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Enfield Local Plan

Local Model Validation Report - RailPlan

London Borough of Enfield

LONDON BOROUGH OF ENFIELD LOCAL MODEL VALIDATION REPORT (LMVR)

Railplan 8

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Railplan 8

WSP

WSP House
70 Chancery Lane
London
WC2A 1AF

Phone: +44 20 7314 5000

Fax: +44 20 7314 5111

WSP.com

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Signature				
Checked by	Christine Elphicke	Christine Elphicke		
Signature				
Authorised by	Christine Elphicke	Christine Elphicke		
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1 INTRODUCTION

1.1 BACKGROUND

1.1.1. WSP was appointed by the London Borough of Enfield (LBE) to provide transport modelling services to support LBE with the preparation of their Local Plan. Strategic transport modelling is required to provide the evidence base for assessing the impacts and the improvements required to support the proposed growth within the Borough.

1.1.2. Enfield is defined as an outer London Borough within the London Plan with connections to a wide range of other boroughs through multiple radial and orbital connections by road and rail. Enfield is the 5th largest borough in London by population (c342,000) and is of average geographic size when compared to other boroughs. The London Plan identifies a 10-year housing target for Enfield of 12,460, which will need to be deliverable from a transport perspective, along with possible additional growth.

1.1.3. A number of substantial high growth Opportunity Areas are proposed in the borough, primarily within the Upper Lea Valley and Meridian Water, see Figure 1-1. The majority of new growth is targeted within the urban areas or close to existing or planned transport infrastructure improvements. Some of the land identified is in less accessible locations, including green belt or strategic or local industrial areas. These locations are dependent on transport infrastructure investment from TfL and the central government, which is yet to be committed. These projects include Crossrail 2 and West Anglia Main line rail projects.

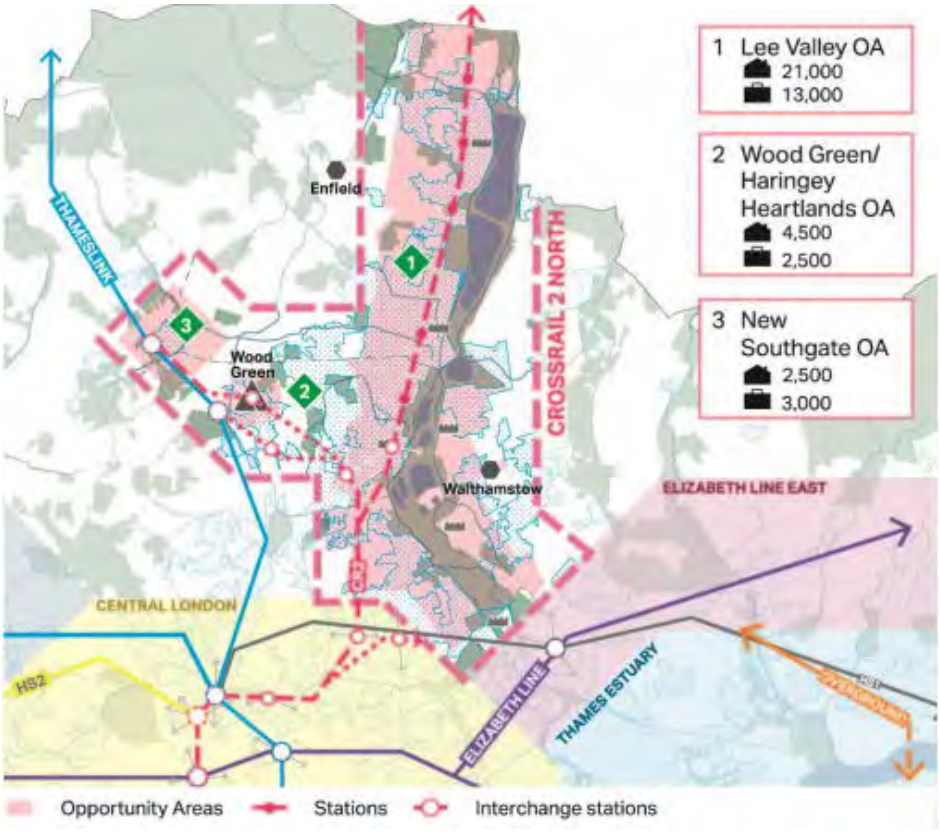


Figure 1-1: LBE Opportunity Areas

1.1.4. From a transport perspective it will be important to be able to demonstrate that this growth can be accommodated both with and without the proposed infrastructure investments, and to provide a realistic set of assumptions around the specific locations and composition of growth.

1.1.5. The recent changes to the London Plan, following the direction from central government will also need careful consideration in the proposed transport strategy.

1.1.6. More locally Enfield as a forward thinking and innovative borough has policy aspirations to reduce car travel, improve air quality and to provide generally sustainable developments, including orbital bus travel and segregated cycle routes. The transport strategy will need to address these objectives by providing emphasis on public transport and active travel modes.

1.1.7. Notwithstanding the need to achieve a higher proportion of trips through non car modes, there are some significant journey time delays experienced on some parts of the highway network, which impact bus journey times and may in some instances result in reduced safety for cyclists and pedestrians.

1.1.8. TfL have developed a multi-modal modelling suite called MoTiON, which aims to predict long-term changes in travel patterns and the associated impacts. MoTiON covers the Greater London area including Enfield, although it is noted that Enfield is situated on the outskirts of this area. MoTiON is the proposed transport modelling tool for this assessment but prior to transport modelling work commencing a base model audit of individual assignment models, which MoTiON consists of, has been undertaken to determine their fitness for purpose.

1.1.9. MoTiON's variable demand model uses numerous demand drivers including land use, socio-economic forecasts and transport supply to calculate future trip generation, trip distribution and mode choice. The trips that MoTiON calculates are then assigned to detailed strategic networks in Railplan (public transport) and LoHAM (highway) models to forecast detailed route choice and cost changes between transport and land use scenarios.

1.1.10. TfL provided WSP with the latest version of MoTiON in March 2021. The latest versions of TfL's assignment models that have been used are described in Table 1-1.

Table 1-1: MoTiON Assignment Models

Mode	Assignment model name	Software	Latest version (March 2021)
Highway	LoHAM	Saturn	4.02
Public Transport	Railplan	Emme	8

1.2 REPORT PURPOSE

1.2.1. Railplan v8 is recent versions of the Railplan model that was calibrated and validated to represent the base year of 2016. The key feature of Railplan v8 is the use demand matrices built from new digital data sources such as Mobile Network Data and Oyster. This version of the Railplan model provides better validation results relative to the previous Railplan v7.2 and v7.3 (see *MoTiON/Railplan v8 Validation Summary, TfL, December 2020*).

1.2.2. In July 2021 WSP produced a Railplan Base Model Audit Report which forms part of Stage 2 of the transport assessment study for the Enfield Local Plan (Model Validation). This assessed whether Railplan v8 is fit-for-purpose for the evaluation of the performance of public transport services within

the Enfield study area. The review found that some improvements were required to Railplan 8 to support the LBE Local plan which included improvements in network coding, zones and connectors as well as some improvements in the calibration and validation of the public transport network for the Lea Valley lines and particularly the Cheshunt branch.

1.2.3. Evidence of model calibration and validation of the strategic PT model at both the strategic and local level will be required:

- At the strategic level, it will be necessary to show that any enhancements of the model carried out at the local level have not had an adverse impact on calibration and validation statistics;
- At the local level, it will be necessary to show that the link flow statistics relating to the study area calibrate and validate well.

1.2.4. Careful attention will be given to each individual feature described in this report, and it will be necessary to explain the reasons for any failing to meet the Transport Analysis Guidance (TAG) criteria set out by Department for Transport (DfT).

1.2.5. After the introductory chapter, the LMVR will be structured as follows:

- **Chapter 2** discusses the refinements and updates made to the Railplan model as part the validation and calibration process;
- **Chapter 3** presents the results of the calibration and validation exercise; and
- **Chapter 4** provides a summary of findings from the model re-validation and concludes the report

2 BASE MODEL UPDATES

2.1 INTRODUCTION

2.1.1. In agreement with TfL, Railplan v8 base model has been used as the basis for this project.

2.1.2. At the strategic level, Railplan 8 has been developed, calibrated and validated to a high standard by TfL. However, individual areas of a strategic model may perform better than others and so it is a requirement of TfL that base model validation is carried out if TAG acceptance criteria and acceptability guidelines laid out in TAG Unit M3.2 PT *Assignment Modelling (May 2020)*[1] are not met in, and around, the LBE. For this reason, a further localised audit was carried out in line with TfL's guidance, to assess the need for base model validation.

2.1.3. Figure 2-1 shows the area which was revised as part of the model audit process which encompasses all public transport services within LBE.

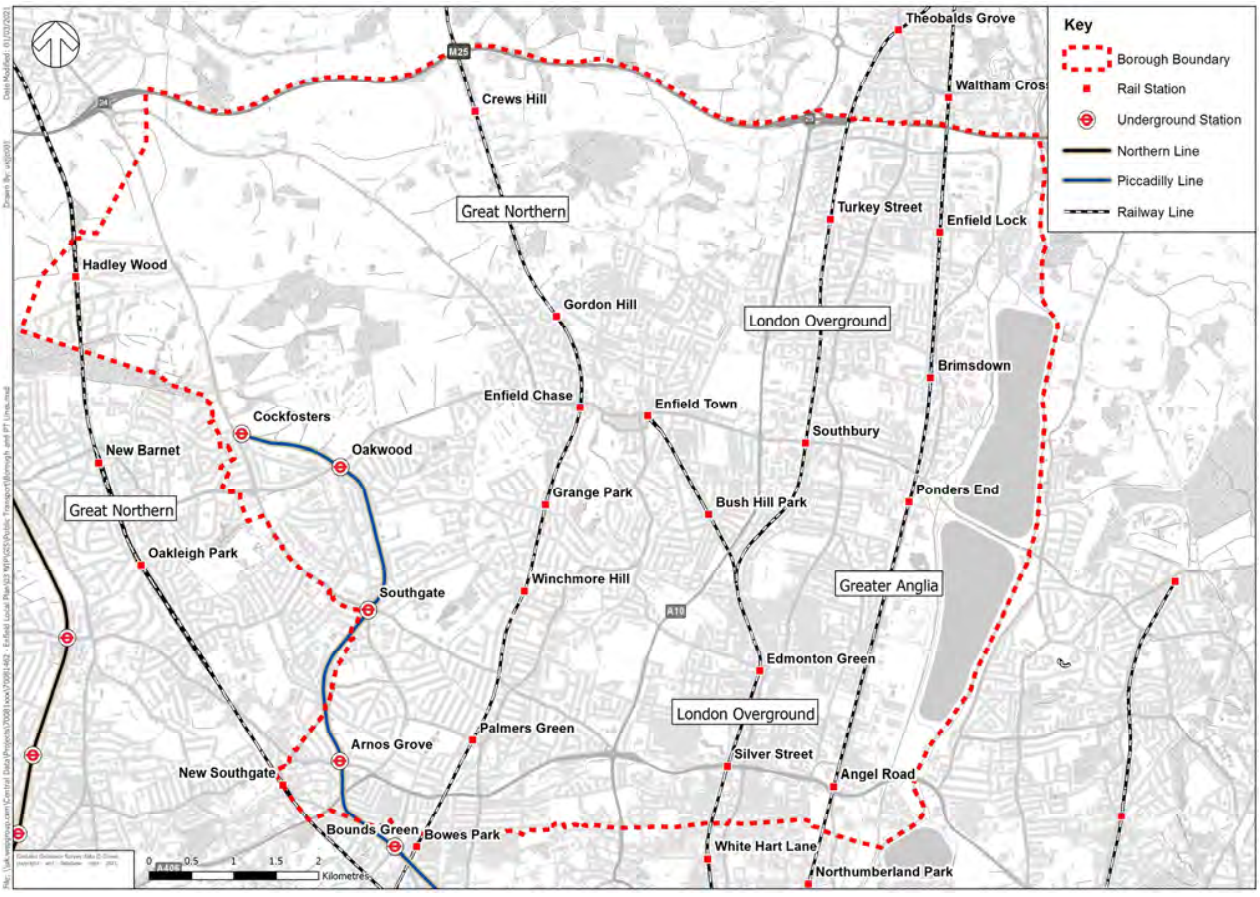


Figure 2-1: Study Area for Base Year Model Validation

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938870/tag-m3-2-public-transport-assignment.pdf

2.1.4. The results of the model audit were reported in the '*London Borough of Enfield Railplan Base Model Audit, WSP, July 2021'.*

2.1.5. The Railplan 8 model scenarios audited are:

- MRC1001A02516C – 2016 Base AM Peak Period (07:00-10:00)
- MRC3001P02516C – 2016 Base PM Peak Period (16:00-19:00)

2.1.6. The versions of the model given to WSP by TfL will henceforth be referred to as BASE-TfL, while the final models produced by the calibration and validation exercise will be referred to as REBASE-LBE.

2.2 BASE MODEL AUDIT

DATA SOURCES

2.2.1. The model audit undertaken compared the passenger demand in Railplan 8 against the following datasets:

- **2016 Rolling Origin Destination Survey (RODS) data:** RODS was a rolling survey programme implemented between 1998 and 2016, which produced an annual data set that represents how passengers travel across the network operated by the London Underground Limited (LUL) on a typical weekday, Saturday and Sunday. RODS data are reconciled to November counts and adjusted to remove the effect of abnormal circumstances such as line closures and strikes. Link flows, boarding and alighting during an average weekday across the LUL network in 2016 were adopted in our model audit of LUL service performance. For this base model update, however, RODS data series will also be used alongside the NUMBAT data for model validation. This is because NUMBAT data, which is a more robust data set, has been finalised and made available following completion of our model audit.
- **2016 NUMBAT data:** NUMBAT utilises ticketing data from smartcards and gateline entry/exit totals for each station to represent the travel demand on a typical autumn weekday, Saturday and Sunday at all stations and lines of the London Underground, London Overground (LO), Docklands Light Railways (DLR), TfL Rail/Elizabeth Line and London Trams. This effectively provides a much larger sample size than previous RODS data sets. Our model audit adopted the 2016 version of the NUMBAT data set which was still "in draft" and was adopted specifically for the validation of passenger demand for the LO lines and also service frequencies for both the LUL and LO services. RODS data will be compared against NUMBAT data in this base model update where available.
- **2016 BUSTO data:** BUSTO is an annual bus demand dataset that was used for validation of bus services in Railplan 8. BUSTO data were developed based on ODX data to estimate the numbers of boarders, alighters, interchangers and load on each route / link across the bus network. Modelled bus passengers are compared against BUSTO data in this base model update where available.
- **2016 SHLAA/LESD postcode data:** Postcode address points developed based on Strategic Housing Land Availability Assessment (SHLAA) dataset and London Employment Sites Dataset (LESD) were adopted in this base model update as the basis for distributing trip ends for disaggregated zones. The postcode data includes both domestic and non-domestic points, which represent 2016 average GLA population and GLA jobs, respectively.

2.2.2. The audit findings indicated the need for base model improvements in the LBE local area. Table 2-1 presents a summary of the model audit findings and recommended improvements.

Table 2-1: Summary of Model Audit Findings

Checks	Summary	Base RAG
Network coding	A variety of network coding fixes would be sensible, particular for the location of the station node where more material offsets from reality have been identified; network enhancements for areas within LBE carried out by AECOM to be reviewed and incorporated in Railplan v8 for forecasting	X
Zones and connectors	Whilst some of the zones in Enfield are large, this is proportionate to the level of development and accessibility to rail stations. Needs to be re-considered for the forecast models.	
Calibration / Validation	Link flows for London Underground are validated well, with 15 out of 16 sections fall within TAG validation criteria. Validation of boarding and alighting for LUL lines are acceptable in general, albeit less robust than the validation of LUL link flows.	
	Network supply and passenger flows for the Lea Valley lines, particularly for the Cheshunt branch, are significantly over-estimated. Network fix will be required to correct the headway assumptions and discourage transfer activities between the Greater Anglia lines and Lea Valley lines. Demand adjustment is recommended to reduce the passenger demand for the Lea Valley lines within Railplan	X
	Greater Anglia lines are validated well for the peak directions at line level (inbound travel during AM peak; outbound travel during PM peak)	
	Validation of bus passenger flows and passenger-kilometre measures at borough level are well within TAG criteria	

Network Coding

2.2.3. Table 2-2 and Table 2-3 outline all the network enhancements recommended for both London Underground, National Rail and London Overground stations, and also our assessment on whether these changes have been addressed in the latest Railplan v8. These network enhancements cover 18 rail stations and 4 London Underground stations, and their connections to the surrounding streets and zones. WSP have incorporated all these changes into Railplan 8. Both internal and external magic triangles have been checked for all the stations where network changes were made.

Table 2-2: Recommended Enhancements to London Underground Stations

Operator	Line / Branch	Station	Suggested Change in RP 7.2
London Underground	Piccadilly	Arnos Grove	Remove eastern station access
London Underground	Piccadilly	Cockfosters	Change station/platform coordinates, review station/platform distances, remove duplicate links
London Underground	Piccadilly	Oakwood	Change station/platform coordinates, review station/platform distances, remove duplicate links, remove spigot, connect station to the Chase Road (SE)
London Underground	Piccadilly	Southgate	Change station/platform coordinates

Table 2-3: Recommended Enhancements to National Rail and London Overground Stations

Operator	Line / Branch	Station	Suggested Change in RP 7.2
Great Northern	East Coast Main Line (ECML)	New Southgate	Update eastern station access – connect into A109 Station Road, remove duplicate links, add western access, add new node along Balmoral Drive for western access connection
Great Northern	East Coast Main Line (ECML)	Hadley Wood	Change station/platform coordinates, review station/platform distances, remove spigot, consider updating network to represent Crescent East from Lancaster Avenue to Camlet Way
Great Northern	Hertford Loop (ECML)	Crews Hill	Change station/platform coordinates, replace existing western access with eastern access from Castlegate Road with new entrance, remove spigot,
Great Northern	Hertford Loop (ECML)	Enfield Chase	Change station/platform coordinates, review station, station/platform distances, reposition station entrance (access should be to the west of the Hertford Loop Line), add new node on A110 for station access connection
Great Northern	Hertford Loop (ECML)	Gordon Hill	Change station/platform coordinates, remove duplicate links

Great Northern	Hertford Loop (ECML)	Grange Park	Change station/platform coordinates, review station/platform distances, remove western access from Cheyne Walk, reconnect station entrance to node on western side of Hertford Loop
Great Northern	Hertford Loop (ECML)	Palmers Green	Change station/platform coordinates, remove duplicate links,
Great Northern	Hertford Loop (ECML)	Winchmore Hill	Change station/platform coordinates, review station/platform distances, remove duplicate links
Greater Anglia	Lea Valley Line (WAML)	Angel Road	Change station/platform coordinates, review station/platform distances
Greater Anglia	Lea Valley Line (WAML)	Brimsdown	Change station/platform coordinates, remove duplicate links, remove southern station access
Greater Anglia	Lea Valley Line (WAML)	Enfield Lock	Change station/platform coordinates, review station/platform distances, remove spigot
Greater Anglia	Lea Valley Line (WAML)	Meridian Water	Review distance from the North Circular, consider station access to the west in future years;
Greater Anglia	Lea Valley Line (WAML)	Ponders End	Change station/platform coordinates, remove duplicate links, reconsider location of eastern access in light of development assumptions
London Overground	Lea Valley line (Cheshunt Branch / Southbury Loop)	Southbury	Change station/platform coordinates, remove spigot, add new node on Southbury Road to the east of Crown Road, reconnect station entrance to aforementioned new node
London Overground	Lea Valley line (Cheshunt Branch / Southbury Loop)	Turkey Street	Change station/platform coordinates, replace western access with eastern access to represent Teal Close, amend link distances accordingly
London Overground	Lea Valley line (Enfield Town Branch)	Bush Hill Park	Remove duplicate links, provide new eastern access from St. Mark's Road, Queen Anne Place's distance (southern approach),
London Overground	Lea Valley line (Enfield Town Branch)	Enfield Town	Change station/platform coordinates, remove duplicate links, reposition station entrance so that it hugs Southbury Road, amend Genotin Road distance
London Overground	Lea Valley Line (Enfield Town Branch, Cheshunt Branch)	Silver Street	Change station/platform coordinates, remove spigots, consider having eastern access or moving current access to split both access points
London Overground / Greater Anglia	Lea Valley Line (Enfield Town Branch, Cheshunt Branch, WAML)	Edmonton Green	Change station/platform coordinates, review station access distance, remove western access, connect Galahad Road to Church Street to facilitate station access from the SW

2.2.4. Table 2-4 summarises all the recommended changes to base year street network to ensure connectivity for future development planned and our checks on whether these changes have been addressed in the latest Railplan v8, where applicable. WSP have incorporated all relevant changes into Railplan 8.

Table 2-4: Recommended Changes to Street Network

Suggested Change in RP 7.2
Add walk network to connect Dyson Road to the North Circular. Delete duplicate links along Dyson Road

Zoning and Connectors

2.2.5. The recommended changes to zoning system for Railplan v7.2 as shown in Figure 2-2 have been re-assessed and updated according to the latest planning assumptions, in close consultation with Enfield Council. The re-assessment of zoning system has been carried out to assess whether the zone disaggregation suggested for Railplan v7.2 is still relevant in supporting the latest committed/planned future development, and whether new zone disaggregation and trip loading methods (centroid connectors) will be required in Railplan 8, given that the zoning system has been changed in Railplan 8. Future development or any change in land use envisaged are highlighted in Figure 2-3, which form the basis for discussions with Enfield Council in the re-assessment of the zone disaggregation.

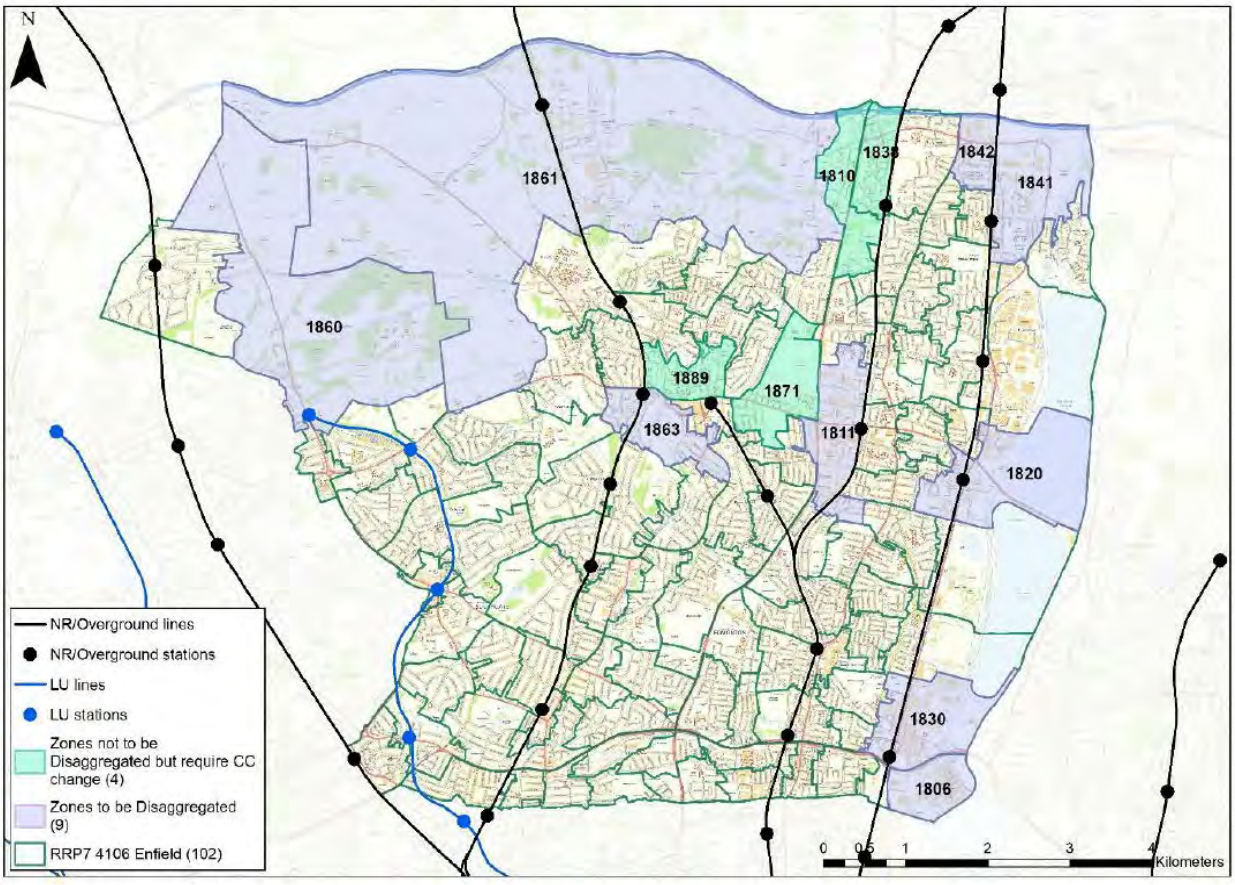
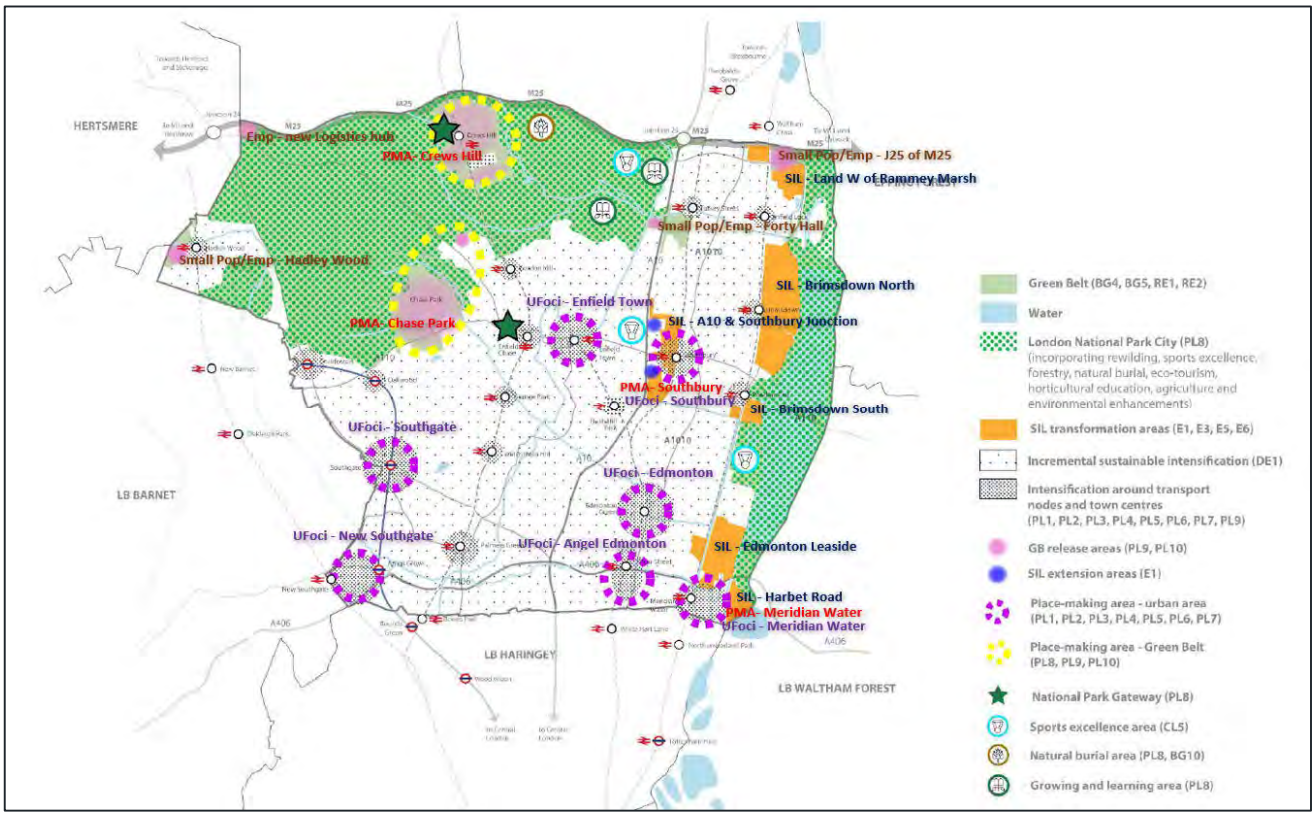


Figure 2-2: Recommended Changes to Zoning System in RP 7.2



Source: Enfield Local Plan - Main issues and preferred approaches (Version for EGM on 9 June 2021), Enfield Council, June 2021

Figure 2-3: Planned Future Development Sites

2.2.6. A lookup table describing the relationship between original zones and disaggregated zones and the split factors are summarised in Table 2-5. The revised zoning system is illustrated in Figure 2-4. Split (or disaggregation) factors were developed based on assessment of land use data SHLAA/LESD postcode data except for the two industrial zones including Meridian Water (Zone 2968) and employment growth area just West of Rammey Marsh (Zone 3029), where 2011 Census at Output Area (OA) level were adopted as the Census data include more representative distribution of households and jobs than the SHLAA/LESD data for industrial zones.

2.2.7. It has been assumed that population is the primary trip generator during the morning peak period. Therefore, population split (in %) amongst the split zones will be applied to split origin trips during morning peak period and destination trips during the afternoon peak period. The opposite has been assumed for splitting employment amongst the disaggregated zones, in which the employment split (in %) has been applied to destination trips during the morning peak period and origin trips during the afternoon peak period.

2.2.8. The standard zone splitting procedure set out by TfL (*"Zone Disaggregation Using Rezoning Tool.docx"*) has been followed and checks have been carried out to ensure trip totals for assignment matrices are same before and after zone disaggregation. Centroid connectors are also coded to ensure reasonable access costs for trips to/from disaggregated zones.

Table 2-5: Zone Disaggregation Rationale and Split factors

Future Development	Description of zone disaggregation	RP 8 Zone	Split Zone	Population Split %	Employment Split %
Meridian Water	Zone 2968 to be split along River Lee Navigation to provide better representation of walk access between east and west sides of the development, following recommendation in RP 7.2	2968	2968	100%	65%
		2968	4571	0%	35%
Edmonton Leaside	Zone 2970 to be split along Pymmes Brook to provide better representation of walk access across east and west side of industrial site, following recommendation in RP 7.2	2970	4570	0%	2%
		2970	2970	100%	98%
Brimsdown South	Zone 2973 to be split along A110 to provide better representation of walk access across north-east industrial site and the rest of the sites within the zone, following recommendations in RP 7.2	2973	4569	0%	27%
		2973	2973	100%	73%
Brimsdown North	New zone disaggregation requirement in RP 8 as it is likely that residential development will be in place whilst the existing industrial development will be moved to Greenbelt area just west of Crews Hill. Zone has been split into 3 zones: east-west split along the railway track, and also north-south split along Millmarsh Ln.	2974	2974	98%	1%
		2974	4574	1%	41%
		2974	4575	1%	58%
West of Rammey Marsh	Zone 3029 to be split into 3 zones, 1) east of River Lea, depending on the size of the employment site, 2) Northern portion and west of River Lea, and 3) Southern portion and west of River Lea, broadly following recommendations in RP 7.2	3029	4567	0%	57%
		3029	4568	30%	26%
		3029	3029	70%	18%
Enfield Town	New zone disaggregation requirement because the zone boundaries have been changed substantially since RP 7.2 Zone 2944 will now split across two north-south splits for better representation of access to Enfield Chase and Enfield Town station at the north and Grange Park station at the bottom	2944	2944	31%	29%
		2944	4572	25%	4%
		2944	4573	44%	67%
Crews Hill (incl. Greenbelt area)	New zone disaggregation requirement in RP 8 with Crews Hill split into 3 areas: one reserved for potential East Crews Hill residential master plan, and also north-south split to enable better representation of access time	2925	2925	68%	35%
		2925	4576	4%	15%
		2925	4577	28%	50%

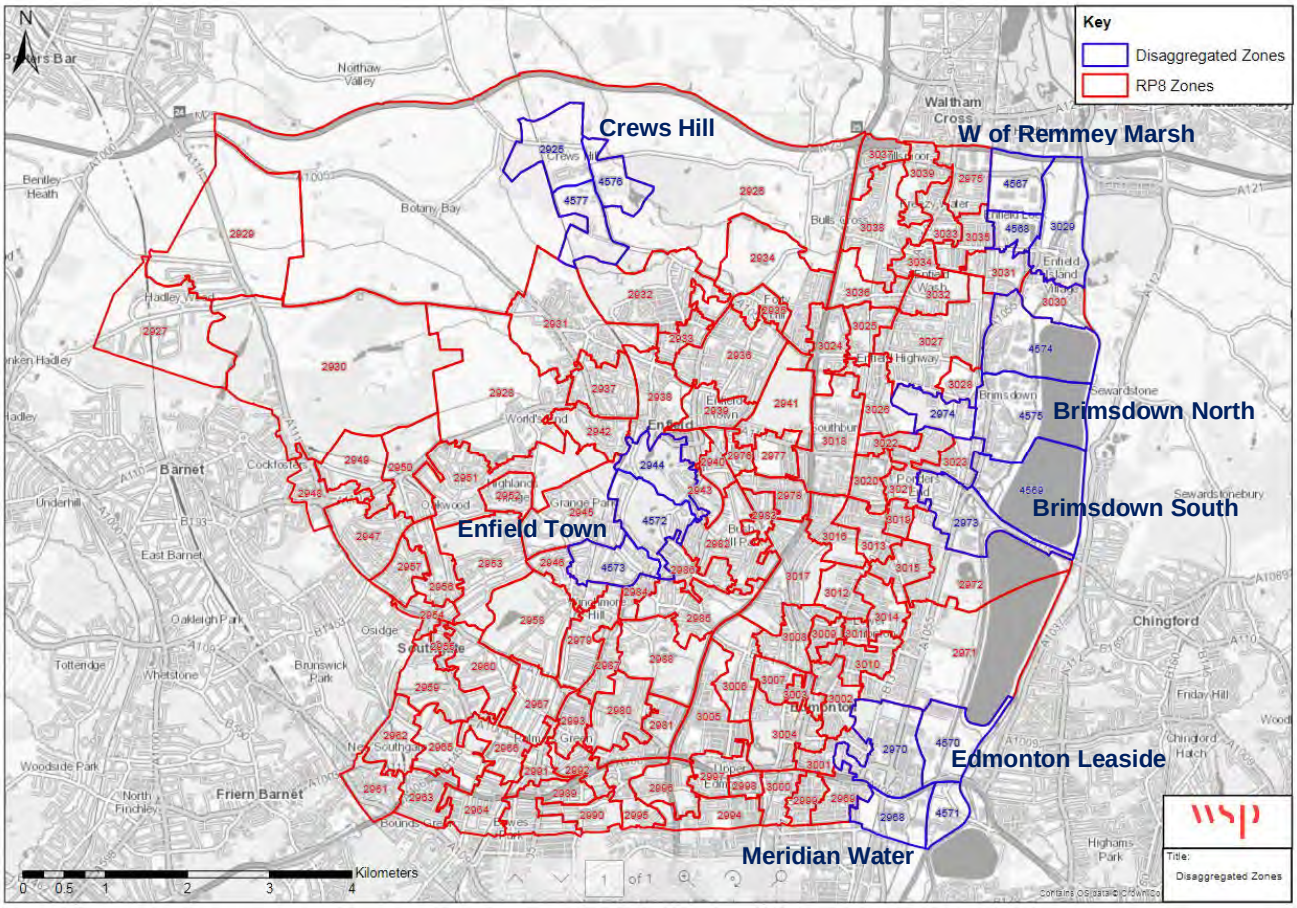


Figure 2-4: Revised Zoning System in RP 8

2.2.9. Final validation results are summarised in the next Chapter.

3 CALIBRATION AND VALIDATION

3.1 INTRODUCTION

3.1.1. This chapter of the LMVR outlines the results of the calibration and validation exercise carried out in the study area to produce the REBASE-LBE model incorporating the network and zone coding improvements outlined in Chapter 2.

3.1.2. Validation results have been presented in accordance with current guidance in TAG Unit M3.2, as follows:

- Across modelled screenlines, modelled flows should, in total, be within 15% of the observed values.
- On individual links in the network (and it is assumed at individual stops) modelled flows should be within 25% of the counts, except where observed hourly flows are particularly low (less than 150 passengers per hour)

3.1.3. Both PT and walk network has been updated for both AM and PM peak periods in REBASE-LBE as described in last section. This section mainly covers the validation of passenger demand only but not for the service frequency.

3.2 LONDON UNDERGROUND - PICCADILLY LINE

SERVICE FREQUECY

3.2.1. The comparison of service frequencies against 2016 NUMBAT data for both morning and afternoon peak periods are shown in Table 3-1. As noted in the model audit report, validation results show that coding of service frequencies in Railplan v8 is largely comparable to observed frequencies, albeit a slight over-estimation of supply for northbound trains in general during morning peak period, which is not the peak directional flow during average workday. Therefore, there are no changes to the headway assumptions for the Piccadilly line services in Railplan v8. Link segments along Piccadilly line that lie within LBE are illustrated in Figure 3-1.

Table 3-1: Validation of Service Frequencies for Piccadilly line

Dir	From	To	AM Peak (07:00-10:00)				PM Peak (16:00-19:00)			
			Obs.	Model.	Diff. %	Diff. Abs.	Obs.	Model.	Diff. %	Diff. Abs.
NB	Bounds Green	Arnos Grove	66	71	8%	5	69	70	1%	1
	Arnos Grove	Southgate	47	53	13%	6	50	52	4%	2
	Southgate	Oakwood	46	53	15%	7	50	52	4%	2
	Oakwood	Cockfosters	46	51	11%	5	50	52	4%	2
SB	Cockfosters	Oakwood	51	49	-4%	-2	50	50	0%	0
	Oakwood	Southgate	54	55	2%	1	53	53	0%	0
	Southgate	Arnos Grove	54	55	2%	1	53	53	0%	0
	Arnos Grove	Bounds Green	72	70	-3%	-2	71	71	0%	0

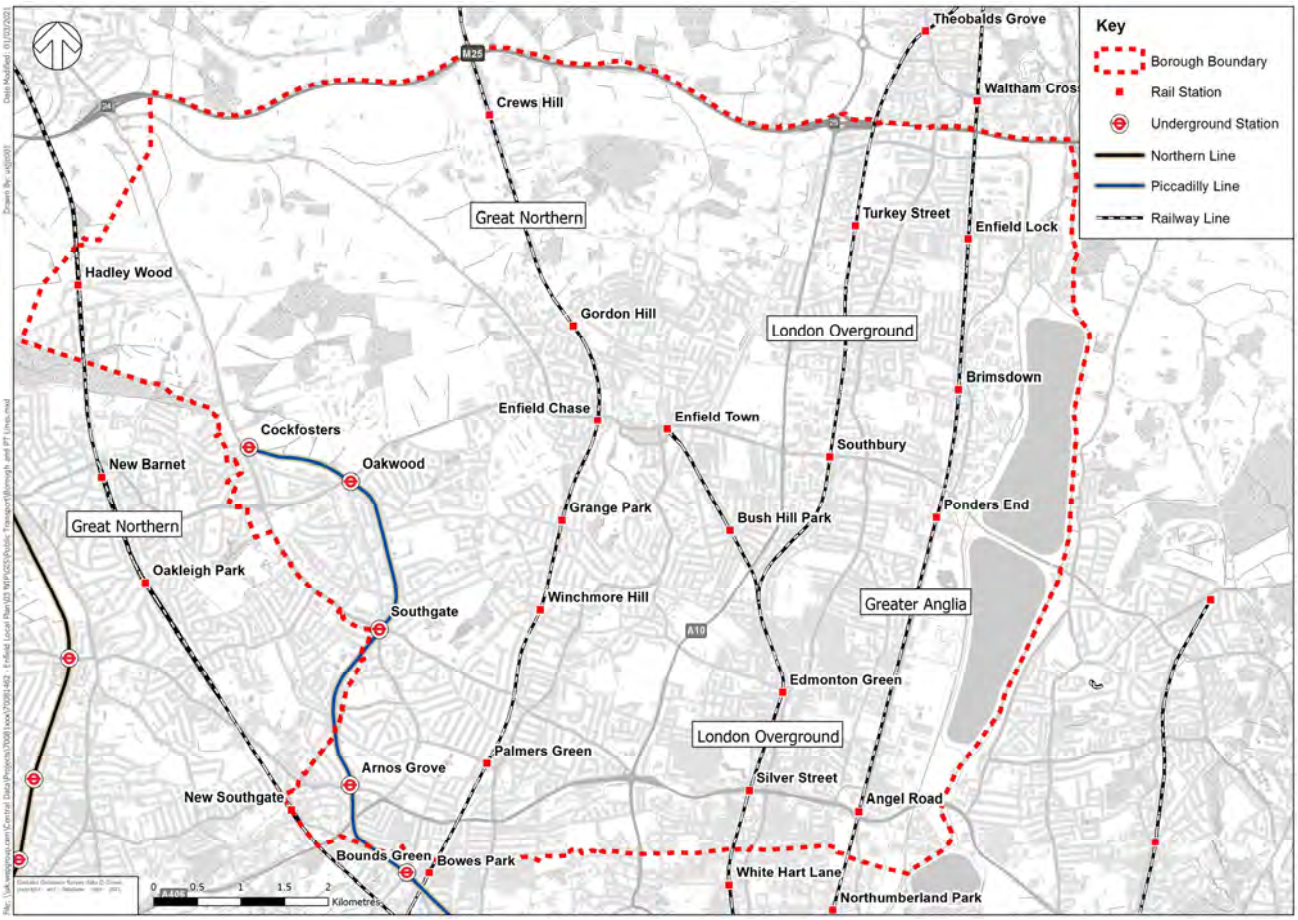


Figure 3-1: Piccadilly Line in LBE

LINK FLOWS

3.2.2. Validation of link flows (or line loading) for all the London Underground services that fall within LBE has been undertaken. Table 3-2 and Table 3-3 show the validation of link flows against RODS data for all four Piccadilly line segments during morning and afternoon peak, respectively. Table 3-4 and Table 3-5 show the validation of link flows against NUMBAT data for all four Piccadilly line segments during morning and afternoon peak, respectively. Comparisons against both RODS and NUMBAT data have been provided as Railplan 8 was developed and calibrated against RODS data but NUMBAT data is the most recent available data source but not used in the development of Railplan 8. It is shown that majority of the link flows between Bounds Green and Cockfosters stations produced by Railplan v8 are validated well against both 2016 RODS and NUMBAT data. Link flows for nearly all but one section (15 out of 16 sections) between Oakwood and Cockfosters satisfy TAG validation criteria.

Table 3-2: Validation of Link Flows for Piccadilly line – AM Peak (RODS)

Dir	From	To	AM Peak (0700-1000)				
			Obs (RODS)	Model	Diff %	Diff Abs	Meets Criteria?
NB	Bounds Green	Arnos Grove	2,747	2,439	-11%	-308	YES
	Arnos Grove	Southgate	1,965	1,726	-12%	-239	YES
	Southgate	Oakwood	912	954	5%	42	YES
	Oakwood	Cockfosters	376	276	-26%	-100	NO
SB	Cockfosters	Oakwood	1,072	813	-24%	-259	YES
	Oakwood	Southgate	2,761	3,041	10%	280	YES
	Southgate	Arnos Grove	6,571	6,077	-8%	-494	YES
	Arnos Grove	Bounds Green	9,534	9,382	-2%	-152	YES

Table 3-3: Validation of Link Flows for Piccadilly Line - PM Peak (RODS)

Dir	From	To	PM Peak (1600-1900)				
			Obs (RODS)	Model	Diff %	Diff Abs	Meets Criteria?
NB	Bounds Green	Arnos Grove	7,749	7,765	0%	16	YES
	Arnos Grove	Southgate	5,508	5,734	4%	226	YES
	Southgate	Oakwood	2,300	2,773	21%	473	YES
	Oakwood	Cockfosters	989	812	-18%	-177	YES
SB	Cockfosters	Oakwood	528	449	-15%	-79	YES
	Oakwood	Southgate	1,329	1,276	-4%	-53	YES
	Southgate	Arnos Grove	2,684	2,026	-25%	-658	YES
	Arnos Grove	Bounds Green	3,784	3,495	-8%	-289	YES

Table 3-4: Validation of Link Flows for Piccadilly line – AM Peak (NUMBAT)

Dir	From	To	AM Peak (0700-1000)				
			Obs (NUMBAT)	Model	Diff %	Diff Abs	Meets Criteria?
NB	Bounds Green	Arnos Grove	2,389	2,439	2%	51	YES
	Arnos Grove	Southgate	1,727	1,726	0%	-1	YES
	Southgate	Oakwood	858	954	11%	96	YES
	Oakwood	Cockfosters	404	276	-32%	-128	NO
SB	Cockfosters	Oakwood	1,059	813	-23%	-246	YES
	Oakwood	Southgate	2,713	3,041	12%	328	YES
	Southgate	Arnos Grove	6,301	6,077	-4%	-224	YES
	Arnos Grove	Bounds Green	9,026	9,382	4%	356	YES

Table 3-5: Validation of Link Flows for Piccadilly Line - PM Peak (NUMBAT)

Dir	From	To	PM Peak (1600-1900)				
			Obs (NUMBAT)	Model	Diff %	Diff Abs	Meets Criteria?
NB	Bounds Green	Arnos Grove	7,174	7,765	8%	590	YES
	Arnos Grove	Southgate	5,033	5,734	14%	701	YES
	Southgate	Oakwood	2,228	2,773	24%	544	YES
	Oakwood	Cockfosters	999	812	-19%	-187	YES
SB	Cockfosters	Oakwood	525	449	-15%	-77	YES
	Oakwood	Southgate	1,289	1,276	-1%	-13	YES
	Southgate	Arnos Grove	2,506	2,026	-19%	-480	YES
	Arnos Grove	Bounds Green	3,496	3,495	0%	0	YES

BOARDING AND ALIGHTING

3.2.3. Total boarding and alighting modelled at the five Piccadilly line stations within LBE are compared against the 2016 RODS and NUMBAT data, as shown from Table 3-6 to Table 3-9. Results show that approximately one third of the entry and exit flows for the four LUL stations (7 out of 16) modelled by Railplan fail to meet the TAG criteria. Whilst validation of the boarding and alighting estimated by Railplan v8 is not as robust as the link flows for LUL services within LBE, it is acknowledged that Railplan 8 is not calibrated at station boarding and alighting level.

3.2.4. Furthermore, the TAG criteria also aim to achieve good validation at the link level and screenline / cordon level, but little is said about validation at station boarding/alighting level. Therefore, it is our view that the boarding/alighting estimates are broadly acceptable as the R-squared goodness-of-fit measures are over 75% for the peak directions. Comparing with RODS and NUMBAT data, R-squared value is 0.77 for boarding during AM peak period, and R-squared value of 0.84-0.85 for alighting during PM peak period), implying a reasonably close boarding/alighting pattern that are modelled by Railplan v8.

Table 3-6: Validation of Boarding and Alighting along Piccadilly Line - AM Peak (RODS)

Station	Boarding					Alighting				
	AM Peak (0700-1000)					AM Peak (07:00-10:00)				
	Obs (RODS)	Model	Diff %	Diff Abs	Meets Criteria?	Obs (RODS)	Model	Diff %	Diff Abs	Meets Criteria?
Cockfosters	1,072	813	-24%	-259	YES	376	276	-26%	-100	NO
Oakwood	1,716	2,311	35%	595	NO	550	761	38%	211	NO
Southgate	3,827	3,256	-15%	-571	YES	1,108	992	-10%	-116	YES
Arnos Grove	3,019	3,732	24%	713	YES	844	1,140	35%	296	NO

Table 3-7: Validation of Boarding and Alighting along Piccadilly Line - PM Peak (RODS)

Station	Boarding					Alighting				
	PM Peak (1600-1900)					PM Peak (16:00-19:00)				
	Obs (RODS)	Model	Diff %	Diff Abs	Meets Criteria?	Obs (RODS)	Model	Diff %	Diff Abs	Meets Criteria?
Cockfosters	528	449	-15%	-80	YES	983	812	-17%	-171	YES
Oakwood	799	909	14%	110	YES	1,285	2,043	59%	758	NO
Southgate	1,397	992	-29%	-405	NO	3,152	3,203	2%	51	YES
Arnos Grove	1,234	1,898	54%	664	NO	2,285	2,459	8%	174	YES

Table 3-8: Validation of Boarding and Alighting along Piccadilly Line - AM Peak (NUMBAT)

Station	Boarding					Alighting				
	AM Peak (0700-1000)					AM Peak (07:00-10:00)				
	Obs (NUMBAT)	Model	Diff %	Diff Abs	Meets Criteria?	Obs (NUMBAT)	Model	Diff %	Diff Abs	Meets Criteria?
Cockfosters	1,059	813	-23%	-246	YES	406	276	-32%	-129	NO
Oakwood	1,691	2,311	37%	620	NO	518	761	47%	242	NO
Southgate	3,779	3,256	-14%	-522	YES	1,085	992	-9%	-93	YES
Arnos Grove	2,971	3,732	26%	761	NO	926	1,140	23%	214	YES

Table 3-9: Validation of Boarding and Alighting along Piccadilly Line - PM Peak (NUMBAT)

Station	Boarding					Alighting				
	AM Peak (0700-1000)					AM Peak (07:00-10:00)				
	Obs (NUMBAT)	Model	Diff %	Diff Abs	Meets Criteria?	Obs (NUMBAT)	Model	Diff %	Diff Abs	Meets Criteria?
Cockfosters	525	449	-15%	-77	YES	1,049	812	-23%	-238	YES
Oakwood	800	909	14%	109	YES	1,342	2,043	52%	701	NO
Southgate	1,393	992	-29%	-401	NO	3,239	3,203	-1%	-35	YES
Arnos Grove	1,217	1,898	56%	681	NO	2,375	2,459	4%	84	YES

3.3 LONDON OVERGROUND - LEA VALLEY LINES

SERVICE FREQUENCY

3.3.1. It was recommended in the Model Audit Report July 2021 that the over-estimation of service frequencies for the Lea Valley lines should be rectified in Railplan v8 to provide a more appropriate level of public transport capacity within LBE. This includes reducing the service frequency of the Cheshunt branch from 10 trains to 6 trains during the PM peak period. We have verified that the service frequency for both Enfield Town and Cheshunt branch during the AM peak period is correct.

3.3.2. Service frequencies for the Lea Valley lines in the base Railplan v8 scenarios that serve the LBE were compared against the 2016 NUMBAT data, the Lea Valley Lines in Railplan 8 was not calibrated to RODS data. Results presented in Table 3-10 indicate comparable service frequencies between the coding in Railplan v8 and the observed frequencies. Link segments along Lea Valley Lines that lie within LBE are illustrated in Figure 3-2.

3.3.3. There are limited peak Greater Anglia services between Hertford East and London Liverpool Street that run along the Southbury loop as shown in Figure 3-2. Due to the lack of 2016 demand and service assumptions available, these Greater Anglia services are not validated in this base model update.

Table 3-10: Validation of Service Frequencies for Lea Valley Lines

Dir	Branch	From	To	AM Peak (07:00-10:00)				PM Peak (16:00-19:00)			
				Obs	Model	Diff %	Diff Abs	Obs	Model	Diff %	Diff Abs
SB	Cheshunt	Cheshunt	Theobalds Grove	6	7	18%	1	6	6	0%	0
		Theobalds Grove	Turkey Street	6	7	18%	1	6	6	0%	0
		Turkey Street	Southbury	6	7	18%	1	6	6	0%	0
		Southbury	Edmonton Green	7	7	1%	0	6	6	0%	0
	Enfield Town	Enfield Town	Bush Hill Park	11	11	1%	0	10	9	-10%	-1
		Bush Hill Park	Edmonton Green	11	11	1%	0	10	9	-10%	-1
	Both Enfield Town & Cheshunt	Edmonton Green	Silver Street	18	18	-1%	0	16	15	-6%	-1
		Silver Street	White Hart Lane	18	18	-1%	0	17	15	-12%	-2
NB	Both Enfield Town & Cheshunt	White Hart Lane	Silver Street	17	16	-6%	-1	17	17	0%	0
		Silver Street	Edmonton Green	17	16	-6%	-1	17	17	0%	0
	Enfield Town	Edmonton Green	Bush Hill Park	11	9	-18%	-2	11	11	1%	0
		Bush Hill Park	Enfield Town	11	9	-18%	-2	11	11	1%	0
	Cheshunt	Edmonton Green	Southbury	7	7	-1%	0	6	6	0%	0
		Southbury	Turkey Street	7	7	-1%	0	6	6	0%	0
		Turkey Street	Theobalds Grove	7	7	-1%	0	6	6	0%	0
		Theobalds Grove	Cheshunt	7	7	-1%	0	6	6	0%	0

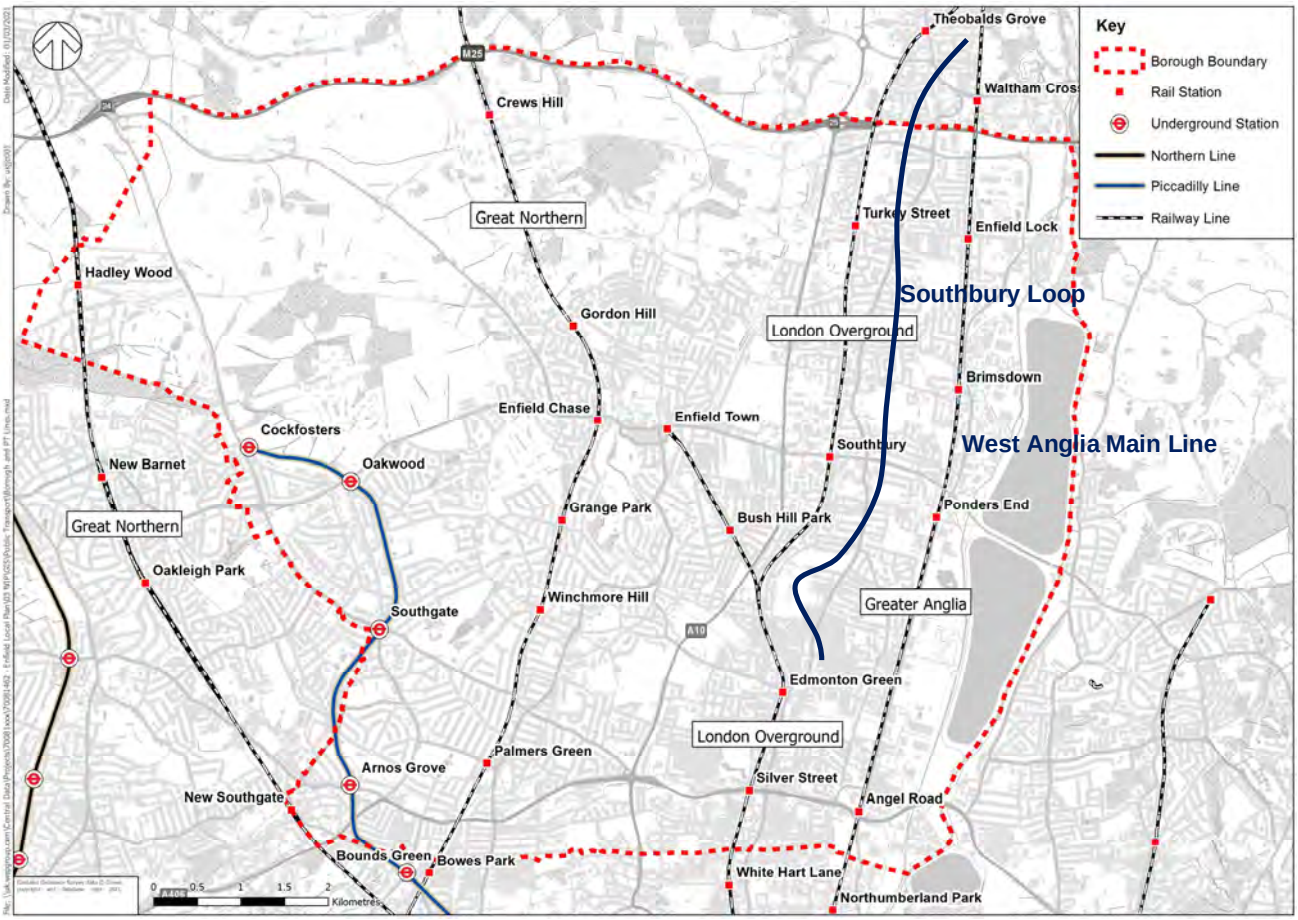


Figure 3-2: Lea Valley Lines in LBE

LINK FLOWS

3.3.4. Link flows modelled by Railplan v8 by adopting the standard TfL crowded assignment procedure for the Lea Valley lines including the Enfield Town and Cheshunt branches were compared against the 2016 NUMBAT data. Table 3-11 and Table 3-12 show the differences between modelled and observed link flows.

3.3.5. For the AM peak period, results show that passenger demand for the Cheshunt branch amongst the two Lea Valley lines are significantly different to the observed data at peak direction (southbound). The over-estimation of the passenger demand for the Cheshunt line also leads to over-estimation of passenger demand just south of Edmonton Green, where both Cheshunt and Enfield Town branches merge.

3.3.6. It is acknowledged by TfL that 2016 NUMBAT data for the London Overground was not available when the calibration for Railplan 8 was undertaken. Therefore, load weigh data was used for the rest of the London Overground lines but for the West Anglia Overground lines data was not available. This is mainly why the validation is poor.

3.3.7. The over-estimation demand for the Cheshunt branch occurs from the beginning leg between Cheshunt and Theobalds Grove, where demand is over-estimated by 769 through passengers (+510%) during the AM peak period, which also got carried downstream. It indicates that further investigation of the boarding activities at Cheshunt station is required, as described next.

3.3.8. Similar pattern is also observed for the PM peak period, in which results indicate that passenger demand for the Cheshunt branch has been over-estimated at peak direction (northbound). The over-estimation of the 576 passengers (+480%) at the last leg between Theobalds Grove and Cheshunt indicates that there is over-estimation of alighters at Cheshunt station.

Table 3-11: Validation of Link Flows for Lea Valley Lines – AM Peak

Dir	Branch	From	To	AM Peak (07:00-10:00)				
				Obs	Model	Diff %	Diff Abs	Meeting Criteria?
SB	Cheshunt	Cheshunt	Theobalds Grove	151	920	510%	769	-
		Theobalds Grove	Turkey Street	429	920	114%	491	NO
		Turkey Street	Southbury	884	1,792	103%	908	NO
		Southbury	Edmonton Green	1,346	2,154	60%	808	NO
	Enfield Town	Enfield Town	Bush Hill Park	1,765	1,570	-11%	-195	YES
		Bush Hill Park	Edmonton Green	2,903	3,275	13%	371	YES
	Both Enfield Town & Cheshunt	Edmonton Green	Silver Street	6,047	8,656	43%	2,609	NO
		Silver Street	White Hart Lane	6,861	10,147	48%	3,286	NO
NB	Both Enfield Town & Cheshunt	White Hart Lane	Silver Street	2,555	2,570	1%	15	YES
		Silver Street	Edmonton Green	2,261	2,404	6%	143	YES
	Enfield Town	Edmonton Green	Bush Hill Park	952	827	-13%	-124	YES
		Bush Hill Park	Enfield Town	852	482	-43%	-370	NO
	Cheshunt	Edmonton Green	Southbury	800	961	20%	161	YES
		Southbury	Turkey Street	475	793	67%	318	NO
		Turkey Street	Theobalds Grove	194	798	312%	604	-
		Theobalds Grove	Cheshunt	98	798	712%	700	-

Table 3-12: Validation of Link Flows for Lea Valley Lines – PM Peak

Dir	Lea Valley Branch (London Liverpool Street Station)	From	To	PM Peak (16:00-19:00)				
				Obs	Model	Diff %	Diff Abs	Meeting Criteria?
SB	Cheshunt	Cheshunt	Theobalds Grove	120	697	482%	577	-
		Theobalds Grove	Turkey Street	210	697	231%	486	-
		Turkey Street	Southbury	402	874	117%	472	NO
		Southbury	Edmonton Green	717	1,152	61%	435	NO
	Enfield Town	Enfield Town	Bush Hill Park	974	472	-52%	-502	NO
		Bush Hill Park	Edmonton Green	1,156	821	-29%	-336	NO
	Both Enfield Town & Cheshunt	Edmonton Green	Silver Street	2,599	2,950	14%	351	YES
		Silver Street	White Hart Lane	3,282	3,291	0%	9	YES
NB	Both Enfield Town & Cheshunt	White Hart Lane	Silver Street	5,846	8,184	40%	2,339	NO
		Silver Street	Edmonton Green	4,996	7,216	44%	2,220	NO
	Enfield Town	Edmonton Green	Bush Hill Park	2,290	2,300	0%	10	YES
		Bush Hill Park	Enfield Town	1,551	882	-43%	-669	NO
	Cheshunt	Edmonton Green	Southbury	1,212	2,285	89%	1,074	NO
		Southbury	Turkey Street	716	1,571	119%	855	NO
		Turkey Street	Theobalds Grove	358	697	95%	339	NO
		Theobalds Grove	Cheshunt	120	696	480%	576	-

3.3.9. By looking at the transfer activities at Cheshunt station, it is found that over-estimation of passenger demand by Railplan v8 between Cheshunt and Edmonton Green stations are contributed by excessive transfers between the Greater Anglia lines that run along the West Anglia Main Line and the Lea Valley lines that run along the Southbury Loop, as the Lea Valley lines along Southbury Loop provide an attractive option to bypass the crowded services along the West Anglia main line for travelling to/from London core.

3.3.10. That said, due to the lack of detailed station coding and transfer access link at the Cheshunt station (see Figure 3-3), which is outside the LBE boundary, it is difficult to reduce the transfer activities at Cheshunt by adding additional penalty on transfer access link. Also, there is no data available for validating the proportion of transfer activities at Cheshunt. In other words, it is unclear how many of the boarders at Cheshunt station at southbound direction are transferred from the Greater Anglia lines in reality. Therefore, line to line transfer penalty has not been tested in this model update, neither attempts in applying matrix estimation to adjust demand at Cheshunt station. Instead, the standard station-specific boarding penalty of 3.5 min has been inflated to 7min as a proxy to test the implementation of transfer penalty. This implies that boarding penalty will also be applicable for any

transfer activities at Cheshunt station between Greater Anglia services that run along the West Anglia Main Line), which is testing the worst-case scenario test to examine discourage all transfer activities at Cheshunt station.

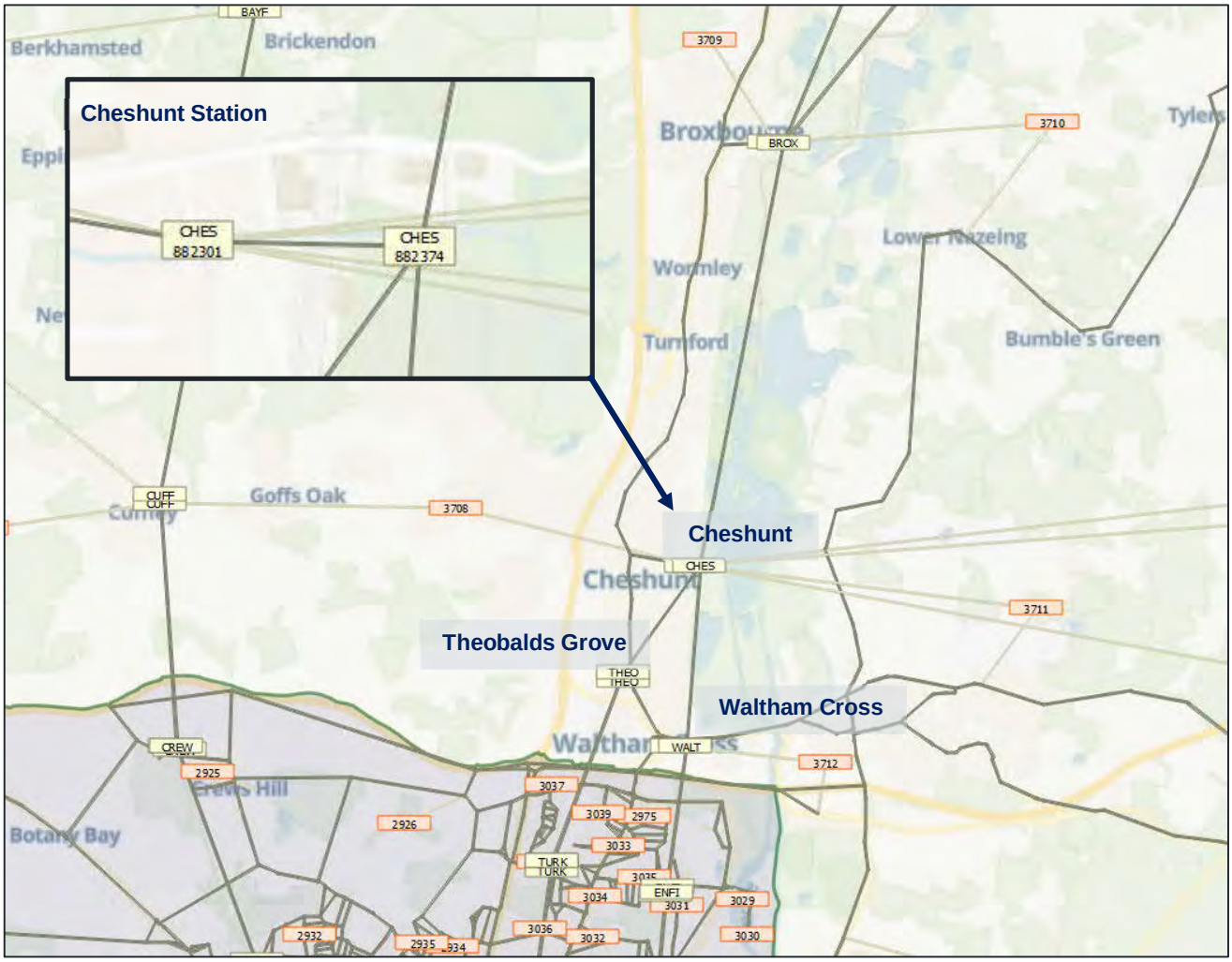


Figure 3-3: Coding of Cheshunt Station

3.3.11. The sensitivity test indicates that by adding extra 3.5 min of boarding penalty in addition to the standard boarding penalty of 3.5 min, there are limited impacts on discouraging transfer activities at the Cheshunt station. Out of the 800 southbound boarders at Cheshunt station during the AM peak as shown in Table 3-11, only 163 of the passengers will be re-assigned to the Great Northern services that run along the East Coast Main Line Hertford Loop. This indicates that that a significant boarding penalty will be required to discourage the transfer activities between Greater Anglia services and London Overground services. Also, the reassignment of trips to Great Northern services implies that any matrix estimation applied in adjusting demand that are originated from or destinated to zones north of the LBE boundary might lead to oscillation of assigned demand between competing train services along West Anglia Main Line and East Coast Main line due to the large zone size and lack of zonal and network details just north of LBE boundary. Given consideration of these concerns, our model update has retained the standard setting for crowded assignment with 3.5 min of boarding penalty assigned to Cheshunt station whilst no matrix estimation is carried out to adjust the demand for the Lea Valley lines for both AM and PM peak periods.

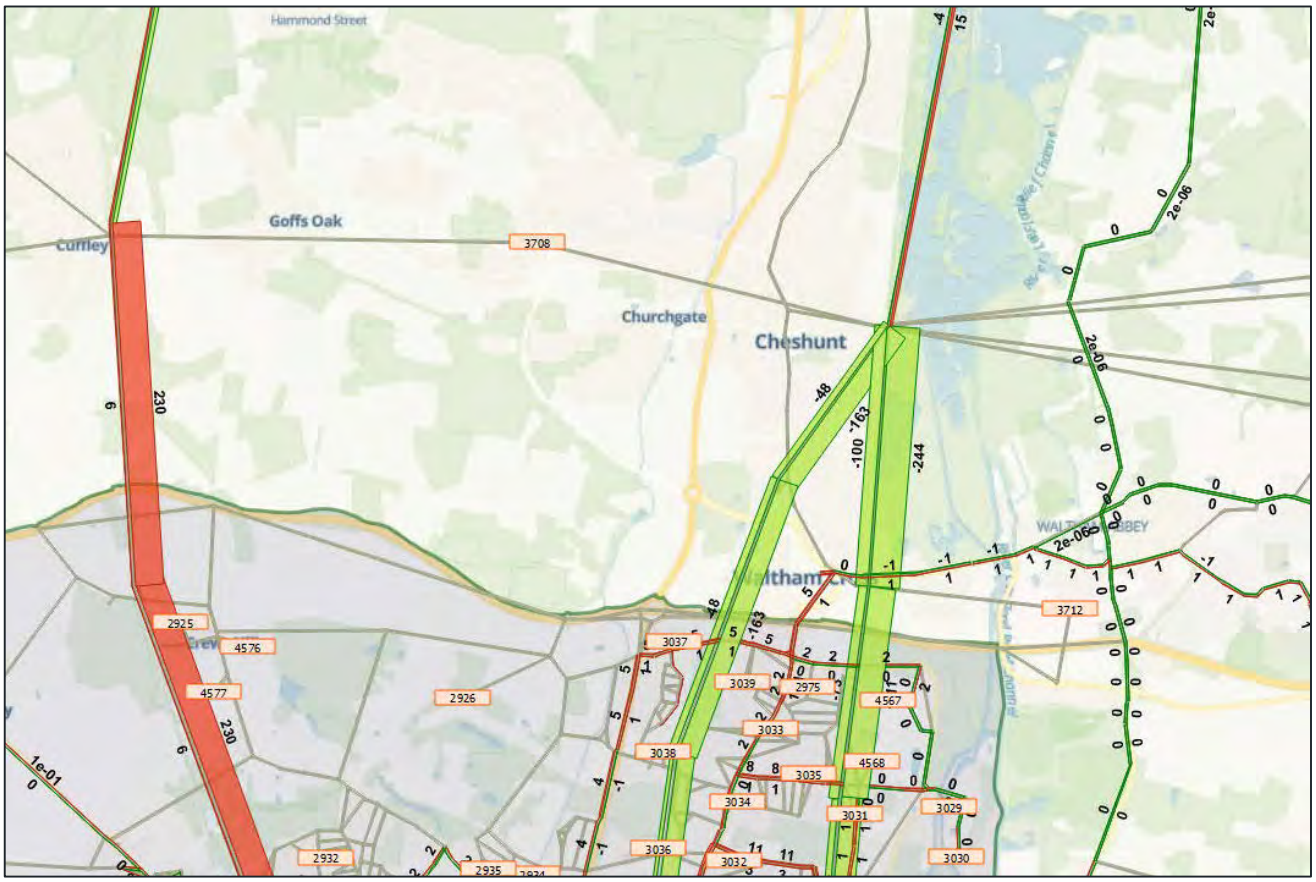


Figure 3-4: Sensitivity Test Results for 7-min of Boarding Penalty at Cheshunt Station in AM Peak

3.3.12. The lack of detailed network coding for zones north of LBE boundary also leads to the lack of station access/egress at Theobalds Grove railway station in Railplan 8, in which link flows modelled between Cheshunt and Turkey Street stations (i.e., Cheshunt to Theobalds Grove, Theobalds Grove to Turkey Street) are identical, as shown in Table 3-11 and Table 3-12.

BOARDING AND ALIGHTING

3.3.13. Consistent with the findings from the link flow validation for the Lea Valley Lines, there are significant discrepancies in boarding and alighting between model results and observed NUMBAT data for both morning and afternoon peak periods. For the AM peak, Railplan 8 significantly over-estimated the number of boarders at Edmonton Green station, with 1,945 additional boarders (+94%) during the AM peak period, whilst additional 1,832 additional alighters (+106%) is estimated during the PM peak period.

3.3.14. As shown in Table 3-13 and Table 3-14, Theobalds Grove Station (outside of the LBE) does not have any boarders or alighters. The key reasons are because the network in this area is not detailed and zones are big. Both Cheshunt and Theobalds Grove stations are located within zone 3708, which is connected to the Cheshunt station directly (see Figure 3-5) but not to Theobalds Grove station. Given that there is no key proposed Local Plan development in this area which is beyond the LBE boundary, a new zone associated with Theobalds Grove is not required in the zone disaggregation process.

3.3.15. It is noted that both the link volumes and boarding/alighting are not calibrated in Railplan v8 due to lack of NUMBAT data by the time of model calibration.

Table 3-13: Validation of Total Boarding/Alighting for Lea Valley Lines – AM Peak

Route	Station	AM Peak (07:00-10:00)									
		Boarding					Alighting				
		Obs	Model	Diff %	Diff Abs	Meeting Criteria?	Obs	Model	Diff %	Diff Abs	Meeting Criteria?
Cheshunt	Cheshunt	151	920	510%	769	-	98	798	717%	700	-
	Theobalds Grove	306	0	-100%	-306	NO	122	0	-100%	-122	-
	Turkey Street	485	1,160	139%	675	NO	300	284	-5%	-16	YES
	Southbury	474	725	53%	252	NO	381	531	40%	150	NO
Enfield Town	Enfield Town	1,765	1,570	-11%	-195	YES	839	482	-43%	-357	NO
	Bush Hill Park	1,165	1,704	46%	540	NO	123	345	181%	222	-
Both Enfield Town & Cheshunt	Edmonton Green	2,060	4,005	94%	1,945	NO	828	1,394	68%	566	NO
	Silver Street	1,072	2,001	87%	929	NO	527	676	28%	149	NO

Table 3-14: Validation of Total Boarding/Alighting for Lea Valley Lines – PM Peak

Route	Station	PM Peak (16:00-19:00)									
		Boarding					Alighting				
		Obs	Model	Diff %	Diff Abs	Meeting Criteria?	Obs	Model	Diff %	Diff Abs	Meeting Criteria?
Cheshunt	Cheshunt	120	697	482%	577	-	119	696	484%	577	-
	Theobalds Grove	121	0	-100%	-121	-	275	1	-100%	-274	-
	Turkey Street	215	359	67%	143	-	421	1,055	151%	634	NO
	Southbury	371	532	44%	162	NO	541	969	79%	428	NO
Enfield Town	Enfield Town	974	472	-52%	-502	NO	1,602	882	-45%	-720	NO
	Bush Hill Park	209	349	67%	140	-	794	1,418	78%	623	NO
Both Enfield Town & Cheshunt	Edmonton Green	958	1,906	99%	948	NO	1,727	3,559	106%	1,832	NO
	Silver Street	635	830	31%	194	NO	968	1,458	51%	489	NO

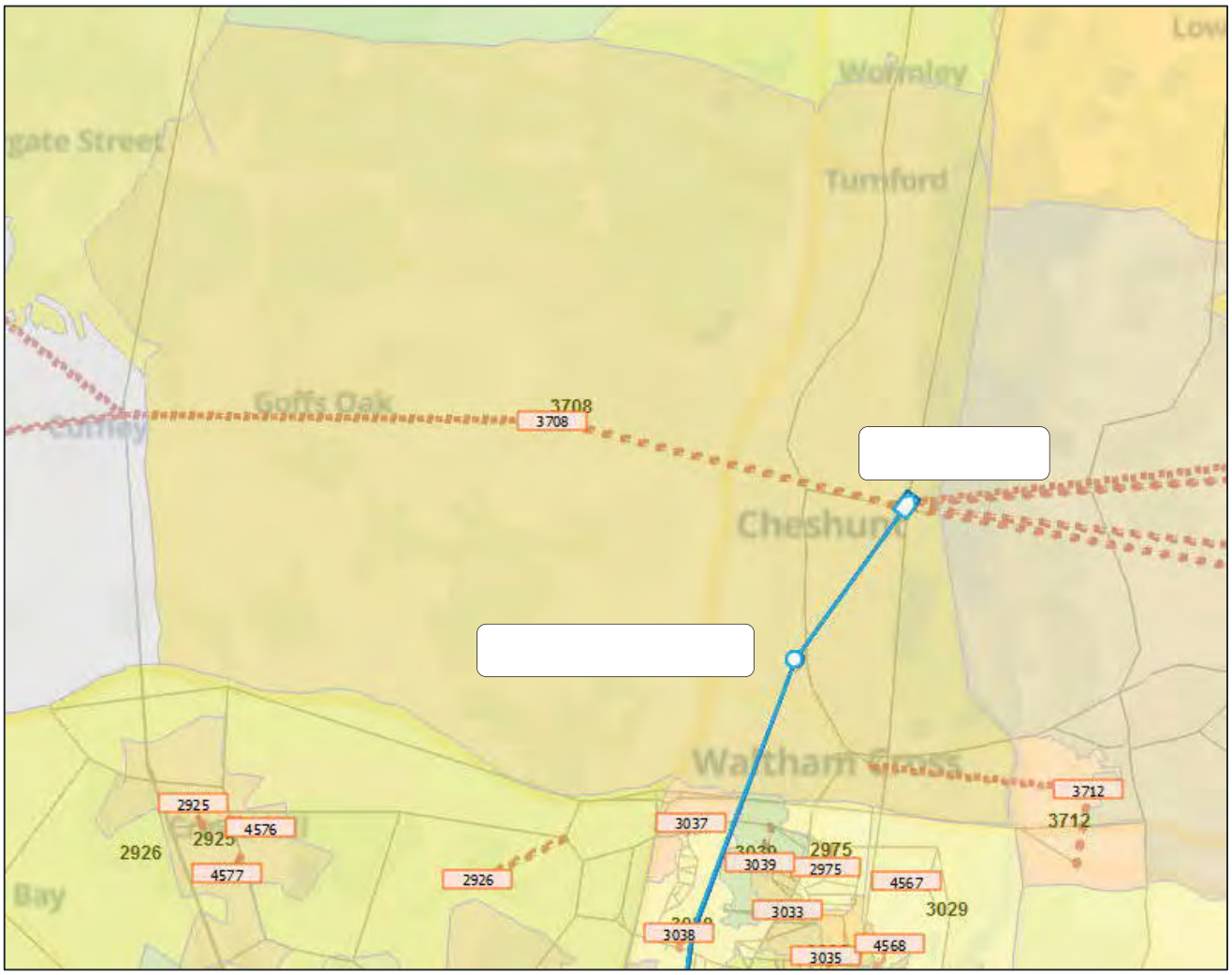


Figure 3-5: Cheshunt and Theobalds Grove stations and Zone Boundary

3.4 NATIONAL RAIL

3.4.1. Passenger demand for the Greater Anglia lines is validated at strategic level, as there is lack of observed MOIRA data for all National Rail services for this model validation. Table 3-15 and Table 3-16 present the validation of inbound and outbound passenger flows for the Greater Anglia lines (via Bethnal Green and Stratford) and London Overground during morning and afternoon peaks, respectively, generated using the TfL dashboard tool. At the line level, these three railway lines serving LBE are validated well at peak directions (i.e., inbound during AM, outbound during PM).

Table 3-15: Validation of Total Passengers for National Rail Lines – AM Peak

Service Group	AM Peak (0700-1000)					
	CAPC				DIFF %	
	Observed		Modelled			
	IN	OUT	IN	OUT	IN	OUT
Greater Anglia - Liverpool Street (via Stratford)	27,796	1,481	27,840	2,348	0.2%	58.5%
Lorol - Liverpool Street (via Bethnal Green)	11,913	1,025	11,738	1,326	-1.5%	29.4%
Greater Anglia - Liverpool Street (via Bethnal Green)	12,852	893	12,126	2,380	-5.6%	166.6%
Great Northern - Old Street (Moorgate)	12,959	436	13,983	1,191	7.9%	0.0%
Great Northern - Kings Cross	17,638	2,532	17,449	3,198	-1.1%	26.3%

Table 3-16: Validation of Total Passengers for National Rail Lines – PM Peak

Service Group	PM Peak (1600-1900)					
	CAPC				DIFF %	
	Observed		Modelled			
	IN	OUT	IN	OUT	IN	OUT
Greater Anglia - Liverpool Street (via Stratford)	2,797	27,504	3,272	27,151	17.0%	-1.3%
Lorol - Liverpool Street (via Bethnal Green)	2,062	8,665	2,063	7,951	0.0%	-8.2%
Greater Anglia - Liverpool Street (via Bethnal Green)	1,736	13,488	2,613	14,759	50.5%	9.4%
Great Northern - Old Street (Moorgate)	1,130	9,938	1,866	11,123	65.1%	11.9%
Great Northern - Kings Cross	3,271	15,871	3,226	16,143	-1.4%	1.7%

3.5 BUS DEMAND

3.5.1. Bus demand modelled by Railplan v8 is validated well at borough level against the observed data obtained from TfL's dashboard. Table 3-17 shows the comparison of total bus boarders and alighters within LBE for both morning and afternoon peak periods. It is shown that both boarding and alighting modelled by Railplan v8 are validated well within the TAG criteria.

Table 3-17: Validation of Bus Boarding/Alighting for LBE

Time Period	Boarder		Alighter		Diff	
	Obs	Model	Obs	Model	Boarder	Alighter
AM	49,025	50,533	43,514	46,220	3.1%	6.2%
PM	39,794	44,553	47,207	47,621	12.0%	0.9%

3.5.2. Bus passenger-kilometres, which measure the cumulative sum of the distances ridden by each passenger as a proxy of overall utilisation of bus system, are validated at borough level. Table 3-18 shows that total usage of the bus system within LBE are validated well for both morning and afternoon peak periods.

Table 3-18: Validation of Bus Passenger-kilometre for LBE

Time Period	Bus Pax Km		Diff
	Obs	Model	
AM	152,655	148,138	-3.0%
PM	138,280	139,444	0.8%

3.6 VALIDATION AT SCREENLINES AND CORDONS

3.6.1. Passenger flows by different modes are further validated at screenline level to understand the strategic movements across LBE, where observed counts are available.

3.6.2. The screenline and cordon system set out in the Model Audit Report was adopted for capturing passenger movements across the four boundaries of LBE, with an additional central screenline developed for capturing the north-south passenger movements crossing A110 and Southbury Road (see Figure 3-6). It is noted that observed counts for the Great Anglia and Great Northern trains are not available; however, they have been included for understanding through passenger trips on trains.

3.6.3. Validation of passenger flows at all screenlines developed for this study are presented in Table 3-19 and Table 3-20 for morning and afternoon peak periods, respectively. Total volumes across screenlines including all PT modes in Railplan are not validated here as observed counts for the National Rail lines are not available for comparison. Observed data that has been used for this comparison is NUMBAT data for London Overground, RODS for LUL and BUSTO data for buses.

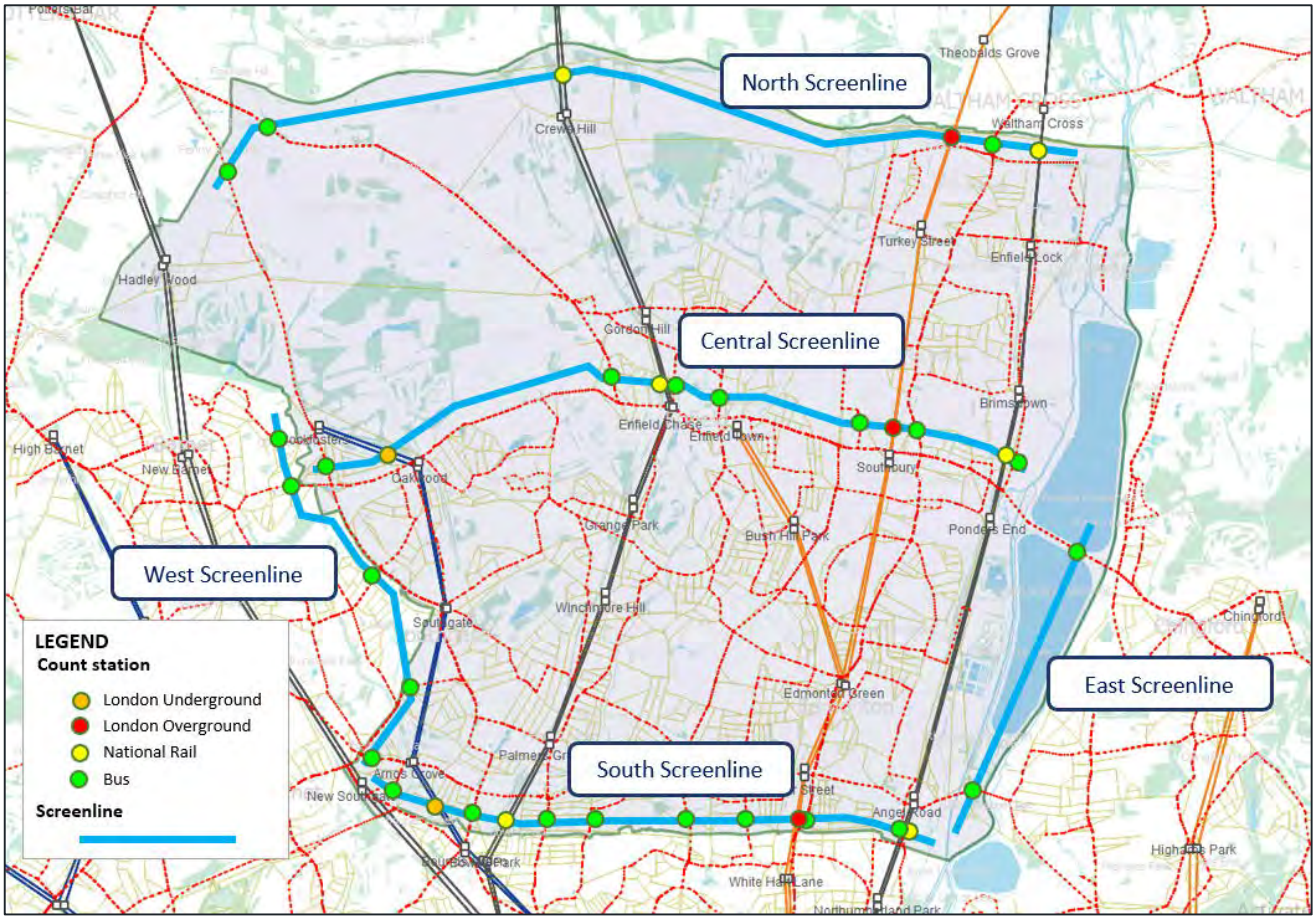


Figure 3-6: Screenline and Cordon system for Validation of Passenger Flows

Table 3-19: Validation of Passengers by Mode at Screenlines – AM Peak

Screenline	Mode	AM Peak (0700-1000)									
		NB /EB					SB / WB				
		Obs	Model	Diff %	Diff Abs	Meets Criteria?	Obs	Model	Diff %	Diff Abs	Meets Criteria?
North	Bus	1,214	893	-26%	-321	NO	602	611	2%	10	YES
	LUL										
	OV	194	798	312%	604	-	429	920	114%	491	NO
	NR		6,954					19,818			
Central	Bus	3,545	3,342	-6%	-203	YES	4,527	4,409	-3%	-118	YES
	LUL	404	276	-32%	-128	NO	1,059	813	-23%	-246	YES
	OV	475	793	67%	318	NO	884	1,792	103%	908	NO
	NR		7,460				0	24,105			
South	Bus	5,240	4,634	-12%	-606	YES	9,416	7,999	-15%	-1,417	NO
	LUL	2,389	2,439	2%	51	YES	9,026	9,382	4%	356	YES
	OV	2,555	2,570	1%	15	YES	6,861	10,147	48%	3,286	NO
	NR		7,995					30,756			
East	Bus	1,539	1,822	18%	283	NO	1,229	1,363	11%	134	YES
West	Bus	2,931	3,885	33%	955	NO	3,007	3,795	26%	788	NO

Table 3-20: Validation of Passengers by Mode at Screenlines – PM Peak

Screenline	Mode	PM Peak (1600-1900)									
		NB					SB				
		Obs	Model	Diff %	Diff Abs	Meets Criteria?	Obs	Model	Diff %	Diff Abs	Meets Criteria?
North	Bus	802	458	-43%	-344	NO	847	1,034	22%	187	NO
	LUL										
	OV	358	697	95%	339	NO	210	697	231%	486	-
	NR		22,403					8,220			
Central	Bus	4,092	4,078	0%	-14	YES	3,009	3,178	6%	169	YES
	LUL	999	812	-19%	-187	YES	525	449	-15%	-77	YES
	OV	716	1,571	119%	855	NO	402	874	117%	472	NO
	NR		25,687					9,297			
South	Bus	9,204	8,978	-2%	-226	YES	6,124	4,817	-21%	-1,307	NO
	LUL	7,174	7,765	8%	590	YES	3,496	3,495	0%	0	YES
	OV	5,846	8,184	40%	2,339	NO	3,282	3,291	0%	9	YES
	NR		32,809					10,458			
East	Bus	1,220	1,616	32%	396	NO	1,251	1,463	17%	212	NO
West	Bus	2,793	3,690	32%	897	NO	2,422	3,746	55%	1,324	NO

LONDON OVERGROUND AND LONDON UNDERGROUND

3.6.4. Link flow validation results for the Lea Valley lines within LBE have been presented in Section 3.3. Here, screenline analysis further confirms that the over-estimation of passenger flows on Lea Valley lines is partly related to demand for travel to/from areas beyond LBE. This is exemplified by the over-estimation of London Overground passenger flows at the north screenline, where Railplan over-estimates passenger flows by 604 (+312%) and 491 (+114%) passengers for the outbound (northbound) and inbound (southbound) travel at cordons during the morning peak period, respectively, as shown in Table 3-19. During the afternoon peak period, Railplan over-estimates passenger demand by 339 (+95%) and 486 passengers (+231%) for the outbound (northbound) and inbound (southbound) movements at the north screenline, as shown in Table 3-20.

3.6.5. Link flows for the Piccadilly Line, on the other hand, are well validated as described in Section 3.2. Screenline validation results indicate that Railplan over-estimates cordon outbound (i.e., southbound at south screenline) passengers by 4% (+359) and 2% (+49) passengers travelling inbound (i.e., northbound at south screenline) on the Piccadilly Line during the morning peak period, both satisfying the validation criteria, as shown in Table 3-19. For the afternoon peak period, Railplan over-estimates demand for the Piccadilly Line for just 8% (+594) at the south screenline, which indicates that movement coming inbound to LBE is validated well for the peak direction, as shown in Table 3-20.

BUS DEMAND

3.6.6. Amongst the various north-south movements (i.e., at north, central and south screenlines), modelled passenger demand is the highest at the south screenline, which captures 4,634 and 7,999 passengers travelling northbound and southbound, respectively during the morning peak period, as shown in Table 3-19. This is compared to 893 and 3,342 passengers travelling northbound by buses during the morning peak at the north and central screenlines, respectively, and 611 and 4,409 passengers travelling southbound during the morning peak at the north and central screenlines.

3.6.7. For the south screenline, northbound modelled flows are validated well against observed BUSTO data, with Railplan underestimating demand by 12% (-606 passengers), whilst underestimating demand by 15% (-1,417 passengers) for the southbound direction during morning peak period, as shown in Table 3-19.

3.6.8. Along the central screenline, bus passenger flows crossing the northern and southern part of LBE are also validated well, with 6% (-203 passengers) and 3% (-118 passengers) under-estimation of passengers during the morning peak period for the northbound and southbound directions, respectively, as shown in Table 3-19.

3.6.9. Overall, bus passenger flows are validated well at LBE cordons during the morning peak period, with inbound bus trips over-estimated by 5% (+492 passengers), and outbound bus trips under-estimated by 4% (-667 passengers) during the morning peak period, as shown in Table 3-21.

3.6.10. For the afternoon peak, modelled passenger demand is also the highest at the south screenline, which captures 8.978 and 4,817 passengers travelling northbound and southbound, respectively, as shown in Table 3-20. This is compared to 458 and 4,078 bus passengers travelling northbound at the north and central screenlines, respectively, and 1,034 and 3,178 bus passengers travelling southbound during the afternoon peak at the north and central screenlines.

3.6.11. For the south screenline during afternoon peak period, northbound modelled flows are validated well against observed BUSTO data, with Railplan underestimating demand by 2% (-226 passengers), whilst underestimating demand by 21% (-1,307 passengers) for the southbound direction during morning peak period, as shown in Table 3-19.

3.6.12. Along the central screenline, bus passenger flows are also validated well, with 0% (-14 passengers) and 6% (+169 passengers) difference only during the afternoon peak period for the northbound and southbound directions, respectively, as shown in Table 3-19.

3.6.13. At cordon level during the afternoon peak period, overall, bus passenger flows are validated well at LBE cordons, with inbound bus trips over-estimated by 8% (+1,070 passengers), and outbound bus trips over-estimated by 1% (+69 passengers) during the afternoon peak period, as shown in Table 3-21.

Table 3-21: Validation of Bus Passenger Flows at Cordons

Cordon	AM Peak (0700-1000)					PM Peak (1600-1900)				
	Obs	Model	Diff %	Diff Abs	Meets Criteria?	Obs	Model	Diff %	Diff Abs	Meets Criteria?
Inbound	10,002	10,494	5%	492	YES	14,094	15,164	8%	1,070	YES
Outbound	15,176	14,509	-4%	-667	YES	10,567	10,636	1%	69	YES

NATIONAL RAIL

3.6.14. Despite that observed passenger flows are not available, modelled passenger flows are included in the screenline for understanding the passenger demand that pass through LBE only. Screenline results presented in Table 3-22 indicate that for the peak direction during the morning peak period, which is the southbound direction, there are 19,811 passengers that travel inbound from the north LBE boundary. After accounting for the boarding and alighting for national rail stations within LBE, there are 30,756 passengers that cross the south screenline, which represents a 55% increase (+10,938) of train passengers comparing to the inbound trips at the north screenline, as summarised in Table 3-22.

3.6.15. During the afternoon peak period, passenger demand reduces from 32,806 passengers travelling northbound at the southern boundary of LBE to 22,403 passengers leaving LBE at the north boundary. This represents a 32% reduction (-10,406) of the passenger flows that are primarily associated with alighting within LBE during the afternoon peak.

3.6.16. These results indicate that a large proportion of National Rail passengers are either originated from or destinated to LBE during the peak period. Therefore, despite the fact that rail demand within LBE are not validated, any changes of rail demand in forecasting scenarios should still be assessed relative to the base volumes, rather than the absolute differences between scenarios for rail demand.

Table 3-22: Validation of National Rail Passenger Flows at Screenlines

Screenline	AM Peak						PM Peak					
	NB			SB			NB			SB		
	Model	vs. south screenline		Model	vs. north screenline		Model	vs. south screenline		Model	vs. north screenline	
North	6,954	-1,041	-13%	19,818			22,403	-10,406	-32%	8,220		
Central	7,460	-535	-7%	24,105	4,287	22%	25,687	-7,123	-22%	9,297	1,077	13%
South	7,995			30,756	10,938	55%	32,809			10,458	1,161	14%

4 CONCLUSION

4.1.1. This LMVR has detailed the update of Railplan 8 base year scenarios including the network and zone refinements incorporated, use of the observed data (where it exists) and the results of the calibration and validation against observed data following standards outlined in DfT's TAG. It is important to understand that the Railplan model will be used to assess the proposed Local Plan growth within LBE and the impacts the growth will have on passenger demand on public transport services in the borough. Therefore, in instances where at a detailed level there are some discrepancies between observed and modelled data, this is adequate for the purpose of the assessment, as long as we are mindful of this in the future scenarios analysis. We will ensure in the future year analysis we focus on the incremental change the scenarios have compared to the base year or the future Do Minimum scenario. This section provides a summary of these processes and lays out key results and insights.

4.1.2. New AM and PM peak period scenarios (REBASE-LBE) have been developed based on the TfL base year scenarios (BASE-TfL) in Railplan 8, where network updates are incorporated across LBE.

4.1.3. The revised scenario in REBASE-LBE includes the following network updates:

- Model Audit findings and recommendations for improvements, Table 2-1
- Network coding improvements to London Underground Stations, Table 2-2, National Rail and London Overground Services, Table 2-3 and changes to the street network, Table 2-4
- Improvements to zoning system and connectors, Table 2-5

4.1.4. Validation results indicate that modelled passenger flows in REABSE-LBE are validated well for link segments within study area for the Piccadilly line in both time periods. All link sections the Piccadilly line services in peak directions meet TAG validation criteria, with the exception of Oakwood-Cockfosters in the AM peak which falls just outside criteria. Boarding and alighting comparisons show one third of entry and exit flows for the four LUL stations (7 out of 16) modelled by Railplan fail to meet the TAG criteria. It is our view that the boarding and alighting estimates are broadly acceptable for the purposes of this study.

4.1.5. Link flows and boarding and alighting for the Lea Valley lines including the Enfield Town and Cheshunt branches have been compared against observed data however it is acknowledged by TfL that 2016 NUMBAT data for the London Overground was not available for Railplan 8 development, and this is why the validation performance is poor on these lines. We have undertaken some investigations into this issue and have not been able to find an easy resolution. Therefore, we are of the view that further improvements are not possible and the results will be adequate for the purposes of our assessment, ensuring in the forecasting work which will be undertaken we will bear this weakness in mind when analysing results.

4.1.6. National Rail services validate well against observed data and bus demand is validated well at borough level against observed data in TfL dashboard.

4.1.7. Screenlines and cordons comparisons have been undertaken where data is available however in many instances the data available does not includes all aspects of the modelled data therefore the comparisons have limited additional value.

4.1.8. In conclusion, WSP are of the view that the REBASE-LBE is of adequate standard to be used to assess the future year local plan growth scenarios proposed with development across the borough.

WSP will ensure that they are mindful of the weaknesses of Railplan in the areas identified and will take this into consideration when analysing the results.

WSP House
70 Chancery Lane
London
WC2A 1AF

wsp.com

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Enfield Local Plan

Local Model Validation Report - LoHAM

London Borough of Enfield

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ENFIELD – SATURN LOCAL MODEL VALIDATION REPORT

WSP

WSP House
70 Chancery Lane
London
WC2A 1AF

Phone: +44 20 7314 5000

Fax: +44 20 7314 5111

WSP.com

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1 INTRODUCTION

1.1 BACKGROUND

1.1.1. In August 2018, WSP was appointed by the London Borough of Enfield (LBE) to provide transport modelling services to support LBE with the preparation of their Local Plan. Strategic transport modelling is required to help provide the evidence base for assessing the impacts and the improvements required to support the proposed growth within the Borough. The LBE envisages a potential provision of at least 25,000 new homes up to 2039 at four designated areas including, Meridian Water, Southbury, Crew Hill and Chase Park. In terms of potential highway infrastructure, the study will closely monitor local roads, major A roads and the Strategic Road Network (SRN). Of the latter, the focus will be placed mainly at M25 Junctions 24 and Junction 25 that are in proximity to the Borough boundary.

1.1.2. The version of Transport for London's (TfL's) London Highway Assignment Model (LoHAM P4.2) has been used. LoHAM is a SATURN highway assignment model covering Greater London. An addendum in Chapter 6 is provided which shows the differences between LoHAM 4.2 and the latest 4.3. The base year model was developed to reflect 2016 network conditions and traffic data.

1.1.3. This Local Model Validation Report (LMVR) discusses the necessary amendments to re-calibrate the strategic highway model and documents the re-calibration and re-validation results of the model. Prior to this exercise, the model audit of LoHAM P4.2 was carried out in April-June 2021, and the audit concludes the LoHAM is deemed to be sufficiently detailed for the evaluation of the development proposals in the Borough subject to further calibration enhancement of key routes. The results of the audit are documented in this report entitled "LoHAM Base Model Audit Enfield Local Plan – Transport Assessment June 2021".

1.1.4. The model audit has been carried out in accordance with TfL's *"Sub-regional Highway Assignment Model Guidance on Model Use" (Version 2.6)* (TfL, 2017).

1.2 CONTEXT

1.2.1. Discussions with TfL resulted in a recommendation that WSP use TfL's strategic model LoHAM P4.2, which was released in 2020 with a revised base year of 2016. A key improvement of the model over the previous version is that it includes observed trip data derived from extensive mobile phone data. LoHAM P4.2 continues to operate within the LTS forecasting framework using the intermediary CHAMP process. The Enfield study area falls entirely within the area of most detail and was concluded to be a good starting point for the assessment of Enfield Local Plan in the Model Audit Report.

1.2.2. Use of HAMOC to create a smaller bespoke study area model was discussed with TfL, however use of the full LoHAM was preferred to a local HAMoc owing to the potential extent of forecast strategic impacts.

1.2.3. The base model re-calibration will focus on the primary roads in / near Enfield. Figure 1-1 shows the extent of the study area which includes Enfield Borough in addition to a 2km buffer and a number of environmentally sensitive areas where forecast traffic flows are likely to be of particular interest.

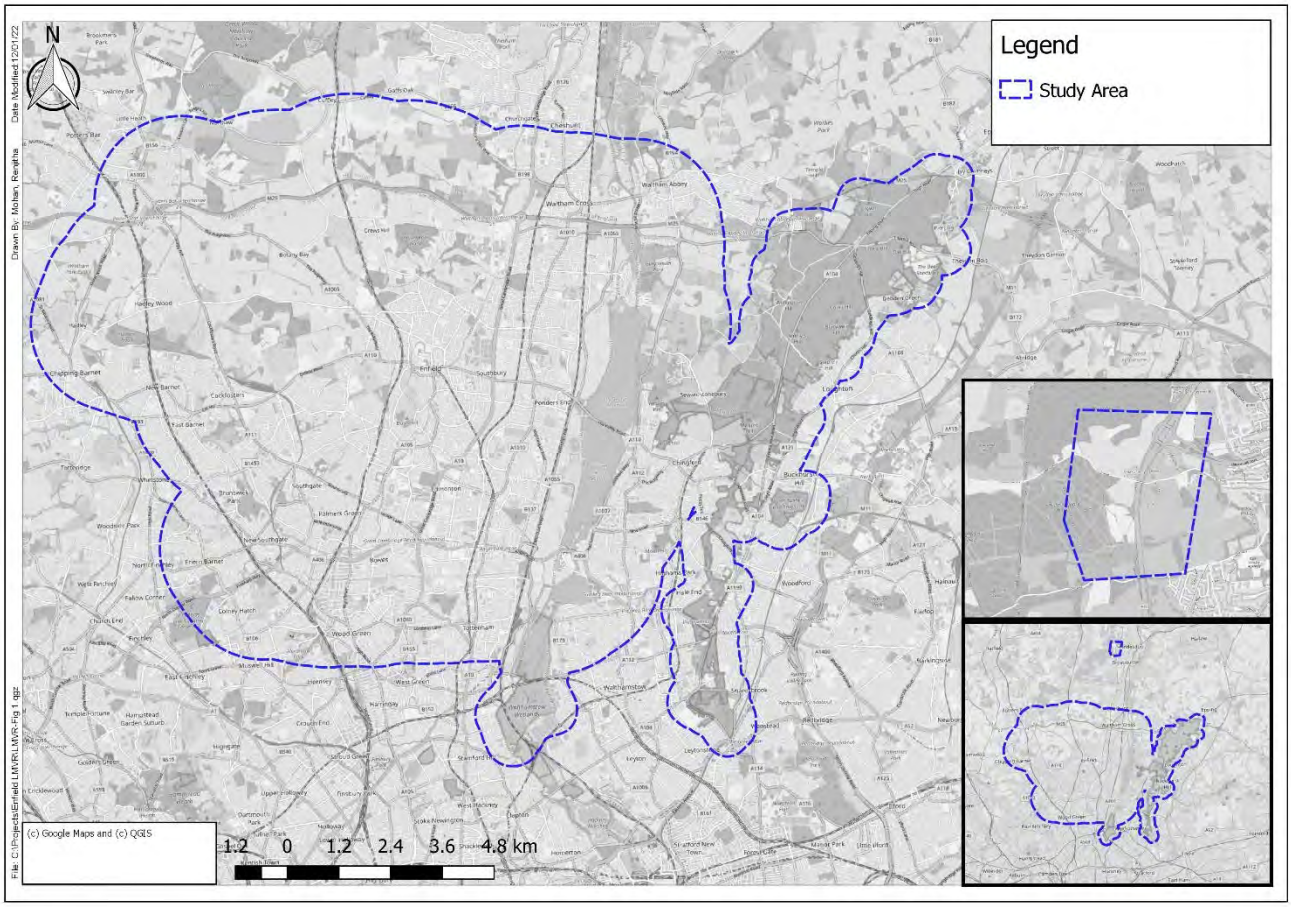


Figure 1-1: Enfield Site Location

1.3 TFL ENDORSEMENT

1.3.1. To achieve TfL endorsement on the HAM results, evidence of the calibration and validation of the LoHAM at both the strategic and local level will be required.

1.3.2. At the strategic level, it will be necessary to show that any enhancements of the model carried out at the local level have not had an adverse impact on calibration and validation statistics. At the local level, it will be necessary to show that the screenlines, counts and journey time routes relating to the study area calibrate and validate well.

1.3.3. Careful attention will be given to each individual feature described in this section, and it will be necessary to explain the reasons for any failing to meet the TAG criteria.

1.4 PURPOSE AND STRUCTURE OF THIS REPORT

1.4.1. The traffic assessment has been guided by the *"Sub Regional Highway Assignment Models. Guidance on Model Use" Version 2.6"* (TfL, June 2017) and it is being completed in several stages:

Stage 1: Inception
Stage 2a: Base Year Model Audit
Stage 2b: Base Year Model re-validation and re-calibration *(if required)*
Stage 3a: Forecast Year Model Audit *(required)* and refinement *(if required)*
Stage 3b: Assessment of planning data and preparation of scenarios
Stage 4: Highway Impact Assessment and reporting
Stage 5: Present findings of the assessment to TfL and London Borough of Enfield and discuss mitigation

1.4.2. This report was prepared following Stage 2a, which indicated the need for base model revalidation and recalibration in the study area. Stage 2a was described in the "LoHAM Base Model Audit. Enfield Local Plan – Transport Assessment June 2021", June 2021.

1.4.3. The purpose of this LMVR is to describe Stage 2b, which deals with the recommendations raised in the base year model audit.

1.4.4. After the introductory chapter, the LMVR is structured as follows:

Chapter 2: *Base Model Updates* – discusses the refinements and updates made to the LoHAM as part of the base model audit, as well as the validation and calibration process;
Chapter 3: *Calibration and Validation* – presents the results of the re-calibration and validation exercise;
Chapter 4: *Model Sense Checks* – outlines the realism checks that were carried out on the final model assignments.

2 BASE MODEL UPDATES

2.1 INTRODUCTION

2.1.1. TfL provided WSP with the latest version of MoTiON in March 2021. The package of files received included LoHAM v4.2 and Railplan v8.0.

2.1.2. The LoHAM base year model was developed by TfL to represent November 2016 network conditions based on the 2016 highway network and traffic demands that were developed from mobile network data. The models provided by TfL cover the following three time periods as listed below, however it has been agreed with LBE and TfL that only the AM and PM periods will be assessed for the purposes of the Enfield Local Plan assessment.

- AM Peak (08:00-09:00)
- IP Peak (average 10:00 – 16:00)
- PM Peak (17:00-18:00)

2.1.3. The Model Audit Report concluded that the existing 2016 base year is deemed to be sufficiently detailed for the assessment of the highway impacts for the transport assessment of Enfield Local Plan subject to further re-calibration of individual link counts and journey times within the study area.

2.1.4. The LoHAM 4.2 model was developed using SATURN version 11.5.05H and this version of SATURN has continued to be used throughout the modelling work. The files used as a basis for the audit and subsequent model updates were as follows:

- L4-2_BY16_V002NET_R046_AM_F.UFS dated 13/08/2020 (AM Peak)
- L4-2_BY16_V002NET_R046_AMq_F.UFS dated 13/08/2020 (AM Peak preload file)
- L4-2_BY16_V002NET_R046_PM_F.UFS dated 13/08/2020 (PM Peak)
- L4-2_BY16_V002NET_R046_PMq_F.UFS dated 13/08/2020 (PM Peak preload file)

2.1.5. The versions of the model given to WSP by TfL will henceforth be referred to as LoHAM , while the final models produced by the calibration and validation exercise will be referred to as the LBE Model.

RE-CALIBRATION APPROACH

2.1.6. The re-calibration exercise relied on the data from the original calibration and validation of LoHAM, and a series of network amendments were carried out. Matrix estimation was also undertaken following the network amendments to improve the model performance within the LBE study area. Due to the extensive coverage of the study area, 32 additional 2019 traffic counts provided by LBE were also adopted. The LBE traffic counts were selected to cover minor roads of the study area and the majority of these counts are adopted as validation counts only. The counts are not used for matrix estimation but are compared with model flows to ensure better representation in these areas. Six additional counts provided by LBE have been included in matrix estimation. The locations of these counts are listed as follows. Their locations are also illustrated in Figure 3-2.

- Hertford Road near Forest Road junction (NB and SB)
- Mollison Avenue near Millmarsh Lane (NB and SB)
- Church Street near Haselbury Road (EB and WB)

2.1.7. LoHAM has a base year of 2016, TfL are currently updating the base year to 2019 but this will not be available until later in 2022 therefore the 2016 model has been used for this study.

2.1.8. No change was carried out on the prior matrix to ensure consistency with the higher-level MoTiON demand model.

LBE COUNT HARMONISATION

2.1.9. Since the traffic counts provided by LBE were collected in March 2019, annual and seasonal adjustments were necessary to adjust these counts to 2016 traffic level. TfL had previously calculated factors to adjust other counts used for LoHAM (documented in Technical Note 03 LoHAM P4 Harmonisation Factors of the LoHAM Modelling Package). These factors were therefore applied to the LBE counts and are outlined in Table 2-1.

Table 2-1: Count Harmonisation Factors

	Annual factor to convert from 2019 to 2016						Seasonal Factor (March)
	AM			PM			
Vehicle Class	Car & Taxi	LGV	HGV	Car & Taxi	LGV	HGV	All
Factor	0.99	0.96	1.02	0.99	0.97	1.03	1.00

Source: Technical Note 03 LoHAM P4 Harmonisation Factors

2.2 MODEL REFINEMENTS

2.2.1. To improve LoHAM within the study area, network refinements were carried out following the recommendations of the base Model Audit Report, which included revising zone connectors and revision of the network structure and intersections. Further refinements were then carried out as part of the calibration and validation exercise. All of the changes made are summarised in the following sections of Chapter 2.

2.2.2. As discussed in the Model Audit Report, AECOM had previously conducted a separate audit of LoHAM V4.01 within the Enfield Borough boundary. These changes were reviewed during WSP's

audit and it was agreed to incorporate their proposed network amendments in this recalibration exercise. These changes are also summarised in the following sections.

ZONE CONNECTOR CHANGES

2.2.3. Based on TfL's guidance, a total of 31 zones within study area were remodelled with spigot type centroid connectors to load zonal trips to the highway network. This revision includes both the addition of new connectors and the modification of existing zone connectors within the study area.

2.2.4. This upgrade will allow more accurate loading locations and better representation of real-life traffic patterns. Furthermore, zone connectors along the key routes and critical area are reviewed to better represent zone connection to the highway network. The locations of the revised spigot connections for various zones are shown below in Figure 2-1.

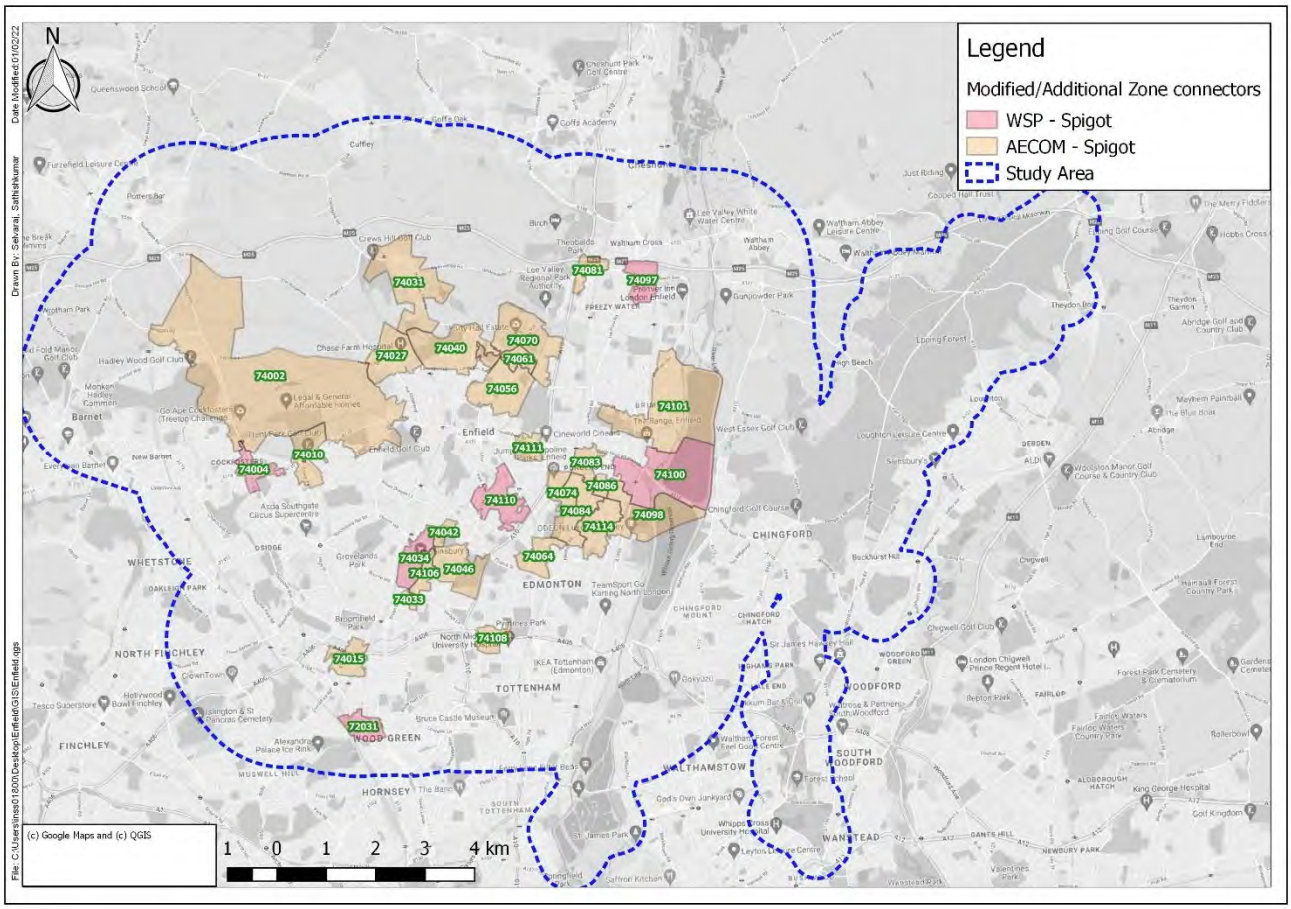


Figure 2-1: Revised Spigot Connection around the Study Area

NETWORK AMENDMENTS IDENTIFIED IN AUDIT

2.2.5. Apart from the spigot upgrade and review, the audit process identified a number of coding issues with the study area and these issues had been rectified. The changes fall into following categories:

- Incorrect junction type
- Missing stacking capacities
- Speed flow curve, speed or distance differ by direction
- Increased no. lanes instead of using flares
- Corrections to coded distances
- Bus lane amendment
- Additional of network link (e.g. Mound Road, Upshir Road)
- Conversion of A406/Harbet Rd/Walthamstow Ave/Advent Way roundabout to exploded roundabout

NETWORK REVIEW

2.2.6. Figure 2-2 shows the junction/road sections reviewed as part of the calibration and validation process. WSP has also carried out a light touch review on the junctions in addition to the AECOM review. As part of the network refinement, Upshir Road, Woodgreen Road and Mount Road have been added to the base model.

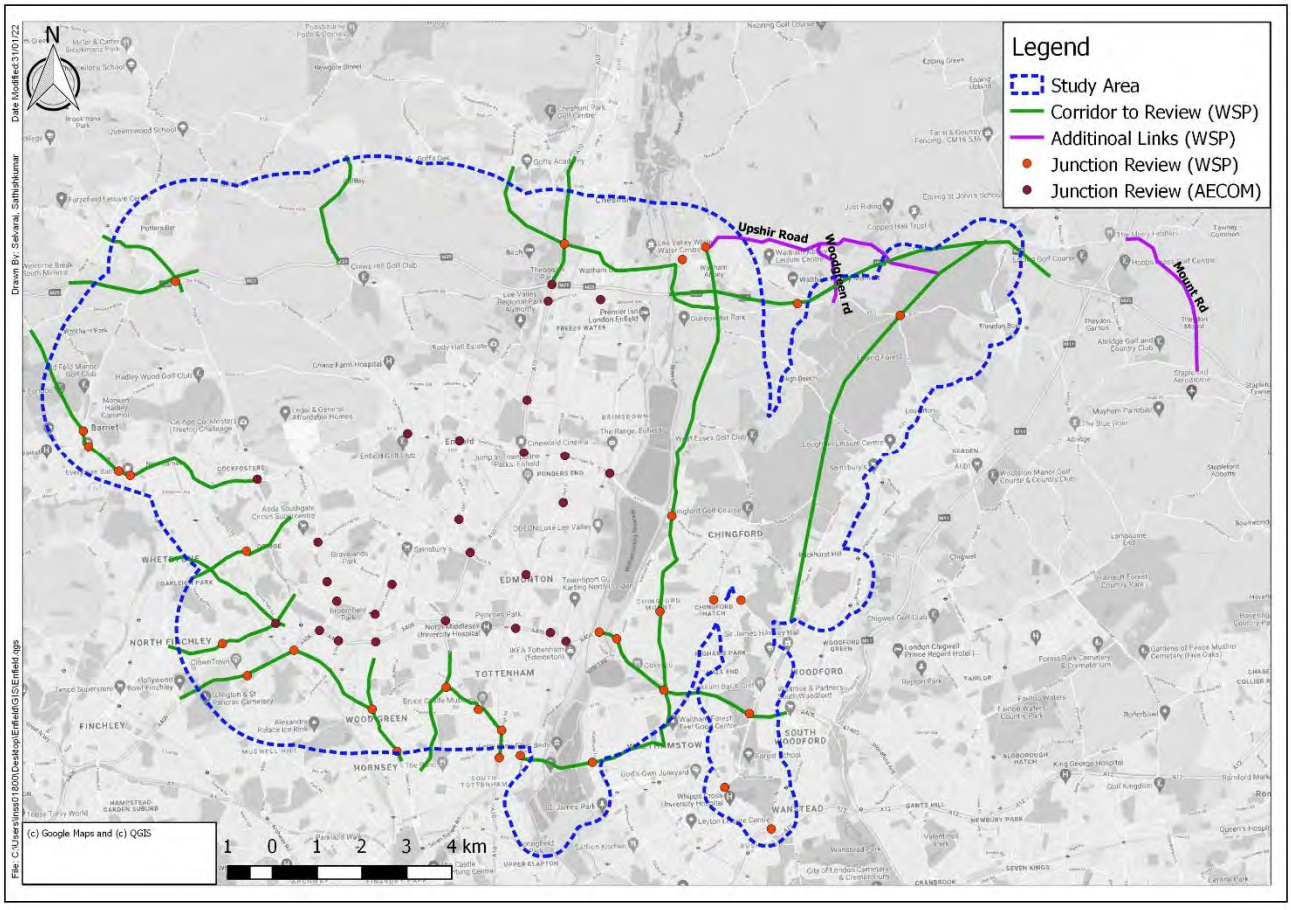


Figure 2-2: Network Structure Review within Study Area

CALIBRATION AND VALIDATION NETWORK CODING REFINEMENTS

2.2.7. In addition to the review of coding issues identified in the audit process, additional network links in the vicinity of the Borough, and other network refinements were made as part of the calibration and validation process to improve the accuracy of the model. These refinements included:

- Corrections to local junction configurations
- Corrections to saturation flows
- Review of priority markers on M25
- Review of the speed flow curve assumption on key roads
- Review of zone connectors along Mollison Ave, etc.

2.3 MATRIX ESTIMATION

2.3.1. Prior to any matrix estimation (ME) being undertaken the performance of the local counts with the existing matrix was reviewed and counts failing to meet criteria investigated to ensure any coding issues were addressed.

2.3.2. TfL provided tools to carry out the matrix estimation through the use of batch files. These were modified to take account of the updated matrices and network. The counts were also re-ordered slightly in terms of importance to the key area. As discussed in Section 2.1.6, a total of 26 additional 2019 link counts provided by LBE were adopted for validation and 6 counts of the same source were included for matrix estimation to better represent the traffic level of minor roads within the Borough.

2.3.3. Table 2-2 specifies some of the key parameters within the SATME2 control files used for the ME process.

Table 2-2: SATME2 Parameter

SATME2 Parameter	Value
SEED	0
EPSILN	0.005
XAMAX	5
ITERMX	100

2.3.4. The results of ME will be discussed in Chapter 3 of this report, however the Prior and Post-ME matrix totals and trip length distribution plots are presented in Appendix A. Overall, the matrix changes following the ME exercise are small as expected, with 1.2% absolute differences between the Prior and Post-ME matrices for AM peak and 1.9% differences for PM peak. The results for LoHAM P4.2 as received from TfL are also included in the appendix for comparison purposes, similar changes of trip distribution following matrix estimation can also be observed. For example, the AM peak matrix total for UC4 was increased by 32% in LBE model and 31% in LoHAM model following matrix estimation.

2.3.5. A detailed sector-to-sector analysis for the LBE Prior, Post ME for LBE and LoHAM P4.2 matrices is also presented in Appendix B to assess the changes of OD movements before and after matrix estimation. A diagram showing the sector definition is also presented in the Appendix. Comparing the Enfield trips between the before and after ME matrices, a larger increase is observed for internal

(intra) trips within Enfield borough sector (at 3,500 and 3,900 for AM and PM respectively), than the trips to/from outside of the Borough. Further comparison of the LoHAM P4.2 results indicate similar increase of internal trips within Enfield sector.

3 CALIBRATION AND VALIDATION

3.1 INTRODUCTION

3.1.1. This chapter of the LMVR outlines the results of the calibration and validation exercise carried out on the LBE model in the study area. This calibration and validation exercise included the following:

- Work to improve the level of calibration and validation of the individual link count within the study area;
- Work to improve the level of calibration and validation of screenlines within the study area; and
- An assessment of the level of validation of the agreed journey time routes in the study area.

3.1.2. Local validation results have been presented in accordance with current guidance in TAG Unit M3.1, which is summarised for each element of the validation process in Table 3-1.

Table 3-1: TAG Unit M3.1 Criteria

Element of Calibration and Validation Exercise	TAG Unit M3.1 Criteria	TAG Unit M3.1 Guideline
Screenlines	Differences between modelled flows and counts should be less than 5% of the counts	Should apply to >95% of screenlines
Link Flows	Individual flows within 100 veh/h of counts for flows <700veh/h Individual flows within 15% of counts for flows from 700 to 2,700 veh/h Individual flows within 400 veh/h of counts for flows >2,700 veh/h **OR** GEH <5 for individual flows	Links and turns should pass either the flow or GEH criteria in >85% of cases
Journey Times	Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%)	Should apply to >85% of routes

3.1.3. TfL have provided WSP with their Dashboard covering all of LoHAM (Dashboard_v4.30_R46_AMF_IPF_PMF.xlsb), as well as their Journey Time Analysis Tool across the HAM (HAM_JTAT_v24_R46.xlsb), to monitor the model accuracy against TAG criteria. The calibration results in TfL dashboard format are presented in Appendix F.

3.1.4. For assessing the performance of the LBE model in relation to the Enfield study area, the re-calibration exercise is focused at two levels:

- Within the study area within the LBE; and
- Across the whole of LoHAM.

3.1.5. The performance of individual criteria is discussed in further detail within this chapter.

3.2 LINK FLOWS

3.2.1. As discussed in Section 2.1.7, two sets of traffic counts were adopted for the calibration and validation exercise. WSP adopted the observed counts provided by TfL (LoHAM) to carry out matrix estimation; the locations of these counts can be seen in Figure 3-1. All TfL counts were included in calibration for matrix estimation to improve the performance within the study area, i.e. no counts were held back for independent validation. No adjustments were carried out to the TfL traffic counts.

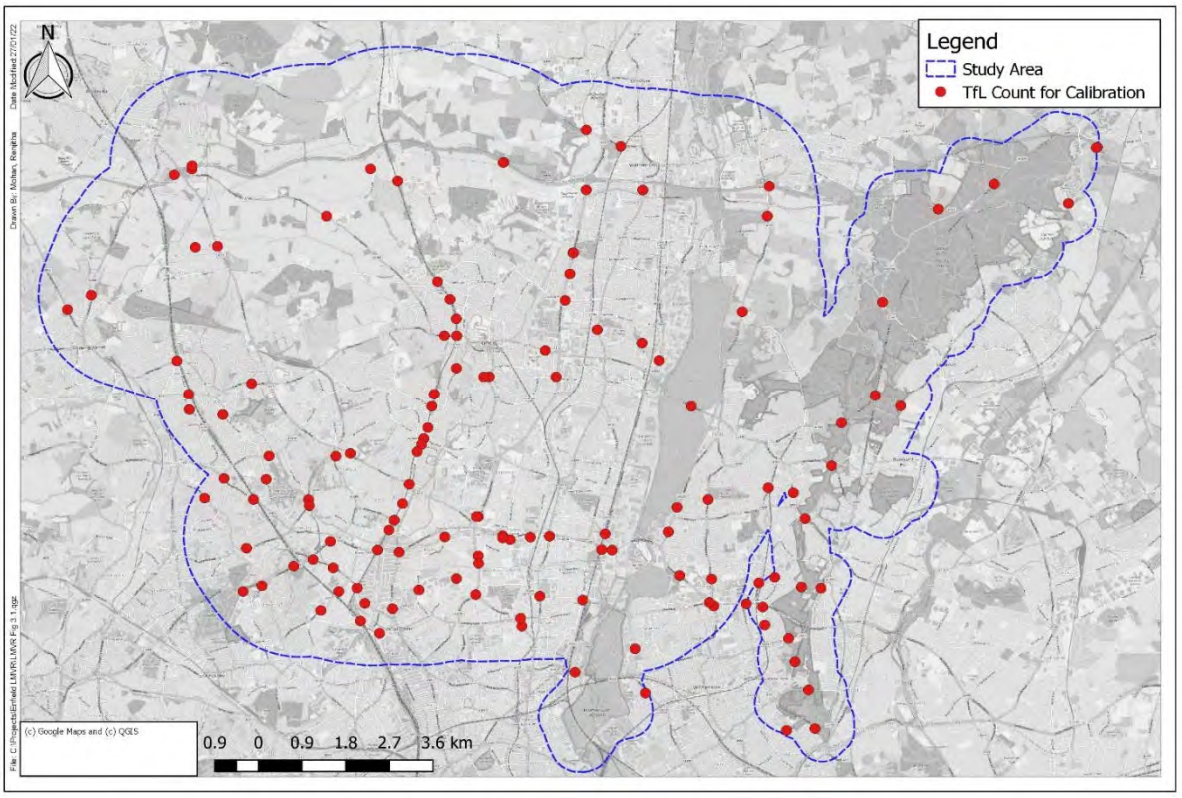


Figure 3-1: Location of TfL Traffic Counts

3.2.2. A total of 13 two-way traffic counts provided by LBE were adopted as independent validation counts, and another 3 two-way LBE counts were adopted for matrix estimation as shown in Figure 3-2. The main purpose of including these counts was to improve the count coverage to minor roads within the Borough, which were not covered by the LoHAM original calibration.

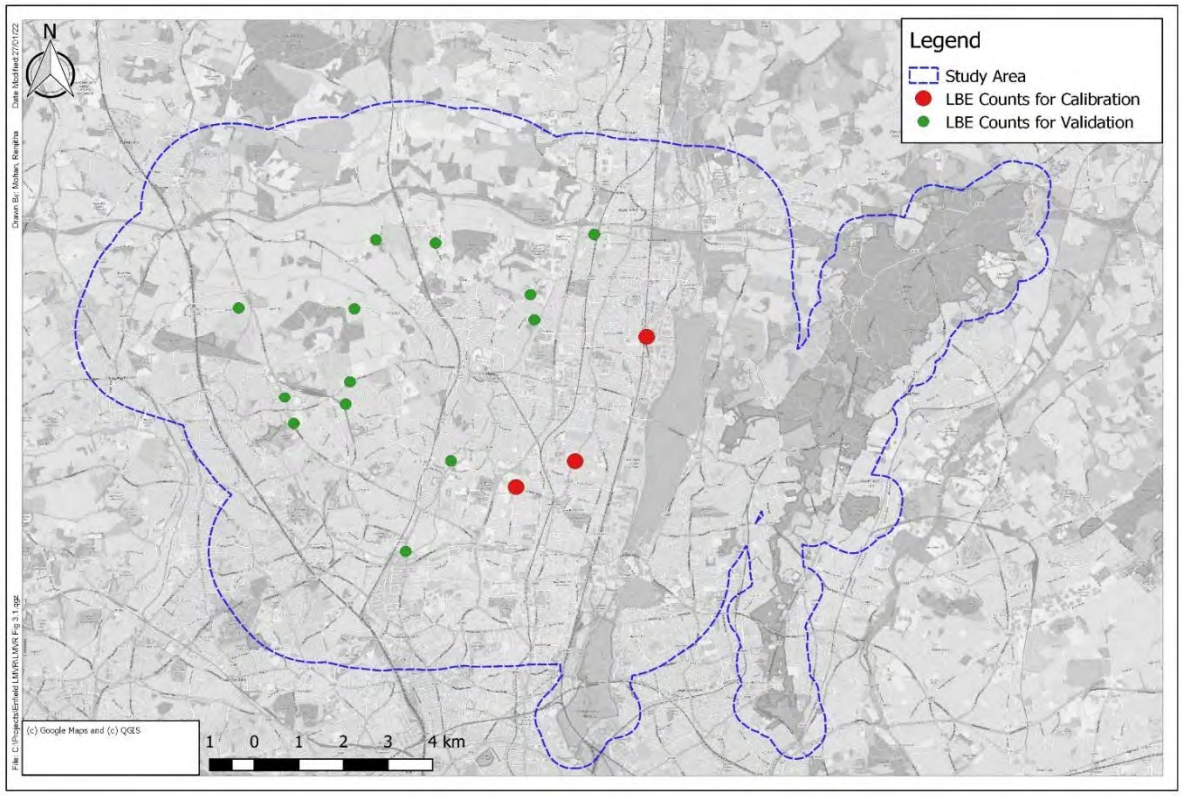


Figure 3-2: Location of LBE Traffic Counts

AM MODEL LINK CALIBRATION AND VALIDATION

3.2.3. The percentage of links passing the criteria in the AM peak in both the local area and the wider LoHAM is presented in Table 3-2 both before and after the calibration exercise was undertaken (LoHAM and LBE Model respectively).

3.2.4. The data within the LBE study area consisted of 249 directional link counts, 81% of which pass either the flow or GEH criteria in the AM period. In the wider model, the percentage of links passing either the flow or GEH criteria is 76%. This shows an improvement from LoHAM within the study area, where 73% of links passed in the study area and 76% in the wider model respectively. Figure 3-3 shows the AM Peak counts in and around the study area that pass the TAG criteria in green, and those that fail in blue, yellow or red dependent on the GEH.

Table 3-2: Summary of Calibration Statistics – AM Peak

Criteria	Acceptability Guideline	LoHAM P 4.2				LBE Model			
		Whole Model		Study area		Whole Model		Study area	
		No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline
Flows < 700vph	>85% of Links	2,734	70%	166	62%	2,734	70%	166	71%
Flows 700-2,700vph	>85% of Links	1,165	81%	72	82%	1,165	81%	72	82%
Flows >2,700vph	>85% of Links	183	96%	11	100%	183	93%	11	91%
GEH <5	>85% of Links	4,082	71%	249	69%	4,082	71%	249	77%
Flow Acceptable or GEH <5	>85% of Links	4,082	76%	249	73%	4,082	76%	249	81%

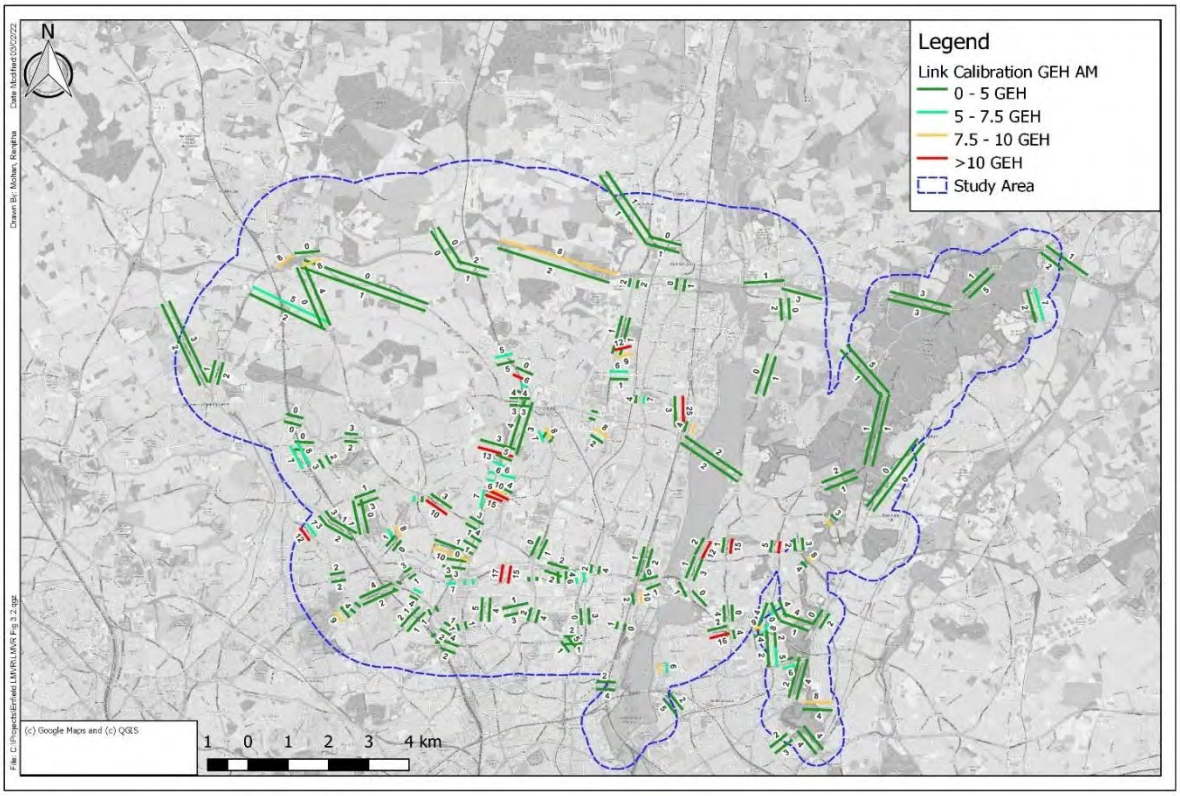


Figure 3-3: Link Calibration in Study Area - AM Peak

3.2.5. The independent link counts, or validation counts, 81% of 26 counts meet the link flow criteria. This is vastly improved over LoHAM where only 35% of the same counts met criteria. The breakdown of the validation link count results can be found in Table 3-3. The location and performance for these counts are illustrated in Figure 3-4.

3.2.6. The flow difference between LoHAM and LBE model for the AM time period is shown in Figure 3-5.

3.2.7. A detailed table of link count performance for the LBE model can be found in Appendix C. The appendix includes the link calibration results for all vehicle types and for car and taxi only.

Table 3-3: Summary of Validation Statistics – AM Peak

Criteria	Acceptability Guideline	AM			
		LoHAM		LBE Model	
		No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline
Flows < 700vph	>85% of Links	21	38%	21	57%
Flows 700-2,700vph	>85% of Links	5	0%	5	40%
Flows >2,700vph	>85% of Links	0	0%	0	0%
GEH <5	>85% of Links	26	31%	26	81%
Flow Acceptable OR GEH <5	>85% of Links	26	35%	26	81%

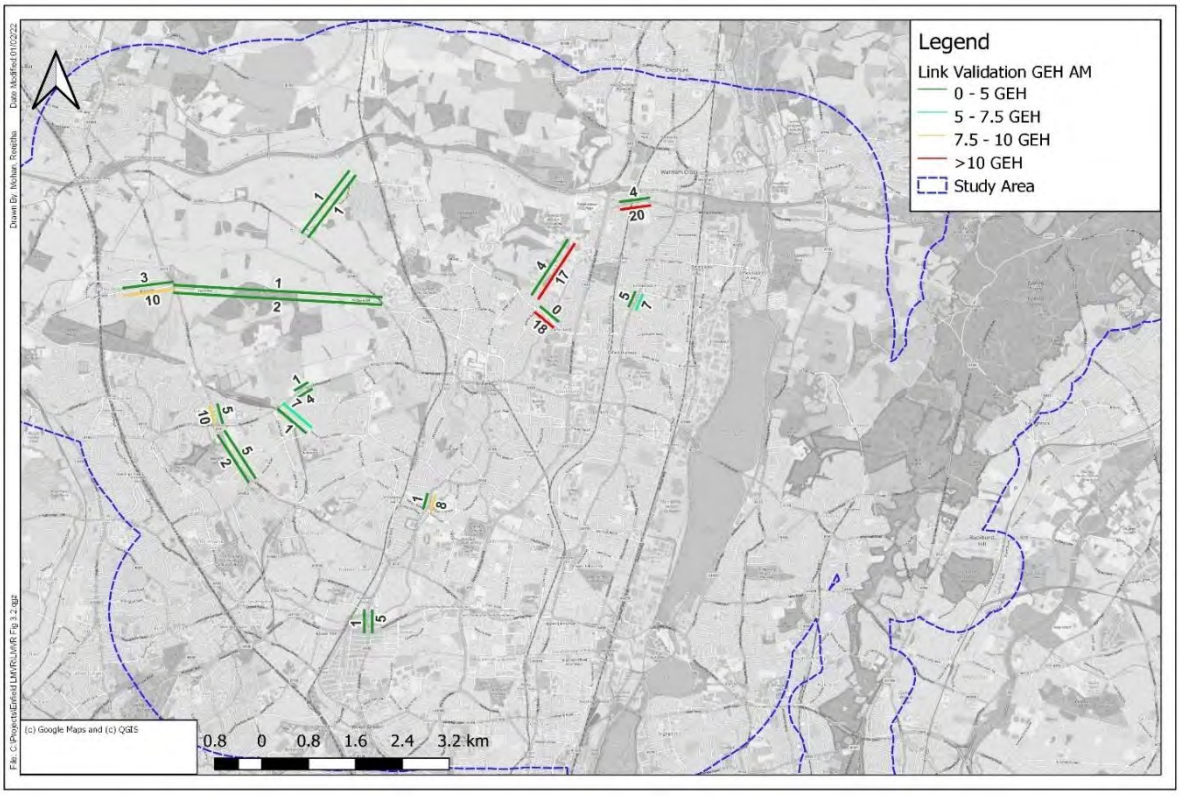


Figure 3-4: Link Validation in Study Area - AM Peak

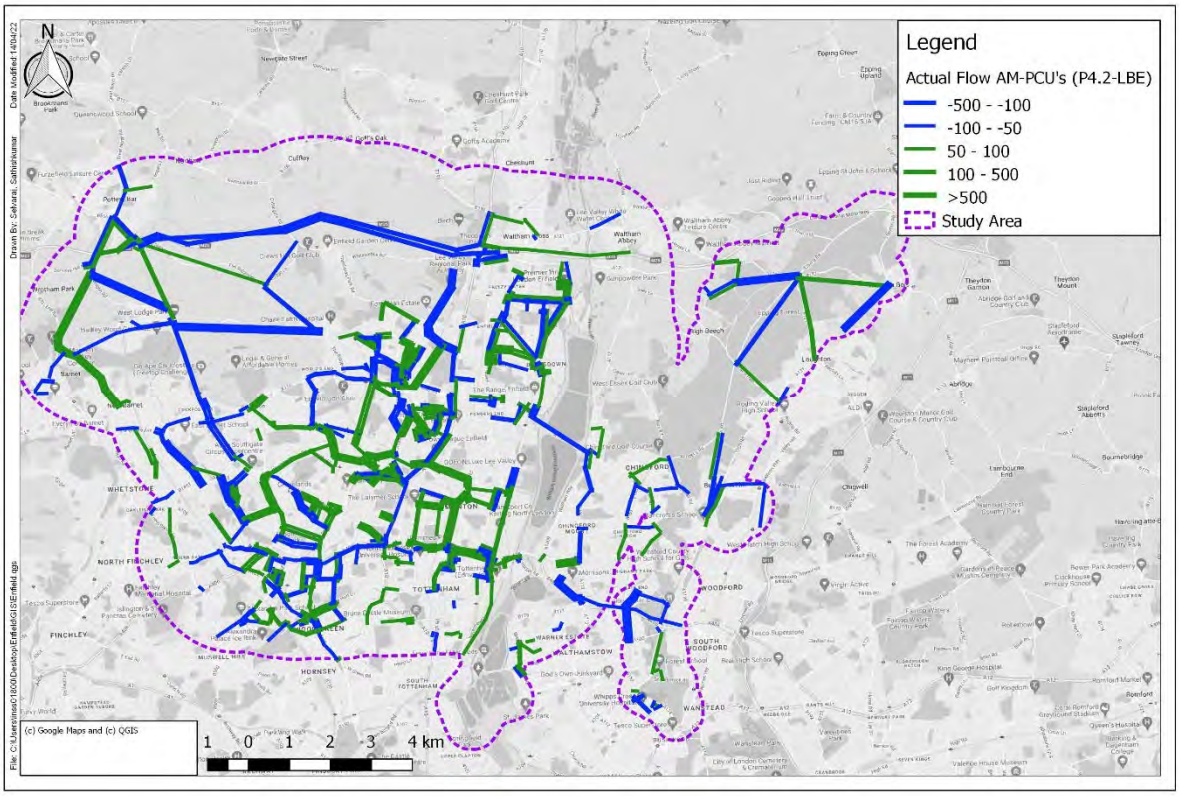


Figure 3-5: Link Flow Difference in Study Area - AM Peak

PM MODEL LINK CALIBRATION AND VALIDATION

3.2.8. Table 3-4 shows the PM peak model percentage of calibration links counts passing the TAG criteria in both the study area and the wider LoHAM area before and after the calibration exercise respectively. Similar statistic for the validation link counts is presented in Table 3-5.

3.2.9. Of the 249 calibration counts in the study area, 81% of links pass either the flow or GEH criteria. In the wider model, 77% of links pass either of the criteria. This shows an improvement for the study area statistic from LoHAM, where 76% of links in the study area and 77% for the wider model passed.

3.2.10. In terms of the validation counts, 77% of the 26 counts meet the TAG criteria. This also improved over the original LoHAM (when these counts are not considered), with only 46%. The breakdown of the validation counts is included in Table 3-5.

3.2.11. Figure 3-6 and Figure 3-7 shows the calibration and validation counts in and around the study area that pass TAG criteria in green, and those that failed in red, in the PM peak. The flow difference between LoHAM and LBE model for AM time period is shown in Figure 3-8.

3.2.12. A detailed report of link count performance for PM peak model can be found in Appendix C.

Table 3-4: Summary of Calibration Statistics – PM Peak

Criteria	Acceptability Guideline	LoHAM P 4.2				LBE Model			
		Whole Model		Study area		Whole Model		Study area	
		No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline
Flows < 700vph	>85% of Links	2,695	70%	167	69%	2,695	71%	167	75%
Flows 700-2,700vph	>85% of Links	1,185	80%	70	84%	1,185	82%	70	86%
Flows >2,700vph	>85% of Links	202	91%	12	92%	202	91%	12	92%
GEH <5	>85% of Links	4,082	71%	249	71%	4,082	72%	249	78%
Flow Acceptable or GEH <5	>85% of Links	4,082	77%	249	76%	4,082	77%	249	81%

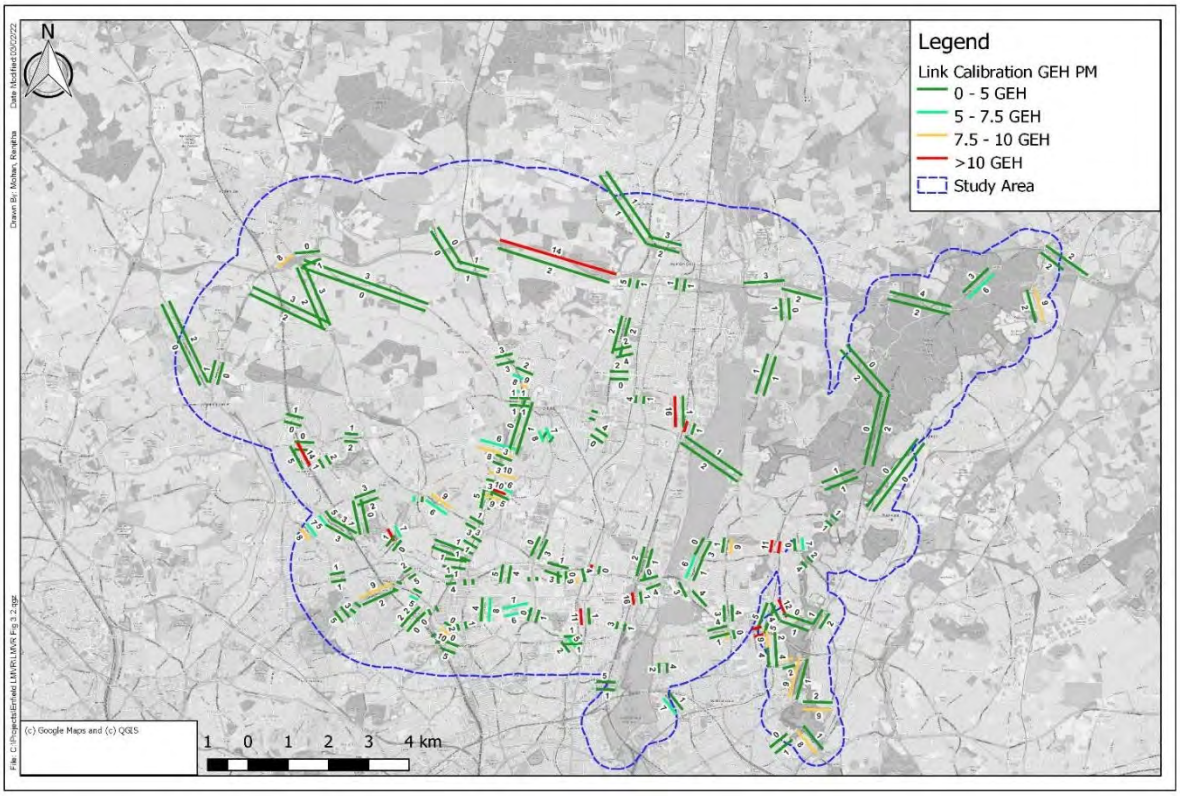


Figure 3-6: Link Calibration in Study Area - PM Peak

Table 3-5: Summary of Validation Statistics – PM Peak

Criteria	Acceptability Guideline	PM			
		LoHAM		LBE Model	
		No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline
Flows < 700vph	>85% of Links	22	36%	22	50%
Flows 700-2,700vph	>85% of Links	4	50%	4	50%
Flows >2,700vph	>85% of Links	0	0%	0	0%
GEH <5	>85% of Links	26	38%	26	73%
Flow Acceptable or GEH <5	>85% of Links	26	46%	26	77%

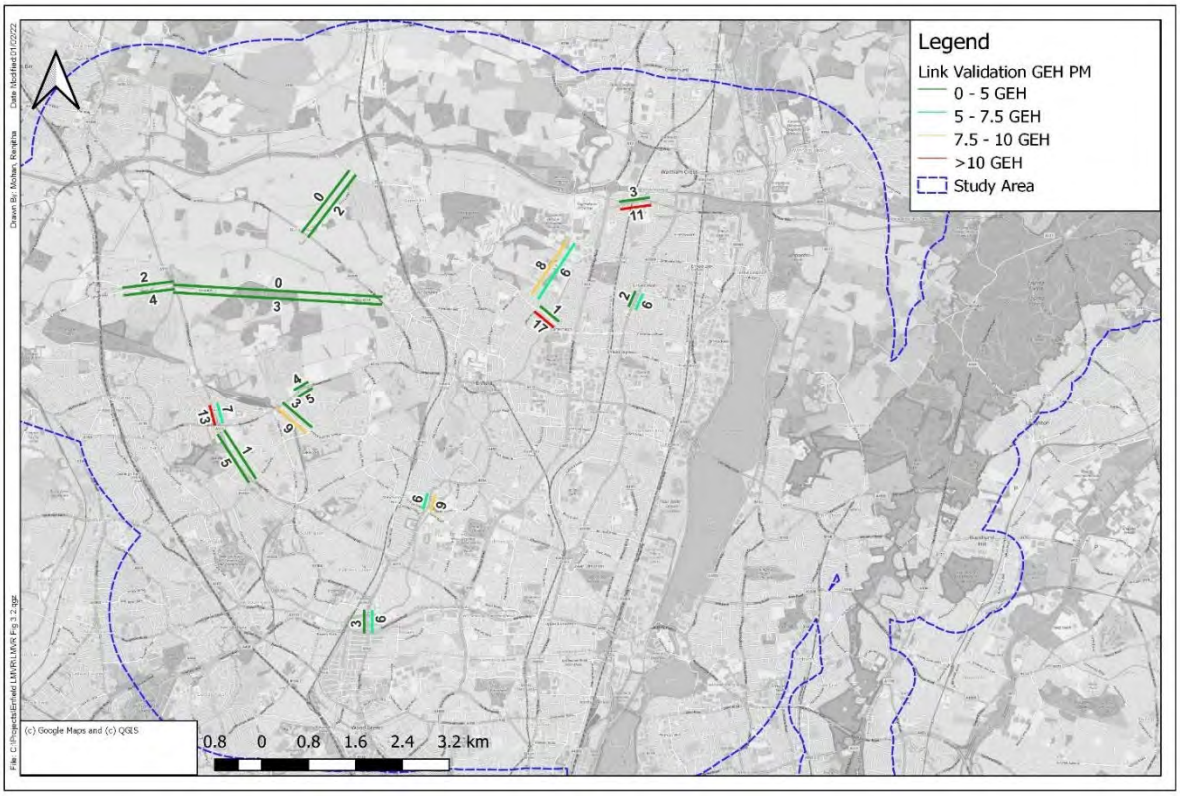


Figure 3-7: Link Validation in Study Area - PM Peak

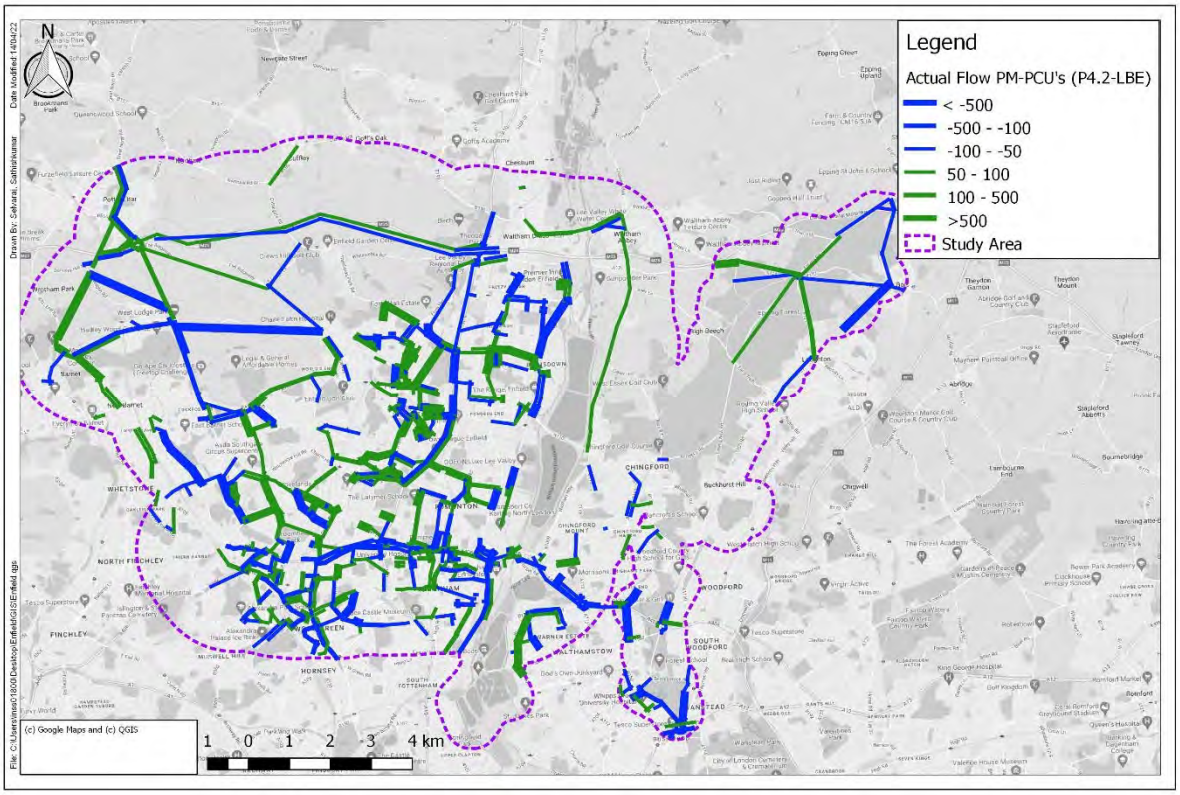


Figure 3-8: Link Flow Difference in Study Area - PM Peak

REGRESSION ANALYSIS

3.2.13. The regression statistics from the comparison of the modelled and observed data are presented in Figure 3-9and Figure 3-10 for the AM and PM peaks respectively. The results show that the modelled and observed match well for the majority of counts, with R square greater than 0.98. With most dots on the plots located close to the diagonal line, this indicates there are no obvious outliers following the matrix estimation process.

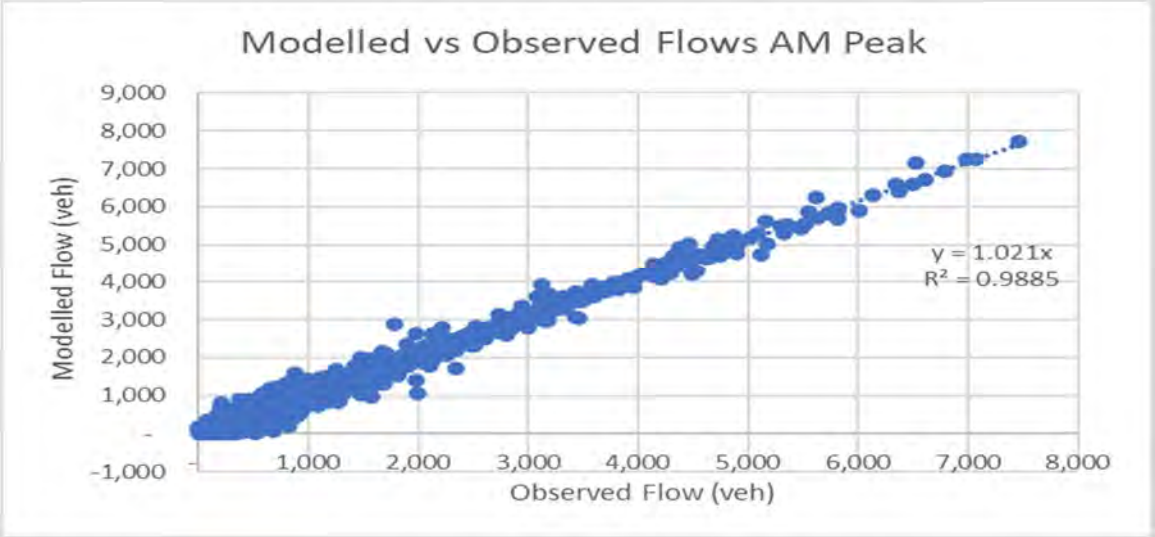


Figure 3-9: Modelled vs Observed Data – AM Peak

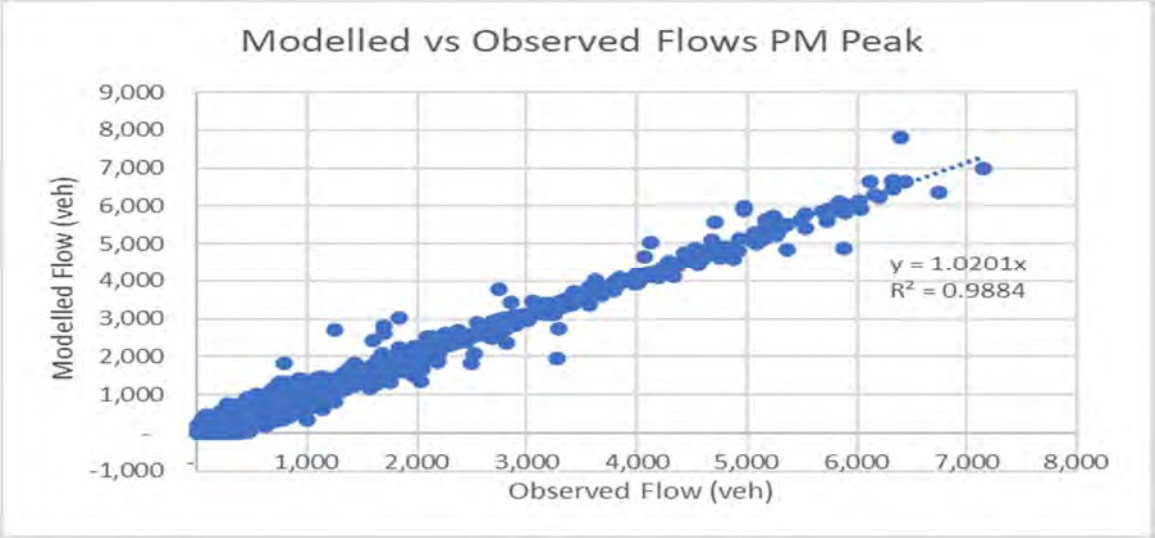


Figure 3-10: Modelled vs Observed Data – PM Peak

SUMMARY

3.2.14. Though the calibration and validation links do not quite meet TAG criteria, both peaks perform well in the local study area, with 81% of links passing either the GEH or flow criteria in AM and PM peaks. Compared to the original LoHAM, this statistic improves by 8% and 4% for AM and PM peaks respectively. In the wider model, the calibration results remain the same after the calibration procedure, with 76% and 77% for AM and PM models respectively.

3.2.15. Validation comparison also shows an improvement following the calibration exercise, with 81% and 77% of validation link counts meet TAG criteria. LoHAM only achieved 35% and 46% when these counts were compared with model flows (although these counts were not considered at the time).

3.3 SCREENLINE PERFORMANCE

3.3.1. TfL's HAM guidance requires calibration and validation of screenlines to determine that the aggregate directional movement of trips in the model is well matched to the observed..

3.3.2. The selected screenlines are illustrated in Figure 3-11, in total 44 directional screenlines within the study area are selected.

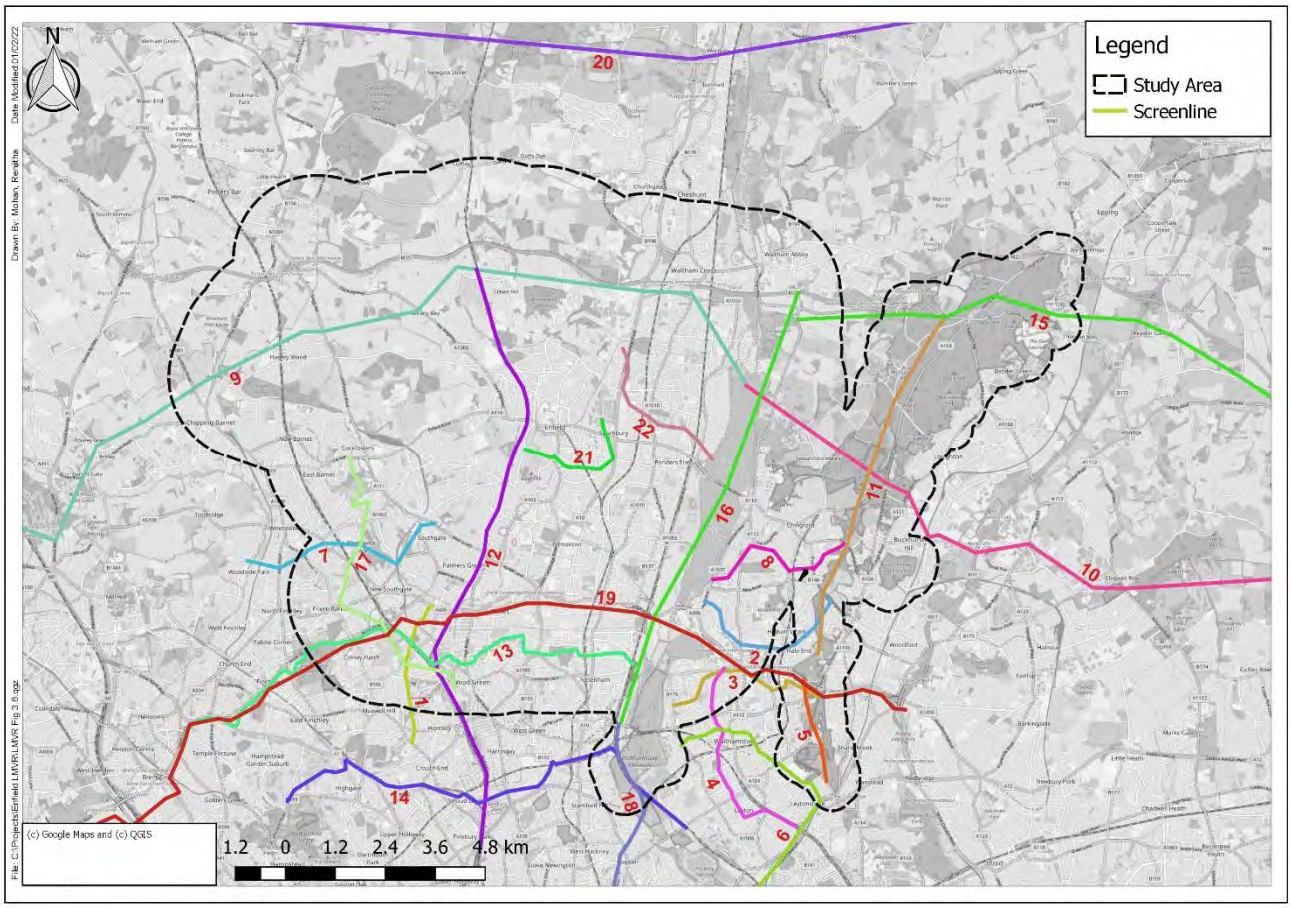


Figure 3-11: Screenlines in Study Area

3.3.3. The name of screenlines corresponding to the ID number in Figure 3-11 is given in Table 3-6:

Table 3-6: Screenline Correspondence

Screenline Name	ID
03 - Alexandra Palace	1
08 - Epping Forest	2
14 - Walthamstow East to West	3
15 - Walthamstow North to South	4
16 - Woodford to Wanstead	5
22 - Waltham Forest (Blackhorse Road to Woodford N	6
23 - Barnet (Southwest to Northeast)	7
24 - Chingford to Edmonton	8
Boundary -NoLHAM	9
Boundary-ELHAM	10
Epping New Road	11
Great North-South	12
Hendon - Tottenham Marshes	13
Inner - North East	14
NorthEast	15
Radial - River Lee	16
28 - East Barnet to Wood Green	17
Tottenham - Inner Central	18
Edmond-A406	19
Far Outer Cordon(N)	20
Enfield Town	21
Enfield East	22

AM MODEL

3.3.4. Table 3-7 summarises the AM performance of LoHAM and the LBE model in relation to local screenlines. TAG criteria states that for screenlines flow differences should be <5%. Comparing the LoHAM and LBE models, the calibration slightly improves the screenline results with 93% (41 screenlines) of the study area screenlines meeting TAG criteria whereas it was originally 40 screenlines in LoHAM. Figure 3-12 shows the screenlines in and around the study area that pass TAG criteria in green, and those that failed in red, in the AM peak.

3.3.5. Out of the total 44 screenlines, the three screenlines failing the TAG criteria are listed below. These screenlines are also highlighted in Table 3-7:

- Walthamstow North to South (Direction 1)
- Epping New Road (Direction 1)
- Enfield Town (Direction 1)

3.3.6. Table 3-7 also presents the screenline results for the AM time period after truncating the screenlines by removing counts which are falling outside the study area. Two screenlines namely Inner - North East and Far Outer Cordon(N) have been ignored fully as all the counts are falling outside the study area. Following this adjustment, the number of screenline meeting TAG criteria is 70% however five sites have a % of just over 5% narrowly falling outside criteria.

Table 3-7: AM Peak Local Screenline Calibration

ID	Screenline	Dir.	LoHAM P 4.2 Model					LBE P 4.2 Model					LBE P 4.2 Model (after truncation)				
			Obs.	Mod.	% Diff	GEH	Within TAG Req.	Obs.	Mod.	% Diff	GEH	Within TAG Req.	Obs.	Mod.	% Diff	GEH	Within TAG Req.
1	Alexandra Palace	1	3,394	3,456	1.80%	1.1	Yes	3,394	3,449	1.60%	0.9	Yes	1,972	2,018	2.34%	1.0	Yes
1	Alexandra Palace	2	3,200	3,095	-3.30%	1.9	Yes	3,200	3,264	2.00%	1.1	Yes	2,232	2,249	0.76%	0.4	Yes
2	Epping Forest	1	3,673	3,813	3.80%	2.3	Yes	3,673	3,789	3.20%	1.9	Yes	3,673	3,789	3.17%	1.9	Yes
2	Epping Forest	2	2,609	2,672	2.40%	1.2	Yes	2,609	2,631	0.80%	0.4	Yes	2,609	2,631	0.83%	0.4	Yes
3	Walthamstow East to West	1	3,060	3,004	-1.80%	1	Yes	3,060	2,916	-4.70%	2.6	Yes	2,524	2,612	3.50%	1.7	Yes
3	Walthamstow East to West	2	2,114	2,250	6.40%	2.9	No	2,114	2,151	1.70%	0.8	Yes	1,798	1,797	-0.06%	0.0	Yes
4	Walthamstow North to South	1	3,316	3,683	11.10%	6.2	No	3,316	3,710	11.90%	6.6	No	409	791	93.42%	15.6	No
4	Walthamstow North to South	2	4,419	4,332	-2.00%	1.3	Yes	4,419	4,350	-1.60%	1	Yes	985	852	-13.47%	4.4	No
5	Woodford to Wanstead	1	2,981	3,052	2.40%	1.3	Yes	2,981	3,004	0.80%	0.4	Yes	2,981	3,004	0.78%	0.4	Yes
5	Woodford to Wanstead	2	2,589	2,630	1.60%	0.8	Yes	2,589	2,635	1.80%	0.9	Yes	2,589	2,635	1.75%	0.9	Yes
6	22 - Waltham Forest (Blackhorse Road to Woodford New Road)	1	6,856	7,059	3.00%	2.4	Yes	6,856	7,073	3.20%	2.6	Yes	882	721	-18.29%	5.7	No
6	22 - Waltham Forest (Blackhorse Road to Woodford New Road)	2	5,691	5,882	3.40%	2.5	Yes	5,691	5,912	3.90%	2.9	Yes	1,036	916	-11.54%	3.8	No
7	Barnet (Southwest to Northeast)	1	5,341	5,435	1.80%	1.3	Yes	5,341	5,437	1.80%	1.3	Yes	3,937	3,973	0.93%	0.6	Yes
7	Barnet (Southwest to Northeast)	2	4,736	4,823	1.80%	1.3	Yes	4,736	4,841	2.20%	1.5	Yes	3,531	3,287	-6.91%	4.2	No
8	Chingford to Edmonton	1	3,088	3,168	2.60%	1.4	Yes	3,088	3,149	2.00%	1.1	Yes	3,088	3,149	1.97%	1.1	Yes
8	Chingford to Edmonton	2	2,751	2,802	1.90%	1	Yes	2,751	2,774	0.80%	0.4	Yes	2,751	2,774	0.83%	0.4	Yes
17	East Barnet to Wood Green	1	3,594	3,843	6.90%	4.1	No	3,594	3,698	2.90%	1.7	Yes	3,594	3,698	2.88%	1.7	Yes
17	East Barnet to Wood Green	2	3,611	3,671	1.70%	1	Yes	3,611	3,694	2.30%	1.4	Yes	3,611	3,694	2.32%	1.4	Yes
9	Boundary -NoLHAM	1	9,825	10,188	3.70%	3.6	Yes	9,825	10,237	4.20%	4.1	Yes	6,240	6,604	5.83%	4.5	No
9	Boundary -NoLHAM	2	8,688	8,931	2.80%	2.6	Yes	8,688	9,025	3.90%	3.6	Yes	5,193	5,439	4.75%	3.4	Yes
10	Boundary-ELHAM	1	25,626	25,782	0.60%	1	Yes	25,626	25,774	0.60%	0.9	Yes	2,514	2,525	0.46%	0.2	Yes
10	Boundary-ELHAM	2	22,522	22,884	1.60%	2.4	Yes	22,522	22,931	1.80%	2.7	Yes	1,904	1,940	1.90%	0.8	Yes

ID	Screenline	Dir.	LoHAM P 4.2 Model					LBE P 4.2 Model					LBE P 4.2 Model (after truncation)				
			Obs.	Mod.	% Diff	GEH	Within TAG Req.	Obs.	Mod.	% Diff	GEH	Within TAG Req.	Obs.	Mod.	% Diff	GEH	Within TAG Req.
11	Epping New Road	1	3,139	3,441	9.60%	5.3	No	3,139	3,449	9.90%	5.4	No	3,139	3,449	9.89%	5.4	No
11	Epping New Road	2	2,905	2,935	1.00%	0.6	Yes	2,905	3,049	5.00%	2.7	Yes	2,905	3,049	4.98%	2.7	Yes
12	Great North-South	1	10,848	11,091	2.20%	2.3	Yes	10,848	11,200	3.20%	3.4	Yes	9,034	9,136	1.12%	1.1	Yes
12	Great North-South	2	12,461	12,395	-0.50%	0.6	Yes	12,461	12,303	-1.30%	1.4	Yes	9,614	9,336	-2.90%	2.9	Yes
13	Hendon - Tottenham Marshes	1	11,385	11,587	1.80%	1.9	Yes	11,385	11,562	1.60%	1.7	Yes	7,589	7,650	0.80%	0.7	Yes
13	Hendon - Tottenham Marshes	2	7,893	8,142	3.20%	2.8	Yes	7,893	8,094	2.50%	2.2	Yes	4,690	4,598	-1.96%	1.3	Yes
14	Inner - North East	1	8,107	8,194	1.10%	1	Yes	8,107	8,274	2.10%	1.8	Yes					
14	Inner - North East	2	7,066	7,331	3.70%	3.1	Yes	7,066	7,370	4.30%	3.6	Yes					
15	NorthEast	1	6,460	6,690	3.60%	2.8	Yes	6,460	6,642	2.80%	2.2	Yes	2,747	2,835	3.20%	1.7	Yes
15	NorthEast	2	5,556	5,796	4.30%	3.2	Yes	5,556	5,805	4.50%	3.3	Yes	2,579	2,716	5.27%	2.6	No
16	Radial - River Lee	2	4,910	4,925	0.30%	0.2	Yes	4,910	4,887	-0.50%	0.3	Yes	4,910	4,887	-0.47%	0.3	Yes
16	Radial - River Lee	1	4,544	4,634	2.00%	1.3	Yes	4,544	4,652	2.40%	1.6	Yes	4,544	4,652	2.38%	1.6	Yes
18	Tottenham - Inner Central	2	3,766	3,687	-2.10%	1.3	Yes	3,766	3,714	-1.40%	0.9	Yes	704	811	15.19%	3.9	No
18	Tottenham - Inner Central	1	3,218	3,311	2.90%	1.6	Yes	3,218	3,284	2.10%	1.2	Yes	603	646	7.20%	1.7	No
19	Edmond-A406	1	32,667	32,943	0.80%	1.5	Yes	32,417	32,751	1.00%	1.9	Yes	10,947	11,158	1.92%	2.0	Yes
19	Edmond-A406	2	25,866	26,344	1.80%	3	Yes	25,866	26,412	2.10%	3.4	Yes	8,255	8,039	-2.61%	2.4	Yes
20	Far Outer Cordon(N)	1	18,354	18,407	0.30%	0.4	Yes	18,354	18,352	0.00%	0	Yes					
20	Far Outer Cordon(N)	2	20,273	20,128	-0.70%	1	Yes	20,273	20,147	-0.60%	0.9	Yes					
21	Enfield Town	1	3,051	3,029	-0.70%	0.4	Yes	3,051	2,805	-8.00%	4.5	No	3,051	2,805	-8.04%	4.5	No
21	Enfield Town	2	3,071	3,029	-1.40%	0.8	Yes	3,071	2,968	-3.40%	1.9	Yes	3,071	2,968	-3.36%	1.9	Yes
22	Enfield East	1	4,616	4,500	-2.50%	1.7	Yes	4,616	4,594	-0.50%	0.3	Yes	4,616	4,594	-0.46%	0.3	Yes
22	Enfield East	2	4,391	4,467	1.70%	1.1	Yes	4,391	4,469	1.80%	1.2	Yes	4,391	4,469	1.78%	1.2	Yes

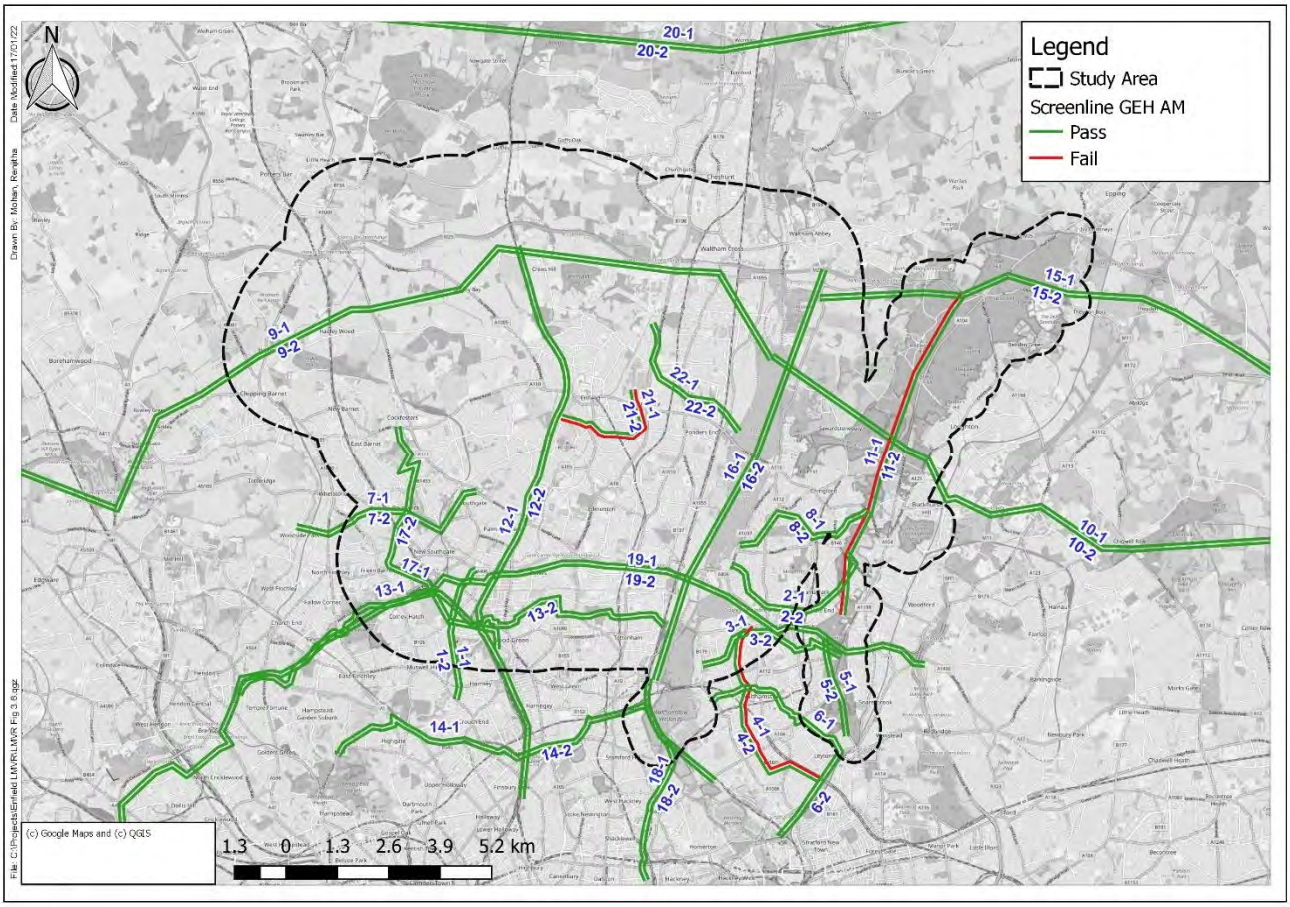


Figure 3-12: Screenlines (TAG criteria) in Study Area – AM Peak

PM MODEL

3.3.7. Table 3-8 summarises the PM performance of LoHAM and the LBE model in relation to local screenlines. 86% of study area screenlines meet the TAG criteria, which is the same as the LoHAM result. The screenlines in and around the study area that pass TAG criteria are shown in Figure 3-13 in green, and those that failed in red.

3.3.8. Table 3-8 also presents the screenlines results for the PM time period after truncating the counts which are falling outside the study area. Following this adjustment, the number of screenline meeting TAG criteria is 78%.

3.3.9. The six screenlines failing the TAG criteria are listed below:

- Walthamstow North to South (Direction 1)
- Walthamstow North to South (Direction 2)
- Great North-South (Direction 1)
- North-East (Direction 2)
- Tottenham - Inner Central (Direction 1)
- Edmond-A406 (Direction 2)

Table 3-8: PM Peak Local Screenline Calibration

ID	Screenline	Dir.	LoHAM P 4.2 Model					LBE P 4.2 Model					LBE P 4.2 Model (after truncation)				
			Obs.	Mod.	% Diff	GEH	Within TAG Req.	Obs.	Mod.	% Diff	GEH	Within TAG Req.	Obs.	Mod.	% Diff	GEH	Within TAG Req.
1	Alexandra Palace	1	3,581	3,593	0.30%	0.2	Yes	3,581	3,578	-0.10%	0.1	Yes	2,525	2,478	-1.87%	0.9	Yes
1	Alexandra Palace	2	3,305	3,201	-3.10%	1.8	Yes	3,305	3,301	-0.10%	0.1	Yes	2,025	2,019	-0.31%	0.1	Yes
2	Epping Forest	1	2,774	2,848	2.70%	1.4	Yes	2,774	2,836	2.20%	1.2	Yes	2,774	2,836	2.24%	1.2	Yes
2	Epping Forest	2	3,987	3,982	-0.10%	0.1	Yes	3,987	3,962	-0.60%	0.4	Yes	3,987	3,962	-0.64%	0.4	Yes
3	Walthamstow East to West	1	2,341	2,368	1.10%	0.6	Yes	2,341	2,228	-4.80%	2.4	Yes	2,012	1,969	-2.11%	1.0	Yes
3	Walthamstow East to West	2	2,951	2,742	-7.10%	3.9	No	2,951	2,830	-4.10%	2.3	Yes	2,408	2,141	-11.08%	5.6	No
4	Walthamstow North to South	1	3,730	4,348	16.60%	9.7	No	3,730	4,171	11.80%	7	No	748	1,007	34.60%	8.7	No
4	Walthamstow North to South	2	4,856	5,011	3.20%	2.2	Yes	4,856	5,185	6.80%	4.6	No	1,277	1,476	15.57%	5.4	No
5	Woodford to Wanstead	1	2,616	2,647	1.20%	0.6	Yes	2,616	2,743	4.90%	2.5	Yes	2,616	2,743	4.87%	2.5	Yes
5	Woodford to Wanstead	2	2,965	2,953	-0.40%	0.2	Yes	2,965	3,050	2.90%	1.5	Yes	2,965	3,050	2.86%	1.5	Yes
6	22 - Waltham Forest (Blackhorse Road to Woodford New Road)	1	5,770	5,741	-0.50%	0.4	Yes	5,770	5,993	3.90%	2.9	Yes	1,037	912	-12.09%	4.0	No
6	22 - Waltham Forest (Blackhorse Road to Woodford New Road)	2	7,539	7,513	-0.30%	0.3	Yes	7,539	7,408	-1.70%	1.5	Yes	1,155	994	-13.93%	4.9	No
7	Barnet (Southwest to Northeast)	1	4,437	4,522	1.90%	1.3	Yes	4,437	4,565	2.90%	1.9	Yes	3,204	3,210	0.20%	0.1	Yes
7	Barnet (Southwest to Northeast)	2	5,132	5,264	2.60%	1.8	Yes	5,132	5,297	3.20%	2.3	Yes	3,654	3,647	-0.17%	0.1	Yes
8	Chingford to Edmonton	1	2,817	2,882	2.30%	1.2	Yes	2,817	2,879	2.20%	1.2	Yes	2,817	2,879	2.21%	1.2	Yes
8	Chingford to Edmonton	2	3,377	3,467	2.70%	1.5	Yes	3,377	3,419	1.20%	0.7	Yes	3,377	3,419	1.24%	0.7	Yes
9	Boundary -NoLHAM	1	8,779	9,057	3.20%	2.9	Yes	8,779	9,118	3.90%	3.6	Yes	5,383	5,619	4.39%	3.2	Yes
9	Boundary -NoLHAM	2	10,220	10,565	3.40%	3.4	Yes	10,220	10,482	2.60%	2.6	Yes	6,293	6,495	3.21%	2.5	Yes
10	Boundary-ELHAM	1	24,374	25,224	3.50%	5.4	Yes	24,374	25,216	3.50%	5.3	Yes	1,946	1,968	1.13%	0.5	Yes
10	Boundary-ELHAM	2	28,177	29,492	4.70%	7.7	Yes	28,177	29,476	4.60%	7.7	Yes	1,976	1,959	-0.90%	0.4	Yes

ID	Screenline	Dir.	LoHAM P 4.2 Model					LBE P 4.2 Model					LBE P 4.2 Model (after truncation)				
			Obs.	Mod.	% Diff	GEH	Within TAG Req.	Obs.	Mod.	% Diff	GEH	Within TAG Req.	Obs.	Mod.	% Diff	GEH	Within TAG Req.
11	Epping New Road	1	3,208	3,221	0.40%	0.2	Yes	3,208	3,311	3.20%	1.8	Yes	3,208	3,311	3.18%	1.8	Yes
11	Epping New Road	2	2,828	2,784	-1.50%	0.8	Yes	2,828	2,761	-2.40%	1.3	Yes	2,828	2,761	-2.37%	1.3	Yes
12	Great North-South	1	11,437	12,067	5.50%	5.8	No	11,437	12,041	5.30%	5.6	No	9,168	9,205	0.41%	0.4	Yes
12	Great North-South	2	11,400	11,417	0.10%	0.2	Yes	11,400	11,488	0.80%	0.8	Yes	8,711	8,688	-0.26%	0.2	No
13	Hendon - Tottenham Marshes	1	9,168	9,272	1.10%	1.1	Yes	9,168	9,229	0.70%	0.6	Yes	5,813	5,827	0.24%	0.2	Yes
13	Hendon - Tottenham Marshes	2	10,979	10,799	-1.60%	1.7	Yes	10,979	11,176	1.80%	1.9	Yes	7,129	7,013	-1.63%	1.4	Yes
14	Inner - North East	1	7,541	7,781	3.20%	2.7	Yes	7,541	7,709	2.20%	1.9	Yes					
14	Inner - North East	2	9,190	9,315	1.40%	1.3	Yes	9,190	9,308	1.30%	1.2	Yes					
15	NorthEast	1	5,980	6,314	5.60%	4.2	No	5,980	6,238	4.30%	3.3	Yes	2,556	2,692	5.30%	2.6	Yes
15	NorthEast	2	6,348	6,718	5.80%	4.6	No	6,348	6,693	5.40%	4.3	No	2,855	2,992	4.80%	2.5	Yes
16	Radial - River Lee	2	4,575	4,840	5.80%	3.9	No	4,575	4,801	5.00%	3.3	Yes	4,575	4,801	4.96%	3.3	Yes
16	Radial - River Lee	1	5,551	5,611	1.10%	0.8	Yes	5,551	5,726	3.20%	2.3	Yes	5,551	5,726	3.15%	2.3	Yes
17	East Barnet to Wood Green	1	3,772	3,832	1.60%	1	Yes	3,772	3,904	3.50%	2.1	Yes	3,772	3,904	3.51%	2.1	Yes
17	East Barnet to Wood Green	2	3,154	3,275	3.80%	2.1	Yes	3,154	3,203	1.60%	0.9	Yes	3,154	3,203	1.55%	0.9	Yes
18	Tottenham - Inner Central	2	3,497	3,529	0.90%	0.5	Yes	3,497	3,383	-3.30%	1.9	Yes	691	716	3.59%	0.9	Yes
18	Tottenham - Inner Central	1	3,879	3,989	2.80%	1.7	Yes	3,879	4,081	5.20%	3.2	No	895	1,044	16.67%	4.8	No
19	Edmond-A406	1	27,847	28,546	2.50%	4.2	Yes	27,597	28,137	2.00%	3.2	Yes	9,355	9,375	0.21%	0.2	Yes
19	Edmond-A406	2	32,523	33,312	2.40%	4.4	Yes	32,523	34,155	5.00%	8.9	No	10,543	11,286	7.05%	7.1	No
20	Far Outer Cordon(N)	1	19,496	19,225	-1.40%	1.9	Yes	19,496	19,075	-2.20%	3	Yes					
20	Far Outer Cordon(N)	2	19,472	19,427	-0.20%	0.3	Yes	19,472	19,266	-1.10%	1.5	Yes					
21	Enfield Town	1	2,946	2,991	1.50%	0.8	Yes	2,946	2,908	-1.30%	0.7	Yes	2,946	2,908	-1.28%	0.7	Yes
21	Enfield Town	2	2,945	2,943	-0.10%	0	Yes	2,945	2,829	-3.90%	2.1	Yes	2,945	2,829	-3.92%	2.1	Yes
22	Enfield East	1	4,728	4,695	-0.70%	0.5	Yes	4,728	4,793	1.40%	0.9	Yes	4,728	4,793	1.38%	0.9	Yes
22	Enfield East	2	4,594	4,700	2.30%	1.6	Yes	4,594	4,729	2.90%	2	Yes	4,594	4,729	2.95%	2.0	Yes

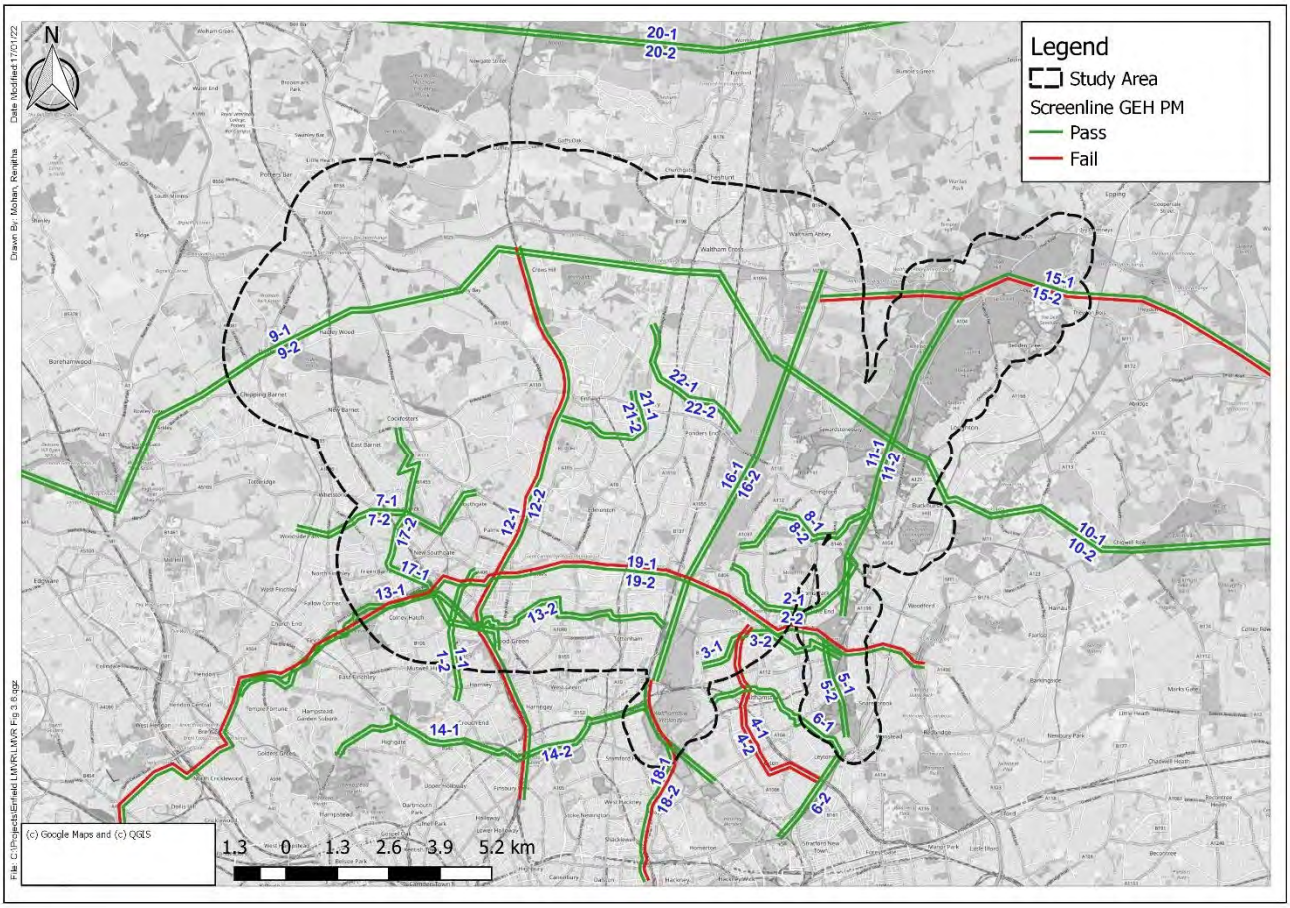


Figure 3-13: Screenlines (TAG criteria) in Study Area – PM Peak

SUMMARY

3.3.10. Considering the size of study area coverage, the results above demonstrate that local screenline performance is at a satisfactory level in relation to the local area. It is worth noting that the re-calibration has only improved slightly the screenline performance of the model, the differences of model flow in the re-calibrated screenlines to the original LoHAM P4.2 are generally small.

3.3.11. A summary of screenline results for the whole model is included in Appendix D.

3.4 JOURNEY TIME PERFORMANCE

3.4.1. TfL's HAM guidance requires that observed journey time data from TrafficMaster are compared against modelled journey times to confirm validation. A total of 40 journey time routes were agreed with TfL in the study area for analysis which are shown in Figure 3-14, the route correspondence is presented in Table 3-9.

Table 3-9: Selected journey time routes within Study Area

Route Reference	Description	Direction
R169	A12 - South (Kingsland Rd to Gants Hill)	N
R170	A12 - South (Gants Hill to Kingsland Rd)	S
R215	M25 Junction 27 to M25 Junction 26	A
R216	M25 Junction 26 to M25 Junction 27	C
R119	A104 (A107 to Whitehall Rd)	N
R120	A104 (Whitehall Rd to A107)	S
R065	A110 (A111 to A112)	E
R074	A504/A1080 (A10 to Fortis Green Rd)	W
R066	A110 (A112 to A111)	W
R067	A411/A110 (A1 to A110)	E
R101	A1000 (A504 to A110)	N
R102	A1000 (A110 to A504)	S
R068	A411/A110 (A110 to A1)	W
R107	A111 (High St A1004 to M25)	N
R108	A111 (M25 to High St A1004)	S
R109	A105 (Seven Sisters A503 to A111)	N
R110	A105 (A111 to Seven Sisters A503)	S
R113	A112 (Walthamstow Central to A110)	N
R069	A406 - Central (B550 to A1037)	E
R114	A112 (A110 to Walthamstow Central)	S
R117	A104 (A406 North Circular to A121)	N
R118	A104 (A121 to A406 North Circular)	S
R123	A406 West (A1037 to Chigwell Rd)	E
R070	A406 - Central (A1037 to B550)	W
R124	A406 West (Chigwell Rd to A1037)	W
R131	M25 Junction 25 to M25 Junction 23	A
R132	M25 Junction 23 to M25 Junction 25	C
R073	A504/A1080 (Fortis Green Rd to A10)	E
R085	A10 - North (M25 junction 5 to Great Cambridge Junction)	N
R086	A10 - North (M25 junction 5 to Great Cambridge Junction)	S
R087	A10 - Central (Great Cambridge Junction to Stamford Hill)	N
R088	A10 - Central (Great Cambridge Junction to Stamford Hill)	S

Route Reference	Description	Direction
R095	A1055 (A406 to A10)	N
R096	A1055 (A10 to A406)	S
R097	A503/A1055 (A1201 to A406)	N
R098	A503/A1055 (A406 to A1201)	S
R121	A112/A1006/A503 (Grove Green Rd to ShernHall)	N
R122	A112/A1006/A503 (Shernhall to Grove Green Rd)	S
R133	M25 Junction 26 to M25 Junction 25	A
R134	M25 Junction 25 to M25 Junction 26	C

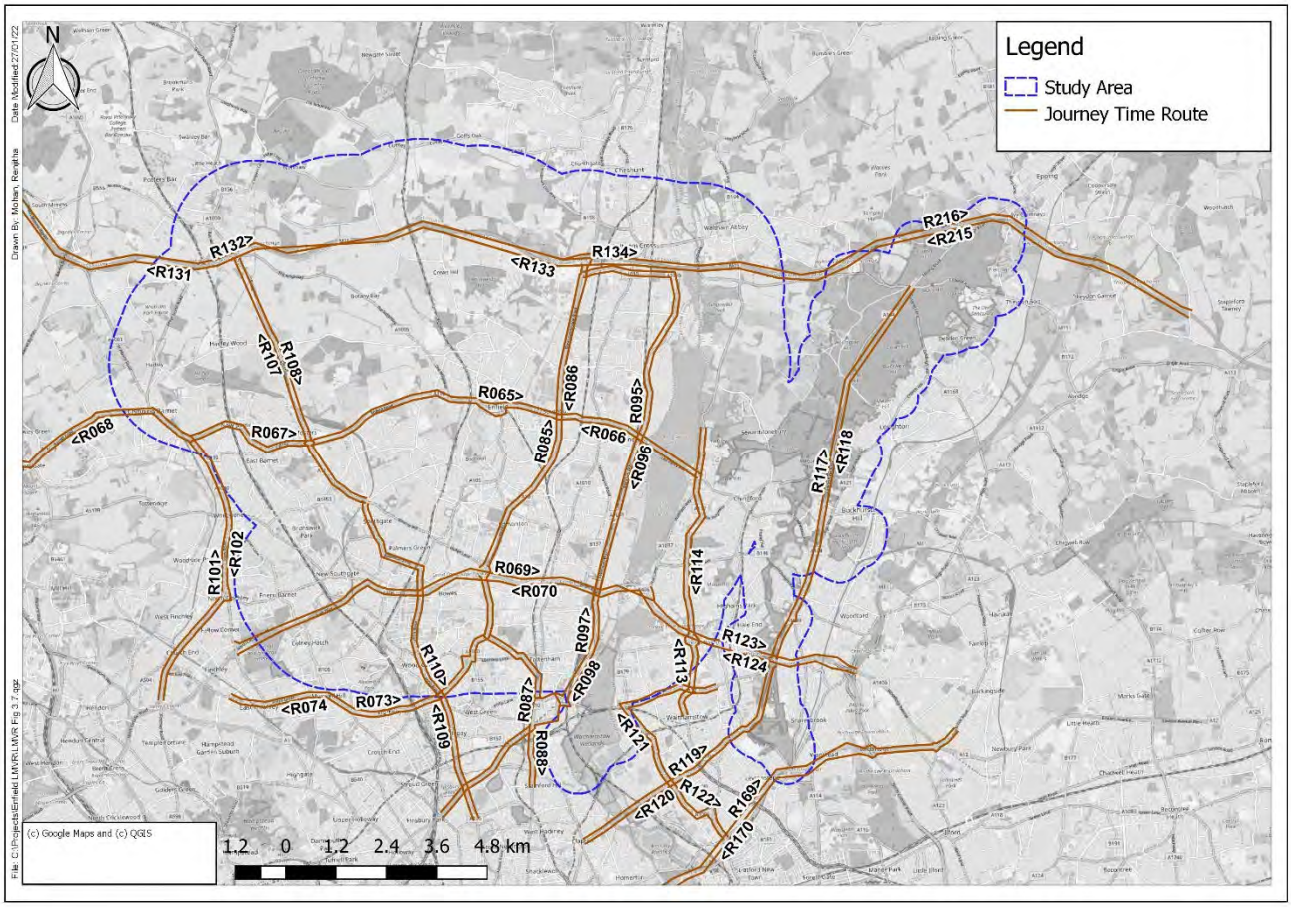


Figure 3-14: Journey Time Routes

AM MODEL

3.4.2. Table 3-10 and Figure 3-15 outline the results for the observed and modelled journey times comparison in the AM period for both LoHAM and LBE model respectively. Comparing the two models, the journey time calibration for LBE model is maintained. 83% (33 out of 40 routes) of journey time routes still meet criteria with both models.

3.4.3. Journey time graphs can be found in Appendix E. It should be noted that it is not expected that modelled journey times follow the trajectory of the observed journey times exactly, however local calibration of junction delay and highway network speed was carried out to reflect the journey time profile as close as possible and improvements in the journey times profiles compared to LoHAM have been achieved.

1.1.1. To examine the effects within the study area journey time routes were curtailed beyond the study area and the results are shown in Table 3-10. In this process 8 routes (bi-directional) were ignored as 90-100% of the route's section were falling either outside the study area or at the verge of study area boundary. Following this adjustment of the journey time routes, only 66% of routes still meet criteria with three routes have a % difference just outside criteria.

Table 3-10: Journey Time Calibration – AM Peak

Route Ref.	Dir.	LoHAM P 4.2 Model					LBE P 4.2 Model					LBE P 4.2 Model (after truncation)				
		Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.	Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.	Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.
R169	N	1,642	1,585	-56	-3%	Yes	1,642	1,604	-38	-2%	Yes					
R170	S	3,578	2,993	-585	-16%	No	3,578	3,059	-519	-14%	Yes					
R215	A	534	606	72	14%	Yes	534	576	42	8%	Yes					
R216	C	434	441	6	1%	Yes	434	440	6	1%	Yes					
R065	E	1,884	2,100	215	11%	Yes	1,884	1,816	-69	-4%	Yes	1,884	1,816	-69	-4%	Yes
R066	W	2,796	2,883	87	3%	Yes	2,796	2,321	-475	-17%	No	2,796	2,321	-475	-17%	No
R067	E	1,963	1,541	-422	-22%	No	1,963	1,533	-430	-22%	No	1,276	1,126	-150	-12%	Yes
R068	W	1,888	1,930	42	2%	Yes	1,888	1,874	-14	-1%	Yes	1,271	1,024	-247	-19%	No
R069	E	1,629	1,840	211	13%	Yes	1,629	1,631	2	0%	Yes	1,629	1,631	2	0%	Yes
R070	W	1,953	1,694	-259	-13%	Yes	1,953	1,688	-265	-14%	Yes	1,953	1,688	-265	-14%	Yes
R073	E	1,815	1,746	-69	-4%	Yes	1,815	1,775	-40	-2%	Yes	356	791	436	122%	No
R074	W	1,735	1,561	-174	-10%	Yes	1,735	1,612	-123	-7%	Yes	585	645	60	10%	Yes
R085	N	815	935	120	15%	Yes	815	902	87	11%	Yes	815	902	87	11%	Yes
R086	S	1,469	1,418	-51	-3%	Yes	1,469	1,261	-208	-14%	Yes	1,469	1,261	-208	-14%	Yes
R087	N	1,490	1,406	-84	-6%	Yes	1,490	1,396	-94	-6%	Yes	1,037	787	-249	-24%	No
R088	S	2,367	2,325	-41	-2%	Yes	2,367	2,401	35	1%	Yes	695	1,108	414	60%	No
R095	N	2,319	2,091	-228	-10%	Yes	2,319	2,063	-256	-11%	Yes	2,319	2,063	-256	-11%	Yes
R096	S	2,218	2,137	-81	-4%	Yes	2,218	1,960	-258	-12%	Yes	2,218	1,960	-258	-12%	Yes
R097	N	1,205	1,408	202	17%	No	1,205	1,306	101	8%	Yes	300	454	154	51%	No
R098	S	2,826	1,785	-1040	-37%	No	2,826	1,969	-856	-30%	No	805	982	177	22%	No
R101	N	1,475	1,339	-136	-9%	Yes	1,475	1,304	-172	-12%	Yes					
R102	S	1,664	1,739	75	5%	Yes	1,664	1,696	32	2%	Yes					
R107	N	843	965	122	14%	Yes	843	925	82	10%	Yes	843	925	82	10%	Yes

Route Ref.	Dir.	LoHAM P 4.2 Model					LBE P 4.2 Model					LBE P 4.2 Model (after truncation)				
		Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.	Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.	Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.
R108	S	1,597	1,413	-184	-12%	Yes	1,597	1,116	-481	-30%	No	1,597	1,116	-481	-30%	No
R109	N	1,801	2,028	226	13%	Yes	1,801	1,854	53	3%	Yes	584	705	121	21%	No
R110	S	2,388	2,492	104	4%	Yes	2,388	2,497	109	5%	Yes	826	731	-95	-11%	Yes
R113	N	1,183	1,266	83	7%	Yes	1,183	1,282	99	8%	Yes	1,183	1,282	99	8%	Yes
R114	S	2,300	1,406	-893	-39%	No	2,300	1,427	-873	-38%	No	2,300	1,427	-873	-38%	No
R117	N	1,020	963	-57	-6%	Yes	1,020	1,007	-13	-1%	Yes	1,020	1,007	-13	-1%	Yes
R118	S	1,758	1,514	-244	-14%	Yes	1,758	1,492	-266	-15%	No	1,758	1,492	-266	-15%	No
R119	N	1,124	1,158	34	3%	Yes	1,124	1,167	43	4%	Yes	372	349	-23	-6%	Yes
R120	S	2,583	1,490	-1093	-42%	No	2,583	1,514	-1069	-41%	No	543	483	-60	-11%	Yes
R121	N	1,684	1,588	-96	-6%	Yes	1,684	1,651	-33	-2%	Yes					
R122	S	1,998	1,648	-351	-18%	No	1,998	1,907	-91	-5%	Yes					
R123	E	357	402	45	13%	Yes	357	404	47	13%	Yes	357	404	47	13%	Yes
R124	W	537	542	5	1%	Yes	537	590	53	10%	Yes	537	590	53	10%	Yes
R131	A	742	798	56	8%	Yes	742	762	20	3%	Yes	620	585	-35	-6%	Yes
R132	C	748	856	108	14%	Yes	748	829	81	11%	Yes	583	629	46	8%	Yes
R133	A	329	366	38	11%	Yes	329	332	4	1%	Yes	329	332	4	1%	Yes
R134	C	249	256	6.91	3%	Yes	249	276	27	11%	Yes	249	276	27	11%	Yes

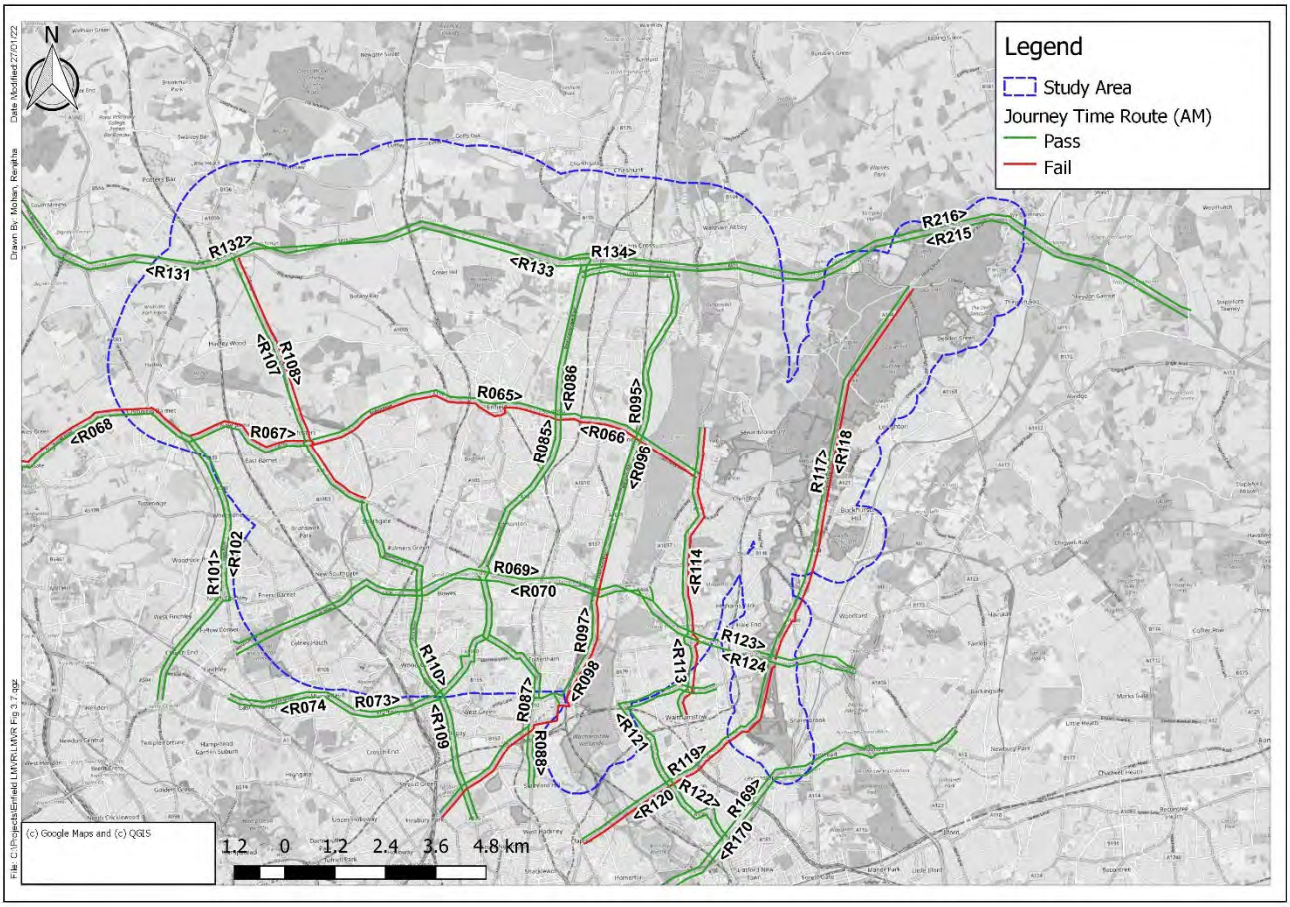


Figure 3-15: Journey Time Calibration - AM Peak

3.4.4. The LBE model calibration also focused on improving the JT calibration of critical area. As a result, some routes have relatively large differences in modelled JT before and after calibration. In the following section, these routes will be discussed.

3.4.5. For Route R066, in the received P4.2 model a 20-minute delay was forecast at A110 Lea Valley Road/ A1055 Mollison Avenue junction WB approach as shown in Figure 3-16. Despite the total JT matching between modelled and observed, such unrealistic delay could potentially encourage traffic to re-route away from this critical corridor of the study. By reviewing the modelled junction configuration, this delay was therefore reduced in the calibrated model so that the journey profile was a better match with the observed data for this section of A110 E-W corridor. Although the JT route now narrowly fails the TAG validation criteria (at -17%), overall it is considered more acceptable for the purposes of this study.

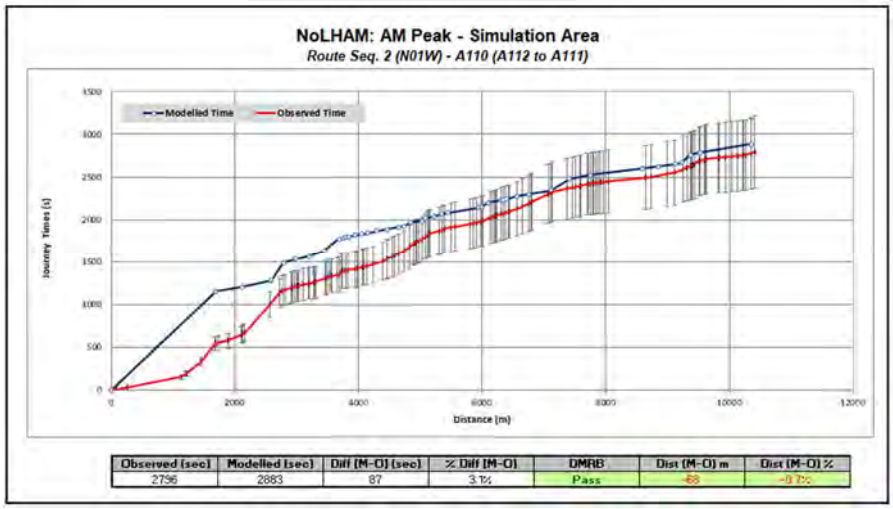


Figure 3-16: Route R066 AM Before Calibration

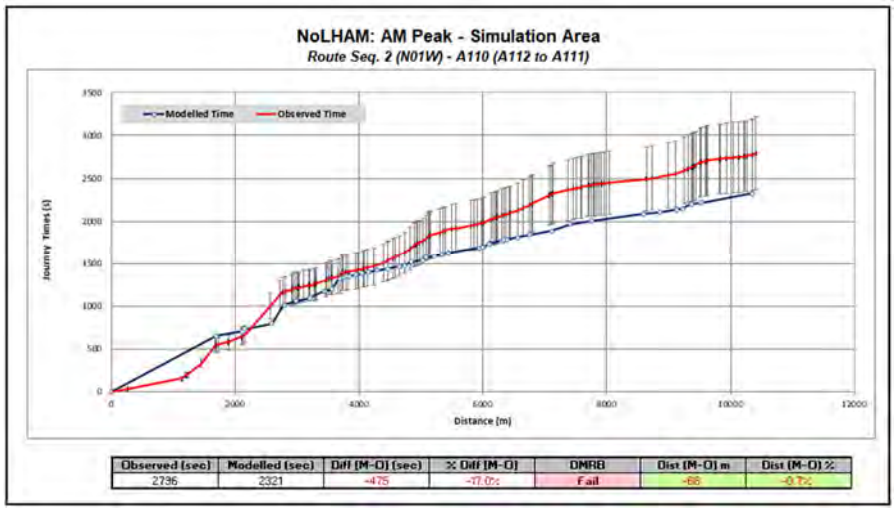


Figure 3-17: Route R066 AM After Calibration

3.4.6. For the JT route R122, the overall speed on the early sections of route near A503 Forest Road / Palmerston Road was too fast in the model. The calibration focused on reducing the overall speed on this section by reviewing the delay and speed flow curve at this location, such that the re-calibrated JT profile matches closer to the observed.

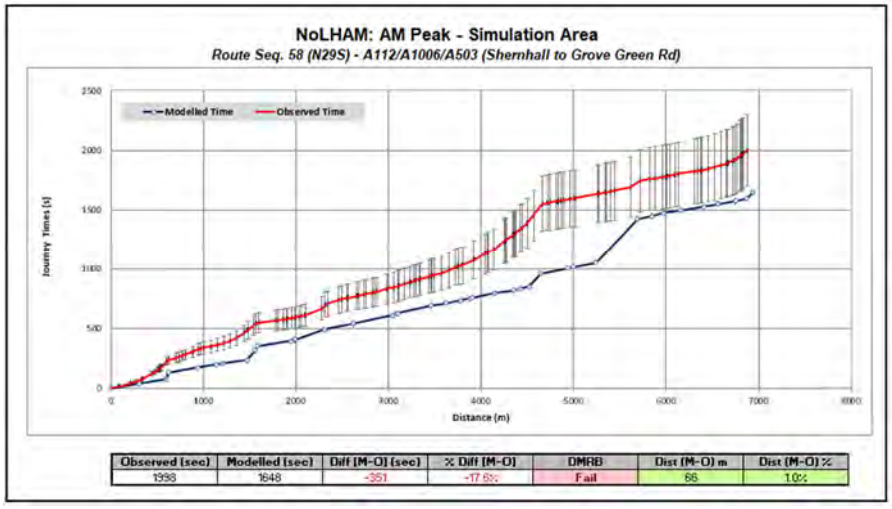


Figure 3-18: Route R122 AM Before Calibration

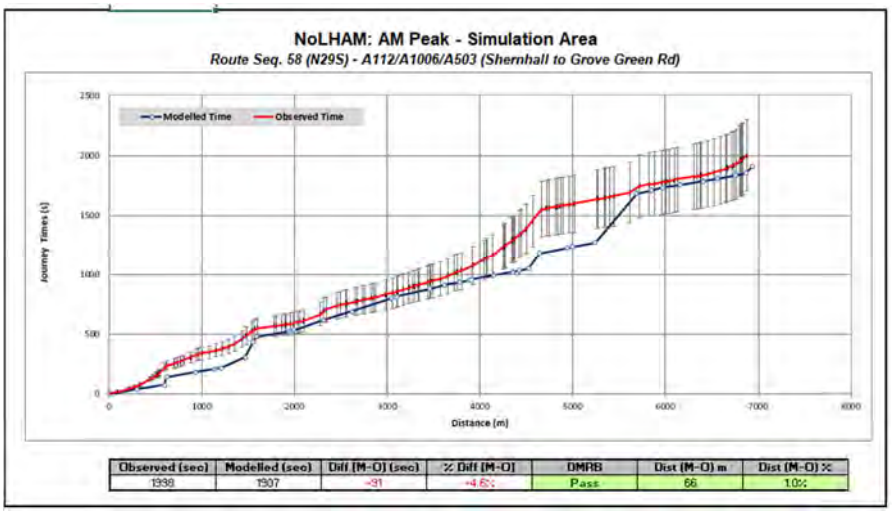


Figure 3-19: Route R122 AM After Calibration

PM MODEL

3.4.7. Table 3-11 and Figure 3-20 detail the results for the observed and modelled journey times comparison for the PM period of the LBE model. A total of 33 journey time routes (83%) pass in the PM peak, the same level of calibration is achieved for both LoHAM and the LBE model.

3.4.8. When the journey time routes are curtailed to remove the section outside the study area, the number of journey time routes meet the TAG criteria is 75%.

3.4.9. Table 3-11 also provides the JT results after curtailing the JT routes beyond the study area.

3.4.10. Journey time graphs for the LBE model can be found in Appendix E.

Table 3-11: Journey Time Calibration – PM Peak

Route Ref.	Dir.	LoHAM P 4.2 Model					LBE P 4.2 Model					LBE P 4.2 Model (after truncation)				
		Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.	Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.	Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.
R169	N	3,081	3,431	350	11%	Yes	3,081	3,462	381	12%	Yes					
R170	S	2,162	2,068	-95	-4%	Yes	2,162	2,013	-150	-7%	Yes					
R215	A	453	484	31	7%	Yes	453	473	20	4%	Yes					
R216	C	489	530	41	8%	Yes	489	521	31	6%	Yes					
R065	E	3,047	2,126	-921	-30%	No	3,047	1,990	-1,057	-35%	No	3,047	1,990	-1,057	-35%	No
R066	W	2,156	1,959	-197	-9%	Yes	2,156	1,896	-260	-12%	Yes	2,156	1,896	-260	-12%	Yes
R067	E	1,662	1,592	-70	-4%	Yes	1,662	1,547	-115	-7%	Yes	1,054	1,136	82	8%	Yes
R068	W	1,884	1,627	-258	-14%	Yes	1,884	1,611	-274	-15%	Yes	1,056	978	-79	-7%	Yes
R069	E	2,438	2,210	-229	-9%	Yes	2,438	1,952	-486	-20%	No	2,438	1,952	-486	-20%	No
R070	W	1,864	1,675	-189	-10%	Yes	1,864	1,403	-461	-25%	No	1,864	1,403	-461	-25%	No
R073	E	1,934	2,196	262	14%	Yes	1,934	1,960	26	1%	Yes	451	961	510	113%	No
R074	W	1,607	1,479	-128	-8%	Yes	1,607	1,452	-155	-10%	Yes	533	493	-40	-8%	Yes
R085	N	1,285	1,293	8	1%	Yes	1,285	1,118	-167	-13%	Yes	1,285	1,118	-167	-13%	Yes
R086	S	916	1,032	117	13%	Yes	916	1,002	87	9%	Yes	916	1,002	87	9%	Yes
R087	N	2,042	2,392	350	17%	No	2,042	2,167	125	6%	Yes	1,091	958	-133	-12%	Yes
R088	S	1,537	1,650	113	7%	Yes	1,537	1,669	132	9%	Yes	598	905	307	51%	No
R095	N	2,564	2,169	-395	-15%	No	2,564	2,308	-256	-10%	Yes	2,564	2,308	-256	-10%	Yes
R096	S	1,390	1,421	31	2%	Yes	1,390	1,395	6	0%	Yes	1,390	1,395	6	0%	Yes
R097	N	2,002	1,922	-80	-4%	Yes	2,002	1,819	-183	-9%	Yes	482	688	205	43%	No
R098	S	1,628	1,471	-156	-10%	Yes	1,628	1,551	-76	-5%	Yes	587	505	-82	-14%	Yes
R101	N	1,990	1,458	-532	-27%	No	1,990	1,411	-579	-29%	No					
R102	S	1,452	1,424	-28	-2%	Yes	1,452	1,423	-29	-2%	Yes					
R107	N	1,025	1,127	102	10%	Yes	1,025	998	-27	-3%	Yes	1,025	998	-27	-3%	Yes

Route Ref.	Dir.	LoHAM P 4.2 Model					LBE P 4.2 Model					LBE P 4.2 Model (after truncation)				
		Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.	Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.	Obs Time (sec)	Mod. Time (sec)	Diff.	% Diff.	Within TAG Req.
R108	S	1,002	1,076	74	7%	Yes	1,002	1,163	162	16%	No	1,002	1,163	162	16%	No
R109	N	2,816	3,225	409	15%	Yes	2,816	2,528	-288	-10%	Yes	987	905	-82	-8%	Yes
R110	S	2,194	2,427	233	11%	Yes	2,194	1,925	-269	-12%	Yes	784	711	-73	-9%	Yes
R113	N	1,706	1,893	187	11%	Yes	1,706	1,926	220	13%	Yes	1,706	1,926	220	13%	Yes
R114	S	1,297	1,382	85	7%	Yes	1,297	1,415	119	9%	Yes	1,297	1,415	119	9%	Yes
R117	N	1,355	1,281	-74	-5%	Yes	1,355	1,327	-28	-2%	Yes	1,355	1,327	-28	-2%	Yes
R118	S	1,056	964	-92	-9%	Yes	1,056	1,024	-32	-3%	Yes	1,056	1,024	-32	-3%	Yes
R119	N	2,421	1,978	-442	-18%	No	2,421	2,018	-403	-17%	No	668	731	63	9%	Yes
R120	S	1,381	1,184	-197	-14%	Yes	1,381	1,227	-154	-11%	Yes	402	412	9	2%	Yes
R121	N	2699	1,801	-897	-33%	No	2,699	1,888	-811	-30%	No					
R122	S	1853	1,472	-381	-21%	No	1,853	1,711	-142	-8%	Yes					
R123	E	530	490	-41	-8%	Yes	530	499	-31	-6%	Yes	530	499	-31	-6%	Yes
R124	W	320	354	34	11%	Yes	320	359	38	12%	Yes	320	359	38	12%	Yes
R131	A	714	698	-17	-2%	Yes	714	687	-27	-4%	Yes	596	513	-83	-14%	Yes
R132	C	953	1,018	65	7%	Yes	953	1,022	69	7%	Yes	657	807	150	23%	No
R133	A	269	258	-11	-4%	Yes	269	257	-12	-4%	Yes	269	257	-12	-4%	Yes
R134	C	312	325	13	4%	Yes	312	353	41	13%	Yes	312	353	41	13%	Yes

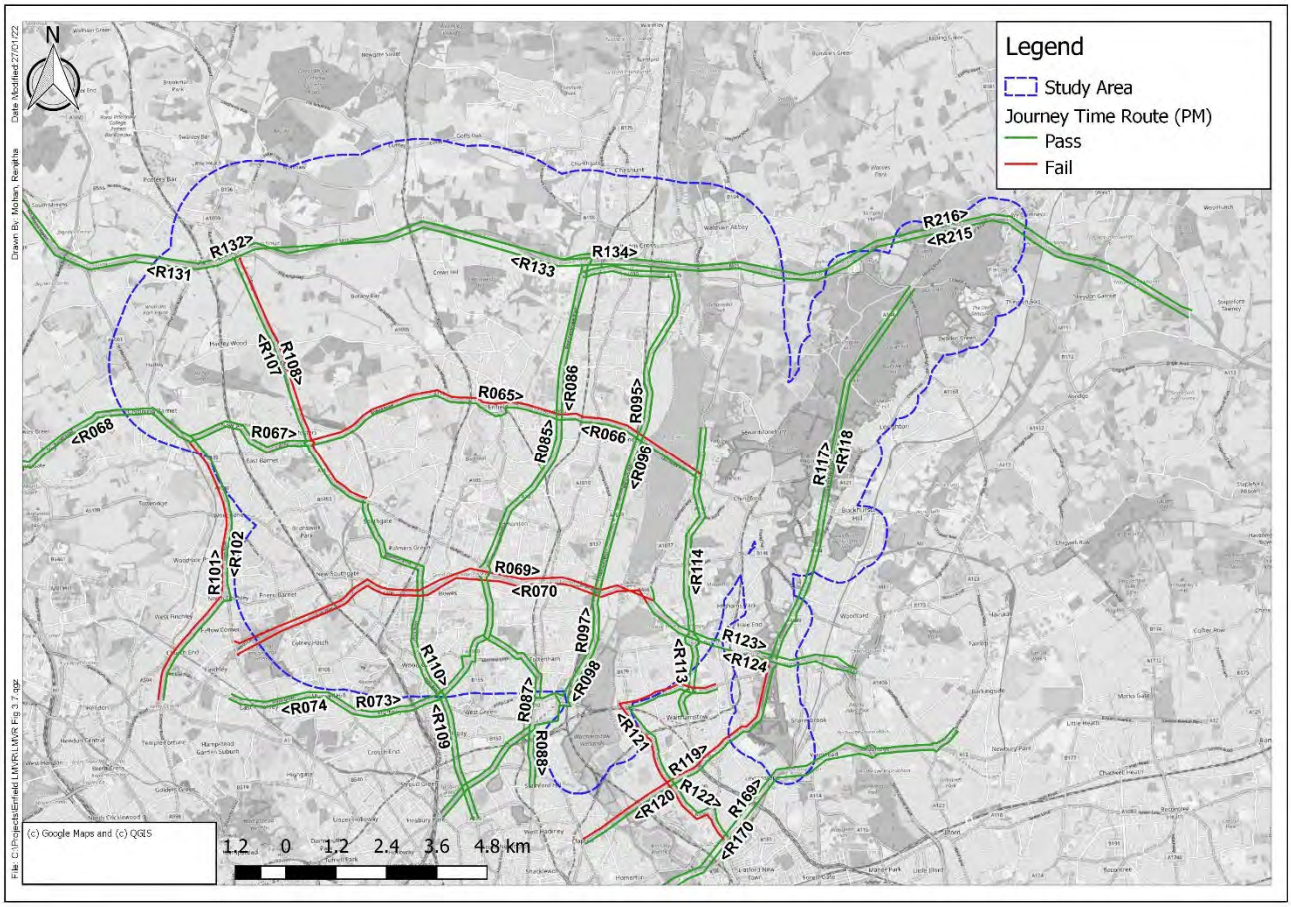


Figure 3-20: Journey Time Calibration - PM Peak

3.4.11. Similar to the AM peak model, the PM peak model journey time profiles were also re-calibrated. The following are some examples where larger differences of modelled JT can be seen before and after the calibration but their overall profiles improved.

3.4.12. For Route R069, the matching of observed and modelled JT for this route in LoHAM was achieved due to a very high delay on a short section of A406 Bowes Road EB. Despite the modelled JT matched with the observed, the forecast delay on this short section was not realistic and could cause unnecessary diversion of traffic. As a result, the re-calibration reduced the estimated delay at this junction by reviewing the modelled junction configuration however the overall modelled JT was then unable to meet the observed journey time. Although the JT route now fails the TAG validation criteria (at -20%), overall it is considered more acceptable for the purposes of this study.

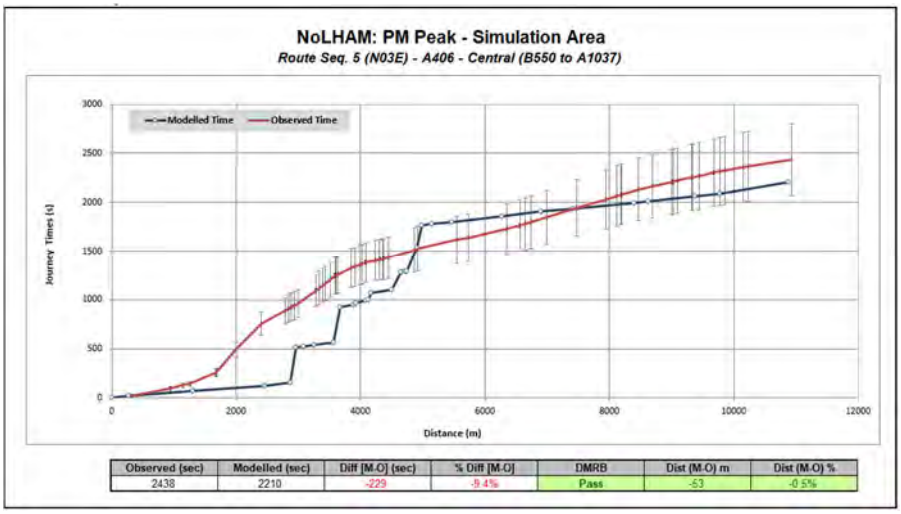


Figure 3-21: Route R069 PM Before Calibration

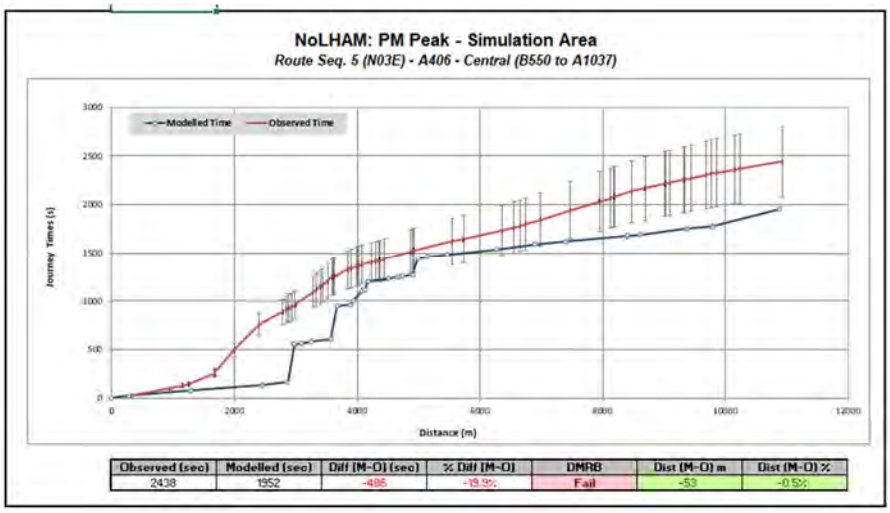


Figure 3-22: Route R069 PM After Calibration

3.4.13. A similar situation is forecast for Route R110 in LoHAM. An unrealistically high delay is modelled on A109 High Road in the PM peak, although the total modelled JT matched with the observed JT despite such high delay. As this delay caused unnecessary rerouting of traffic, the re-calibration removed such delay but maintained the overall modelled JT within the acceptable range.

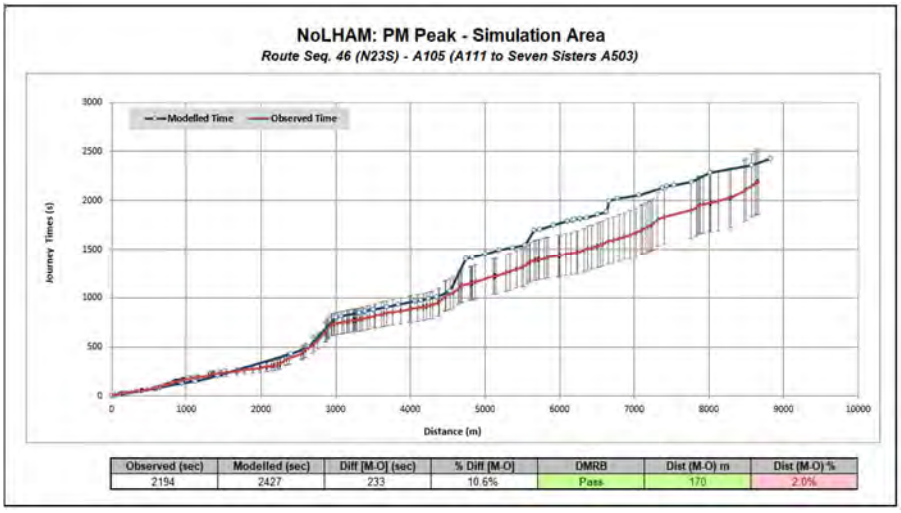


Figure 3-23: Route R110 PM Before Calibration

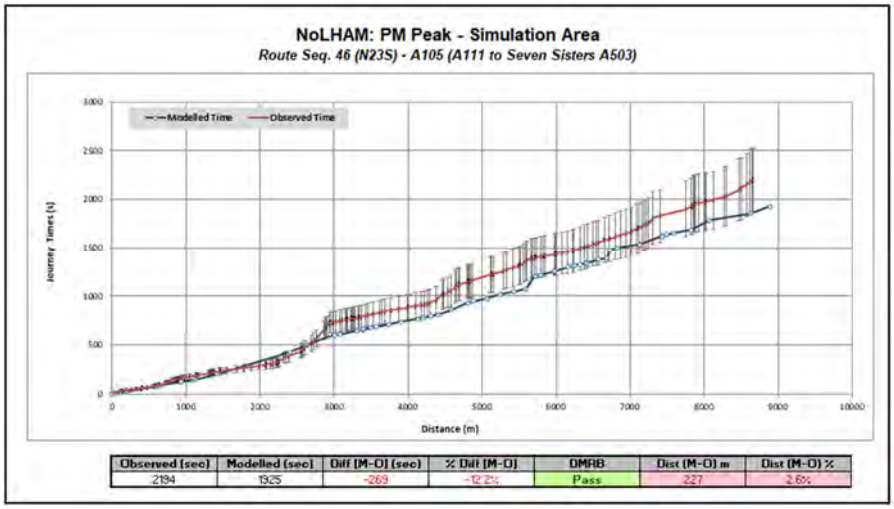


Figure 3-24: Route R110 PM After Calibration

SUMMARY

3.4.14. In summary, 83% of journey time routes in the local study area pass TAG criteria in both peaks. When the journey time routes are curtailed to only include the route sections within the study area, the number of routes meet the criteria is 66% and 75% for AM and PM peak respectively.

3.5 MODEL CONVERGENCE

3.5.1. The LBE model successfully converged in both peaks with the convergence statistics presented in Table 3-12 and Table 3-13 for the AM and PM peaks respectively.

Table 3-12: Model Convergence Statistics – AM Peak

N	Assignment Delta Function (%)	Simulation Final Average Absolute Change in out CFP (PCU/hr)	% Link Flows Differing by <1%	% Turn Delays Differing by <1%	% Variational Inequality	% GAP
39	0.0208	0.076	87.9	96.1	0.00022	0.029
40	0.0174	0.111	91.1	96.8	0.00068	0.028
41	0.0193	0.175	92.3	97.3	0.00024	0.031
42	0.0243	0.108	91.4	96.9	0.00003	0.027

Table 3-13: Model Convergence Statistics – PM Peak

N	Assignment Delta Function (%)	Simulation Final Average Absolute Change in out CFP (PCU/hr)	% Link Flows Differing by <1%	% Turn Delays Differing by <1%	% Variational Inequality	% GAP
24	0.0248	0.038	87.1	96.3	0.00002	0.031
25	0.0205	0.204	89.0	96.6	0.00006	0.031
26	0.0234	0.200	89.0	96.7	0.00020	0.028
27	0.0218	0.059	89.7	96.8	0.00019	0.025

4 MODEL SENSE CHECKS

4.1 INTRODUCTION

4.1.1. Once the calibration and validation exercise was completed, realism checks were undertaken on the Enfield model which included:

- Excessive delays and blocking back
- Queuing
- High volume/capacity ratios (greater than 90%)

4.2 EXCESSIVE DELAYS AND BLOCKING BACK

4.2.1. In the following section, Google Map delay information will be adopted to compare with model results. With the absence of other source of observed data, the information will be used as sense checking to indicate the model representation.

4.2.2. Junctions with excessive delay (greater than 120 seconds) and links with blocking back in the study area are shown in Figure 4-1 and Figure 4-2 for the AM and PM periods respectively. The junctions with more than 180 seconds delay are located along the M25 and near the North Circular Road A406 corridor as expected. Figures 4-3 and 4-4 are screenshots captured from Google Maps, which shows high levels of congestion in these areas under typical traffic conditions, which suggests the model is replicating real life conditions. Further discussion of these problem junctions can be found in Section 4.4.6-4.4.12.

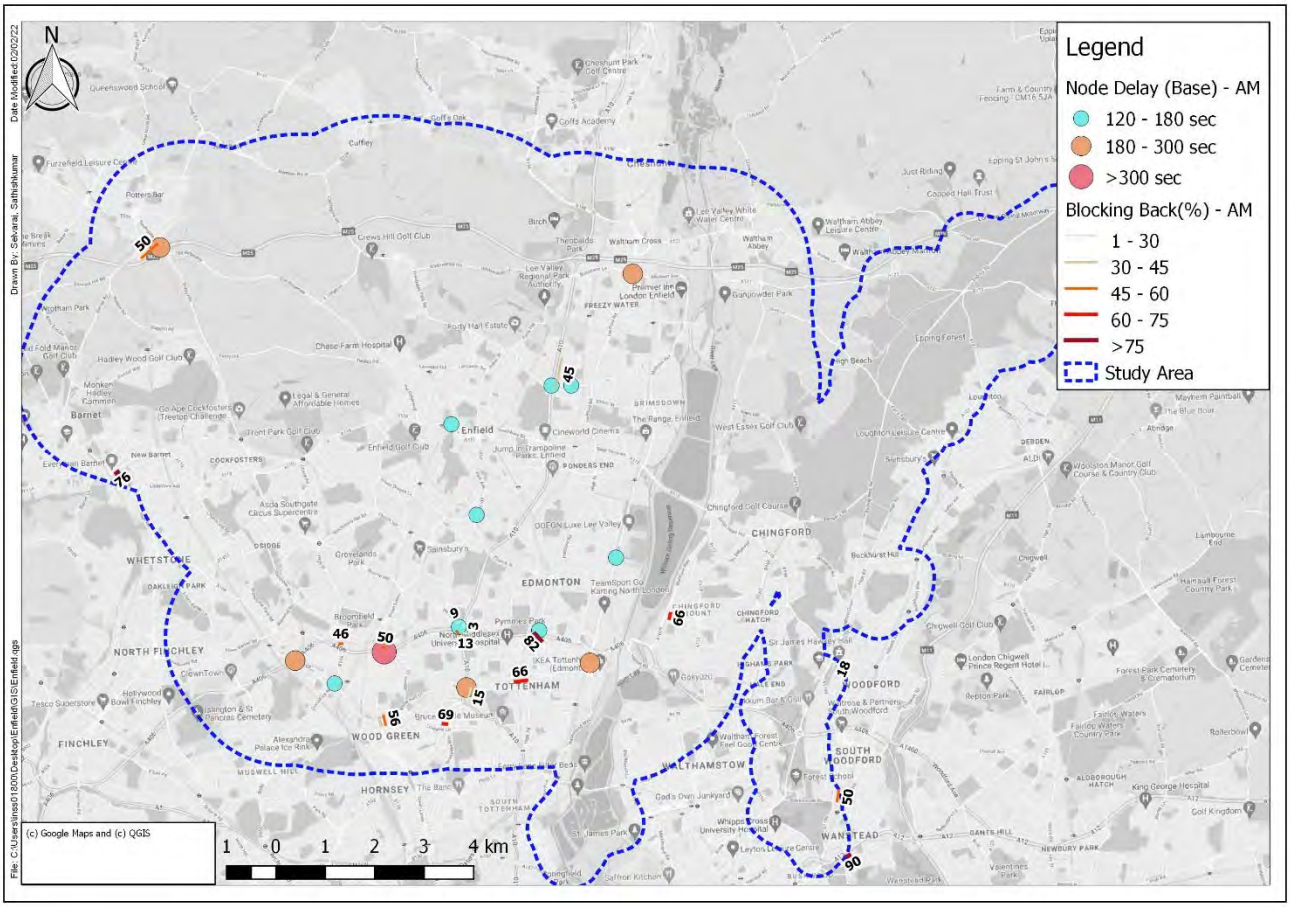


Figure 4-1: Excessive Delays and Blocking Back in Study Area – AM Peak

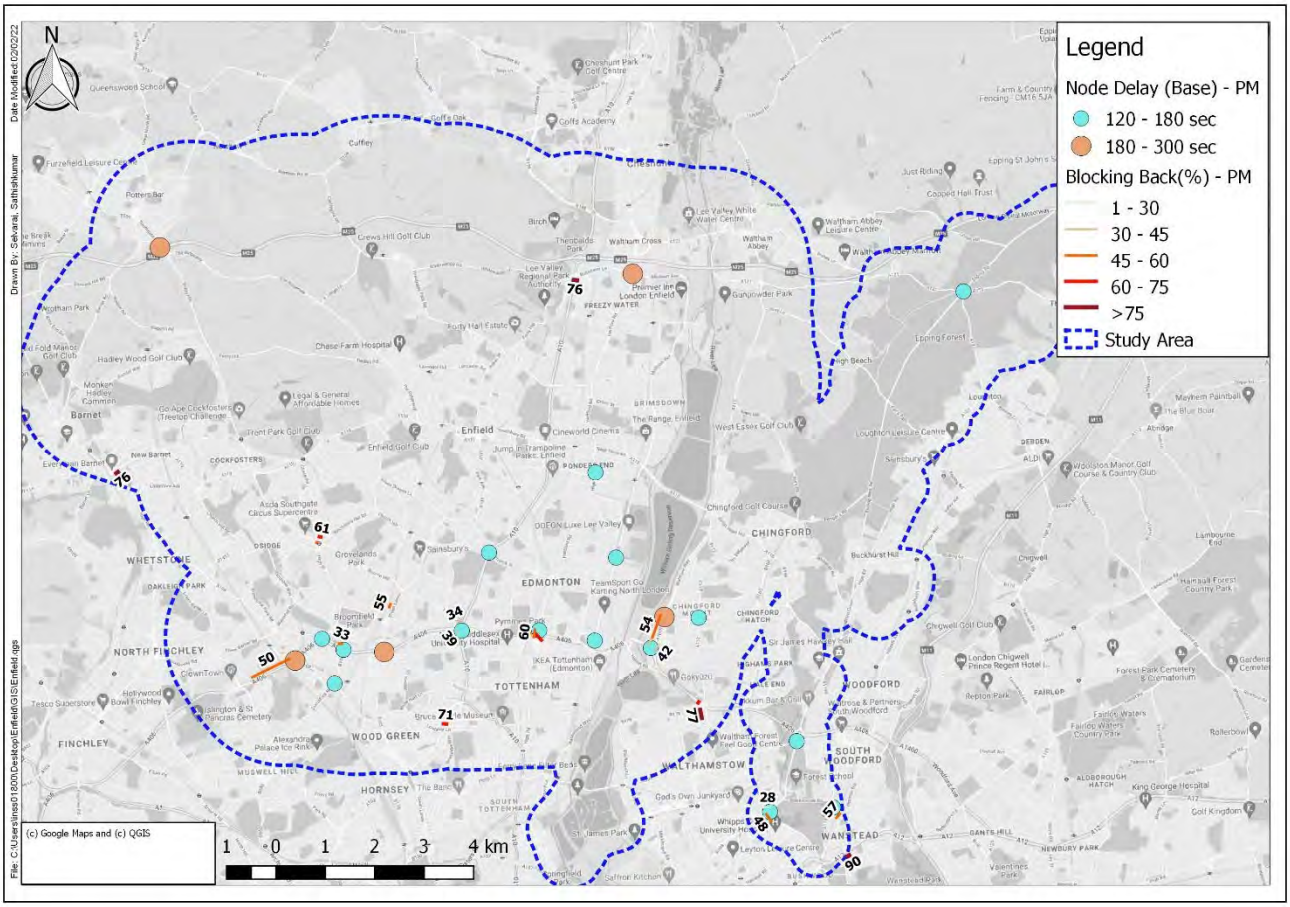


Figure 4-2: Excessive Delays and Blocking Back in Study Area – PM Peak

4.2.3. Key junctions identified in this investigation as having an overall average delay of greater than 120 seconds in the AM and PM time periods are listed in Table 4-1.

Table 4-1: List of Junctions with Excessive Delay of more than 120 seconds (AM and PM)

Junction Name	Time Period
A1009/A1037	PM
A1009/A112	PM
A114/A104(Lea Bridge Rd)	PM
A104/A503	PM
A406/A1009(Hall Ln)	PM
A1199(Hollybush Hill)/High St	PM
A109/Durnsford Rd	AM/PM
A10/White Hart Ln	AM
A406/B1452/A1110	PM
A406/B106(Powys Ln)	PM
Angel road/A1010(Fore St)	AM/PM
A10/B154	PM
A105/Church St	AM
A110/Old Park Ave	AM
High St/South St	PM
A10/Carterhatch Lane	AM
A1010(Hertford Road)/A1055(Mollison Ave)	AM/PM
A406 (off slip - EB) / Taplow Rd	AM
A1055/Conduit Ln	PM
A1055/Pickett's Lock Ln	AM/PM
A10/Ostliffe Rd	PM
A406/A109(Station Rd)	AM/PM
A406/A105(Green Ln)	AM/PM
A1055/Glover Dr	AM
Carterhatch Lane/Pembroke Ave	AM
M25 (J24) – Off slip (NB) Approach to Potters Bar Interchange	AM/PM
A121/B1393/B172/A104/A121	PM

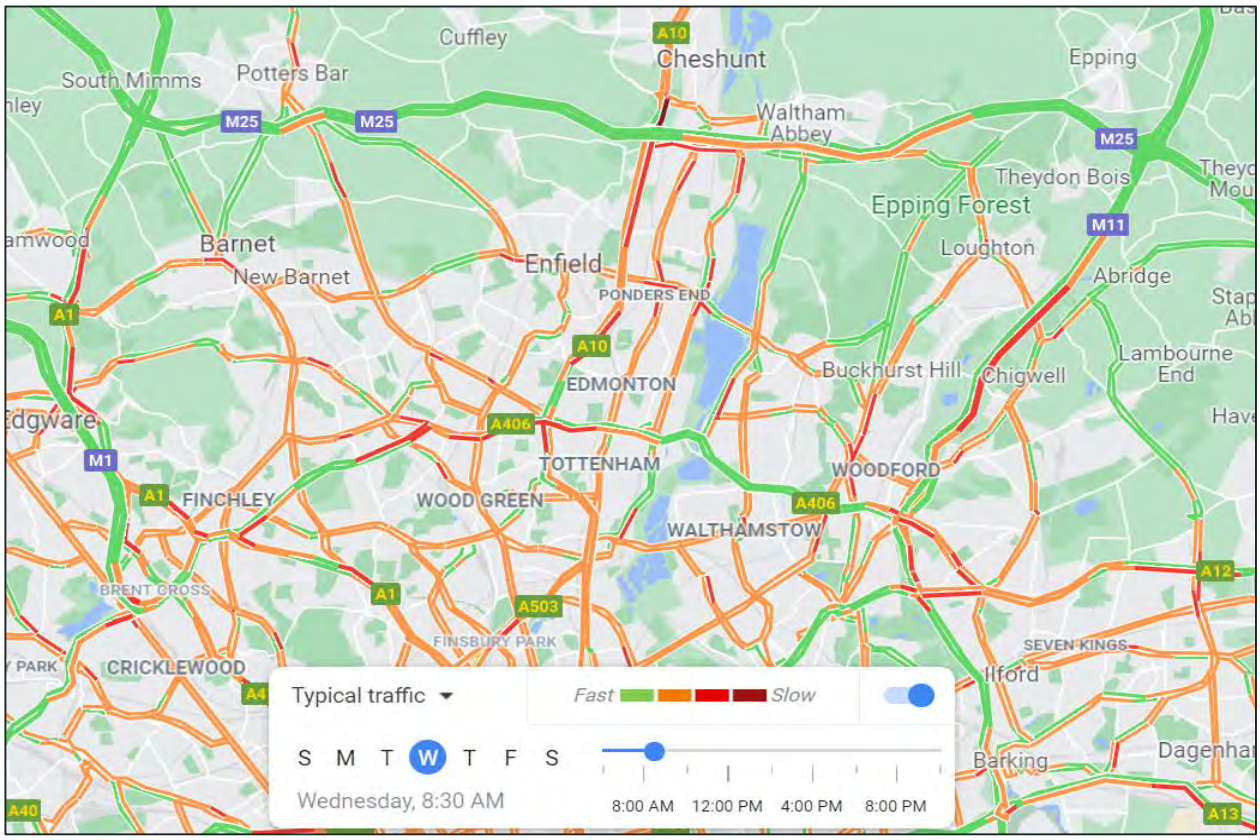


Figure 4-3: Typical 2022 Traffic Levels in the Study Area – AM Peak

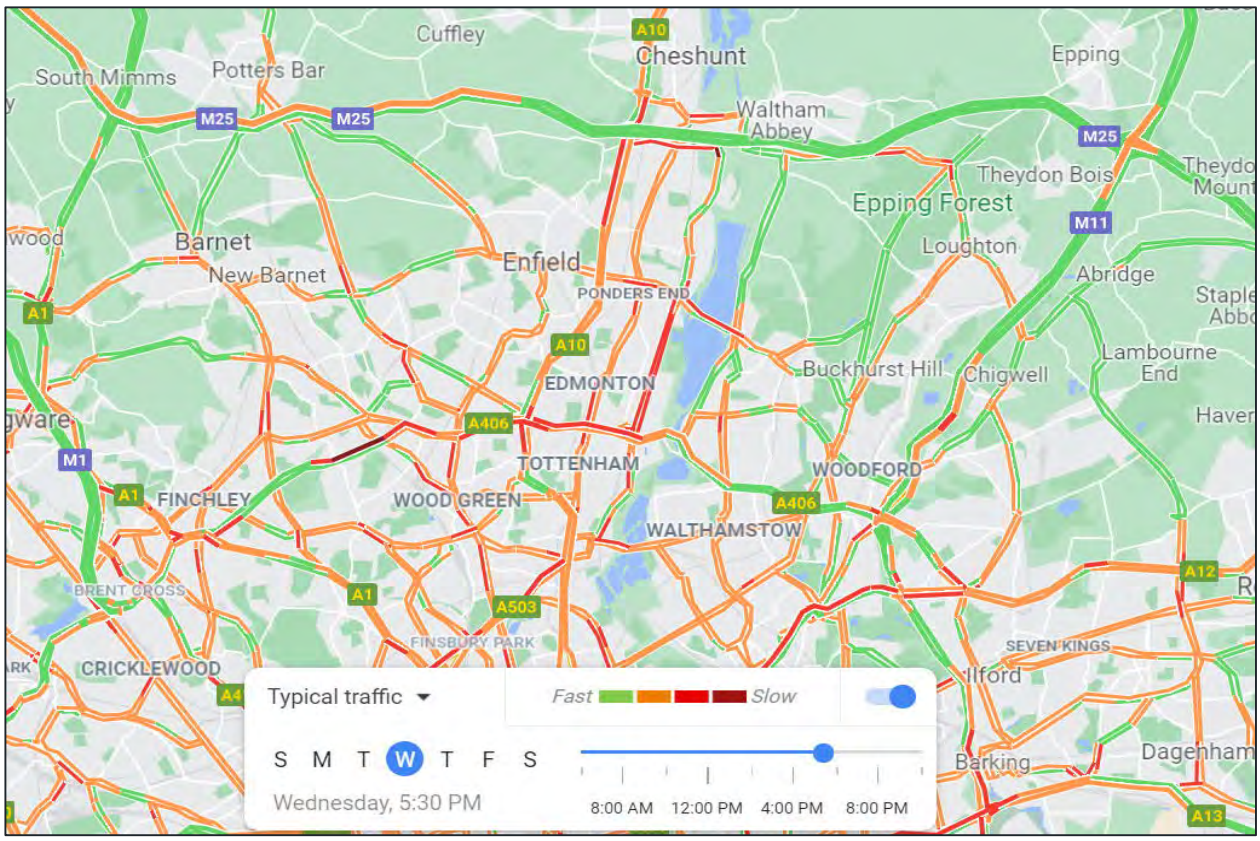


Figure 4-4: Typical 2021 Traffic Levels in the Study Area – PM Peak

4.3 QUEUING

4.3.1. Figure 4-5 and Figure 4-6 identify the locations at which there is queuing(>20PCUs) in the AM and PM time periods respectively. These locations reflect the severe delay modelled in previous plots.

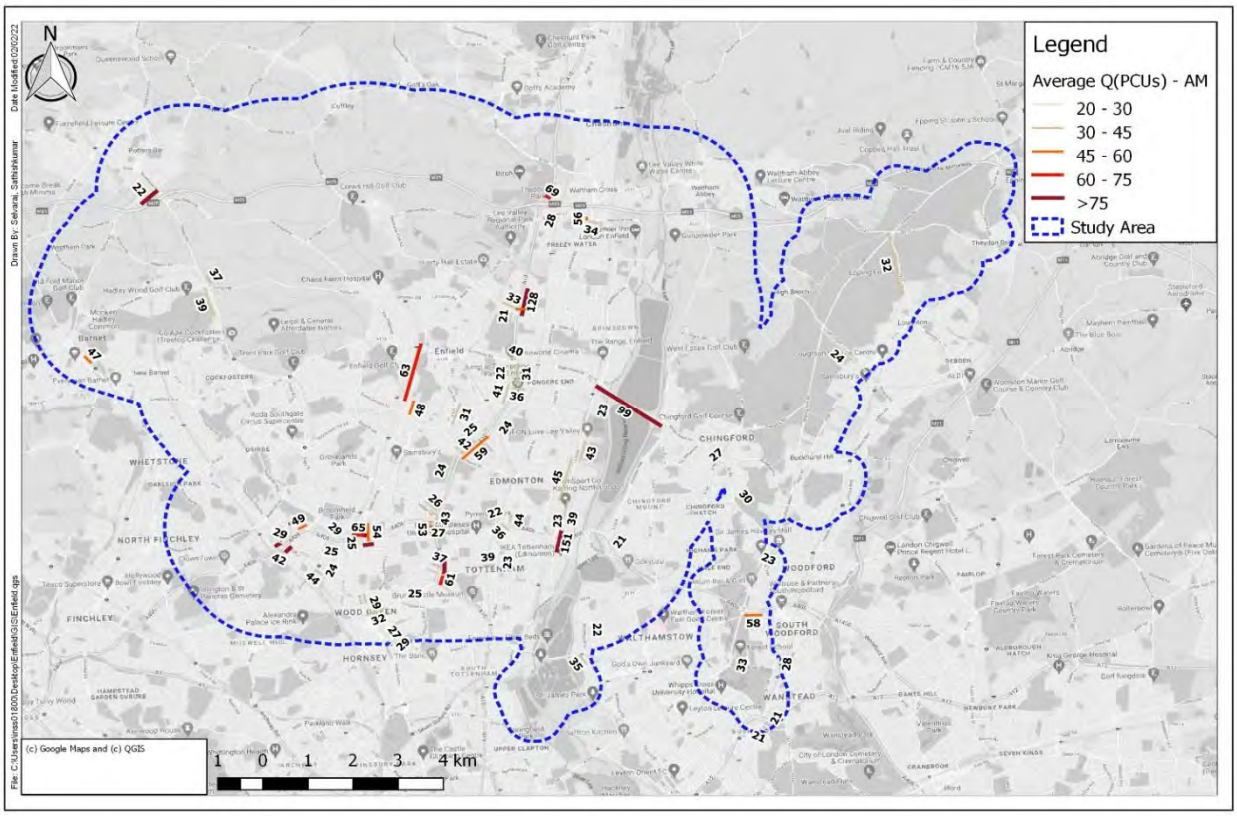


Figure 4-5: Links with Queues (>20PCUs)– AM Peak

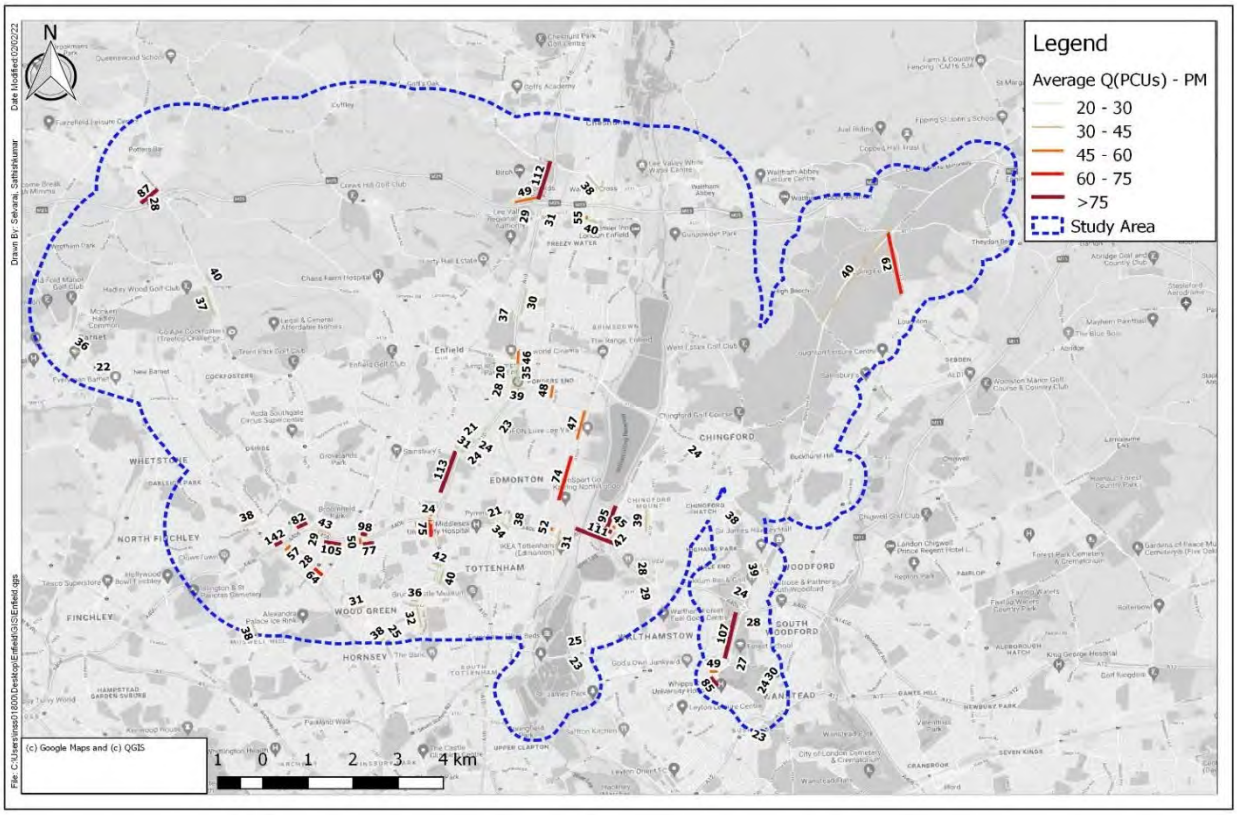


Figure 4-6: Links with Queues (>20PCUs) – PM Peak

4.4 HIGH VOLUME / CAPACITY RATIOS

4.4.1. Volume/capacity (V/C) ratio plots are shown in Figure 4-7 and Figure 4-8 for the AM and PM periods respectively. Links with V/C higher than 90% are highlighted.

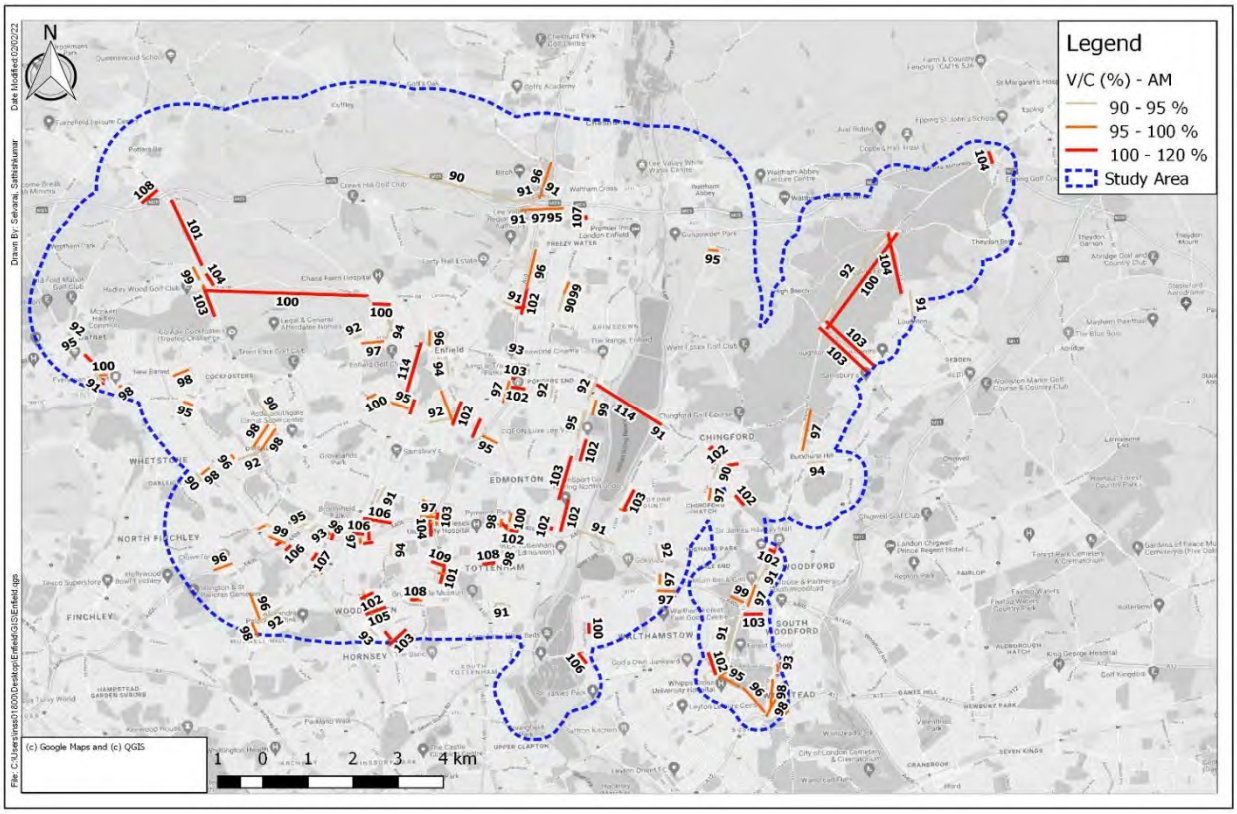


Figure 4-7: Link V/C Ratio(>90%) – AM Peak

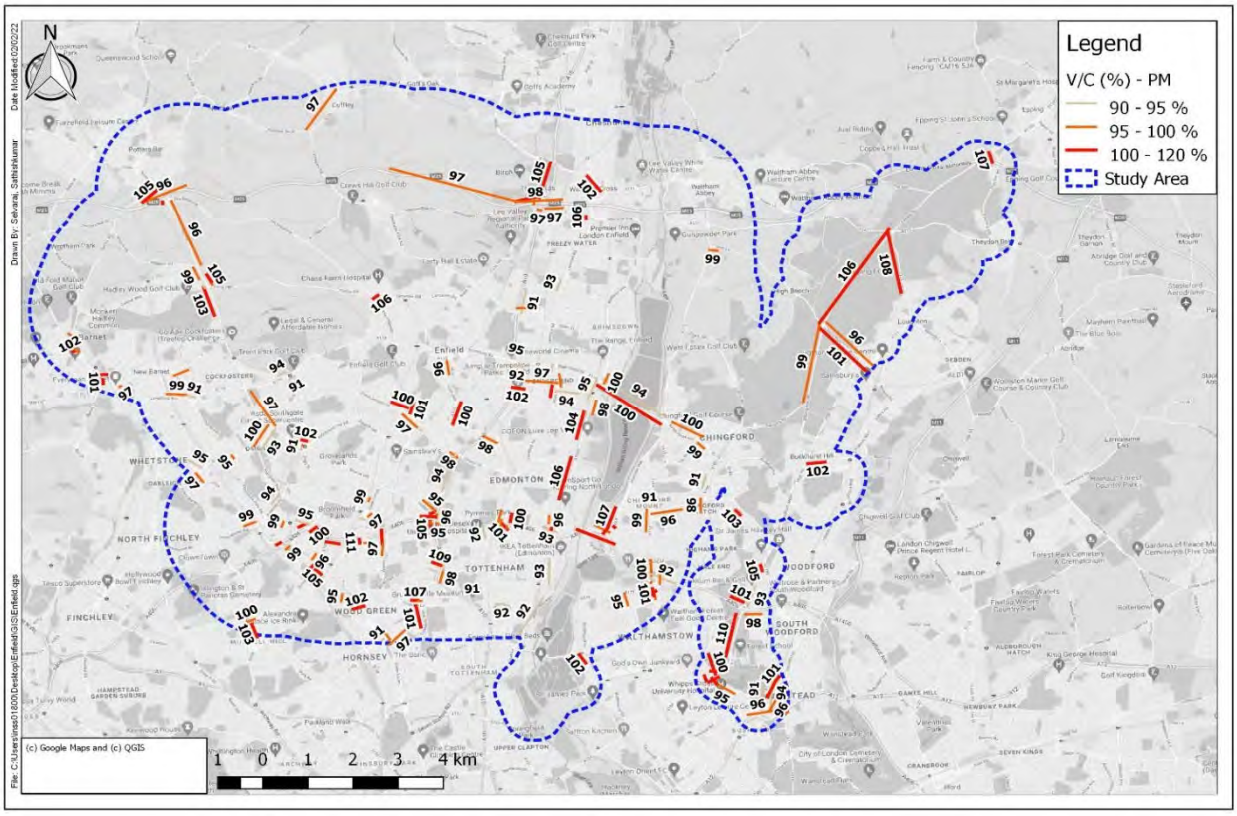


Figure 4-8: Link V/C Ratio (>90%) – PM Peak

4.4.2. The locations with high V/C ratios (>90%) are shown to correspond with the junctions at which high delays occur, as well as the typical traffic level plots in Figure 4-3 and 4-4.

4.4.3. Based on the above sense checks a few of the worst performing junctions are discussed in upcoming sections. These junctions were selected based on junction delay more than 180 seconds for both AM and PM.

4.4.4. Most of the critical junctions discussed in the section below are common to both AM and PM time periods. The Google map comparisons are done based on 2022 typical day traffic data from Google maps (which may underestimate congestion due to the post-Covid situation).

A1010(Hertford Road) / A1055 (Mollison Road) (74125)

4.4.5. The average junction delay experienced at this node is more than 190 seconds in both AM and PM peaks. In AM peak it experiences average queues along A1010 (southern arm) of 56 PCUs and on Mollison Ave (eastern arm) of 34 PCUs along with a V/C of about 107% for the southern arm. This is a signalised junction at which the right turn from Mollison Ave EB to A1010 NB experiences the highest delay of more than 600 seconds which is mainly due to high flows with insufficient green time. However, it should be noted that the journey time for this route (R095) is calibrated well within TAG criteria for both AM and PM peaks. The comparison of Google Maps traffic for 2022 typical weekday is shown in Figure 4-9.

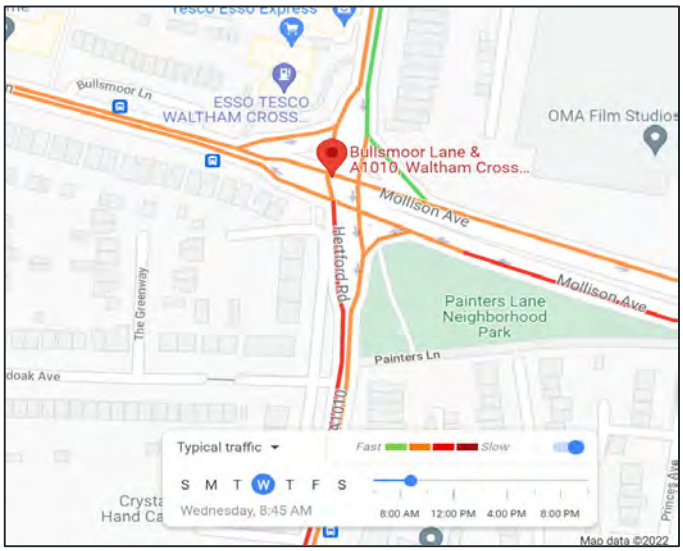


Figure 4-9: Google Maps Traffic (Typical AM) – A1055/A1010

M25 (J24) – Off slip (NB) approach to Potters Bar Interchange (79210)

4.4.6. The signalised junction the M25 NB off-slip at Potters Bar Interchange experiences link delay of about 570s in AM peak with average junction delay of about 200+ seconds in both AM and PM peaks. High delay was observed along approach arm which has green time of 15s in AM peak, and blocking back of vehicles is also forecast due to insufficient stacking capacity. Similar congestion has been recorded in Google Maps for this junction as shown in Figure 4-10.

Figure 4-10: Google Maps Traffic (Typical AM) – A1055/A1010

A406(N Circular Road)/A105(Green Lane) (74269)

4.4.7. This junction is forecast to be over-capacity. At least one of the turning movements at each arm experiences V/C greater than 100% in AM peak, with 112% for the ahead movement along A406 WB. Blocking back is forecast along A406 EB approach in AM. Overall, there is insufficient capacity at this junction to handle the arrival flows resulting in high delays. The average junction delay at his junction exceeds 300 second in AM time period and the same scenario has been observed on ground as shown in Figure 4-11 .

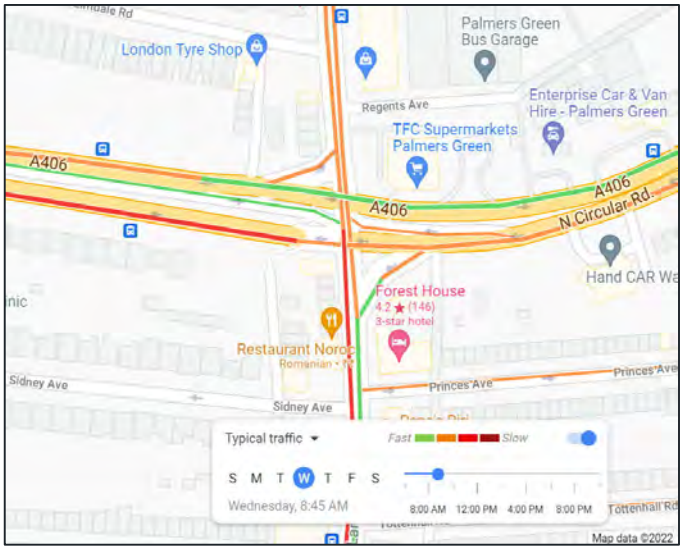


Figure 4-11: Google Map Traffic (Typical AM) – A406/A105

A406/A109(Station Rd) (74230)

4.4.8. Due to high flows and insufficient junction capacity, three out of the four approach arms are at capacity or with V/C exceeding 100% (except Bounds Green Rd) in the AM peak. The highest link delay of about 350 seconds is forecast in the AM peak for the A406 SB (northern arm) and the same trend has also been observed in the PM peak. The congestion levels equivalent to what is shown in Google Maps as shown in Figure 4-12.

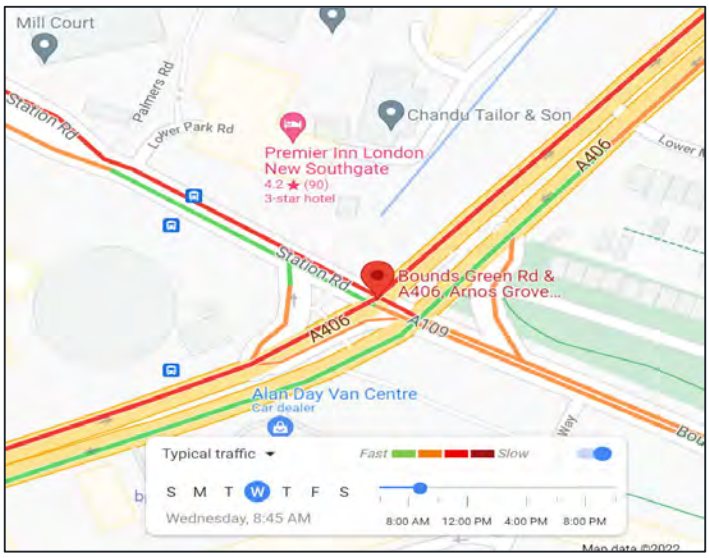


Figure 4-12: Google Maps Traffic (Typical AM) – A406/A105

A10/White Hart Lane (72762)

4.4.9. Three approaching arms of this junction are forecast to be near-capacity or over-capacity with link V/C between 94%-110%, traffic is blocked back from the upstream A10/The Roundway junction in the AM model. The link delays for all approaches are forecast to be between 30 seconds on the A10 NB approach to 430 seconds on the A10 SB approach. Such levels of delay are similar to the observed traffic conditions recorded by Google Maps as illustrated in Figure 4-13. For the PM peak, the delay is less severe, although the A10 SB is also forecast to be near-capacity.

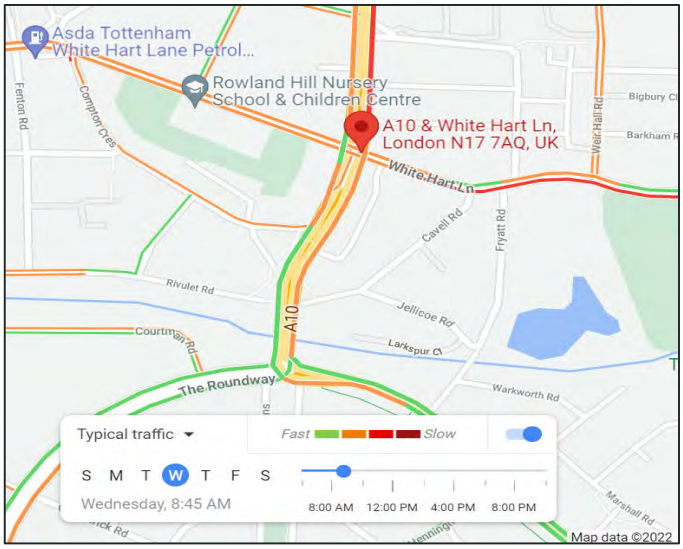


Figure 4-13: Google Maps Traffic (Typical AM) – A410/White Hart Lane

A1009 (Hall Lane)/A1037(Waltham Way) (36088)

4.4.10. This junction experiences high delays in the PM peak which is mainly caused by blocking back for northbound traffic along Hall Lane (and southbound in AM) with one lane approach roundabout carrying the high volume of traffic for both ahead (Waltham Way) and right turning to A1009. Figure 4-14 shows the typical traffic (Google Maps) in PM peak which indicates similar congestion.

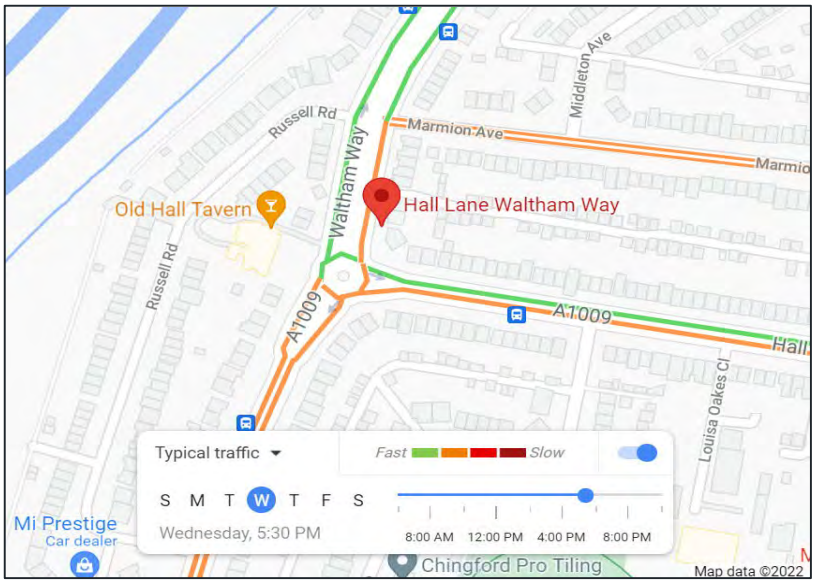


Figure 4-14: Google Map Traffic (Typical AM) – A1009/Waltham Way

4.5 JUNCTIONS ALONG M25

4.5.1. As per the request from National Highway, the traffic performance for junctions along M25 were checked in the model. Appendix G shows the GEH comparison of observed and modelled flow along M25, modelled actual flows in PCU/hr and delay(sec) at major junction along M25 which are falling within the study area.

4.5.2. Following are the list of junctions of interest:

- M25(J25)/A10
- M25/Stagg Hill (Potters Bar Interchange)
- M25/Honey Lane(A121)

5 CONCLUSION

5.1.1. This LMVR has described the calibration exercise undertaken on the LBE Model and assessed how well it calibrates in a base year of 2016 in the local area in Enfield study area, while maintaining good calibration statistics in the wider model.

5.1.2. In the study area, the model was calibrated against 2016 count data where possible. Both the AM and PM time periods achieve 81% of individual links passing either the flow or GEH criteria in AM and PM peaks, slightly lower than TAG guidance. However, this statistic has improved by 8% and 4% for AM and PM peaks respectively when compared with LoHAM results. In the wider model, the calibration results remain the same as LoHAM after the calibration procedure, with 76% and 77% for AM and PM models respectively.

5.1.3. Additional independent validation was also carried out in this exercise. The validation comparison also shows a good improvement over LoHAM, with 81% and 77% of validation link counts meeting TAG criteria. LoHAM only achieved 35% and 46% when these counts were compared with its model flows.

5.1.4. With respect to the screenline performance, 93% and 86% of the local screenlines satisfy the criteria in the AM and PM peak respectively.

5.1.5. The LBE model was validated against observed journey time data in the study area. For the modelled journey times 83% of total journey routes were matching the TAG criteria which is the same as the original LoHAM.

5.1.6. Overall the calibration exercise maintains the high standard of calibration for the study area and wider LoHAM network, in terms of screenline and journey time, while the model representation for the individual links counts within the study area has improved. Additionally, the minor roads of Enfield study area which were not reviewed in LoHAM original calibration are validated with the LBE link counts. It is therefore concluded that the refined LBE model is sufficiently robust and fit for the purpose of assessing the impact of developments in Enfield on the strategic network. The local calibration and validation have yielded worthwhile improvements in the LBE study area with no material disturbance to the wider strategic model.

6 LOHAM V4.3 UPDATE ADDENDUM

INTRODUCTION

6.1.1. As discussed in Section 1.2, the LBE model was originally based on LoHAM P4.2, and was calibrated and validated to improve model performance within the LB Enfield study area in late 2021.

6.1.2. In December 2021, the annual update of LoHAM (P4.3) was released by TfL replacing the previous version of P4.2. Following discussion with TfL, it was suggested that the LBE model should migrate from LoHAM P4.2 to LoHAM P4.3, due to the potential improvements including on forecast model convergence. This Addendum therefore documents the necessary changes to the model for this process and provides a results summary to assess the impact on base year model calibration performance in particularly in the Enfield study area.

6.1.3. This Addendum is divided into the follow sections:

- Highway Network and Matrix Update
- Model Performance

HIGHWAY NETWORK AND MATRIX UPDATE

6.1.4. The following changes have been made in the original LoHAM P4.3 from the previous version of LoHAM P4.2. These changes are therefore incorporated to the updated LBE model. All of these changes are likely to affect the assignment of a highly congested network:

- SATURN 11.5.05N is adopted for model building and assignment. LoHAM P4.2 utilised version 11.5.05H.
- PPK and PPM values are revised
- Signal timing changes
- Speed flow curve changes
- Centroid connector changes
- Bus coding changes

6.1.5. In addition, all the network changes carried out in the process of LBE model recalibration and validation have been adopted in the LBE P4.3 update.

6.1.6. Due to the network changes introduced, matrix estimation was repeated based on the revised LBE P4.3 network to update the post ME matrices, the results of this process are discussed in the following sections.

MODEL PERFORMANCE

6.1.7. In this section, the calibration performance, in terms of individual link counts, screenline and journey time are discussed.

Calibration and Validation of Link Counts

6.1.8. Table 6-1 to Table 6-5 present the comparison of link calibration and validation for two different versions of the LBE model derived from LoHAM P4.2 and LoHAM P4.3. This comparison mainly focusses on percentage of links meeting the TAG criteria, which shows the same calibration results for both AM and PM in comparison with LBE's LoHAM P4.2 version. Whereas within the study area, the LoHAM P4.3 model shows slight reduction of about 1%.

6.1.9. Also, the validation results have dropped by 4% for AM which is the difference of one count has failed to meet the TAG criteria from the previous model version. The reverse effect has been observed in PM, with improvement of additional one count location meeting the TAG criteria.

Table 6-1: Link Flow Calibration Summary Comparison (LoHAM P4.2 and LoHAM P4.3) - AM

Criteria	Acceptability Guideline	LBE Model (LoHAM P4.2)				LBE Model (LoHAM P4.3)			
		Whole Model		Study area		Whole Model		Study area	
		No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline
Flows < 700vph	>85% of Links	2,734	70%	166	71%	2,734	70%	166	72%
Flows 700-2,700vph	>85% of Links	1,165	81%	72	82%	1,165	81%	72	85%
Flows >2,700vph	>85% of Links	183	93%	11	91%	183	93%	11	91%
GEH <5	>85% of Links	4,082	71%	249	77%	4,082	71%	249	76%
Flow Acceptable or GEH <5	>85% of Links	4,082	76%	249	81%	4,082	76%	249	80%

Table 6-2: Link Flow Validation Summary Comparison (LoHAM P4.2 and LoHAM P4.3) - AM

Criteria	Acceptability Guideline	AM			
		LBE Model (LoHAM P4.2)		LBE Model (LoHAM P4.3)	
		No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline
Flows < 700vph	>85% of Links	21	57%	21	52%
Flows 700-2,700vph	>85% of Links	5	40%	5	40%
Flows >2,700vph	>85% of Links	0	0%	0	0%
GEH <5	>85% of Links	26	81%	26	77%
Flow Acceptable OR GEH <5	>85% of Links	26	81%	26	77%

Table 6-3: Link Flow Calibration Summary Comparison (LoHAM P4.2 and LoHAM P4.3) - PM

Criteria	Acceptability Guideline	LBE Model (LoHAM P4.2)				LBE Model (LoHAM P4.3)			
		Whole Model		Study area		Whole Model		Study area	
		No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline
Flows < 700vph	>85% of Links	2,695	71%	167	75%	2,695	71%	167	72%
Flows 700-2,700vph	>85% of Links	1,185	82%	70	86%	1,185	81%	70	87%
Flows >2,700vph	>85% of Links	202	91%	12	92%	202	92%	12	92%
GEH <5	>85% of Links	4,082	72%	249	78%	4,082	72%	249	78%
Flow Acceptable or GEH <5	>85% of Links	4,082	77%	249	81%	4,082	77%	249	80%

Table 6-4: Link Flow Validation Summary Comparison (LoHAM P4.2 and LoHAM P4.3) - PM

Criteria	Acceptability Guideline	PM			
		LBE Model (LoHAM P4.2)		LBE Model (LoHAM P4.3)	
		No. of Obs. For Comp.	% Meeting Guideline	No. of Obs. For Comp.	% Meeting Guideline
Flows < 700vph	>85% of Links	22	50%	22	55%
Flows 700-2,700vph	>85% of Links	4	50%	4	75%
Flows >2,700vph	>85% of Links	0	0%	0	0%
GEH <5	>85% of Links	26	73%	26	77%
Flow Acceptable or GEH <5	>85% of Links	26	77%	26	81%

Calibration of Screenline Counts

6.1.10. Table 6-5 compares the screenline calibration results within the study area between LBE LoHAM P4.2 and P4.3 models. It is noted that the overall percentage (meeting TAG criteria) of screenlines within the study area of LBE P4.3 version has slightly reduced for the AM peak model, the percentage is reduced from 93% to 89% (from 41 screenlines to 39 screenlines). For PM model, the percentage increases to 93% from 86% (from 38 screenlines to 41 screenlines).

Table 6-5: Screenline Calibration within Study Area

Time period	LBE - LoHAM P4.2		LBE - LoHAM P4.3	
	Whole model (flow <5%)	Within study area (flow <5%)	Whole model (flow <5%)	Within study area (flow <5%)
AM Peak	86%	93%	85%	89%
PM Peak	86%	86%	87%	93%

Calibration of Journey Time

6.1.11. The model journey time results between LBE LoHAM P4.2 and P4.3 are presented in Table 6-6. The LBE P4.3 version of the model shows a slight improvement to 83% for the whole model summary and the same as before for within the study area in the AM time period (note - route R170 now fails the TAG criteria and R118 has improved, therefore the total passing remains the same).

6.1.12. In PM peak, JT route R113 has now failed to meet the TAG criteria in comparison with original LBE LoHAM P4.2 model which causes the reduction of 3% as presented below.

Table 6-6: Journey time validation within Study Area

Time period	LBE - LoHAM P4.2		LBE - LoHAM P4.3	
	Whole model (% journey time routes within 15% or 60s of observed	Within study area (% journey time routes within 15% or 60s of observed	Whole model (% journey time routes within 15% or 60s of observed	Within study area (% journey time routes within 15% or 60s of observed
AM Peak	82%	83%	83%	83%
PM Peak	83%	83%	81%	80%

CONCLUSION

6.1.13. In conclusion, the above comparison shows link counts, screenline and journey time calibration are similar or slightly worse between LBE LoHAM P4.2 and P4.3, in AM time period. In PM the results have slightly improved or remain the same in case of link count and screenline summary, journey time routes have reduced by a slight margin with a difference of one route.

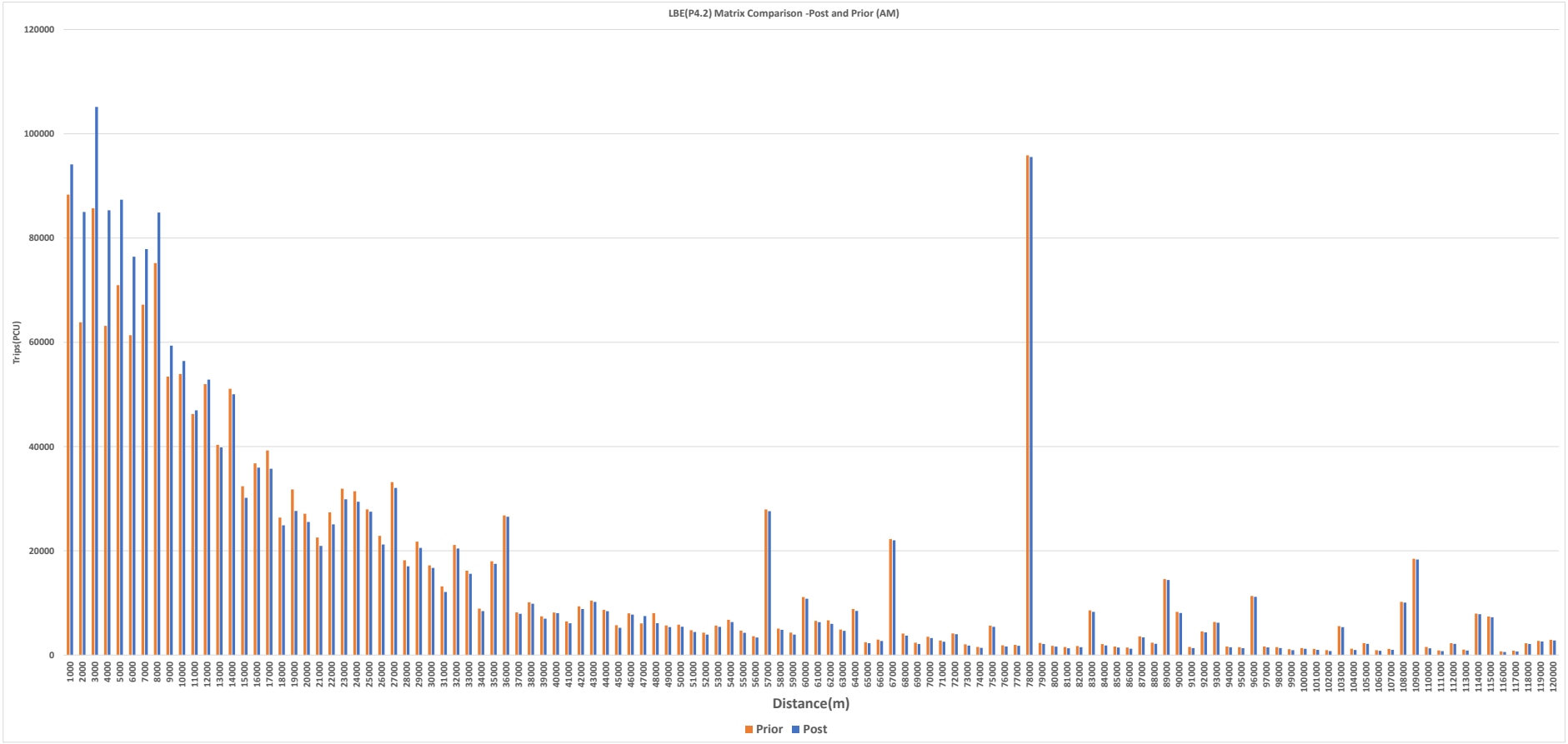
6.1.14. As there are no significant differences in terms of model calibration performance, we would recommend accepting TfL's suggestion that it would be appropriate to adopt the LoHAM P4.3 model for further forecast model development.

Appendix A

PRIOR VS POST MATRIX ESTIMATION MATRIX COMPARISON

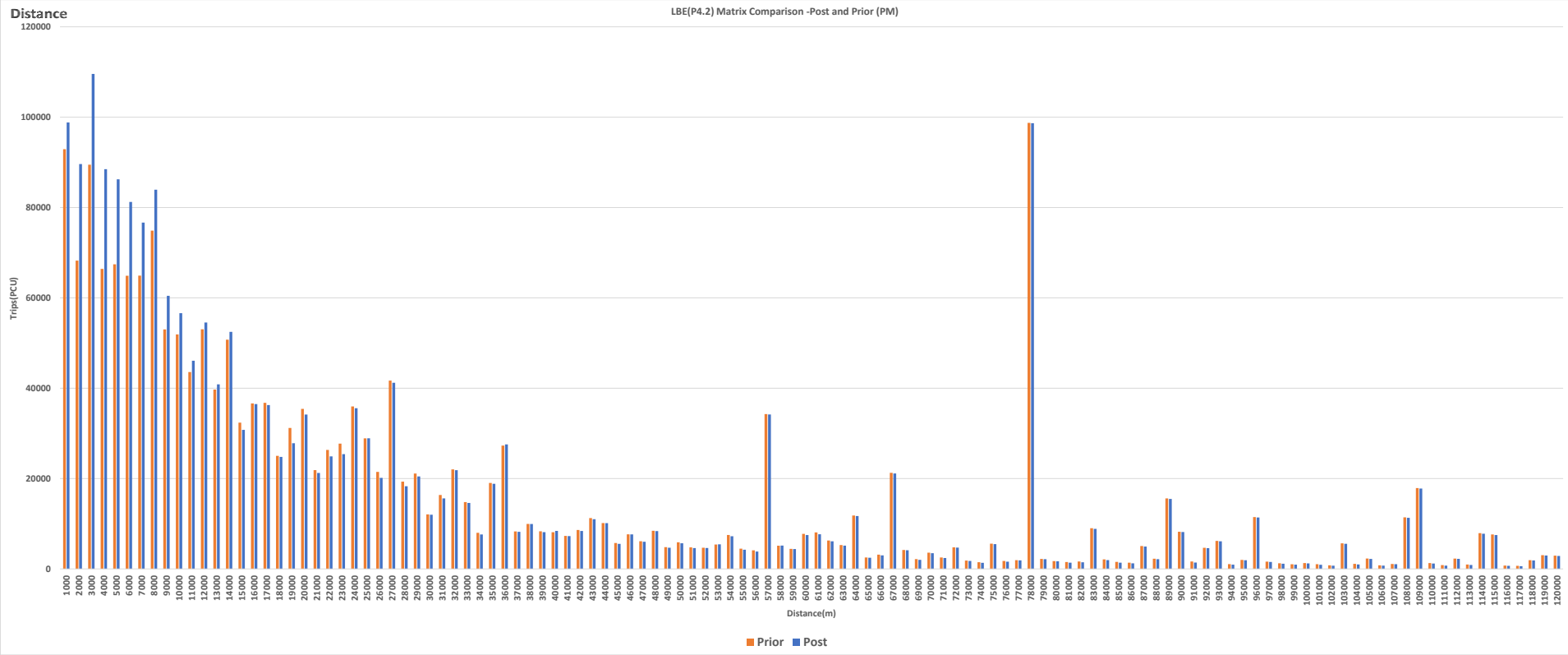
LBE(P4.2) - Post and Prior Matrix Comparison (AM Peak)

User Class	Prior Matrix Total	Post ME Matrix Total	% Difference
UC1	518131	512991	-1.0%
UC2	4233792	4281019	1.1%
UC3	31669	34187	8.0%
UC4	13161	17387	32.1%
UC5	519673	533682	2.7%
UC6	261850	266164	1.6%
All UC	**5578276**	**5645431**	**1.2%**



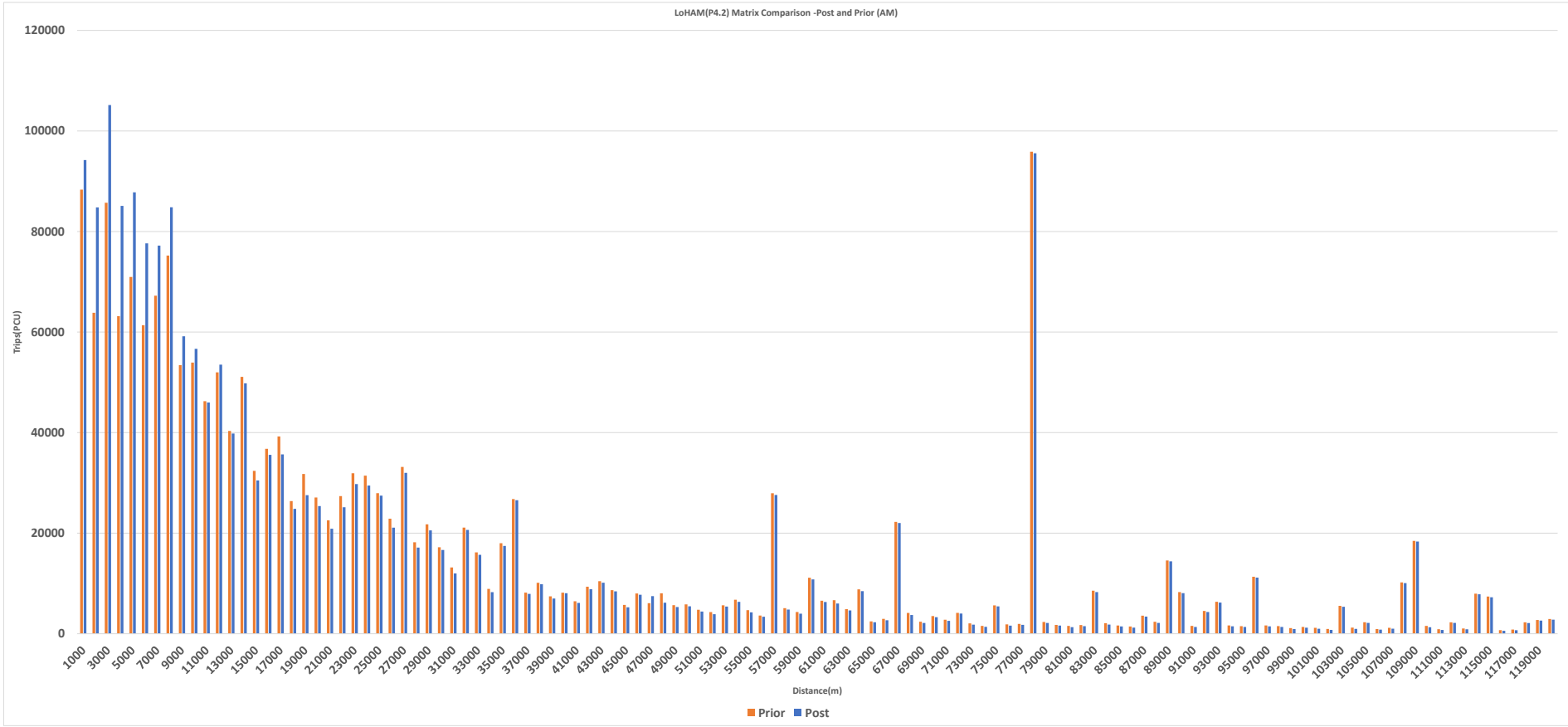
LBE(P4.2) - Post and Prior Matrix Comparison (PM Peak)

User Class	Prior Matrix Total	Post ME Matrix Total	% Difference
UC1	531925	534005	0.4%
UC2	4856546	4942033	1.8%
UC3	27180	31035	14.2%
UC4	22408	26394	17.8%
UC5	418595	432468	3.3%
UC6	140937	144401	2.5%
All UC	**5997591**	**6110336**	**1.9%**



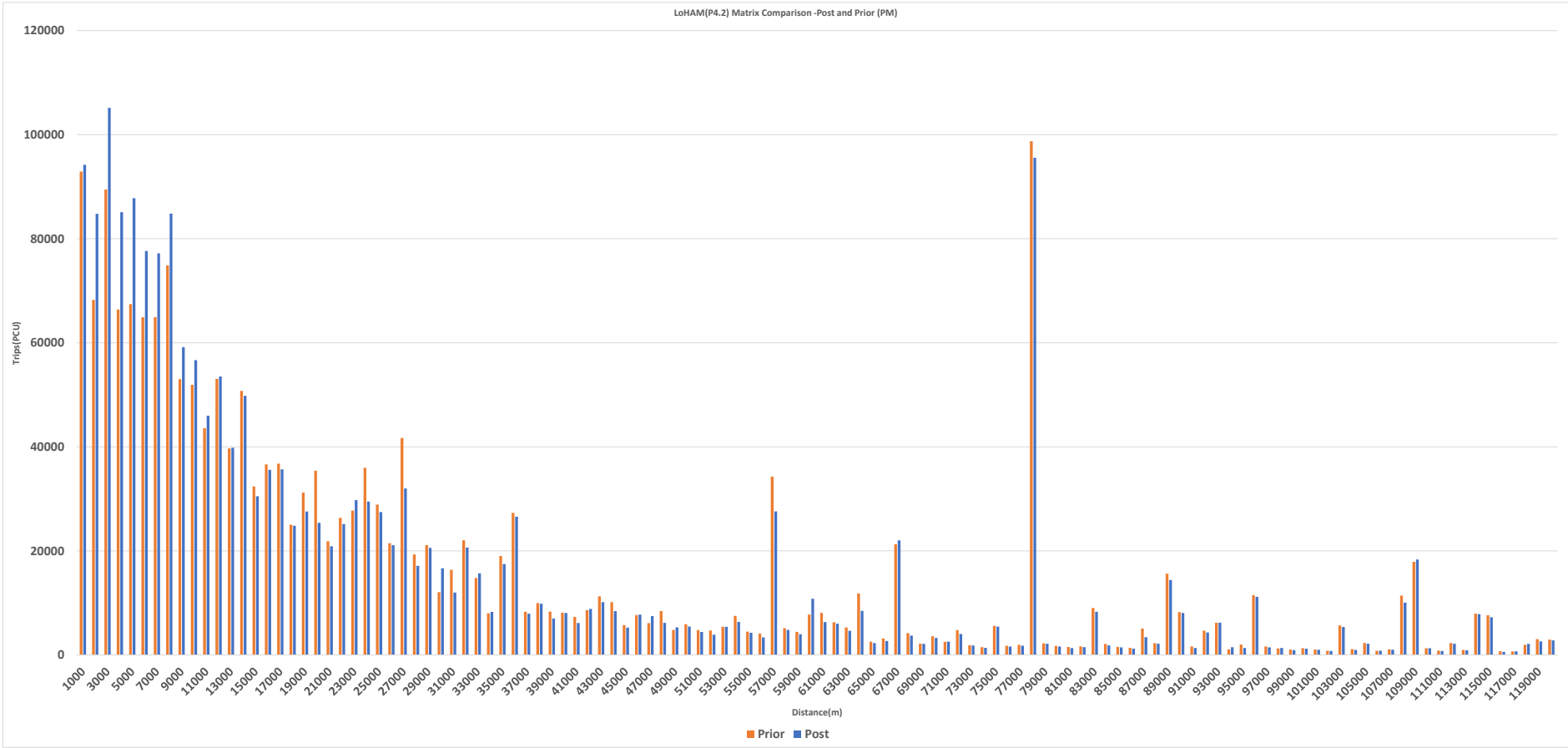
LoHAM(P4.2) - Post and Prior Matrix Comparison (AM Peak)

User Class	Prior Matrix Total	Post ME Matrix Total	% Difference
UC1	518131	512972	-1.0%
UC2	4233792	4280928	1.1%
UC3	31669	34089	7.6%
UC4	13161	17228	30.9%
UC5	519673	533898	2.7%
UC6	261850	265839	1.5%
All UC	**5578276**	**5644954**	**1.2%**



LoHAM(P4.2) - Post and Prior Matrix Comparison (PM Peak)

User Class	Prior Matrix Total	Post ME Matrix Total	% Difference
UC1	531925	534056	0.4%
UC2	4856546	4941565	1.8%
UC3	27180	31065	14.3%
UC4	22408	26428	17.9%
UC5	418595	432313	3.3%
UC6	140937	144423	2.5%
All UC	**5997591**	**6109849**	**1.9%**



Appendix B

SECTOR-TO-SECTOR ANALYSIS

Sector-to-Sector Analysis

AM Peak

AM Prior (Total PCU)

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	10,199	8,538	3,545	1,929	152
Inner	19,803	84,393	31,994	7,293	2,695
Outer (Ex Enfield)	13,137	54,891	343,374	66,674	5,133
External	5,098	11,610	74,608	4,800,483	3,782
Enfield	688	5,149	5,864	3,301	13,944

LBE AM Post ME (Total PCU)

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	13,295	11,396	2,973	1,403	130
Inner	17,450	105,684	34,464	5,659	3,190
Outer (Ex Enfield)	4,932	47,176	430,950	67,590	6,017
External	1,353	6,727	78,219	4,769,859	4,284
Enfield	204	6,103	5,518	3,425	17,433

Absolute Difference AM Peak (LBE Prior vs Post ME)

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	3,096	2,858	572	527	22
Inner	2,354	21,290	2,470	1,634	495
Outer (Ex Enfield)	8,206	7,715	87,577	916	884
External	3,745	4,883	3,611	30,624	502
Enfield	484	954	346	124	3,489

% Difference AM Peak (LBE Prior vs Post ME)

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	30%	33%	-16%	-27%	-15%
Inner	-12%	25%	8%	-22%	18%
Outer (Ex Enfield)	-62%	-14%	26%	1%	17%
External	-73%	-42%	5%	-1%	13%
Enfield	-70%	19%	-6%	4%	25%

LoHAM 4.2 AM Post ME

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	13,242	11,606	3,126	1,421	133
Inner	16,894	104,517	34,443	5,575	3,601
Outer	5,150	46,630	430,893	67,409	5,838
External	1,471	6,559	78,182	4,769,457	4,539
Enfield	206	6,542	5,554	3,380	18,585

Absolute Difference AM Peak (LBE Prior vs LoHAM Post ME)

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	3,044	3,068	419	508	19
Inner	2,910	20,123	2,450	1,717	906
Outer (Ex Enfield)	7,987	8,261	87,520	735	706
External	3,628	5,051	3,574	31,027	757
Enfield	482	1,393	310	79	4,641

% Difference AM Peak (LBE Prior vs LoHAM Post ME)

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	30%	36%	-12%	-26%	-13%
Inner	-15%	24%	8%	-24%	34%
Outer (Ex Enfield)	-61%	-15%	25%	1%	14%
External	-71%	-44%	5%	-1%	20%
Enfield	-70%	27%	-5%	2%	33%

PM Peak

PM Prior (Total PCU)

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	13,806	15,298	8,966	3,541	441
Inner	9,855	77,552	44,209	9,966	4,205
Outer (Ex Enfield)	4,042	30,957	343,929	68,532	5,366
External	2,251	8,198	66,971	5,251,171	3,522
Enfield	157	2,743	4,607	3,283	14,025

LBE PM Post ME (Total PCU)

	Central	Inner	Outer	External	Enfield
Central	17,122	14,776	4,744	1,619	159
Inner	11,778	100,706	45,358	8,941	5,085
Outer (Ex Enfield)	3,461	36,269	437,634	77,151	6,435
External	1,468	5,874	68,345	5,227,413	3,485
Enfield	174	3,939	6,035	4,402	17,959

Absolute Difference PM Peak (LBE Prior vs Post ME)

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	3,316	522	4,221	1,922	281
Inner	1,924	23,154	1,149	1,025	880
Outer (Ex Enfield)	581	5,312	93,705	8,619	1,069
External	783	2,323	1,375	23,758	37
Enfield	16	1,196	1,429	1,119	3,934

% Difference PM Peak (LBE Prior vs Post ME)

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	24%	-3%	-47%	-54%	-64%
Inner	20%	30%	3%	-10%	21%
Outer (Ex Enfield)	-14%	17%	27%	13%	20%
External	-35%	-28%	2%	0%	-1%
Enfield	10%	44%	31%	34%	28%

LoHAM 4.2 PM Post ME

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	17,094	14,732	4,691	1,670	164
Inner	11,879	101,160	45,386	8,917	4,922
Outer	3,385	36,198	437,837	76,918	5,900
External	1,445	5,920	68,204	5,227,078	3,432
Enfield	170	4,064	5,710	4,479	18,496

Absolute Difference PM Peak (LBE Prior vs LoHAM Post ME)

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	3,288	566	4,275	1,871	277
Inner	2,024	23,608	1,177	1,049	717
Outer (Ex Enfield)	657	5,241	93,908	8,386	534
External	806	2,278	1,233	24,093	90
Enfield	13	1,321	1,103	1,196	4,472

% Difference PM Peak (LBE Prior vs LoHAM Post ME)

	Central	Inner	Outer (Ex Enfield)	External	Enfield
Central	24%	-4%	-48%	-53%	-63%
Inner	21%	30%	3%	-11%	17%
Outer (Ex Enfield)	-16%	17%	27%	12%	10%
External	-36%	-28%	2%	0%	-3%
Enfield	8%	48%	24%	36%	32%

Appendix C

LOCAL STUDY AREA LINK FLOW CALIBRATION

Link Calibration Summary (TfL Counts)

						AM Peak							PM Peak						
						All Vehicles				Car+Taxi			All Vehicles				Car+Taxi		
S.No.	Calibration/ Validation	Within Study Area	Site Location	Direction	Ref	Obs	Mod	GEH	Flow/ GEH Pass?	Obs	Mod	GEH	Obs	Mod	GEH	Flow/ GEH Pass?	Obs	Mod	GEH
1	Calibration	*Yes*	A112	1	80024-80393	863	872	0.3	Yes	669	692	0.9	809	822	0.4	Yes	709	739	1.1
2	Calibration	*Yes*	A121 Woodridden Hill	1	80067-80075	672	741	2.6	Yes	518	533	0.7	698	797	3.6	Yes	600	643	1.7
3	Calibration	*Yes*	Epping Road	1	80088-80084	822	697	4.5	Yes	709	602	4.2	690	536	6.2	No	644	507	5.7
4	Calibration	*Yes*	Piercing Hill	1	80096-80089	340	486	7.2	No	292	421	6.8	309	488	9.0	No	296	460	8.4
5	Calibration	*Yes*	A112	2	80393-80024	718	764	1.7	Yes	600	648	1.9	849	823	0.9	Yes	684	678	0.3
6	Calibration	*Yes*	A121 Woodridden Hill	2	80075-80067	739	814	2.7	Yes	599	624	1.0	806	863	2.0	Yes	743	766	0.8
7	Calibration	*Yes*	Epping Road	2	80084-80088	646	620	1.0	Yes	564	548	0.7	697	788	3.3	Yes	666	740	2.8
8	Calibration	*Yes*	Piercing Hill	2	80089-80096	427	464	1.8	Yes	384	425	2.1	453	405	2.3	Yes	421	362	3.0
9	Calibration	*Yes*	St Albans Road	2	78262-70196	436	492	2.6	Yes	341	369	1.5	377	424	2.4	Yes	344	355	0.6
10	Calibration	*Yes*	East Barnet Road	2	70144-70369	752	749	0.1	Yes	575	581	0.2	751	747	0.1	Yes	620	622	0.1
11	Calibration	*Yes*	Longmore Avenue	2	70187-70314	857	851	0.2	Yes	655	662	0.3	653	660	0.3	Yes	539	551	0.6
12	Calibration	*Yes*	St Albans Road	1	70196-78262	600	660	2.4	Yes	549	591	1.8	615	613	0.1	Yes	519	517	0.1
13	Calibration	*Yes*	East Barnet Road	1	70369-70144	673	673	0.0	Yes	514	524	0.4	686	710	0.9	Yes	566	579	0.5
14	Calibration	*Yes*	Longmore Avenue	1	70314-70187	683	678	0.2	Yes	522	526	0.2	824	823	0.0	Yes	680	692	0.5
15	Calibration	*Yes*	Cat Hill	Eastbound	70531-70533	666	741	2.8	Yes	601	630	1.2	662	692	1.1	Yes	598	619	0.8
16	Calibration	*Yes*	Netherlands Road	Inbound	70021-70425	606	435	7.5	No	462	333	6.5	247	68	14.3	No	203	56	13.0
17	Calibration	*Yes*	Churchill Road	Inbound	70528-70527	753	793	1.5	Yes	575	668	3.7	573	620	1.9	Yes	472	544	3.2
18	Calibration	*Yes*	Cat Hill	Outbound	70533-70531	804	849	1.6	Yes	720	739	0.7	750	795	1.6	Yes	692	725	1.2
19	Calibration	*Yes*	Netherlands Road	Outbound	70425-70021	227	135	6.9	Yes	173	111	5.3	374	292	4.5	Yes	308	243	4.0
20	Calibration	*Yes*	Churchill Road	Outbound	70527-70528	590	511	3.3	Yes	451	414	1.8	627	616	0.5	Yes	518	525	0.3
21	Validation	*Yes*	A1009 Hall Lane	Inbound	36088-36413	1,086	1,170	2.5	Yes	869	920	1.7	730	709	0.8	Yes	616	604	0.5
22	Validation	*Yes*	A112 Chingford Road	Inbound	36079-36051	606	603	0.1	Yes	484	496	0.5	567	656	3.6	Yes	487	538	2.3
23	Validation	*Yes*	B160 Winchester Road	Inbound	36379-36277	555	392	7.5	No	490	299	9.6	357	268	5.0	Yes	315	217	6.0
24	Validation	*Yes*	Hale End Road	Inbound	36120-36083	704	825	4.4	Yes	538	715	7.1	422	703	11.8	No	348	644	13.3
25	Validation	*Yes*	A1009 Chingford Lane	Inbound	36108-36122	572	768	7.6	No	500	664	6.8	547	493	2.4	Yes	495	449	2.1
26	Validation	*Yes*	A1009 Hall Lane	Outbound	36413-36088	550	570	0.8	Yes	422	426	0.2	1,120	915	6.4	No	926	781	5.0
27	Validation	*Yes*	A112 Chingford Road	Outbound	36051-36079	554	646	3.8	Yes	413	507	4.4	919	1,008	2.9	Yes	786	845	2.1
28	Validation	*Yes*	B160 Winchester Road	Outbound	36277-36379	332	271	3.5	Yes	279	195	5.5	479	589	4.8	Yes	420	490	3.3
29	Validation	*Yes*	Hale End Road	Outbound	36083-36120	409	405	0.2	Yes	312	354	2.3	565	470	4.2	Yes	466	402	3.1
30	Validation	*Yes*	A1009 Chingford Lane	Outbound	36122-36108	565	675	4.4	Yes	497	588	3.9	704	805	3.7	Yes	616	714	3.8
31	Calibration	*Yes*	Blackhorse Lane	Inbound	36451-36405	555	717	6.4	No	423	616	8.4	410	497	4.1	Yes	338	424	4.4
32	Calibration	*Yes*	A112 Chingford Road	Inbound	36307-36140	862	971	3.6	Yes	710	748	1.4	716	715	0.1	Yes	626	614	0.5
33	Calibration	*Yes*	Hale End Road	Inbound	36334-36274	407	522	5.3	No	311	477	8.4	186	237	3.5	Yes	153	217	4.6
34	Calibration	*Yes*	Blackhorse Lane	Outbound	36405-36451	311	508	9.8	No	237	400	9.2	538	495	1.9	Yes	443	373	3.5
35	Calibration	*Yes*	A112 Chingford Road	Outbound	36140-36307	591	619	1.1	Yes	474	492	0.8	762	558	8.0	No	633	432	8.7
36	Calibration	*Yes*	Hale End Road	Outbound	36274-36334	196	222	1.8	Yes	150	195	3.5	407	335	3.8	Yes	336	298	2.1
37	Calibration	*Yes*	Billet Road	Inbound	36308-36024	159	439	16.2	No	135	364	14.5	498	531	1.4	Yes	432	449	0.8
38	Calibration	*Yes*	Billet Road	Outbound	36024-36308	685	734	1.9	Yes	565	585	0.9	977	1,096	3.7	Yes	848	902	1.8
39	Validation	*Yes*	Forest Road	Inbound	36337-36338	747	592	6.0	No	570	464	4.7	592	651	2.4	Yes	487	555	3.0
40	Validation	*Yes*	Woodford New Road	Inbound	36275-36440	1,004	1,139	4.1	Yes	756	869	3.9	1,014	998	0.5	Yes	882	855	0.9
41	Validation	*Yes*	Snaresbrook Road	Inbound	38246-36012	317	248	4.1	Yes	288	233	3.4	334	184	9.4	No	303	171	8.6
42	Validation	*Yes*	Whipps Cross Road	Inbound	36327-36258	912	1,024	3.6	Yes	772	842	2.5	676	911	8.3	No	554	758	8.0
43	Validation	*Yes*	Forest Road	Outbound	36338-36337	415	392	1.1	Yes	316	326	0.6	692	493	8.1	No	570	402	7.6
44	Validation	*Yes*	Woodford New Road	Outbound	36440-36275	947	1,006	1.9	Yes	800	813	0.5	1,122	1,427	8.5	No	920	1,186	8.2
45	Validation	*Yes*	Whipps Cross Road	Outbound	36258-36327	891	1,025	4.3	Yes	708	831	4.4	806	828	0.8	Yes	711	736	0.9
46	Validation	*Yes*	Snaresbrook Road	Outbound	36012-38246	337	211	7.6	No	300	196	6.6	345	301	2.4	Yes	319	279	2.3
47	Calibration	*Yes*	Blackhorse Road	Inbound	36029-36213	385	355	1.6	Yes	293	263	1.8	431	402	1.4	Yes	355	315	2.2
48	Calibration	*Yes*	James Lane	Inbound	36043-36252	398	348	2.6	Yes	304	274	1.8	506	476	1.4	Yes	418	406	0.6
49	Calibration	*Yes*	Blackhorse Road	Outbound	36213-36029	343	258	4.9	Yes	262	171	6.2	381	261	6.7	No	314	212	6.3
50	Calibration	*Yes*	James Lane	Outbound	36252-36043	543	585	1.8	Yes	415	502	4.1	624	620	0.2	Yes	515	537	0.9
51	Calibration	*Yes*	Friern Barnet lane	Inbound	70163-70158	633	472	6.8	No	549	379	7.9	558	396	7.4	No	508	353	7.5
52	Calibration	*Yes*	Oakleigh Road North	Inbound	70166-70165	728	806	2.8	Yes	557	697	5.6	646	778	4.9	Yes	533	700	6.7
53	Calibration	*Yes*	Brunswick Park Road	Inbound	70175-70160	495	502	0.3	Yes	462	468	0.3	168	171	0.2	Yes	148	151	0.3
54	Calibration	*Yes*	Hampden Way	Inbound	70552-74239	709	517	7.7	No	542	400	6.5	514	374	6.6	No	424	315	5.6
55	Calibration	*Yes*	A1004, High Street	Inbound	74455-74454	562	674	4.5	Yes	453	558	4.7	603	575	1.1	Yes	532	504	1.2
56	Calibration	*Yes*	The Bourne	Inbound	74220-74469	710	781	2.6	Yes	621	685	2.5	615	844	8.5	No	544	748	8.0
57	Calibration	*Yes*	Friern Barnet lane	Outbound	70158-70163	660	395	11.5	No	602	352	11.5	655	470	7.8	No	566	407	7.2
58	Calibration	*Yes*	Oakleigh Road North	Outbound	70165-70166	642	712	2.7	Yes	491	602	4.8	660	805	5.4	No	545	700	6.2
59	Calibration	*Yes*	Brunswick Park Road	Outbound	70160-70175	277	290	0.7	Yes	253	260	0.5	328	341	0.7	Yes	303	312	0.6
60	Calibration	*Yes*	Hampden Way	Outbound	74239-70552	514	379	6.4	No	393	302	4.9	655	383	12.0	No	541	325	10.4
61	Calibration	*Yes*	A1004, High Street	Outbound	74454-74455	666	533	5.4	No	586	434	6.7	564	720	6.2	No	471	598	5.5
62	Calibration	*Yes*	The Bourne	Outbound	74469-74220	671	968	10.4	No	571	873	11.2	691	863	6.2	No	613	769	5.9
63	Calibration	*Yes*	Waltham Way	Inbound	36054-36053	392	664	11.8	No	265	493	11.7	549	630	3.3	Yes	462	539	3.5
64	Calibration	*Yes*	Old Church Road	Inbound	36057-36064	494	215	14.8	No	392	162	13.8	352	535	8.7	No	290	441	7.9
65	Calibration	*Yes*	Larkshall Road	Inbound	36069-36091	571	889	11.7	No	437	742	12.6	405	673	11.6	No	334	588	11.8
66	Calibration	*Yes*	Friday Hill	Inbound	36143-36105	671	758	3.3	Yes	572	645	3.0	533	385	6.9	No	472	348	6.1

						AM Peak							PM Peak						
						All Vehicles				Car+Taxi			All Vehicles				Car+Taxi		
S.No.	Calibration/ Validation	Within Study Area	Site Location	Direction	Ref	Obs	Mod	GEH	Flow/ GEH Pass?	Obs	Mod	GEH	Obs	Mod	GEH	Flow/ GEH Pass?	Obs	Mod	GEH
67	Calibration	*Yes*	White Hall Road	Inbound	36893-38113	561	497	2.8	Yes	494	439	2.5	579	561	0.8	Yes	504	480	1.1
68	Calibration	*Yes*	Waltham Way	Outbound	36053-36054	444	412	1.5	Yes	342	314	1.6	845	852	0.3	Yes	722	733	0.4
69	Calibration	*Yes*	Old Church Road	Outbound	36064-36057	411	430	0.9	Yes	341	350	0.5	431	454	1.1	Yes	359	369	0.5
70	Calibration	*Yes*	Larkshall Road	Outbound	36091-36069	405	503	4.6	Yes	309	431	6.3	528	814	11.0	No	436	712	11.5
71	Calibration	*Yes*	Friday Hill	Outbound	36105-36143	571	518	2.3	Yes	518	462	2.5	666	665	0.1	Yes	577	584	0.3
72	Calibration	*Yes*	White Hall Road	Outbound	38113-36893	520	765	9.6	No	444	653	8.9	507	495	0.5	Yes	460	424	1.7
73	Calibration	*Yes*	Station Road	Inbound	72072-72073	458	550	4.1	Yes	347	404	2.9	667	656	0.4	Yes	550	549	0.1
74	Calibration	*Yes*	B1453 - Osidge Lane	Inbound	70175-70176	635	670	1.4	Yes	484	537	2.4	794	876	2.8	Yes	654	740	3.3
75	Calibration	*Yes*	Oakleigh Road North	Inbound	70165-70159	596	625	1.2	Yes	486	526	1.8	600	665	2.6	Yes	491	562	3.1
76	Calibration	*Yes*	Friern Barnet Rd	Inbound	70143-70574	607	658	2.0	Yes	493	520	1.2	685	715	1.1	Yes	582	598	0.7
77	Calibration	*Yes*	B106 Albert Road	Inbound	72396-72251	445	477	1.5	Yes	367	393	1.3	712	770	2.1	Yes	585	636	2.0
78	Calibration	*Yes*	Station Road	Outbound	72073-72072	616	565	2.1	Yes	467	456	0.5	422	528	4.9	Yes	348	409	3.2
79	Calibration	*Yes*	B1453 - Osidge Lane	Outbound	70176-70175	749	820	2.5	Yes	571	661	3.6	654	711	2.2	Yes	539	604	2.7
80	Calibration	*Yes*	Oakleigh Road North	Outbound	70159-70165	454	408	2.2	Yes	369	339	1.6	428	372	2.8	Yes	383	331	2.8
81	Calibration	*Yes*	Friern Barnet Rd	Outbound	70574-70143	548	583	1.5	Yes	431	443	0.6	488	504	0.7	Yes	436	444	0.4
82	Calibration	*Yes*	B106 Albert Road	Outbound	72251-72396	579	600	0.9	Yes	471	487	0.8	307	314	0.4	Yes	255	262	0.4
83	Calibration	*Yes*	A109 Bounds Green	1	72250-74537	827	984	5.2	No	620	743	4.7	963	1,070	3.4	Yes	812	908	3.2
84	Calibration	*Yes*	A109 Bounds Green	2	74537-72250	853	982	4.2	Yes	652	764	4.2	818	980	5.4	No	679	809	4.8
85	Calibration	*Yes*	Cross Roads	1	80030-80025	344	333	0.6	Yes	307	304	0.2	441	490	2.2	Yes	418	459	2.0
86	Calibration	*Yes*	A1069 Rangers Road	1	36000-36132	541	519	1.0	Yes	414	399	0.7	349	339	0.6	Yes	288	289	0.0
87	Calibration	*Yes*	Oak Hill	1	36438-36083	229	237	0.5	Yes	175	208	2.4	201	221	1.4	Yes	166	190	1.8
88	Calibration	*Yes*	Cross Roads	2	80025-80030	508	410	4.5	Yes	440	369	3.5	337	333	0.2	Yes	334	327	0.4
89	Calibration	*Yes*	A1069 Rangers Road	2	36132-36000	302	342	2.3	Yes	231	275	2.8	371	359	0.6	Yes	306	291	0.9
90	Calibration	*Yes*	Oak Hill	2	36083-36438	140	94	4.2	Yes	107	74	3.5	146	142	0.3	Yes	120	131	0.9
91	Calibration	*Yes*	A112 Sewardstone Road	I	80006-80387	731	716	0.6	Yes	514	513	0.0	649	625	1.0	Yes	511	523	0.5
92	Calibration	*Yes*	A104 Epping New Road	I	80030-80385	1,080	1,104	0.7	Yes	871	890	0.6	721	765	1.6	Yes	645	682	1.5
93	Calibration	*Yes*	A121 High Road	I	80022-80238	703	706	0.1	Yes	595	606	0.5	575	579	0.1	Yes	532	537	0.2
94	Calibration	*Yes*	A1000 - Great North Road, Monken Hadley	I	70198-70016	275	302	1.6	Yes	225	239	0.9	331	338	0.4	Yes	298	304	0.3
95	Calibration	*Yes*	Unc - Waggon Road, Hadley Wood	I	78260-74102	382	283	5.4	Yes	339	229	6.5	265	219	2.9	Yes	250	193	3.8
96	Calibration	*Yes*	A111 - Cockfosters Road	I	79198-74102	549	645	3.9	Yes	431	482	2.4	757	673	3.2	Yes	660	577	3.3
97	Calibration	*Yes*	A1005 - The Ridgeway, Botany Bay	I	79201-74116	574	573	0.1	Yes	463	451	0.6	513	575	2.7	Yes	449	481	1.5
98	Calibration	*Yes*	Unc - Cattlegate Lane, Crews Hill	I	78019-74120	884	893	0.3	Yes	755	783	1.0	370	363	0.3	Yes	305	304	0.1
99	Calibration	*Yes*	A10 - A10 Great Cambridge Road	I	74299-74298	2,074	2,143	1.5	Yes	1,682	1,686	0.1	1,938	1,996	1.3	Yes	1,635	1,698	1.5
100	Calibration	*Yes*	A1010 - High Street, Waltham Cross	I	74234-74125	1,016	1,047	1.0	Yes	850	900	1.7	781	818	1.3	Yes	679	713	1.3
101	Calibration	*Yes*	A112 Sewardstone Road	O	80387-80006	629	639	0.4	Yes	492	520	1.2	721	705	0.6	Yes	558	561	0.2
102	Calibration	*Yes*	A104 Epping New Road	O	80385-80030	679	712	1.3	Yes	602	628	1.0	753	742	0.4	Yes	664	653	0.5
103	Calibration	*Yes*	A121 High Road	O	80238-80022	596	589	0.3	Yes	512	522	0.4	502	512	0.4	Yes	454	467	0.6
104	Calibration	*Yes*	A1000 - Great North Road, Monken Hadley	O	70016-70198	313	328	0.8	Yes	274	270	0.3	466	493	1.2	Yes	417	439	1.1
105	Calibration	*Yes*	Unc - Waggon Road, Hadley Wood	O	74102-78260	360	323	2.0	Yes	334	303	1.7	175	196	1.5	Yes	143	179	2.8
106	Calibration	*Yes*	A111 - Cockfosters Road	O	74102-79198	691	688	0.1	Yes	571	570	0.0	993	934	1.9	Yes	829	794	1.2
107	Calibration	*Yes*	A1005 - The Ridgeway, Botany Bay	O	74116-79201	507	536	1.3	Yes	428	452	1.1	509	518	0.4	Yes	438	452	0.6
108	Calibration	*Yes*	Unc - Cattlegate Lane, Crews Hill	O	74120-78019	349	345	0.2	Yes	273	275	0.1	664	664	0.0	Yes	568	574	0.3
109	Calibration	*Yes*	A10 - A10 Great Cambridge Road	O	74298-74299	1,451	1,541	2.3	Yes	1,130	1,195	1.9	1,747	1,954	4.8	Yes	1,488	1,600	2.8
110	Calibration	*Yes*	A1010 - High Street, Waltham Cross	O	74125-74234	872	864	0.3	Yes	691	683	0.3	1,074	1,029	1.4	Yes	933	906	0.9
111	Calibration	*Yes*	A503 Ferry Lane	WB	72441-72069	704	811	3.9	Yes	491	513	1.0	691	716	0.9	Yes	581	598	0.7
112	Calibration	*Yes*	A406 - North Circular, Angel Road	WB	75020-74187	3,373	3,407	0.6	Yes	2,577	2,658	1.6	3,146	3,388	4.2	Yes	2,599	2,785	3.6
113	Calibration	*Yes*	A110 Lea Valley Road	WB	36102-74088	732	669	2.4	Yes	534	500	1.5	638	692	2.1	Yes	542	564	0.9
114	Calibration	*Yes*	A503 Ferry Lane	EB	72069-72441	603	646	1.7	Yes	448	451	0.1	895	1,044	4.8	Yes	694	789	3.5
115	Calibration	*Yes*	A406 - North Circular, Angel Road	EB	74196-75019	3,321	3,340	0.3	Yes	2,579	2,622	0.9	3,777	3,772	0.1	Yes	3,057	3,059	0.0
116	Calibration	*Yes*	A110 Lea Valley Road	EB	74088-36102	519	562	1.8	Yes	379	393	0.7	779	812	1.2	Yes	658	672	0.6
117	Calibration	*Yes*	Cattlegate Rd, at Crews Hill Stn railway bridge	EB	74120-90061	832	787	1.6	Yes	670	688	0.7	389	371	0.9	Yes	330	328	0.1
118	Calibration	*Yes*	Lavender Hill, between Shooters Rd & Lavender Gdns	EB	74106-74366	450	346	5.2	No	362	287	4.2	603	537	2.8	Yes	512	477	1.6
119	Calibration	*Yes*	Holtwhite's Hill, between Monks Rd & Kirkland Dr	EB	74134-74090	246	244	0.1	Yes	215	225	0.7	317	276	2.4	Yes	289	237	3.2
120	Calibration	*Yes*	Chase Green Ave, between W Bank & Conical Corner	EB	74113-74147	162	255	6.4	Yes	149	228	5.8	148	287	9.4	No	132	261	9.2
121	Calibration	*Yes*	A110, at Enfield Chase Stn railway bridge	EB	74640-74076	716	828	4.0	Yes	608	699	3.6	710	732	0.8	Yes	609	624	0.6
122	Calibration	*Yes*	Vera Ave, between Merridene & Homewillow Cl	EB	74136-74140	212	264	3.4	Yes	194	248	3.6	191	275	5.5	Yes	159	256	6.7
123	Calibration	*Yes*	Grn Dragon Ln, between Hadley Way & Hoodcote Gdns	EB	74013-74059	678	802	4.6	Yes	631	715	3.2	641	712	2.7	Yes	570	612	1.8
124	Calibration	*Yes*	Vicar's Moor Ln, at railway bridge	EB	74259-74060	104	179	6.3	Yes	99	170	6.1	93	216	9.9	No	80	193	9.7
125	Calibration	*Yes*	Station Rd, at Winchmore Hill Stn railway bridge	EB	74280-74043	432	345	4.4	Yes	348	313	1.9	460	335	6.3	No	390	293	5.3
126	Calibration	*Yes*	Compton Rd, between Hoopers Rd & Roseneath Ave	EB	74208-75521	92	19	9.9	Yes	80	18	8.8	86	14	10.2	Yes	76	14	9.4
127	Calibration	*Yes*	Hoopers Rd, between Downes Ct & Arlow Rd	EB	74208-90011	343	190	9.4	No	302	167	8.8	227	174	3.7	Yes	195	149	3.5
128	Calibration	*Yes*	A111, between Woodland Way & Hoopers Rd	EB	74157-74040	613	683	2.8	Yes	548	611	2.6	623	648	1.0	Yes	520	566	2.0
129	Calibration	*Yes*	Fox Ln, between Old Park Rd & Pellipar Cl	EB	74452-74155	351	287	3.6	Yes	304	260	2.6	303	252	3.0	Yes	263	191	4.8
130	Calibration	*Yes*	A1004, at Palmers Green Stn railway bridge	EB	74035-74038	346	336	0.5	Yes	284	252	2.0	415	429	0.7	Yes	353	333	1.1
131	Calibration	*Yes*	Broomfield Ln, between Substation & Bridge Dr	EB	74150-74124	378	373	0.3	Yes	324	332	0.5	437	459	1.0	Yes	364	415	2.6
132	Calibration	*Yes*	A406, between Pymmes Cl & Palmerston Rd	EB	75504-74616	1,878	1,986	2.5	Yes	1,509	1,565	1.4	2,074	2,038	0.8	Yes	1,759	1,673	2.1
133	Calibration	*Yes*	A109, between Palace Rd & Whittington Rd	EB	72233-72090	783	772	0.4	Yes	599	598	0.0	938	920	0.6	Yes	774	775	0.0

						AM Peak							PM Peak						
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S.No.	Calibration/ Validation	Within Study Area	Site Location	Direction	Ref	Obs	Mod	GEH	Flow/ GEH Pass?	Obs	Mod	GEH	Obs	Mod	GEH	Flow/ GEH Pass?	Obs	Mod	GEH
134	Calibration	*Yes*	Buckingham Rd, between Brdige Rd & Bedford Rd	EB	72081-72252	417	441	1.2	Yes	331	353	1.2	513	531	0.8	Yes	402	415	0.7
135	Calibration	*Yes*	Cattlegate Rd, at Crews Hill Stn railway bridge	WB	90061-74120	281	265	1.0	Yes	226	228	0.1	545	523	1.0	Yes	463	461	0.1
136	Calibration	*Yes*	Lavender Hill, between Shooters Rd & Lavender Gdns	WB	74366-74106	592	711	4.7	Yes	476	616	6.0	425	486	2.9	Yes	360	410	2.5
137	Calibration	*Yes*	Holtwhite's Hill, between Monks Rd & Kirkland Dr	WB	74090-74134	370	188	10.9	No	339	167	10.8	318	197	7.5	No	278	177	6.7
138	Calibration	*Yes*	Chase Green Ave, between W Bank & Conical Corner	WB	74147-74113	219	298	4.9	Yes	204	273	4.4	185	262	5.1	Yes	161	240	5.6
139	Calibration	*Yes*	A110, at Enfield Chase Stn railway bridge	WB	74076-74640	623	693	2.8	Yes	484	550	2.9	683	708	1.0	Yes	593	609	0.6
140	Calibration	*Yes*	Vera Ave, between Merridene & Homewillow Cl	WB	74140-74136	342	629	13.0	No	298	597	14.1	234	372	7.9	No	206	340	8.2
141	Calibration	*Yes*	Grn Dragon Ln, between Hadley Way & Hoodcote Gdns	WB	74059-74013	679	830	5.5	No	594	761	6.4	638	722	3.2	Yes	573	655	3.3
142	Calibration	*Yes*	Vicar's Moor Ln, at railway bridge	WB	74060-74259	208	129	6.1	Yes	197	120	6.1	99	125	2.5	Yes	88	120	3.2
143	Calibration	*Yes*	Station Rd, at Winchmore Hill Stn railway bridge	WB	74043-74280	480	281	10.2	No	386	236	8.5	376	293	4.5	Yes	319	267	3.0
144	Calibration	*Yes*	Compton Rd, between Hoopers Rd & Roseneath Ave	WB	75521-74208	299	86	15.3	No	270	81	14.3	191	86	8.9	No	173	81	8.1
145	Calibration	*Yes*	Hoopers Rd, between Downes Ct & Arlow Rd	WB	90011-74208	290	177	7.4	No	261	158	7.1	224	156	4.9	Yes	194	133	4.8
146	Calibration	*Yes*	A111, between Woodland Way & Hoopers Rd	WB	74040-74157	711	732	0.8	Yes	594	653	2.4	640	710	2.7	Yes	580	637	2.3
147	Calibration	*Yes*	Fox Ln, between Old Park Rd & Pellipar Cl	WB	74155-74452	376	363	0.7	Yes	336	287	2.7	315	295	1.2	Yes	272	260	0.7
148	Calibration	*Yes*	A1004, at Palmers Green Stn railway bridge	WB	74038-74035	180	338	9.9	No	141	254	8.1	193	207	1.0	Yes	153	165	0.9
149	Calibration	*Yes*	Broomfield Ln, between Substation & Bridge Dr	WB	74124-74150	442	388	2.7	Yes	372	326	2.4	319	300	1.1	Yes	295	279	1.0
150	Calibration	*Yes*	A406, between Pymmes Cl & Palmerston Rd	WB	74616-75504	2,103	1,784	7.2	No	1,689	1,401	7.3	1,996	1,813	4.2	Yes	1,693	1,527	4.1
151	Calibration	*Yes*	A109, between Palace Rd & Whittington Rd	WB	72090-72233	893	898	0.1	Yes	718	722	0.1	858	954	3.2	Yes	705	789	3.1
152	Calibration	*Yes*	Buckingham Rd, between Brdige Rd & Bedford Rd	WB	72252-72081	528	546	0.8	Yes	426	447	1.0	471	479	0.3	Yes	403	411	0.4
153	Calibration	*Yes*	Coppetts Rd, between Bobby Moore Way & Joint Rd	I	70393-70147	7	-	3.9	Yes	6	-	3.4	5	-	3.1	Yes	5	-	3.1
154	Calibration	*Yes*	B550 Colney Hatch Ln, between Onion Rd & Trott Rd	I	70222-70114	1,191	1,295	3.0	Yes	955	1,022	2.1	1,055	1,100	1.4	Yes	922	953	1.0
155	Calibration	*Yes*	B106 Dumsford Rd, between Maya Pl & Woodford Way	I	72394-72251	704	729	1.0	Yes	552	576	1.0	404	409	0.3	Yes	349	355	0.3
156	Calibration	*Yes*	A109, between Imperial Rd & Eastern Rd	I	72352-72089	1,064	1,101	1.1	Yes	847	917	2.4	745	755	0.4	Yes	642	665	0.9
157	Calibration	*Yes*	A105 High Rd, between Kings Rd & Trinity Rd	I	72091-72351	739	764	0.9	Yes	572	576	0.2	523	555	1.4	Yes	434	464	1.4
158	Calibration	*Yes*	Wolves Ln, between cemetery & Woodside Rd	I	74547-72097	424	504	3.7	Yes	372	436	3.2	213	337	7.5	No	172	290	7.7
159	Calibration	*Yes*	White Hart Lane, between Fenton Rd & Self Storage	I	72204-72115	525	470	2.5	Yes	415	385	1.5	458	332	6.4	No	389	275	6.2
160	Calibration	*Yes*	A10 Gt Cambridge Rd, between A1080 & Cavell Rd	I	72762-72098	1,596	1,458	3.5	Yes	1,225	1,139	2.5	1,374	1,395	0.6	Yes	1,174	1,188	0.4
161	Calibration	*Yes*	A1010 High Rd, btwn Bill Nicholson Way & Park Lane	I	72103-72099	644	722	3.0	Yes	491	544	2.3	494	516	1.0	Yes	394	403	0.5
162	Calibration	*Yes*	Shelbourne Road, between Manor Road & Park Lane	I	72100-72285	596	585	0.4	Yes	431	446	0.7	442	429	0.6	Yes	372	373	0.0
163	Calibration	*Yes*	Coppetts Rd, between Bobby Moore Way & Joint Rd	O	70147-70393	80	17	9.1	Yes	73	15	8.6	89	142	4.9	Yes	75	112	3.9
164	Calibration	*Yes*	B550 Colney Hatch Ln, between Onion Rd & Trott Rd	O	70114-70222	539	650	4.6	Yes	422	506	3.9	906	926	0.7	Yes	756	766	0.4
165	Calibration	*Yes*	B106 Dumsford Rd, between Maya Pl & Woodford Way	O	72251-72394	452	477	1.2	Yes	387	393	0.3	766	724	1.5	Yes	594	597	0.1
166	Calibration	*Yes*	A109, between Imperial Rd & Eastern Rd	O	72089-72352	591	554	1.6	Yes	459	461	0.1	987	699	9.9	No	823	550	10.4
167	Calibration	*Yes*	A105 High Rd, between Kings Rd & Trinity Rd	O	72351-72091	424	438	0.7	Yes	292	299	0.4	638	694	2.1	Yes	490	536	2.1
168	Calibration	*Yes*	Wolves Ln, between cemetery & Woodside Rd	O	72097-74547	269	348	4.5	Yes	233	296	3.9	588	696	4.3	Yes	471	589	5.1
169	Calibration	*Yes*	White Hart Lane, between Fenton Rd & Self Storage	O	72115-72204	410	397	0.7	Yes	322	332	0.6	549	399	6.9	No	455	319	6.9
170	Calibration	*Yes*	A10 Gt Cambridge Rd, between A1080 & Cavell Rd	O	72098-72762	1,028	981	1.5	Yes	840	807	1.1	1,319	1,333	0.4	Yes	1,065	1,085	0.6
171	Calibration	*Yes*	A1010 High Rd, btwn Bill Nicholson Way & Park Lane	O	72099-72103	429	436	0.3	Yes	310	329	1.1	570	852	10.6	No	454	661	8.8
172	Calibration	*Yes*	Shelbourne Road, between Manor Road & Park Lane	O	72285-72100	318	300	1.0	Yes	240	244	0.2	568	502	2.9	Yes	449	433	0.8
173	Calibration	*Yes*	Lieutenant Ellis Way	EB	78359-78287	567	579	0.5	Yes	473	483	0.5	352	364	0.6	Yes	288	300	0.7
174	Calibration	*Yes*	Lieutenant Ellis Way	WB	78287-78359	440	452	0.6	Yes	348	358	0.5	776	793	0.6	Yes	637	649	0.5
175	Calibration	*Yes*	Winston Churchill Way	WB	78894-78287	646	623	0.9	Yes	449	422	1.3	466	519	2.4	Yes	386	437	2.5
176	Calibration	*Yes*	Winston Churchill Way	EB	78287-78894	776	774	0.1	Yes	599	598	0.1	436	504	3.1	Yes	346	411	3.3
177	Calibration	*Yes*	A406 Telford Road	EB	74394-74393	1,122	1,207	2.5	Yes	858	796	2.1	1,298	1,212	2.4	Yes	1,071	933	4.4
178	Calibration	*Yes*	A406 Telford Road	WB	74393-74394	1,773	1,731	1.0	Yes	1,355	1,338	0.5	1,737	1,550	4.6	Yes	1,433	1,274	4.3
179	Calibration	*Yes*	A109 Bounds Green Road between A406 and Ring Way	Southbound	74230-72248	969	1,032	2.0	Yes	743	779	1.3	861	870	0.3	Yes	725	728	0.1
180	Calibration	*Yes*	A105 Green Lanes between A406 and Princes Avenue	Southbound	74269-74611	698	861	5.9	No	538	649	4.6	610	688	3.1	Yes	509	583	3.2
181	Calibration	*Yes*	Chequers Way between Mitchell Road and mini-roundabout	Southbound	74268-74554	309	98	14.8	No	249	80	13.2	159	108	4.3	Yes	135	94	3.8
182	Calibration	*Yes*	A10 Great Cambridge Road between Ostliffe Road and Lister Gardens	Southbound	74025-74624	1,545	1,368	4.6	Yes	1,177	1,092	2.5	1,339	1,371	0.8	Yes	1,104	1,141	1.1
183	Calibration	*Yes*	Bull Lane between A406 and Watermill Lane	Southbound	74222-74026	583	681	3.9	Yes	469	598	5.5	604	610	0.2	Yes	513	547	1.5
184	Calibration	*Yes*	Gloucester Road between Somerset Road and Sterling Way	Southbound	74197-74028	449	306	7.4	No	362	243	6.9	186	140	3.6	Yes	158	106	4.6
185	Calibration	*Yes*	A1010 Fore Street between Raynham Road and Sterling Way	Southbound	74031-74588	910	1,037	4.1	Yes	715	791	2.8	689	698	0.3	Yes	569	570	0.0
186	Calibration	*Yes*	A1055 Angel Edmonton Road between Leeside Road and Glover Drive	Southbound	74384-72766	1,681	1,311	9.6	No	1,147	988	4.8	1,301	1,331	0.8	Yes	1,088	1,121	1.0
187	Calibration	*Yes*	B160 Fulbourne Road between Garner Road and Wadham Road	Westbound/Inbound	36277-36523	294	269	1.5	Yes	258	188	4.7	428	237	10.5	No	376	189	11.1
188	Calibration	*Yes*	Hale End Road between Wadham Road and Heathcroft Gardens	Southbound	36278-36334	485	522	1.7	Yes	390	477	4.2	208	237	1.9	Yes	176	216	2.9
189	Calibration	*Yes*	A109 Bounds Green Road between A406 and Ring Way	Northbound	72248-74230	871	850	0.7	Yes	676	642	1.3	1,035	1,099	2.0	Yes	876	920	1.5
190	Calibration	*Yes*	A105 Green Lanes between A406 and Princes Avenue	Northbound	74611-74269	394	558	7.5	No	301	431	6.8	369	418	2.5	Yes	274	316	2.5
191	Calibration	*Yes*	Chequers Way between Mitchell Road and mini-roundabout	Northbound	74554-74268	365	103	17.1	No	294	77	15.9	421	324	5.0	Yes	357	282	4.2
192	Calibration	*Yes*	A10 Great Cambridge Road between Ostliffe Road and Lister Gardens	Outbound/Outbound	74624-74025	882	858	0.8	Yes	672	671	0.0	963	936	0.9	Yes	794	784	0.3
193	Calibration	*Yes*	Bull Lane between A406 and Watermill Lane	Northbound	74026-74222	165	154	0.9	Yes	133	113	1.7	305	266	2.3	Yes	259	218	2.7
194	Calibration	*Yes*	Gloucester Road between Somerset Road and Sterling Way	Northbound	74028-74197	392	517	5.9	No	316	448	6.8	409	609	8.9	No	347	533	8.9
195	Calibration	*Yes*	A1010 Fore Street between Raynham Road and Sterling Way	Northbound	74588-74031	430	482	2.4	Yes	298	358	3.3	480	781	12.0	No	383	594	9.6
196	Calibration	*Yes*	A1055 Angel Edmonton Road between Leeside Road and Glover Drive	Northbound	72766-74384	1,104	1,048	1.7	Yes	750	773	0.8	2,029	1,360	16.2	No	1,598	1,093	13.8
197	Calibration	*Yes*	B160 Fulbourne Road between Garner Road and Wadham Road	Eastbound	36523-36277	506	320	9.2	No	425	235	10.4	310	667	16.1	No	271	557	14.1
198	Calibration	*Yes*	Hale End Road between Wadham Road and Heathcroft Gardens	Northbound	36334-36278	287	222	4.1	Yes	231	195	2.5	518	335	8.9	No	440	299	7.3
199	Calibration	*Yes*	A406 NCR Pinkham Way	E	70230-74009	2,133	1,946	4.1	Yes	1,389	1,326	1.7	2,517	2,091	8.9	No	1,904	1,661	5.8
200	Calibration	*Yes*	A406 NCR Pinkham Way	W	74009-70230	2,466	2,387	1.6	Yes	1,772	1,782	0.2	2,311	2,383	1.5	Yes	1,917	1,942	0.6

						AM Peak							PM Peak						
						All Vehicles				Car+Taxi			All Vehicles				Car+Taxi		
S.No.	Calibration/ Validation	Within Study Area	Site Location	Direction	Ref	Obs	Mod	GEH	Flow/ GEH Pass?	Obs	Mod	GEH	Obs	Mod	GEH	Flow/ GEH Pass?	Obs	Mod	GEH
201	Calibration	*Yes*	A406 NCR Lea Valley Viaduct	E	36294-36151	3,923	3,899	0.4	Yes	2,989	3,019	0.5	4,870	4,592	4.0	Yes	4,012	3,833	2.9
202	Calibration	*Yes*	A406 NCR Lea Valley Viaduct	W	36412-36297	3,816	3,787	0.5	Yes	2,908	2,926	0.3	4,333	4,139	3.0	Yes	3,570	3,455	1.9
203	Calibration	*Yes*	Windmill Hill	E	74639-74135	662	780	4.4	Yes	505	619	4.8	602	627	1.0	Yes	496	512	0.7
204	Calibration	*Yes*	Windmill Hill	W	74135-74639	550	612	2.6	Yes	419	481	2.9	719	702	0.7	Yes	593	591	0.1
205	Calibration	*Yes*	Woodford New Road	N	38156-38079	880	878	0.1	Yes	743	746	0.1	977	1,007	0.9	Yes	875	884	0.3
206	Calibration	*Yes*	Woodford New Road	S	38079-38156	922	972	1.6	Yes	804	845	1.4	731	786	2.0	Yes	644	689	1.7
207	Calibration	*Yes*	A10 Great Cambridge Road NB	N	74203-74119	1,451	1,505	1.4	Yes	1,186	1,238	1.5	1,639	1,717	1.9	Yes	1,342	1,414	1.9
208	Calibration	*Yes*	A10 Great Cambridge Road SB	S	74119-74203	1,688	1,737	1.2	Yes	1,282	1,301	0.5	1,742	1,808	1.6	Yes	1,494	1,553	1.5
209	Calibration	*Yes*	Meridian Way	S	74389-74189	979	916	2.1	Yes	746	714	1.2	894	923	1.0	Yes	736	784	1.7
210	Calibration	*Yes*	Meridian Way	N	74189-74389	811	825	0.5	Yes	618	654	1.4	824	892	2.3	Yes	679	725	1.7
211	Calibration	*Yes*	A1055 Great Cambridge Road	S	74626-74132	2,023	1,992	0.7	Yes	1,546	1,557	0.3	1,583	1,682	2.5	Yes	1,306	1,406	2.7
212	Calibration	*Yes*	A1055 Great Cambridge Road	N	74132-74626	1,434	1,443	0.2	Yes	1,096	1,118	0.7	1,695	1,704	0.2	Yes	1,398	1,416	0.5
213	Calibration	*Yes*	Bruce Grove	S	72087-72455	479	376	4.9	Yes	365	282	4.6	503	391	5.3	No	414	332	4.2
214	Calibration	*Yes*	Bruce Grove	N	72455-72087	365	348	0.9	Yes	278	254	1.4	398	448	2.4	Yes	328	378	2.6
215	Calibration	*Yes*	A406 NCR Stirling Way EB	E	74129-74224	2,846	2,762	1.6	Yes	2,207	2,148	1.3	2,900	2,843	1.1	Yes	2,344	2,306	0.8
216	Calibration	*Yes*	A406 NCR Stirling Way WB	W	74222-74128	2,373	2,467	1.9	Yes	1,813	1,896	1.9	2,739	2,905	3.1	Yes	2,263	2,406	3.0
217	Calibration	*Yes*	M25 between J24 and J25	CW	74294-75031	4,456	5,005	8.0	No	3,075	3,570	8.6	4,967	5,990	13.8	No	3,796	4,580	12.1
218	Calibration	*Yes*	M25, Junction 25 - 26	CW	80741-80034	3,828	3,905	1.2	Yes	2,642	2,692	1.0	5,299	5,544	3.3	Yes	4,050	4,262	3.3
219	Calibration	*Yes*	M25 between J26 and J27	CW	80395-80123	3,760	3,830	1.1	Yes	2,595	2,650	1.1	5,200	5,363	2.2	Yes	3,975	4,129	2.4
220	Calibration	*Yes*	M25 between J27 and J26	AC	80112-80396	4,493	4,649	2.3	Yes	3,101	3,216	2.0	4,473	4,597	1.8	Yes	3,419	3,526	1.8
221	Calibration	*Yes*	M25, Junction 26 - 25	AC	80038-80033	4,862	5,054	2.7	Yes	3,355	3,495	2.4	4,547	4,651	1.5	Yes	3,475	3,560	1.4
222	Calibration	*Yes*	M25 between J25 and J24	AC	74306-74295	5,350	5,505	2.1	Yes	3,692	3,815	2.0	4,604	4,713	1.6	Yes	3,519	3,610	1.5
223	Calibration	*Yes*	M25 J24 clockwise exit	CW	78273-79210	880	666	7.7	No	607	482	5.4	889	677	7.6	No	679	534	5.9
224	Calibration	*Yes*	AC, M25, Junction 24 Offslip	AC	79200-79207	582	785	7.8	No	402	592	8.5	406	422	0.8	Yes	310	323	0.8
225	Calibration	*Yes*	CW, M25, Junction 24 Onslip	CW	79208-79202	380	381	0.1	Yes	262	264	0.1	612	618	0.3	Yes	468	501	1.5
226	Calibration	*Yes*	Mollison Avenue	Northbound	74651-74107	1,176	1,317	4.0	Yes	899	992	3.0	972	1,388	12.1	No	802	1,133	10.6
227	Calibration	*Yes*	Alma Road	Northbound	74519-74137	257	209	3.2	Yes	197	188	0.6	480	187	16.0	No	396	173	13.2
228	Calibration	*Yes*	Hertford Road (South)	Northbound	74647-74646	461	377	4.1	Yes	352	274	4.4	573	474	4.3	Yes	473	376	4.7
229	Calibration	*Yes*	Carterhatch Road	Eastbound	74115-74433	686	863	6.3	No	524	751	9.0	903	839	2.2	Yes	745	719	1.0
230	Calibration	*Yes*	Hoe Lane	Eastbound	74203-74432	584	324	12.2	No	514	245	13.8	161	188	2.0	Yes	141	173	2.6
231	Calibration	*Yes*	Mollison Avenue	Southbound	74107-74651	961	1,290	9.8	No	735	961	7.8	1,386	1,434	1.3	Yes	1,144	1,205	1.8
232	Calibration	*Yes*	Alma Road	Southbound	74137-74519	666	160	24.9	No	509	127	21.4	191	203	0.9	Yes	157	181	1.8
233	Calibration	*Yes*	Hertford Road (South)	Southbound	74646-74647	540	720	7.2	No	412	590	7.9	631	601	1.2	Yes	521	482	1.7
234	Calibration	*Yes*	Carterhatch Road	Westbound	74433-74115	528	504	1.1	Yes	404	393	0.5	575	579	0.2	Yes	475	495	0.9
235	Calibration	*Yes*	Hoe Lane	Westbound	74432-74203	8	58	8.7	Yes	8	45	7.3	69	105	3.9	Yes	60	80	2.4
236	Calibration	*Yes*	Old Park Avenue	Southbound	74140-74076	722	617	4.1	Yes	615	566	2.0	544	544	0.0	Yes	467	479	0.6
237	Calibration	*Yes*	London Road	Northbound	74484-74485	536	638	4.2	Yes	409	476	3.2	534	591	2.4	Yes	440	472	1.5
238	Calibration	*Yes*	Uvedale Road	Northbound	74484-74486	24	-	6.9	Yes	18	-	6.0	28	-	7.5	Yes	23	-	6.8
239	Calibration	*Yes*	Lincoln Road	Northbound	74293-74085	258	227	2.0	Yes	198	191	0.4	289	286	0.2	Yes	238	241	0.2
240	Calibration	*Yes*	Southbury Road	Westbound	74371-74175	560	589	1.2	Yes	428	445	0.8	601	605	0.1	Yes	496	490	0.3
241	Calibration	*Yes*	Old Park Avenue	Southbound	74076-74140	722	651	2.7	Yes	615	577	1.5	544	532	0.5	Yes	467	469	0.1
242	Calibration	*Yes*	London Road	Southbound	74485-74484	624	666	1.7	Yes	477	525	2.2	597	617	0.8	Yes	492	513	0.9
243	Calibration	*Yes*	Uvedale Road	Southbound	74486-74484	34	-	8.2	Yes	26	-	7.2	26	-	7.2	Yes	21	-	6.6
244	Calibration	*Yes*	Lincoln Road	Southbound	74085-74293	225	116	8.3	No	172	103	5.9	187	138	3.9	Yes	154	107	4.2
245	Calibration	*Yes*	Southbury Road	Eastbound	74175-74371	617	696	3.1	Yes	471	503	1.4	741	799	2.1	Yes	612	644	1.3
246	Calibration	*Yes*	Waterfall Road	Southbound	74287-74725	935	921	0.4	Yes	712	732	0.7	460	463	0.2	Yes	379	391	0.6
247	Calibration	*Yes*	Waterfall Road	Northbound	74725-74287	542	573	1.3	Yes	413	450	1.8	988	970	0.6	Yes	814	813	0.0
248	Calibration	*Yes*	Lordship Lane	Eastbound	72087-72278	467	429	1.8	Yes	354	352	0.2	622	634	0.5	Yes	513	566	2.3
249	Calibration	*Yes*	Lordship Lane	Westbound	72278-72087	592	621	1.2	Yes	449	487	1.8	532	517	0.6	Yes	439	439	0.0

Link Calibration and Validation Summary (Additonal LBE counts)

					LBE Model								LoHAM P4.2							
					AM				PM				AM				PM			
					Total Vehicles				Total Vehicles				Total Vehicles				Total Vehicles			
S.No	A_B	Calibration/Validation	Site Description	Direction	Obs	Mod	GEH	Flow/ GEH Pass	Obs	Mod	GEH	Flow/ GEH Pass	Obs	Mod	GEH	Flow/ GEH Pass	Obs	Mod	GEH	Flow/ GEH Pass
1	74080_74225	Validation	ATC2	EB	298	244	3	Yes	284	314	2	Yes	298	104	14	No	284	116	12	No
2	74225_74080	Validation	ATC2	WB	285	141	10	No	205	153	4	Yes	285	142	10	No	205	153	4	Yes
3	74103_74104	Validation	ATC3	EB	236	228	1	Yes	267	272	0	Yes	236	38	17	No	267	69	15	No
4	74104_74103	Validation	ATC3	WB	403	439	2	Yes	264	320	3	Yes	403	315	5	Yes	264	194	5	Yes
5	74327_74655	Validation	ATC7	NB	501	761	10	No	321	605	13	No	501	696	8	No	321	565	12	No
6	74655_74327	Validation	ATC7	SB	617	752	5	No	560	739	7	No	617	661	2	Yes	560	800	9	No
7	74232_74654	Validation	ATC13	NB	909	843	2	Yes	814	680	5	Yes	909	743	6	No	814	673	5	No
8	74654_74232	Validation	ATC13	SB	947	811	5	Yes	895	870	1	Yes	947	739	7	No	895	828	2	Yes
9	74053_74325	Validation	ATC19	EB	368	241	7	No	362	425	3	Yes	368	246	7	No	362	197	10	No
10	74325_74053	Validation	ATC19	WB	327	311	1	Yes	355	203	9	No	327	376	3	Yes	355	69	20	No
11	74248_74658	Validation	ATC21	NB	556	540	1	Yes	674	568	4	Yes	556	512	2	Yes	674	684	0	Yes
12	74658_74248	Validation	ATC21	SB	743	629	4	Yes	618	495	5	No	743	604	5	No	618	495	5	No
13	74043_90012	Validation	ATC25	NB	456	429	1	Yes	615	774	6	No	456	635	8	No	615	867	9	No
14	90012_74043	Validation	ATC25	SB	627	452	8	No	535	346	9	No	627	597	1	Yes	535	461	3	Yes
15	74391_74200	Validation	ATC64	NB	249	188	4	Yes	286	171	8	No	249	79	13	No	286	202	5	Yes
16	74200_74391	Validation	ATC64	SB	407	134	17	No	178	105	6	Yes	407	10	28	No	178	22	16	No
17	74392_74101	Validation	ATC66	EB	654	646	0	Yes	590	603	1	Yes	654	502	6	No	590	461	6	No
18	74101_74392	Validation	ATC66	WB	878	413	18	No	972	499	17	No	878	229	28	No	972	349	24	No
19	74436_74204	Validation	ATC70	NB	752	609	5	No	765	828	2	Yes	752	277	21	No	765	672	3	Yes
20	74204_74436	Validation	ATC70	SB	677	882	7	No	579	728	6	No	677	842	6	No	579	774	7	No
21	74424_74649	Validation	ATC5	EB	692	593	4	Yes	659	591	3	Yes	692	417	12	No	659	511	6	No
22	74649_74424	Validation	ATC5	WB	598	192	20	No	534	306	11	No	598	290	15	No	534	365	8	No
23	74116_74120	Validation	ATC9	NB	294	316	1	Yes	401	391	0	Yes	294	234	4	Yes	401	361	2	Yes
24	74120_74116	Validation	ATC9	SB	345	370	1	Yes	303	273	2	Yes	345	352	0	Yes	303	216	5	Yes
25	**74387_74178**	**Calibration**	ATC35	NB	823	769	2	Yes	1057	1000	2	Yes	823	437	15	No	1057	739	11	No
26	**74178_74387**	**Calibration**	ATC35	SB	1002	960	1	Yes	889	880	0	Yes	1002	1228	7	No	889	671	8	No
27	74269_74152	Validation	ATC42	NB	426	454	1	Yes	508	576	3	Yes	426	382	2	Yes	508	519	0	Yes
28	74152_74269	Validation	ATC42	SB	392	500	5	No	439	576	6	No	392	567	8	No	439	719	12	No
29	**75528_74046**	**Calibration**	ATC79	EB	351	448	5	Yes	515	509	0	Yes	351	704	15	No	515	706	8	No
30	**74046_75528**	**Calibration**	ATC79	WB	411	401	0	Yes	508	493	1	Yes	411	848	17	No	508	845	13	No
31	**74070_90022**	**Calibration**	ATC87	NB	271	273	0	Yes	436	481	2	Yes	271	363	5	Yes	436	353	4	Yes
32	**90022_74070**	**Calibration**	ATC87	SB	425	349	4	Yes	424	311	6	No	425	569	6	No	424	350	3.731	Yes

Appendix D

LOCAL STUDY AREA SCREENLINE CALIBRATION

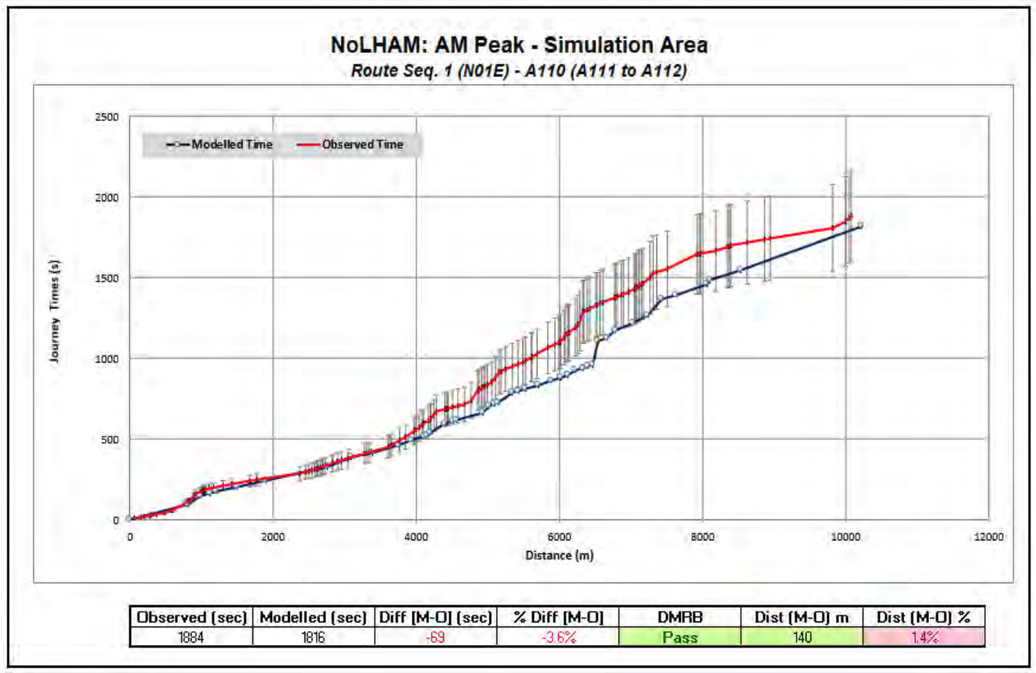
Screenline Summary - Local Study Area

Screenl ne			AM Peak								PM Peak							
			All Vehicles				Car+Taxi				All Vehicles				Car+Taxi			
S.No	Name	Type	Obs	Mod	% Diff	GEH	Obs	Mod	% Diff	GEH	Obs	Mod	% Diff	GEH	Obs	Mod	% Diff	GEH
1	03 - Alexandra Palace	Calibration	3,394	3,449	1.6%	1	2,723	2,747	0.9%	0	3,581	3,578	-0.1%	0	3,022	3,024	0.1%	0
2	03 - Alexandra Palace	Calibration	3,200	3,264	2.0%	1	2,580	2,598	0.7%	0	3,305	3,301	-0.1%	0	2,781	2,781	0.0%	0
3	08 - Epping Forest	Validation	3,673	3,789	3.2%	2	3,020	3,124	3.5%	2	2,774	2,836	2.2%	1	2,401	2,458	2.4%	1
4	08 - Epping Forest	Validation	2,609	2,631	0.8%	0	2,103	2,134	1.5%	1	3,987	3,962	-0.6%	0	3,394	3,399	0.1%	0
5	14 - Walthamstow East to West	Calibration	3,060	2,916	-4.7%	3	2,465	2,408	-2.3%	1	2,341	2,228	-4.8%	2	1,997	1,922	-3.7%	2
6	14 - Walthamstow East to West	Calibration	2,114	2,151	1.7%	1	1,713	1,715	0.1%	0	2,951	2,830	-4.1%	2	2,469	2,315	-6.3%	3
7	15 - Walthamstow North to South	Calibration	3,316	3,710	11.9%	7	2,682	2,973	10.8%	5	3,730	4,171	11.8%	7	3,218	3,560	10.6%	6
8	15 - Walthamstow North to South	Calibration	4,419	4,350	-1.6%	1	3,648	3,560	-2.4%	1	4,856	5,185	6.8%	5	4,101	4,314	5.2%	3
9	16 - Woodford to Wanstead	Validation	2,981	3,004	0.8%	0	2,386	2,408	0.9%	0	2,616	2,743	4.9%	2	2,226	2,338	5.0%	2
10	16 - Woodford to Wanstead	Validation	2,589	2,635	1.8%	1	2,124	2,167	2.0%	1	2,965	3,050	2.9%	2	2,520	2,603	3.3%	2
11	22 - Waltham Forest (Blackhorse Rd to Woodford New Rd)	Calibration	6,856	7,073	3.2%	3	5,197	5,332	2.6%	2	5,770	5,993	3.9%	3	4,953	5,128	3.5%	2
12	22 - Waltham Forest (Blackhorse Rd to Woodford New Rd)	Calibration	5,691	5,912	3.9%	3	4,452	4,627	3.9%	3	7,539	7,408	-1.7%	2	6,053	5,924	-2.1%	2
13	23 - Barnet (Southwest to Northeast)	Calibration	5,341	5,437	1.8%	1	4,500	4,600	2.2%	1	4,437	4,565	2.9%	2	3,911	4,052	3.6%	2
14	23 - Barnet (Southwest to Northeast)	Calibration	4,736	4,841	2.2%	2	4,071	4,187	2.8%	2	5,132	5,297	3.2%	2	4,449	4,599	3.4%	2
15	24 - Chingford to Edmonton	Calibration	3,088	3,149	2.0%	1	2,528	2,589	2.4%	1	2,817	2,879	2.2%	1	2,429	2,486	2.4%	1
16	24 - Chingford to Edmonton	Calibration	2,751	2,774	0.8%	0	2,322	2,348	1.1%	1	3,377	3,419	1.2%	1	2,921	2,951	1.0%	1
17	28 - East Barnet to Wood Green	Calibration	3,594	3,698	2.9%	2	3,041	3,090	1.6%	1	3,772	3,904	3.5%	2	3,206	3,316	3.4%	2
18	28 - East Barnet to Wood Green	Calibration	3,611	3,694	2.3%	1	3,013	3,054	1.4%	1	3,154	3,203	1.6%	1	2,806	2,833	1.0%	1
19	Boundary -NoLHAM	Calibration	9,825	10,237	4.2%	4	7,978	8,231	3.2%	3	8,779	9,118	3.9%	4	7,662	7,902	3.1%	3
20	Boundary -NoLHAM	Calibration	8,688	9,025	3.9%	4	7,269	7,592	4.4%	4	10,220	10,482	2.6%	3	8,516	8,738	2.6%	2
21	Boundary-ELHAM	Calibration	25,626	25,774	0.6%	1	19,369	19,537	0.9%	1	24,374	25,216	3.5%	5	20,591	21,258	3.2%	5
22	Boundary-ELHAM	Calibration	22,522	22,931	1.8%	3	17,544	18,144	3.4%	4	28,177	29,476	4.6%	8	22,730	24,018	5.7%	8
23	Edmond-A406	Calibration	32,417	32,751	1.0%	2	25,063	25,441	1.5%	2	27,597	28,137	2.0%	3	23,687	24,167	2.0%	3
24	Edmond-A406	Calibration	25,866	26,412	2.1%	3	20,582	21,005	2.1%	3	32,523	34,155	5.0%	9	26,375	27,837	5.5%	9
25	Epping New Road	Calibration	3,139	3,449	9.9%	5	2,615	2,867	9.7%	5	3,208	3,311	3.2%	2	2,870	2,933	2.2%	1
26	Epping New Road	Calibration	2,905	3,049	5.0%	3	2,428	2,520	3.8%	2	2,828	2,761	-2.4%	1	2,499	2,395	-4.2%	2
27	Far Outer Cordon(N)	Calibration	18,354	18,352	0.0%	0	14,434	14,609	1.2%	1	19,496	19,075	-2.2%	3	15,581	15,350	-1.5%	2
28	Far Outer Cordon(N)	Calibration	20,273	20,147	-0.6%	1	15,519	15,577	0.4%	0	19,472	19,266	-1.1%	1	16,434	16,517	0.5%	1
29	Great North-South	Calibration	10,848	11,200	3.2%	3	9,028	9,314	3.2%	3	11,437	12,041	5.3%	6	9,565	9,948	4.0%	4
30	Great North-South	Calibration	12,461	12,303	-1.3%	1	10,160	10,098	-0.6%	1	11,400	11,488	0.8%	1	9,815	9,943	1.3%	1
31	Hendon - Tottenham Marshes	Calibration	11,385	11,562	1.6%	2	9,003	9,194	2.1%	2	9,168	9,229	0.7%	1	7,899	7,957	0.7%	1
32	Hendon - Tottenham Marshes	Calibration	7,893	8,094	2.5%	2	6,440	6,636	3.0%	2	10,979	11,176	1.8%	2	8,940	9,134	2.2%	2
33	Inner - North East	Calibration	8,107	8,274	2.1%	2	5,882	6,121	4.1%	3	7,541	7,709	2.2%	2	6,231	6,321	1.5%	1
34	Inner - North East	Calibration	7,066	7,370	4.3%	4	5,213	5,501	5.5%	4	9,190	9,308	1.3%	1	7,346	7,486	1.9%	2
35	NorthEast	Calibration	6,460	6,642	2.8%	2	5,276	5,440	3.1%	2	5,980	6,238	4.3%	3	5,176	5,369	3.7%	3
36	NorthEast	Calibration	5,556	5,805	4.5%	3	4,587	4,794	4.5%	3	6,348	6,693	5.4%	4	5,580	5,843	4.7%	3
37	Radial - River Lee	Calibration	4,910	4,887	-0.5%	0	3,692	3,671	-0.6%	0	4,575	4,801	5.0%	3	3,811	3,953	3.7%	2
38	Radial - River Lee	Calibration	4,544	4,652	2.4%	2	3,496	3,559	1.8%	1	5,551	5,726	3.2%	2	4,498	4,608	2.4%	2
39	Tottenham - Inner Central	Calibration	3,766	3,714	-1.4%	1	2,505	2,519	0.6%	0	3,497	3,383	-3.3%	2	2,831	2,746	-3.0%	2
40	Tottenham - Inner Central	Calibration	3,218	3,284	2.1%	1	2,371	2,417	1.9%	1	3,879	4,081	5.2%	3	2,948	3,149	6.8%	4
41	Enfield East	Calibration	4,616	4,594	-0.5%	0	3,672	3,687	0.4%	0	4,728	4,793	1.4%	1	3,899	3,987	2.2%	1
42	Enfield East	Calibration	4,391	4,469	1.8%	1	3,349	3,417	2.0%	1	4,594	4,729	2.9%	2	3,851	3,996	3.8%	2
43	Enfield Town	Calibration	3,051	2,805	-8.0%	5	2,495	2,266	-9.2%	5	2,946	2,908	-1.3%	1	2,492	2,443	-2.0%	1
44	Enfield Town	Calibration	3,071	2,968	-3.4%	2	2,495	2,401	-3.8%	2	2,945	2,829	-3.9%	2	2,482	2,395	-3.5%	2

Appendix E

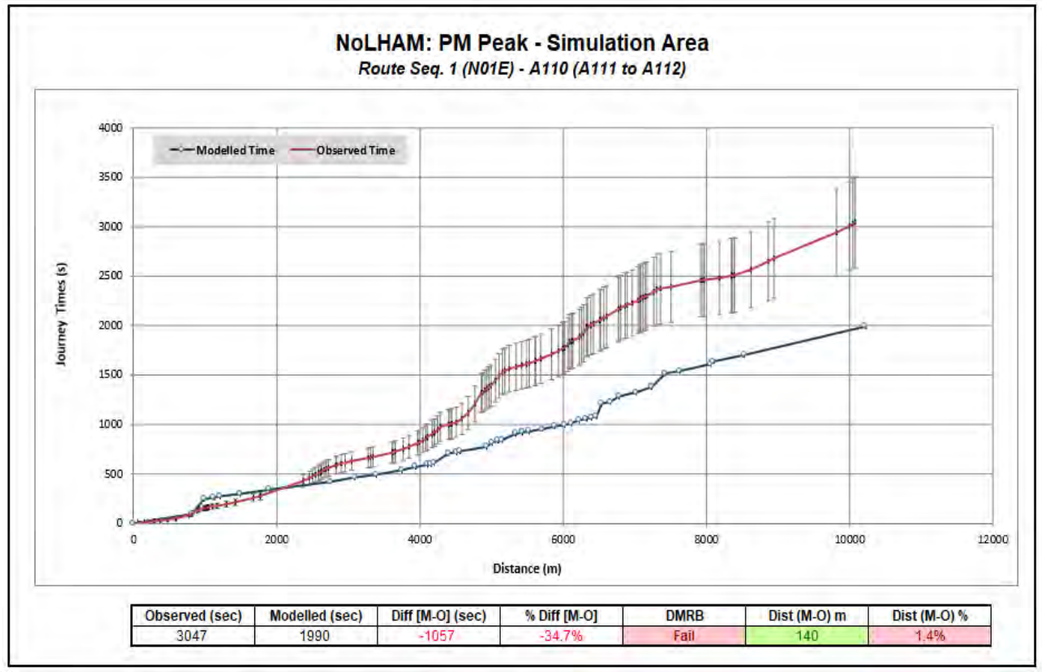
JOURNEY TIME GRAPHS

R 065-AM



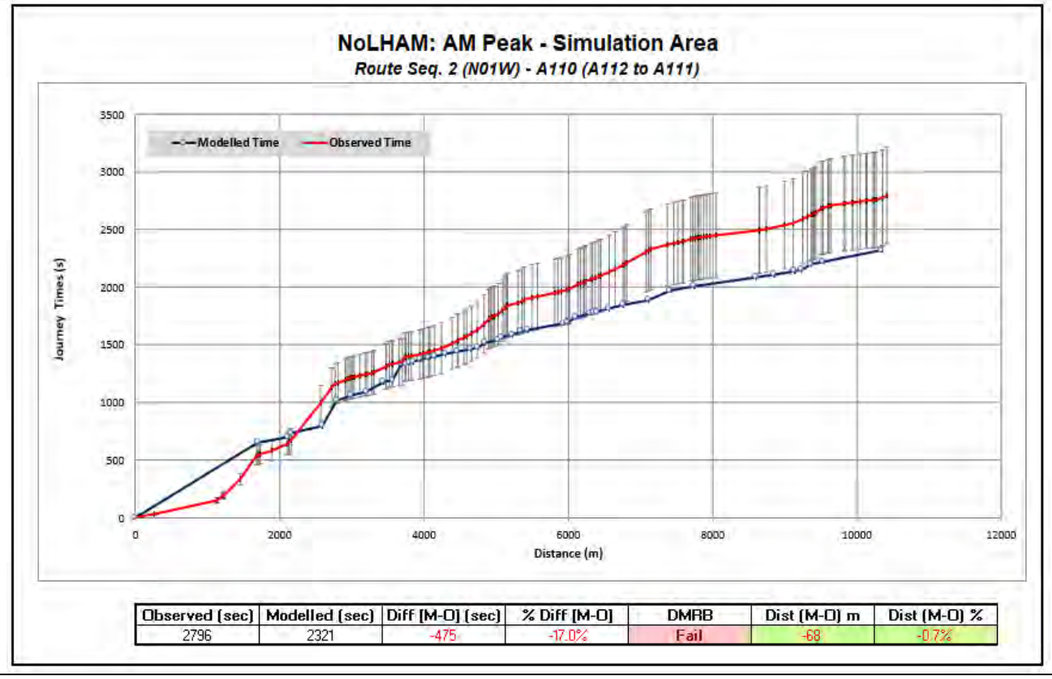
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1884	1816	-69	-3.6%	Pass	140	1.4%

R065- PM



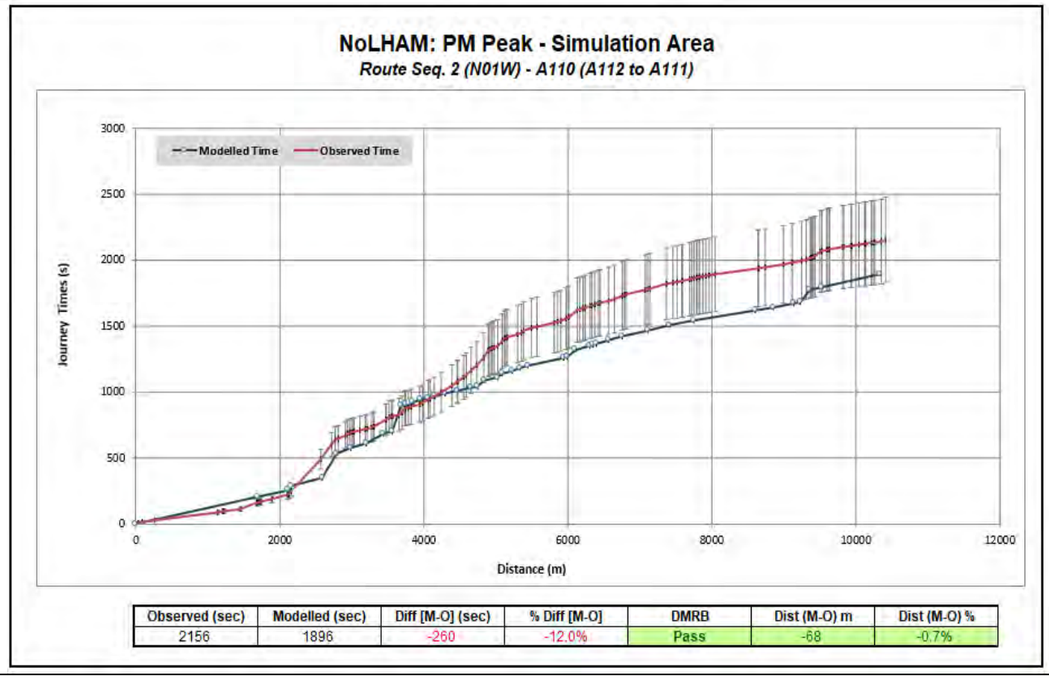
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
3047	1990	-1057	-34.7%	Fail	140	1.4%

R 066-AM



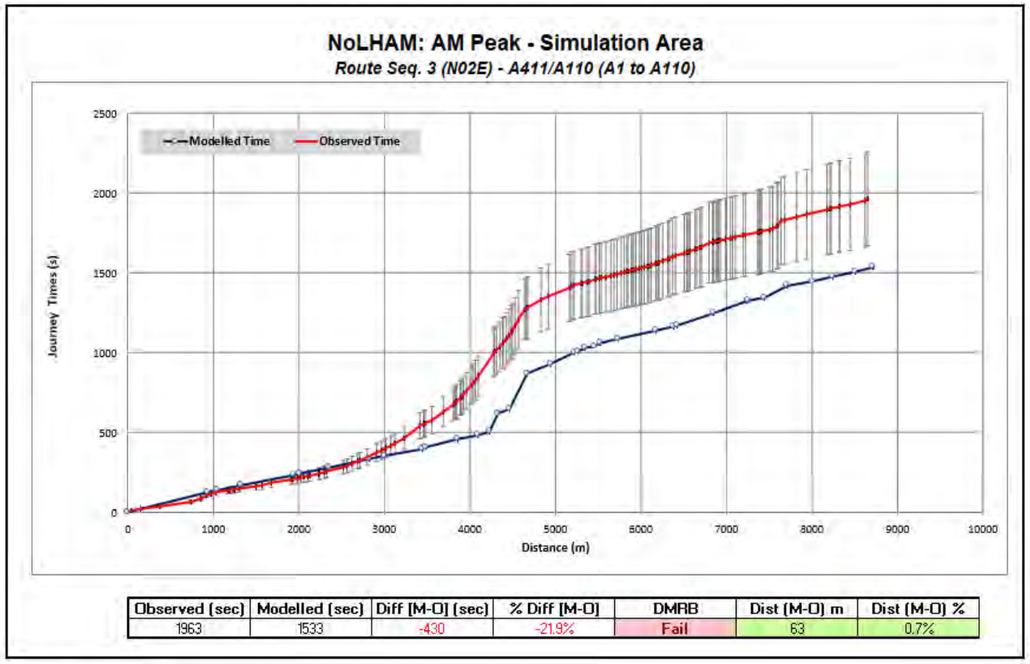
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
2796	2321	-475	-17.0%	Fail	-68	-0.7%

R 066-PM



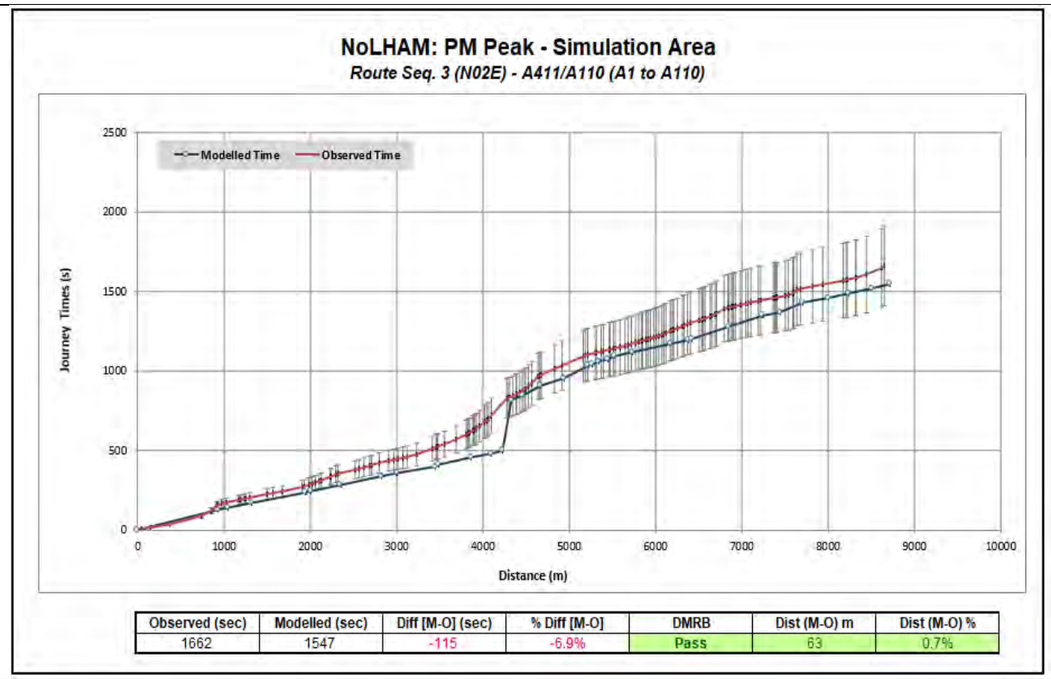
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
2156	1896	-260	-12.0%	Pass	-68	-0.7%

R 067-AM



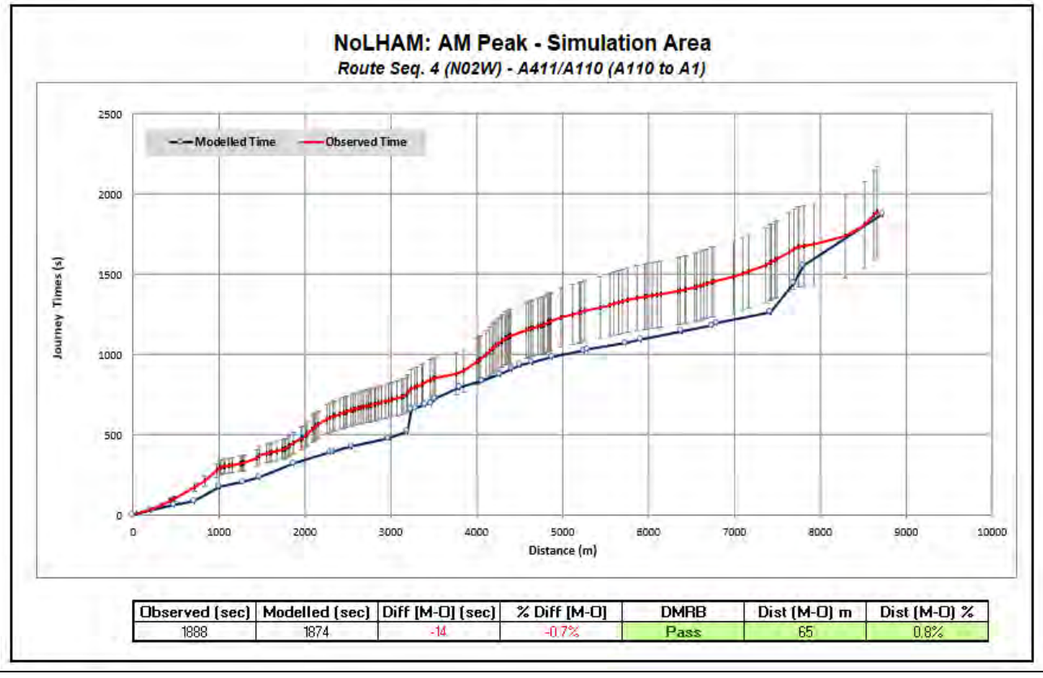
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1963	1533	-430	-21.9%	Fail	63	0.7%

R067 PM



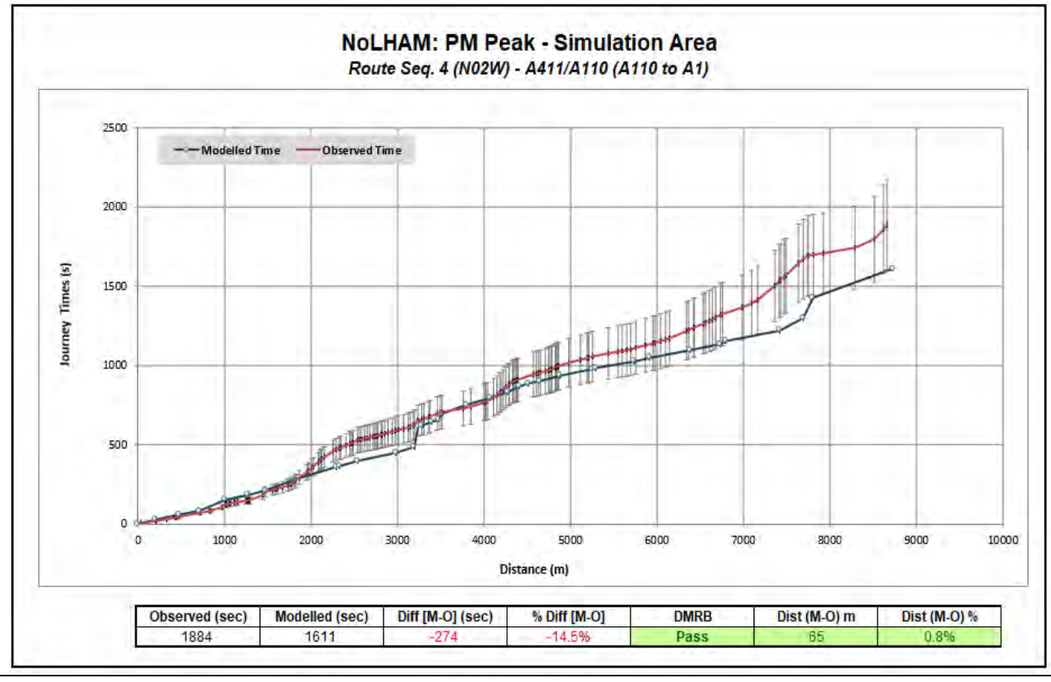
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1662	1547	-115	-6.9%	Pass	63	0.7%

R 068-AM



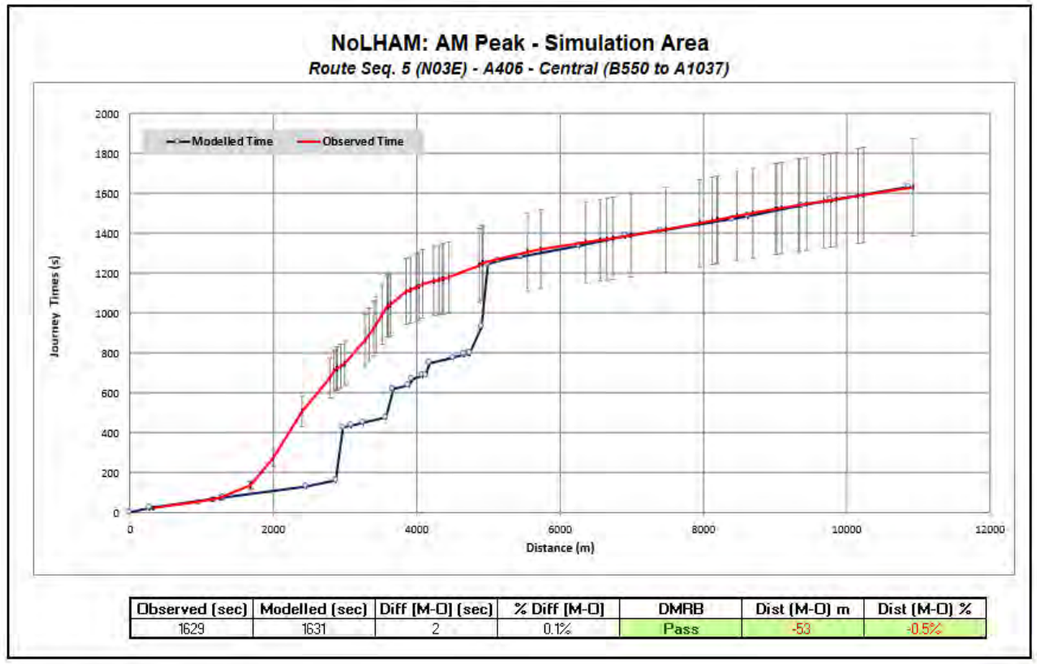
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1888	1874	-14	-0.7%	Pass	65	0.8%

R 068-PM



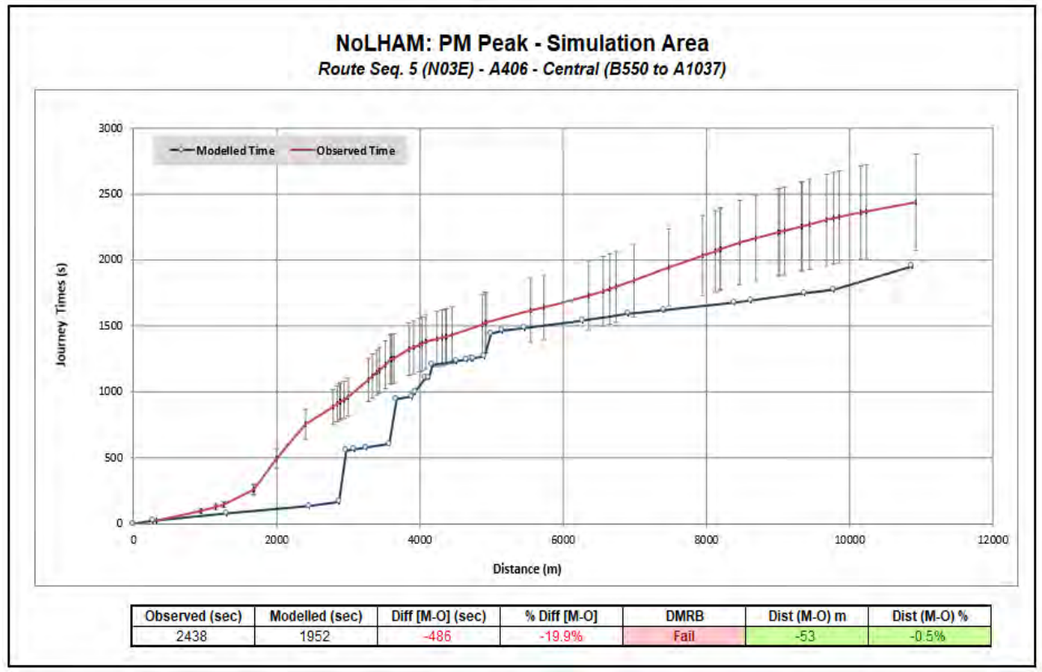
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1884	1611	-274	-14.5%	Pass	65	0.8%

R 069-AM



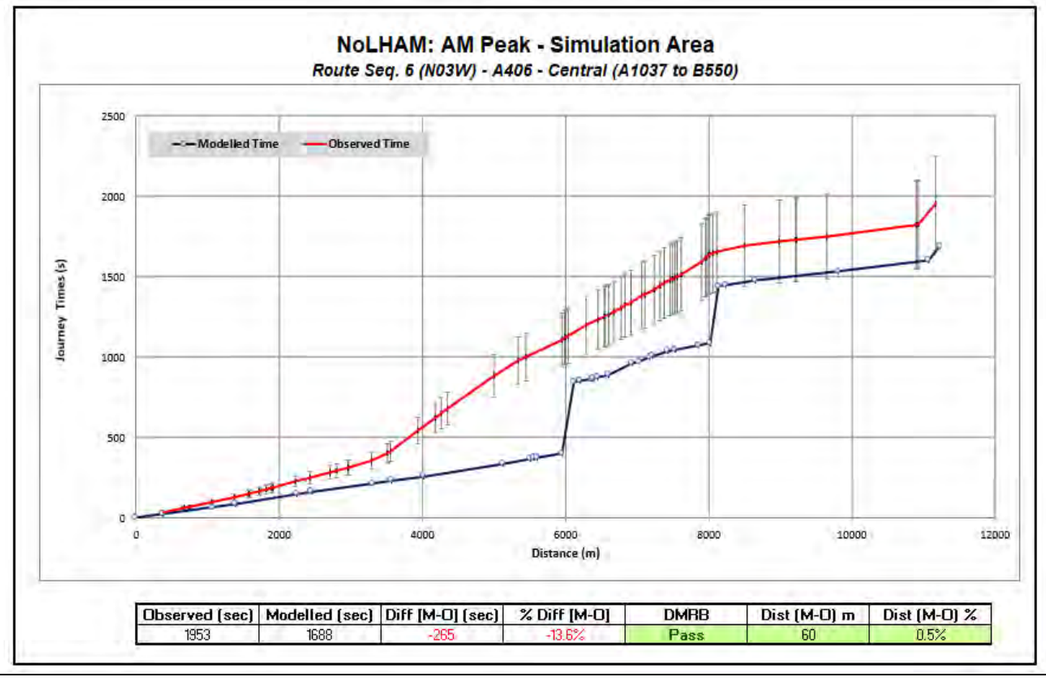
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1629	1631	2	0.1%	Pass	-53	-0.5%

R069- PM



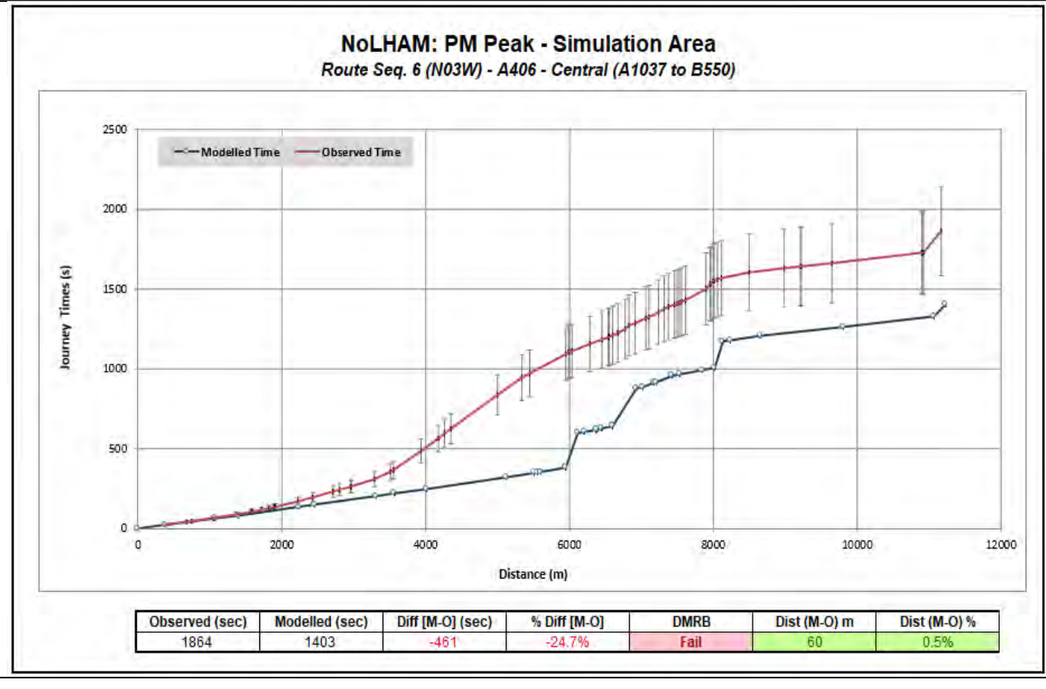
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
2438	1952	-486	-19.9%	Fail	-53	-0.5%

R 070-AM



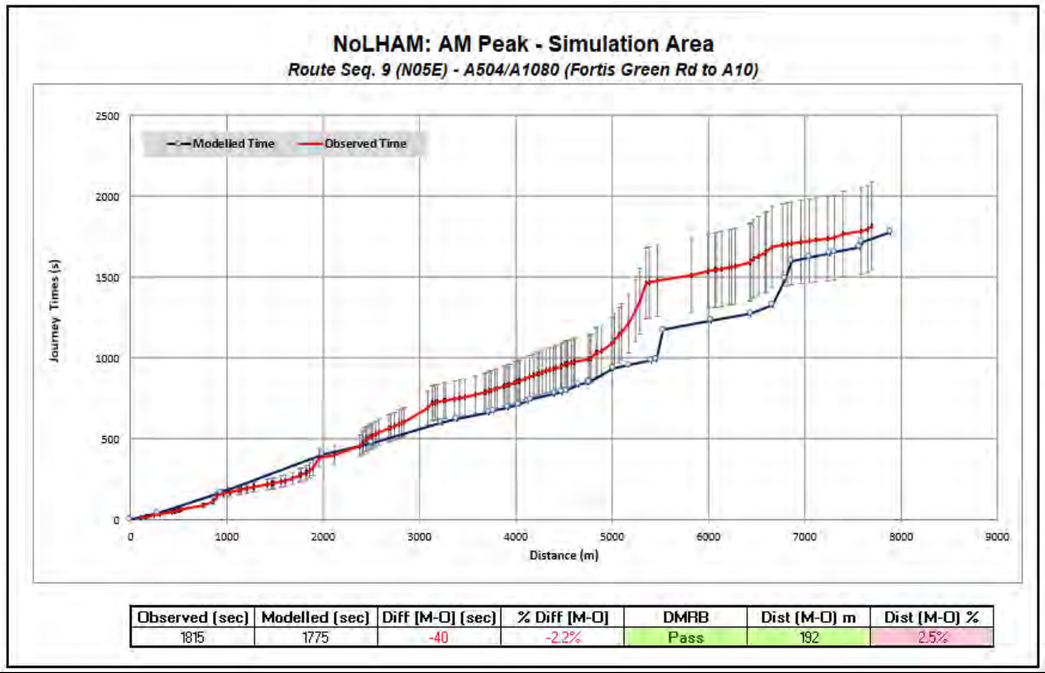
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1953	1688	-265	-13.6%	Pass	60	0.5%

R 070-PM



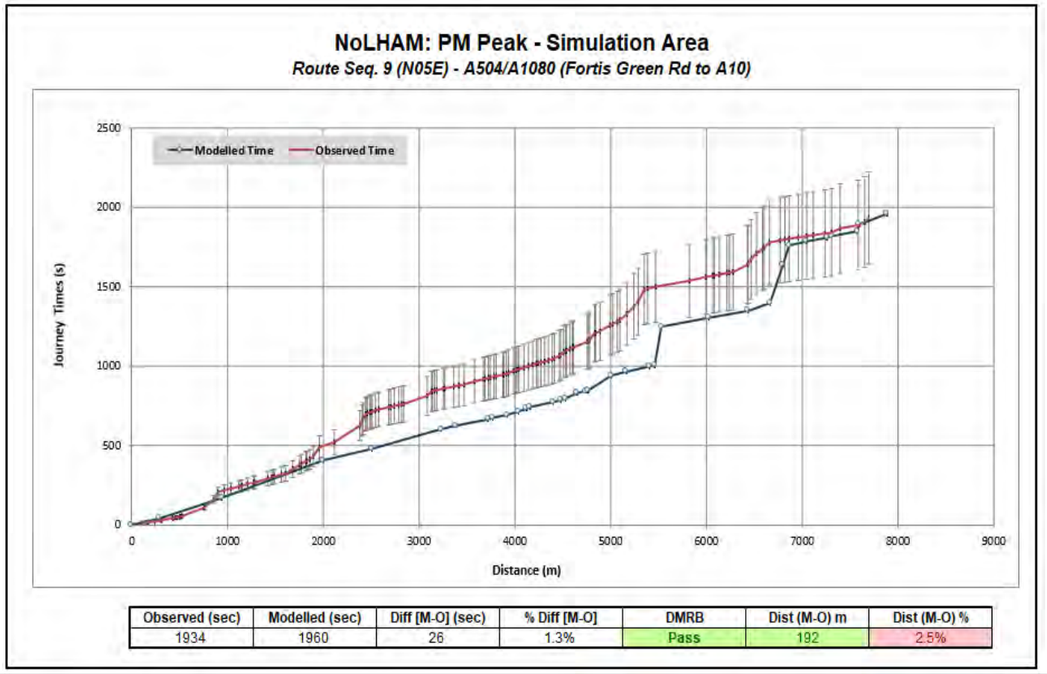
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1864	1403	-461	-24.7%	Fail	60	0.5%

R 073-AM



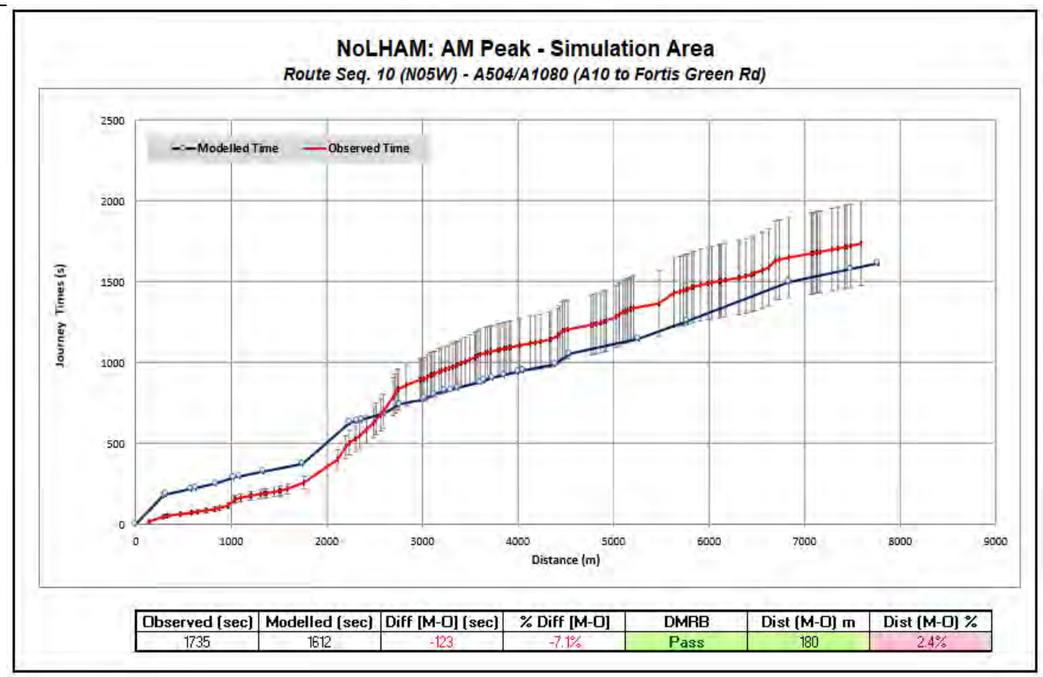
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1815	1775	-40	-2.2%	Pass	192	2.5%

R073- PM



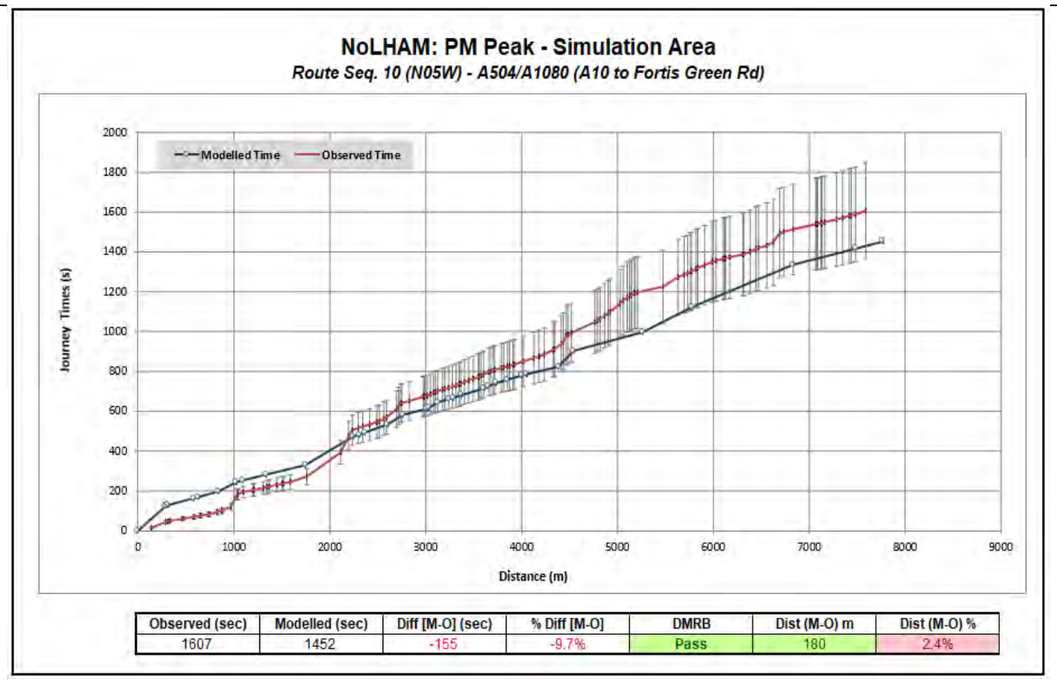
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1934	1960	26	1.3%	Pass	192	2.5%

R 074-AM



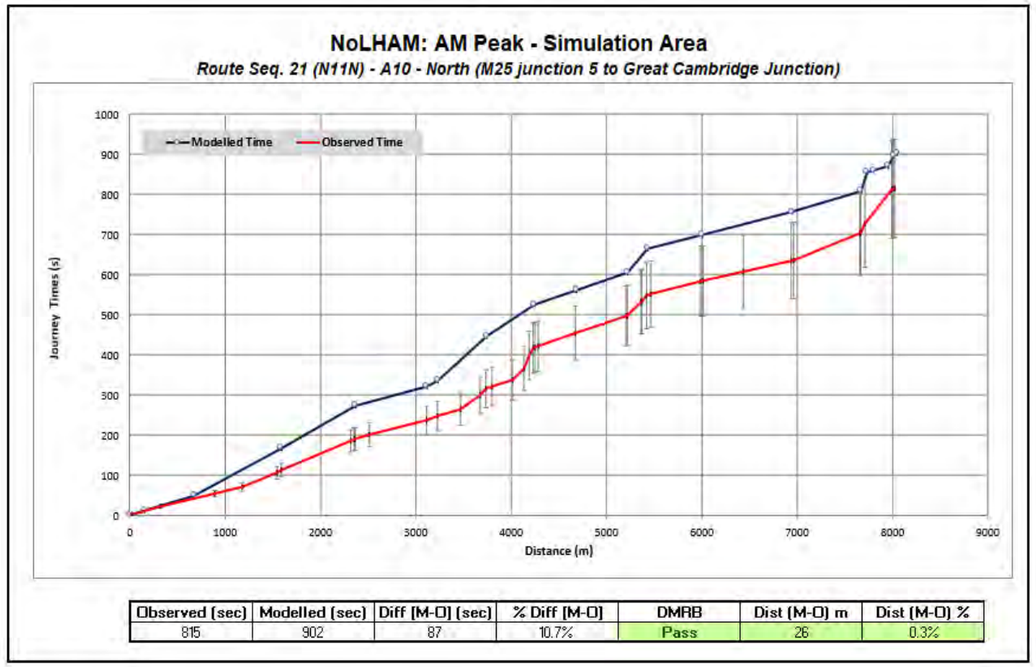
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1735	1612	-123	-7.1%	Pass	180	2.4%

R 074-PM



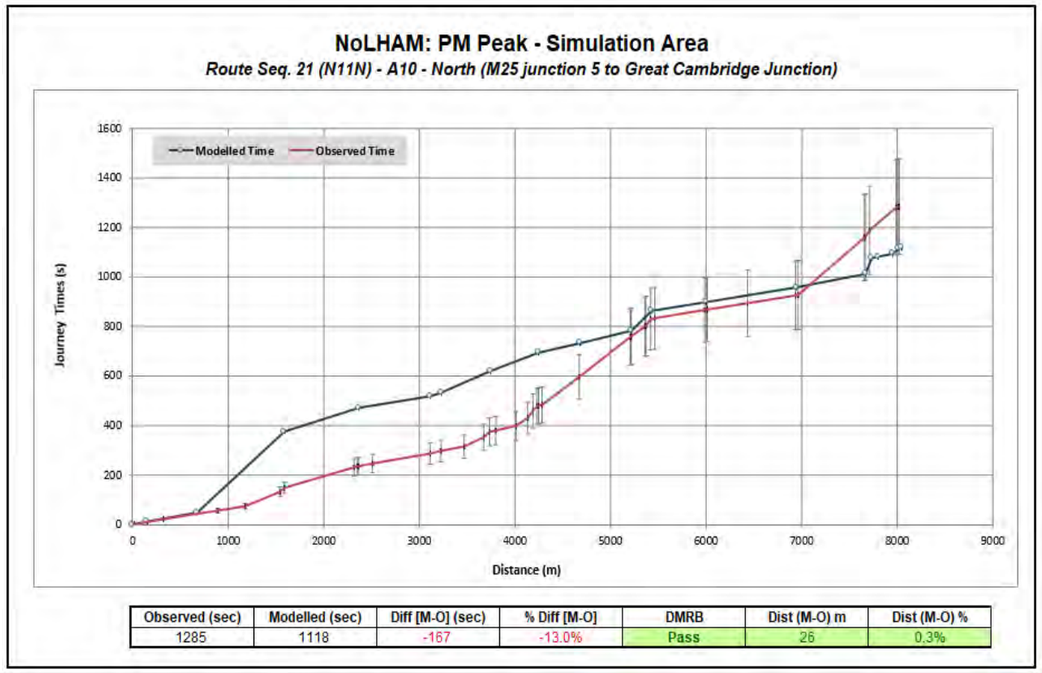
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1607	1452	-155	-9.7%	Pass	180	2.4%

R 085-AM



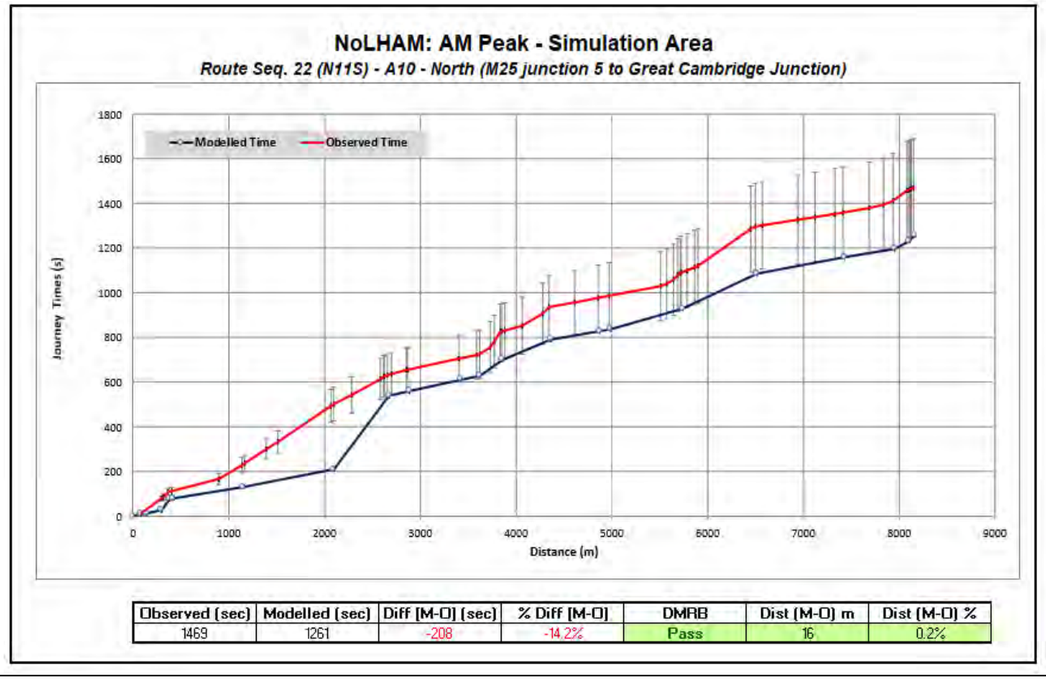
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
815	902	87	10.7%	Pass	26	0.3%

R085- PM



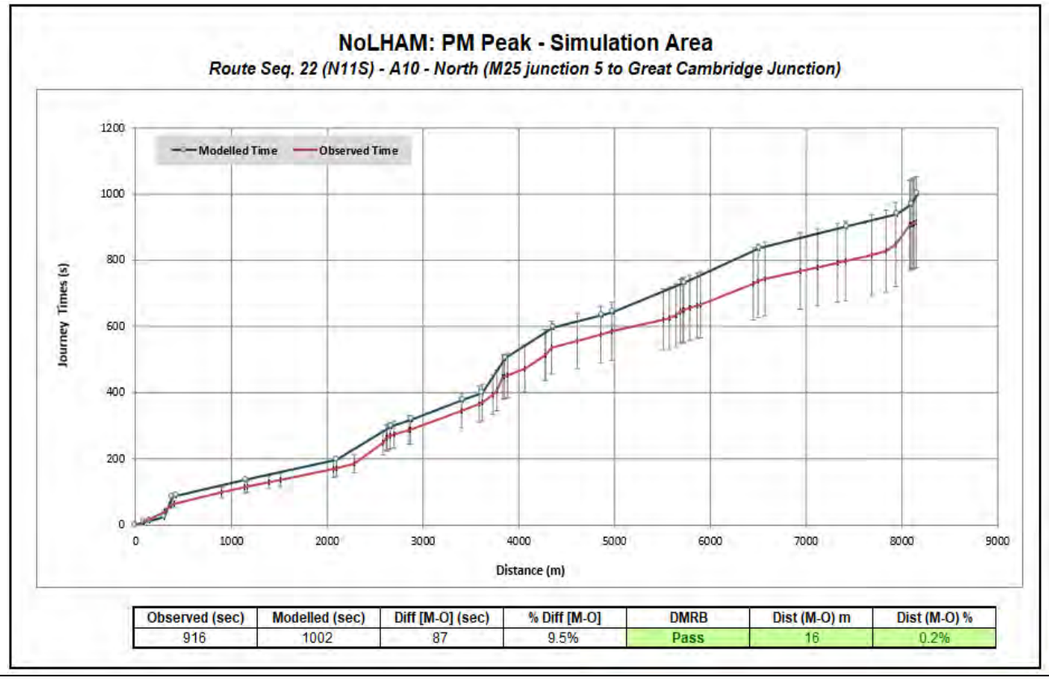
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1285	1118	-167	-13.0%	Pass	26	0.3%

R 086-AM



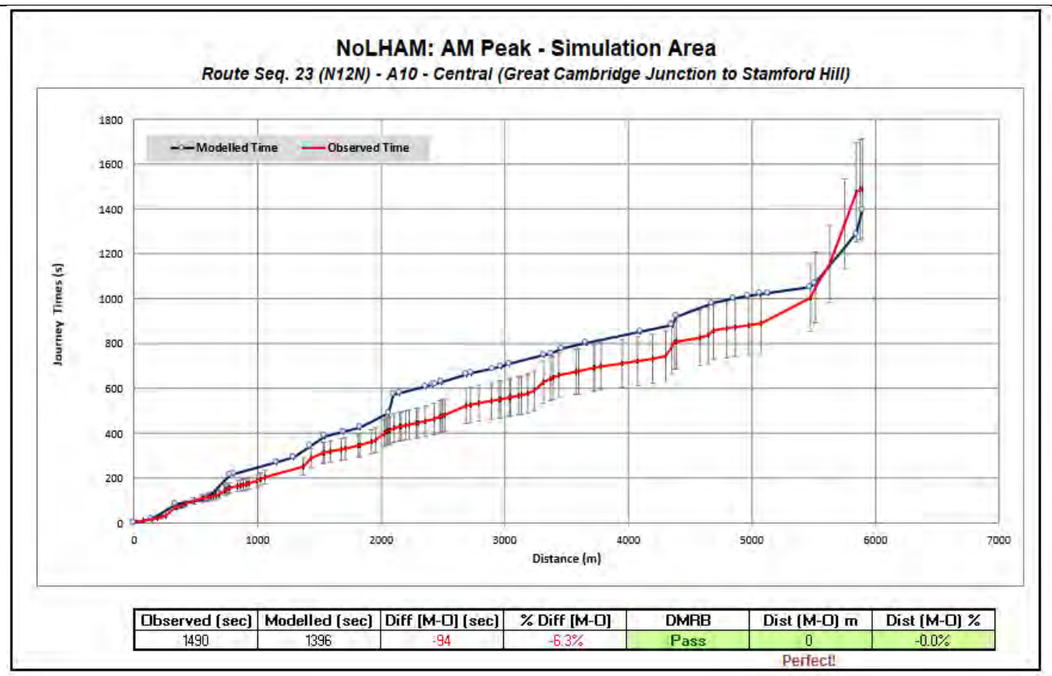
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1469	1261	-208	-14.2%	Pass	16	0.2%

R 086-PM



Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
916	1002	87	9.5%	Pass	16	0.2%

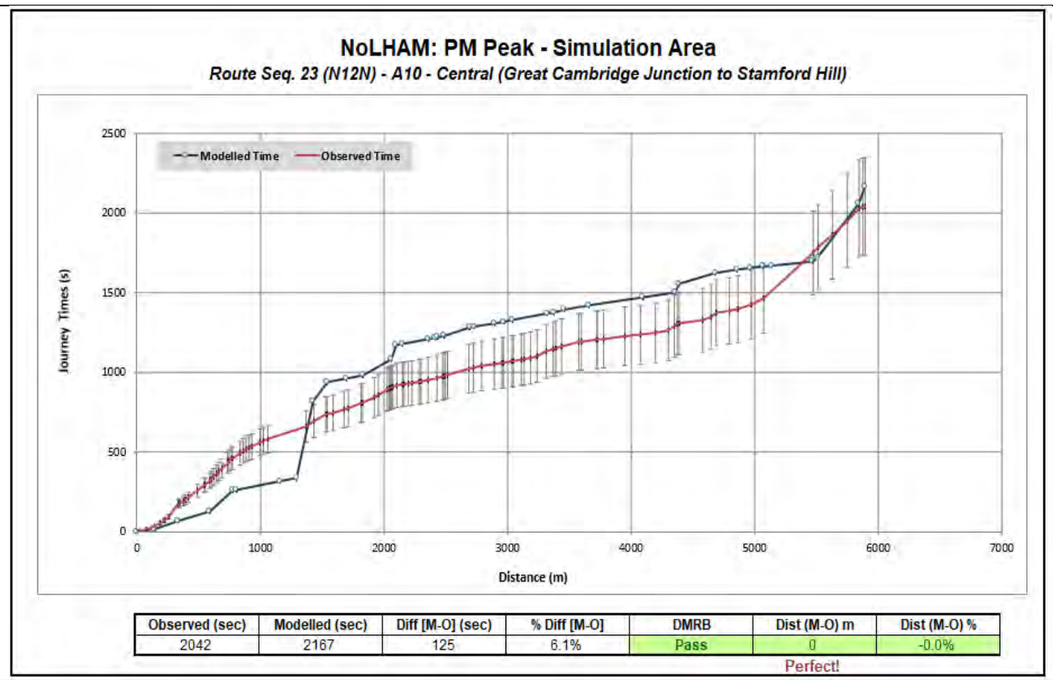
R 087-AM



Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1490	1396	-94	-6.3%	Pass	0	-0.0%

Perfect!

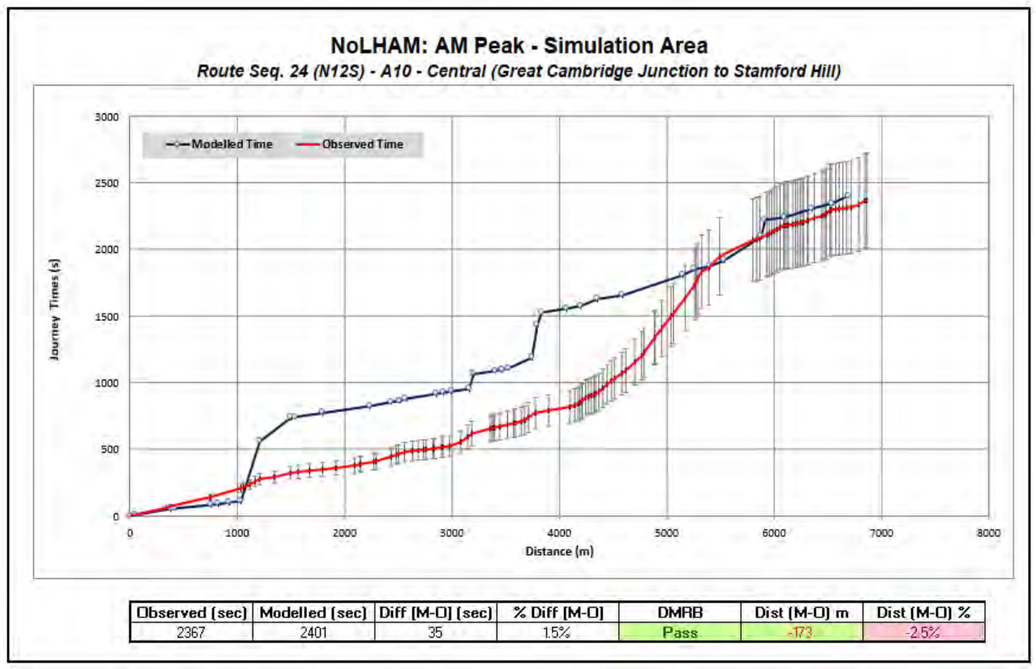
R087- PM



Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
2042	2167	125	6.1%	Pass	0	-0.0%

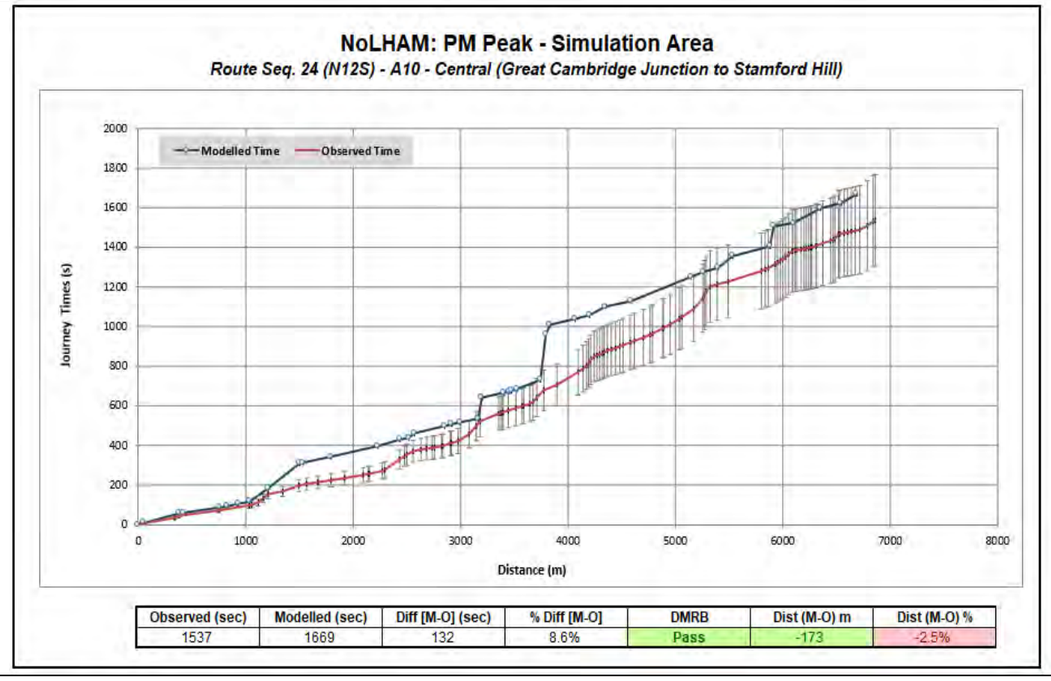
Perfect!

R 088-AM



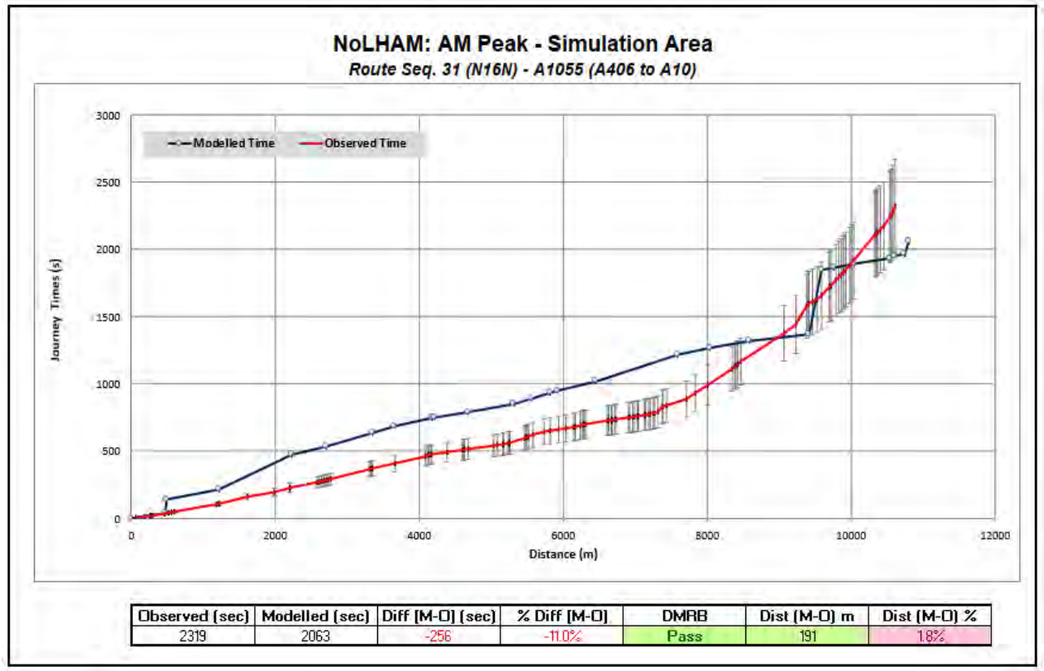
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
2367	2401	35	1.5%	Pass	-173	-2.5%

R 088-PM



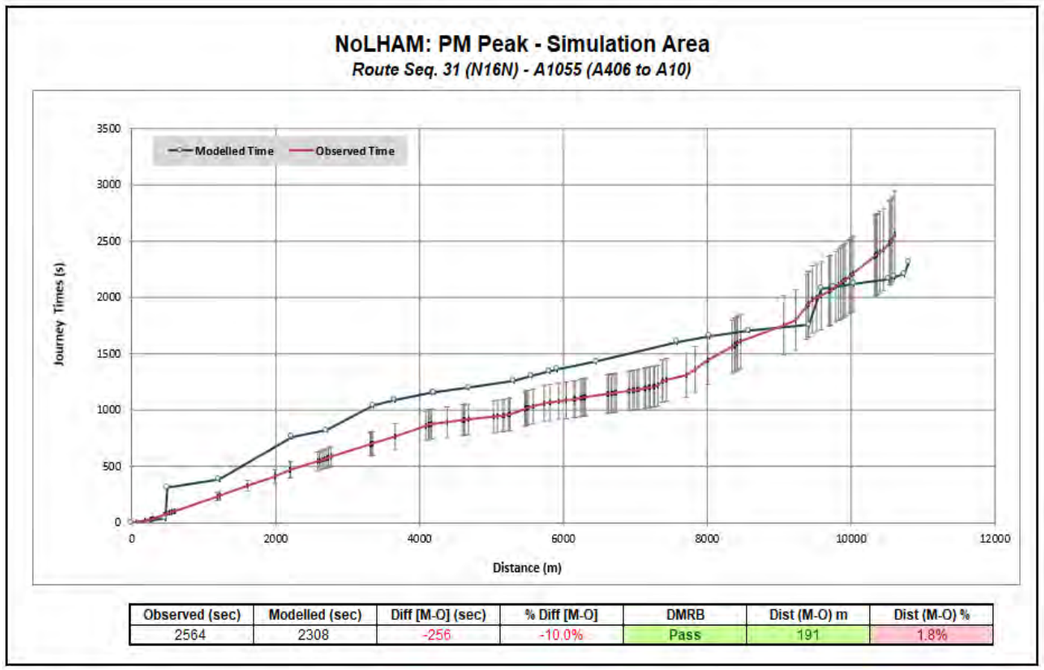
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1537	1669	132	8.6%	Pass	-173	-2.5%

R 095-AM



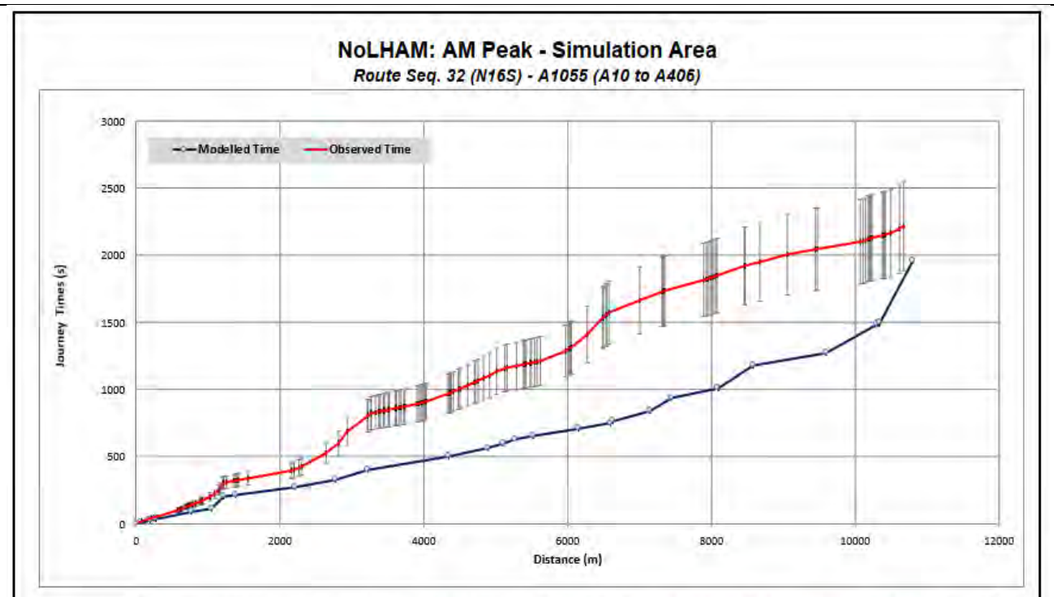
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
2319	2063	-256	-11.0%	Pass	191	1.8%

R095- PM



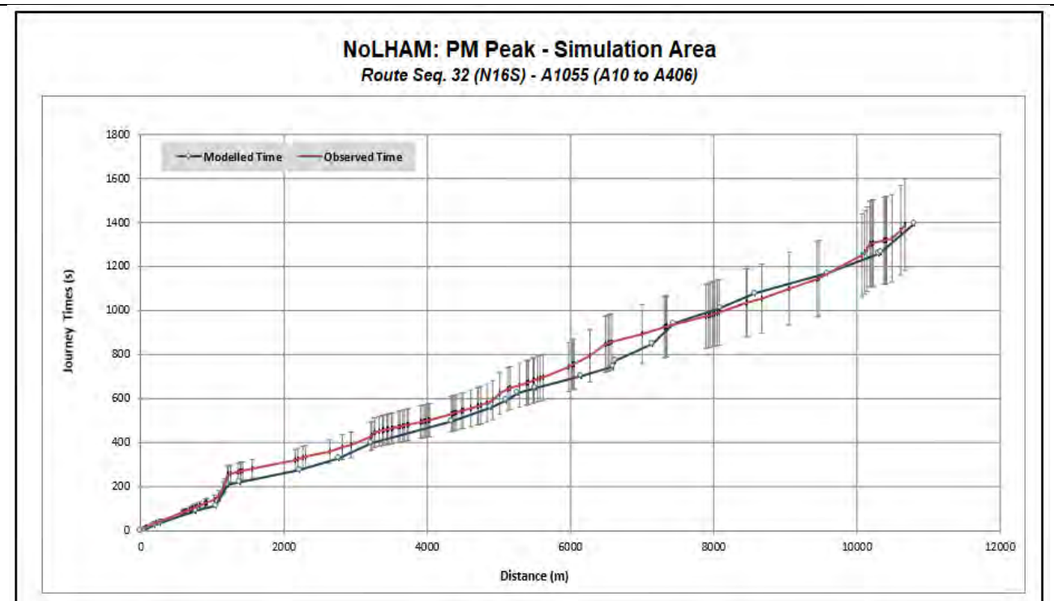
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
2564	2308	-256	-10.0%	Pass	191	1.8%

R 096-AM



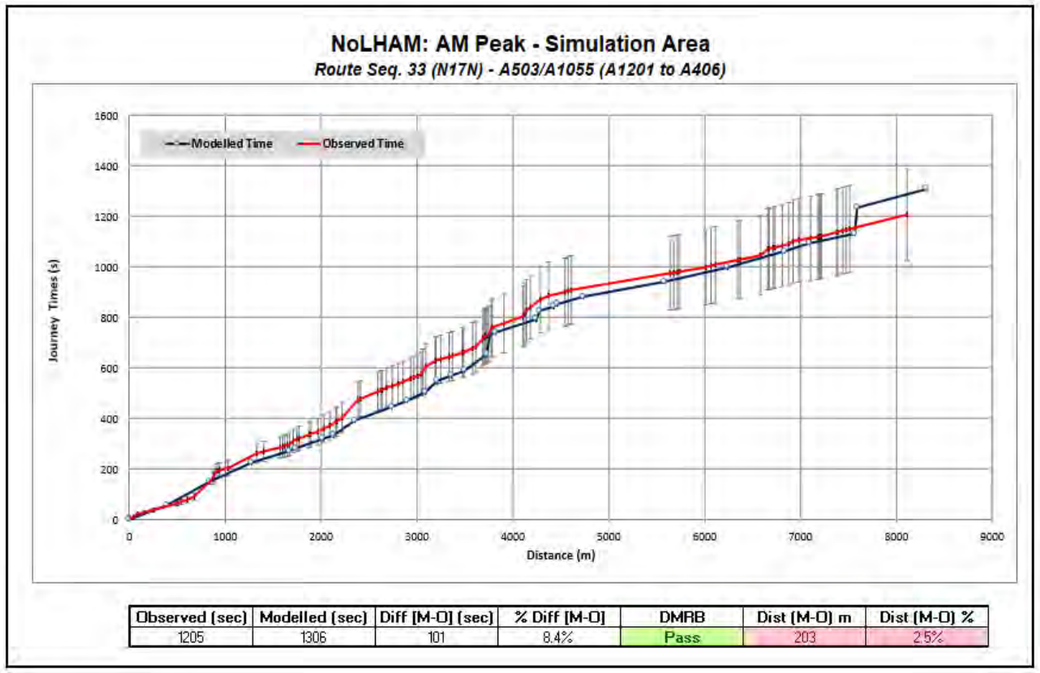
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
2218	1960	-258	-11.6%	Pass	130	1.2%

R 096-PM



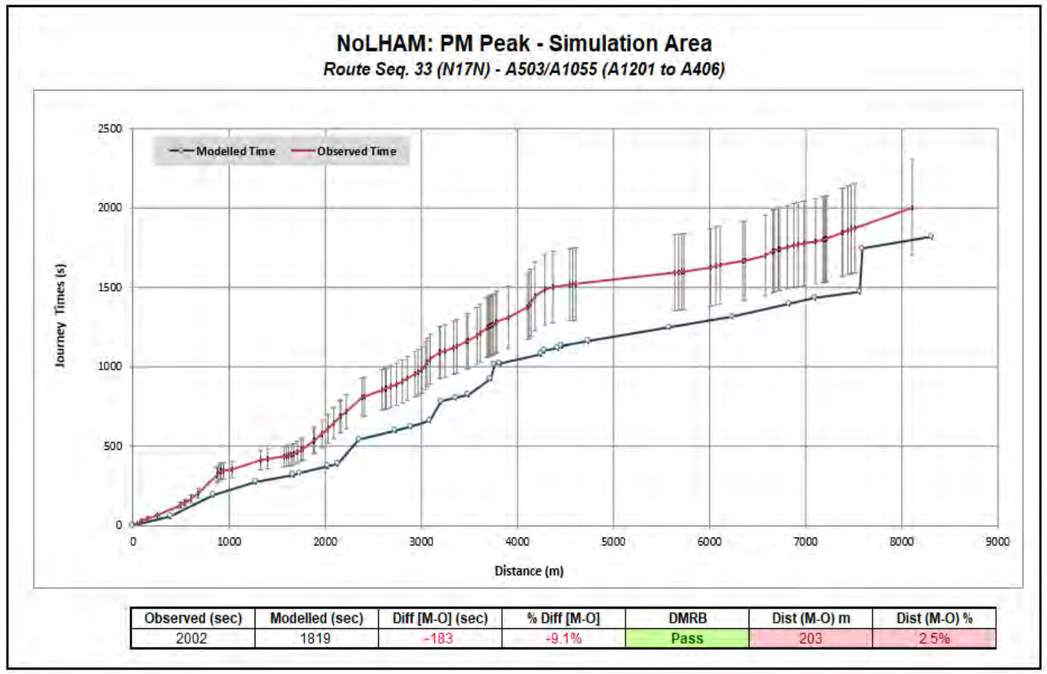
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1390	1395	6	0.4%	Pass	130	1.2%

R 097-AM



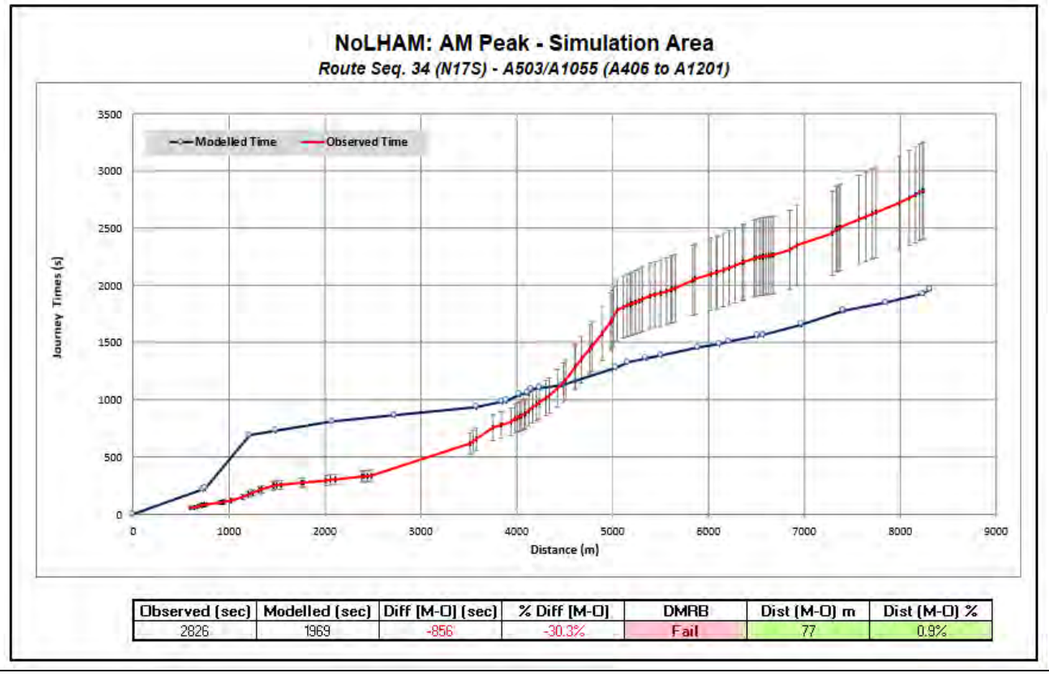
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1205	1306	101	8.4%	Pass	203	2.5%

R097- PM



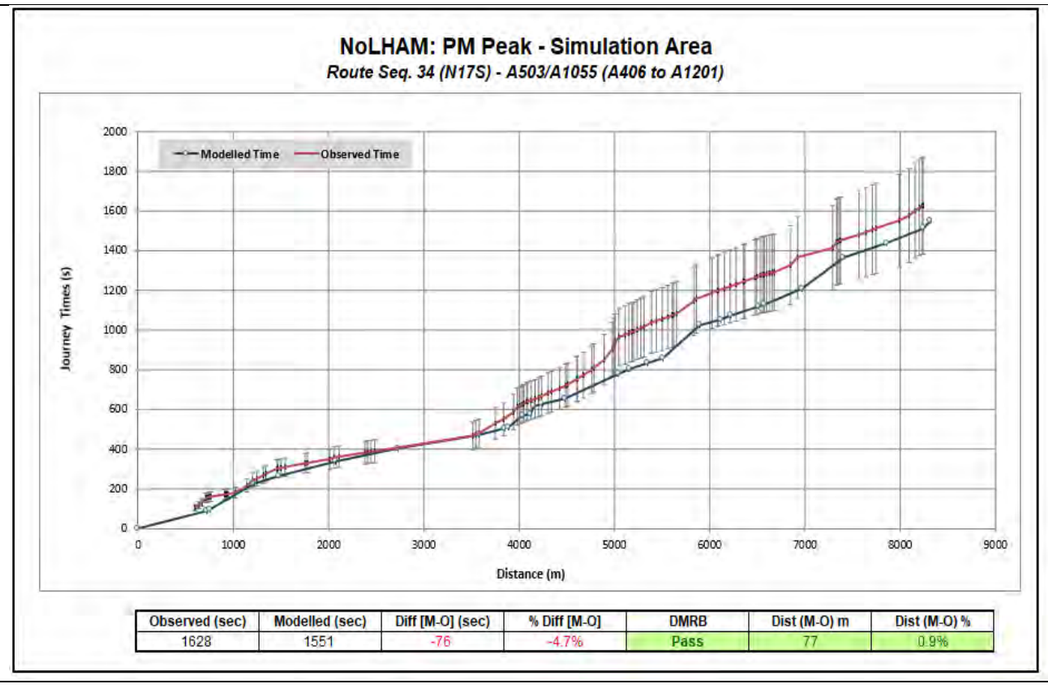
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
2002	1819	-183	-9.1%	Pass	203	2.5%

R 098-AM



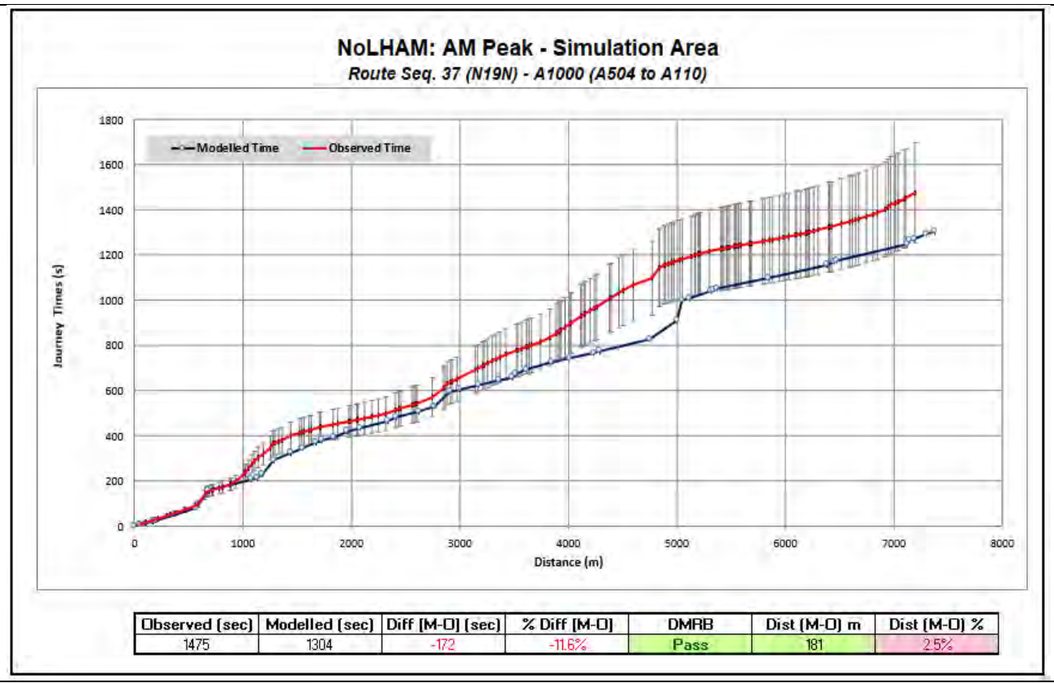
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
2826	1969	-856	-30.3%	Fail	77	0.9%

R 098-PM



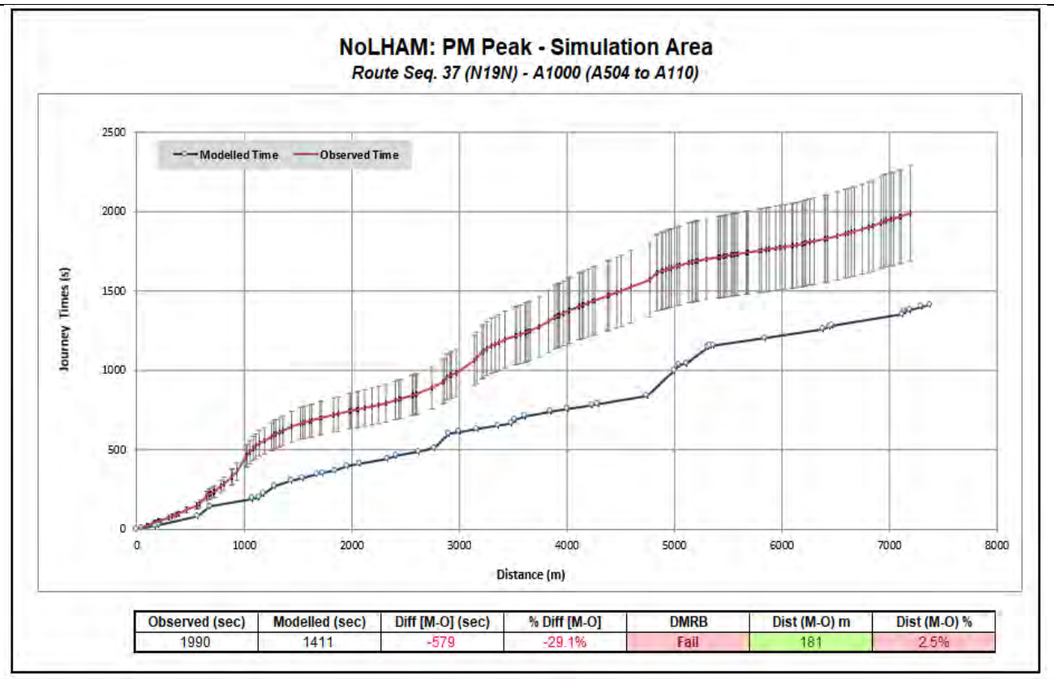
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1628	1551	-76	-4.7%	Pass	77	0.9%

R 101-AM



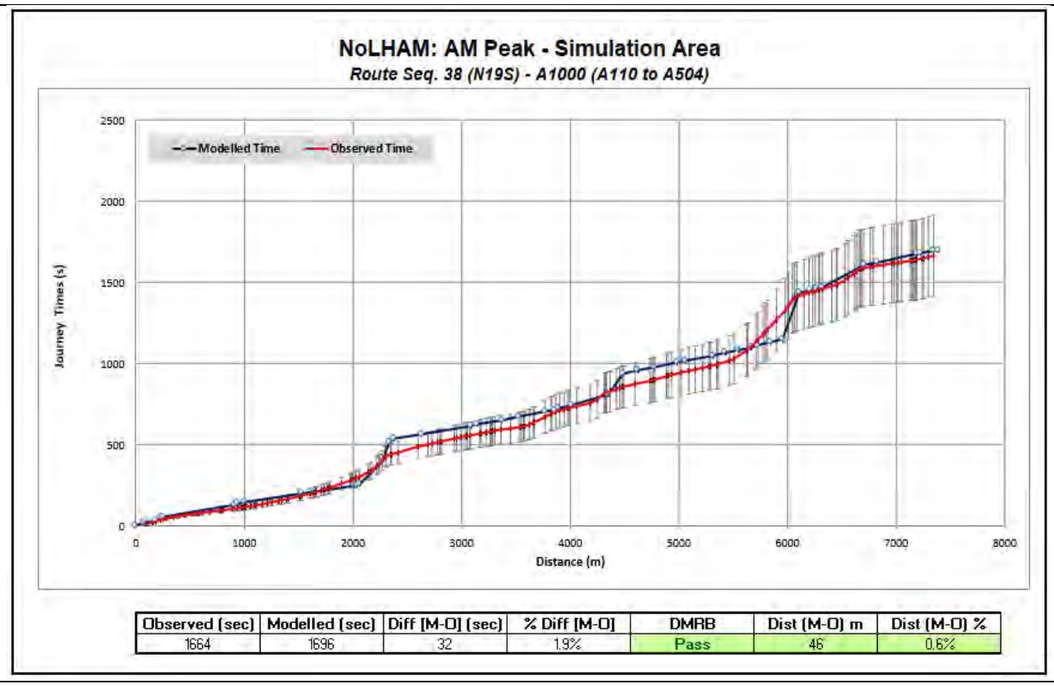
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1475	1304	-172	-11.6%	Pass	181	2.5%

R101- PM



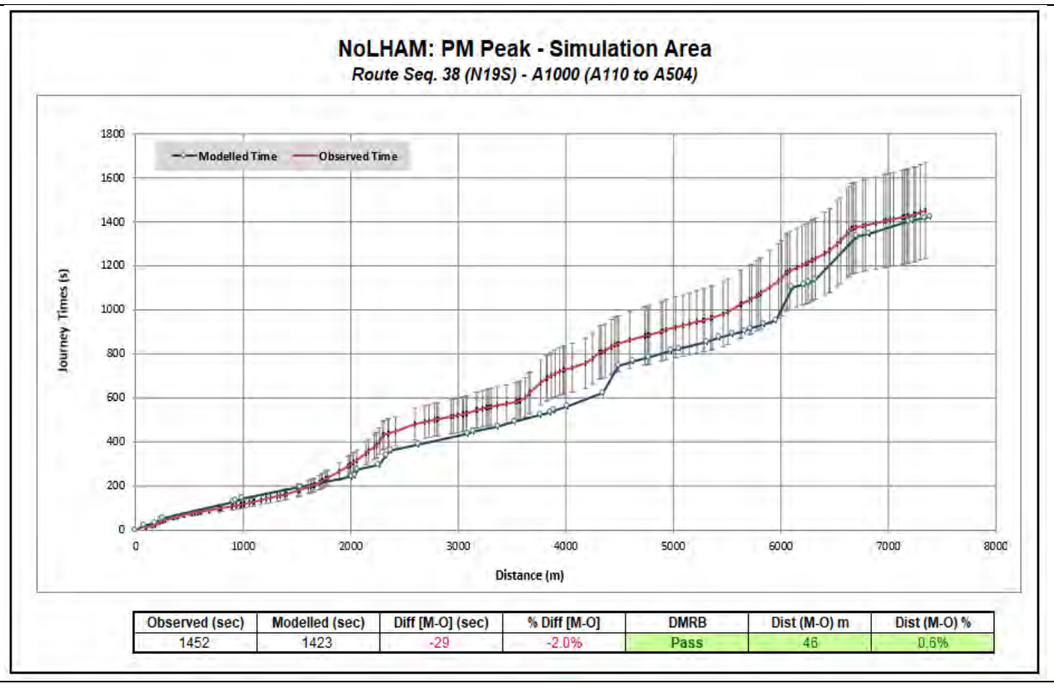
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1990	1411	-579	-29.1%	Fail	181	2.5%

R 102-AM



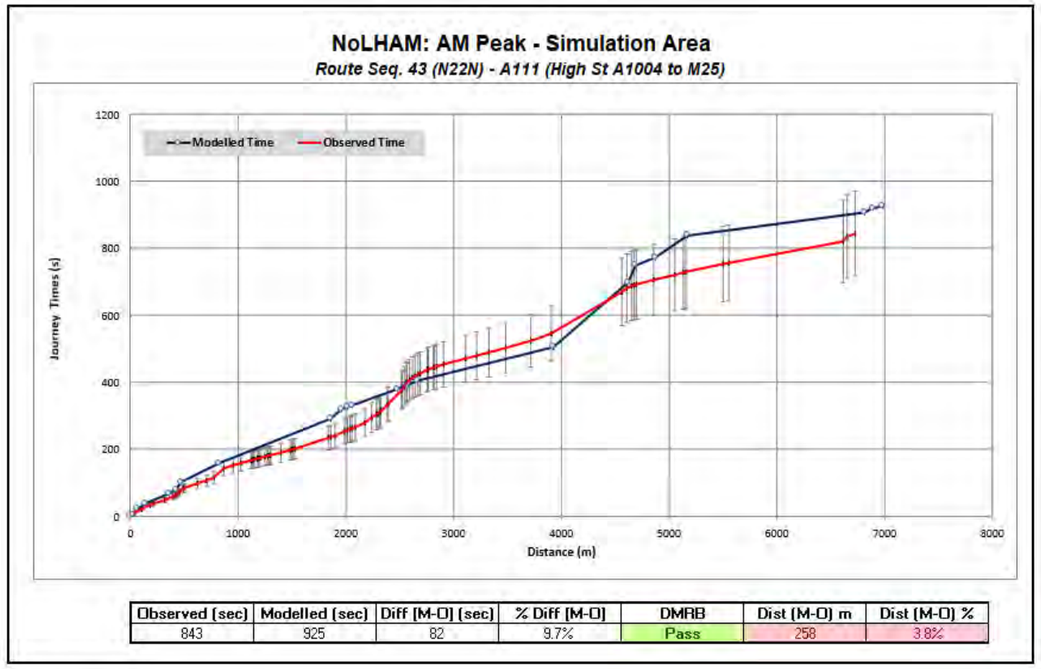
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1664	1696	32	1.9%	Pass	46	0.6%

R 102-PM



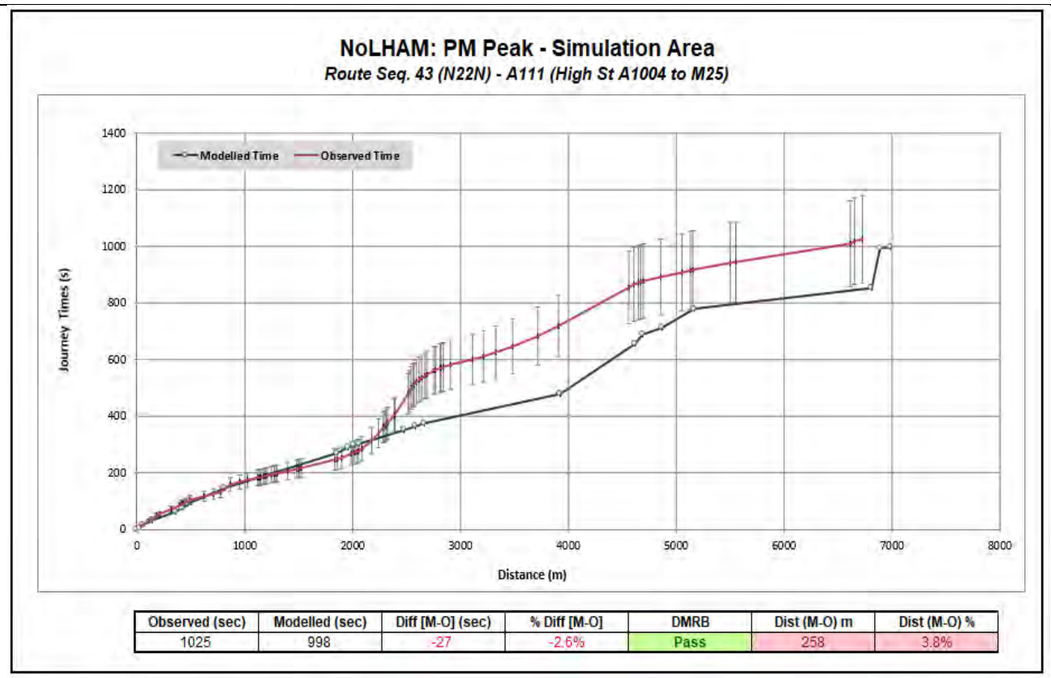
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1452	1423	-29	-2.0%	Pass	46	0.6%

R 107-AM



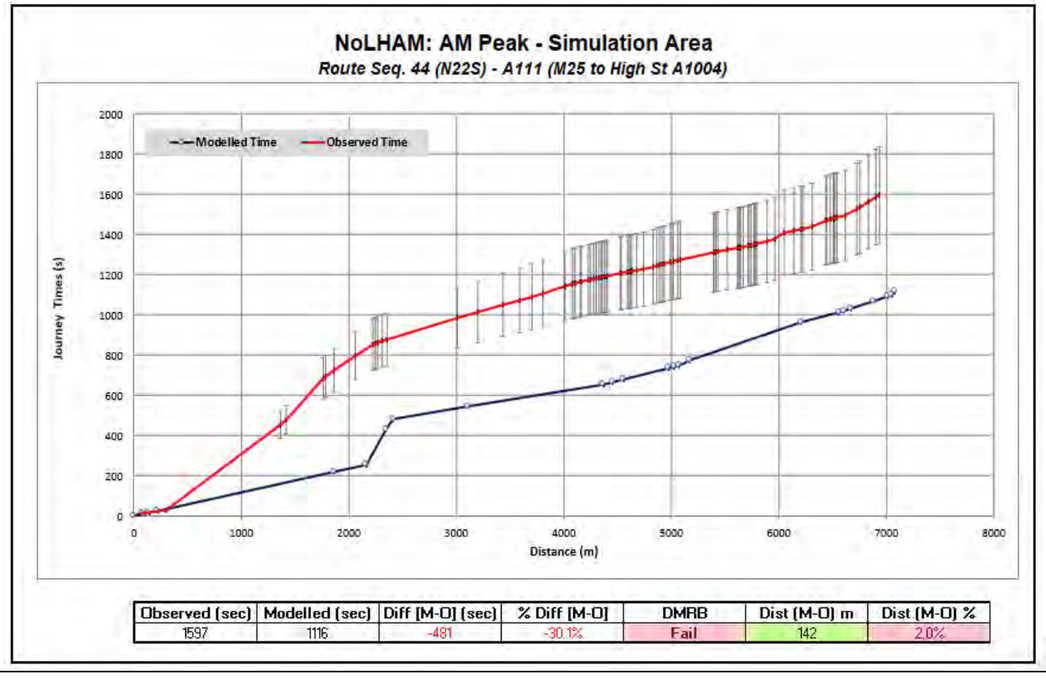
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
843	925	82	9.7%	Pass	258	3.8%

R107- PM



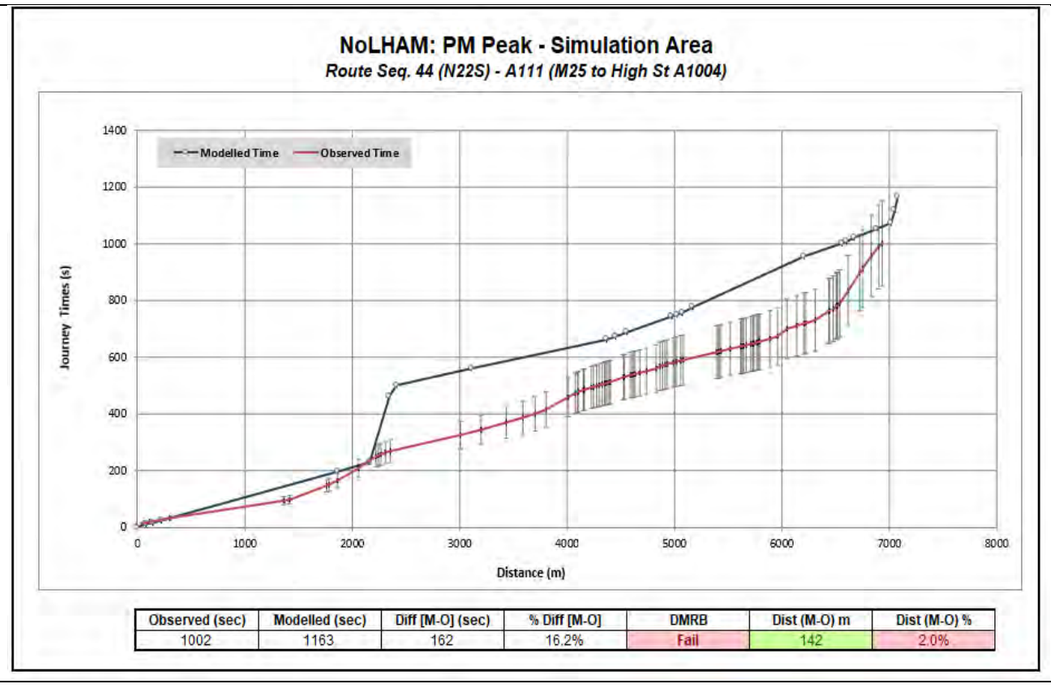
Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1025	998	-27	-2.6%	Pass	258	3.8%

R 108-AM



Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1597	1116	-481	-30.1%	Fail	142	2.0%

R 108-PM



Observed (sec)	Modelled (sec)	Diff [M-O] (sec)	% Diff [M-O]	DMRB	Dist (M-O) m	Dist (M-O) %
1002	1163	162	16.2%	Fail	142	2.0%