%
		Dandenong	1,951	2,092		141	7%
		Hallam-Berwick	3,694	5,290		1,596	43%
		Huntingdale-Westall	3,731	3,135	-	596	-16%
		Merinda Park-Cranbourne	1,547	2,788		1,241	80%
		Springvale-Yarraman	4,935	4,363	-	572	-12%
	Glenhuntly-Franston	Aspendale-Carrum	3,558	3,923		364	10%
		Glenhuntly-Moorabbin	5,486	4,399	-	1,086	-20%
		Highett-Mordialloc	5,586	5,264	-	321	-6%
		Seaford-Frankston	5,145	4,117	-	1,028	-20%
	Prahran-Sandringham	Brighton Beach-Sandringham	2,303	2,963		661	29%
		Prahran-Middle Brighton	7,466	6,035	-	1,431	-19%
	Hawksburn-Malvern	Hawksburn-Malvern	3,642	1,869	-	1,773	-49%
	Caulfield	Caulfield	2,452	924	-	1,527	-62%
Clifton Hill	Jolimont-Clifton Hill	Jolimont-Clifton Hill	2,402	2,022	-	380	-16%
	Russhall-Epping	Russhall-Epping	9,793	10,005		213	2%
	Westgarth-Hurstbridge	Diamond Creek-Hurstbridge	1,132	1,376		244	22%
		Montmorency-Eltham	1,983	1,663	-	321	-16%
		Westgarth-Greensborough	10,256	8,762	-	1,495	-15%
City Loop	City Loop	City Loop	7,618	9,768		2,151	28%
Inner City Interchange	North Melbourne	North Melbourne	460	526		66	14%
	Richmond	Richmond	1,182	606	-	576	-49%
	South Yarra	South Yarra	2,135	1,094	-	1,041	-49%
Northern	Footscray	Footscray	2,568	2,240	-	328	-13%
	Kensington-Craigieburn	Coolaroo-Craigieburn	1,975	3,779		1,804	91%
		Glenbervie-Broadmeadows	5,480	5,376	-	105	-2%
		Kensington-Essendon	6,138	4,138	-	2,000	-33%
	Macaulay-Upfield	Macaulay-Upfield	4,576	4,456	-	120	-3%
	Middle Footscray-Sydenham	Albion-St Albans	4,041	5,219		1,178	29%
		Keilor Plains-Sydenham	3,991	4,867		876	22%
		Middle Footscray-Sunshine	3,676	3,685		9	0%
	Newport Corridor	Laverton-Werribee	6,545	8,398		1,852	28%
		North Williamstown-Williamstown	1,131	1,357		226	20%
		South Kensington-Newport	4,230	3,446	-	784	-19%
		Seaholme-Westona	999	1,460		461	46%

Table C.6 - AM Peak Train Boardings by Line Segment

PM Train Boardings by Line Segment							
Group	Line Corridor	Line Segment	Observed	Modelled	Difference	% Difference	
Burnley	Camberwell Corridor	Auburn & Hawthorn	744	464	-	280	-38%
		Box Hill	2,369	1,732	-	636	-27%
		Camberwell	1,692	502	-	1,190	-70%
		East Camberwell-Mont Albert	555	478	-	76	-14%
		Glenferrie	2,597	909	-	1,688	-65%
		Heathmont-Belgrave	959	1,165		206	22%
		Laburnum-Ringwood	2,412	2,703		291	12%
		Ringwood East-Lilydale	1,029	995	-	33	-3%
		Riversdale-Alamein	381	411		30	8%
	East Richmond-Glen Waverley	East Richmond-Glen Waverley	4,122	3,197	-	925	-22%
Caulfield	Dandenong Corridor	Beaconsfield-Pakenham	340	353		13	4%
		Carnegie-Oakleigh	1,367	1,659		292	21%
		Dandenong	1,536	1,128	-	408	-27%
		Hallam-Berwick	823	941		118	14%
		Huntingdale-Westall	2,046	1,970	-	75	-4%
		Merinda Park-Cranbourne	217	273		57	26%
		Springvale-Yarraman	1,663	1,168	-	495	-30%
	Glenhuntly-Franston	Aspendale-Carrum	652	590	-	62	-10%
		Glenhuntly-Moorabbin	1,680	1,620	-	61	-4%
		Highett-Mordialloc	1,355	1,644		288	21%
		Seaford-Frankston	1,851	1,300	-	550	-30%
	Prahran-Sandringham	Brighton Beach-Sandringham	438	427	-	11	-3%
		Prahran-Middle Brighton	3,514	3,624		111	3%
	Hawksburn-Malvern	Hawksburn-Malvern	1,356	1,614		258	19%
Caulfield	Caulfield	3,295	849	-	2,447	-74%	
Clifton Hill	Jolimont-Clifton Hill	Jolimont-Clifton Hill	2,717	3,674		958	35%
	Rushall-Epping	Rushall-Epping	2,581	2,824		243	9%
	Westgarth-Hurstbridge	Diamond Creek-Hurstbridge	87	63	-	24	-27%
		Montmorency-Eltham	432	276	-	156	-36%
		Westgarth-Greensborough	2,401	2,215	-	187	-8%
City Loop	City Loop	City Loop	109,784	113,256		3,472	3%
Inner City Interchange	North Melbourne	North Melbourne	1,059	1,352		293	28%
	Richmond	Richmond	1,977	1,790	-	187	-9%
	South Yarra	South Yarra	2,517	1,745	-	772	-31%
Northern	Footscray	Footscray	2,479	801	-	1,677	-68%
	Kensington-Craigieburn	Coolaroo-Craigieburn	371	500		129	35%
		Glenbervie-Broadmeadows	1,355	1,237	-	117	-9%
		Kensington-Essendon	1,715	1,261	-	454	-26%
	Macaulay-Upfield	Macaulay-Upfield	2,281	1,885	-	396	-17%
	Middle Footscray-Sydenham	Albion-St Albans	1,072	874	-	198	-18%
		Keilor Plains-Sydenham	587	557	-	30	-5%
		Middle Footscray-Sunshine	1,154	978	-	176	-15%
	Newport Corridor	Laverton-Werribee	1,111	1,135		24	2%
		North Williamstown-Williamstown	294	349		55	19%
		South Kensington-Newport	1,061	898	-	164	-15%
		Seaholme-Westona	221	215	-	6	-3%

Table C.7 - PM Peak Train Boardings by Line Segment

Tram Route	AM Observed	AM Modelled	PM Observed	PM Modelled	Daily Observed	Daily Modelled
1	3,659	4,273	6,233	5,101	25,545	25,022
3	3,727	2,650	2,888	2,521	17,812	14,562
5	2,907	2,528	3,828	2,364	16,919	12,667
6	3,612	3,075	5,273	3,092	21,163	15,759
8	7,112	4,871	5,438	4,772	31,685	25,298
11		1,481	476	2,340	2,817	4,494
16	4,193	5,904	6,839	4,245	32,520	27,647
19	6,808	4,719	6,279	4,977	38,426	25,718
24	550	822	483	1,250	1,413	2,285
30	694	933	546	2,063	4,145	5,006
48	5,358	4,294	5,027	3,815	25,753	21,302
55	4,657	6,023	4,123	8,002	18,689	31,387
57	3,101	3,197	3,543	3,804	18,973	19,094
59	4,997	5,442	4,587	4,569	27,585	27,489
64	3,497	3,453	4,016	2,950	16,770	17,533
67	3,096	3,546	3,414	3,255	18,838	18,333
70	2,984	3,380	2,710	3,823	15,307	20,886
72	3,145	3,803	5,205	3,912	21,854	21,642
75	4,322	5,372	5,113	5,645	26,933	29,679
78	1,209	1,827	1,763	1,882	9,242	9,589
82			1,575	1,318	5,772	9,080
86	9,318	8,274	6,997	8,260	52,251	45,890
96	4,920	5,794	11,338	6,673	55,497	30,890
109	10,003	8,522	9,541	8,885	45,894	42,929
112	6,541	6,289	5,789	6,495	34,020	37,317
TOTAL	100,409	102,482	113,023	106,011	585,823	541,500

Table C.8 - Tram Route Boardings by Time of Day

Cordon Location	Tram Routes	Count Type	Direction	Observed	Modelled
Bourke St / Spring St	86, 96	Arrival	West Bound	2,890	4,305
Clarendon St (Crown Casino)	96, 109, 112	Arrival	North Bound	3,686	3,889
Elgin St / Lygon St	1, 8	Arrival	South Bound	2,005	1,957
Errol St / Victoria St	57	Arrival	South Bound	703	1,746
Flinders St / Russell St	35, 70	Arrival	West Bound	406	821
Haymarket (Elizabeth St)	19, 59	Arrival	South Bound	3,047	1,630
Peel St / Victoria St	55	Arrival	South Bound	1,687	1,945
Queensbridge St (Casino East)	55	Arrival	North Bound	891	814
St Vincents Plaza	24, 30, 109, 112	Arrival	West Bound	3,500	5,120
Swanston St / Flinders St (Federation Sq)	1,3,5,6,8,16,64,67,7 2	Arrival	North Bound	4,296	6,235
Wellington Pde / Jolimont Rd	48, 75	Arrival	West Bound	2,190	3,774
Other Locations					
Swanston St / Flinders St (Federation Sq)	1,3,5,6,8,16,64,67,7 2	Departure	South Bound	6,706	4,648
Domain Interchange (St Kilda Rd)	1,3,5,6,8,16,64,67,7 2	Departure	North Bound	3,881	5,723
Domain Interchange (St Kilda Rd)	1,3,5,6,8,16,64,67,7 2	Arrival	South Bound	5,010	3,683
Swanston St / Latrobe St	1,3,5,6,8,16,64,67,7 2	Departure	North Bound	2,773	3,437
Swanston St / Latrobe St	1,3,5,6,8,16,64,67,7 2	Arrival	South Bound	2,419	2,587
St Kilda Rd / Carlisle St	3, 67	Arrival	North Bound	811	1,162

Table C.9 – AM Peak Tram Loads at the CBD Cordon and Other Key Locations

SLA	Observed	Modelled	Difference	%Difference
Banyule (C) - North	2,170	2,165	-5	0%
Bayside (C) - Brighton	599	2,050	1,451	242%
Boroondara (C) - Camberwell N.	6,240	10,330	4,090	66%
Boroondara (C) - Camberwell S.	6,027	8,980	2,953	49%
Boroondara (C) - Hawthorn	12,378	12,358	-20	0%
Boroondara (C) - Kew	11,463	12,831	1,368	12%
Darebin (C) - Northcote	8,114	8,147	33	0%
Darebin (C) - Preston	11,982	17,348	5,366	45%
Glen Eira (C) - Caulfield	10,179	19,116	8,937	88%
Maribyrnong (C)	5,781	9,572	3,791	66%
Melbourne (C) - Inner	206,690	128,048	-78,642	-38%
Melbourne (C) - Remainder	122,087	112,353	-9,734	-8%
Melbourne (C) - S'bank-D'lands	30,867	21,780	-9,087	-29%
Moonee Valley (C) - Essendon	12,457	19,415	6,958	56%
Moonee Valley (C) - West	2,023	3,173	1,150	57%
Moreland (C) - Brunswick	18,945	14,110	-4,835	-26%
Moreland (C) - Coburg	9,354	9,982	628	7%
Port Phillip (C) - St Kilda	23,654	23,598	-56	0%
Port Phillip (C) - West	25,778	18,189	-7,589	-29%
Stonnington (C) - Malvern	10,636	17,124	6,488	61%
Stonnington (C) - Prahran	18,750	23,969	5,219	28%
Whitehorse (C) - Box Hill	8,541	10,551	2,010	24%
Whitehorse (C) - Nunawading E.	907	1,432	525	58%
Whitehorse (C) - Nunawading W.	1,951	2,771	820	42%
Whittlesea (C) - South-East	2,330	1,958	-372	-16%
Yarra (C) - North	27,369	32,312	4,943	18%
Yarra (C) - Richmond	18,166	11,783	-6,383	-35%
Grand Total	615,438	566,365	-49,073	-8%

Table C.10 – Daily Tram Boardings by SLA

Appendix D - Validation of Traffic Flows

Screenline	AM Observed	AM Model	PM Observed	PM Model	Daily Observed	Daily Model
899	10,693	13,350	12,420	15,076	72,189	89,010
Inbound	6,980	10,229	4,333	4,380	35,752	44,538
Outbound	3,713	3,121	8,087	10,696	36,437	44,472
900	49,481	54,802	56,813	57,598	342,295	366,517
Inbound	32,865	36,276	19,255	20,814	171,134	182,682
Outbound	16,616	18,526	37,558	36,784	171,161	183,834
901	275,538	299,809	304,792	308,339	1,990,785	1,888,565
Inbound	157,487	168,495	131,456	124,311	978,607	912,454
Outbound	118,051	131,314	173,336	184,029	1,012,178	976,111
902	216,722	215,113	222,734	219,586	1,519,408	1,426,387
Inbound	136,356	135,373	98,440	93,938	785,858	748,027
Outbound	80,366	79,740	124,294	125,649	733,550	678,360
903	129,748	130,553	136,661	136,949	840,618	855,663
Inbound	72,188	73,454	64,768	61,576	419,935	427,517
Outbound	57,560	57,098	71,893	75,373	420,683	428,146
904	48,336	53,262	54,105	55,470	311,619	334,873
Inbound	31,170	33,881	20,011	21,349	154,180	168,070
Outbound	17,166	19,381	34,094	34,120	157,439	166,804
905	15,924	17,416	18,932	19,223	108,025	110,075
Inbound	9,289	11,590	8,152	6,824	53,382	54,996
Outbound	6,635	5,826	10,780	12,399	54,643	55,079
906	131,956	134,012	144,582	142,761	927,392	939,637
Inbound	74,985	75,721	64,271	63,969	460,241	471,173
Outbound	56,971	58,291	80,311	78,792	467,151	468,464
907	42,649	38,535	47,957	41,240	306,668	258,464
Inbound	24,237	26,923	22,107	14,586	154,125	130,705
Outbound	18,412	11,612	25,850	26,653	152,543	127,758
908	98,641	104,992	107,512	112,701	690,296	729,034
Inbound	59,635	66,726	44,891	43,101	346,887	366,572
Outbound	39,006	38,266	62,621	69,599	343,409	362,462
909	231,892	227,966	236,164	241,502	1,606,655	1,565,381
Inbound	125,269	123,380	109,469	108,401	796,203	766,755
Outbound	106,623	104,586	126,695	133,101	810,452	798,626
910	116,016	112,768	121,457	117,810	761,954	732,651
Inbound	70,408	67,284	52,183	48,901	380,764	366,650
Outbound	45,608	45,484	69,274	68,909	381,190	366,002
911	156,215	155,666	166,654	164,739	1,004,521	1,023,564
Inbound	100,711	97,078	65,382	64,744	504,357	511,256
Outbound	55,504	58,588	101,272	99,995	500,164	512,308
912	59,416	64,909	64,347	68,154	427,193	423,974
Inbound	32,234	34,815	29,659	31,708	212,480	214,670
Outbound	27,182	30,094	34,688	36,446	214,713	209,304
913	54,336	55,185	63,802	60,870	407,585	373,770
Inbound	32,173	35,276	26,137	21,487	196,921	183,470
Outbound	22,163	19,909	37,665	39,383	210,664	190,300
914	75,496	79,878	84,540	88,736	531,960	554,282
Inbound	50,398	56,000	29,742	29,814	264,935	277,352
Outbound	25,098	23,878	54,798	58,922	267,025	276,930
915	18,275	19,366	22,131	20,943	126,792	139,719
Inbound	11,202	13,030	8,863	7,516	63,065	69,390
Outbound	7,073	6,336	13,268	13,427	63,727	70,329
916	89,234	92,018	104,975	98,939	611,204	612,913
Inbound	57,559	58,973	40,803	37,706	304,745	306,006
Outbound	31,675	33,045	64,172	61,232	306,459	306,907
917	4,134	5,284	5,034	5,770	28,107	35,931
Inbound	2,773	3,846	1,892	1,813	13,906	17,775
Outbound	1,361	1,438	3,142	3,957	14,201	18,156
918	59,606	61,340	59,001	61,067	411,126	394,986
Inbound	37,023	36,521	25,030	24,205	205,132	195,002
Outbound	22,583	24,819	33,971	36,862	205,994	199,984
919	27,860	30,265	30,483	32,428	185,727	207,608
Inbound	19,055	19,809	11,256	12,302	93,898	103,797
Outbound	8,805	10,456	19,227	20,125	91,829	103,811
920	47,213	44,413	47,066	47,627	318,021	300,571
Inbound	29,741	27,329	20,424	19,180	158,889	149,760
Outbound	17,472	17,084	26,642	28,447	159,132	150,811
Grand Total	1,959,381	2,010,903	2,112,162	2,117,527	13,530,140	13,363,576

Table B.11 – AM, PM and Daily Model Wide Directional Screenline Flows

Appendix E - Statistics used in Model Validation

- GEH statistic is defined as:

$$GEH_a = \sqrt{\frac{(V_a^n - V_a^{n-1})^2}{\frac{1}{2}(V_a^n + V_a^{n-1})}}$$

V_a^n = travel time of OD pair or flow of link a in an iteration n. It can be observed hourly flow and modelled hourly flow if the GEH is used for validation of traffic flow.

- The percent root mean square error (%RMSE) for travel time or link flow:

$$\%RMSE = 100N \frac{\sqrt{\sum_{a=1}^N (V_a^n - V_a^{n-1})^2 / (N-1)}}{\sum_{a=1}^N V_a^{n-1}}$$

where N = total number of OD pairs or links

V_a^n = travel time of OD pair or flow of link a in an iteration n. Similarly, it can be observed hourly flow and modelled hourly flow if the GEH is used for validation of traffic flow.

- OTZenith provides RGAP as its main indicator for convergence:

$$RGAP = \frac{\sum_{a=1}^N (V_a^{n-1} C_a^{n-1}) - \sum_{a=1}^N (F_a^n C_a^{n-1})}{\sum_{a=1}^N (V_a^{n-1} C_a^{n-1})}$$

where C_a^{n-1} = cost of link a in iteration n

F_a^n = all or nothing flow in iteration n based on C_a^{n-1}