Essex Highways

Local Model Validation Report

Enhanced Essex Countywide Model

October 2020

RINGWAY JACOBS

Essex County Council

Document Control Sheet

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Contents page

Appendices

1 Introduction

1.1 Model Overview

As specialist consultant to Ringway Jacobs, the framework provider to Essex County Council (ECC), Jacobs UK Limited have been commissioned to develop the required strategic modelling necessary to understand how people currently travel strategically within the South Essex region and how this might change with future growth and as specific major schemes are implemented. The model should also be appropriate for the following tasks:

- Help to develop South Essex regionwide transport strategies;
- Help to assess the impact of highway schemes;
- Help to assess the combined impact of Local Plans on the strategic / primary road network;
- Provide evidence for early appraisal and sifting of strategic major scheme options;
- Provide a basis for potentially producing corridor microsimulation models in the PTV VISSIM software platform; and
- to be used specifically for the appraisal of potential highway schemes along the A127 corridor.

The model is to be known as the Enhanced Essex Countywide Strategic Model (EECSM).

The modelling approach makes use of previous work on the development of the Essex Countywide Strategic Model; that model used mobile network data to formulate the highway demand and will form the basis of the demand for the EECSM. The 2017 Essex Countywide Model network and prior matrices were used as the starting point for the EECSM development. Using the matrices provides analytical consistency and removes duplication of work. Most of the network has been retained from the existing Countywide model which was further checked and refined with extended network coverage and detail to reflect the scope of the model.

1.2 Purpose of this Report

This Base Model Local Model Validation Report (LMVR) summarises the work carried out in the development of the EECSM, including the key design considerations and features of the model, the data sources used in its development, the checks that have been undertaken on the demand and supply components of the model, and the resulting calibration and validation of the model. The EECSM has been validated to a base year of 2019 and is available in AM peak, Inter-peak and PM peak versions.

This report demonstrates that the model produces an accurate representation of existing traffic conditions in the study area, making it suitable for the evaluation of improvements and land use changes in future year scenarios. In order to demonstrate the suitability of the model, its level of accuracy has been quantified and described with reference to TAG guidance.

The purpose of this report is therefore to:

- Describe the development of the base year EECSM;
- Detail the extent to which the model reproduces an existing, independently observed, situation;
- Summarise the accuracy of the base from which the forecasts are to be prepared; and
- Describe the model's fitness for purpose

1.3 Report Structure

The remainder of this report is set out as follows:

- **Section 2 -** Details the uses of the model and key design considerations;
- **Section 3 -** Identifies the standards to which the model was built;
- **Section 4 -** Describes the key features of the model;
- **Section 5 -** Details the data used for model calibration and validation;
- **Section 6 -** Describes the processes used in developing the modelled network;
- **Section 7 -** Describes the checks carried out on the network;
- **Section 8 -** Describes the route choice calibration;
- **Section 9 -** Describes the processes used in developing the modelled demand (i.e. trip matrices);
- **Section 10 -** Provides information on the calibration and validation of the trip matrices;
- **Section 11 -** Details the calibration and validation of the assignment, as well as the model outputs; and
- **Section 12 -** Provides a summary of the model and its development.

2 Proposed Uses of the Model and Key Model Design Considerations

2.1 Proposed Use of the Model

Over the next thirty years, the South Essex region is facing significant growth and the challenge of meeting increasing travel demands whilst actively encouraging economic growth, protecting the environment, enhancing well-being, increasing housing supply and creating new communities. In order to facilitate this, Essex County Council (ECC) need a tool to understand how people currently travel strategically within the region and how this might change with future growth and as major transport schemes are implemented. The tool will be used for testing of a number of major highway schemes along the A127 corridor / development scenarios individually and in parallel, allowing the cumulative impact of these to be assessed. The EECSM is likely to be required to serve a number of purposes including:

- Evidence for Local Plan development and hearings (and cumulative impacts once Local Plans are in place);
- Ability to understand the influences on the performance of transport systems, such as housing and employment growth and major transport schemes, and to identify and assess options for mitigation;
- Evidence to support Business Case submissions to secure Government funding for new infrastructure and maintenance, specifically for the appraisal of potential highway schemes along the A127 corridor;
- Provide evidence to support responses to Government department or company consultations;
- Support the development consent order and town and country planning process on key schemes;
- Understand suitable phasing of maintenance and utilities work to manage congestion impacts;
- Optimisation of the performance of the existing transport network using technology; and
- Accessibility planning for key land uses.

The base year model will be developed such that it can be used, with suitable forecasting methodologies, to fulfil all of the above functions.

2.2 Key Model Design Considerations

In order to test the strategic impacts of any potential transport development or scheme within the area of interest, the model extends to an area that is sufficient to assess strategic movements and key route choices as well as local movements within the study area. An area of influence test (AoI) was undertaken to confirm that the model extent would be appropriate. This is further discussed in Section 4.2. Based on the AoI test, the area of detailed modelling of the EECSM is focussed on the extents within the South Essex region including (wholly or partially) the districts of Basildon, Brentwood, Rochford, Castle Point and local authority boundaries of Southend-on-Sea and Thurrock. Beyond this, the level of detail in the model is gradually reduced. The study area is shown in Figure 2-1 below.

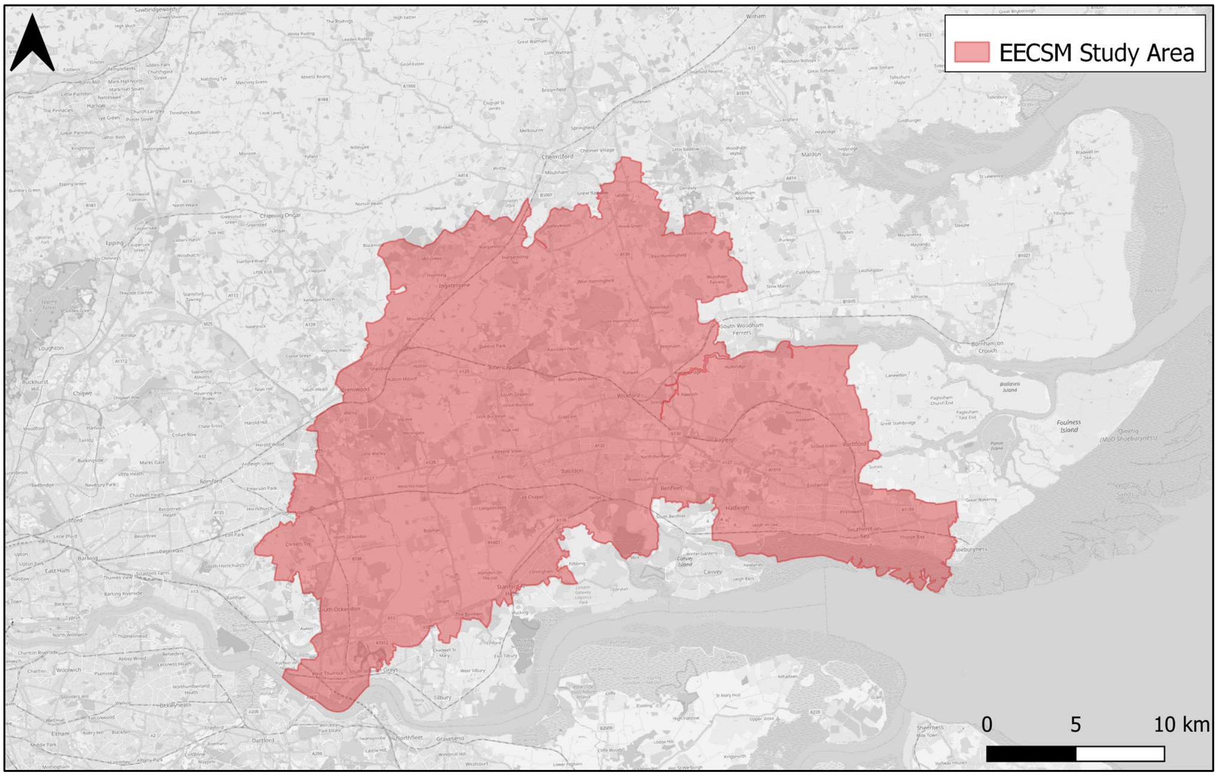

Figure 2-1: Study Area

The EECSM zoning system makes use of administrative and census reporting areas with the intention of preserving National Trip End Model (NTEM) zone boundaries. The lowest level of spatial detailed used within the study area is Output Areas (OAs) or aggregation of OAs, (those aggregations stay at a finer level than MSOA boundaries). For areas where less spatial detail is required, the zones have been grouped into Middle Layer Super Output Areas (MSOAs) and aggregations of MSOAs, and then Local Authority districts, London Boroughs (where applicable), Counties, and Regions.

In the Area of Detailed Modelling, the highway network includes motorways, A, B roads and all local distributor roads which are considered necessary to ensure that trips generated from within residential or employment areas load onto the wider network appropriately. The network in this area includes link and junction capacity constraints. The immediate surrounding area comprising the Rest of the Fully Modelled Area is modelled to a decreasing level of detail, although highway capacity constraint is still modelled, but on links only. The remainder of the study area consists of an external area based on a skeleton network of key roads without capacity restraint (i.e. links have fixed speeds).

In order to test the strategic impacts of any potential transport development or scheme within the area of interest, the model extends to an area that is sufficient to assess strategic movements and key route choices as well as local movements within the South Essex region. The model has been built with regard to the relevant guidance provided in TAG. Specifically, it was necessary to ensure that strategic movements on the A127, the A13, the A130, the A12, and the interaction of these with the rest of the road network, are well represented as these are key routes in South Essex and the exact stretches of road that are expected to be impacted by the presence of any proposed strategic schemes on, or in the vicinity of the A127 corridor. These key roads are labelled in Figure 2.2.

Figure 2-2: Key Strategic Routes in South Essex

It is anticipated that the model will be used to inform an evidence base for the Business Case for a number of schemes (yet to be defined). To reflect and quantify the impact that the schemes have during the busiest parts of the day, morning peak hour and evening peak hour models have been developed. An average inter-peak hour has also been developed in order to quantify and provide scheme benefits and impacts during less busy times of the day.

Although some schemes may impact both public transport (PT) trips and highway trips, it is beyond the scope of the current commission to develop a full PT model. Should the need to develop a PT model arise in the future, the required functionality can be added to the highway model. Also, beyond the scope of work is the development of a variable demand model (VDM). Should this be developed as part of a separate piece of work, the demand model process and results will be presented in additional reporting.

The model is built using the latest PTV VISUM software version 2020 (this is an upgraded version of the same software used in the existing Essex Countywide Model) platform and utilises the Intersection Capacity Analysis (ICA) module to enable detailed evaluation of junction performance and representation of blocking back and queuing (also known as flow metering). This software is acknowledged as being appropriate for the development of models of this nature, as well as being consistent with TAG.

2.2.1 Forecast Scenarios

As part of the current scope of work, a reference case scenario for 2036 will be developed. The demand forecast will represent a core growth scenario based on National Trip End Model (NTEM) v7.2.

The reference forecast will include those developments and transport schemes which have sufficient certainty of coming forward. To aid and document this decision-making, an Uncertainty Log will be developed. Total modelled growth will be constrained to NTEM at the district level (districts within South Essex), and growth outside of that authority will be derived entirely from the NTEM growth (i.e. with no specific developments modelled).

3 Model Standards

3.1 Validation Criteria and Acceptability Guidelines

An assessment of the suitability of the EECSM to assess schemes in the study area has been informed using the criteria set out in TAG Unit M3.1. The TAG guidance sets out measures to compare the base year model against observed independent data to quantify the level of fit. The validation of the highway assignment model included comparisons of the following criteria which have been taken from TAG unit M3.1 chapter 3.3:

- Assigned flows and counts totalled for each screenline or cordon, as a check on the quality of the trip matrices;
- Assigned flows and counts on individual links. as a check on the quality of the assignment. Due to the size and strategic nature of the EECSM, it is not expected to validate to the level of detail of specific junction movements; and
- Modelled and observed journey times along routes, as a check on the quality of the network and the assignment.

These criteria are further detailed below.

3.1.1 Link Flow Validation

Highways assignment validation is defined as the percentage difference between modelled flows and counts at screenline level within the model. Comparisons at screenline level provide information on the quality of the trip matrices. The criterion and acceptability guidelines are set out in Table 3-1 below.

Criteria	Acceptability Guideline
Differences between modelled flows and counts should be less than 5% of the counts	All or nearly all (i.e. 95%) screenlines

Table 3-1: Screenline Flow Validation Criterion and Acceptability Guideline

TAG specifies the following criteria for screenlines, within unit M3.1 paragraph 3.3.8:

- Screenlines should normally consist of five or more links;
- The comparison of modelled and observed flows for screenlines containing high flow routes (such as motorways) should be presented both with and without such routes;
- The comparison should be presented separately for:
  - Data used to inform matrix development;
  - Other screenlines used as constraints in matrix estimation; and
  - Screenlines used as independent validation;
- The comparison should be presented by vehicle type, i.e. for car, Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV) traffic; and
- The comparison should be presented separately for each modelled period.

In addition to validation of total screenline flows, TAG Unit M3.1 (paragraphs 3.3.10 and 3.3.11) also contains guidelines on the validation criteria for individual links or turning movements. Link flow validation will be based on the following measures:

- The absolute and percentage differences between modelled flows and counts; and
- The GEH statistic, which is a form of the Chi-squared statistic that incorporates both relative and absolute errors. The GEH statistic is detailed below:

$$GEH = \sqrt{\frac{(M - C)^2}{(M + C)/2}}$$

where:

GEH is the GEH statistic
M is the modelled flow; and
C is the observed count

The validation criteria and acceptability guidelines for link flows are defined below in Table 3-2. For a link to become valid it must satisfy at least one of the two criteria in the table below.

Criteria	Description of Criteria	Acceptability Guideline
1	Individual flows within 100 veh/hr of counts for flows less than 700 veh/hr	> 85% of cases
	Individual flows within 15% of counts for flows from 700 veh/hr to 2,700 veh/hr	
	Individual flows within 400 veh/hr of counts for flows more than 2,700 veh/hr	
2	GEH < 5 for individual flows	> 85% of cases

Table 3-2: Link Flow and Turning Movement Validation Criteria and Acceptability Guidelines

TAG guidance unit M3.1 paragraph 3.3.12 states that the above comparison of modelled and observed flows should be applied to link flows and turning movements, although acceptability may be difficult to achieve for turning movements. The comparisons should be presented for total vehicle flows and for car flows, but not for LGV and HGV flows unless sufficiently accurate link counts have been obtained. In addition, the above information should be presented by modelled time period. In line with this guidance, results in Section 11 are published for cars and total vehicles for each peak, but not for LGV and HGV specifically.

Data collection sites used in the calibration and validation of the base year model are presented in Section 5, and the results of the model validation provided in Section 11. As previously noted in Section 3.1 above, due to the size and strategic nature of the EECSM, it is not expected to validate to the level of detail of specific junction movements.

3.1.2 Journey Time Validation

TAG also contains acceptability guidelines for the validation of journey times, in TAG unit M3.1 paragraph 3.3.15. The journey time validation will be presented separately for each modelled period for light vehicles only. The measure which will be used is the percentage difference between modelled and observed journey times, subject to an absolute maximum difference. The acceptability criterion for journey time validation is given below in Table 3-3.

Criteria	Acceptability Guideline
Modelled times along routes should be within 15% of surveyed times (or 1 minute if higher than 15%)	> 85% of routes

Table 3-3: Journey Time Validation Criterion and Guidelines

3.1.3 Checks on Matrix Estimation

Independent validation as specified above quantifies the ability of the model to replicate base year travel conditions within the model area. To ensure these conditions have a sound basis, TAG provides guidance (in unit M3.1 paragraphs 8.3.14 and 8.3.15) as to the acceptable level of change to the highway 'prior' matrices that should result from the application of matrix estimation. The purpose of matrix estimation is to refine trips, but it is important that the effects of matrix estimation on the underlying trip patterns are minimised. The changes brought about by matrix estimation should therefore be carefully monitored by the following means:

- Scatter plots of matrix zonal cell values, prior to and post matrix estimation, with regression statistics (slopes, intercepts and R^2 values);
- Scatter plots of zonal trip ends, prior to and post matrix estimation, with regression statistics (slopes, intercepts and R^2 values);
- Trip length distributions, prior to and post matrix estimation, with means and standard deviations; and
- Sector to Sector level matrices, prior to and post matrix estimation, with absolute and percentage changes.

The changes brought about by matrix estimation should not be significant. The criteria by which significance of the changes brought about by matrix estimation may be judged are shown in Table 3-4.

Measure	Acceptability Guidelines
Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95
Matrix zonal trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98
Trip length distributions	Means within 5% Standard deviations within 5%
Sector to sector level matrices	Differences within 5%

Table 3-4: Significance of Matrix Estimation Changes

TAG unit M3.1 paragraph 8.3.17 states that matrix estimation should not be allowed to make significant changes to the prior matrices in order that the validation standards are met. In these cases, the limits set out in Table 3-4 should be respected, the impacts of matrix estimation should be reduced so that they do not become significant, and a lower standard of validation reported.

3.2 Convergence Criteria and Standards

In order for the outcomes of the modelling to be reliable, the stability of the modelled flows needs to be confirmed at the appropriate level. The importance of achieving convergence is related to providing stable, consistent and robust model results. This ensures that when modelling a scheme, any flow changes which occur do so directly as a result of the scheme rather than as a result of random flow changes due to poor model convergence.

Sufficient iterations should be carried out to achieve an acceptably low value for %GAP (the difference between the costs along the chosen routes and those along the minimum cost routes, summed across the whole network and expressed as a percentage of the minimum costs). GAP is the single most valuable indicator of overall model convergence and the method for calculating GAP (denoted δ) is outlined below with the guideline for GAP being 0.1% or less.

$$\delta = \frac{\sum \boldsymbol{T}_{pij}\,(\boldsymbol{C}_{pij} - \boldsymbol{C}*_{ij})}{\sum \boldsymbol{T}_{ij}\,\boldsymbol{C}*_{ij}}$$

where:

$\mathbf{T}_{pij}$	is the flow on route p from the origin i to destination j
$\mathbf{T}_{ij}$	is the total travel from i to j
$\mathbf{C}_{pij}$	is the (congested) cost of travel from i to j on path p
$\mathbf{C}_{ij*}$	is the minimum cost of travel from i to j

Source: TAG Unit M3.1 paragraph C.2.4

In addition, the model should converge to a point whereby routes obey Wardrop's First Principle of Traffic Equilibrium which unit M3.1 paragraph 2.7.3 defines as: *"Traffic arranges itself on networks such that the cost of travel on all routes used between each OD pair is equal to the minimum cost of travel and all unused routes have equal or greater cost."*

This relates to how close the model is to a particular converged solution, which varies depending on the preferences of the user or software package being used. The gap value therefore represents the excess cost incurred by failing to travel on the route with the lowest generalised cost and is expressed relative to that minimum route cost. The excess cost is summed over each route between each origin-destination (OD) pair and multiplied by the number of trips between each OD pair. This is divided by the minimum cost summed over each route between each OD pair, also multiplied by the number of trips between each OD pair.

For the model to be considered sufficiently well converged, the GAP value must be less than 0.1%. A full summary of the most appropriate convergence measures (of proximity and stability) and the values generally considered acceptable for use in establishing a base model is expressed in Table 3-5.

Measure of Convergence	Base Model Acceptability Guidelines
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P) <1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2) <1%	Four consecutive iterations greater than 98%

Table 3-5: Summary of Convergence Measures and Base Model Acceptability Guidelines

Within EECSM, the “Assignment with ICA” methodology will be used whereby, within each outer iteration, an equilibrium LUCE assignment which does not include flow metering, is run to convergence, before flow metering and blocking back is then applied. Subsequent iterations then consider the delay caused by flow metering and blocking back when choosing routes. This process therefore includes the “inner iterations” of the equilibrium assignment and the “outer iterations” of the assignment with flow metering and blocking back. The methodology utilised is therefore consistent with the relevant guidance in TAG (Unit M3.1, section 2.7) for a model of this form and purpose. The assignment methodology is described in more detail in Section 4.8.

4 Key Features of the Model

4.1 Summary

The key characteristics of the EECSM are described in Table 4-1 below.

Characteristic	Model Coverage
Model Structure	Highway assignment model
Software Platform	VISUM version 2020
Assignment Methodology	VISUM Assignment with ICA using the equilibrium LUCE algorithm as sub-assignment
Time Periods	AM peak hour (07:30 – 08:30), Average inter-peak hour (between 10:00 and 16:00), PM peak hour (17:00 to 18:00)
Assignment Trip Matrices (private transport modes)	Car Commute, Car Business, Car Other, LGV and HGV
Base Year	2019
Forecast Year	2036 reference case scenario for currently commissioned work. Other forecast years may be required in subsequent commissions.
Calibration / Validation	To follow TAG

Table 4-1: Key Model Features

4.2 Fully Modelled Area and External Area

In establishing the geographical coverage of the model, TAG unit M3.1 section 2.2.1 has been followed. This advises of the need to:

- Allow for the strategic re-routing impacts of interventions;
- Ensure that areas outside the main area of interest, which are potential alternative destinations, are properly represented; and
- Ensure that the full lengths of trips are represented for the purpose of deriving costs.

The breakdown of the network structure is therefore outlined broadly as:

- Fully modelled area:
  - Area of Detailed Modelling; and
  - Rest of the Fully Modelled Area
- External Area

To ensure that the model's coverage is appropriate, the scale of the impact of the A127 corridor schemes were assessed by coding a preliminary A127 corridor widening design into the existing Essex Countywide 2036 reference forecast model and running an assignment. It should be noted that this is not intended to imply that any scheme of that sort is due to come forwards. At the time of specifying the model, the exact nature of an A127 scheme was unknown. To ensure that the model extents would be sufficient for any eventuality, the most drastic form of improvement (widening across the length of the corridor) was used as a proxy for all potential schemes.

The fully modelled area has been selected on the basis of the area where the flow differences due to the scheme are considered significant. Outside of this area it is assumed that the scheme does not have an influence and thus is not included in the fully modelled area. The modelled area was selected as that covering the area where the flow differences are considered to be significant, as shown in the image below.

Figure 4-1: A127 Area of Influence

From the image above, it is evident that significant reassignment is seen along the A127, the A13, the A130, the A12, and to an extent on several roads parallel to the A127.

Figure 4-2 below shows the breakdown of the network structure for the EECSM, based on the extent and proposed use of the model.

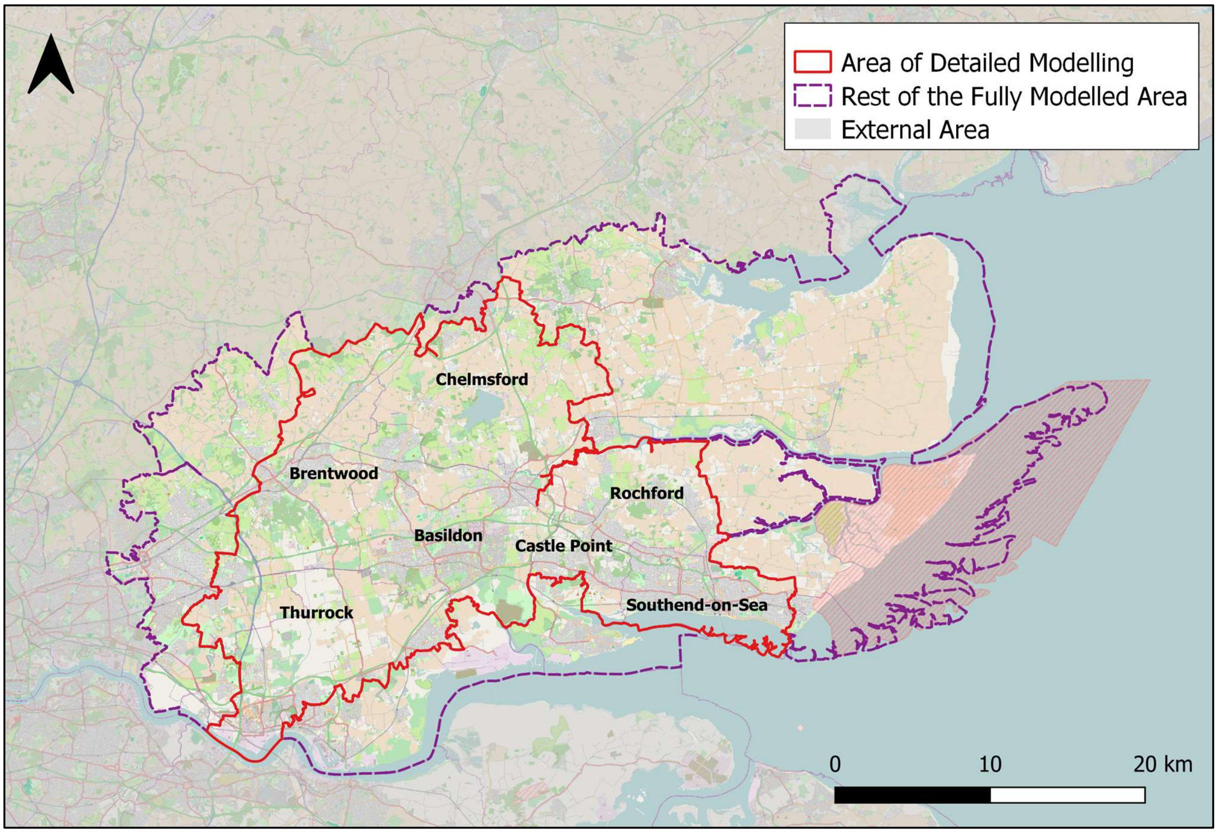

Figure 4-2: Fully Modelled Area for the EECSM

The EECSM is focussed on the area contained within the South Essex region (which coincides with the Area of Detailed Modelling). The selection of this area is determined by the extent of the Area of Influence of a preliminary A127 corridor widening scheme, capturing within it any significant traffic impacts as shown in Figure 4-1.. The immediate surrounding area comprising the Rest of the Fully Modelled Area is modelled to a decreasing level of detail based on proximity from South Essex, although highway capacity constraint is still considered for links only. The remainder of the study area consists of an external area, based on a skeleton network of key roads without capacity constraint (i.e. network travel times are based on fixed speeds). The model structure is reflected in the accompanying model zoning system, detailed in Section 4.3 and in the network structure, detailed in Section 4.5.

4.3 Zoning System

The existing Essex Countywide Model was used as the basis for the zone system, which was itself based on census boundary areas (and aggregations thereof), however it has been revised to add further detail within the EECSM study area. A total of 32 additional zones were created by splitting large existing zones around Basildon, East of Rochford, and South of Chelmsford.

The EECSM zone system around South Essex is shown in Figure 4-3.

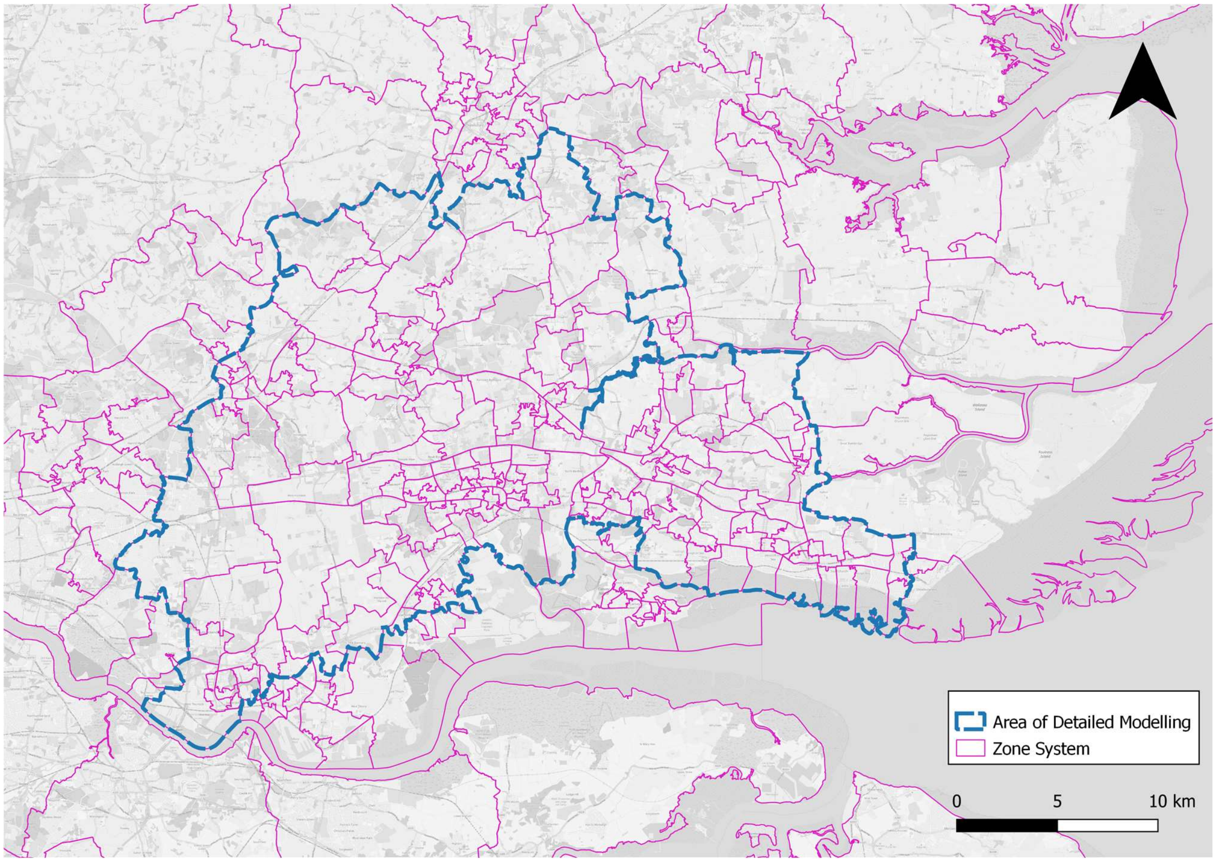

Figure 4-3: EECSM Zone System

Figure 4-4 below shows the zone system across the full model. There are 332 zones in the network. The zone system within the model is hierarchical with higher levels of detail within the South Essex region, decreasing in detail as the distance from the study area increases.

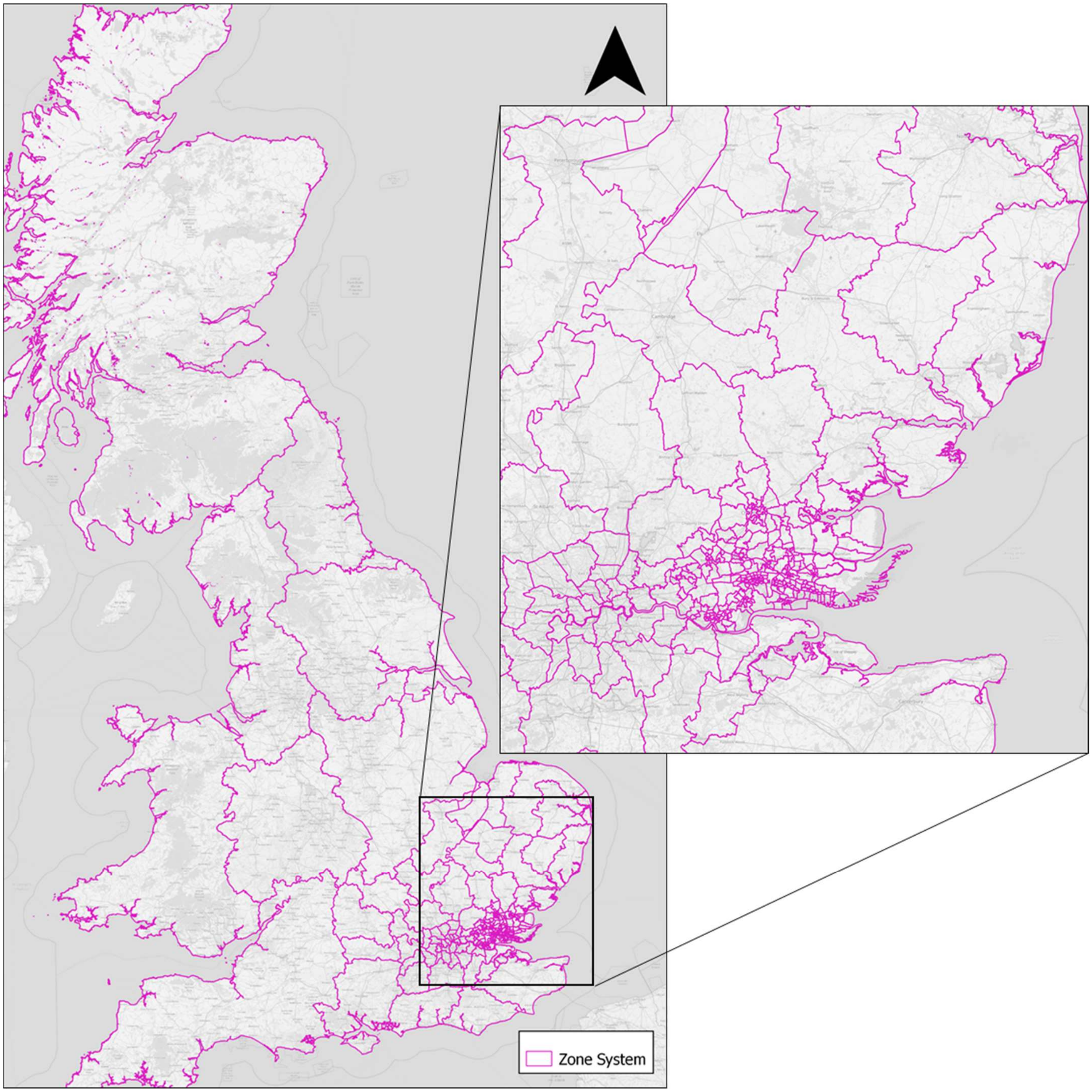

Figure 4-4: EECSM Zone System, Full Model

4.3.1 Zone Sectoring

For ease of reporting and subsequent analysis, the zones in the model have been aggregated into ‘sectors’. The sectors are shown below in Figure 4-5.

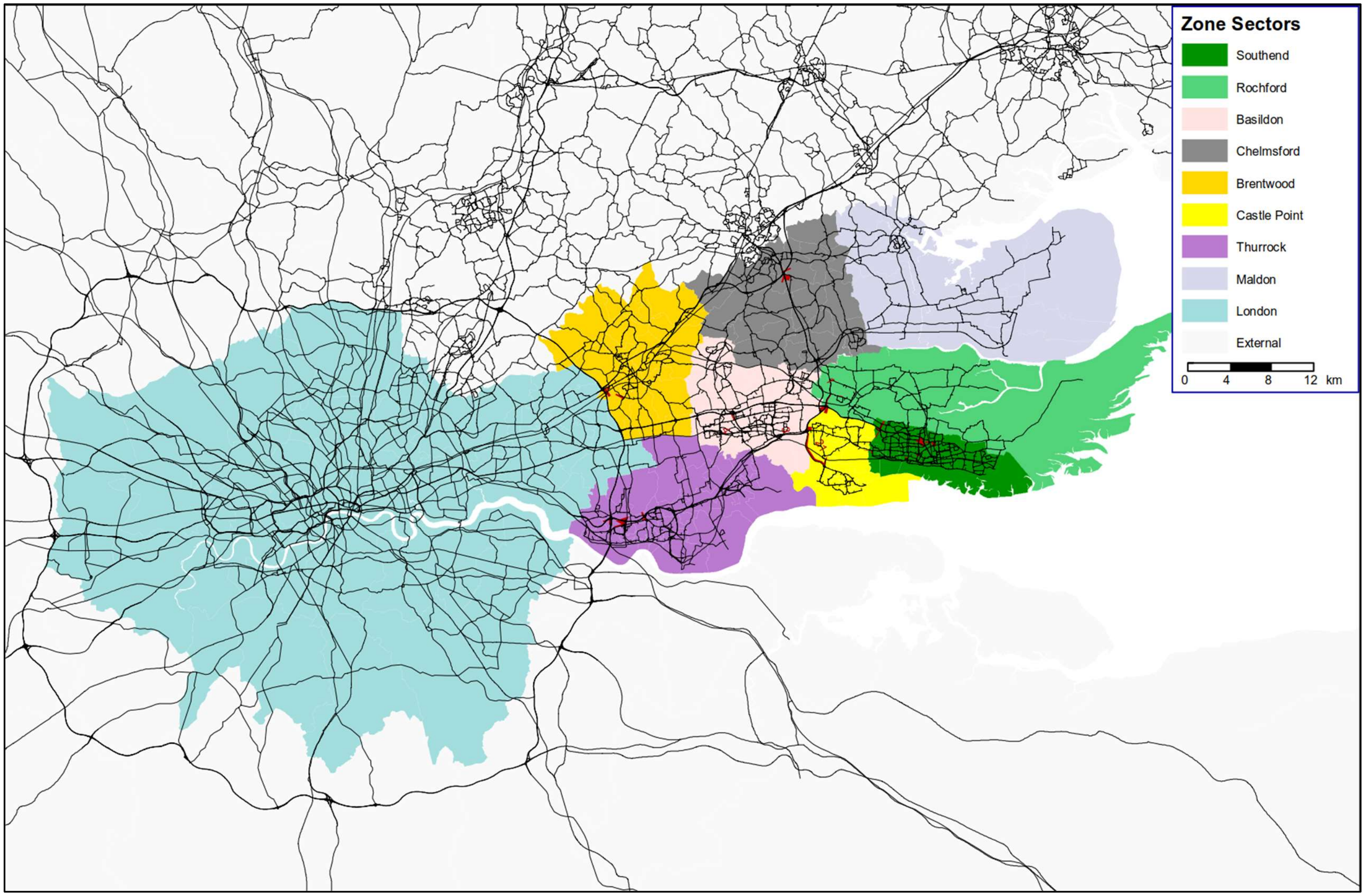

Figure 4-5: EECSM Sector System

The ten sectors identified in the figure correspond to the areas identified in the following table:

Sector	Sector Area
1	Southend
2	Rochford
3	Basildon
4	Chelmsford
5	Brentwood
6	Castle Point
7	Thurrock
8	Maldon
9	London
10	External

Table 4-2: Sector to Area Correspondence

4.4 Centroid Connectors

Trips to and from zones are loaded onto the network from the zone centroid (centre of gravity of the zone) using specialised links known as centroid connectors. The points at which these connectors load on to the network was chosen to reflect actual access points and to avoid major junctions. This is illustrated in Figure 4-6 which focusses on the Basildon area but is indicative of the way connectors have been coded across the study area.

The loading point for each connector was selected, based on professional judgement, as the most representative location for demand generated within the zone to enter and exit the network. For the detail model area, every effort has been made to ensure, where possible, that connectors did not join the network at major junctions or directly onto main roads. Following the guidance in TAG 2.3.10, the number of centroid connectors for each zone has been minimised, with most zones having only one connector.

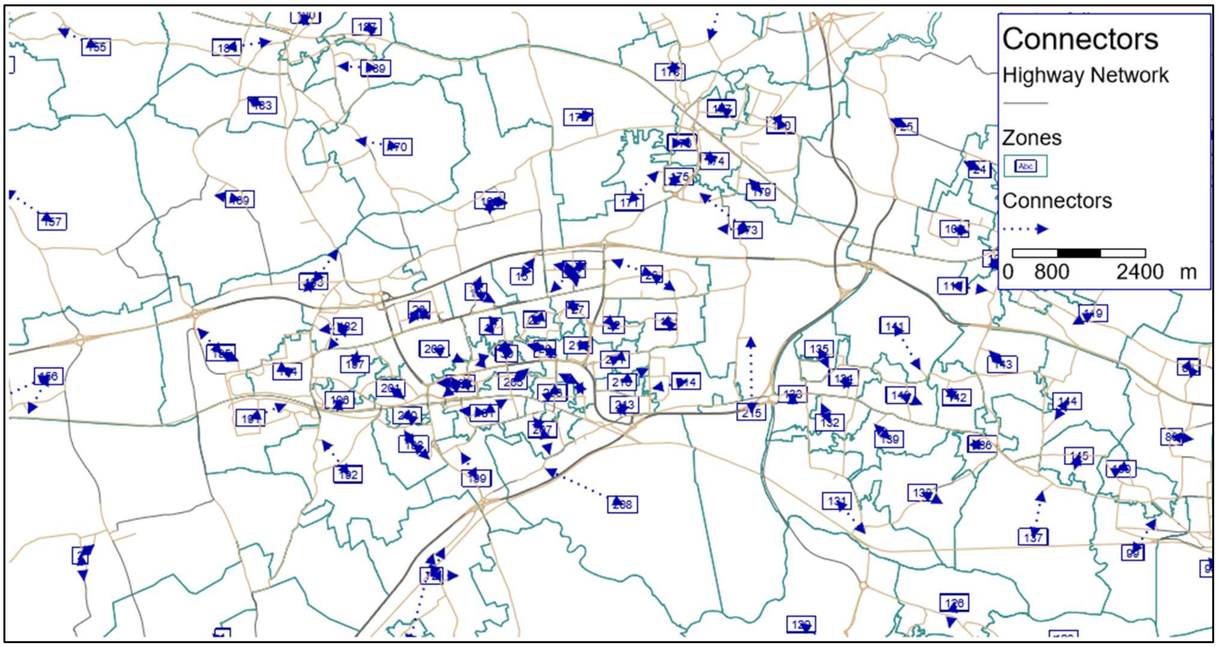

Figure 4-6: Connectors Modelled in the South Essex Area

4.5 Network Structure

In accordance with TAG Unit M3.1 section 2.4, and as alluded to in Section 4.2, the network for the EECSM has been developed with three different levels of detail. The level of detail of network coding reduces further away from the South Essex region boundary, which is also consistent with the boundary for the area of detailed modelling. Within this area the detail of the network and zones is at its greatest, and capacity constraint is modelled on links and junctions. The rest of the fully modelled area is where the level of detail is not as great, but capacity constraint is still modelled with speed-flow curves on links but not on junctions. The external area is where the level of detail is at its lowest, with the network in this area based on a skeleton network of key roads without capacity restraint (i.e. vehicles travel at fixed speeds).

The geographical extents of the three-tiered network structure are shown in Figure 4-7 below. The highway network inside the area of detailed modelling includes motorways, A roads, B, roads and all local distributor roads which are considered necessary to ensure that trips generated from within residential or employment areas load onto the wider network appropriately. Within this area capacity restraint is modelled through the use of speed flow curves and junction delays.

The network structure in the rest of the modelled area includes A roads, B roads and major distributor roads entering the detailed modelled area. The level of detail is not as great, and capacity constraint is modelled, but through the use of speed-flow curves only.

The level of detail required in the External Modelled Area is defined in order to replicate long-distance trips; the level of detail is at its lowest with no capacity constraint and link speeds determined using fixed speeds. The external network coded includes just Motorways, A roads, and some B roads (B-roads are excluded as the distance from the study area increases).

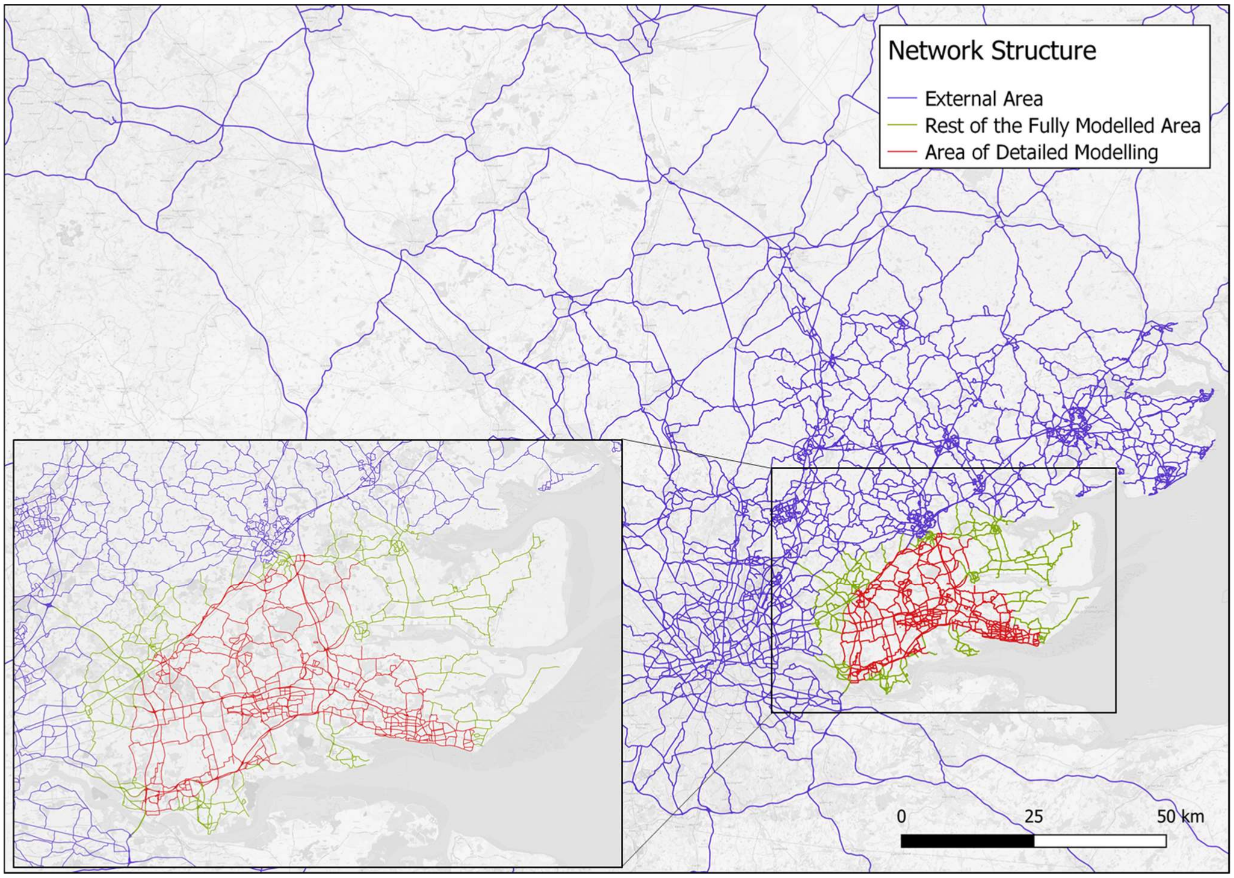

Figure 4-7: Network Structure

The EECSM network structure was derived from the existing Essex Countywide Model. To better reflect network capacity, updates to the network for this new model were undertaken which included further network coverage and detail in and around the South Essex area, and additional junction coding which had not previously been included in the model. The majority of local distributor roads are included; these are necessary to ensure that trips generated from within residential areas load on to the wider network appropriately. Figure 4.8 shows the network elements where the level of detail of network coding is highest.

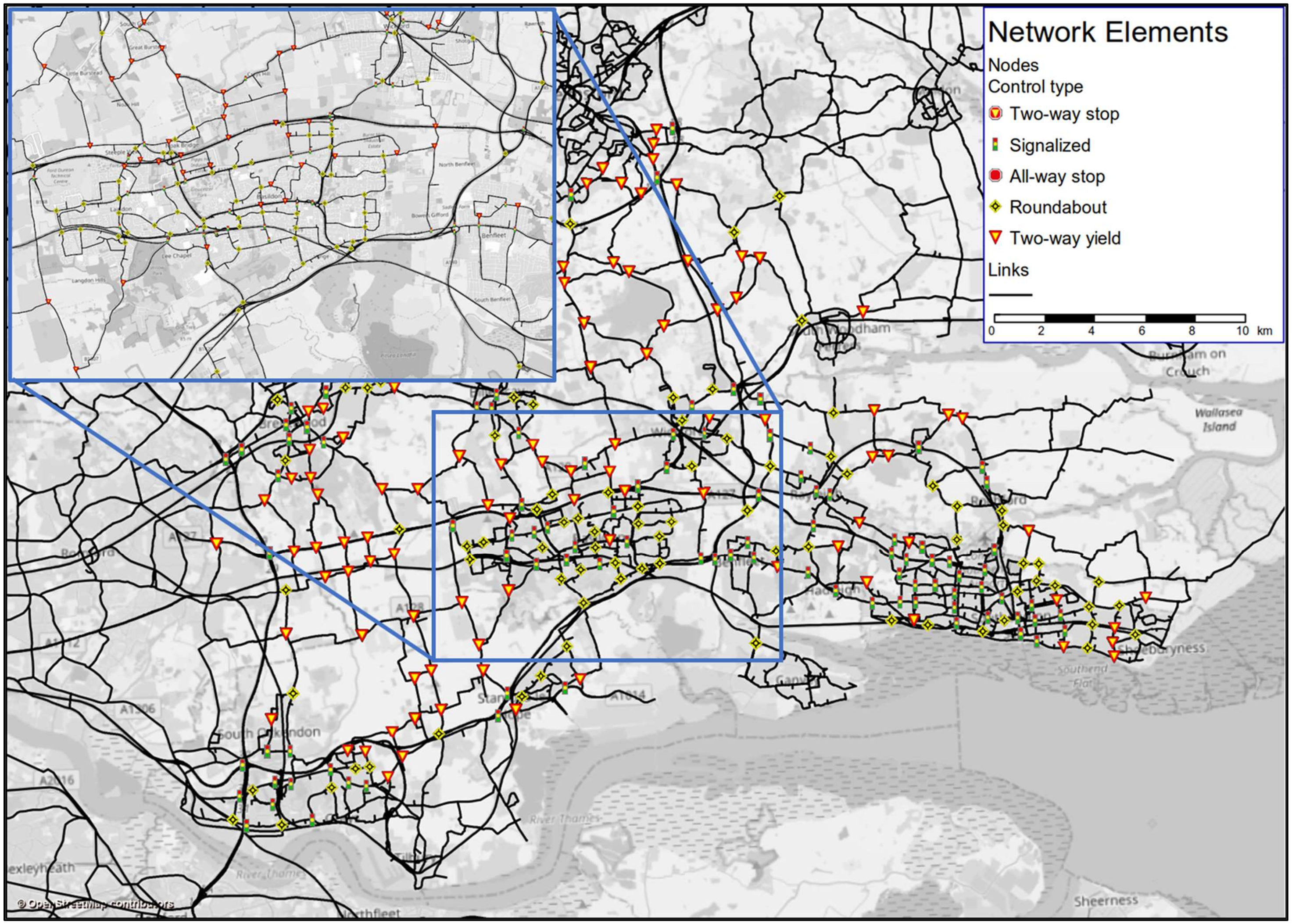

Figure 4.8: Model Network Coverage for South Essex

The process of network development, including the definition of link characteristics, junction coding, and the development of the zone system are further detailed in Section 6.

4.6 Time Periods

The model has been built to represent three time periods, for which Automated Traffic Count (ATC)data from the South Essex region were used to derive the peak hours. The modelled time periods are:

- AM peak hour (07:30-08:30);
- PM peak hour (17:00-18:00); and
- Average hour in the interpeak (10:00-16:00).

The peak hours represent the times at which observed traffic volumes were the highest in each peak period, and an average hour for the interpeak model.

4.7 User Classes

Detailed demand segmentation was required. For the assignment model, car trips were segmented into separate Commute (UC1), Business (UC2) and Other (UC3) trip purposes. In addition to this, separate user classes were used for LGV and HGVs.

Additional trip purposes were used in the demand model, with non-home based car trips incorporated into the Business and Other trip purposes during the assignment. The segmentation is summarised in Table 4-3 below.

<table>
<tr><th>Assignment Mode</th><th>Vehicle Class</th><th>Assignment User Class</th><th>Demand Model Trip Purposes</th></tr>
<tr><td rowspan="10">Private Transport</td><td rowspan="8">Car (VC1)</td><td>Car Commute (UC1)</td><td>Home Based Work (HBW)</td></tr>
<tr><td rowspan="2">Car Employer Business (UC2)</td><td>Home Based Employer’s Business (HBEB)</td></tr>
<tr><td>Non-Home-Based Employer’s Business (NHBEB)</td></tr>
<tr><td rowspan="4">Car Other (UC3)</td><td>Home Based Education (HBED)</td></tr>
<tr><td>Home Based Shopping (HBShop)</td></tr>
<tr><td>Home Based Other (HBO)</td></tr>
<tr><td>Non-Home Based Other (NHBO)</td></tr>
<tr><td>LGV (VC2)</td><td>LGV (UC4)</td><td>-</td></tr>
<tr><td>HGV (VC3)</td><td>HGV (UC5)</td><td>-</td></tr>
</table>

Table 4-3: Purpose/ User Class/ Vehicle Class Correspondence

Link flow validation was performed at the level of vehicle class flows. The trip purpose and user class definitions are consistent with the guidance contained in TAG unit M3.1, section 2.6.

Vehicle classes 1 and 2 (cars and LGVs) were assigned a PCU factor of 1.0. Vehicles class 3 (HGVs) was given a PCU factor of 2.5. This is consistent with guidance in Appendix D of TAG unit M3.1, which advises use of this factor on motorways and dual carriageways. Although there are other roads in the study area, the South Essex area includes key strateigc routes in the form of A127, the A13, the A130, the A12, so a value of 2.5 was considered most appropriate.

4.8 Assignment Methodology

The VISUM software assignment methodology used in the EECSM is known as “Assignment with ICA”. This ensures that generalised costs used for the purposes of route choice include junction delays calculated using Intersection Capacity Analysis (ICA) (where these junctions are coded as such) within the area of detailed modelling).

The “Assignment with ICA” method also ensures that flow metering and blocking back is calculated. For the assignment with ICA, the Linear User Cost Equilibrium (LUCE) assignment was used as a subordinate assignment procedure with the advantage that it provides stable route distribution and the calculation of the blocking back model is considerably faster than using the paths of other assignment methods. Due to the stable route distribution, the blocking back result is also more stable and convergence is reached much faster than with other methods. The fundamentals of the LUCE assignment are that, for any node, a user equilibrium shall be reached on all forward edges for the local route choice of drivers heading to a destination zone[1].

The above is consistent with the latest TAG guidance on highway assignment modelling.

Within the blocking back model, it is assumed that one PCU takes up 7.0 metres of road space when in a queue.

4.9 Generalised Cost Formulations and Parameter Values

The values of time (VOT) used in the model were taken from the TAG data book, released in May 2020, which was the latest version of the data book available at the time the model development was started. Similarly, vehicle operating costs (VOC) were based on formulations and parameters within the TAG data book. When calculating the VOC, an average network speed of 40 kph was assumed. The generalised cost is defined below, it has been taken from TAG unit M3-1:

$$\boldsymbol{GC} = \mathbf{T} + \frac{\mathbf{VOC \text{ x } D}}{\mathbf{VoT}} + \frac{\boldsymbol{M}}{\boldsymbol{VoT}}$$

where:

GC	= Generalised costs
VOC	= Vehicle Operating Cost
VoT	= Value of Time
T	= time
D	= distance
M	= monetary charge

In this case, the variable ‘**M**’ is set to zero as there are no toll roads or user charging in the base situation within the modelled area. It is acknowledged that the Dartford Crossing is on the edge of the study area, but demand there is captive in the context of this model extent as we are not modelling any alternative competing crossings over the Thames further west.

Generalised cost is therefore a time value. It should be noted that the **VoT** and **VOC** values differ by trip purpose and appropriate parameter values are defined based on the values of time (VoT) and vehicle operating costs (VOC) set out in the TAG data book (May 2020, which was the latest version at the time the base model development was undertaken). Parameters have been calculated for each user class (business, commute, other, LGV and HGV). The VoT for the HGV user class has been doubled, as per guidance contained in TAG unit 2.8.8.

[1] PTV VISUM 20 Manual. 2020 PTV AG, Karlsruhe, Germany

Generalised costs for LGVs, HGVs have a higher emphasis on the distance component than is the case for cars. Recently revised values of time, in which values are considered to vary based on overall trip distance for business users, have been noted. For assignment purposes an average was used in order to simplify the assignment. These are outlined in Table 4-4 below.

Time Period	User Class	2019 Base Year (From May 2020 TAG Databook)	
		VoT p/min	VOC p/km
AM	UC1 (Commute)	20.81	6.45
	UC2 (Business)	31.02	13.55
	UC3 (Other)	14.35	6.45
	LGV	22.48	14.90
	HGV	44.78	45.46
IP	UC1 (Commute)	21.14	6.17
	UC2 (Business)	31.79	12.94
	UC3 (Other)	15.29	6.17
	LGV	22.48	14.45
	HGV	44.78	43.08
PM	UC1 (Commute)	20.88	6.45
	UC2 (Business)	31.47	13.55
	UC3 (Other)	15.03	6.45
	LGV	22.48	14.90
	HGV	44.78	45.46

Table 4-4: Generalised Cost Parameters

4.10 Capacity Resistant Mechanisms

4.10.1 Links

Delays and capacity restraint along links were calculated according to volume-delay functions (VDFs) which regulate how average travel speeds on a link change with respect to traffic volume. Parameters for volume-delay functions for specific link types are shown in Appendix B and a detailed description of these calculations is given in Section 6.2.2.

4.10.2 Junctions

As previously mentioned in section 4.8, the assignment methodology uses “Assignment with ICA” which ensures that capacity restraint at junctions are modelled using VISUM’s Intersection Capacity Analysis (ICA) model. This uses the US Highway Capacity Manual as the underlying basis for the capacity restraint and is appropriate for use at priority and signalised junctions. For roundabouts, the Kimber method developed by the Transportation Research Laboratory (TRL) is used.

4.11 Relationship with Other Models

A multi-modal strategic transport model covering the whole of Essex, known as the Essex Countywide Model, has been recently developed and has coverage of the South Essex area. It has a base year of 2017 and has been used as the base for development of other strategic town/region modelling projects. The highway and demand model methodologies within the Essex Countywide Model were developed in line with current best practice set out in TAG and use TEMPro, National Travel Survey (NTS), and mobile network data. The 2017 Essex Countywide Model highway prior matrices are used as the starting point for the EECSM matrices. Using the matrices provides analytical consistency and removes duplication of work.

Subject to subsequent commissioning, there is the potential that a PT model and a VDM will be developed to sit alongside the EECSM highway model. The highway model development was cognisant of this possibility. Should these models be developed, further reporting will be forthcoming.

4.12 Use of Existing Model Information

Following a review of the network and zoning system of the 2017 Essex Countywide Model, it was established that additional detail was required in the fully modelled area for the 2019 EECSM.

Highlighted in Table 4-5 below are the risks associated with using previous models and the mitigation methods that have been put in place for this project.

Risk	Mitigation
Parts of the network might be outdated	Model has been updated following review of latest on-ground conditions, updated information from Essex County Council and local knowledge from other sources.
Errors in the model carried forward	The network coding has been re-checked
Zoning system might not be suitable	Identified areas in proximity to the scheme that lack sufficient detail and have split the old zoning system in these areas to provide more granularity.

Table 4-5: Risks Associated with Use of the Essex Countywide Model (2017) and Mitigation Methods in Place

4.13 Use of Traffic Survey Data

Traffic data is required to improve the understanding of the existing transport conditions in South Essex and inform the development of the EECSM. Traffic data has a direct input into the model; it is therefore important that sufficient quantity and quality of relevant data is available.

For the purpose of this model development, a number of different types of data have been collected to further develop the model. The different types of data, quantity and their uses are set out below in Table 4-6.

Type of Data	Timescale	Overview of Key Uses
Automatic Traffic Counts (ATC)	2 weeks	Provides traffic volume data by vehicle type, direction and time of day for an agreed point Collected in order to calibrate and validate the updated model
Manual Classified Counts (MCC)	1 day	
Teletrac Data	March 2019 – November 2019 (July and August excluded)	Collected in order to validate journey times in the model
Traffic signal data	2019 signal controller information	For updating the model network with the latest signal timing data

Table 4-6: Summary of Traffic Survey Data

Further detail on the traffic data used to construct, calibrate, and validate the 2019 Enhanced Essex Countywide Strategic Model can be found in the Data Collection Report[2].

4.14 Use of Other Data

Other available data was collected to inform model development. The different types of data, and a brief description of their source and uses are set out below in Table 4-7.

Type of Data	Source of Data	Overview of Key Uses
Residential and workplace population at Output Area (OA) level	2011 UK Census, accessed via the nomis data portal website	Converting demand matrices from the Essex Countywide model zoning system to that of the EECSM.
National Trip End Model (NTEM) 7.2 Car growth factors	Trip End Model Presentation Program (TEMPro) v7.2, the software providing the user interface for accessing NTEM data	Uplifting car matrices from Essex Countywide model base year of 2017 to required 2019 base year for the EECSM update
Road Traffic Forecast (RTF) 2018 goods vehicle miles travelled	RTF Scenario 1 produced by DfT	Uplifting goods vehicle matrices from Essex Countywide model base year of 2017 to required 2019 base year for the EECSM update

Table 4-7: Outline of Other Data, Sources, and Key Uses

These datasets were used in the matrix development process, which is further discussed in Section 9.

[2] Jacobs, 2020, Enhanced Essex Countywide Data Collection Report

5 Calibration and Validation Data

5.1 Model Data Sources

An array of survey data was collected in order to gain an understanding of traffic conditions in the base year. The data sources used are described in turn below.

5.2 Traffic Counts

Traffic count data described above has been used in the EECSM to adjust the base year matrices and network parameters (calibration), as well as to provide the independent comparisons of the model against observed traffic data (validation). Sections 5.2.1 and 5.2.2 describe the locations of counts used for each of these processes.

It is important that data used to calibrate the model is independent from data used to validate the model. A total of 222 (76% of the total) counts were used for the purposes of calibration and 70 (24%) counts were retained for the purposes of validation.

Screenlines were created, across which the modelled and observed flows are compared to provide insight into the quality of the trip matrices. These screenlines are intended to capture the key movements through the study area. The screenlines and location of counts used in the model for calibration and validation are shown in Figure 5-1. As can be seen from the figure, a small number of counts do not sit along screenlines and are classed as independent counts. They serve as a means of model calibration or validation at key links in the modelled network, which are not covered by the screenlines.

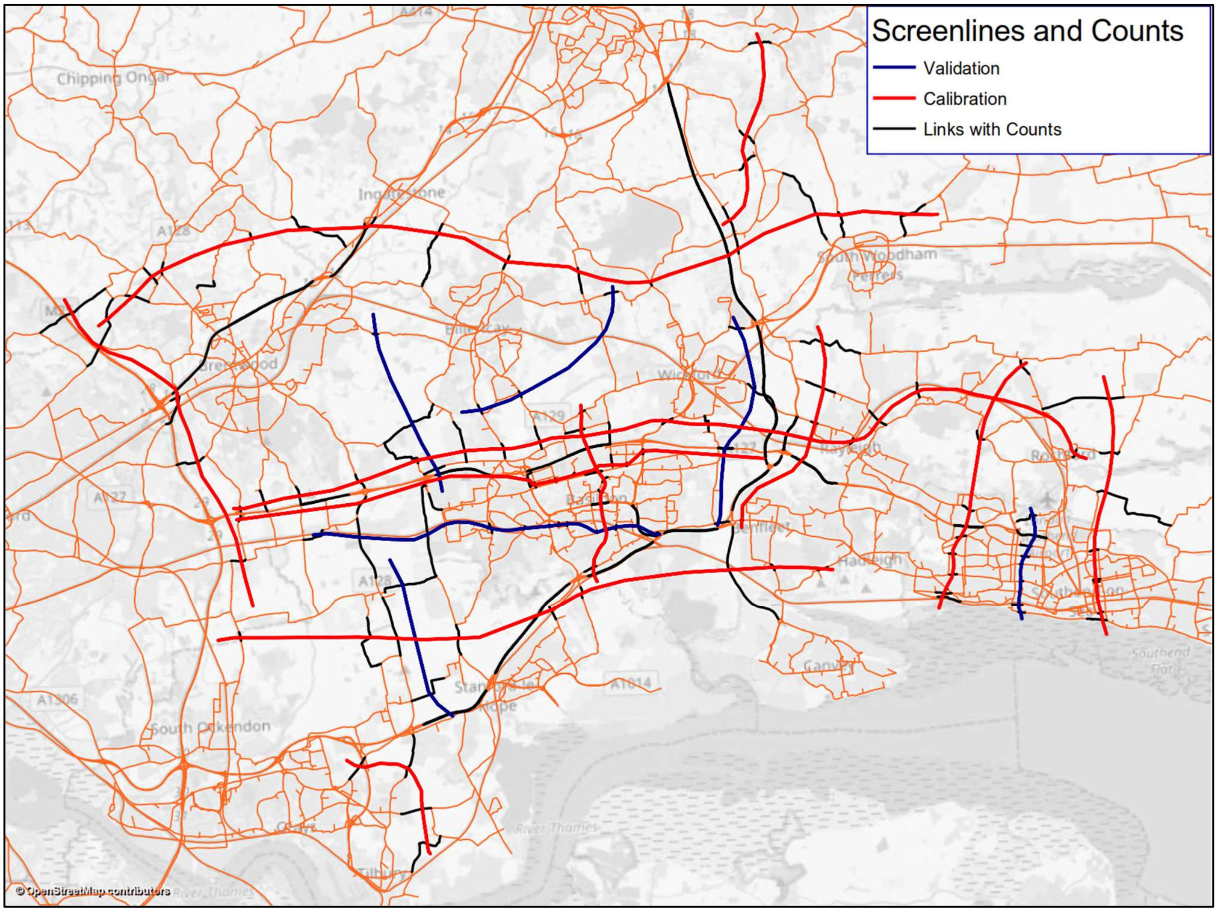

Figure 5-1: Calibration and Validation Counts and Screenlines

5.2.1 Traffic Counts for Calibration

A number of counts, along with the defined calibration screenlines, were utilised to calibrate the model. The calibration screenlines and counts are shown in Figure 5-2.

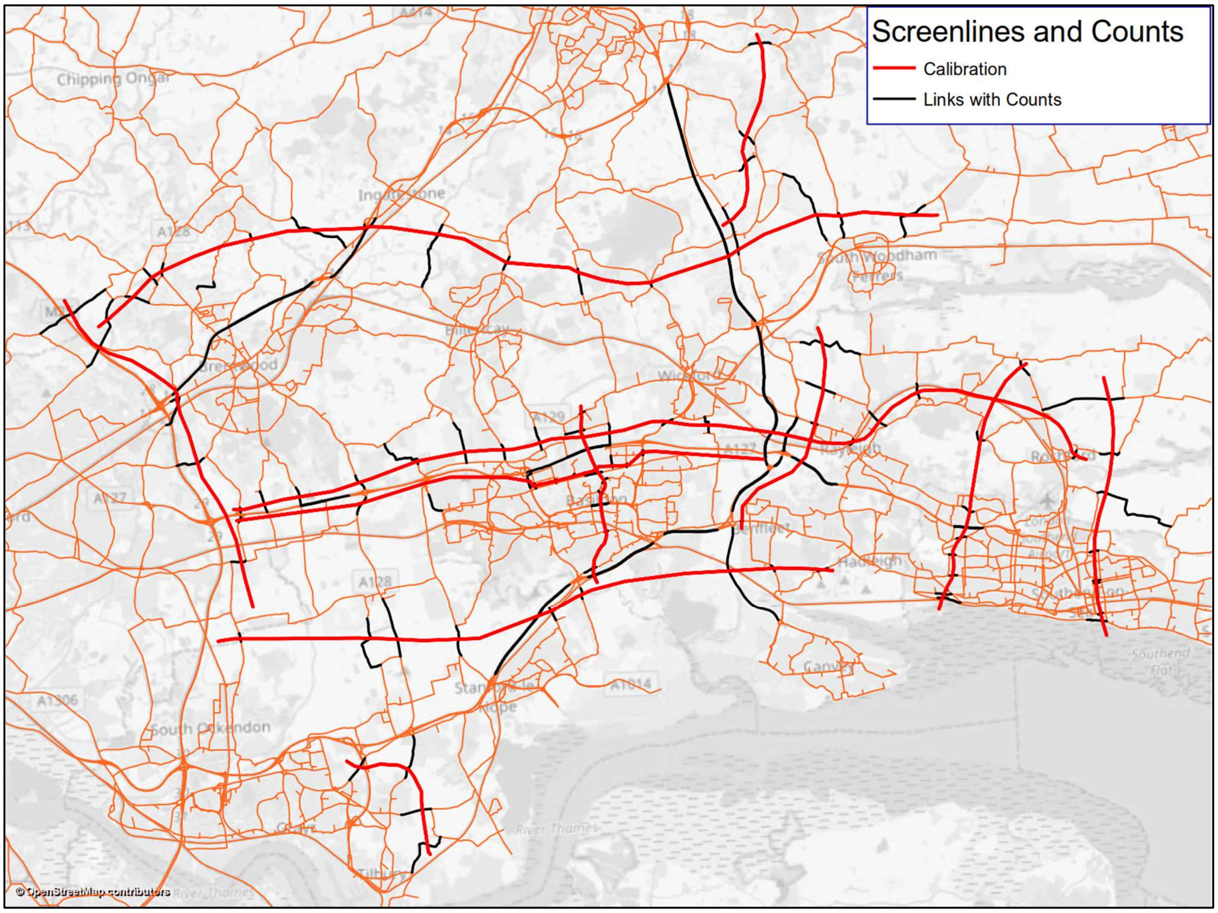

Figure 5-2: Calibration Counts

5.2.2 Traffic Counts for Validation

A series of counts dedicated to validation (i.e. not used in any stages of model calibration) were used in the model, along the defined validation screenlines. The validation screenlines and counts are shown in Figure 5-3.

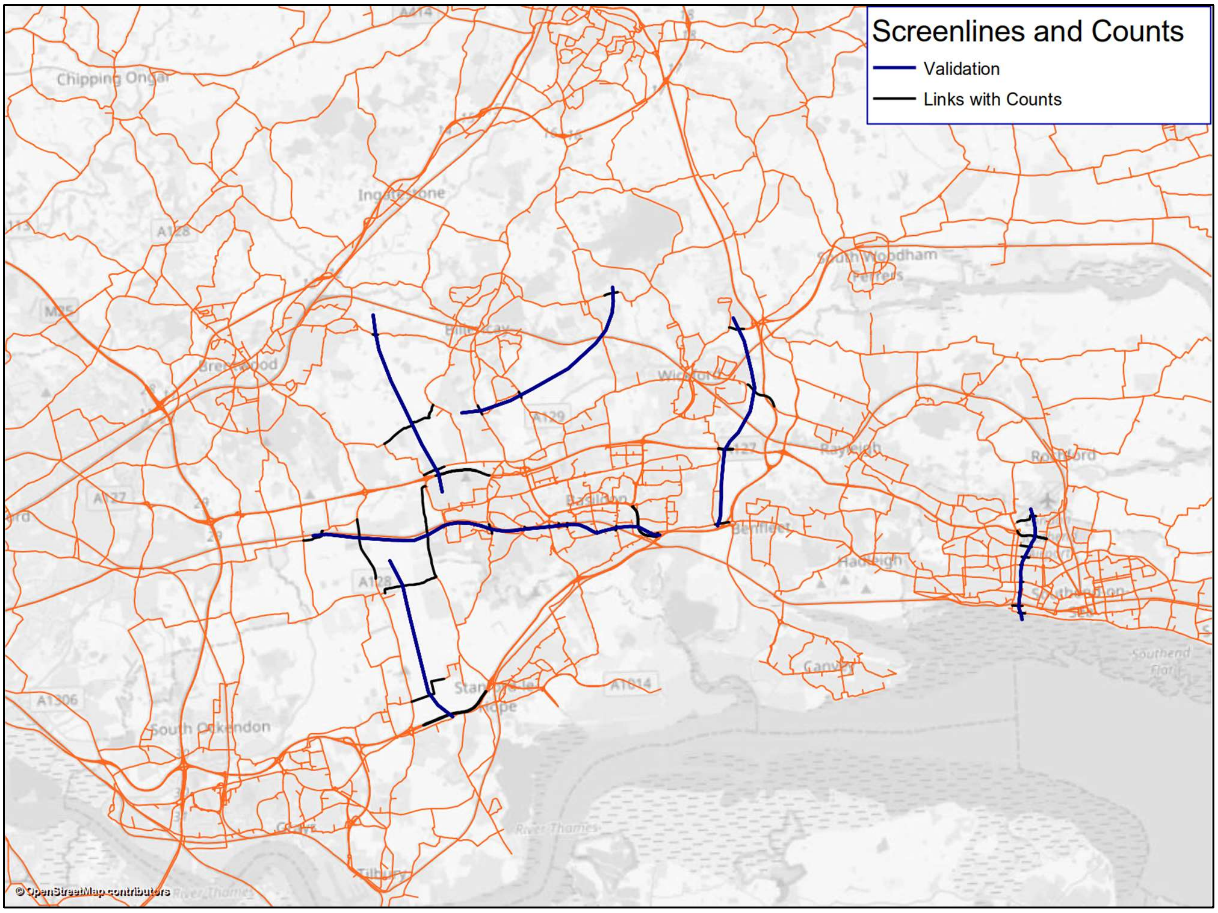

Figure 5-3: Validation Screenlines

5.3 Journey Times

Journey time data is used to check and compare the delays and travel times calculated by the model against observed data. Journey time data was collected from Teletrac. Teletrac is a dataset made available to local authorities and is based on data gathered using satellite navigation devices installed in cars and other vehicles. Travel times are specified for links in the Integrated Transport Network (ITN). Times along a set route are collated by aggregating the set of ITN links along the route. The routes used for comparing the travel times in the EECSM are depicted in Figure 5.4. There are 11 bi-directional routes in total.

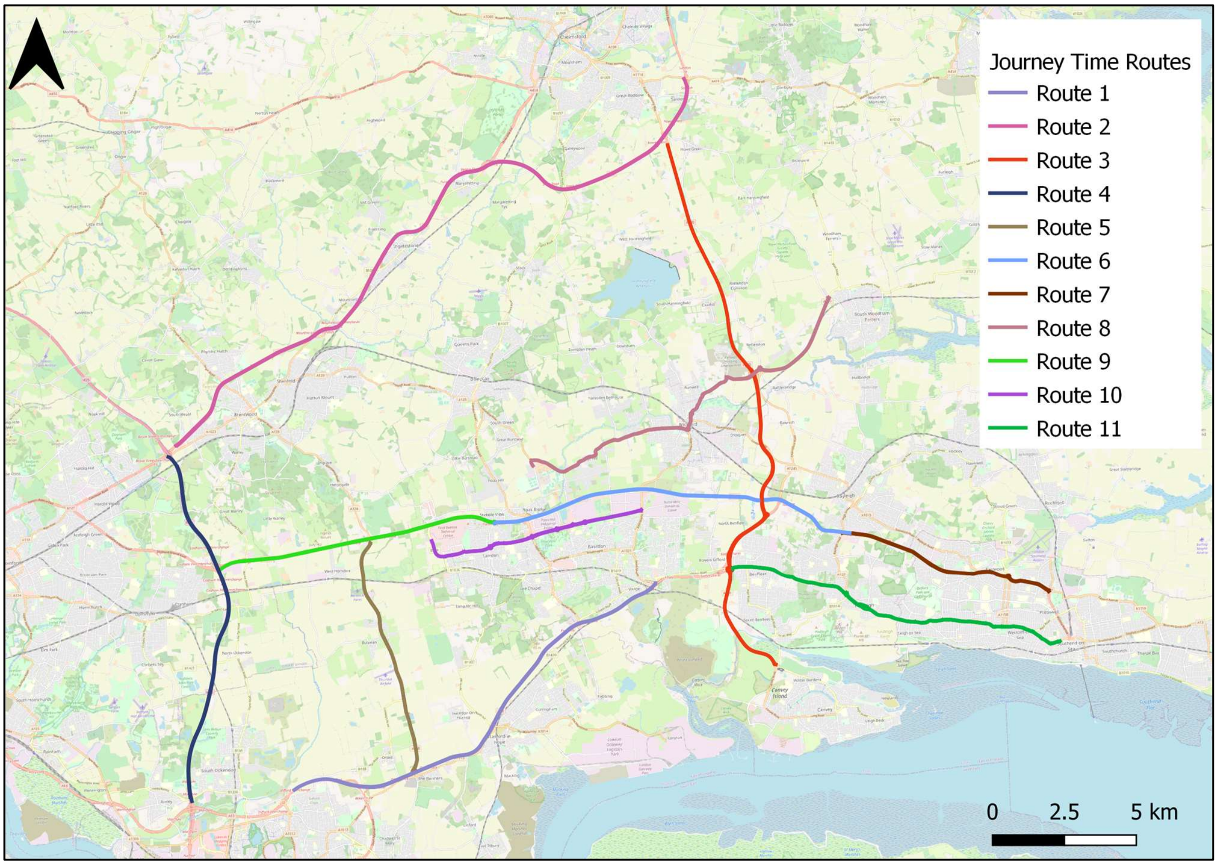

Figure 5.4: Journey Time Routes for Model Validation

TAG unit M3.1 specifies that journey time validation routes should neither be excessively long (greater than 15km) or too short (less than 3km) and that they should not take longer to travel than about 40 minutes (so as to fit comfortably within the modelled peak hour). All but two routes chosen for the EECSM fall within the distance criteria, though the observed travel times are well within the guidance of 40 minutes. The margin by which these three routes are above and below the suggested journey time route lengths is not deemed to have a detrimental effect on the journey time validation and were included in order to reflect realistic routes undertaken in the study area.

For this model development, the journey time data for the year of 2019 was extracted from Teletrac, making sure to avoid non-neutral months and holidays/periods affected by holidays. The length and observed time for all routes is presented in Table 5-1.

Route No.	Description	Length (km)	AM Observed time [min:sec]	IP Observed time [min:sec]	PM Observed time [min:sec]
1	A13/Baker Street --> A13/Pitsea Flyover	13.68	10:41	11:06	18:31
	A13/Pitsea Flyover --> A12/Baker Street	13.26	14:20	10:01	10:38
2	A12/Brook Street Interchange --> A12/Junction 18	23.97	16:06	14:52	20:22
	A12/Junction 18--> A12/Brook Street Interchange	24.12	17:45	14:38	14:54
3	A130 Canvey Way/Somnes Avenue --> A12/Junction 17	20.71	21:08	15:02	16:53
	A12/Junction 17 --> A130 Canvey Way/Somnes Avenue	20.77	16:10	15:01	27:51
4	M25/Brook Street Interchange --> M25/ Mar Dyke	12.09	07:46	07:08	08:45
	M25/ Mar Dyke --> M25/Brook Street Interchange	12.22	08:21	07:19	07:33
5	A128/A13 Interchange --> A128/A127 Interchange	8.38	07:26	07:00	07:11
	A128/A127 Interchange --> A128/A13 Interchange	8.34	07:59	07:25	09:08
6	A127/Rayleigh Weir --> A127/High Road North	13.10	15:04	09:58	10:44
	A127/High Road North --> A127/Rayleigh Weir	13.03	10:23	09:46	19:40
7	A127, Southend-on-Sea --> A127, Rayleigh	7.22	15:55	10:08	13:02
	A127, Rayleigh --> A127, Southend-on-Sea	7.34	17:32	11:05	16:19
8	A132/Ferrers Road --> A129/Barleylands Road	13.62	18:37	16:33	18:42
	A129/Barleylands Road --> A132/Ferrers Road	13.69	18:08	17:04	20:15
9	A127/Dunton Interchange --> A127/M25	9.37	10:18	06:32	08:10
	A127/M25 --> A127/Dunton Interchange	9.06	10:13	06:43	13:31
10	B148/Mandeville Way --> A1235/A132	7.14	11:18	10:08	14:04
	A1235/A132 --> B148/Mandeville Way	7.16	10:18	09:12	10:59
11	A13 London Road/Queensway London Road --> A13 Saddlers Farm Roundabout/A130	12.09	36:13	27:57	30:10
	A13 Saddlers Farm Roundabout/A130 --> A13 London Road/Queensway London Road	12.13	36:30	28:22	31:51

Table 5-1: Observed Journey Times

6 Network Development

6.1 Network Basis

The basis of the modelled network for EECSM was the network from the 2017 Essex Countywide Model. That modelled network was originally created using two Ordnance Survey datasets; the Integrated Transport Network (ITN) and Meridian 2. The ITN network was used as a basis for the modelled network within South Essex; beyond this, Meridian 2 layers were used.

ITN segregates links into motorways, A-roads, B-roads, minor roads, local streets, private roads, and alleys, in descending order of importance.

The modelled highway network was built initially using digital mapping databases, which were combined into a model network using ArcGIS software.

The detailed model network was then imported into VISUM making sure that data on highway network types was retained. The model accommodates all paved inter-urban traffic roads.

A total of 71 different highways classes or types were coded in the model, following guidance from COBA Volume 13 Section 1 part 5, classifying roads based on characteristics such as: road class, number of lanes, speeds, and modes allowed. A full list of all the defined link types can be found in Appendix B, however, the main classes considered in the analysis can be seen below:

- Motorways;
- Rural single carriageway;
- Rural double carriageway;
- Urban non-central;
- Urban central;
- Small town;
- Suburban single carriageway;
- Suburban dual carriageway;
- Residential road; and
- Roundabout.

The first three classes were assigned for all-purpose roads and motorways that are generally not subject to a local speed limit. Urban central and non-central were used for roads in large towns or conurbations typically subject to 30 mph speed limits. Small town was used as the link type in small towns or villages, while suburban was used for major routes though towns and cities which are generally subject to 40 mph speed limits. Figure 6-1 below presents an example of the kind of link allocated to a suburban link type.

Figure 6-1: Suburban Slight Development Link Type Example (London Road)

6.2 Links

6.2.1 Link Characteristics

In all areas, physical properties such as number of lanes, speed and capacity were taken from the existing model and checked using recent satellite imagery (Google Earth and Google Street View).

Highway attributes data, such as link class, user class restrictions, and turning movement restrictions were also coded using Google Earth, Google Street View, local knowledge, and field observations.

As Section 6.1 details, there are 71 unique network link types which have been defined according to their classification under the following attributes:

- Roadway functional class (e.g. motorway, trunk road, residential street);
- Roadway location (urban, suburban, rural);
- Roadway geometry (lane width, number of lanes); and
- User type prohibitions (bus links, HGV, LGV, general traffic, etc.).

6.2.2 Link Speeds and Speed-Flow Relationships

The attributes of modelled links such as number of lanes, capacity, and free flow speed are derived from associating each link with a link type defined in the COBA manual and selected based upon the link's characteristics as described above. The COBA manual dictates the relationship between speed and traffic flow (or in other terms volume and delay) which are translated into appropriate Volume-Delay Function (VDF) parameters in VISUM, for those link types.

As part of the original Essex Countywide model, the choice of COBA link type to assign to each link was established using the attributes associated within the ITN layer (which formed the basis of network development), and also from inspection of the network in Google Earth, Google Street View, and local knowledge. These were reviewed as part of the current model update. The VDF reflects delays on links that result from traffic travelling along a link and are independent of delays that result from junctions.

To create VDFs for the EECSM, Highways England's (HE's) Traffic Appraisal, Modelling and Economics group (TAME) approved Speed Flow Curves (SFCs were used. These were originally derived from COBA for use in HE's Regional Transport Models (RTMs). For EECSM, these SFCs were used as a starting point by calibrating VISUM VDFs to the RTM SFCs. This was undertaken for various link types which broadly fall under the following categories:

- Motorway;
- Rural All Purpose;
- Rural Roads;
- Suburban;
- Urban; and
- Small town.

The travel time on a link in VISUM is determined by different pre-defined VDFs in the software. Based on previous VISUM best practices used in a number of model development studies, a VDF formulation called "BPR2", which was developed by the US Bureau of Public Roads, was used to calculate link delays, and is repeated below:

$$\mathrm{t_{cur}} = \begin{cases} t_0\left(1 + a.\left(\dfrac{q}{q_{max}.c}\right)^{b}\right), & \dfrac{q}{q_{max}.c} \leq 1 \\ t_0\left(1 + a.\left(\dfrac{q}{q_{max}.c}\right)^{b\prime}\right), & \dfrac{q}{q_{max}.c} > 1 \end{cases}$$

where:

t_{cur} is the calculated link travel time;

t_o is the link travel time at free flow conditions;

q is the flow on the link;

q_{max} is the link capacity; and

a, b, b', and *c* are parameters specific to each link type.

For EECSM, the *a, b, b'*, and *c* parameters were calibrated to replicate the RTM SFCs.

In order to reflect some of the delays observed between interchanges on the A127 near Fairglen, two additional volume delay functions were created. These were necessary because those parts of the network which have grade separated junctions in close proximity to each other (as is the case for the A127 near Fairglen), create a weaving movement. This reduces traffic speeds (for the same flow volumes) to a much greater extent than when junctions are spaced further apart; the additional VDFs created replicate this effect.

Appendix A provides further background on the SFC-VDF correlation and the following graphs show curves for the BPR2 VDF for motorways, rural all-purpose carriageways, rural, suburban, urban and small town link types.

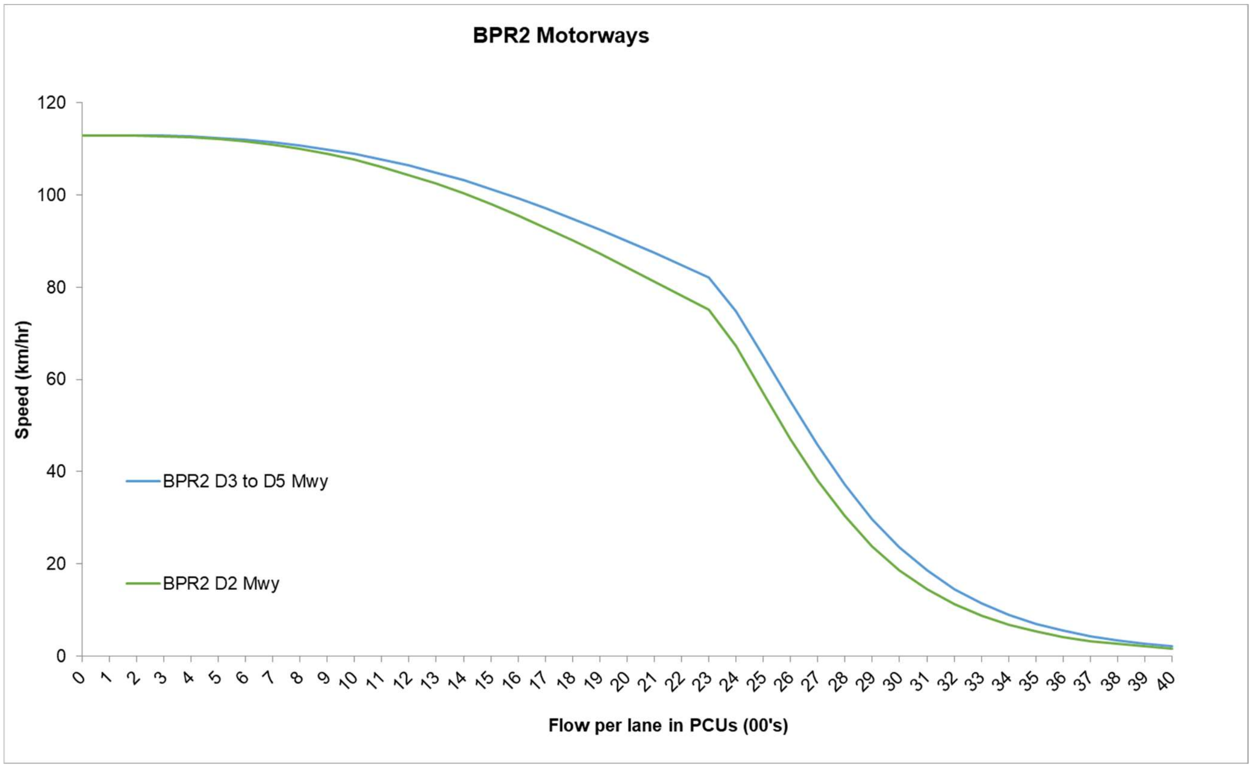

Figure 6.2: VDF Motorway Link Type

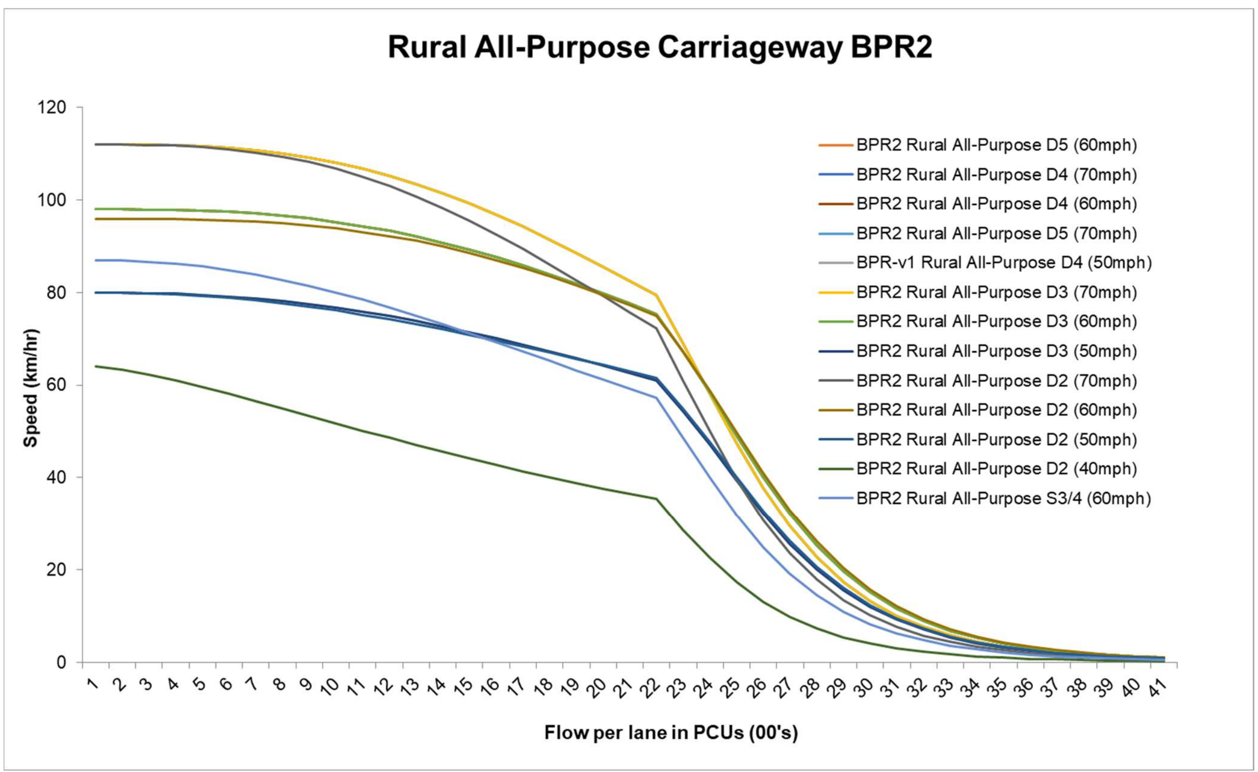

Figure 6.3: VDF Rural All-Purpose Carriageway Link Type

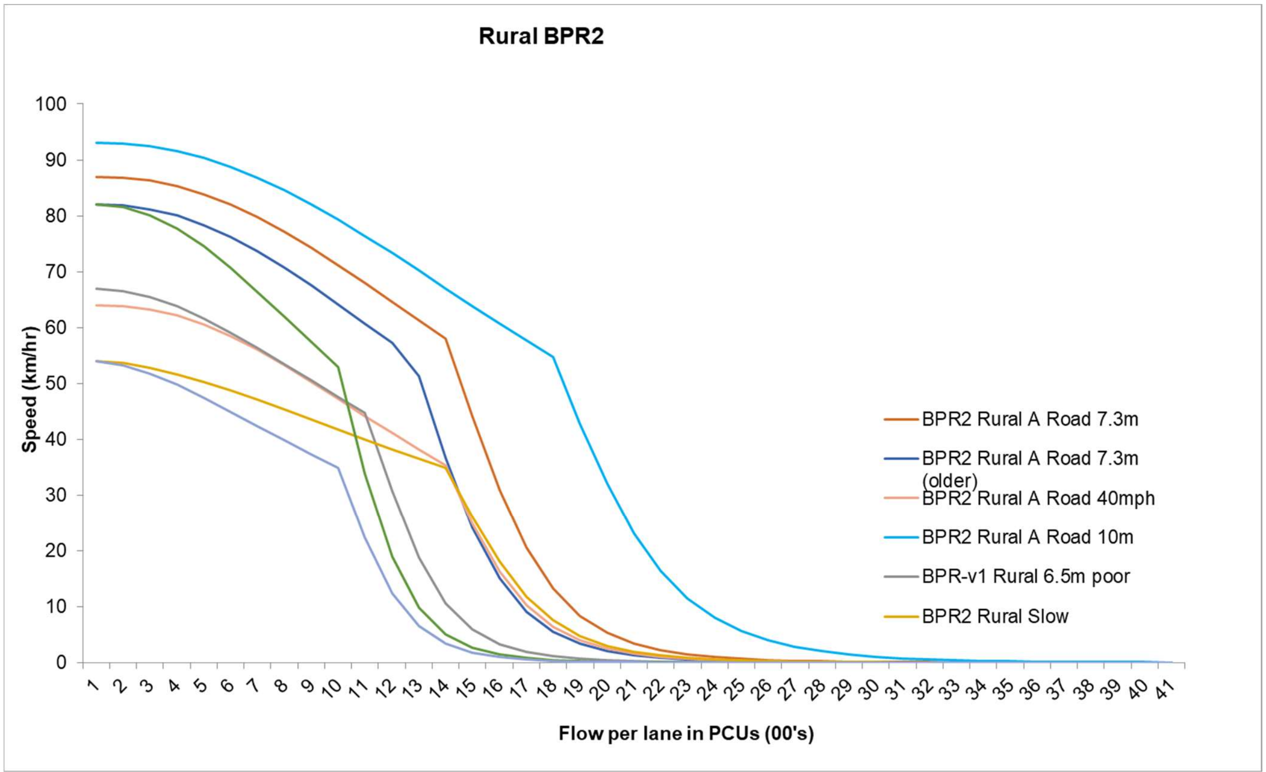

Figure 6.4: VDF Rural Link Type

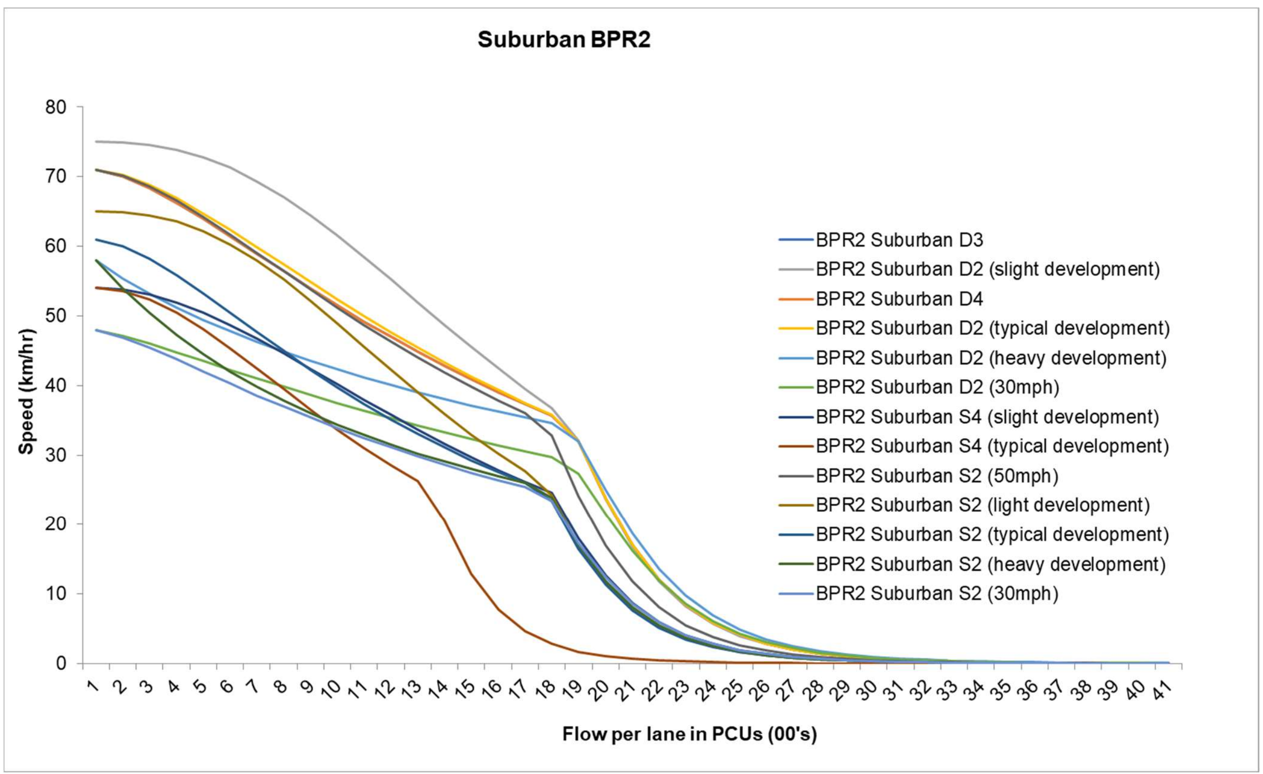

Figure 6.5: VDF Suburban Link Type

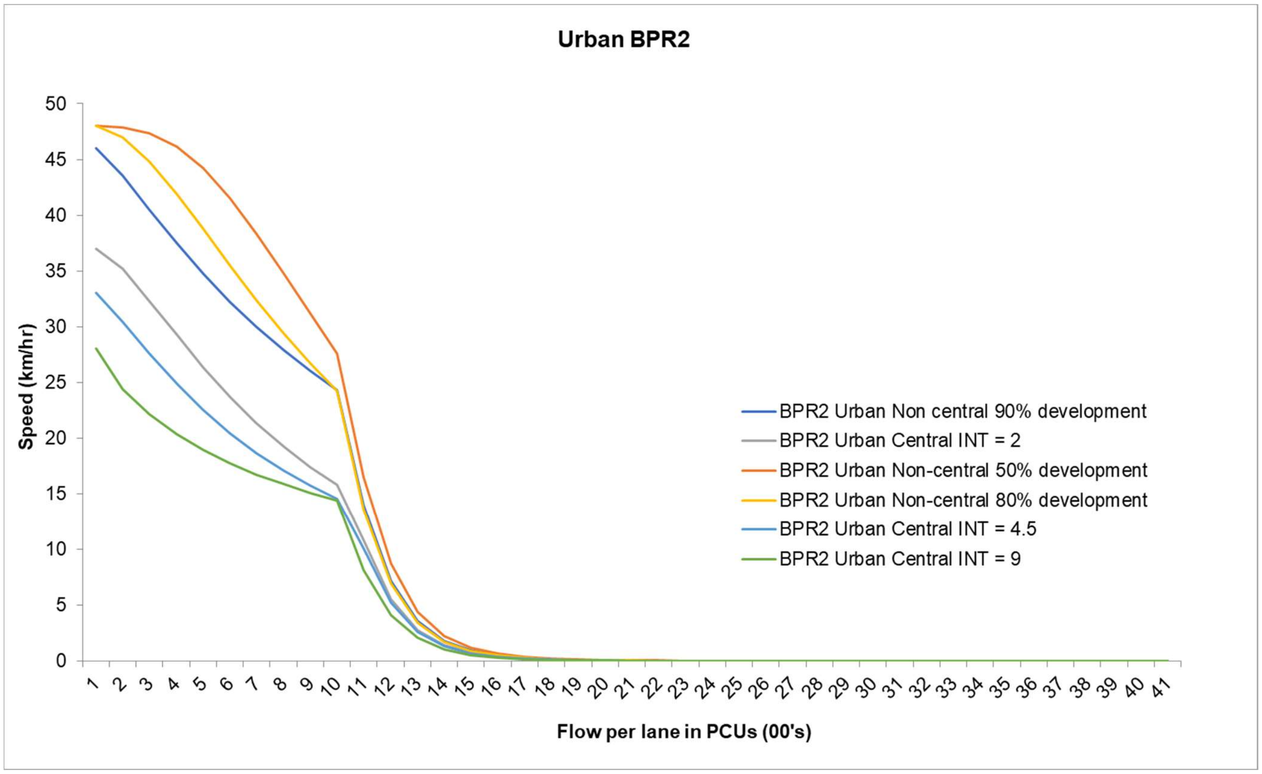

Figure 6.6: VDF Urban Link Type

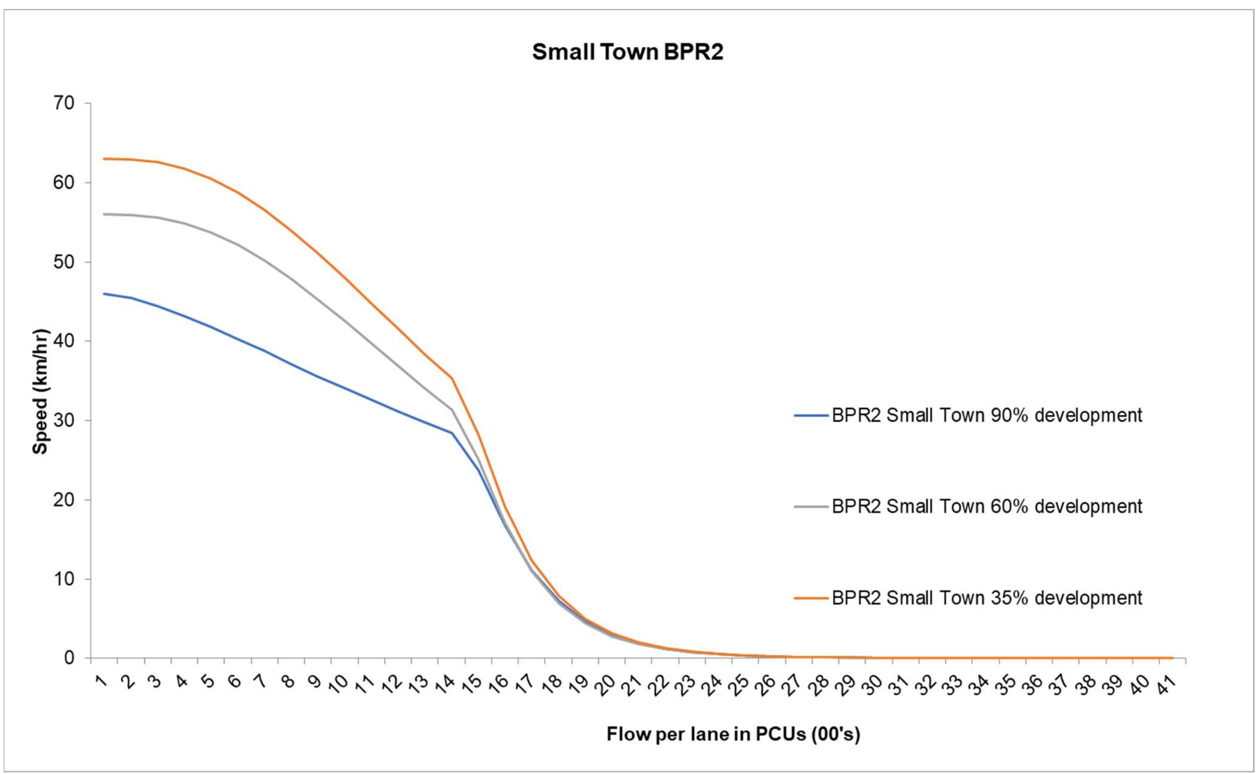

Figure 6.7: VDF Small Town Link Type

Local knowledge was also used to inform link restrictions, such as one-way links or bus only links, as well as height, width, and weight restrictions (e.g. due to bridges) for goods vehicles.

6.3 Junctions

The junctions (known as nodes) in the model are a point of connection between links. Junctions coded into the model study area are defined by a number of attributes, as required by VISUM's Intersection Capacity Analysis (ICA) functionality. The junctions were coded with the following attributes defined:

- Junction type;
- Major flow (i.e. which turning movements had priority);
- Banned turns (if any);
- Number of lanes at stop lines;
- Turn type (i.e. straight on, left, right);
- Lane allocations (which turns are made from which lanes); and
- Signal timings (for signalised junctions).

These attributes were coded using local knowledge, Google Earth and Google Street View. They were checked for accuracy in the predecessor Essex Countywide model and were checked again to ensure the coding is acceptable for the EECSM.

The flow/delay relationship for signalised and priority junctions were calculated using VISUM's Intersection Capacity Analysis (ICA) functionality. ICA uses formulae set by the 2010 edition of the Highway Capacity Manual, published by the US Transportation Research Board, which is commonly used within VISUM models and has been demonstrated to reproduce observed delays to a high degree of accuracy. The formulae are specific to the junction type. ICA relies on the input attributes identified above and uses a number of default global values to calculate the capacity and delay for each movement at a modelled junction. The default values cover aspects such as saturation flows per lane and turn type and gap acceptance values for vehicles on a minor arm. It was found that for some junctions the default values required replacement with bespoke values in order to achieve a good match to observed journey time data which can be seen from the journey time validation given in Section 11.8. Manual overrides were applied for those junctions by adjusting the critical gap and follow-up times on each node individually depending on the number of accessing lanes. Roundabouts were an exception to this general approach, as described in section 6.3.3.

Other specific details for signalised and priority junctions are described below.

6.3.1 Signal Timings

For signalised junctions, the latest signal controller information was obtained from ECC as part of network calibration.

An example of the coding of a signalised junction in the model is illustrated below (Figure 6.8) where the actual junction is shown alongside the signalised junction modelled coding of Gardiners Lane S and Cranes Farm Road.

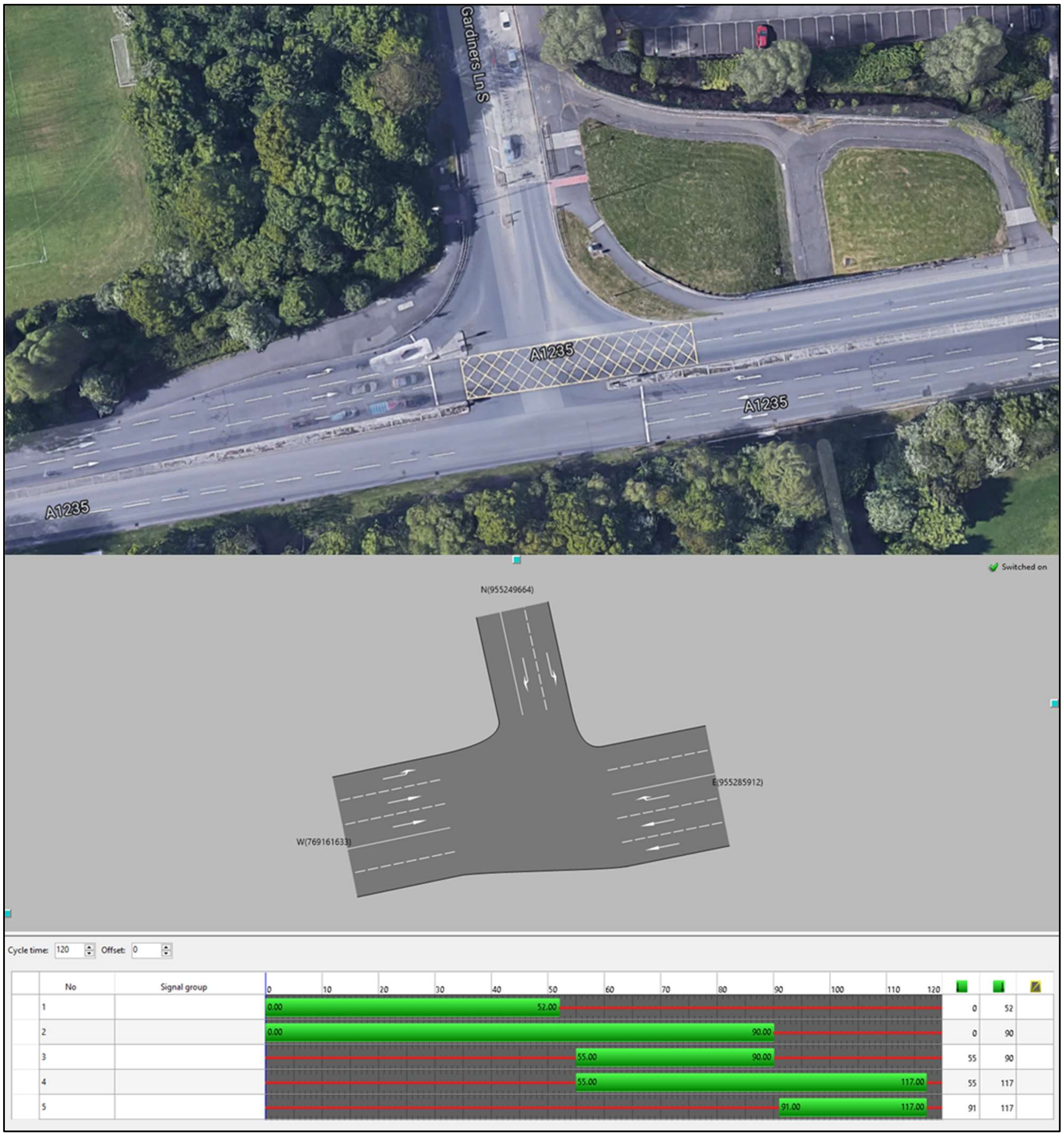

Figure 6.8: Actual Junction and the Equivalent Modelled Signalised Junction

6.3.2 Saturation Flows at Signals and Capacity of Priority Junctions

The saturation flows typically assumed for signalised junctions are 1,900 PCUs per hour per lane.

For priority junctions, the major flows effectively operate without any capacity restriction. Turn capacities on the minor arms are a function of the gap acceptance values and the conflicting traffic volumes; saturation flows are not considered. As an example, using the default gap acceptance values, the following figure illustrates the capacities for a left turn from a minor arm, under differing levels of conflicting flow:

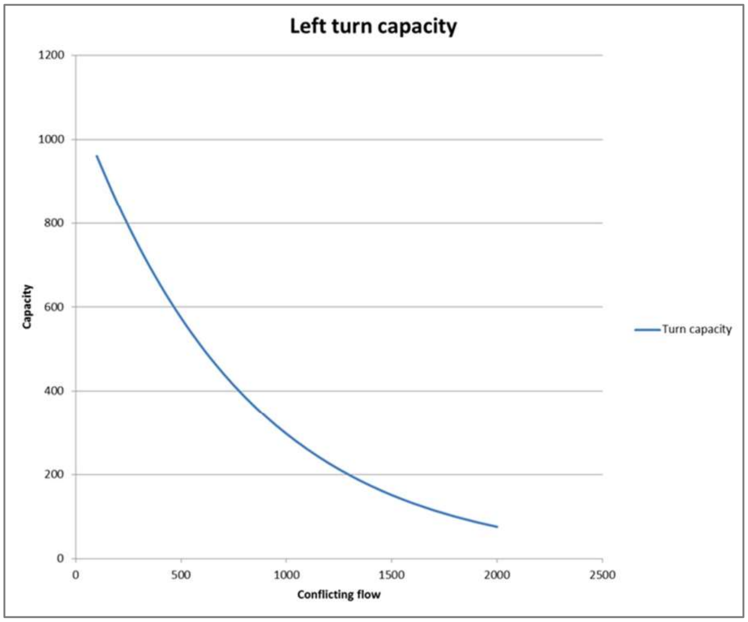

Figure 6.9: Left Turn Capacity at Priority Junctions

6.3.3 Roundabouts

All roundabouts are modelled as a series of expanded nodes with the exception of some very small mini-roundabouts. The Kimber method has been utilised to configure roundabouts and the parameters adopted for different approach geometries are detailed in Table 6-1.

Arm		Approach half width (V) *(m)*	Entry width (E) *(m)*	Flare Length ('l) *(m)*	Entry Radius (R) *(m)*	Inscribed Roundabout Diameter (D) *(m)*	Entry Conflict Angle (PHI) *(Deg)*
Short flare/ No flare length (<3 cars or 10m)	**1 In approach, no flare**	3.65	4	5	15	User Defined	30
	2 In approach, no flare	7.30	8	5	15		30
	3 In approach, no flare	10.95	12	5	15		30
	1 In approach, 2 In entry	3.65	8	10	15		30
	2 In approach, 3 In entry	7.30	12	10	15		30
Long Flare length (<=10 cars or 60m)	**1 In approach, 2 In entry**	3.65	8	30	15		30
	2 In approach, 3 In entry	7.30	12	30	15		30
Multi-Node Roundabout	**Circulatory Arm**	15	20	100	1000	200	0

Table 6-1: Roundabout Parameters to Adopt for TRL/Kimber Method

6.4 EECSM Zone Reconfiguration

The EECSM zoning system closely follows that of the 2017 Essex Countywide model. The 2017 model's zoning system was reviewed, and a total of 32 additional zones were created by re-configuring large existing zones around Basildon, East of Rochford and South of Chelmsford to increase the granularity of the zone system in these areas. The original zone system boundaries are consistent with census area boundaries, therefore any splitting undertaken followed Output Area (OA) outlines. This consistency with OA boundaries ensured the demographic data reported at OA level could be used for an accurate conversion of the demand matrices to the updated EECSM zone system from the Essex Countywide model, as detailed in Section 9.3.

Where the boundaries of the 2017 and 2019 zone systems are consistent, and where splitting has been undertaken can be viewed in Figure 6.10**.**

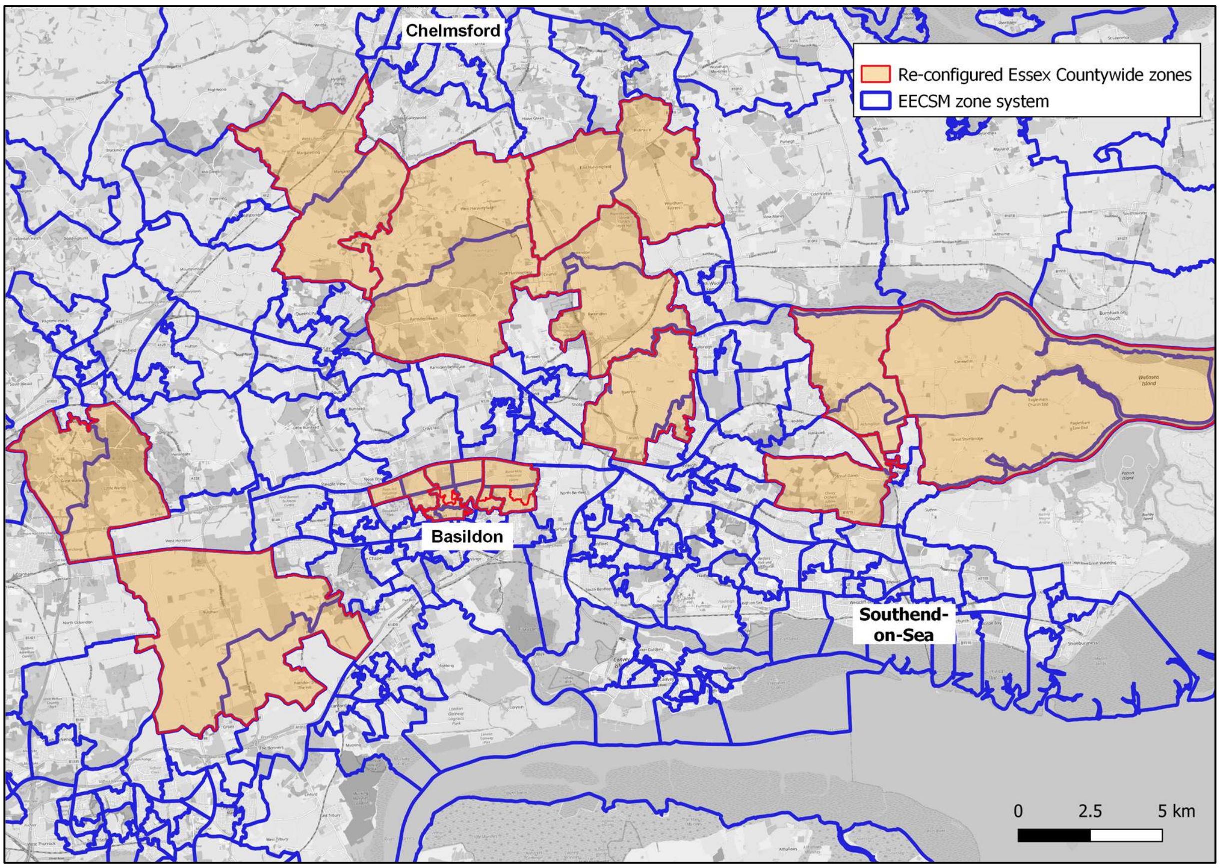

Figure 6.10: EECSM Zone System and Zone Re-Configuration from the Original Essex Countywide Model

Zone splitting was mainly undertaken to improve the suitability of the 2019 model for planned forecast modelling, this included improved capturing of any traffic impacts emanating from the A127 in the forecasts, impacts on the A12 and A130, and any known forecast schemes in these locations.

7 Network Calibration and Validation

7.1 Network Checking and Calibration

Based on the coded characteristics of each link, a number of checks of the network were made. The first of these was the standard network check offered by the VISUM modelling package, which checked aspects of the model such as network connectivity and illogical coding of junctions.

A network check list informed by advice in TAG Unit M3.1 was created, and the model was checked against each aspect of the list. The list is reproduced in Appendix C. Additional checking focused on the coded attributes of the links, including link speeds, number of lanes and capacity, as detailed below.

Free flow link speeds are a function of the link type (as specified in Appendix B). These speeds were checked by plotting them in VISUM and colouring links according to speed in bands. This plot is shown in Figure 7-1 below for the detailed study area.

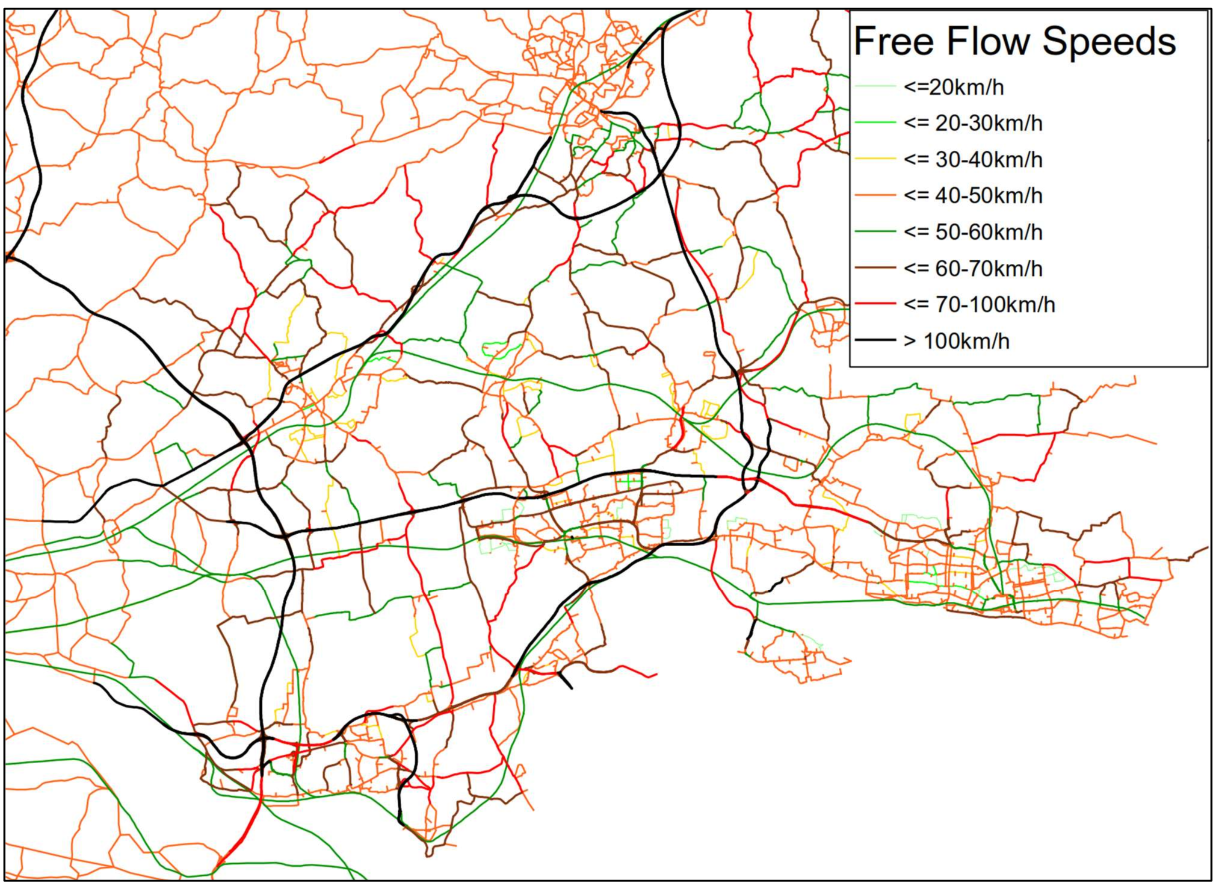

Figure 7-1: Free Flow Speeds in South Essex

The plot shows that urban areas in the study area such as Basildon, Southend on Sea, and Brentwood have coded free flow speeds of around 20-30kph on minor residential streets, 40-50kph on more major residential streets, and 50-70kph on main through roads. For instance, the A127 has a mix of free flow speeds ranging from 60kph to in excess of 100 kph. In rural areas the free flow speed is between 70kph and 100kph; these roads are national speed limit roads. Finally, roads such as the A12, the A13, M25 have free flow speeds in excess of 100kph, as would be expected on a major dual carriageway or motorway. However, it is to be noted that the section on the A13 between the A1089/A128 and the A1014 was coded with a free flow speed of 64kph because this section was undergoing construction as part of road widening, with construction management in place, during the time period represented by the base model.

The coded number of lanes was checked in a similar manner, with this plot shown in Figure 7-2 below.

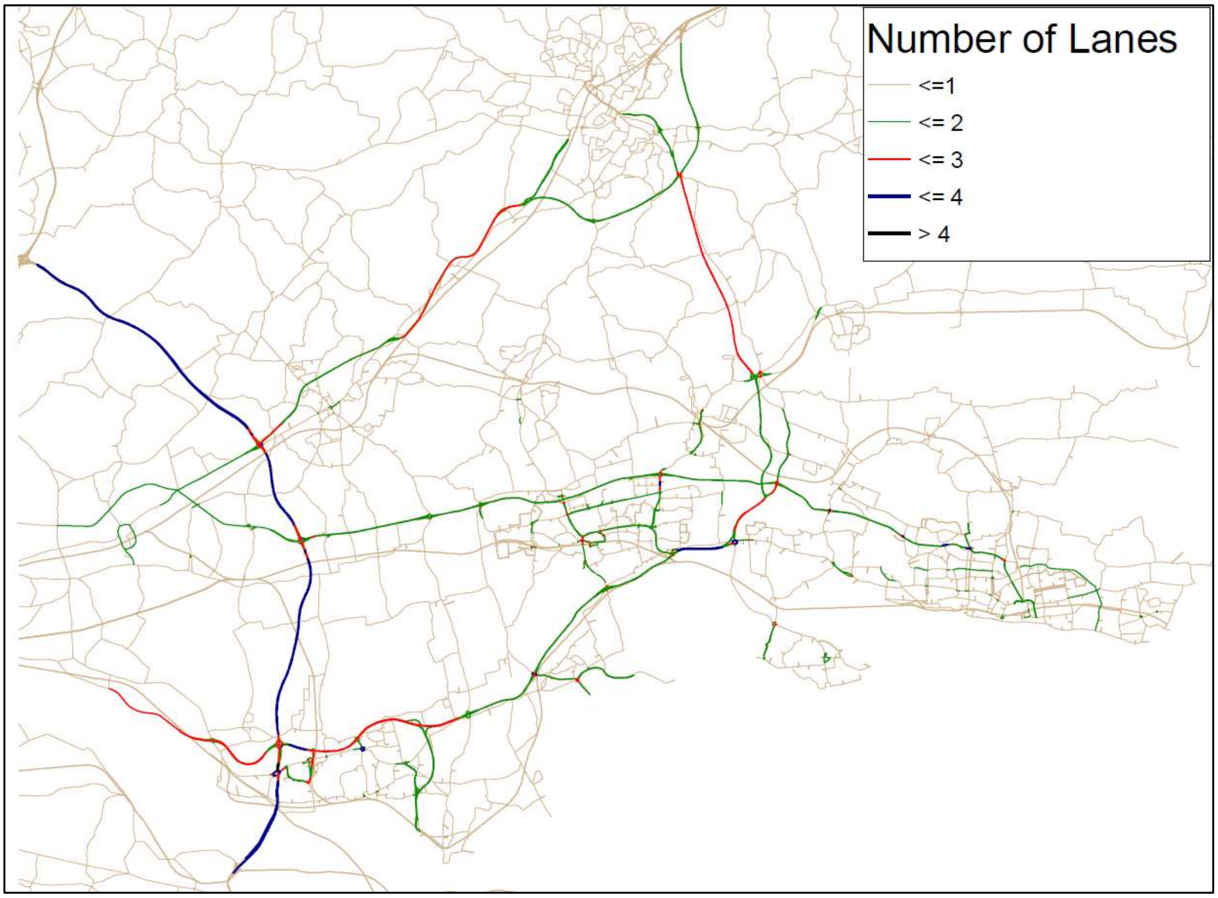

Figure 7-2: Number of Lanes on Each Link in EECSM

The plot shows that the majority of the links are coded as a single lane except for the main through routes and some links, which have been coded with two or three lanes, as expected from network checks and local knowledge. Again, the M25 shows a 4-lane carriageway which is expected and a small section of the A13 south of Basildon is also coded with 4 lanes, which correctly replicates the road characteristics.

Link capacity is again checked in a similar way, as shown below in Figure 7-3.

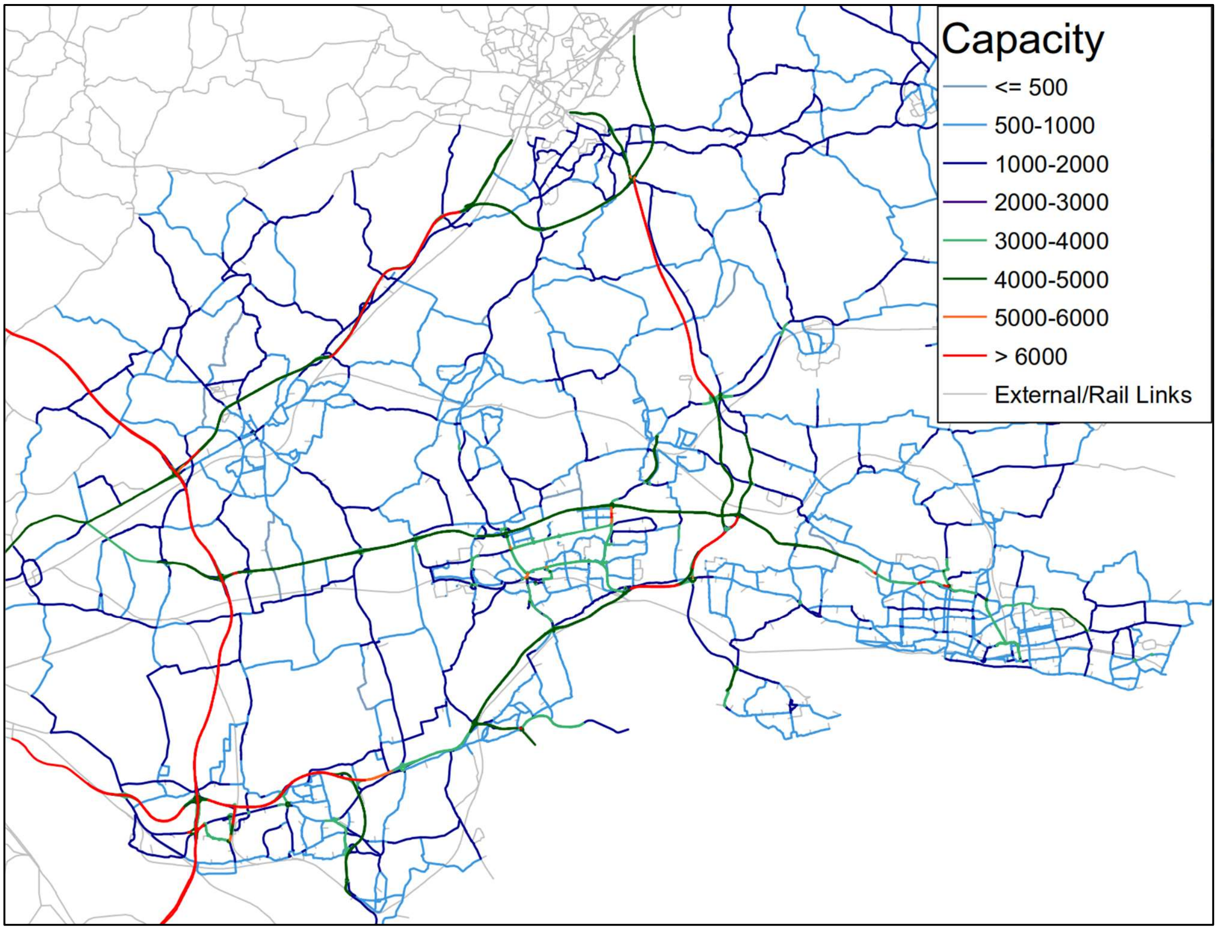

Figure 7-3: Link Capacity in EECSM

Urban residential roads show the lowest capacities of around 500 vehicles per hour or less, whilst the A12, A130, A13, and the M25 have the largest capacities. Main through roads tend to have capacity between 1,000 and 3,000 vehicles per hour. This is all considered to be a correct representation of the real link characteristics and capacities.

Finally, it should be noted that checks were made to ensure that there was a consistency of coding across all time periods, and these confirmed that only signal timings differed between the periods.

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8 Route Choice Calibration

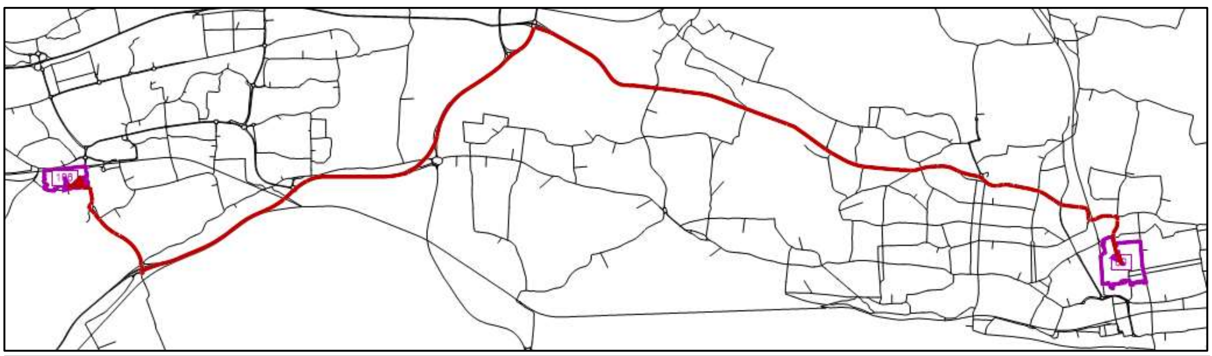
The model was further checked by examining shortest paths and minimum generalised cost routes through the network. These checks were done at an early stage of the model development and again towards the end of the model development process. Major urban areas covered by the network were identified and routes between them checked against Google Maps.

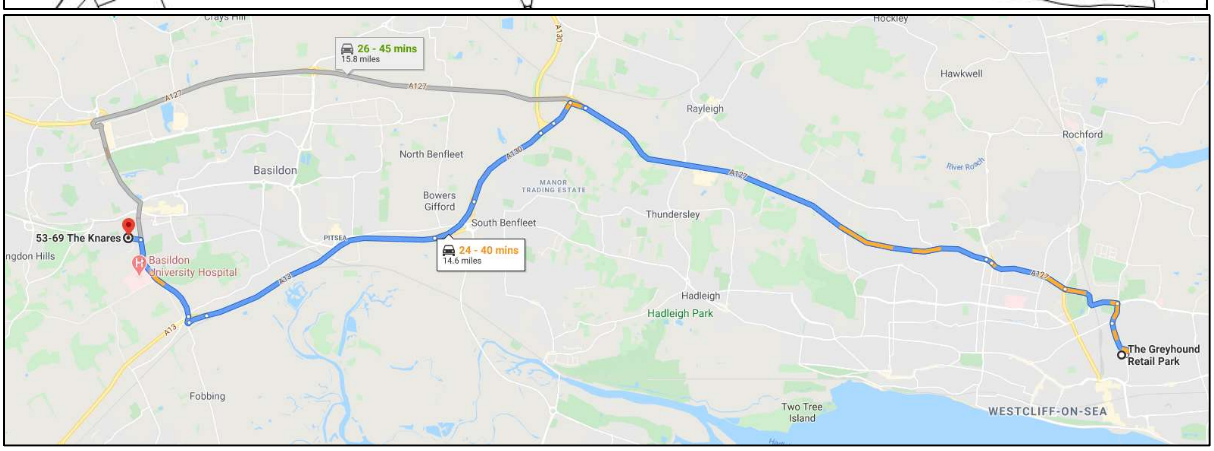
According to TAG unit M3.1, the number of routes that should be checked is defined by:

(number of zones in model)$^{0.25}$ x number of user classes

The EECSM has 332 zones and five user classes, meaning that 21.13 routes should be checked. This has been rounded up to 22 for the purposes of the EECSM.

Where the route choice was contrary to expectations, the modelled network was checked and adjusted to correct the route. Some examples of the routes checked in the model are illustrated below, with the modelled route shown in red and equivalent route from Google Maps shown adjacent. A full set of route checks undertaken is presented in Appendix E.





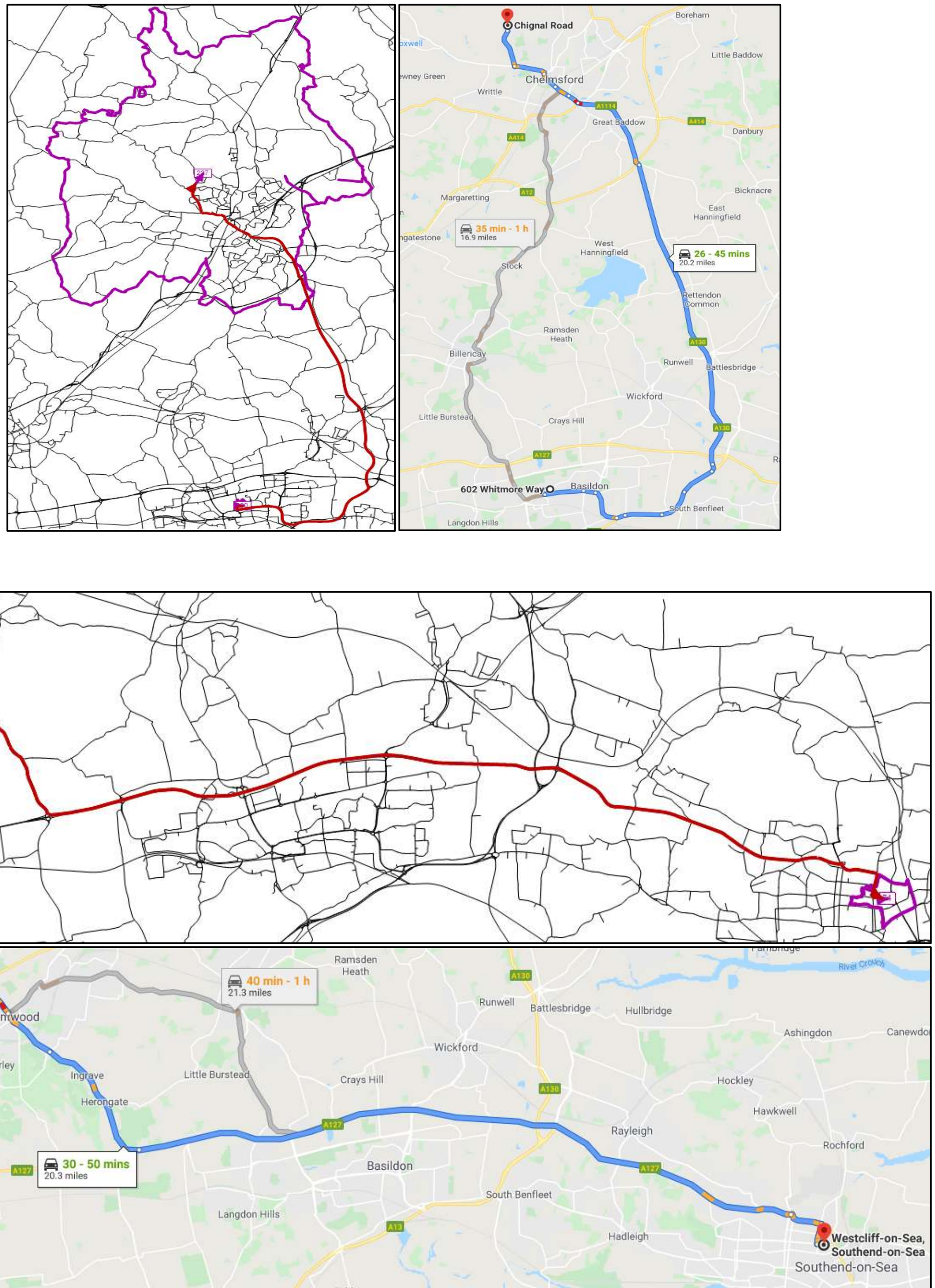


Figure 8-1: Route Choice Checks; Modelled Compared to Observed

9 Trip Matrix Development

9.1 Overview

The demand matrices have been derived using the 2017 Essex Countywide Model as the starting point. As the base year for the EECSM is 2019, the Countywide matrices were uplifted based on background growth rates from the DfT's Trip End Modelling Programme (TEMPro), as well as known planning completions between 2017 and 2019. In addition, the matrices were converted from the Countywide zone system to the EECSM zone system.

9.2 Essex Countywide and Use of Mobile Phone Data

The 2017 Essex Countywide Model, which is used as the basis for the development of demand matrices for this model, made use of aggregated and anonymised mobile network data (MND) provided specifically for that study by Telefonica. This development of Essex Countywide matrices was largely driven by this data, however other data sources such as 2011 Census Journey to Work, National Travel Survey data, National Trip End Model, and bespoke synthetic matrices were used to augment the MND and to check and correct for its known biases. For example, the nature of MND data means that it does not sufficiently represent short distance trips, and therefore these types of trips needed to be infilled by data from the synthetic matrices.

Figure 9.1 summarises the methodology followed for developing the Essex Countywide Matrices.

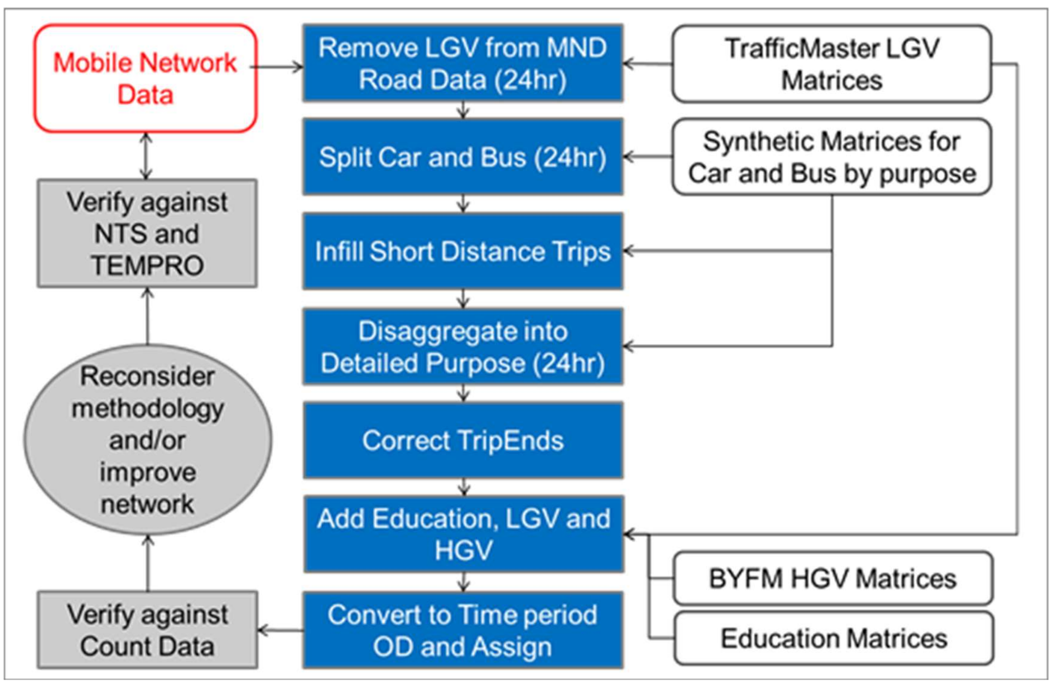


Figure 9.1: Summary of Matrix Building Process for the Essex Countywide Model

The trip matrix development for the Essex Countywide Model, including the processing of raw MND and its verification, is discussed in greater detail in Appendix F. The following summarises the highway matrix development:

- Car matrices were derived from MND as a primary source, with infilling of short distance trips through synthesised data;

- LGV matrices were derived from October - November 2014 and March 2015 Trafficmaster (currently referred as Teletrac) data; and
- HGV matrices were derived from 2006 Base Year Freight Matrices (BYFM).

9.3 Conversion from Essex Countywide zoning system

The conversion of the prior demand matrices from the Essex Countywide Model zone system to the EECSM zone system is undertaken through a review and application of 2011 Census data, against the boundaries of the two model zone systems. It is to be noted that the prior matrices from Essex Countywide Model were used - this was because, in anticipation of having to undertake matrix estimation for the EECSM, it was important not to 'correct' already estimated matrices, which would distort the underlying trip patterns significantly.

The matrices from the Essex Countywide Model zone system were aggregated and disaggregated to match the boundaries of the EECSM zone system. Further away from the study area, where the level of network detail in the EECSM is lower and zones larger, the Essex Countywide demand was taken directly and simply aggregated to fit the EECSM zoning system. However, in South Essex, where the level of network detail is highest in the EECSM, there was a need to disaggregate the Essex Countywide matrices. The permanent residential population and workplace population, at Output Area (OA) level, was used to translate the demand matrices from the Essex Countywide to the EECSM zone system. This was facilitated by both zone systems being derived from OA boundaries, so there was a consistent spatial basis for the conversion.

For origin-destination matrices, the census datasets used to disaggregate Essex Countywide demand were dependent on the user class and peak modelled time period, as shown in the following table:

User Class (UC)	Vehicle Class (VC)	AM Matrices		IP Matrices		PM Matrices	
		Origin	Destination	Origin	Destination	Origin	Destination
UC1 (Car Commute)	VC1	Residential Population	Workplace Population	Workplace Population	Residential Population	Workplace Population	Residential Population
UC2 (Car Employer Business)		Residential Population	Workplace Population	Workplace Population	Residential Population	Workplace Population	Residential Population
UC3 (Car Other)		Residential Population	Workplace Population	Workplace Population	Residential Population	Workplace Population	Residential Population
UC4 (LGV)	VC2	Workplace Population	Workplace Population	Workplace Population	Workplace Population	Workplace Population	Workplace Population
UC5 (HGV)	VC3	Workplace Population	Workplace Population	Workplace Population	Workplace Population	Workplace Population	Workplace Population

Table 9-1: Conversion of Origin-Destination Matrices

Across the car user classes, the disaggregation of matrices at trip end level was undertaken using different census datasets depending on the peak period modelled. The origin trip end in the AM peak is disaggregated using the residential population dataset, while in the interpeak and PM peak models the workplace population is used. The reverse is true for the destination trip end.

For LGV and HGV matrices, the disaggregation was controlled by the workplace population dataset. For goods vehicles, both the origin and destination of a trip are more likely to be linked to an employment than a residential site.

9.4 Developments

Land use is key to establishing travel demand for the area. As discussed in the previous section, land use data has been derived from the previous Countywide Model, which detailed the land uses up to 2017. The land uses for the EECSM were then updated to a 2019 base year by using planning completions data between 2017 and 2019 from Rochford, Basildon, Castle Point and Southend-on-Sea District Councils and adjusted growth factors derived from the National Trip End Model (NTEM) v7.2 dataset; these are detailed in the following section.

Developments with a quantum sufficiently large to generate an additional 1,000 weekday trips were modelled explicitly. Trip Rate Information Computer System (TRICS) trip rates were applied to the development quanta and then added to the base zone the development is situated in. The remainder of traffic growth in the model between 2017 and 2019 is covered by growth factors derived from the NTEM dataset. The completions data for developments modelled explicitly between 2017 to 2019 and their locations within the EECSM zoning system can be viewed below.

Development Name	Development Completions 2017-2019	
	Dwellings	Employment Area (Sqm)
Oak Rd/ Hall Rd, Rochford	240	0
Heath House & Carby House, Southend-on-Sea	280	0
Roscommon Way Canvey Island, Castle Point	0	4255

Table 9-2: Major Developments in EECSM

Figure 9.2: Map of Major Developments, Against the Model Zoning System

9.5 TEMPro Uplift

TEMPro version 7.2 provided the NTEM growth factors to be applied to uplift car matrices from 2017 to the required 2019 base year. These factors were calculated after discounting the development sites modelled explicitly, using the TEMPro alternative assumptions functionality. Regional Road Traffic Forecast 2018 (RTF18, Scenario 1) growth factors were used to uplift the goods vehicle matrices. Factors for each region and user class are detailed in the table below. The zones within Basildon were uplifted at Middle Super Output Area (MSOA), Castle Point, Rochford, Southend-on-Sea and Brentwood were uplifted at District level. Other zones in the model were uplifted based on their region.

Region	AM										IP										PM									
	UC1		UC2		UC3		LGV		HGV		UC1		UC2		UC3		LGV		HGV		UC1		UC2		UC3		LGV		HGV	
	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D
Basildon 015	1.02	1.02	1.02	1.03	1.04	1.04	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.04	1.04	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
Basildon 012	1.02	1.02	1.02	1.02	1.03	1.04	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
Basildon 011	1.01	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.03	1.02	1.04	1.04	1.01	1.01
Basildon 013	1.03	1.02	1.03	1.02	1.04	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.04	1.04	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.03	1.03	1.03	1.04	1.04	1.01	1.01
Basildon 009	1.00	1.02	1.01	1.02	1.02	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.02	1.02	1.02	1.04	1.04	1.01	1.01	1.02	1.00	1.02	1.01	1.02	1.02	1.04	1.04	1.01	1.01
Basildon 006	1.01	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.01	1.02	1.02	1.04	1.04	1.01	1.01
Basildon 008	1.01	1.02	1.01	1.02	1.02	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.01	1.02	1.02	1.04	1.04	1.01	1.01
Basildon 005	1.02	1.02	1.02	1.03	1.03	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
Basildon 007	1.01	1.02	1.01	1.02	1.02	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.02	1.02	1.02	1.04	1.04	1.01	1.01	1.02	1.00	1.02	1.01	1.02	1.02	1.04	1.04	1.01	1.01
Basildon 020	1.02	1.03	1.02	1.03	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.03	1.03	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.03	1.02	1.03	1.03	1.04	1.04	1.01	1.01
Basildon 010	1.01	1.02	1.01	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.01	1.02	1.02	1.04	1.04	1.01	1.01
Basildon 004	1.01	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
Basildon 002	1.01	1.02	1.01	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.01	1.02	1.02	1.04	1.04	1.01	1.01
Basildon 001	1.01	1.02	1.01	1.02	1.02	1.03	1.04	1.04	1.01	1.01	1.01	1.00	1.01	1.01	1.02	1.02	1.04	1.04	1.01	1.01	1.01	1.00	1.01	1.01	1.02	1.02	1.04	1.04	1.01	1.01
Basildon 003	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
Basildon 021	1.01	1.02	1.01	1.02	1.02	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.01	1.02	1.02	1.04	1.04	1.01	1.01
Basildon 014	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.02	1.03	1.04	1.04	1.01	1.01
Basildon 016	1.03	1.02	1.03	1.02	1.04	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.04	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
Basildon 017	1.02	1.02	1.02	1.02	1.03	1.04	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
Basildon 019	1.03	1.02	1.03	1.02	1.04	1.04	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.04	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.03	1.03	1.03	1.04	1.04	1.01	1.01
Basildon 022	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
Basildon 018	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.03	1.02	1.03	1.03	1.04	1.04	1.01	1.01
Southend-on-Sea	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
Castle Point	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.01	1.03	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.01	1.01	1.02	1.03	1.04	1.04	1.01	1.01
Brentwood	1.01	1.02	1.01	1.02	1.02	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.01	1.02	1.02	1.04	1.04	1.01	1.01
Rochford	1.01	1.02	1.01	1.02	1.02	1.03	1.04	1.04	1.01	1.01	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.00	1.02	1.01	1.02	1.02	1.04	1.04	1.01	1.01
LON	1.03	1.03	1.03	1.03	1.04	1.04	1.04	1.04	1.01	1.01	1.03	1.03	1.03	1.03	1.04	1.04	1.04	1.04	1.01	1.01	1.02	1.03	1.03	1.03	1.03	1.03	1.04	1.04	1.01	1.01
Essex	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
East	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
SE	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01
GB	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.01	1.01

Table 9-3: TEMPro Growth Factors

9.6 Adjusted AM Peak Hour

As noted in section 4.6, ATC counts from the detailed area of modelling were used to identify the peak (busiest) hours within the peak periods. These are:

- AM peak hour (07:30-08:30)
- PM peak hour (17:00-18:00)
- Average hour in the interpeak (10:00-16:00)

The above peak hours represent the times at which observed traffic volumes were the highest for the AM (7:00-10:00) and PM (16:00-19:00) time periods, and an average modelled hour for interpeak.

As detailed in the sub-sections above, the demand matrices for the EECSM are derived from the Essex Countywide Model. These modelled hours are consistent with the EECSM for the interpeak and PM peak, however the AM peak hour in the Countywide Model is 08:00-09:00. Therefore, an uplift factor based on ATC count data within the area of detailed modelling, was applied to the AM matrices to ensure they accurately reflect the demand for the 07:30-08:30 peak hour for the EECSM. The factors used are shown in the table below.

User Class	Uplift Factor
Car	1.027302
LGV	1.142111
HGV	1.003502

Table 9-4: Uplift Factors for AM Peak (07:30-08:30)

10 Trip Matrix Calibration and Validation

The following section outlines the adjustment process to improve the prior demand matrices and describes the resulting calibration of trip matrices through matrix estimation.

10.1 Prior Matrices Adjustments

The prior matrices, derived following the steps described above, were assigned to the EECSM network and the assigned flows were compared against observed flows across screenlines. This comparison identified a need for further refinement of the trip matrices, especially to account for a shortfall in shorter distance trips due to the lack of urban detail in the Essex Countywide Model. The matrix development steps were reviewed, however since the required refinement was relatively small, it was decided not to revise the matrix development processes. Rather, small-scale adjustments were made to the trip matrices by aggregating into sectors and applying factors to the sector-to-sector movements to make adjustments to better reflect the identified observed movements across screenlines. Checks were carried out to confirm that the adjustments did not significantly change patterns. Table 10-1 below shows the scale of change brought about by the adjustments to the matrix totals.

User Class	AM			IP			PM		
	Initial Prior Matrix	Final Prior Matrix	%Change	Initial Prior Matrix	Final Prior Matrix	%Change	Initial Prior Matrix	Final Prior Matrix	%Change
UC1	153417	157206	2.41%	35784	36832	2.85%	132643	135615	2.19%
UC2	58048	59327	2.16%	38659	39461	2.03%	54405	55046	1.16%
UC3	120973	123848	2.32%	155356	159812	2.79%	177378	181697	2.38%
LGV	135288	135288	0.00%	116963	116963	0.00%	101098	101580	0.47%
HGV	77331	77331	0.00%	79883	79883	0.00%	39375	39435	0.15%
Total	545057	553000	1.44%	426644	432952	1.46%	504900	513373	1.65%

Table 10-1: Prior Matrix Adjustments

As a further test of the effect of matrix adjustments on trip length distribution, a series of plots have been produced comparing trip length distribution for the initial and final prior matrices, for all car user classes, which are shown in Appendix J. These plots illustrate that there is relatively little change in the trip length distribution and therefore that the effects of adjustments on trip patterns are minimal for cars. As an example, plots showing trip length distribution change for UC1 AM and UC3 PM are shown below:

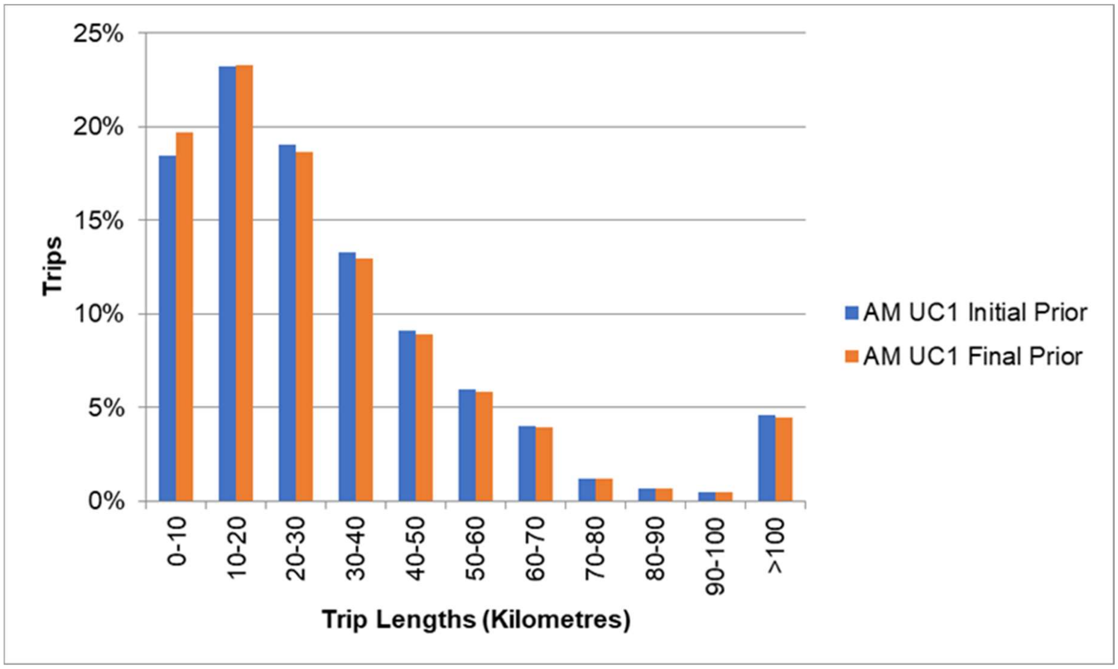


Figure 10.1: Matrix Trip Length Changes, UC1 AM

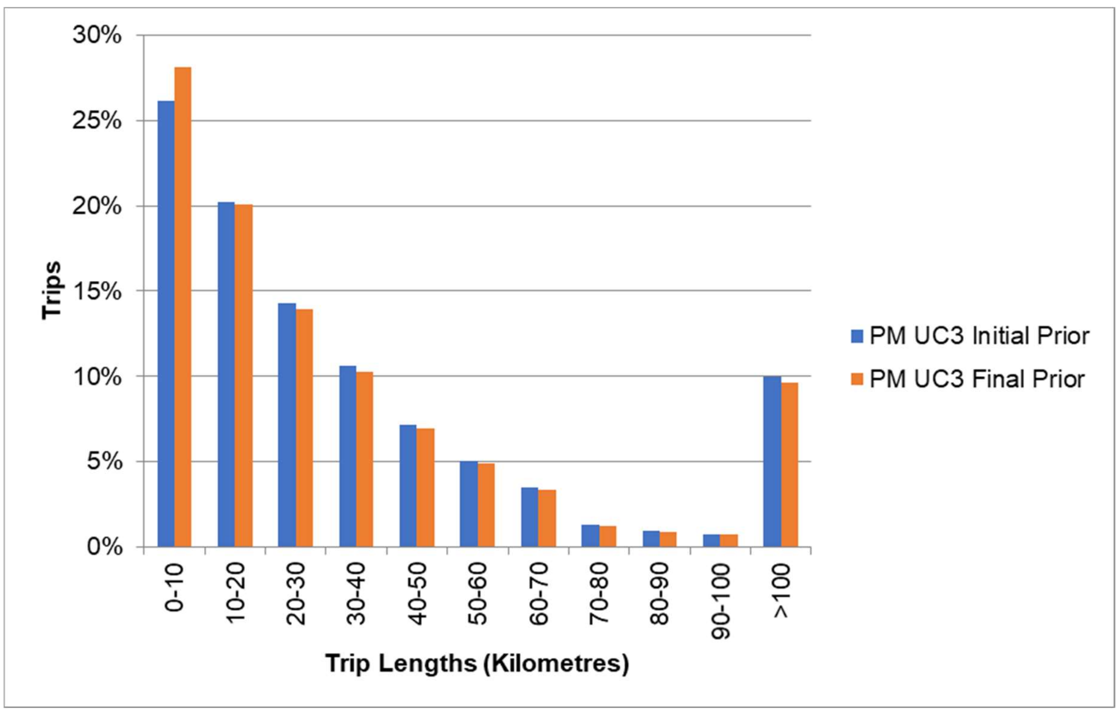


Figure 10.2: Matrix Trip Length Changes, UC3 PM

Adjustments were made mainly for cars, with an exception of a small adjustment to LGV and HGV matrices in the PM peak. These adjusted matrices were taken as “final prior matrices” for matrix estimation. The matrix estimation process is described in the following section.

10.2 Matrix Estimation

After an initial assignment and refining of the modelled network, the trip matrices underwent a process of 'matrix estimation' whereby trip matrices were adjusted such that the resulting assigned flows better represented observed counts. The "TFlowFuzzy" module within VISUM was used for this process. The process of matrix estimation in general is well understood within the modelling community and will not be expanded upon here. The VISUM manual contains details of the specifics of the TFlowFuzzy process, but in principal it is much the same as any other matrix estimation process in any other transport modelling package.

The available count data is given for cars, LGVs, and HGVs and matrix estimation undertaken for those vehicle classes separately. With specific reference to car trips, matrix estimation was run on the three user class matrices (commute, business, and other) jointly in a single process. This was done using the modelling procedure for matrix estimation which has the capability to split the car counts into three user class proportions based on the assigned user class volumes on links. It is important when running matrix estimation processes that the 'prior' (to estimation) trip matrices are not distorted such that the underlying trip patterns in the 'post' matrices are altered. To test whether this altering process has occurred, the guidelines set out within Table 5 of TAG unit M3-1 have been applied to the prior- and post-ME matrices, as detailed below in Table 10-2 below.

Measure	Acceptability Guidelines
Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95
Matrix zone trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98
Trip length distributions	Means within 5% Standard deviation within 5%
Sector to sector level matrices	Differences within 5%

Table 10-2: Significance of Matrix Estimation Changes

The significance of matrix estimation for each measure detailed in the above table is described in section 10.2.2 to 10.2.5.

10.2.1 Matrix Totals

There is no current guidance set out in TAG unit M 3.1 on the acceptability of the amount of change brought about by matrix estimation to the matrix totals. However, a comparison of the matrix totals before and after the application of matrix estimation to show the impact of matrix estimation is shown in Table 10-3.

Vehicle Class	AM			IP			PM		
	Prior	Post ME	% Diff	Prior	Post ME	% Diff	Prior	Post ME	% Diff
UC1	157206	154991	-1.43%	36832	36625	-0.57%	135615	133240	-1.78%
UC2	59327	58374	-1.63%	39461	39083	-0.97%	55046	54135	-1.68%
UC3	123848	122542	-1.07%	159812	158910	-0.57%	181697	178804	-1.62%
LGV	135288	134946	-0.25%	116963	116291	-0.58%	101580	101308	-0.27%
HGV	77331	77185	-0.19%	79883	79680	-0.25%	39435	39233	-0.51%
Total	553000	548038	-0.91%	432952	430589	-0.55%	513373	506721	-1.31%

Table 10-3: Comparison of Matrix Totals - Prior vs Post ME

The table above shows that at a matrix total level across all vehicle classes, changes in the number of trips in the matrix are within 2% for all vehicle types, which demonstrates that matrices post estimation are not significantly altered in terms of total number of trips.

10.2.2 Matrix Zonal Cell Value Changes

The graphs in Figure 10.3 to Figure 10.8 show for each time period and vehicle type and for cars and all vehicles, the cell values of the prior matrix plotted (on the horizontal axis) against the values in the same cell of the post matrix (on the vertical axis). All trip movements except intrazonals are included in the analysis. A trend line, with equation and R^2 value has also been plotted. Graphs for each separate highway user class are presented in Appendix H.

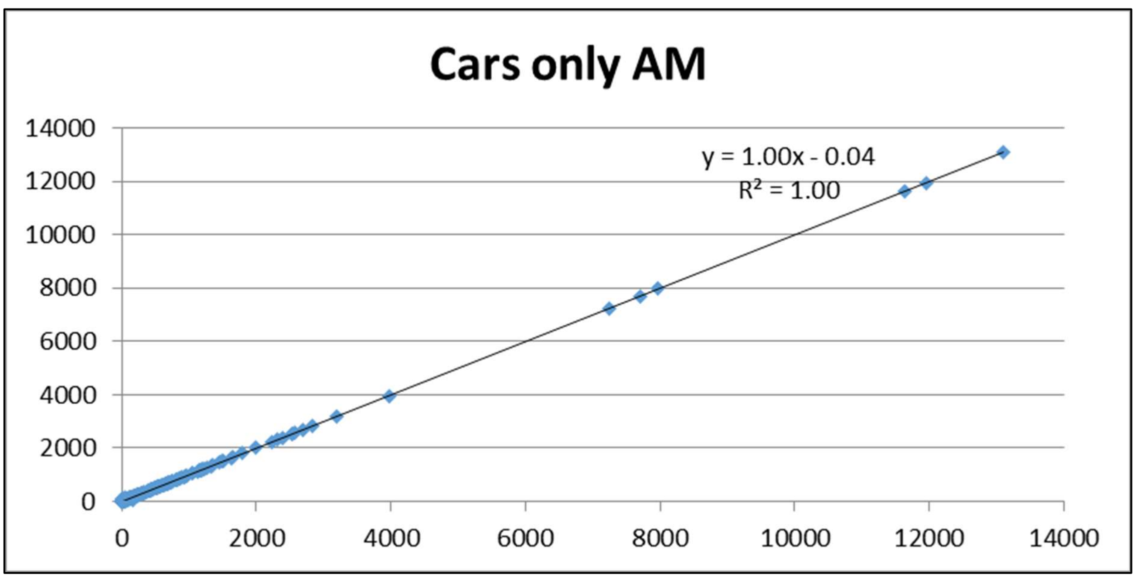


Figure 10.3: Cell Value of Prior Matrix Against Post ME Matrix, Cars AM

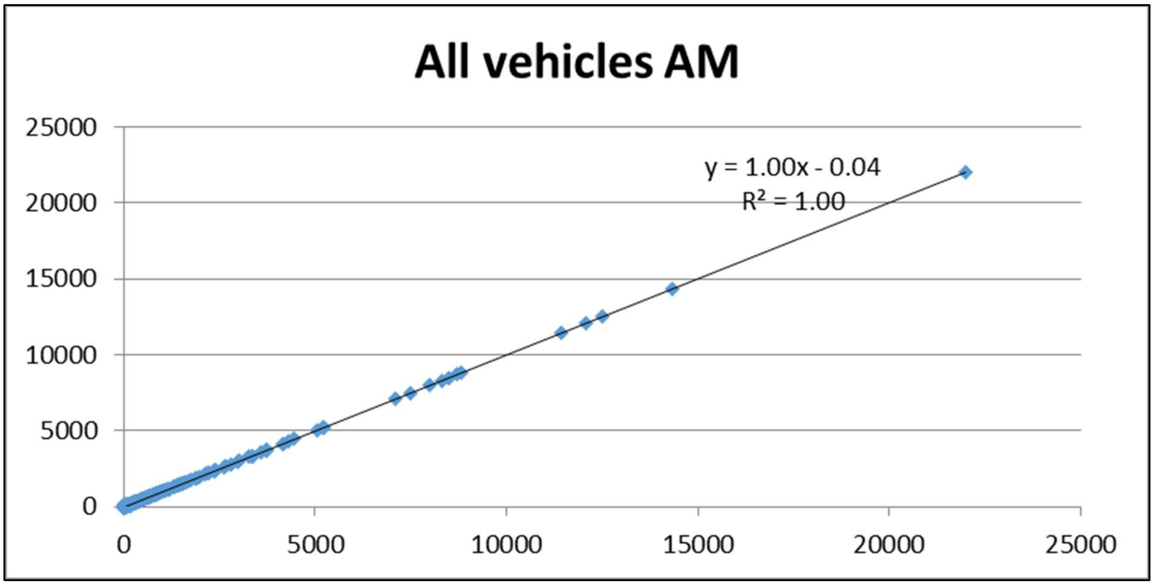


Figure 10.4: Cell Value of Prior Matrix Against Post ME Matrix, All Vehicles AM

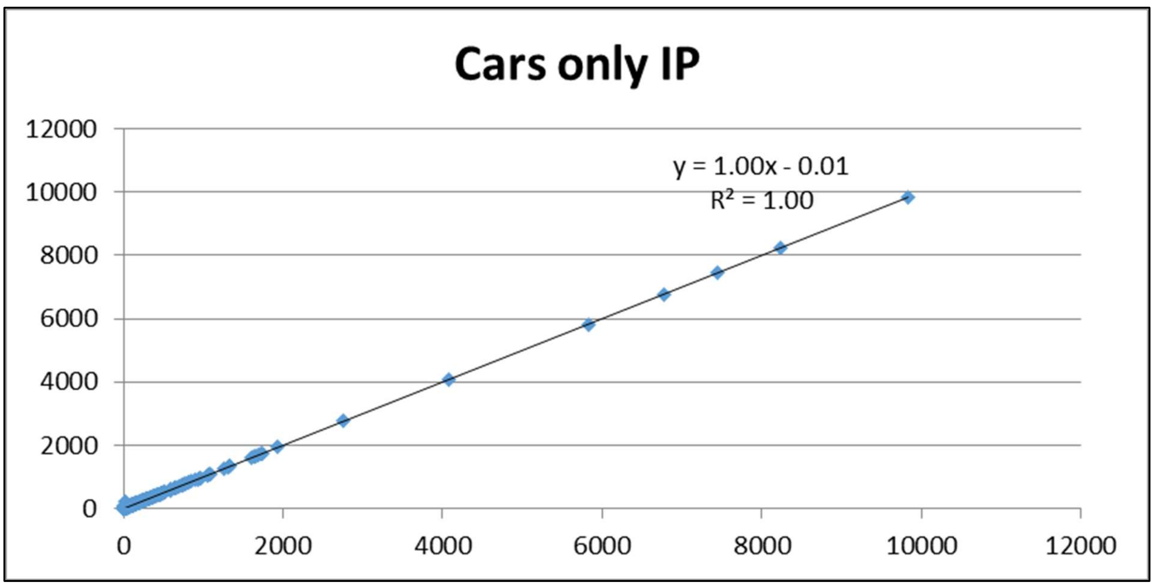


Figure 10.5: Cell Value of Prior Matrix Against Post ME Matrix, Car IP

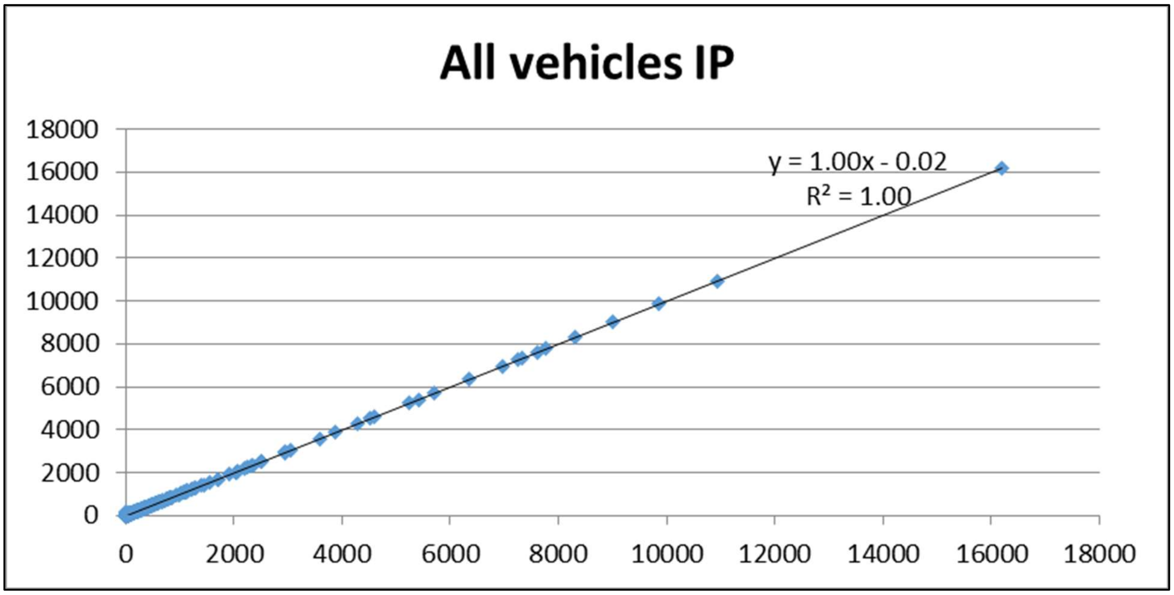


Figure 10.6: Cell Value of Prior Matrix Against Post ME Matrix, All Vehicles IP

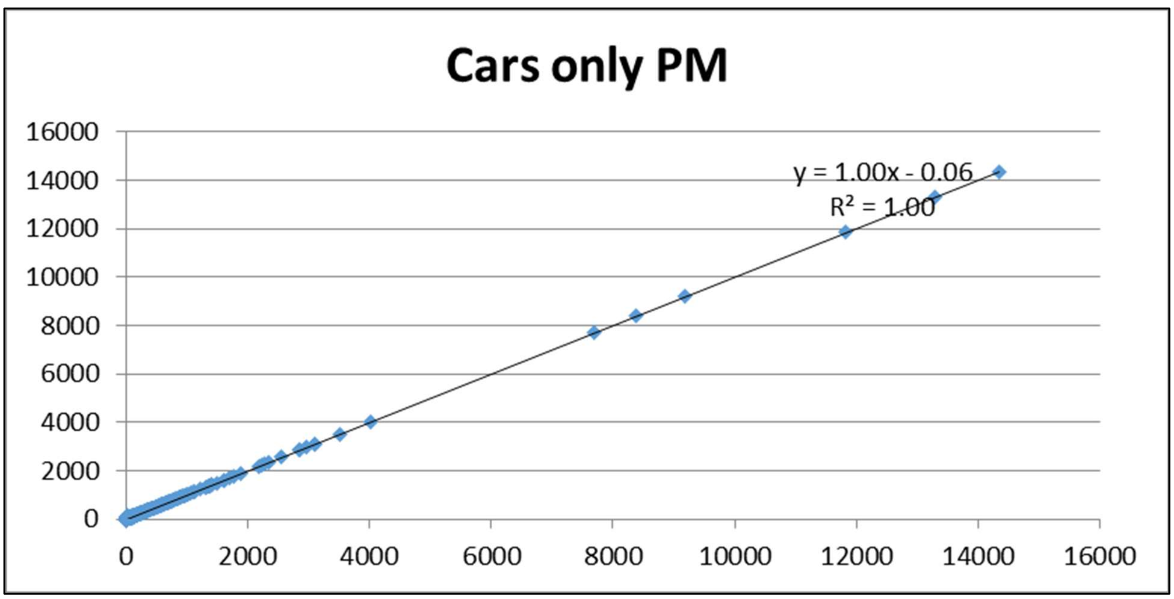


Figure 10.7: Cell Value of Prior Matrix Against Post ME Matrix, Car PM

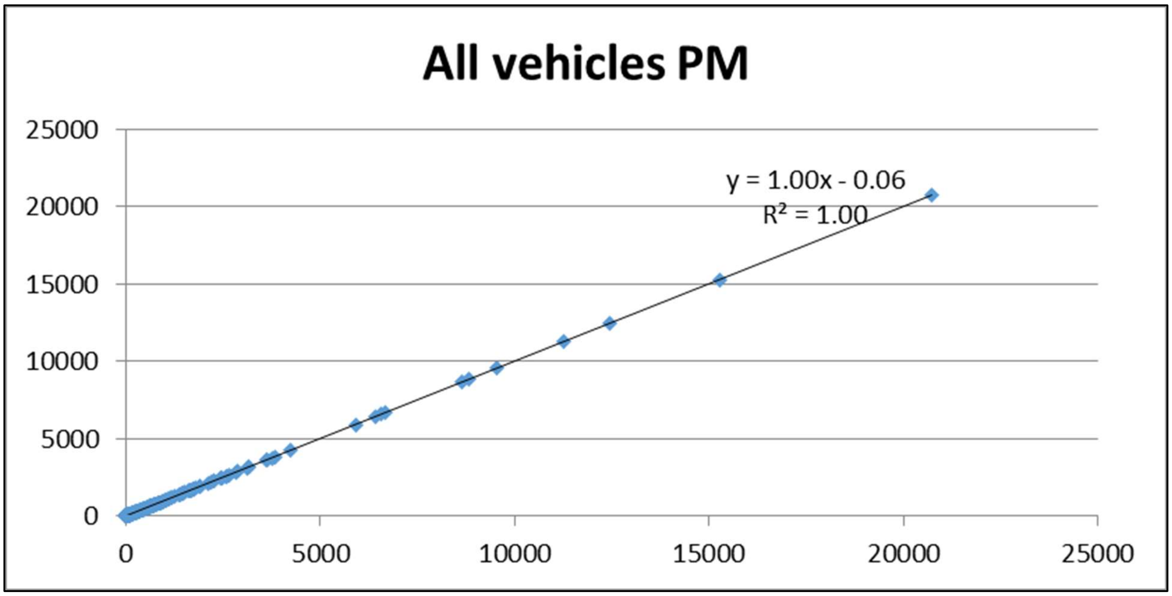


Figure 10.8: Cell Value of Prior Matrix Against Post ME Matrix, All Vehicles PM

The guidance states that the trend line must have a gradient between 0.98 and 1.02, an intercept close to zero, and an R^2 value exceeding 0.95. Table 10-4 below summarises the data in the graphs and demonstrates that these conditions are met for cars and all vehicles in the AM and PM peak models. The table also includes data on LGV and HGVs, and again, they meet the conditions.

Zonal cell value summary	AM			IP			PM		
	R^2	Slope	Intercept	R^2	Slope	Intercept	R^2	Slope	Intercept
All vehicles	1.00	1.00	-0.04	1.00	1.00	-0.02	1.00	1.00	-0.06
Car	1.00	1.00	-0.04	1.00	1.00	-0.01	1.00	1.00	-0.06
Car C	1.00	1.00	-0.02	1.00	1.00	-0.00	1.00	1.00	-0.02
Car EB	1.00	1.00	-0.01	1.00	1.00	-0.00	1.00	1.00	-0.01
Car O	1.00	1.00	-0.01	1.00	1.00	-0.01	1.00	1.00	-0.03
LGV	1.00	1.00	-0.00	1.00	1.00	-0.01	1.00	1.00	-0.00
HGV	1.00	1.00	-0.00	1.00	1.00	-0.00	1.00	1.00	-0.00

Table 10-4: Zonal Cell Value Summary

10.2.3 Matrix Trip End Changes

The check on how much matrix trip ends have been affected by matrix estimation is similar to the check on individual cell values in that the prior and post trip ends must be plotted on a graph and a trend line added. The graphs showing these for cars and all vehicles are below in Figure 10.9 to Figure 10.14. A full set of graphs by individual user class can be found under Appendix I. All trip movements except intrazonals have been included in the trip end totals.

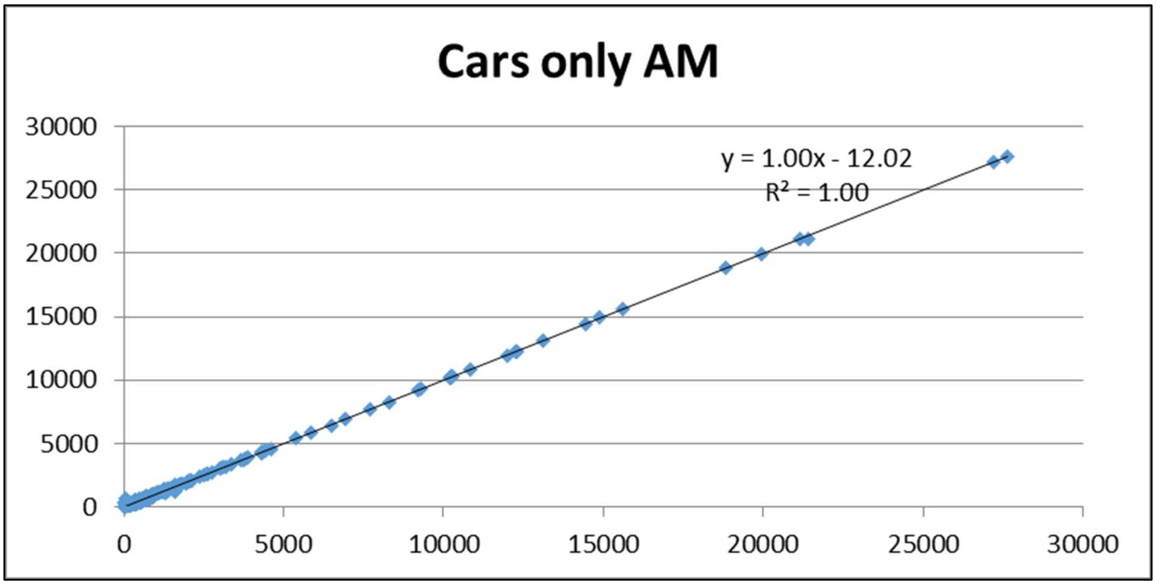


Figure 10.9: Matrix Trip End Changes, Car AM

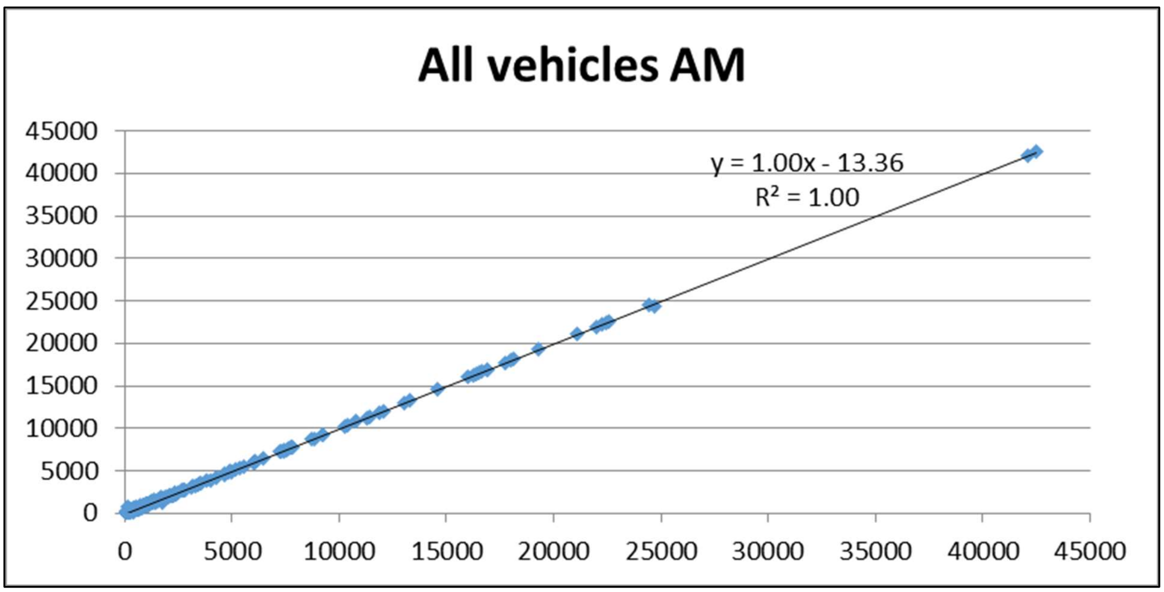


Figure 10.10: Matrix Trip End Changes, All Vehicles AM

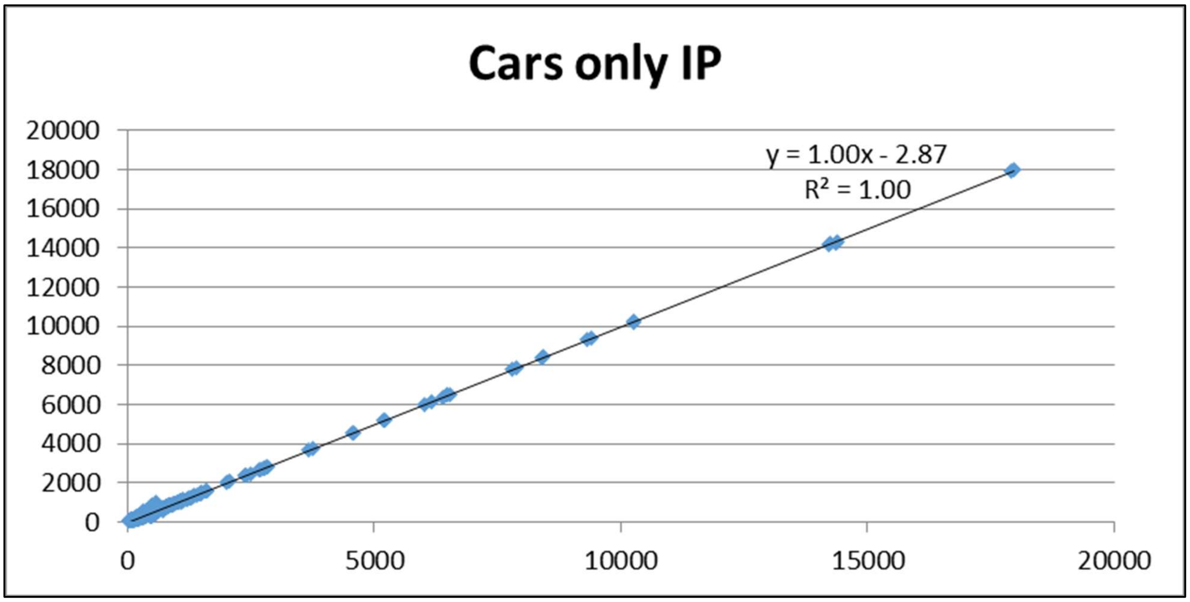


Figure 10.11: Matrix Trip End Changes, Car IP

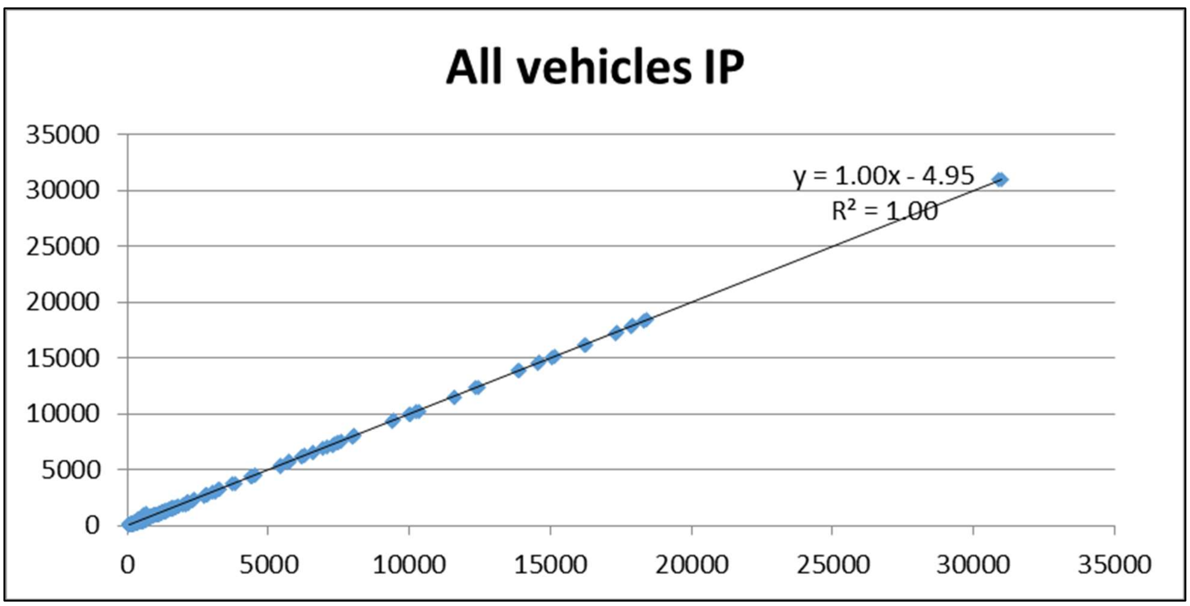


Figure 10.12: Matrix Trip End Changes, All Vehicles IP

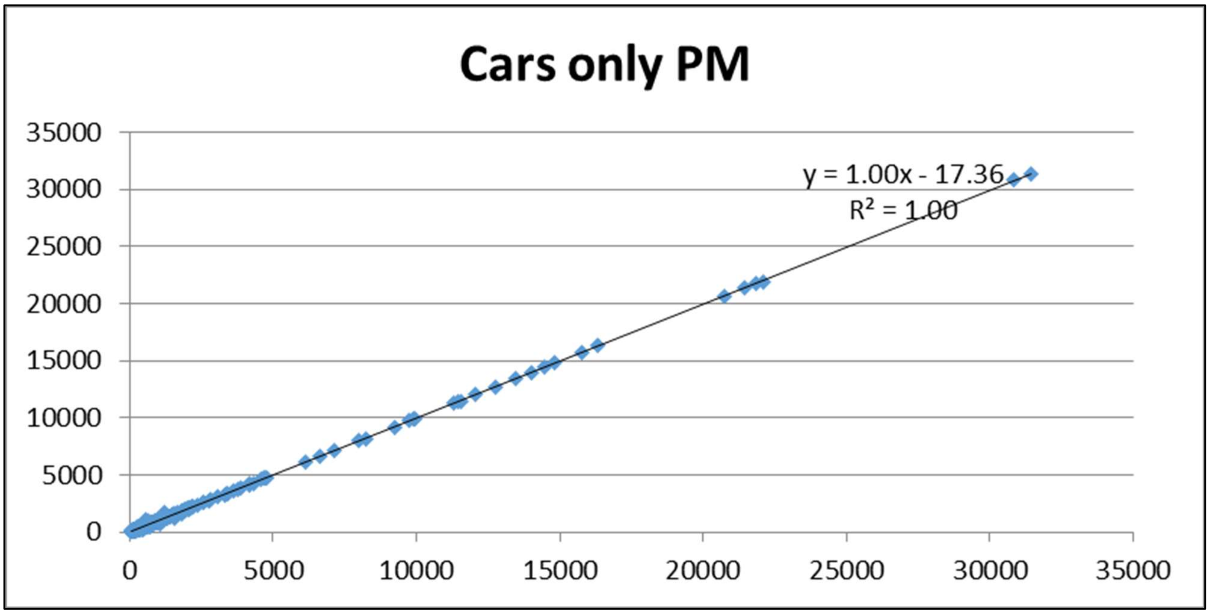


Figure 10.13: Matrix Trip End Changes, Car PM

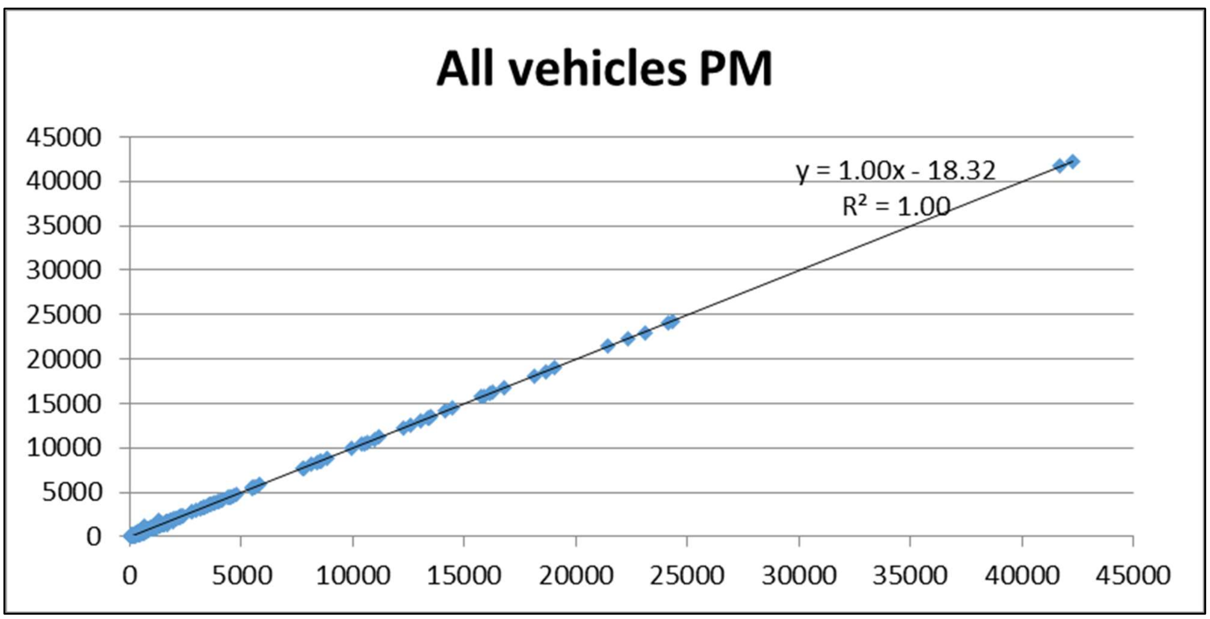


Figure 10.14: Matrix Trip End Changes, All Vehicles PM

The guidance on these trend lines is the following:

- Slope to be within 0.99 and 1.01;
- Intercept near zero; and
- R^2 in excess of 0.98.

As with the test on cell values, the R^2 and slope values for all highway user classes meet the TAG criteria stated above, which can be seen in Table 10-5 below. Although the intercept is further from the criteria than for matrix cell values, given the relative size of the trip end values in the regression graph, these intercepts are still relatively close to zero.

Trip end summary	AM			IP			PM		
	R^2	Slope	Intercept	R^2	Slope	Intercept	R^2	Slope	Intercept
All vehicles	1.00	1.00	-13.36	1.00	1.00	-4.95	1.00	1.00	-18.32
Car	1.00	1.00	-12.02	1.00	1.00	-2.87	1.00	1.00	-17.36
Car C	1.00	1.00	-6.06	1.00	1.00	-0.34	1.00	1.00	-6.60
Car EB	1.00	1.00	-2.49	1.00	1.00	-0.82	1.00	1.00	-2.42
Car O	1.00	1.00	-3.48	1.00	1.00	-1.77	1.00	1.00	-8.40
LGV	1.00	1.00	-0.73	1.00	1.00	-1.76	1.00	1.00	-0.51
HGV	1.00	1.00	-0.42	1.00	1.00	-0.58	1.00	1.00	-0.56

Table 10-5: Trip End Summary

10.2.4 Trip Length Distributions

For trip length distributions, it is recommended in TAG that both the mean and standard deviation of the post matrix trip lengths must not differ by more than 5% from those of the prior matrices. The mean and standard deviations for all the matrices (not including intrazonal trips) are summarised in Table 10-6 and Table 10-7 below.

Time and Trip Type	All Vehicles - Prior	All Vehicles - Post	% Change
AM Average Trip length	38.95	38.80	-0.39%
AM Standard Deviation	73.84	73.92	0.10%
IP Average Trip length	43.49	43.10	-0.89%
IP Standard Deviation	83.38	83.24	-0.16%
PM Average Trip length	35.82	35.74	-0.22%
PM Standard Deviation	66.80	66.87	0.10%

Table 10-6: Table of Trip Lengths and Standard Deviation, All vehicles

Time and Trip Type	Car - Prior	Car- Post	% Change
AM Average Trip length	29.39	29.31	-0.26%
AM Standard Deviation	50.01	50.06	0.11%
IP Average Trip length	32.51	32.12	-1.20%
IP Standard Deviation	60.84	60.54	-0.50%
PM Average Trip length	30.61	30.68	0.23%
PM Standard Deviation	53.94	54.08	0.26%

Table 10-7: Table of Trip Lengths and Standard Deviation, Car

The tables above show that the change in average and standard deviation trip lengths is minimal and well within guidelines for cars and all vehicles across all time periods.

As a further test of the effect of matrix estimation on trip length distribution, a series of plots have been produced comparing trip length distribution for the pre and post estimated matrices, for all car user classes, HGVs and LGVs which are shown in Appendix K. These plots illustrate that there is relatively little change in the trip length distribution and therefore that the effects of matrix estimation on trip patterns are minimal for cars, LGVs and HGVs. As an example, plots showing trip length distribution change for UC1 AM and UC3 PM are shown below:

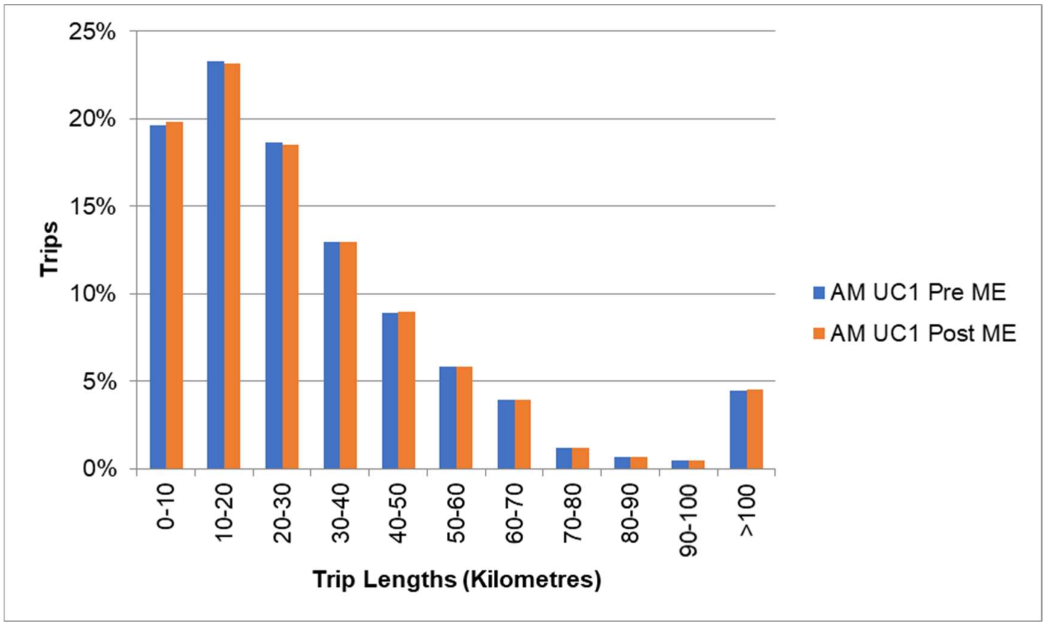


Figure 10.15: Matrix Trip Length Changes, UC1 AM

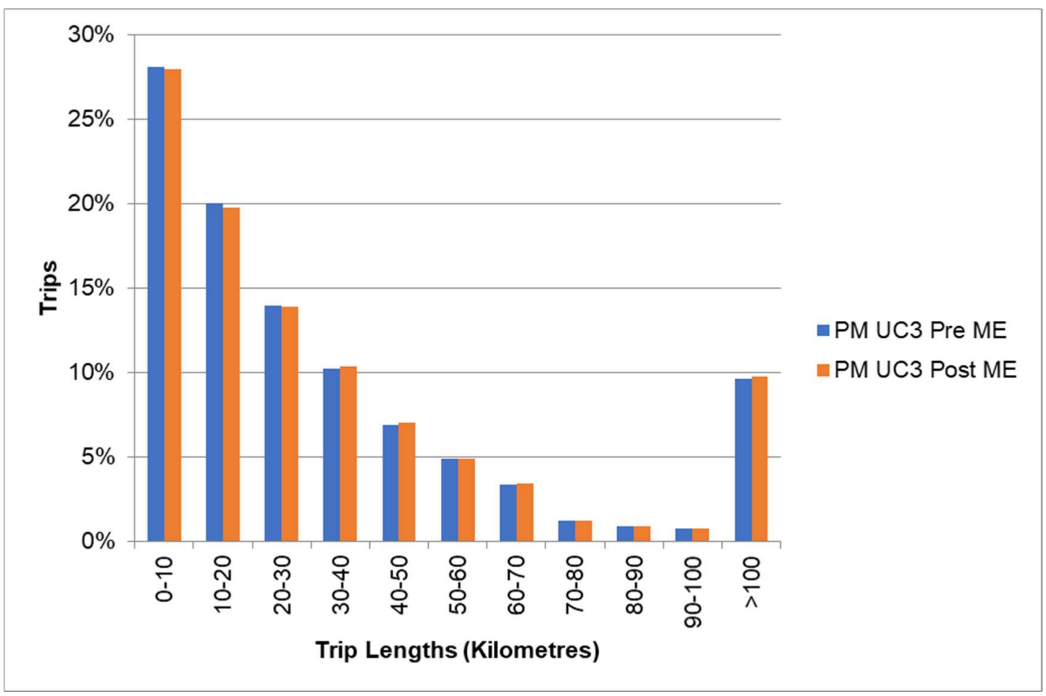


Figure 10.16: Matrix Trip Length Changes, UC3 PM

10.2.5 Sector-to-Sector Movements

Finally, the TAG guidelines require a check on the matrix cells on a sector basis. The guidelines state that trips should not change by more than 5%. Using the sectors specified in section 4.3.1 and in Figure 10.17 (on the following page), the percentage and absolute change for each user class and each sector-to-sector movement as a result of matrix estimation are shown in Appendix L and M respectively. The tables in Appendix J show that some of the percentage changes of the sector-to-sector movements for Cars and All Vehicles clearly exceed the 5% criteria. However, according to guidelines, the criteria is to be applied regardless of the number of trips in the sector; for sector-to-sector movements with relatively few trips, it is more difficult to stay within the 5% criteria, although this could have been achieved if larger sectors were selected.

Noting that in some cases there are relatively few trips, the tables of changes expressed as GEH values provide greater insight into the significance of some of these percentage changes. The sector-to-sector matrices upon which this summary is derived can be found in Appendix N. As can be seen from Tables in Appendix N, some sectors have changes in GEH values that are within 5, though some are more than 5, but changes overall provide assurance that matrix estimation is not significantly changing the underlying trip patterns. As an example, Table 10-8 below provides a summary of the range of GEH statistics in the sectored matrices for all Car user classes for each time period.

User Class	GEH	AM	IP	PM
Commute	< 5	91.0%	94.0%	93.0%
	5 to 10	9.0%	6.0%	6.0%
	> 10	0.0%	0.0%	1.0%
Employer Business	< 5	97.0%	99.0%	100.0%
	5 to 10	3.0%	1.0%	0.0%
	> 10	0.0%	0.0%	0.0%
Other	< 5	93.0%	90.0%	91.0%
	5 to 10	7.0%	10.0%	9.0%
	> 10	0.0%	0.0%	0.0%

Table 10-8: Matrix Estimation Changes – Sector-to-Sector Movements in GEH Range

This analysis shows that the majority of movements at a sector level have adjustments with a GEH less than 5, with only a few movements having a GEH greater than 5. These adjustments are considered acceptable.

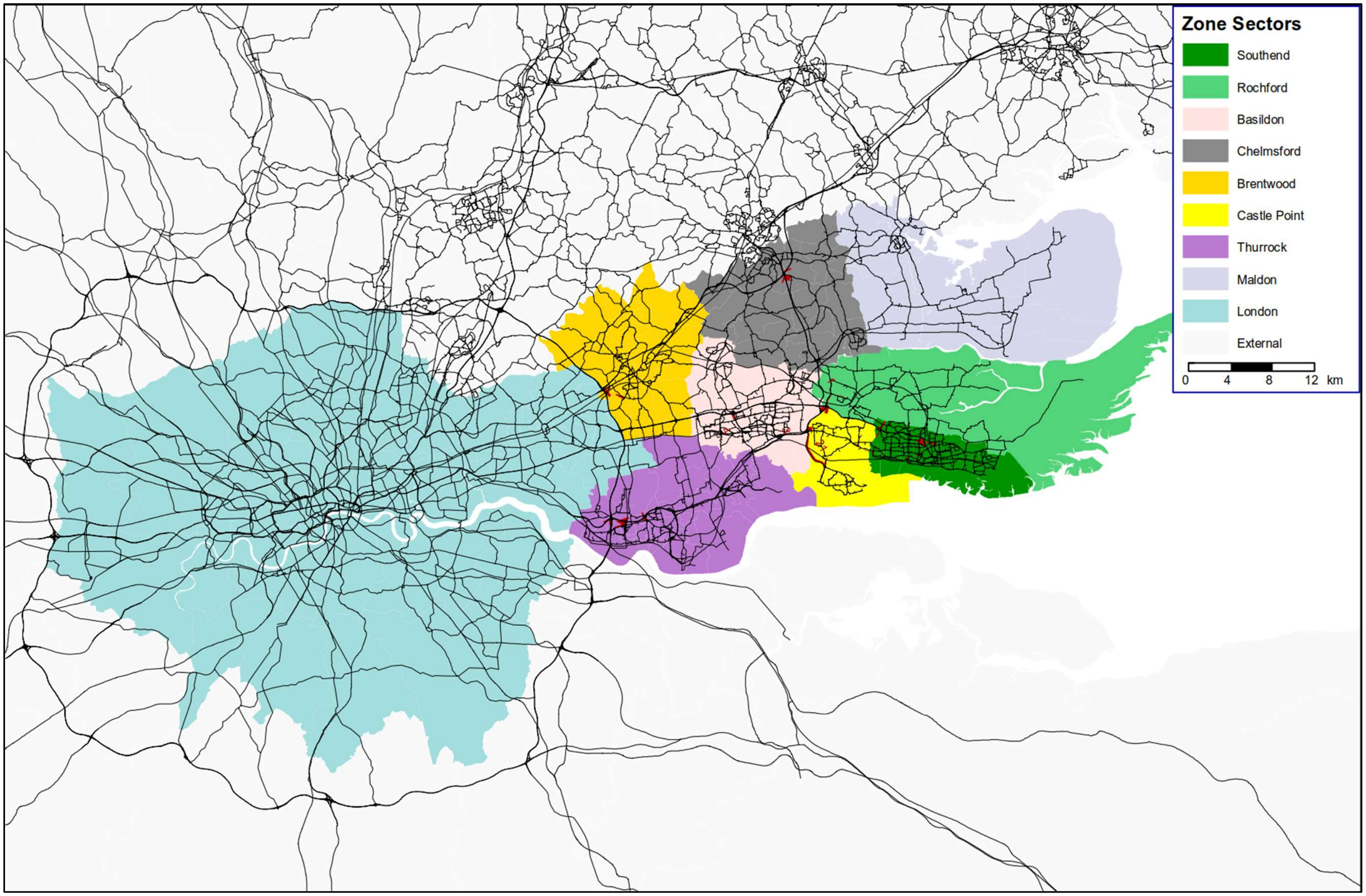


Figure 10.17: EECSM Zone Sectoring

11 Assignment, Calibration and Validation

11.1 Convergence

A summary of the assignment method used is given in section 4.8. For ease of reference, the convergence criteria are repeated below in Table 11-1.

Measure of Convergence	Base Model Acceptability Guidelines
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P) < 1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2) < 1%	Four consecutive iterations greater than 98%

Table 11-1: Convergence Criteria

Convergence statistics for the final base model are shown in Table 11-2 below.

Time Period	Iteration Loop		Proximity Indicator: Gap (%)	Percentage of Links with Flow Change < 1%	Percentage of Links with Cost Change < 1%
AM	Final - 3	13	0.00025	98.34%	98.95%
	Final - 2	14	0.00024	99.35%	99.35%
	Final - 1	15	0.00024	99.25%	99.39%
	Final	16	0.00023	99.76%	99.61%
IP	Final - 3	9	0.00001	99.73%	99.78%
	Final - 2	10	0.00001	99.87%	99.85%
	Final - 1	11	0.00001	99.95%	99.90%
	Final	12	0.00001	99.97%	99.92%
PM	Final - 3	12	0.00018	98.64%	99.06%
	Final - 2	13	0.00022	98.69%	99.07%
	Final - 1	14	0.00018	99.23%	99.36%
	Final	15	0.00017	99.68%	99.58%

Table 11-2: Details of ICA Assignment Convergence

The results in Table 11-2 show that the model has a level of convergence in line with the guidance from TAG.

11.2 Screenlines

All the counts (calibration and validation) are arranged along screenlines as illustrated in Figure 11.1.

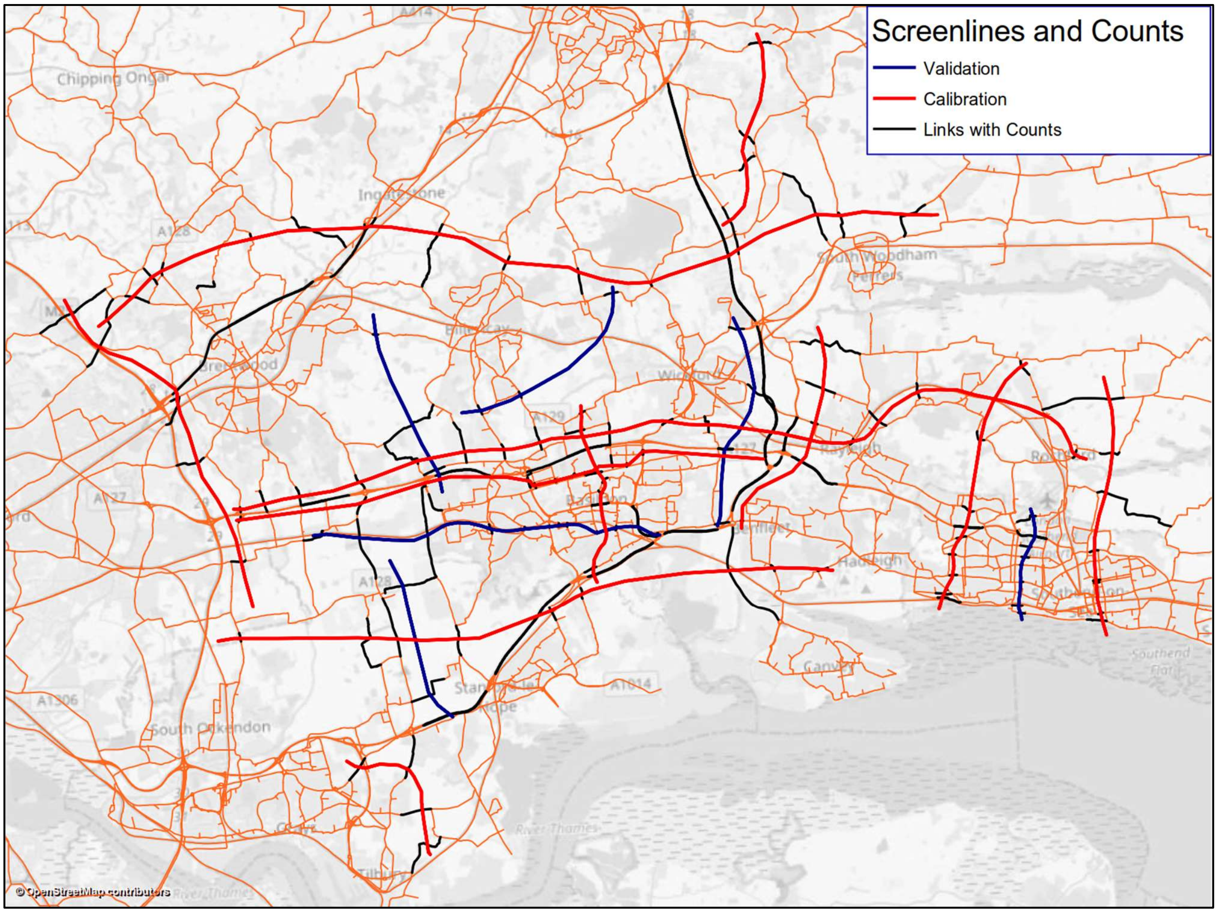


Figure 11.1: Calibration and Validation Screenlines

The following sections summarise the calibration and validation of the model.

11.3 Count Calibration

The counts used for calibration are those on the calibration screenlines in Figure 11.1. The performance of the model in terms of comparisons with count data are measured in two ways. The first is GEH statistic and the second is made by reference to in Table 3-2 in Section 3.

TAG advises that in ordinary circumstances the practitioner should aim to reach a state where at least 85% of modelled links have a GEH of less than 5 or satisfy the criterion in Table 3-2. There were 216 calibration counts used in the base year model. The comparison of modelled flows against these calibration counts are summarised below in Table 11-3.

Measure	AM Peak			
	Cars	LGV	HGV	Total Vehicles
No. links with modelled flows meeting criteria	212/222	220/222	222/222	210/222
% links with modelled flows meeting criteria	95%	99%	100%	95%
Measure	Interpeak			
	Cars	LGV	HGV	Total Vehicles
No. links with modelled flows meeting criteria	211/222	222/222	222/222	208/222
% links with modelled flows meeting criteria	95%	100%	100%	94%
Measure	PM Peak			
	Cars	LGV	HGV	Total Vehicles
No. links with modelled flows meeting criteria	198/222	221/222	222/222	196/222
% links with modelled flows meeting criteria	89%	100%	100%	88%

Table 11-3: Calibration Link Flow Comparison with Observed Flows (Cars, LGV, HGV and Total Vehicles)

The table above shows that the 85% criterion for calibration counts is exceeded for all time vehicle classes across all time periods. This is encouraging as it gives confidence that the model is representing base year traffic flows realistically. A full breakdown of the comparison at the individual count level is included in Appendix O.

11.4 Screenline Calibration

The TAG criterion for total screenline flows, as a check on the validity of the trip matrices, is that total modelled flows on all links crossing a screenline must be within 5% of the observed totals. The performance of the model along the calibration screenlines is summarised in Table 11-4 below.

Screenline	No. links	AM			IP			PM		
		Obs.	Mod.	% Diff.	Obs.	Mod.	% Diff	Obs.	Mod.	% Diff.
Cal 1 - Inbound	4	458	469	2%	398	398	0%	990	982	-1%
Cal 1 - Outbound	4	1156	1189	3%	369	367	-1%	381	391	3%
Cal 2 - Inbound	17	7161	7169	0%	4380	4593	5%	6799	6834	1%
Cal 2 - Outbound	16	6932	6841	-1%	4254	4313	1%	6223	6152	-1%
Cal 3 - Inbound	4	1849	1738	-6%	1094	1154	5%	1421	1484	4%
Cal 3 - Outbound	4	1220	1260	3%	1094	1070	-2%	1907	1735	-9%
Cal 4 - Inbound	6	2754	2878	5%	1748	1886	8%	2779	2873	3%
Cal 4 - Outbound	7	5585	5814	4%	3837	4022	5%	5228	5401	3%
Cal 5 - Inbound	19	11030	10774	-2%	7419	7107	-4%	9808	9543	-3%
Cal 5 - Outbound	19	10439	10030	-4%	7605	7255	-5%	10614	10443	-2%
Cal 6 - Inbound	10	8415	8532	1%	5595	5562	-1%	7179	7215	1%
Cal 6 - Outbound	10	6558	6705	2%	5422	5434	0%	8010	7774	-3%
Cal 7 - Inbound	10	7164	6834	-5%	4432	4481	1%	6299	6160	-2%
Cal 7 - Outbound	10	5625	5347	-5%	4705	4500	-4%	6773	7192	6%
Cal 8 - Inbound	10	11055	10939	-1%	6622	6645	0%	8167	8125	-1%
Cal 8 - Outbound	10	7441	7424	0%	7355	7439	1%	11550	11537	0%
Cal 9 - Inbound	5	7973	7910	-1%	4651	4704	1%	5056	5035	0%
Cal 9 - Outbound	5	5662	5663	0%	5122	5171	1%	7774	7788	0%
Cal 10 - Inbound	9	5345	5358	0%	4477	4475	0%	5855	5858	0%
Cal 10 - Outbound	9	6326	6198	-2%	4708	4793	2%	6204	6197	0%
Cal 11 - Inbound	8	3596	3465	-4%	2965	2804	-5%	3032	2879	-5%
Cal 11 - Outbound	8	2801	2535	-9%	3006	2821	-6%	4163	3965	-5%
Total		**126545**	**125074**	**-1%**	**91258**	**90994**	**0%**	**126212**	**125563**	**-1%**
Total Screenlines		**22**								
< 5% Difference		**20/22 (91%)**			**18/22 (82%)**			**19/22 (86%)**		
< 7.5% Difference		**21/22 (95%)**			**21/22 (95%)**			**21/22 (95%)**		
< 10% Difference		**22/22 (100%)**			**22/22 (100%)**			**22/22 (100%)**		

Table 11-4: Calibration Screenline Comparison Table

As demonstrated in the table above, of the 22 calibration screenlines in total, 20 screenlines in the AM peak, 18 in the IP and 19 in the PM peak have total modelled flows within 5% of the observed totals. 21 out of 22 screenlines across all peaks have total modelled flows within 7.5% of the observed totals and all screenlines have total modelled flows within 10% of the observed totals. This gives confidence that the base year model reproduces the observed traffic flows. Further detail on the screenline calibration is given in Appendix Q including a breakdown of individual vehicle classes. Also, as mentioned in Section 3.1.1, following TAG unit M3.1 paragraph 3.3.8, additional screenline summaries with high flow roads (e.g. motorways) excluded have also been provided in Appendix Q.

11.5 Count Validation

Count validation relies on making similar comparisons to the ones made for the count calibration, but against independent counts, i.e. those not used in the model building process up to this point in either the matrix building or the matrix estimation process.

There are 70 counts used in validation, and the model's performance against these counts is summarised in Table 11-5 below.

Measure	**AM Peak**			
	Cars	**LGV**	**HGV**	**Total Vehicles**
No. links with modelled flows meeting criteria	61/70	68/70	69/70	60/70
% links with modelled flows meeting criteria	87%	97%	99%	86%
Measure	**Interpeak**			
	Cars	**LGV**	**HGV**	**Total Vehicles**
No. links with modelled flows meeting criteria	63/70	69/70	70/70	61/70
% links with modelled flows meeting criteria	90%	99%	100%	87%
Measure	**PM Peak**			
	Cars	**LGV**	**HGV**	**Total Vehicles**
No. links with modelled flows meeting criteria	61/70	68/70	70/70	60/70
% links with modelled flows meeting criteria	87%	97%	100%	86%

Table 11-5: Validation Link Flow Comparison with Observed Flows (Cars, LGV, HGV and Total Vehicles)

The table above shows that the 85% criterion for validation counts is exceed in all time periods and across all vehicle classes, including total vehicles. This gives more confidence that the model is representing base year traffic flows realistically. A full breakdown of the comparison at the individual count level is included in Appendix P.

11.6 Screenline Validation

All the validation counts are arranged across screenlines, as illustrated in Figure 11.1 above. Table 11-6 below shows the performance of validation counts across screenlines.

Screenline	No. links	AM			IP			PM		
		Obs.	Mod.	% Diff.	Obs.	Mod.	% Diff.	Obs.	Mod.	% Diff.
Val 1 - Inbound	12	6942	6688	-4%	5029	4664	-7%	6757	6466	-4%
Val 1 - Outbound	12	6345	6517	3%	5227	4769	-9%	7522	7319	-3%
Val 2 - Inbound	4	1792	1736	-3%	1370	1334	-3%	1933	1974	2%
Val 2 - Outbound	4	2006	1908	-5%	1311	1227	-6%	1630	1555	-5%
Val 3 - Inbound	4	5731	5403	-6%	3300	3291	0%	3855	3681	-5%
Val 3 - Outbound	4	3970	3776	-5%	3552	3519	-1%	5521	5015	-9%
Val 4 - Inbound	8	4262	3963	-7%	3581	3413	-5%	4566	4488	-2%
Val 4 - Outbound	8	5066	4936	-3%	3918	3632	-7%	4970	4619	-7%
Val 5 - Inbound	4	3301	3343	1%	3106	3104	0%	4653	4334	-7%
Val 5 - Outbound	4	4638	4440	-4%	2814	2786	-1%	3480	3485	0%
Val 6 - Inbound	3	3218	3373	5%	2827	2719	-4%	4349	4198	-3%
Val 6 - Outbound	3	3959	3699	-7%	2354	2307	-2%	2955	2842	-4%
Total		**51230**	**49782**	**-3%**	**38389**	**36765**	**-4%**	**52191**	**49976**	**-4%**
Total Screenlines		**12**								
< 5% Difference		**9/12 (75%)**			**8/12 (67%)**			**9/12 (75%)**		
< 7.5% Difference		**12/12 (100%)**			**11/12 (92%)**			**11/12 (92%)**		
< 10% Difference		**12/12 (100%)**			**12/12 (100%)**			**12/12 (100%)**		

Table 11-6: Validation Screenline Comparison

As demonstrated in the table above, of the 12 validation screenlines in total, 9 screenlines in the AM peak, 8 in the IP and 9 in the PM peak have total modelled flows within 5% of the observed totals. 12 screenlines in the AM peak and 11 in the IP and the PM peak have total modelled flows within 7.5% of the observed totals and all screenlines have total modelled flows within 10% of the observed totals. This gives confidence that the base year model reproduces the observed traffic flows. Further detail on the screenline validation is given in Appendix Q including a breakdown of individual vehicle classes. Also, as mentioned in Section 3.1.1, following TAG unit M3.1 paragraph 3.3.8 additional screenline summaries with high flow roads (e.g. motorways) excluded have also been provided in Appendix Q..

11.7 Modelled Flows Directly Affecting the Study Area

Although the modelled flows as a whole are representative of observed flows in the study area, it was important to also ensure that the links in the immediate vicinity of a potential highway scheme along the A127 corridor were well validated. This is not to imply that the model will *only* be used for assessing schemes on the A127, but that, since that is one known use for the model, it is important to ensure it is suitable for that purpose. The comparison of modelled flows against observed counts on the A127 is summarised below:

Peak	No. links with Modelled Flows Meeting GEH or Criteria 1			
	Cars	LGV	HGV	Total Vehicles
AM Peak	14/14	11/14	14/14	14/14
Interpeak	11/14	13/14	14/14	13/14
PM Peak	13/14	12/14	14/14	13/14

Table 11-7: A127 Link Flow Comparison with Observed Flows

The results are encouraging as they give confidence that modelled flows as a whole are representative of observed traffic flows along the A127.

As other schemes or developments emerge, it is recommended that a similar exercise, examining the model's representation in the vicinity of those schemes, be undertaken.

11.8 Journey Time Validation

Journey times within the model were checked by comparison of the modelled journey times against the observed times along the routes identified in Section 3.1.2 and Figure 11.2 below. TAG advises that the total modelled journey time from start to finish be within 15% of the observed time, and that this should ideally be the case for 85% of all journey time routes. However, that simple comparison ignores the fact that modelled and observed journey times could deviate significantly from each other along specific sections of a route, and the overall time could still be within the specified acceptance criteria. To ensure rigour in the modelled delays and journey times, the model has been developed in order to ensure that the modelled times match the observed times not just for the total time along the routes, but also at all points of the routes. To that end, distance versus time graphs for the modelled and observed times are also provided in Appendix R.

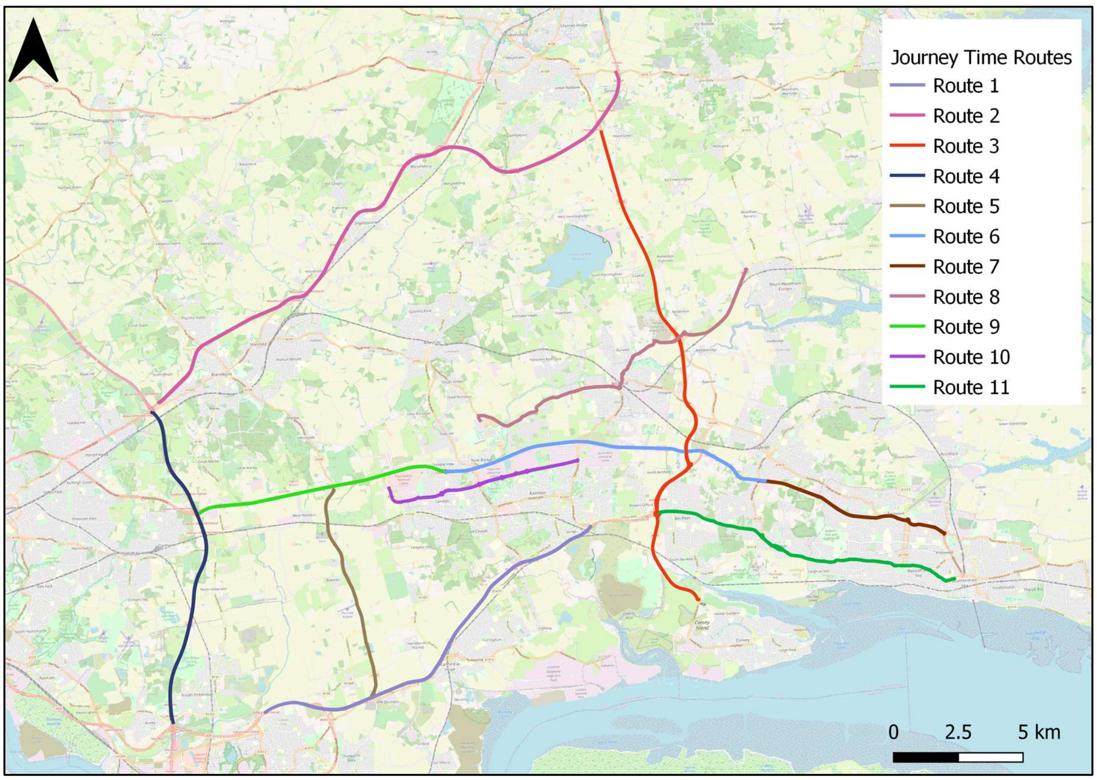


Figure 11.2: Journey Time Validation Routes

A summary of the journey time validation across each time period is given below in Table 11-8.

Time Period	Number of Routes	Number of Routes Within 15%	Total % of Routes Meeting Criteria
AM	24	24	100%
IP	24	24	100%
PM	24	22	91%

Table 11-8: Journey Time Validation Summary

The following table details the performance of the model along each route separately for each peak:

Route No.		Description	Length	AM Observed Time	AM Modelled Time	Difference	IP Observed Time	IP Modelled Time	Difference	PM Observed Time	PM Modelled Time	Difference
			(km)	[min:sec]	[min:sec]	%	[min:sec]	[min:sec]	%	[min:sec]	[min:sec]	%
1	101	A13/Baker Street --> A13/Pitsea Flyover	13.68	10:41	12:02	12.51%	11:06	11:06	0.12%	18:31	14:54	-19.51%
	102	A13/Pitsea Flyover --> A12/Baker Street	13.26	14:20	13:34	-5.33%	10:01	10:06	0.94%	10:38	10:30	-1.24%
2	201	A12/Brook Street Interchange --> A12/Junction 18	23.97	16:06	15:58	-0.84%	14:52	15:22	3.35%	20:22	17:53	-12.20%
	202	A12/Junction 18--> A12/Brook Street Interchange	24.12	17:45	17:20	-2.32%	14:38	14:09	-3.38%	14:54	14:37	-1.87%
3	301	A130 Canvey Way/Somnes Avenue --> A12/Junction 17	20.71	21:08	21:02	-0.50%	15:02	14:00	-6.89%	16:53	14:55	-11.71%
	302	A12/Junction 17 --> A130 Canvey Way/Somnes Avenue	20.77	16:10	16:30	2.06%	15:01	14:42	-2.05%	27:51	25:09	-9.67%
4	401	M25/Brook Street Interchange --> M25/ Mar Dyke	12.09	07:46	07:08	-8.07%	07:08	07:00	-1.84%	08:45	06:58	-20.38%
	402	M25/ Mar Dyke --> M25/Brook Street Interchange	12.22	08:21	07:22	-11.63%	07:19	07:14	-1.14%	07:33	07:08	-5.56%
5	501	A128/A13 Interchange --> A128/A127 Interchange	8.38	07:26	08:22	12.71%	07:00	06:57	-0.70%	07:11	07:27	3.71%
	502	A128/A127 Interchange --> A128/A13 Interchange	8.34	07:59	08:11	2.55%	07:25	07:01	-5.39%	09:08	08:43	-4.54%
6	601	A127/Rayleigh Weir --> A127/High Road North	13.1	15:04	14:49	-1.70%	09:58	09:41	-2.78%	10:44	10:18	-3.99%
	602	A127/High Road North --> A127/Rayleigh Weir	13.03	10:23	10:15	-1.38%	09:46	09:49	0.49%	19:40	18:16	-7.12%
7	701	A127, Southend-on-Sea --> A127, Rayleigh	7.22	15:55	15:50	-0.57%	10:08	10:54	7.59%	13:02	12:19	-5.42%
	702	A127, Rayleigh --> A127, Southend-on-Sea	7.34	17:32	16:42	-4.81%	11:05	11:47	6.41%	16:19	13:56	-14.61%
8	801	A132/Ferrers Road --> A129/Barleylands Road	13.62	18:37	19:12	3.15%	16:33	16:18	-1.56%	18:42	17:23	-7.04%
	802	A129/Barleylands Road --> A132/Ferrers Road	13.69	18:08	16:36	-8.49%	17:04	16:13	-4.97%	20:15	18:52	-6.81%
9	901	A127/Dunton Interchange --> A127/M25	9.37	10:18	11:15	9.22%	06:32	06:40	2.18%	08:10	08:14	0.88%
	902	A127/M25 --> A127/Dunton Interchange	9.06	10:13	09:39	-5.56%	06:43	07:27	10.99%	13:31	11:53	-12.15%
10	1001	B148/Mandeville Way --> A1235/A132	7.14	11:18	11:21	0.46%	10:08	09:21	-7.76%	14:04	12:32	-10.92%
	1002	A1235/A132 --> B148/Mandeville Way	7.16	10:18	09:37	-6.66%	09:12	08:49	-4.03%	10:59	09:38	-12.26%
11	1101	A13 London Road/Queensway London Road --> A13 Saddlers Farm Roundabout/A130	12.09	36:13	33:24	-7.82%	27:57	27:53	-0.24%	30:10	31:57	5.90%
	1102	A13 Saddlers Farm Roundabout/A130 --> A13 London Road/Queensway London Road	12.13	36:30	32:00	-12.33%	28:22	27:59	-1.38%	31:51	33:39	5.64%

Table 11-9: Comparison of Modelled Journey Time against Observed

In addition to the comparisons above, Appendix P shows the journey time graphs (plotting time against distance for the modelled and observed data) for all routes in the model.

The above tables demonstrate that the TAG criteria are met and exceeded, as more than 85% of the journey times across all peaks are in accordance with the 15% criteria. It is also notable that the differences in times are not consistently positive or negative, suggesting there is no underlying bias of too quick or too slow journey times in the model.

All routes in the AM and IP have met the criteria, whilst two routes (101 and 401) in the PM peak have failed marginally below the criteria. Route 101, which is along the A13 between the A1089/A128 and the A1014, was undergoing construction as part of road widening, with construction management in place in this section of the A13. Whilst the model was able to replicate delays during construction across all peaks on the northbound carriageway, for the PM peak only the model could not replicate the southbound delays. Considerable effort was expended in trying to improve this situation; however, this only improved the model up to a point. Given that in this case the model was trying to replicate an atypical situation, and that the traffic management will not be present in the future, further attempts to revise the base model were ruled out as they were not considered proportionate, and it was decided not to ‘overfit’ the model to an atypical travel condition.

Similarly, the model could not replicate delays on route 401 in the PM peak. This route runs along the M25 and is subject to high volumes of weaving and merging traffic. Attempts were made to improve the performance of the model in the PM peak, but this came at a detriment to the count validation and the validation in other time periods. Although these routes fail to meet the criteria, the overall performance of the model in the PM peak is still in exceedance of the criteria.

The graphs in Appendix P show that there is also a good match in journey times along the whole length of these routes, not just as a comparison of total times. This provides assurance that the impacts predicted by the forecast model have a credible basis.

12 Summary of Model

12.1 Summary of Model Development

The EECSM will be used for testing of a number of major schemes / development scenarios individually and in parallel, allowing the cumulative impact of these to be assessed. The model is likely to be required to serve a number of purposes including:

- Evidence for Local Plan development and hearings (and cumulative impacts once Local Plans are in place);
- Ability to understand and mitigate impact of external influences e.g. Housing allocations, transport schemes;
- Evidence to support Business Case submissions to secure Government funding for new infrastructure and maintenance;
- Provide evidence to support responses to Government department or company consultations;
- Support the development consent order and town and country planning process on key schemes;
- Understand suitable phasing of maintenance and utilities work to manage congestion impacts;
- Optimisation of the performance of the existing transport network using technology; and
- Accessibility planning for key land uses.

The model approach made use of previous work on the development of the Essex Countywide Strategic Model; that model used mobile network data to formulate the highway demand and formed the base demand for the Chelmsford model update. The 2017 Essex Countywide Model prior matrices were used as the starting point for the updated Chelmsford Model matrices. Using the matrices provides analytical consistency and removes duplication of work.

Most of the network has been retained from the existing Essex Countywide Strategic Model, and which was further checked and refined to reflect the scope of the model update. The new model also increased the detail of network coverage within the study area, particularly in Basildon and in the proximity of the A127.

The modelled assignment satisfies the TAG criteria for a well converged model. Modelled flows and journey times compare favourably to observed data, both for independent data, and data used as part of the model building process. This is particularly true for observed data in the vicinity of areas likely to be affected by the proposed scheme. Journey times exceed the criteria set out in the guidance and, in the majority of time periods, flow validation exceeds the criteria set out in the guidance.

12.2 Summary of Standards Achieved

The standards to which the model aims to conform are set out in section 3. The table below summarises how the model has actually performed against those standards:

Model Aspect	Criterion	Acceptability Guideline	Actual Model Performance
Matrix validation	Differences between modelled flows and counts should be less than 5% of the counts	All or nearly all screenlines	Criteria is met for nearly all screenlines.
Matrix estimation	Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95	Model meets the criteria for cars and all vehicles.
	Matrix zone trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98	Model meets the criteria for cars and all vehicles.
	Trip length distributions	Means within 5% Standard deviations within 5%	Change in average and standard deviation trip lengths is minimal and well within guidelines for cars and all vehicles.
	Sector to sector level matrices	Differences within 5%	Does not meet the criterion in all time periods.
Assignment convergence	Delta and %GAP	Less than 0.1%	GAP value of less than 0.1% is met in all time periods, and the flow and cost changes on links show stability in the model.
Link calibration	Individual flows within 100 veh/hr of counts for flows less than 700 veh/hr	> 85% of cases	AM peak: > 85% criteria met for car flows (95%) and total vehicles (95%) Interpeak: > 85% criteria met for car flows (95%) and total vehicles (94%) PM peak: > 85% criteria met for car flows (89%) and total vehicles (88%) In summary, criteria were satisfied in all time periods
	Individual flows within 15% of counts for flows from 700 veh/hr to 2,700 veh/hr	> 85% of cases	
	Individual flows within 400 veh/hr of counts for flows more than 2,700 veh/hr	> 85% of cases	
	GEH < 5 for individual flows	> 85% of cases	
Link validation	Same as for link calibration, but for independent counts		AM peak: > 85% criteria met for car flows (87%) and total vehicles (86%) Interpeak: > 85% criteria met for car flows (90%) and total vehicles (87%) PM peak: > 85% criteria met for car flows (87%) and total vehicles (86%) In summary, criteria were satisfied in all time periods
Journey times	Modelled times along routes should be within 15% of surveyed time, or 1 minute if higher	> 85% of all routes	100%, 100% and 91% of journey time routes in the AM, IP and PM respectively are within the TAG criteria

12.3 Assessment of Fitness for Purpose

As demonstrated in this LMVR, the model has been constructed in a manner consistent with guidance, and performs well against the standards set out in TAG. Modelled flows and journey times compare favourably to observed data, both for independent data, and data used as part of the model building process.

This should serve to give confidence and provide reassurance that the model is representative of current conditions. However, it is acknowledged that simply meeting the validation criteria does not in itself qualify the model to be a suitable tool for assessing the effects of a planning application or a potential outline business case for highway schemes along the A127 corridor.

To consider further whether the model is suitable for assessment of A127 schemes, the quality of the model's representation of the observed traffic conditions around the A127 corridor has been considered. It was found that the model does replicate observed conditions in the vicinity of potential schemes along the A127 corridor. Given that the model has a very good overall level of validation and that it validates very well in the vicinity of the poetntial scheme, and noting that the model has been developed consistenly with TAG, it is considered that the model is fit for purpose for the assessment of potential higway schemes along the A127 corridor.

Noting that there are other intended purposes for the model aside from an assessment of schemes on the A127 which are general and not specific to any single infrastructure project, it is not possible to say automatically that the model is fit for purpose for assessing every hypothetical scheme. However, as evidenced by the overall calibration/validation statistics, it is considered that the model provides a good overall representation of current travel conditions for those areas included within the modelled network and that therefore the model is likely to be fit for purpose for the assessment of most large scale schemes in the area covered by the model.

The suitablity of the model for assessing any other specific schemes in the local area should be reviewed once more is known about those schemes (athough it is considered likely that even if the model were found not suitable, only relatively minor revisions would be necessary).

Appendices

Appendix A - Volume Delay Function Technical Note

1.1 Introduction

This technical note sets out the methodology for determining the Volume Delay Functions (VDF) which was applied during the development of the Enhanced Essex Countywide Model and for other modelling projects on the VISUM platform. It is anticipated that during model calibration, the parameters will be modified to better fit local conditions.

For links in a highway transport model, the parameters governing speeds, capacities and the relationship between speed and traffic flow (or in other terms volume and delay) are derived from the COBA manual. The link characteristics described in the manual are translated into appropriate Volume-Delay Function (VDF) parameters in VISUM or Speed-Flow Curve (SFC) parameters in SATURN for use in the model development.

In order to have a consistent modelling approach, a correlation exercise between SATURN SFCs and VISUM VDFs was undertaken where the Traffic Appraisal, Modelling and Economics group (TAME) approved Speed Flow Curves that were adopted in Regional Transport Models (RTM) were used as a starting point. SFCs in RTMs were defined for various link types which broadly fall under the following categories:

a) Motorway
b) Rural All Purpose
c) Rural Roads
d) Suburban
e) Urban
f) Small town

The SATURN methodology makes use of three pieces of information from the COBA curve; these are the free flow speed (S_0), the speed (S_1) at intermediate break point where the curve gradient (F) changes, and the Speed (S_2) at Capacity (C). The SATURN power curve made use of these parameters and the best fit value of power N was then determined. As per Section 5 of the SATURN manual, the travel time on a link is determined based on the power law curve below:

$$t = \begin{cases} t_0 + A \cdot (V)^n, & V \le C \\ t_0 + A \cdot (C)^n + B.\left(\frac{V-C}{C}\right), & V \ge C \end{cases}$$

Where: t is the calculated link travel time, t_0 is the link travel time at free flow conditions, V is the flow on the link, C is the link capacity, and B is a constant which is equal to 30*length of time period modelled which is typically one hour.

The travel time on a link in VISUM is determined by different pre-defined VDFs in the software:

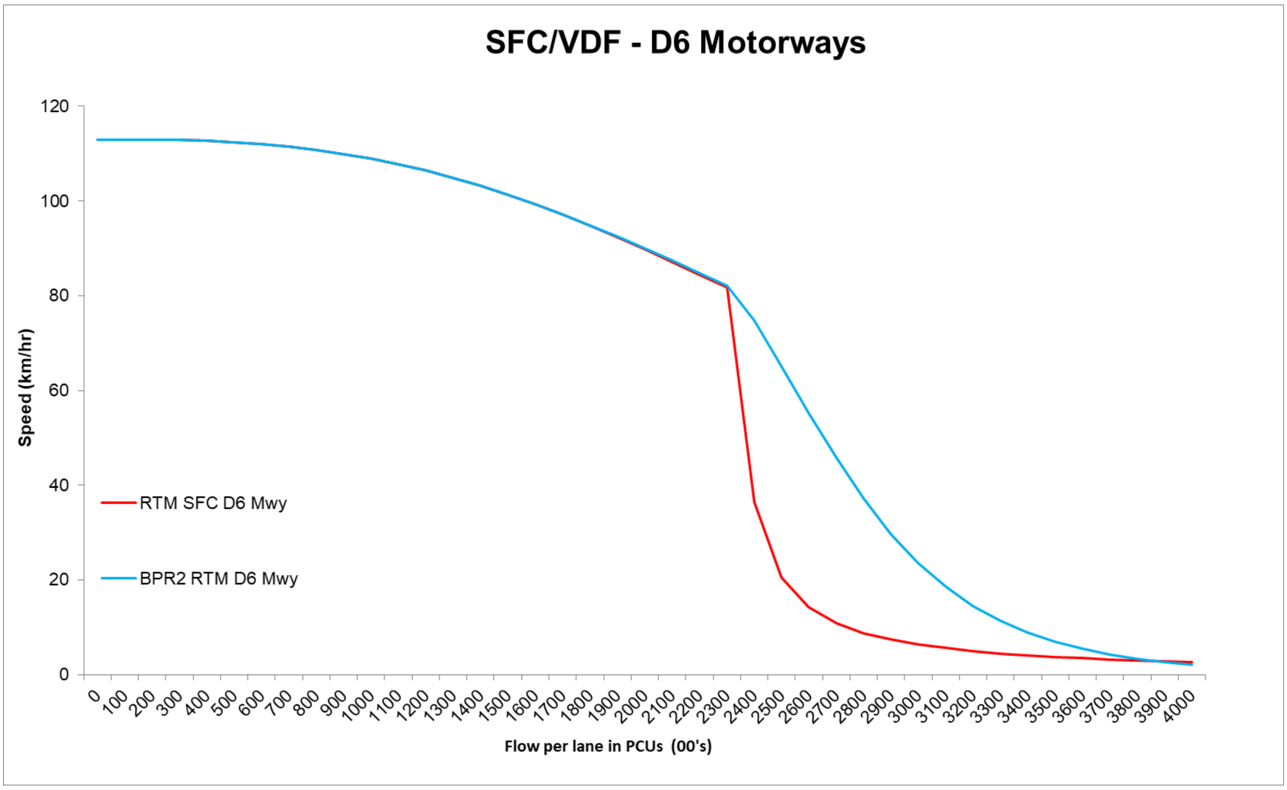
a) Based on previous VISUM best practices that Jacobs have developed, a VDF called "BPR2" (developed by the US Bureau of Public Roads) was used in several model development studies. The BPR2 curve takes the form shown below:

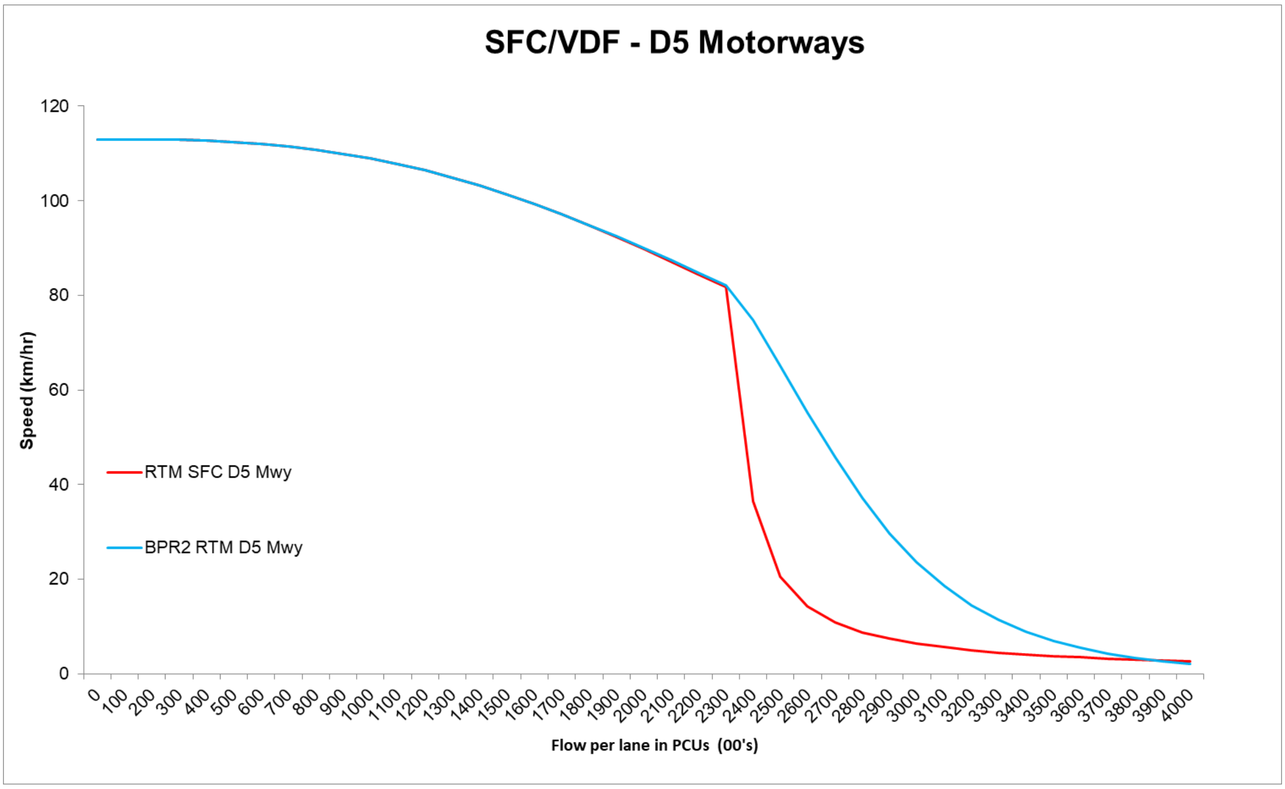
$$t_{cur} = \begin{cases} t_0\left(1 + a \cdot \left(\frac{q}{q_{max} \cdot c}\right)^{b}\right), & \frac{q}{q_{max} \cdot c} \le 1 \\ t_0\left(1 + a \cdot \left(\frac{q}{q_{max} \cdot c}\right)^{b'}\right), & \frac{q}{q_{max} \cdot c} > 1 \end{cases}$$

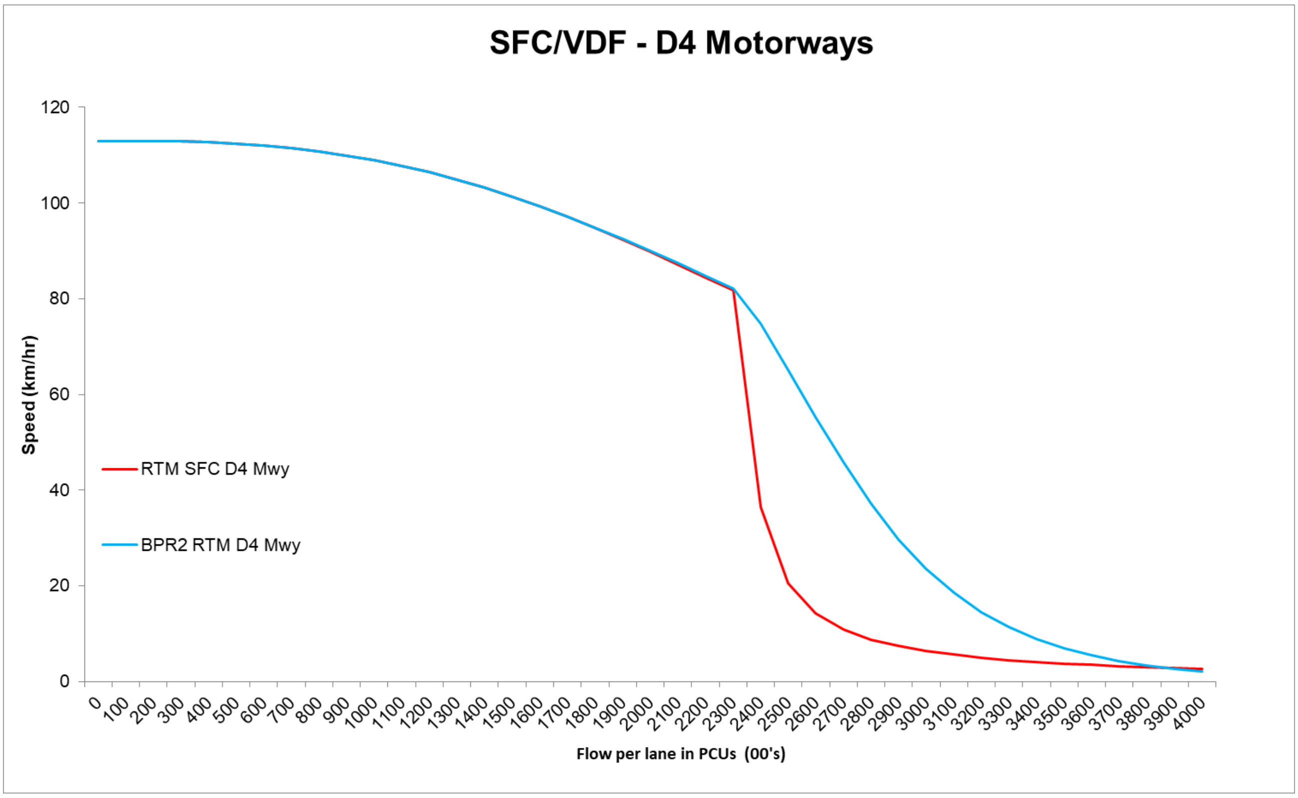
Where: t_{cur} is the calculated link travel time, t_0 is the link travel time at free flow conditions, q is the flow on the link, q_{max} is the link capacity, and a, b, b', and c are parameters specific to each link type.

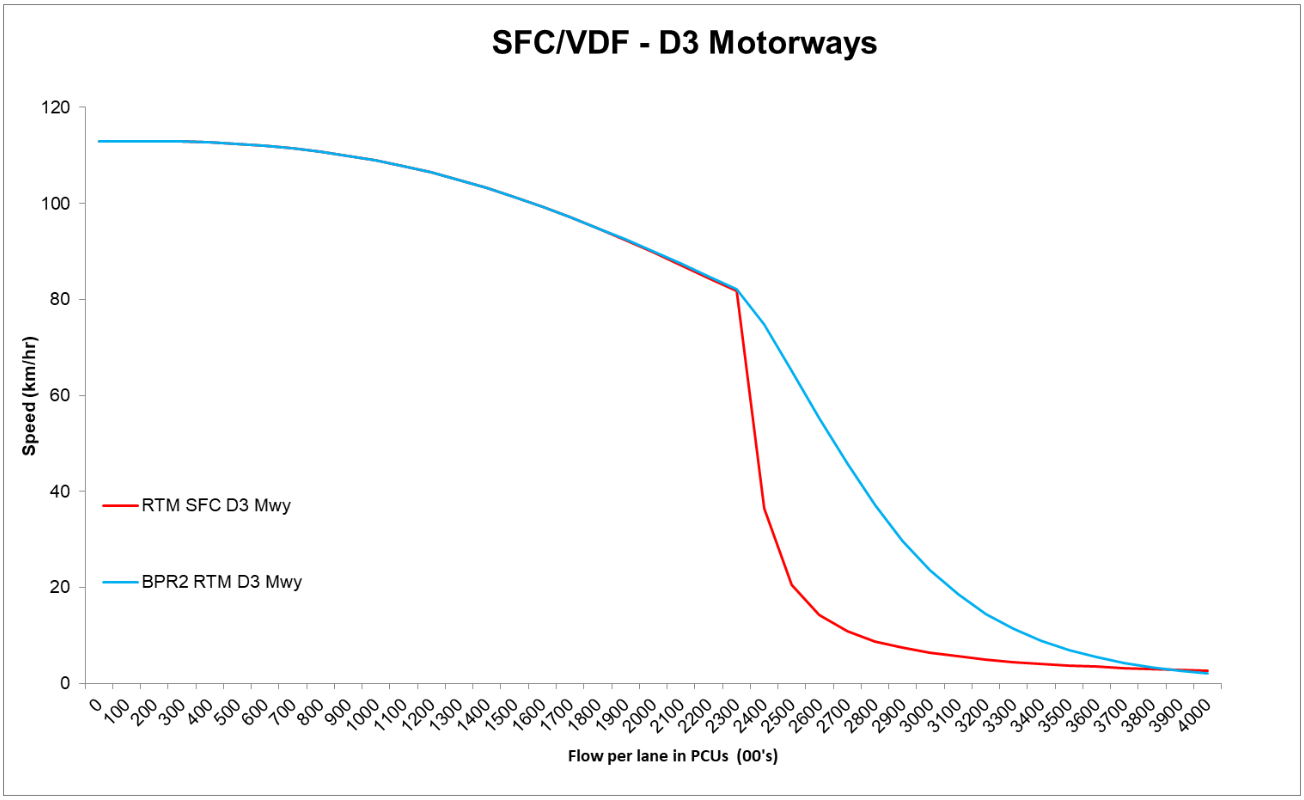
1.2 VDF – SFC Correlation

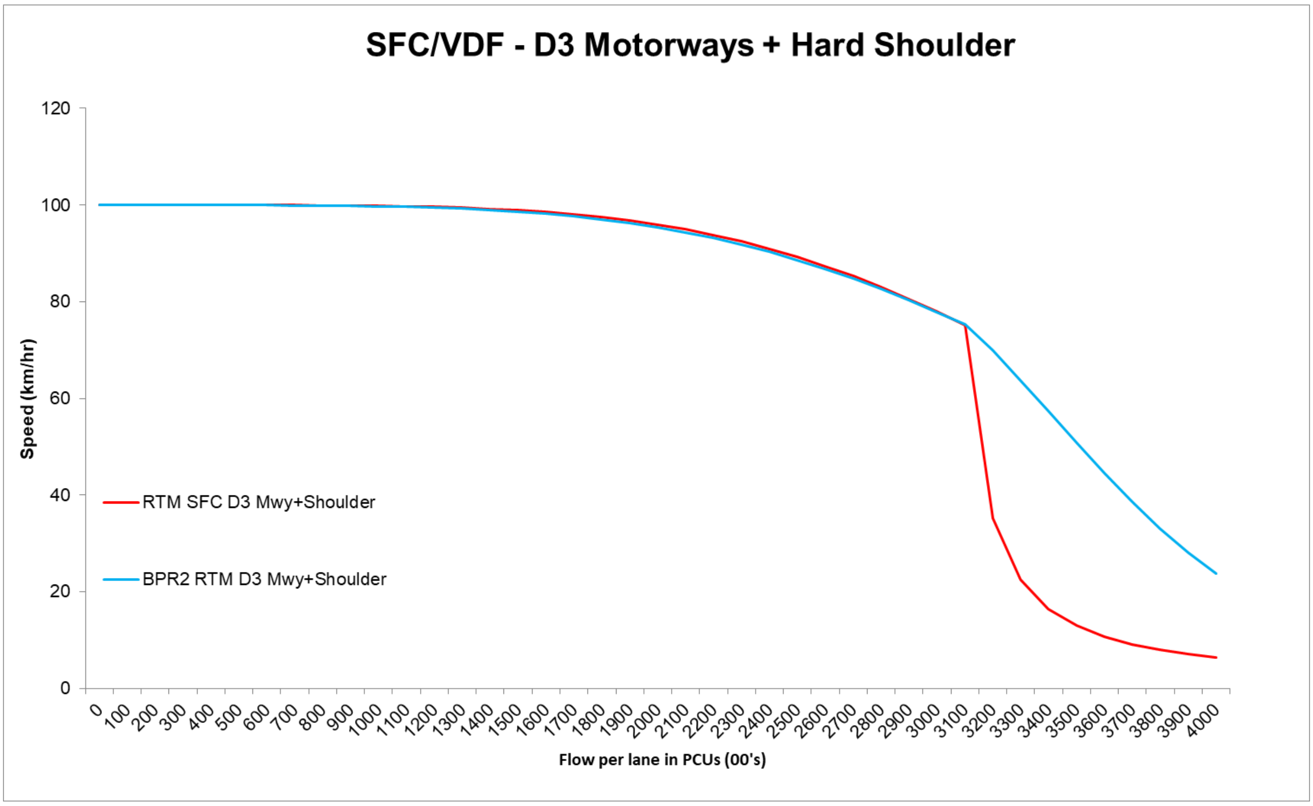
This section illustrates the correlation exercise undertaken to fit VDF to the RTM SFC curves for different link types. The parameters used to fit the individual VDF curve have also been presented.

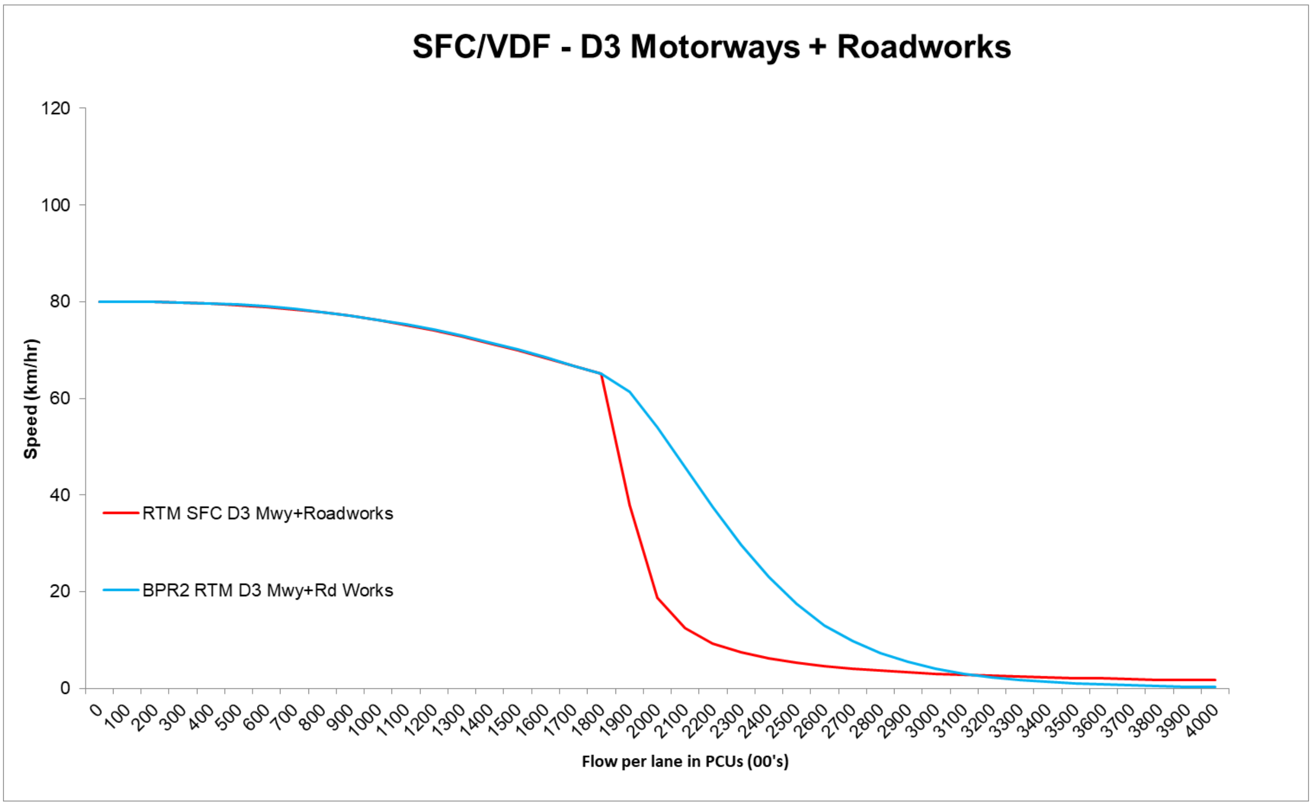

SFC/VDF - D6 Motorways
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC D6 Mwy
BPR2 RTM D6 Mwy

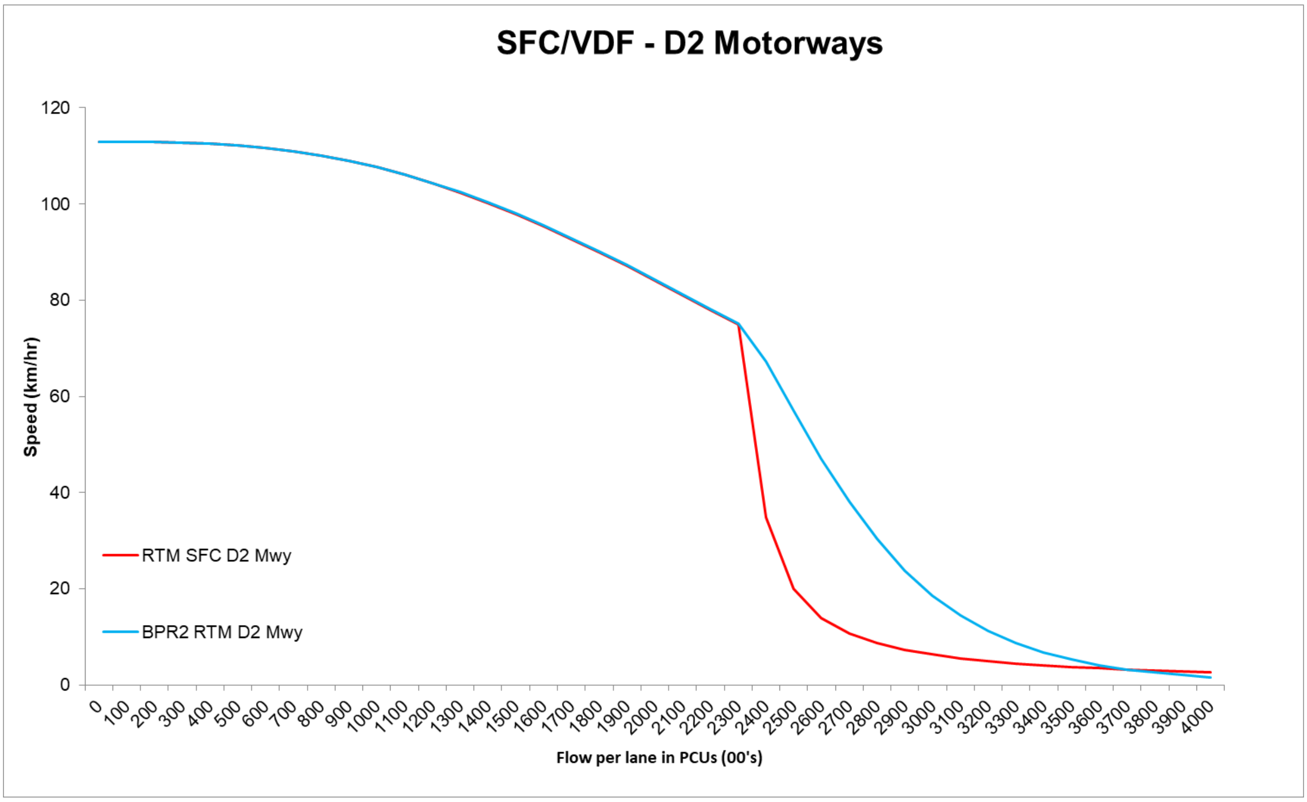

SFC/VDF - D5 Motorways
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC D5 Mwy
BPR2 RTM D5 Mwy

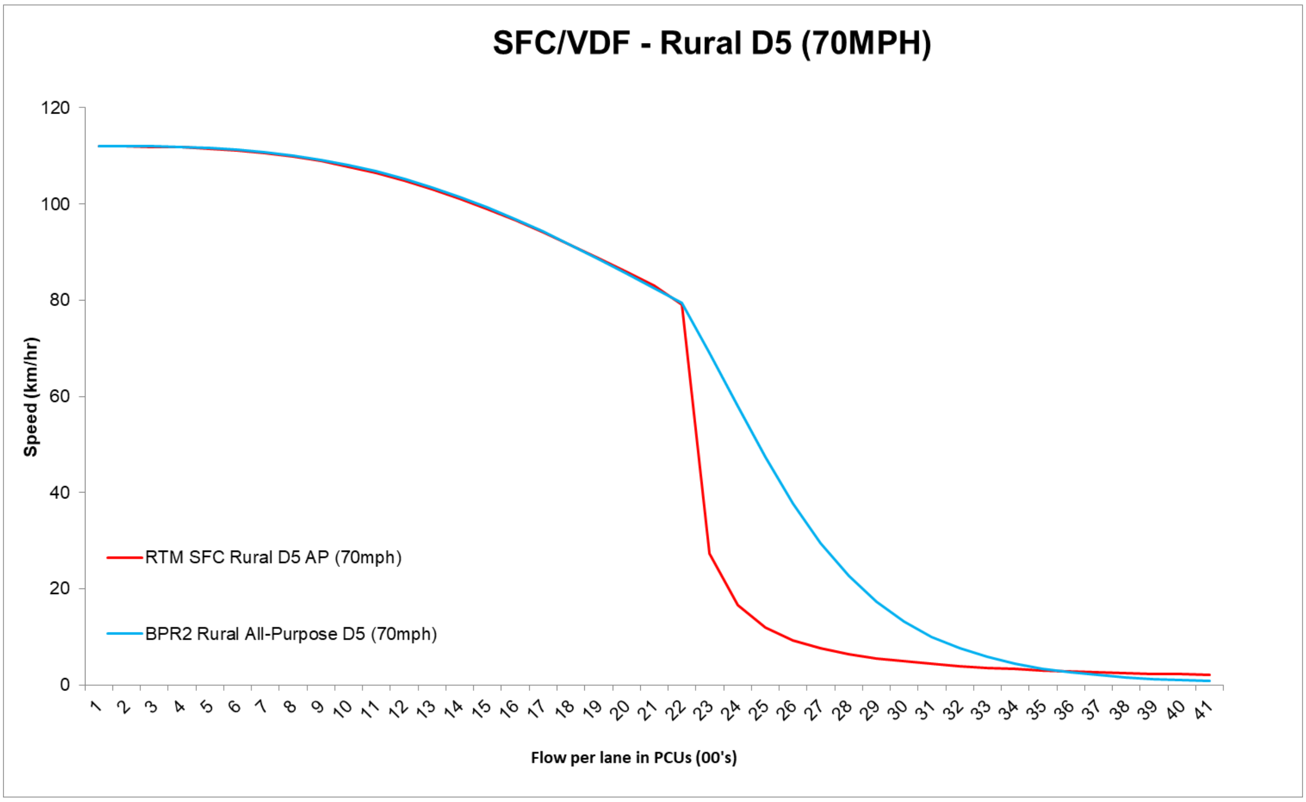

SFC/VDF - D4 Motorways
Speed (km/hr)
120
100
80
60
40
20
0
RTM SFC D4 Mwy
BPR2 RTM D4 Mwy
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200 3300 3400 3500 3600 3700 3800 3900 4000
Flow per lane in PCUs (00's)

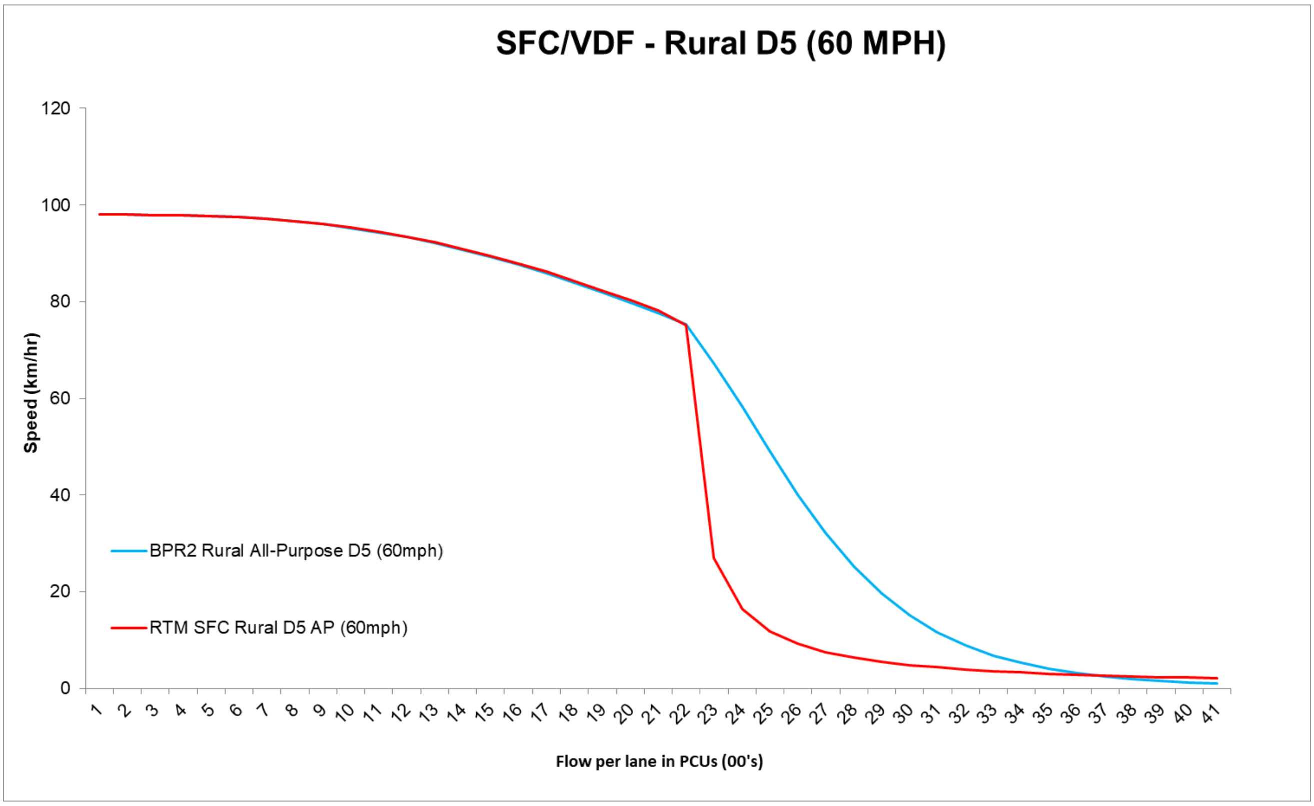

SFC/VDF - D3 Motorways
Speed (km/hr)
120
100
80
60
40
20
0
RTM SFC D3 Mwy
BPR2 RTM D3 Mwy
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200 3300 3400 3500 3600 3700 3800 3900 4000
Flow per lane in PCUs (00's)

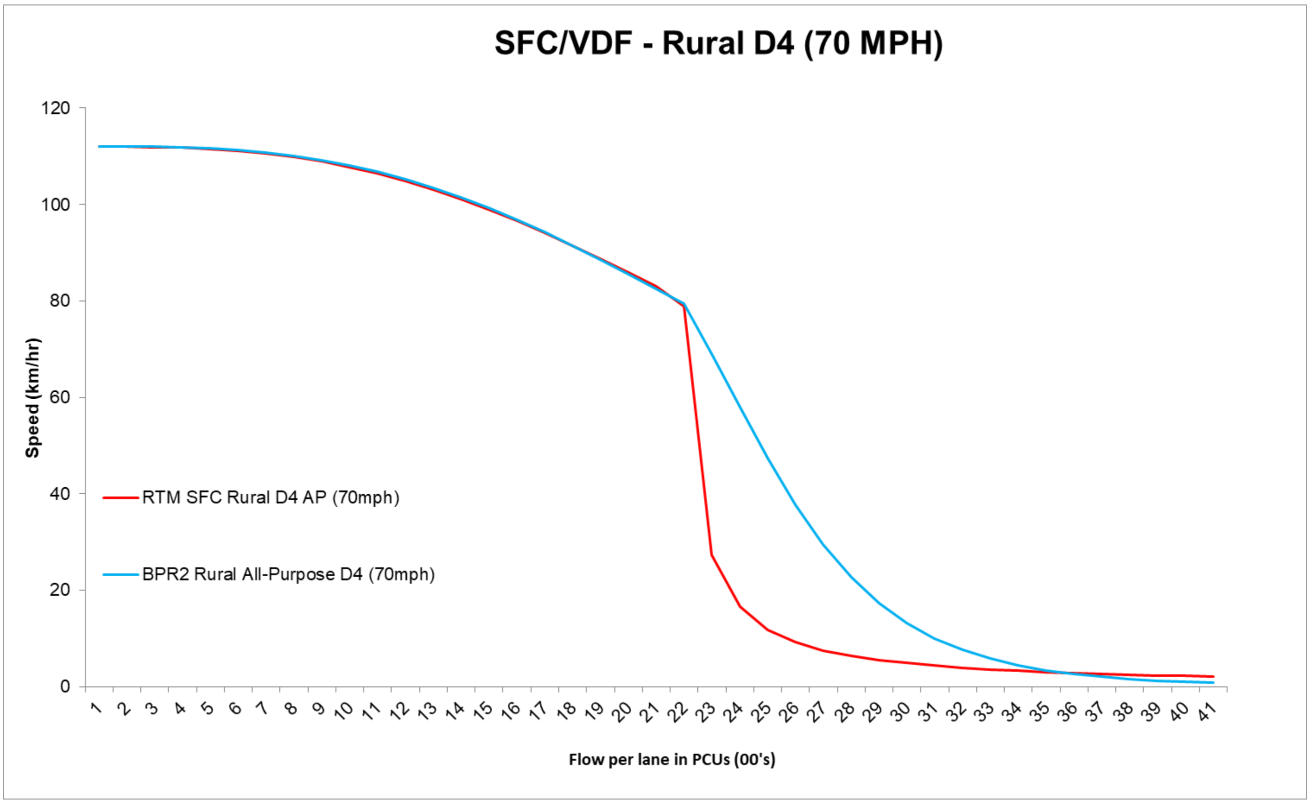

SFC/VDF - D3 Motorways + Hard Shoulder
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC D3 Mwy+Shoulder
BPR2 RTM D3 Mwy+Shoulder

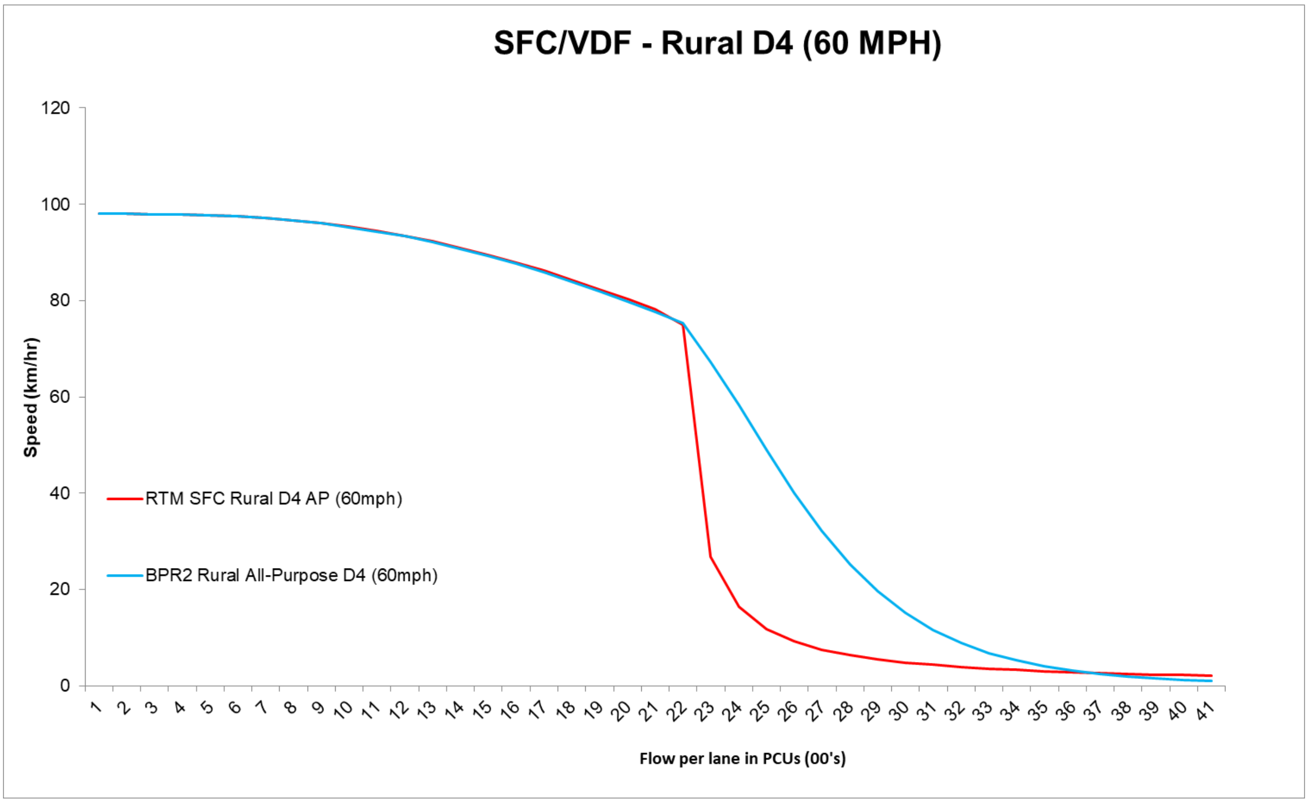

SFC/VDF - D3 Motorways + Roadworks
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC D3 Mwy+Roadworks
BPR2 RTM D3 Mwy+Rd Works


SFC/VDF - D2 Motorways
Speed (km/hr)
120
100
80
60
40
20
0
RTM SFC D2 Mwy
BPR2 RTM D2 Mwy
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200 3300 3400 3500 3600 3700 3800 3900 4000
Flow per lane in PCUs (00's)

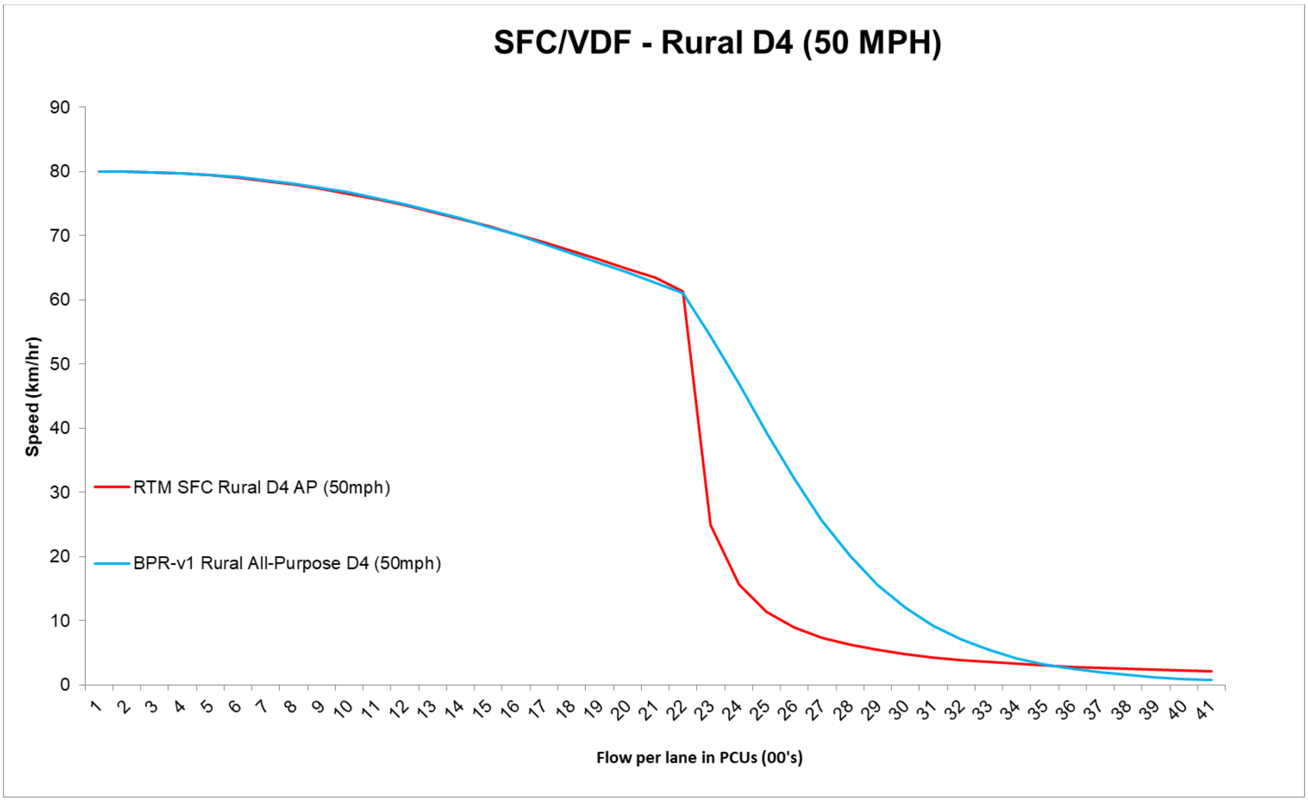

SFC/VDF - Rural D5 (70MPH)
Speed (km/hr)
120
100
80
60
40
20
0
RTM SFC Rural D5 AP (70mph)
BPR2 Rural All-Purpose D5 (70mph)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
Flow per lane in PCUs (00's)


SFC/VDF - Rural D5 (60 MPH)
Speed (km/hr)
Flow per lane in PCUs (00's)
BPR2 Rural All-Purpose D5 (60mph)
RTM SFC Rural D5 AP (60mph)

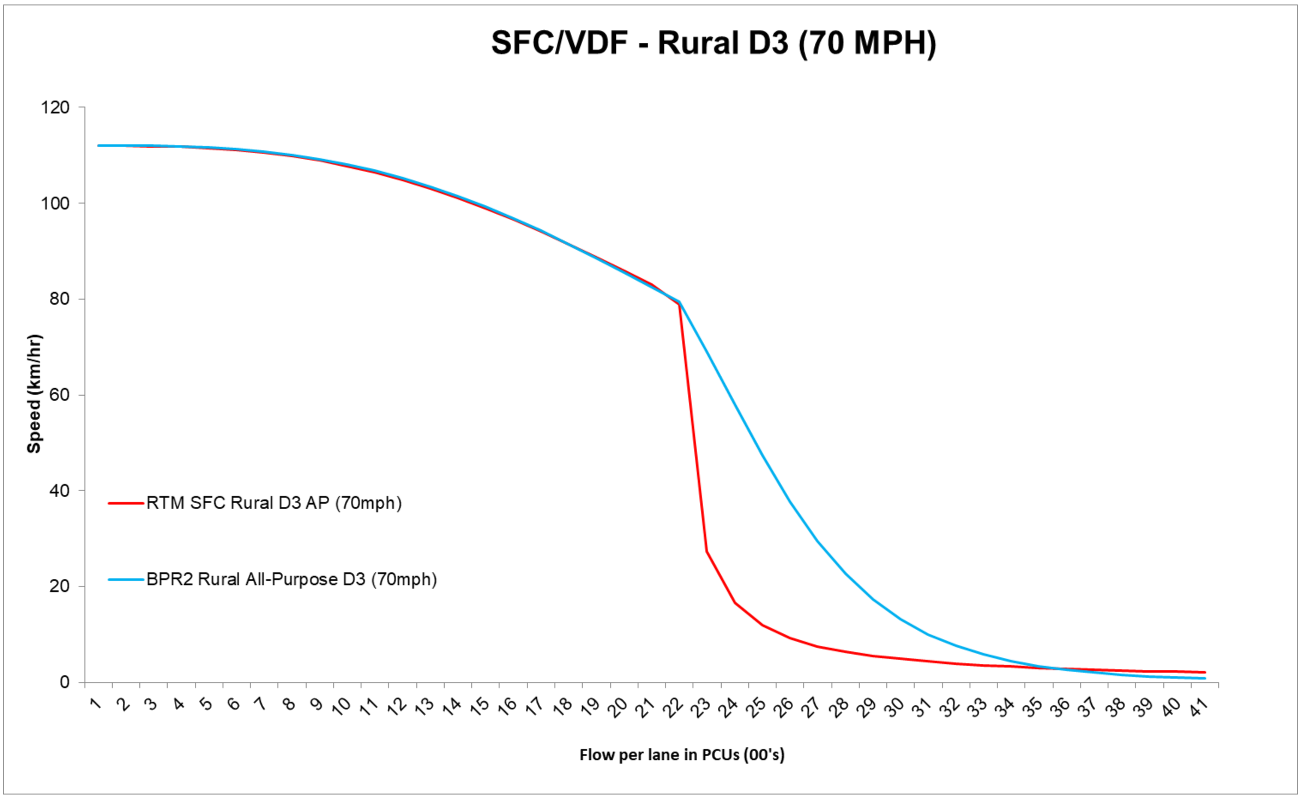

SFC/VDF - Rural D4 (70 MPH)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Rural D4 AP (70mph)
BPR2 Rural All-Purpose D4 (70mph)

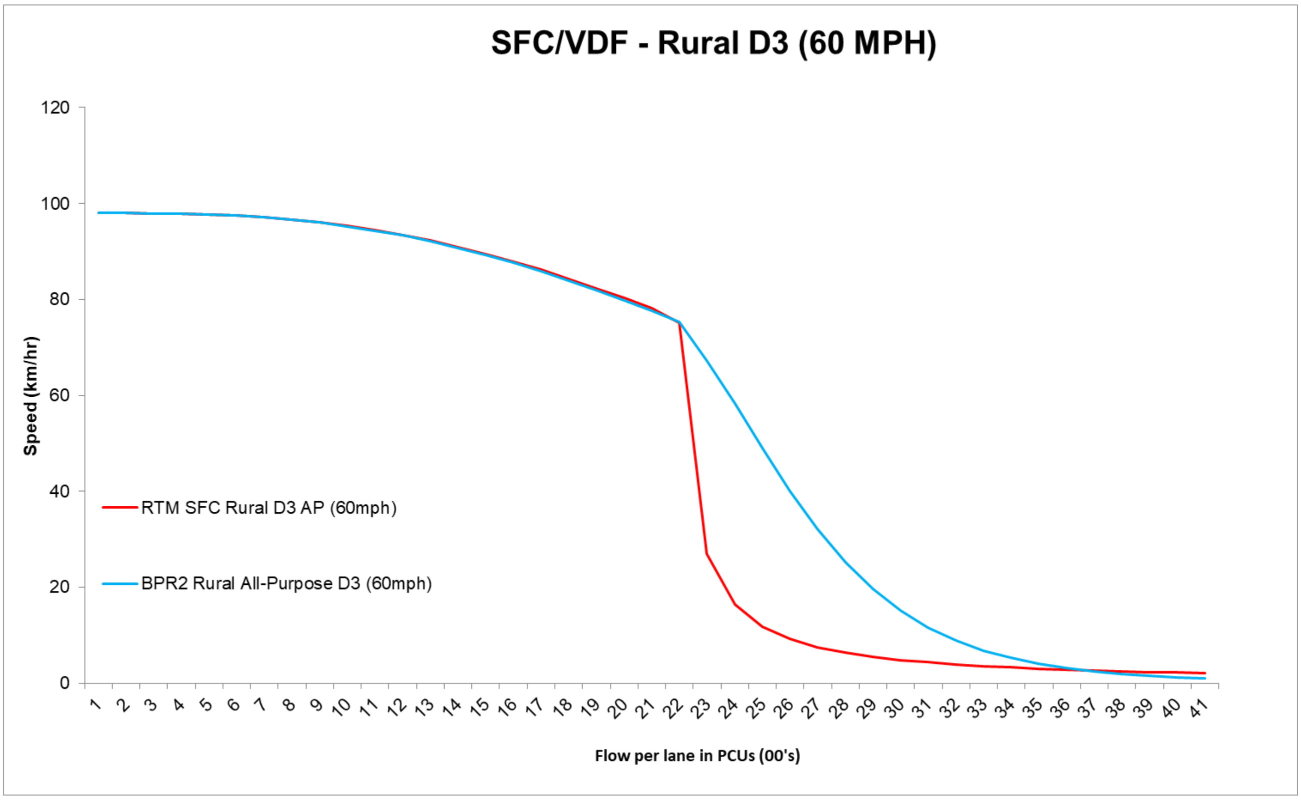


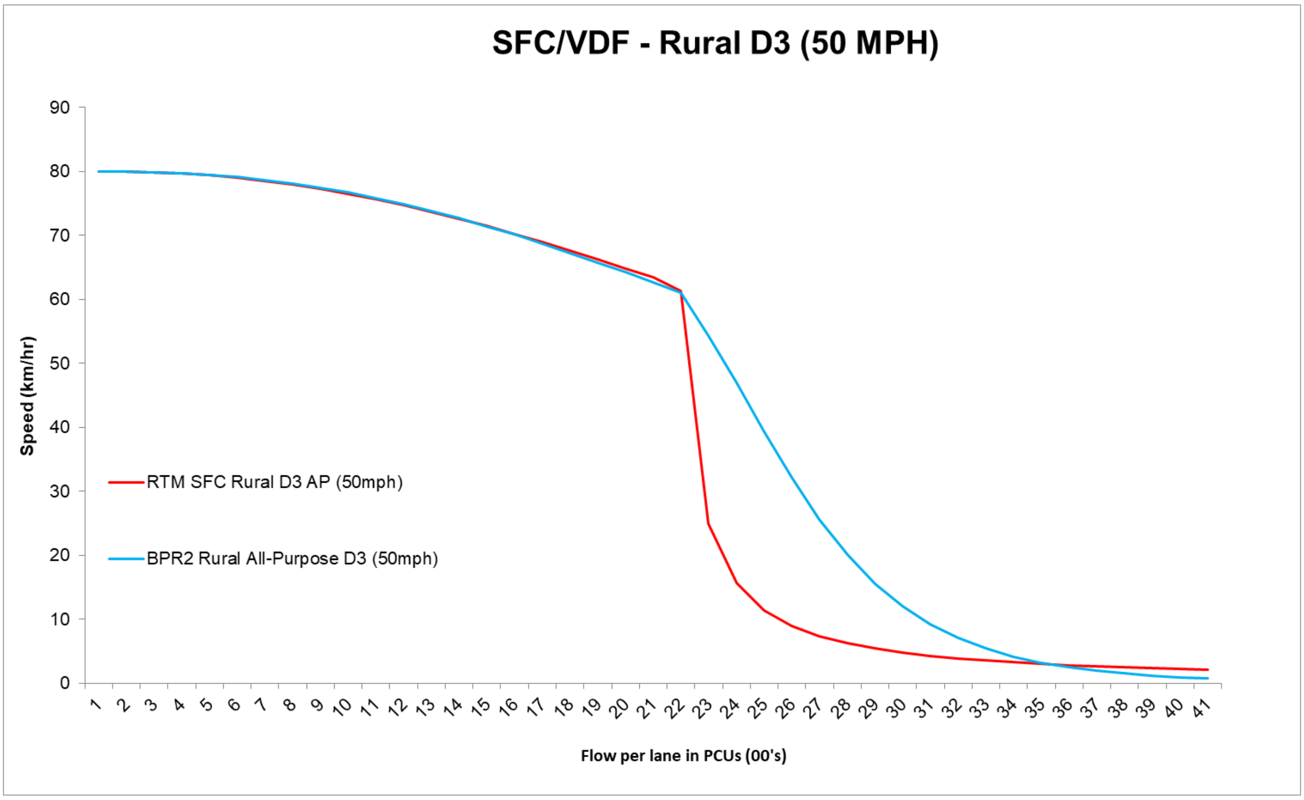
SFC/VDF - Rural D4 (60 MPH)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Rural D4 AP (60mph)
BPR2 Rural All-Purpose D4 (60mph)

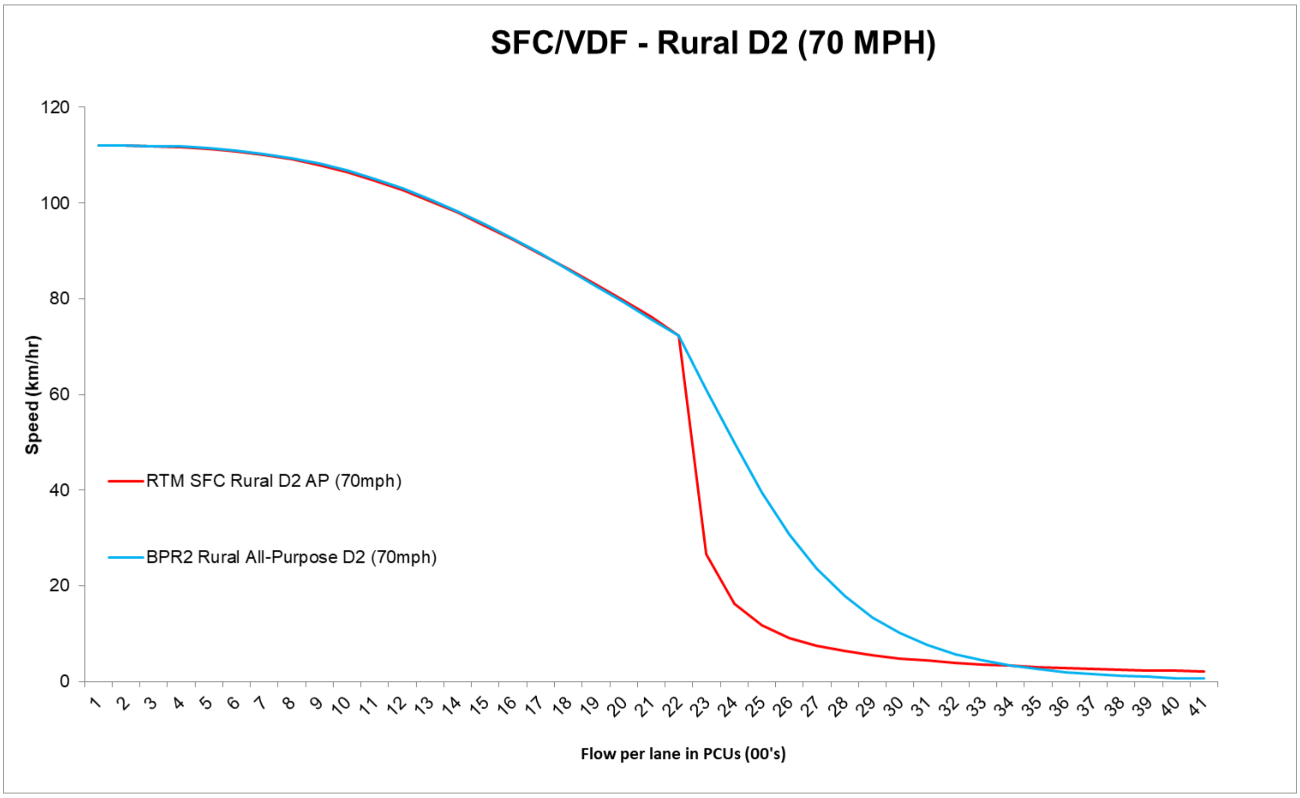


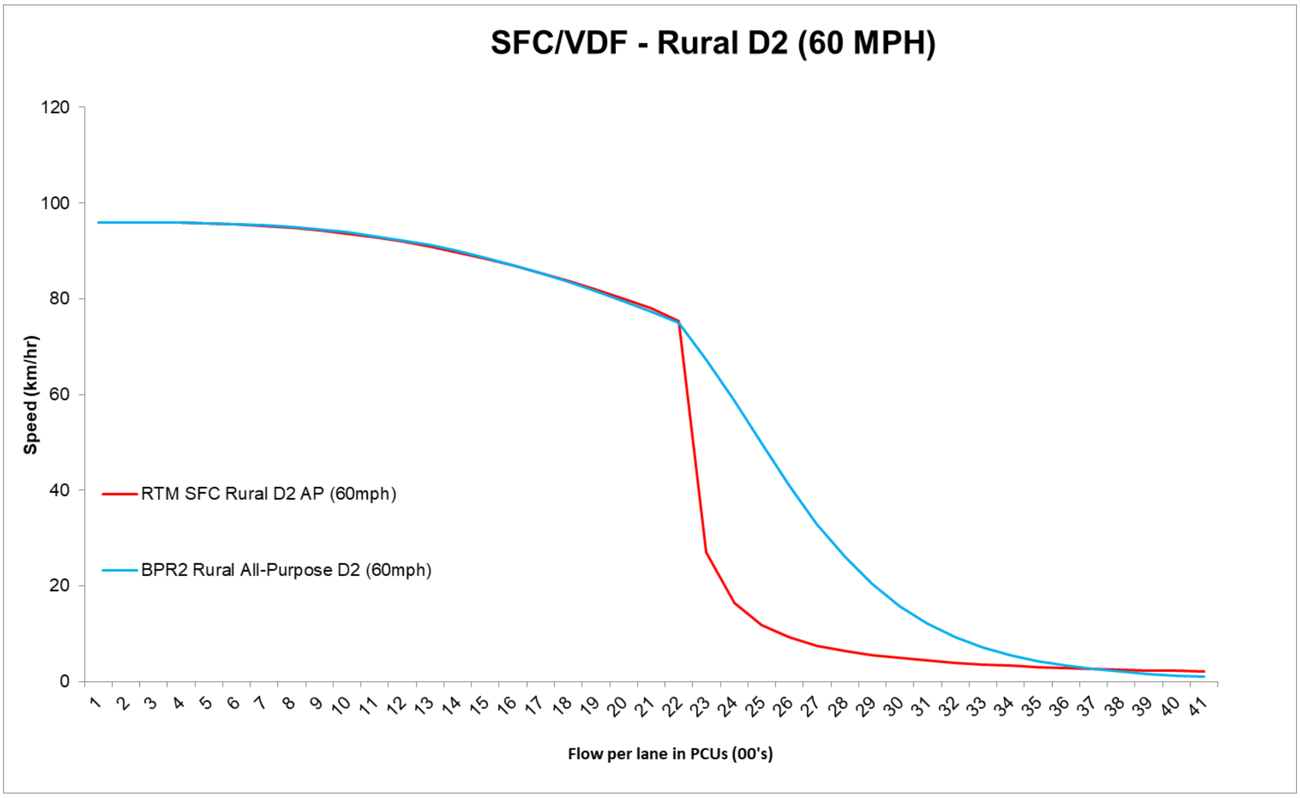
SFC/VDF - Rural D4 (50 MPH)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Rural D4 AP (50mph)
BPR-v1 Rural All-Purpose D4 (50mph)

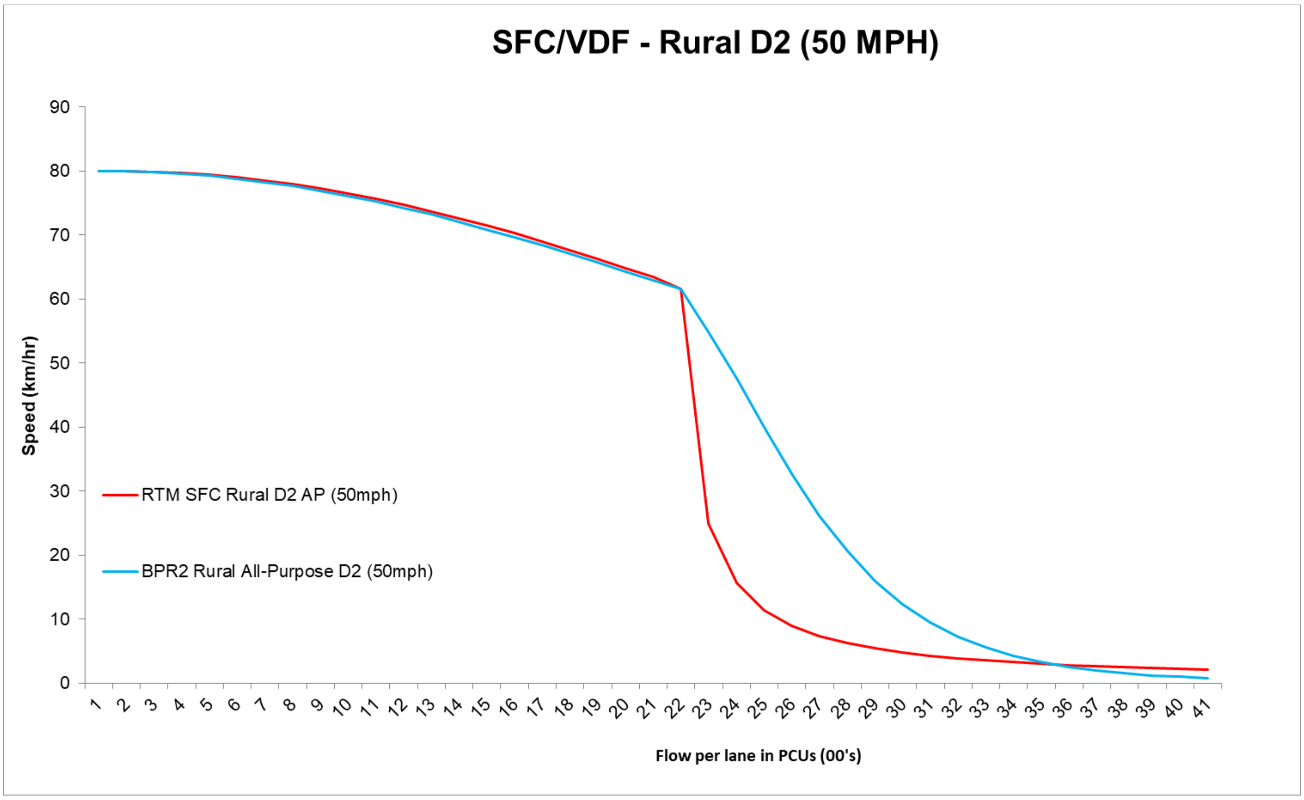

SFC/VDF - Rural D3 (70 MPH)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Rural D3 AP (70mph)
BPR2 Rural All-Purpose D3 (70mph)

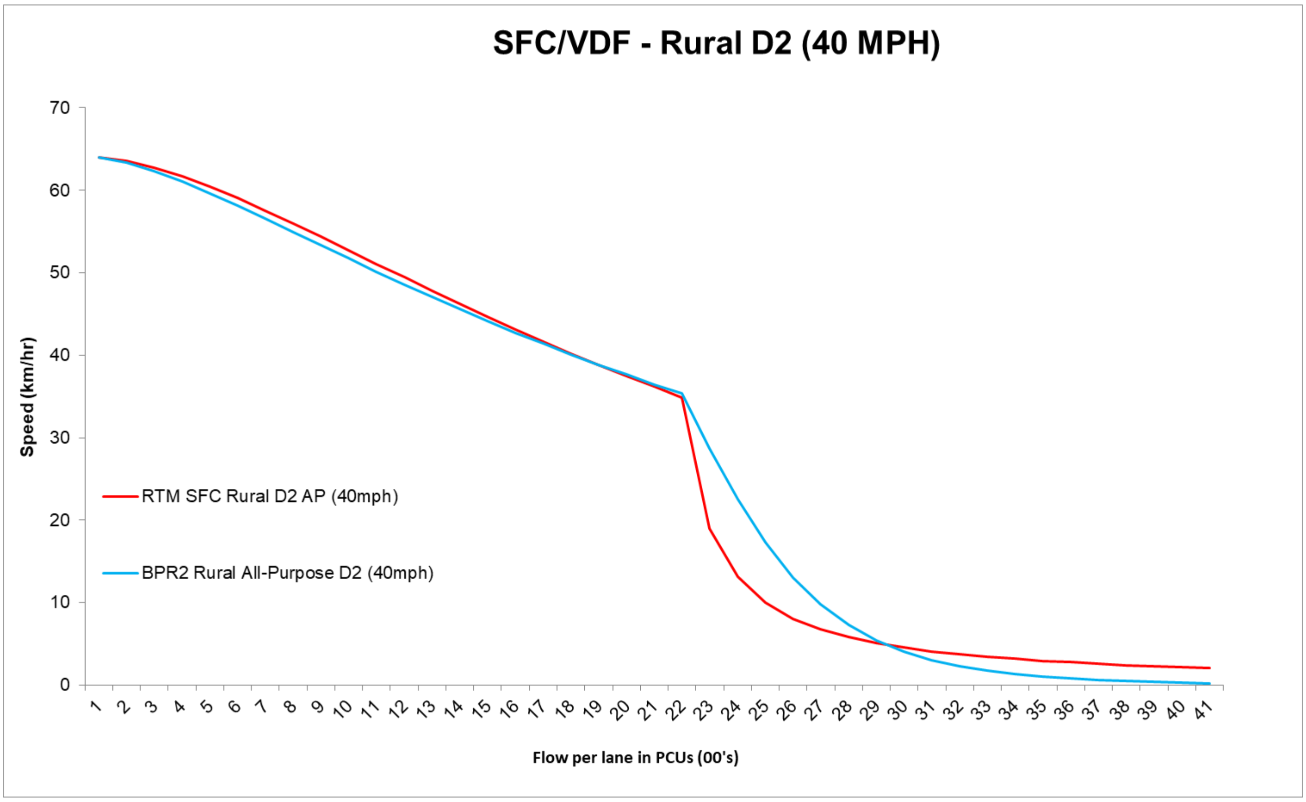

SFC/VDF - Rural D3 (60 MPH)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Rural D3 AP (60mph)
BPR2 Rural All-Purpose D3 (60mph)

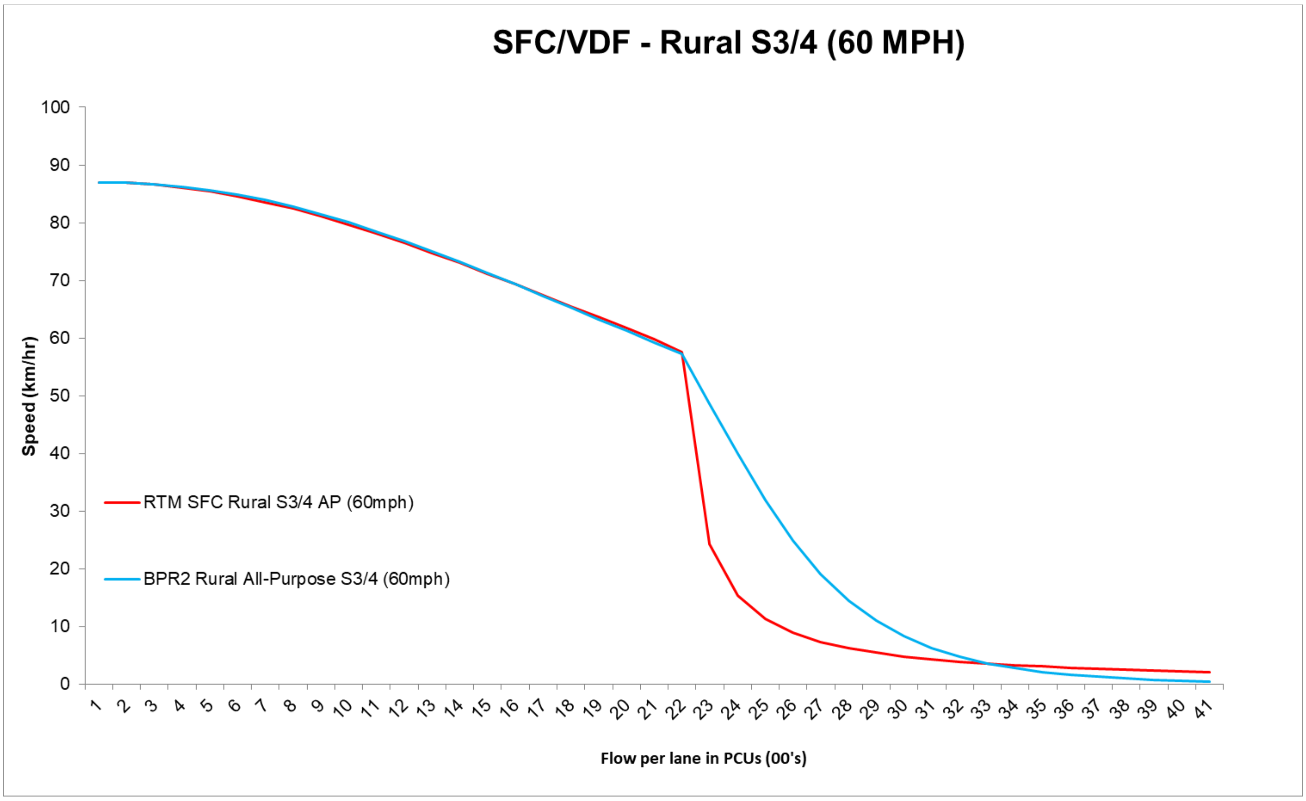

SFC/VDF - Rural D3 (50 MPH)
Speed (km/hr)
90
80
70
60
50
40
30
20
10
0
RTM SFC Rural D3 AP (50mph)
BPR2 Rural All-Purpose D3 (50mph)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
Flow per lane in PCUs (00's)

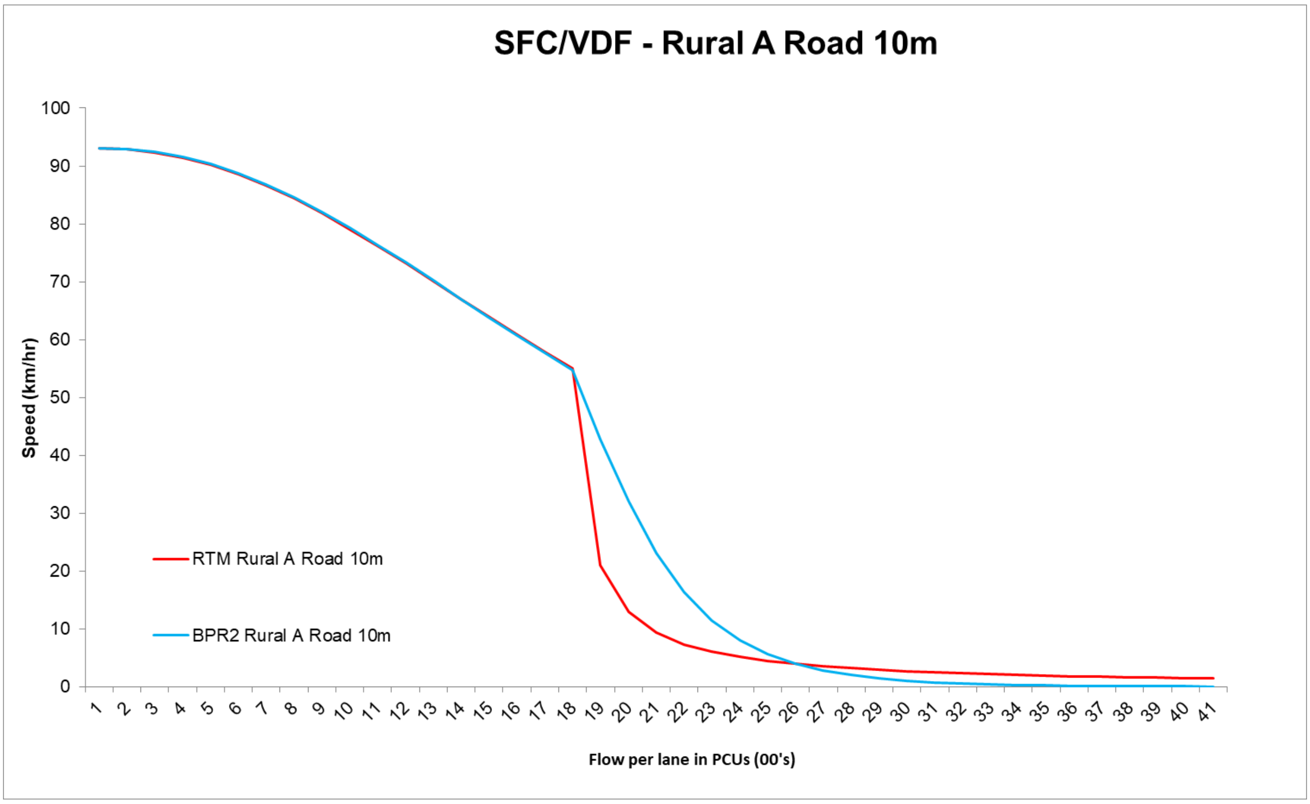

SFC/VDF - Rural D2 (70 MPH)
Speed (km/hr)
120
100
80
60
40
20
0
RTM SFC Rural D2 AP (70mph)
BPR2 Rural All-Purpose D2 (70mph)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
Flow per lane in PCUs (00's)

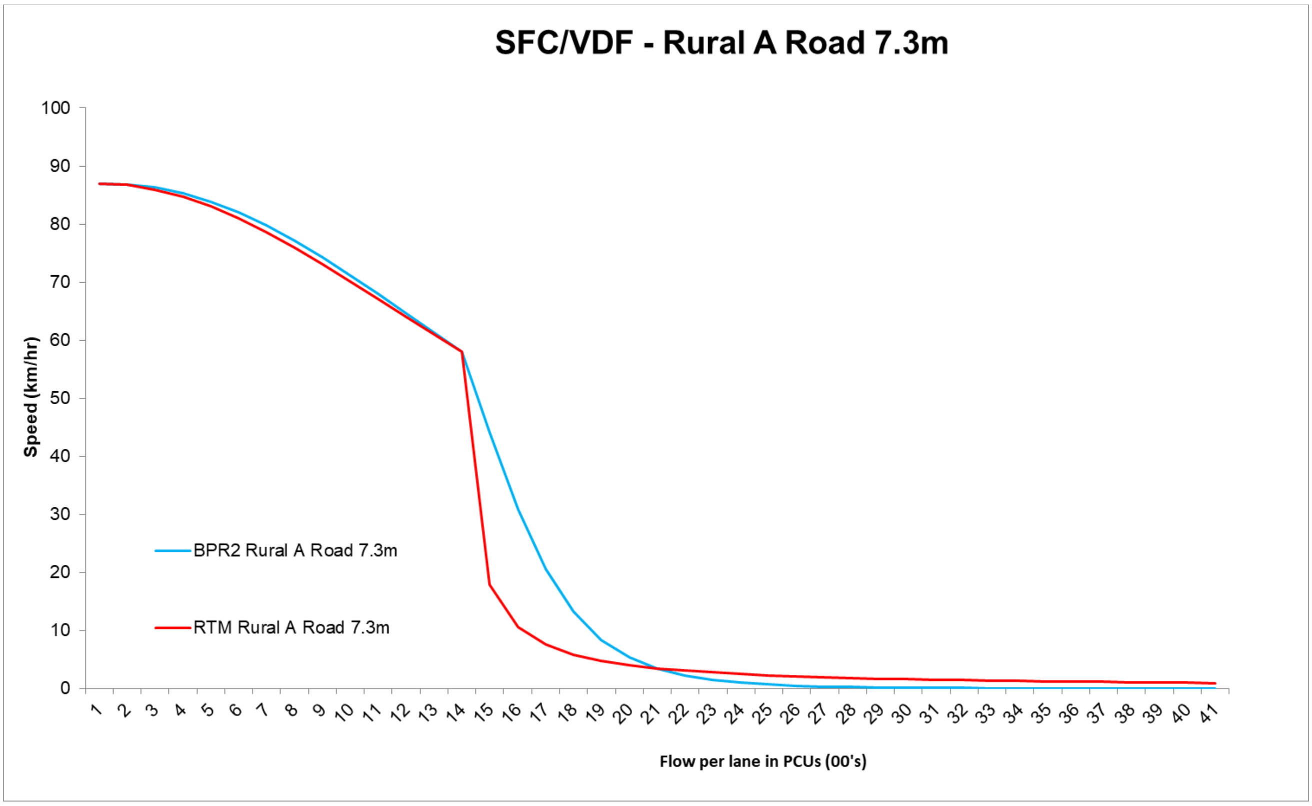

SFC/VDF - Rural D2 (60 MPH)
Speed (km/hr)
120
100
80
60
40
20
0
RTM SFC Rural D2 AP (60mph)
BPR2 Rural All-Purpose D2 (60mph)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
Flow per lane in PCUs (00's)

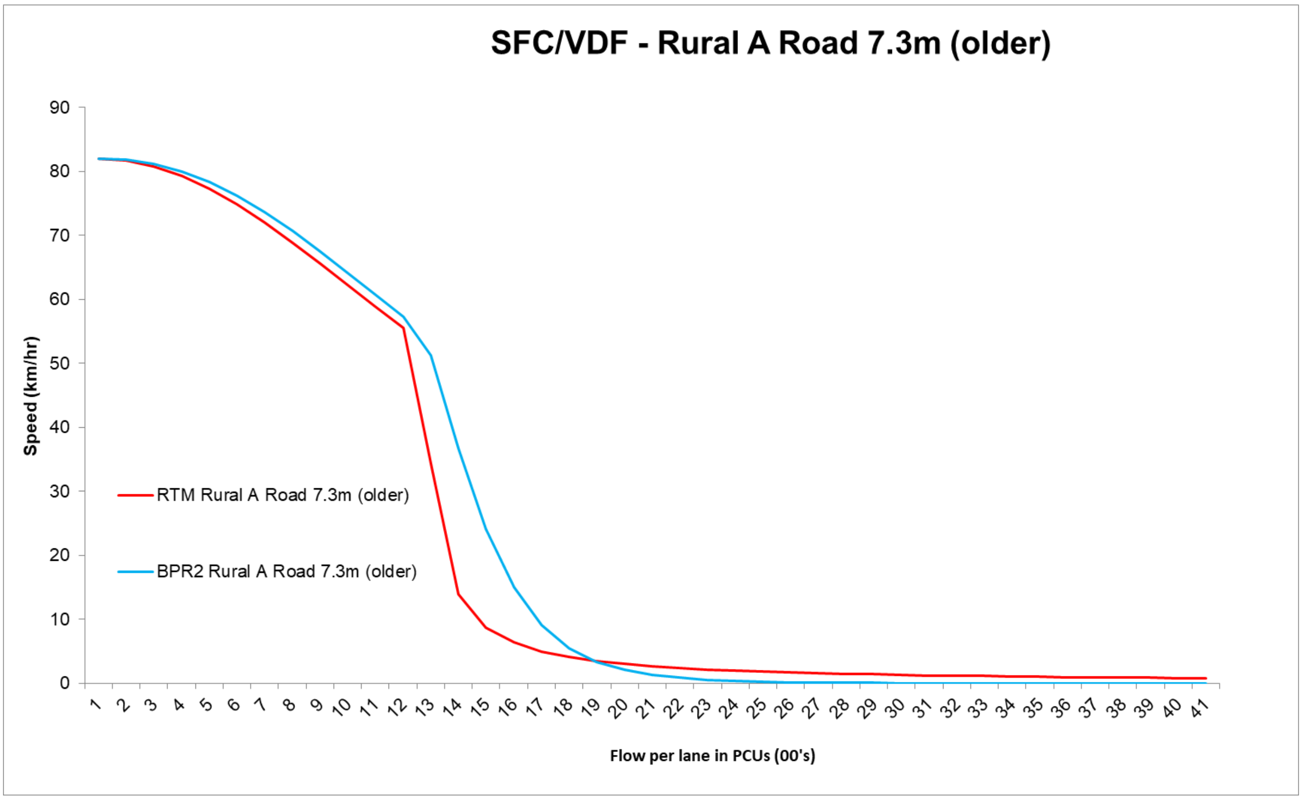

SFC/VDF - Rural D2 (50 MPH)
Speed (km/hr)
90
80
70
60
50
40
30
20
10
0
RTM SFC Rural D2 AP (50mph)
BPR2 Rural All-Purpose D2 (50mph)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
Flow per lane in PCUs (00's)

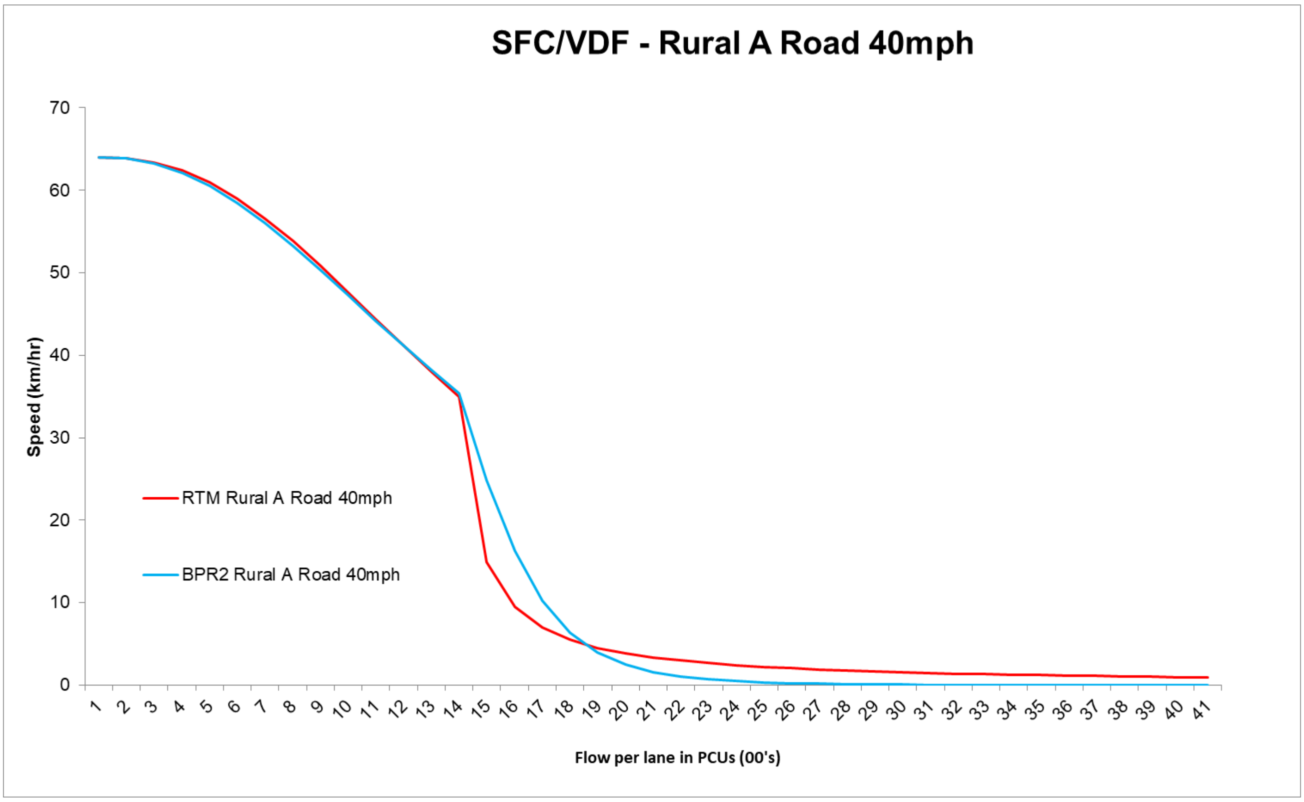

SFC/VDF - Rural D2 (40 MPH)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Rural D2 AP (40mph)
BPR2 Rural All-Purpose D2 (40mph)

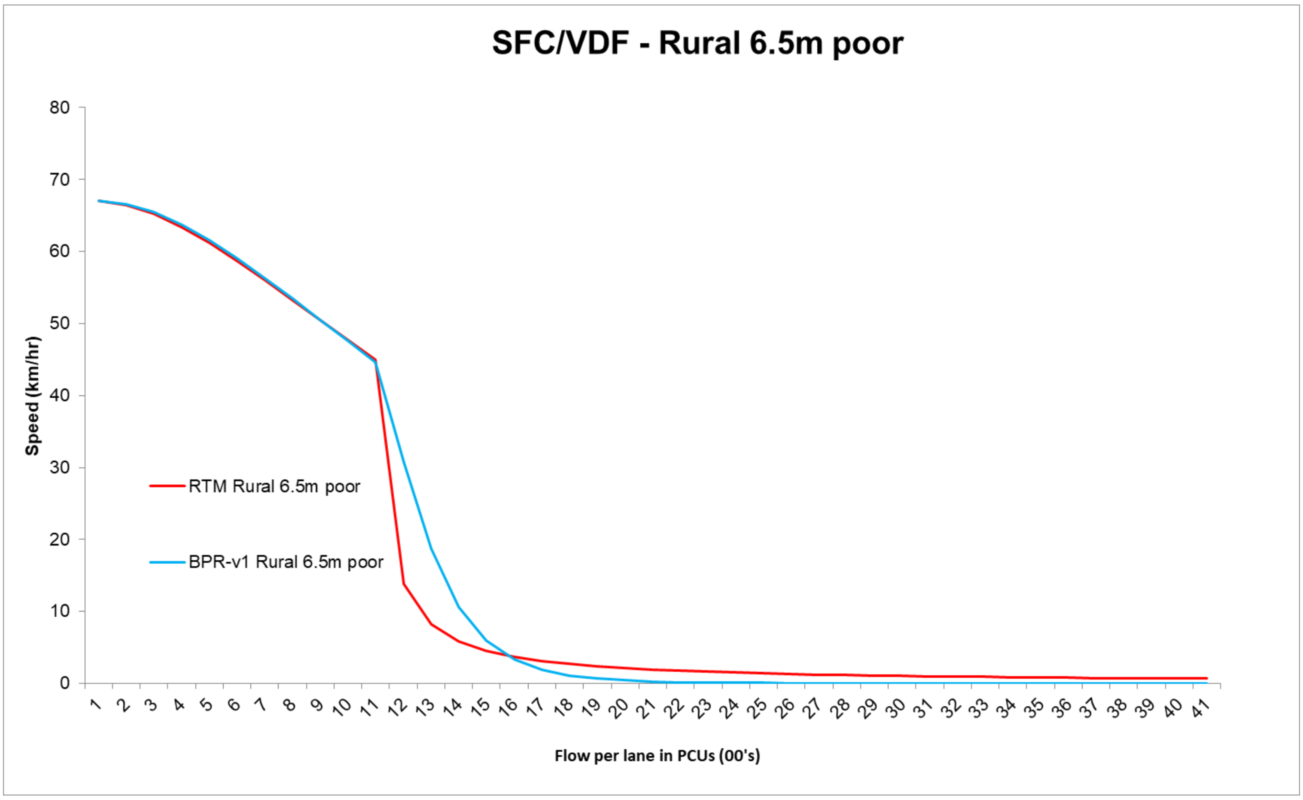

SFC/VDF - Rural S3/4 (60 MPH)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Rural S3/4 AP (60mph)
BPR2 Rural All-Purpose S3/4 (60mph)

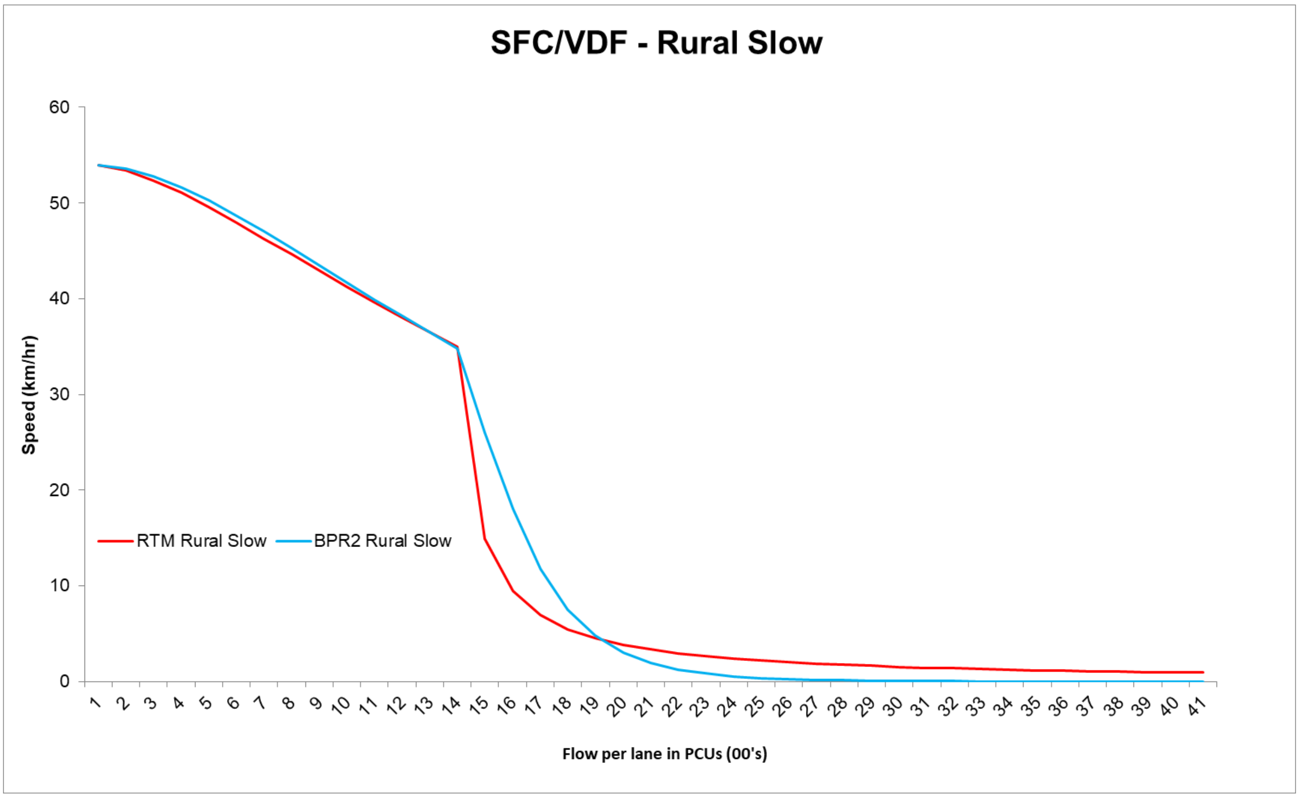

SFC/VDF - Rural A Road 10m
Speed (km/hr)
RTM Rural A Road 10m
BPR2 Rural A Road 10m
Flow per lane in PCUs (00's)

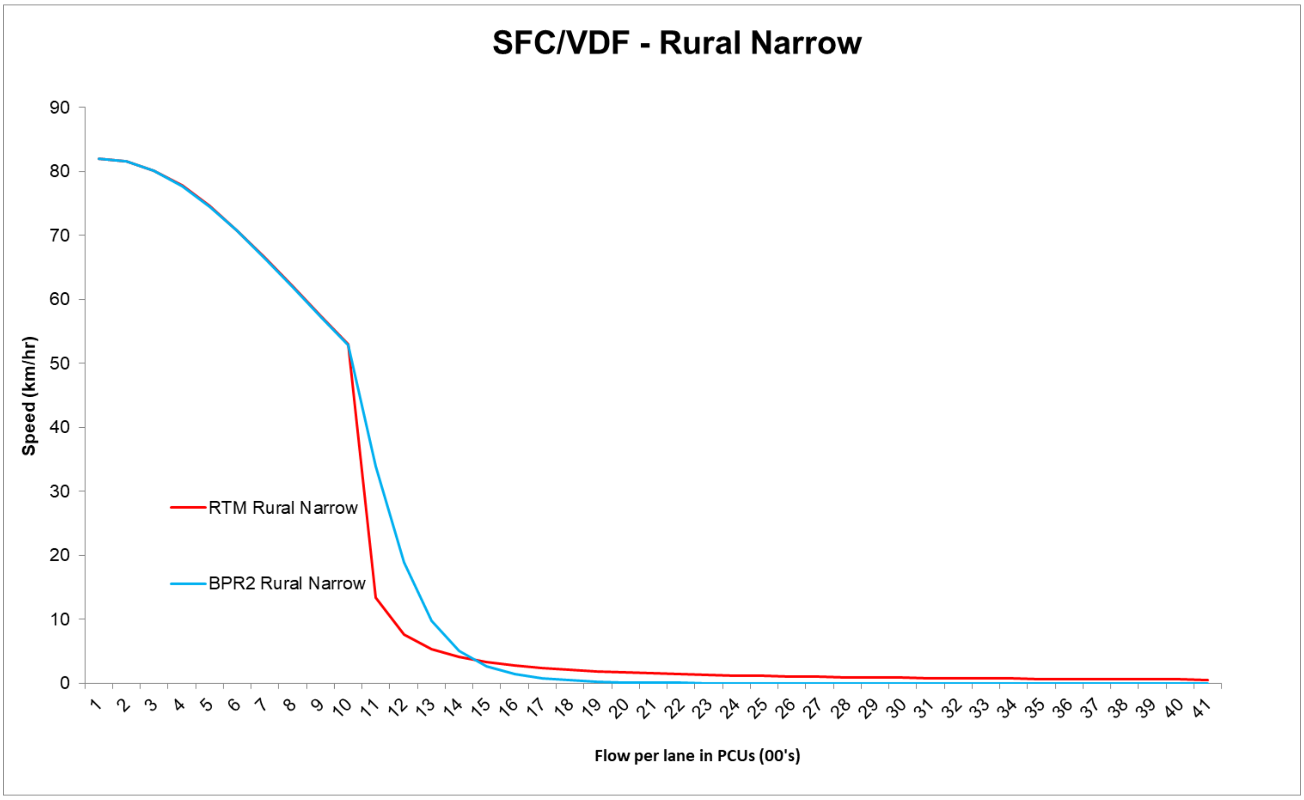

SFC/VDF - Rural A Road 7.3m
Speed (km/hr)
BPR2 Rural A Road 7.3m
RTM Rural A Road 7.3m
Flow per lane in PCUs (00's)

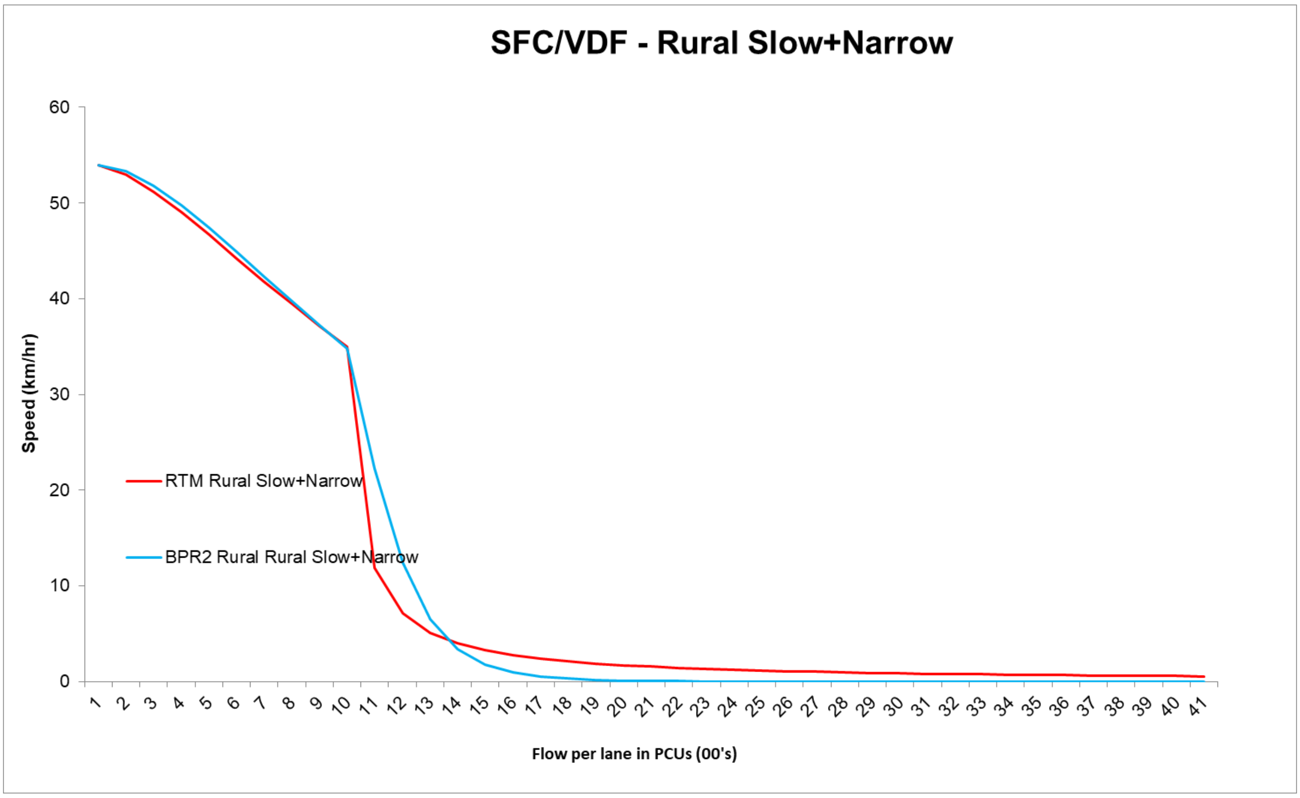

SFC/VDF - Rural A Road 7.3m (older)
90
80
70
60
50
40
30
20
10
0
Speed (km/hr)
RTM Rural A Road 7.3m (older)
BPR2 Rural A Road 7.3m (older)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
Flow per lane in PCUs (00's)

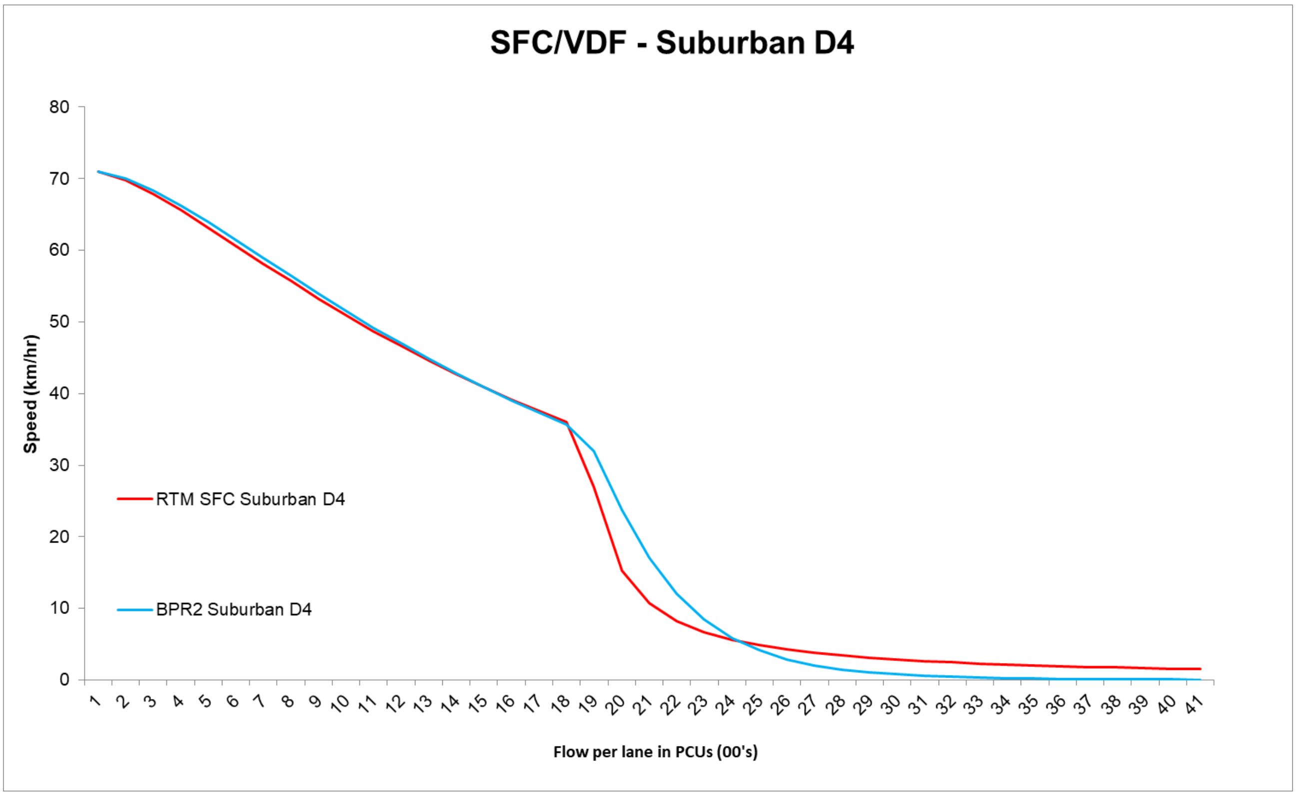

SFC/VDF - Rural A Road 40mph
70
60
50
40
30
20
10
0
Speed (km/hr)
RTM Rural A Road 40mph
BPR2 Rural A Road 40mph
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
Flow per lane in PCUs (00's)

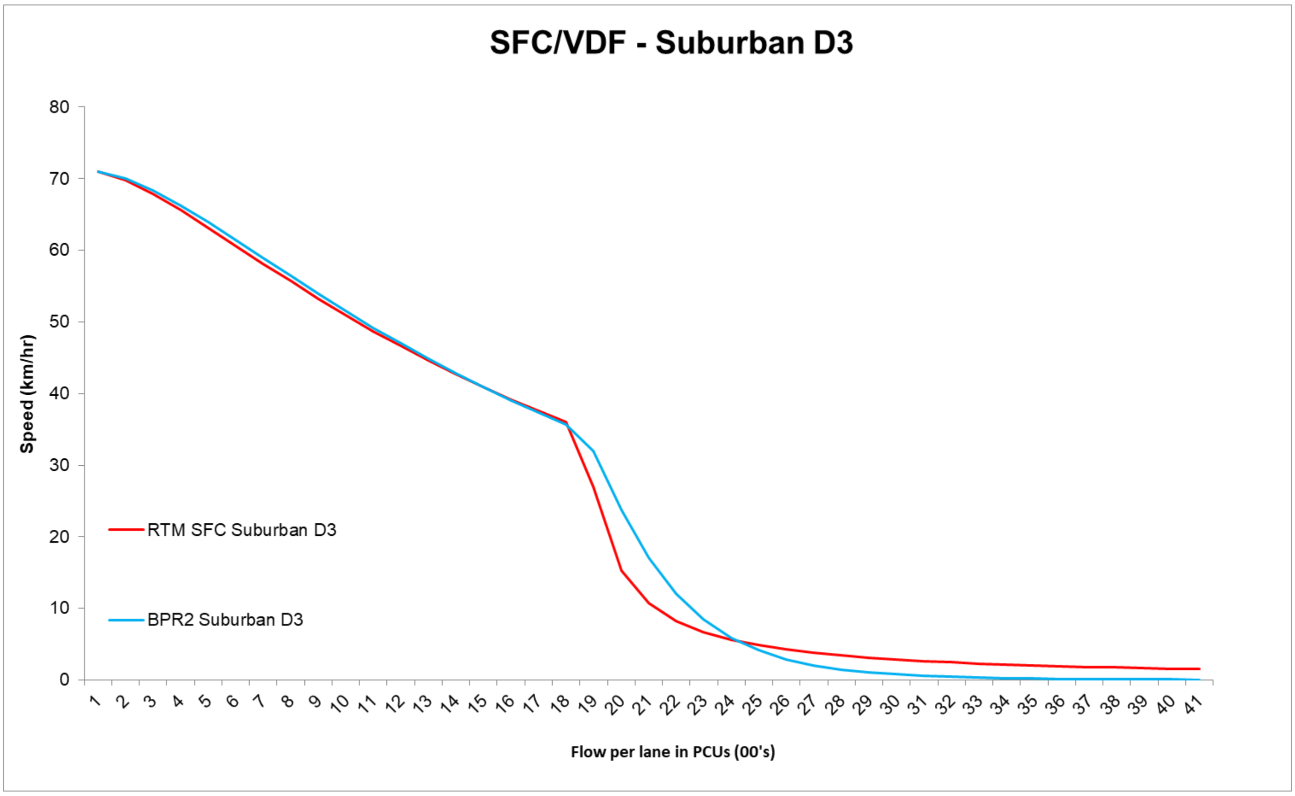

SFC/VDF - Rural 6.5m poor
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM Rural 6.5m poor
BPR-v1 Rural 6.5m poor
80
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

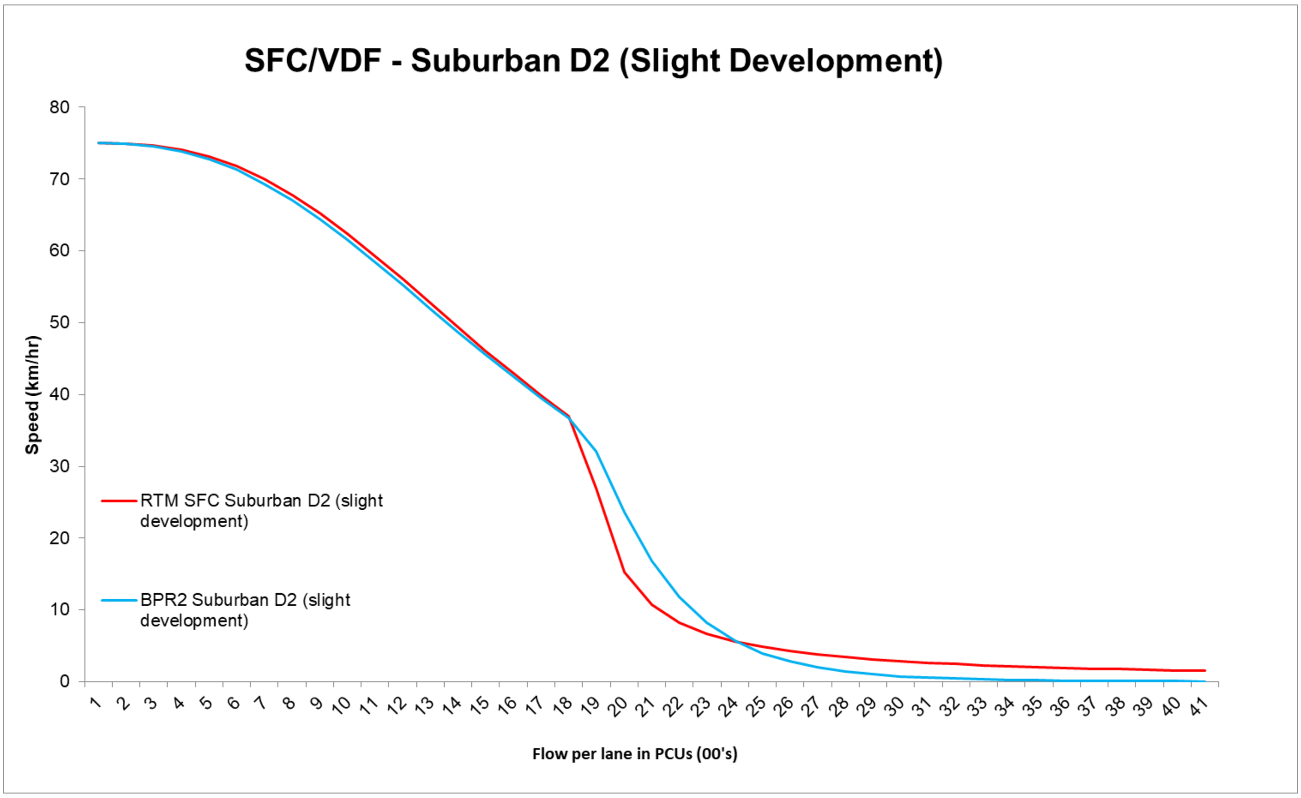

SFC/VDF - Rural Slow
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM Rural Slow
BPR2 Rural Slow
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

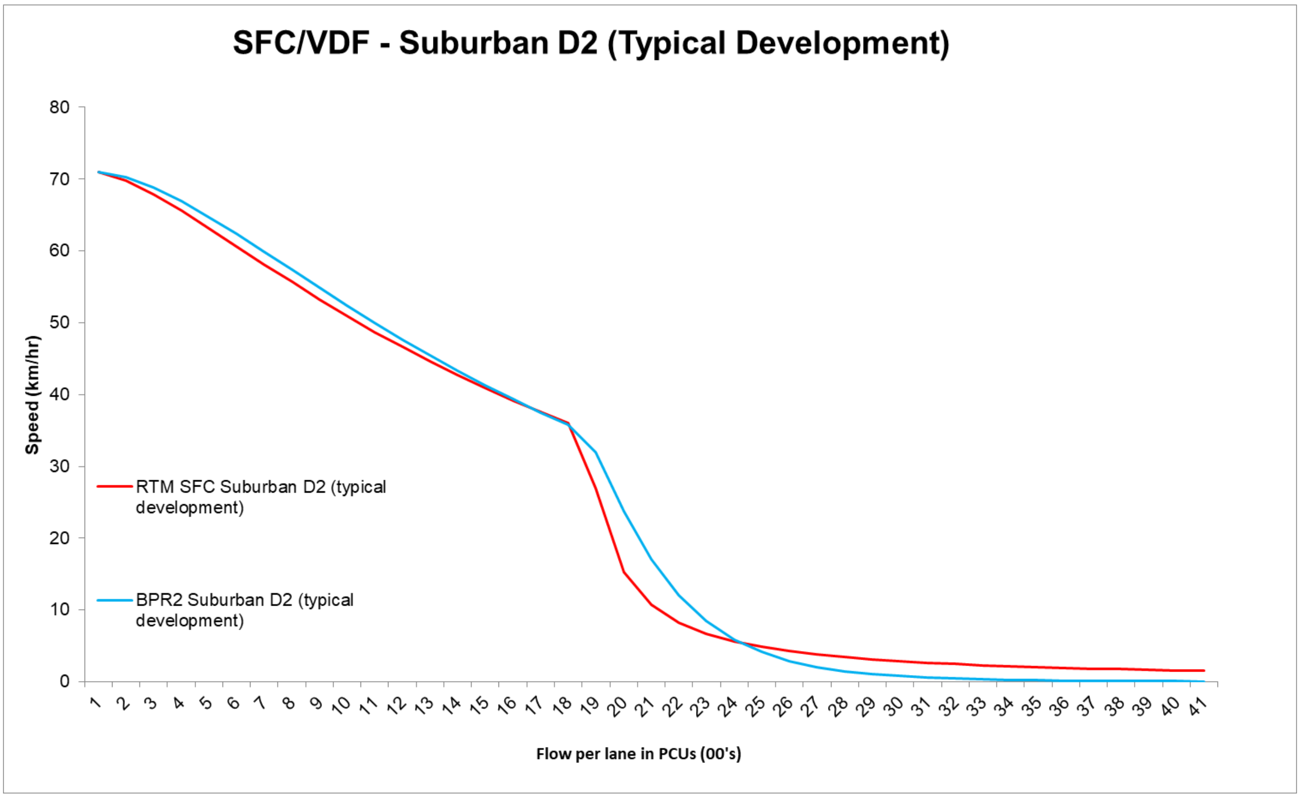

SFC/VDF - Rural Narrow
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM Rural Narrow
BPR2 Rural Narrow

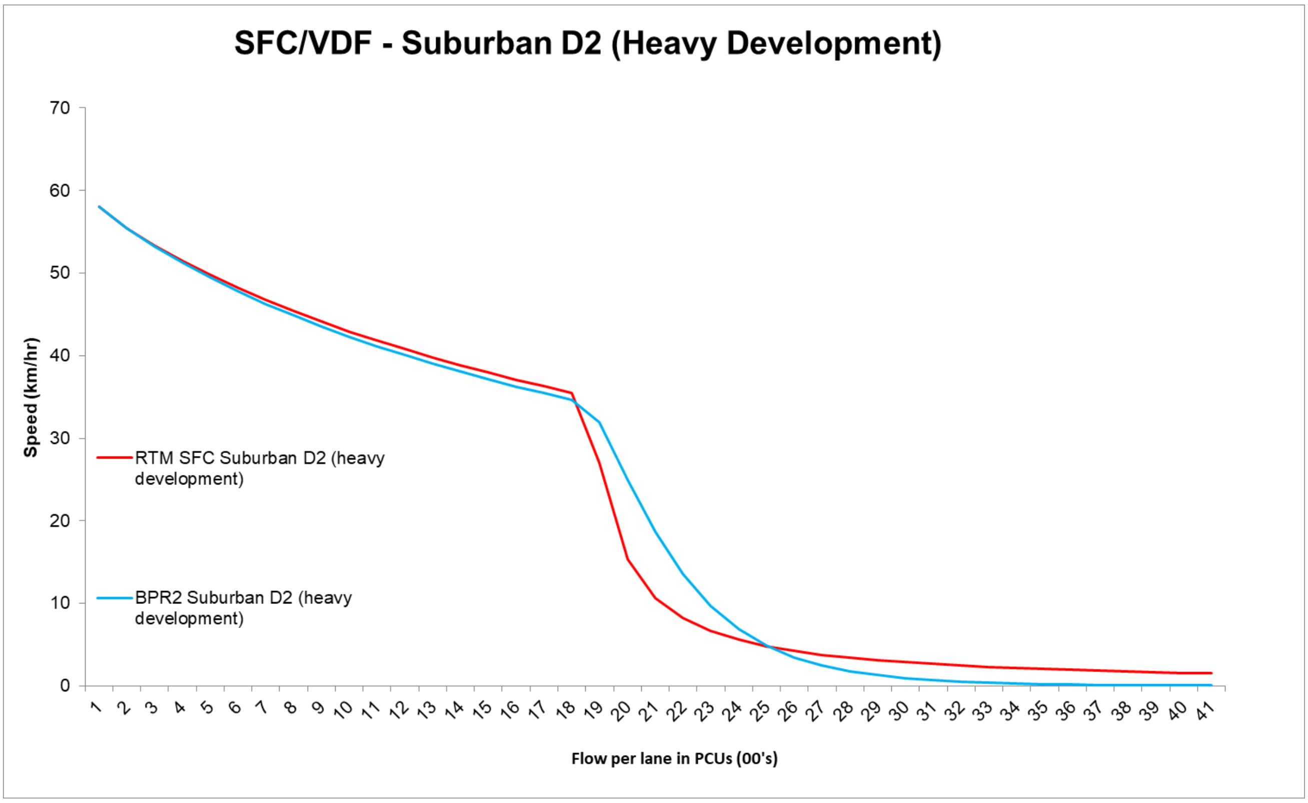

SFC/VDF - Rural Slow+Narrow
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM Rural Slow+Narrow
BPR2 Rural Rural Slow+Narrow


SFC/VDF - Suburban D4
Speed (km/hr)
0
10
20
30
40
50
60
70
80
RTM SFC Suburban D4
BPR2 Suburban D4
Flow per lane in PCUs (00's)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41

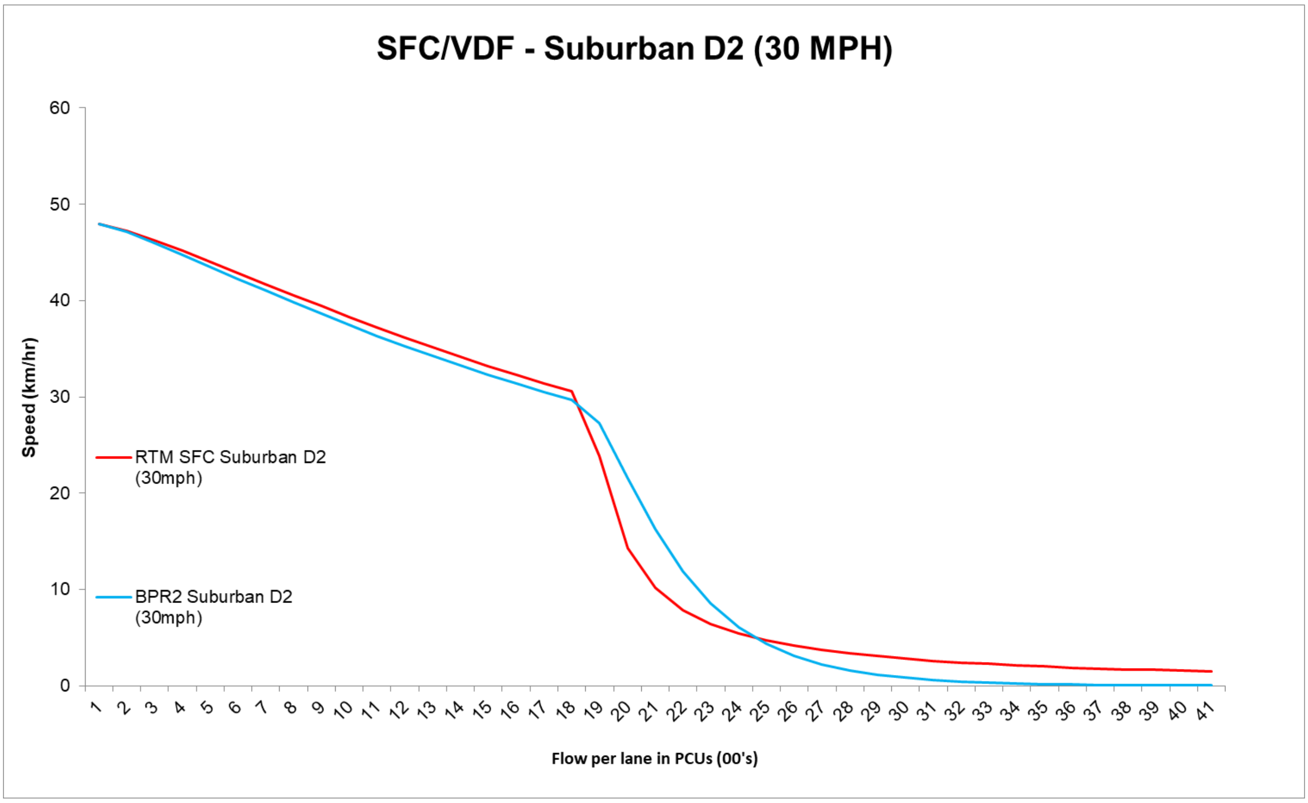

SFC/VDF - Suburban D3
Speed (km/hr)
0
10
20
30
40
50
60
70
80
RTM SFC Suburban D3
BPR2 Suburban D3
Flow per lane in PCUs (00's)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41


SFC/VDF - Suburban D2 (Slight Development)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Suburban D2 (slight development)
BPR2 Suburban D2 (slight development)

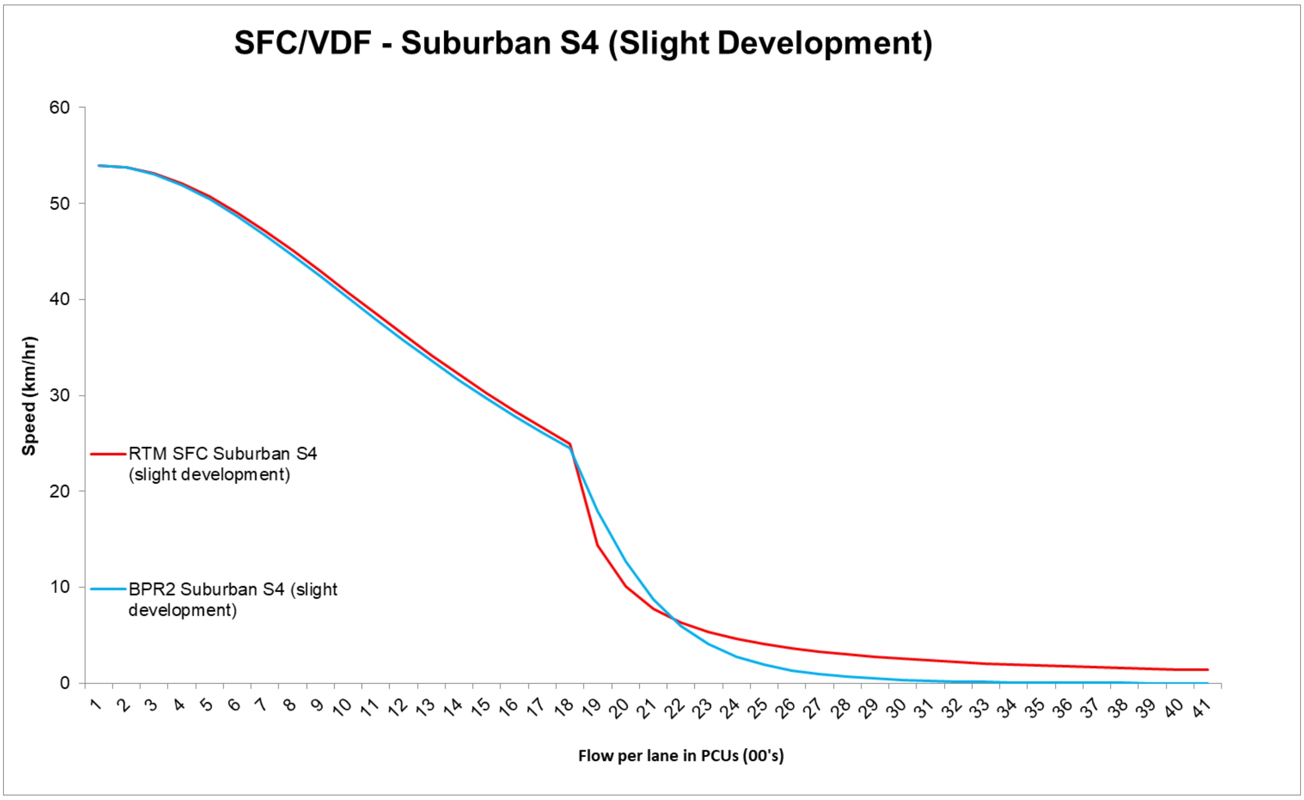

SFC/VDF - Suburban D2 (Typical Development)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Suburban D2 (typical development)
BPR2 Suburban D2 (typical development)

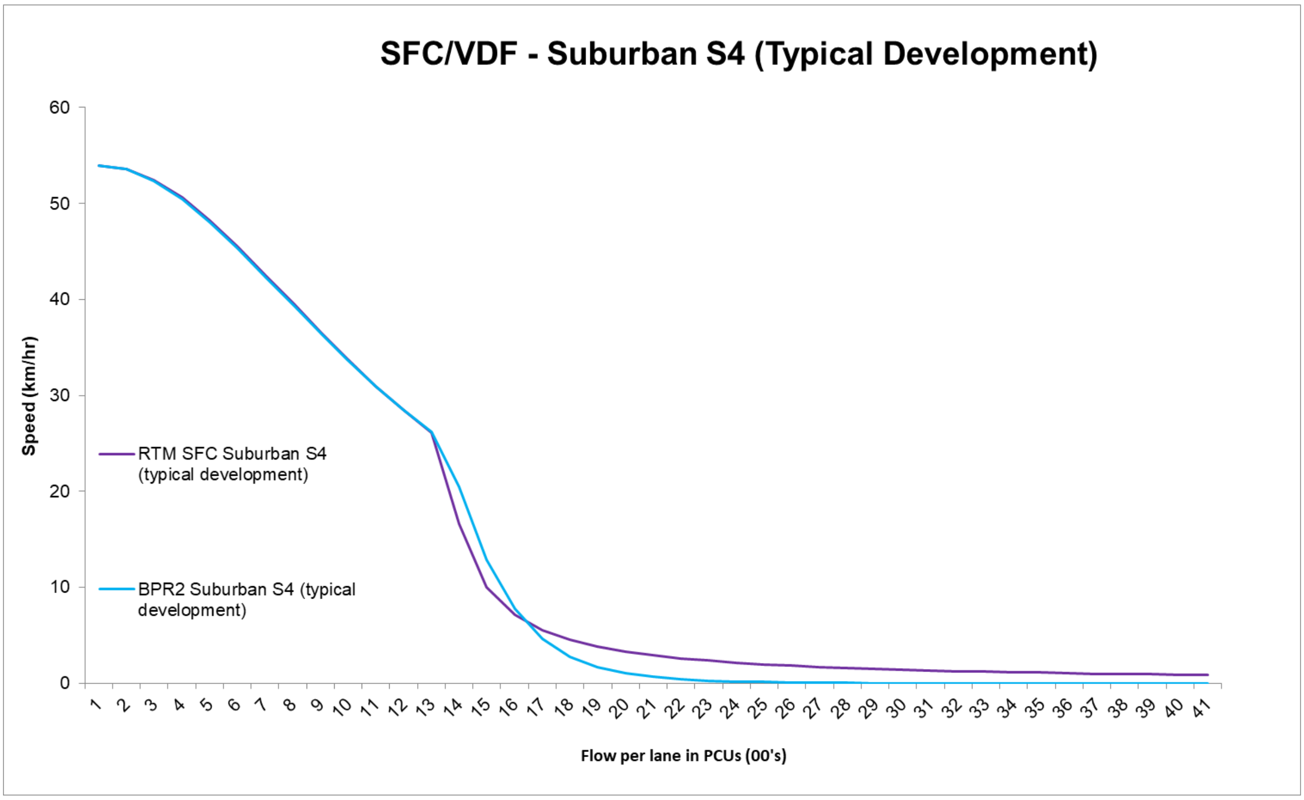


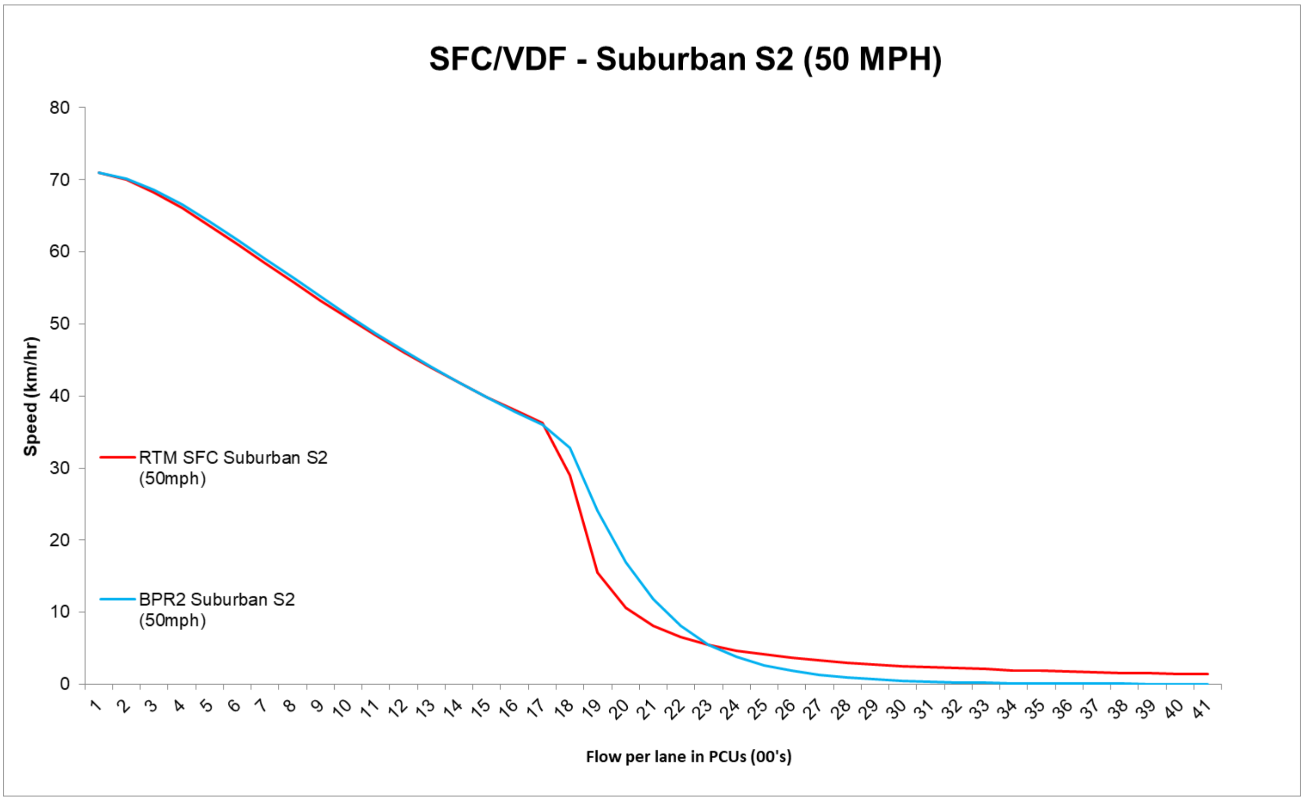
SFC/VDF - Suburban D2 (Heavy Development)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Suburban D2 (heavy development)
BPR2 Suburban D2 (heavy development)

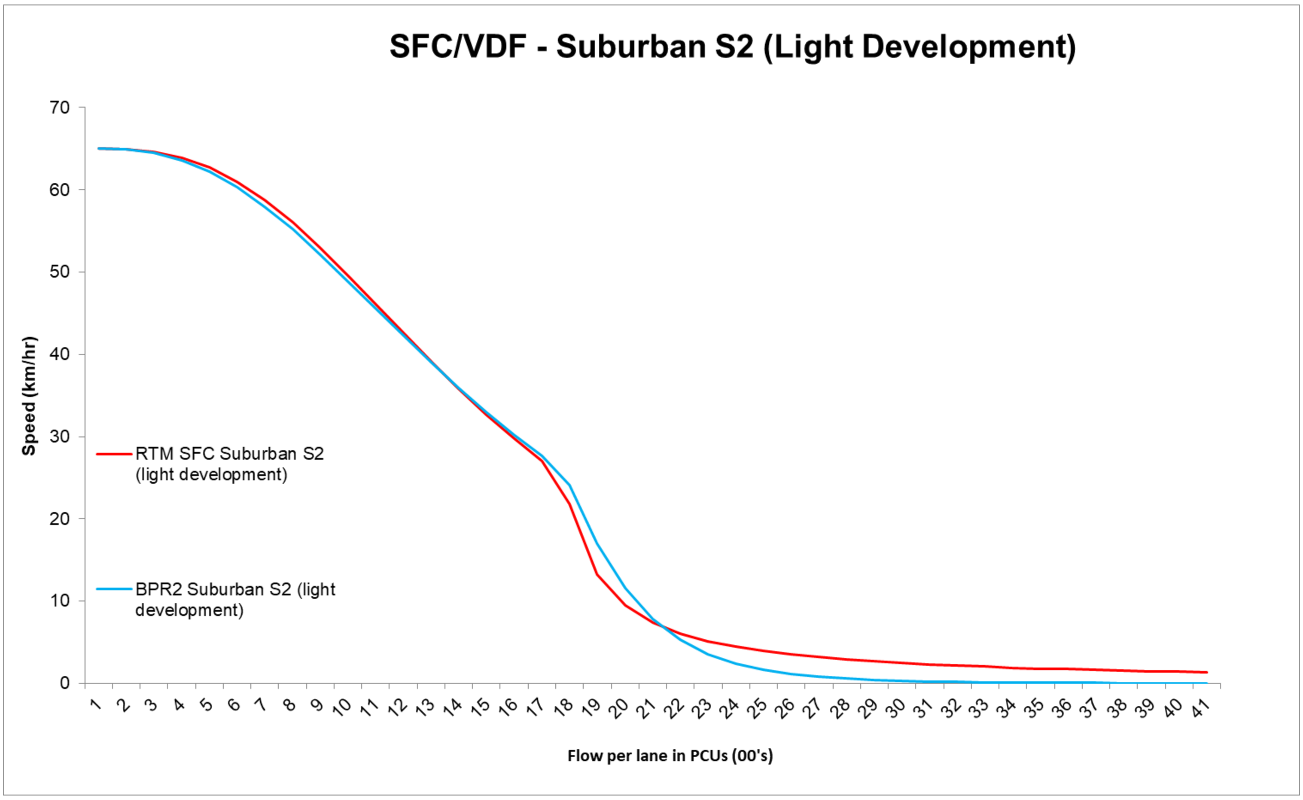


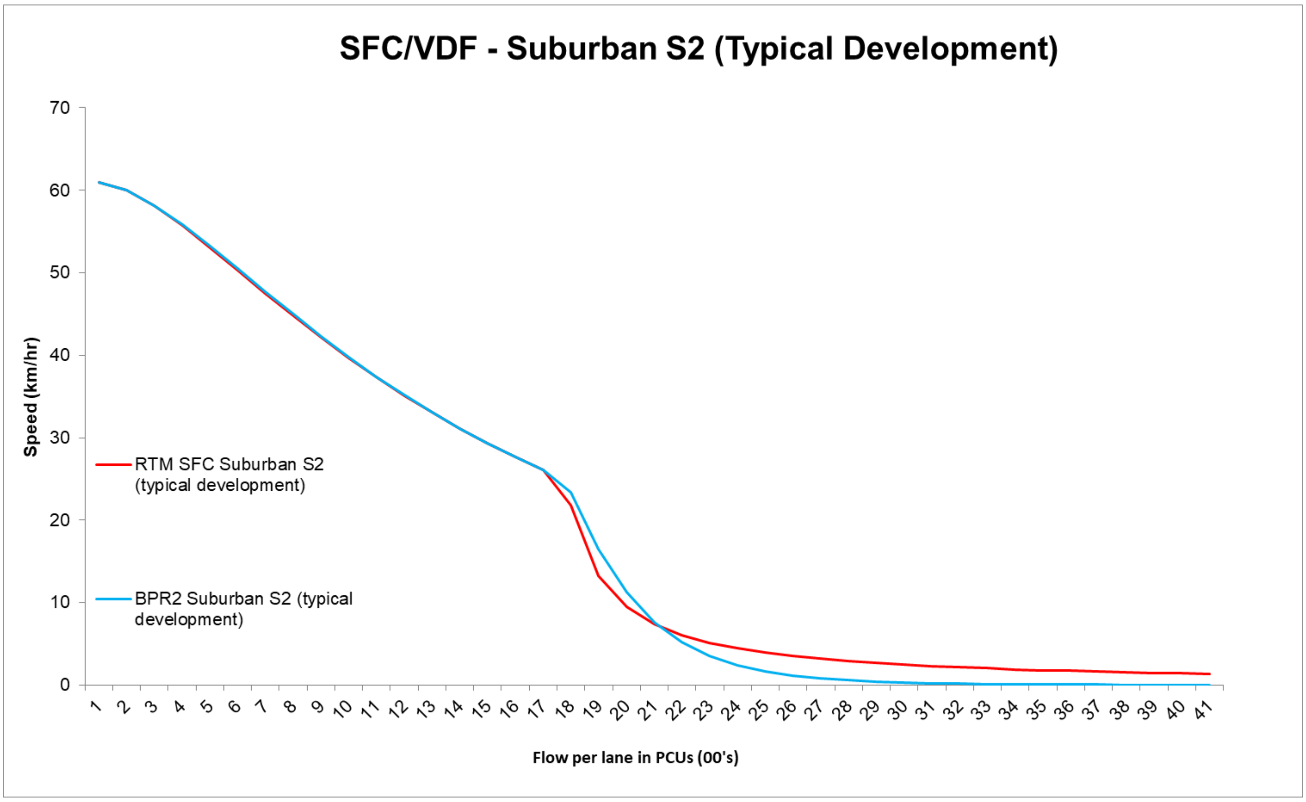
SFC/VDF - Suburban D2 (30 MPH)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Suburban D2 (30mph)
BPR2 Suburban D2 (30mph)

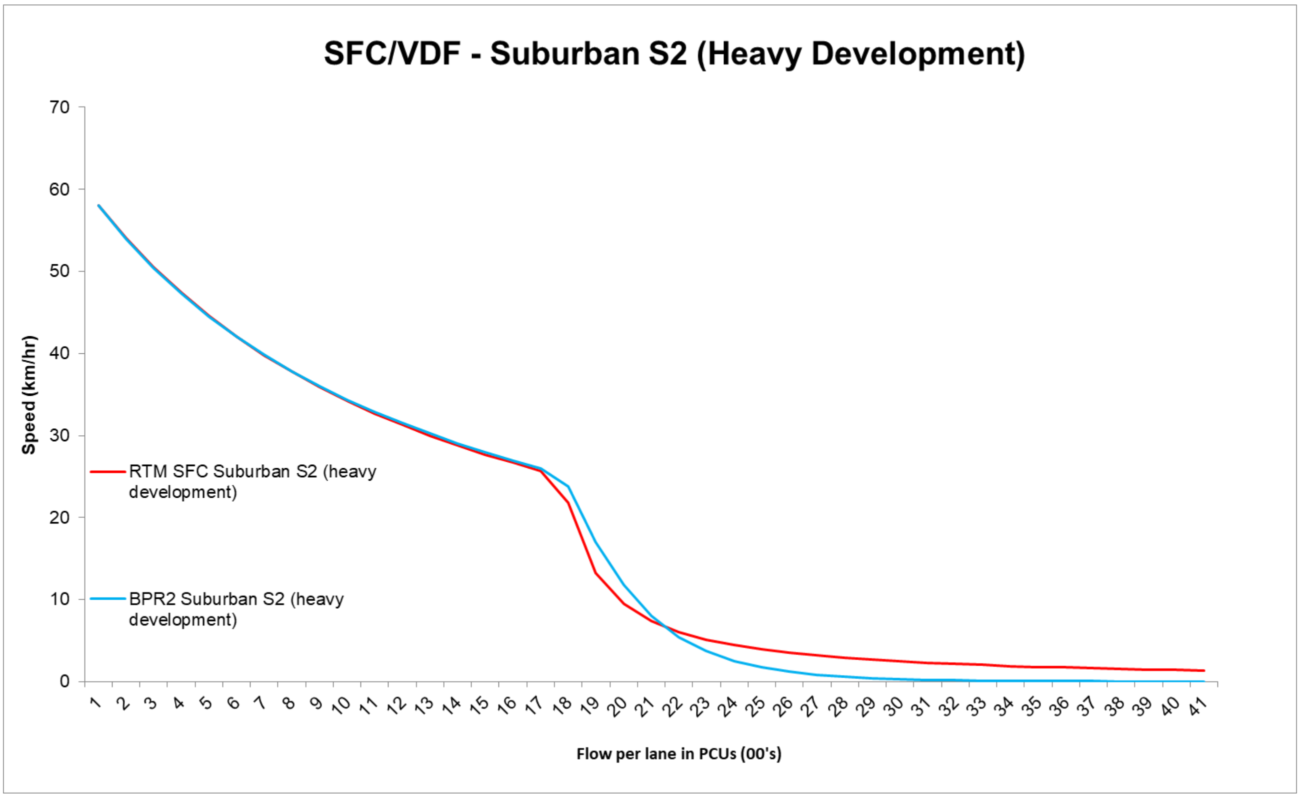

SFC/VDF - Suburban S4 (Slight Development)
Speed (km/hr)
RTM SFC Suburban S4 (slight development)
BPR2 Suburban S4 (slight development)
Flow per lane in PCUs (00's)

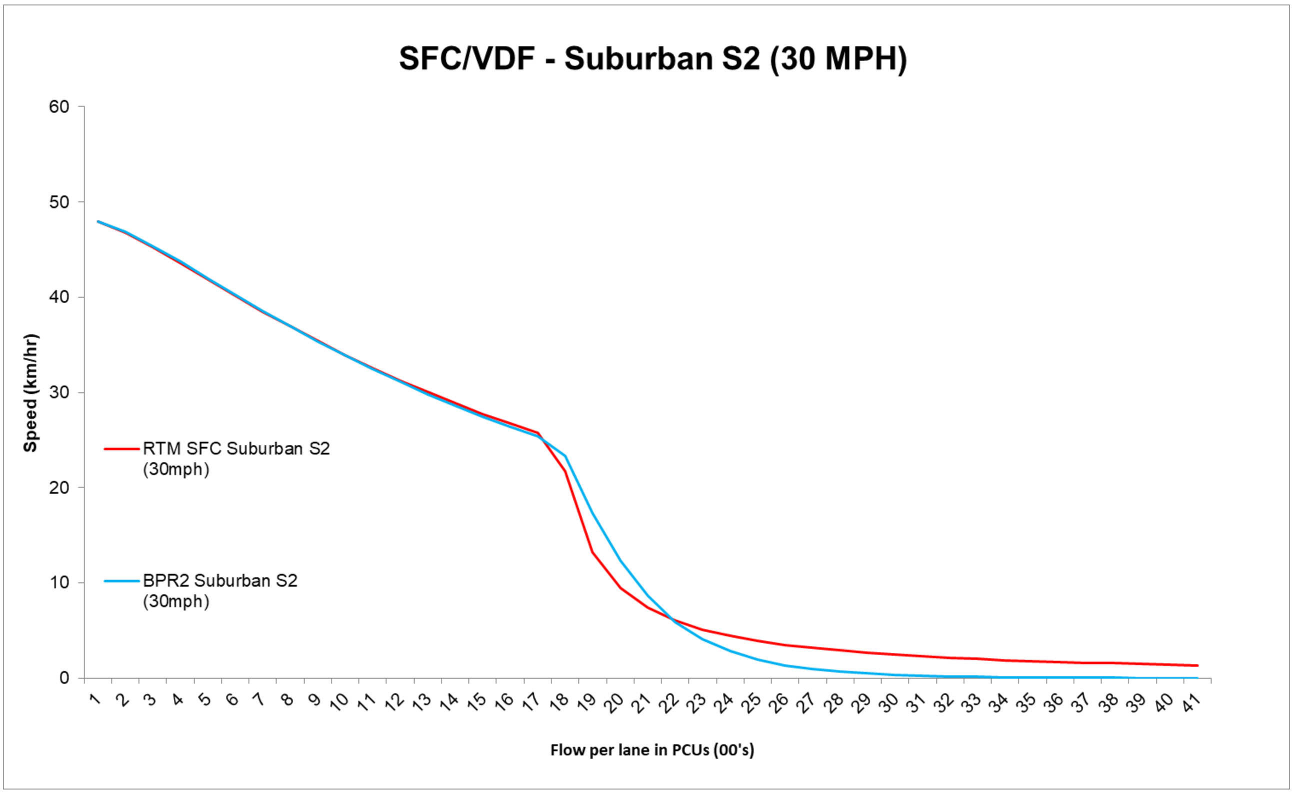

SFC/VDF - Suburban S4 (Typical Development)
Speed (km/hr)
RTM SFC Suburban S4 (typical development)
BPR2 Suburban S4 (typical development)
Flow per lane in PCUs (00's)

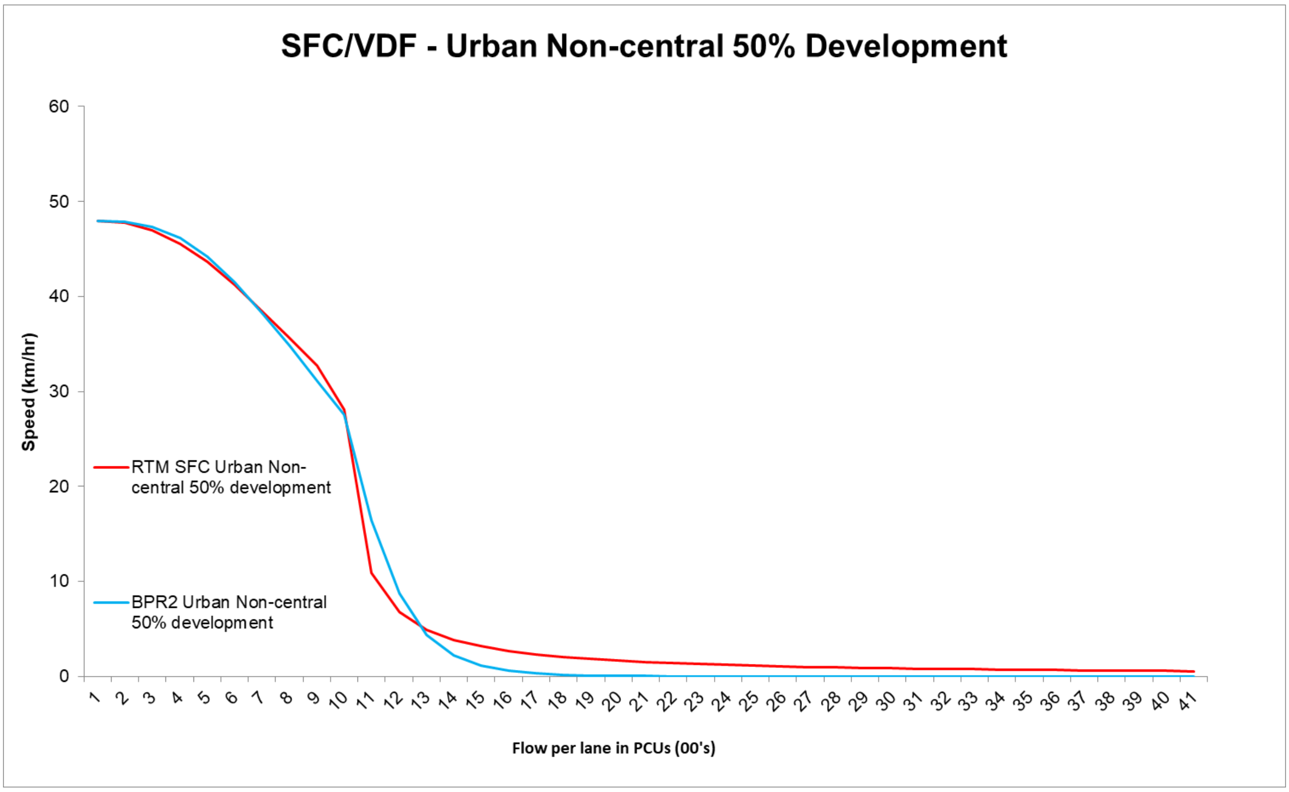

SFC/VDF - Suburban S2 (50 MPH)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Suburban S2 (50mph)
BPR2 Suburban S2 (50mph)

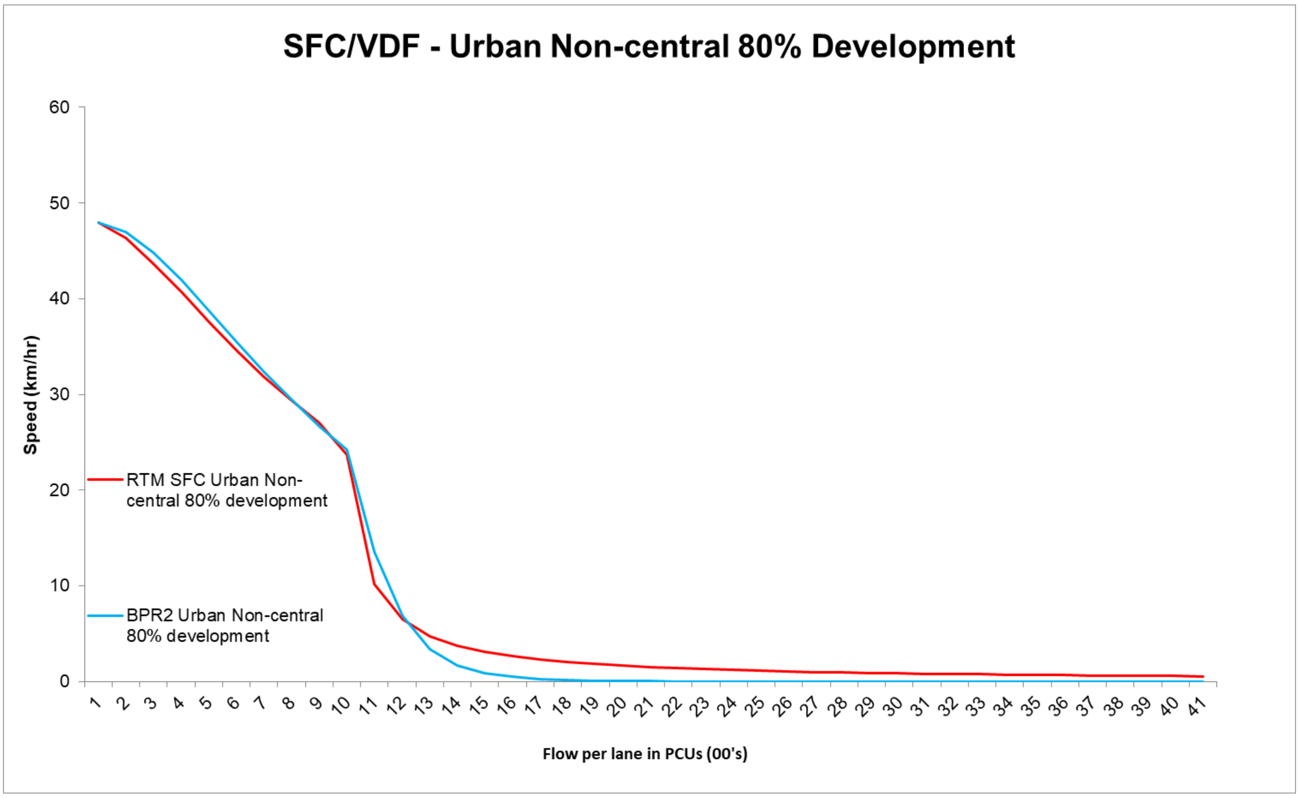

SFC/VDF - Suburban S2 (Light Development)
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Suburban S2 (light development)
BPR2 Suburban S2 (light development)


SFC/VDF - Suburban S2 (Typical Development)
Speed (km/hr)
70
60
50
40
30
20
10
0
RTM SFC Suburban S2 (typical development)
BPR2 Suburban S2 (typical development)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
Flow per lane in PCUs (00's)

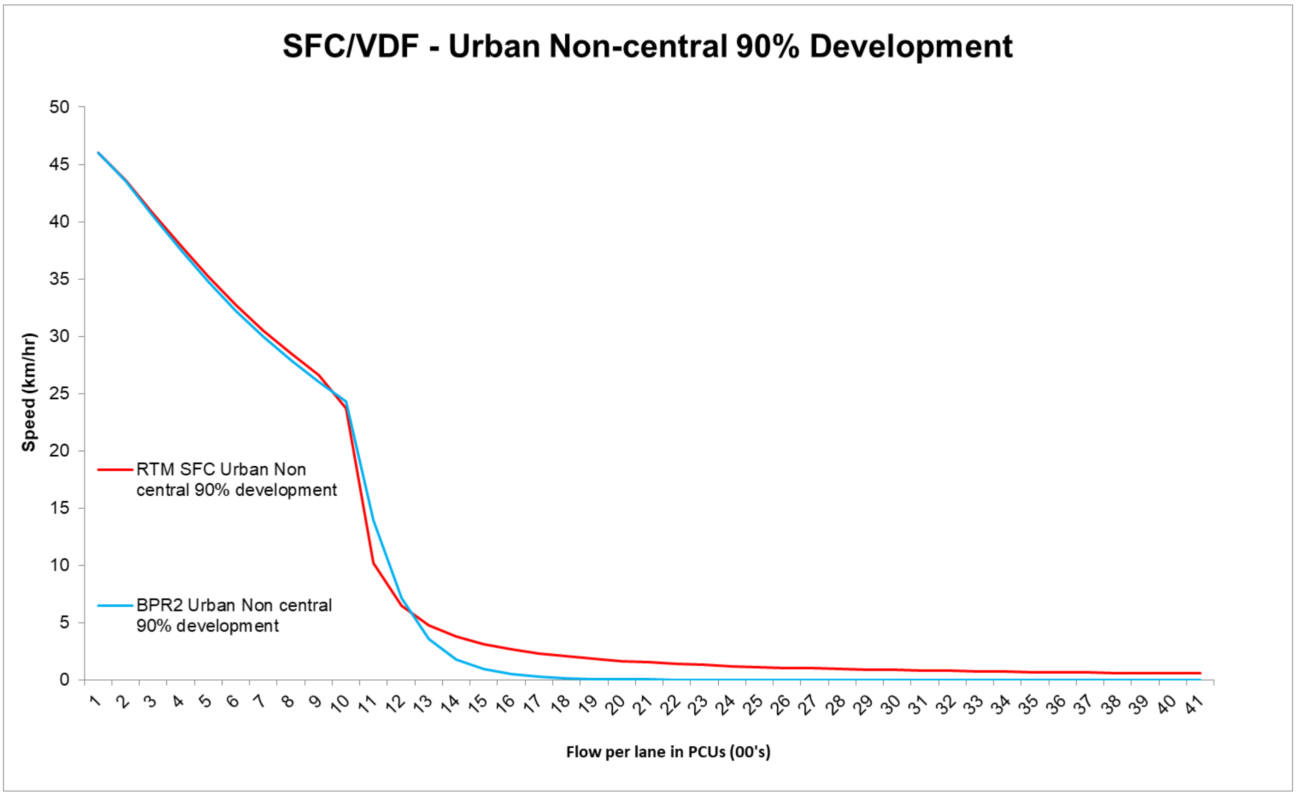

SFC/VDF - Suburban S2 (Heavy Development)
Speed (km/hr)
70
60
50
40
30
20
10
0
RTM SFC Suburban S2 (heavy development)
BPR2 Suburban S2 (heavy development)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
Flow per lane in PCUs (00's)


SFC/VDF - Suburban S2 (30 MPH)
Speed (km/hr)
RTM SFC Suburban S2 (30mph)
BPR2 Suburban S2 (30mph)
Flow per lane in PCUs (00's)

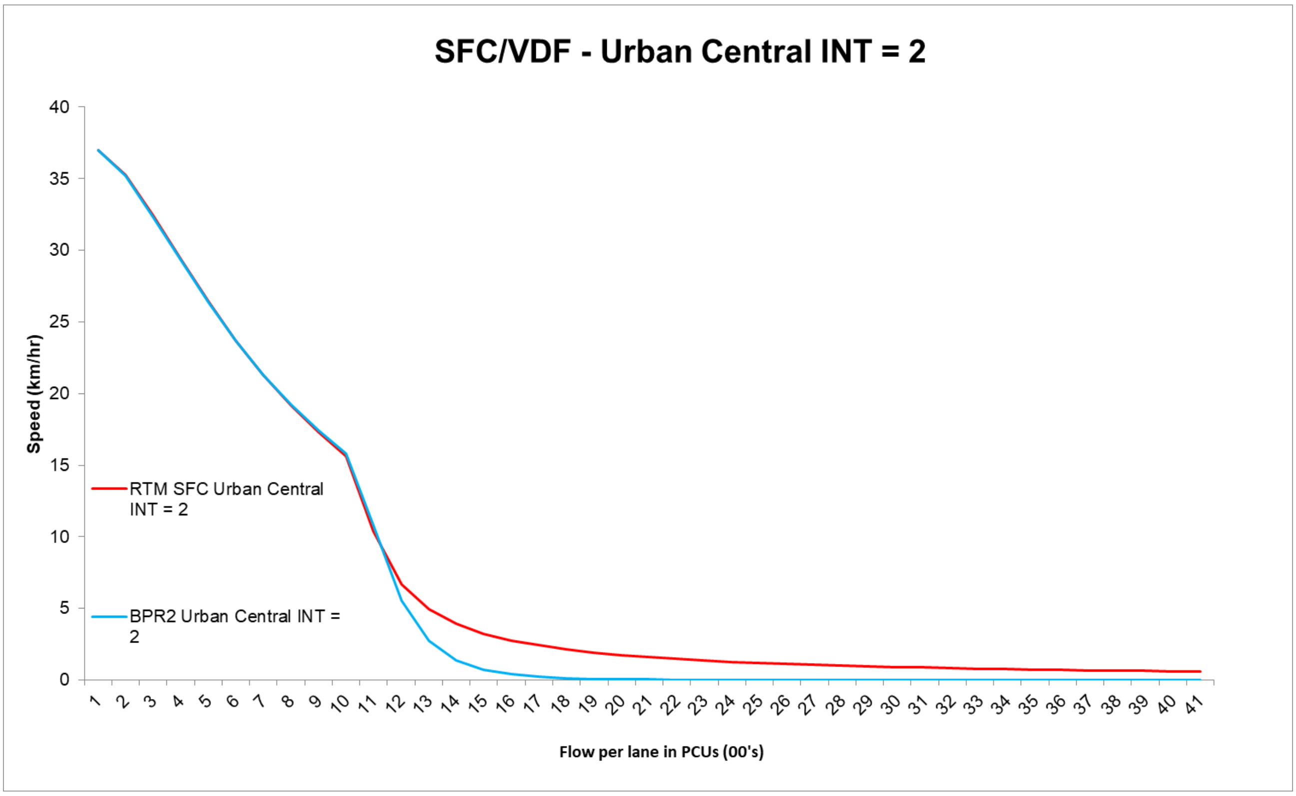

SFC/VDF - Urban Non-central 50% Development
Speed (km/hr)
RTM SFC Urban Non-central 50% development
BPR2 Urban Non-central 50% development
Flow per lane in PCUs (00's)

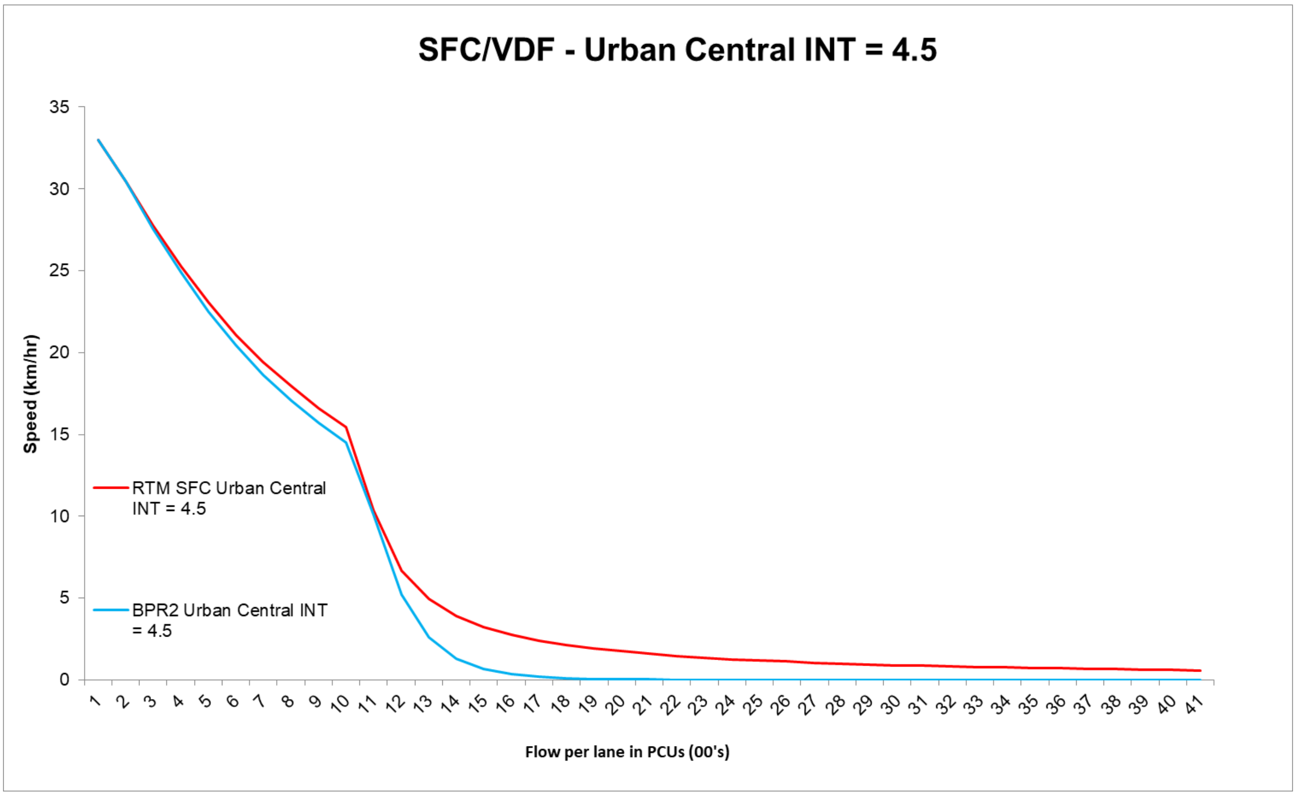


SFC/VDF - Urban Non-central 80% Development
Speed (km/hr)
60
50
40
30
20
10
0
RTM SFC Urban Non-central 80% development
BPR2 Urban Non-central 80% development
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
Flow per lane in PCUs (00's)



SFC/VDF - Urban Non-central 90% Development
Speed (km/hr)
50
45
40
35
30
25
20
15
10
5
0
RTM SFC Urban Non central 90% development
BPR2 Urban Non central 90% development
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
Flow per lane in PCUs (00's)


SFC/VDF - Urban Central INT = 2
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Urban Central INT = 2
BPR2 Urban Central INT = 2
0
5
10
15
20
25
30
35
40
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41


SFC/VDF - Urban Central INT = 4.5
Speed (km/hr)
Flow per lane in PCUs (00's)
RTM SFC Urban Central INT = 4.5
BPR2 Urban Central INT = 4.5
0
5
10
15
20
25
30
35
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
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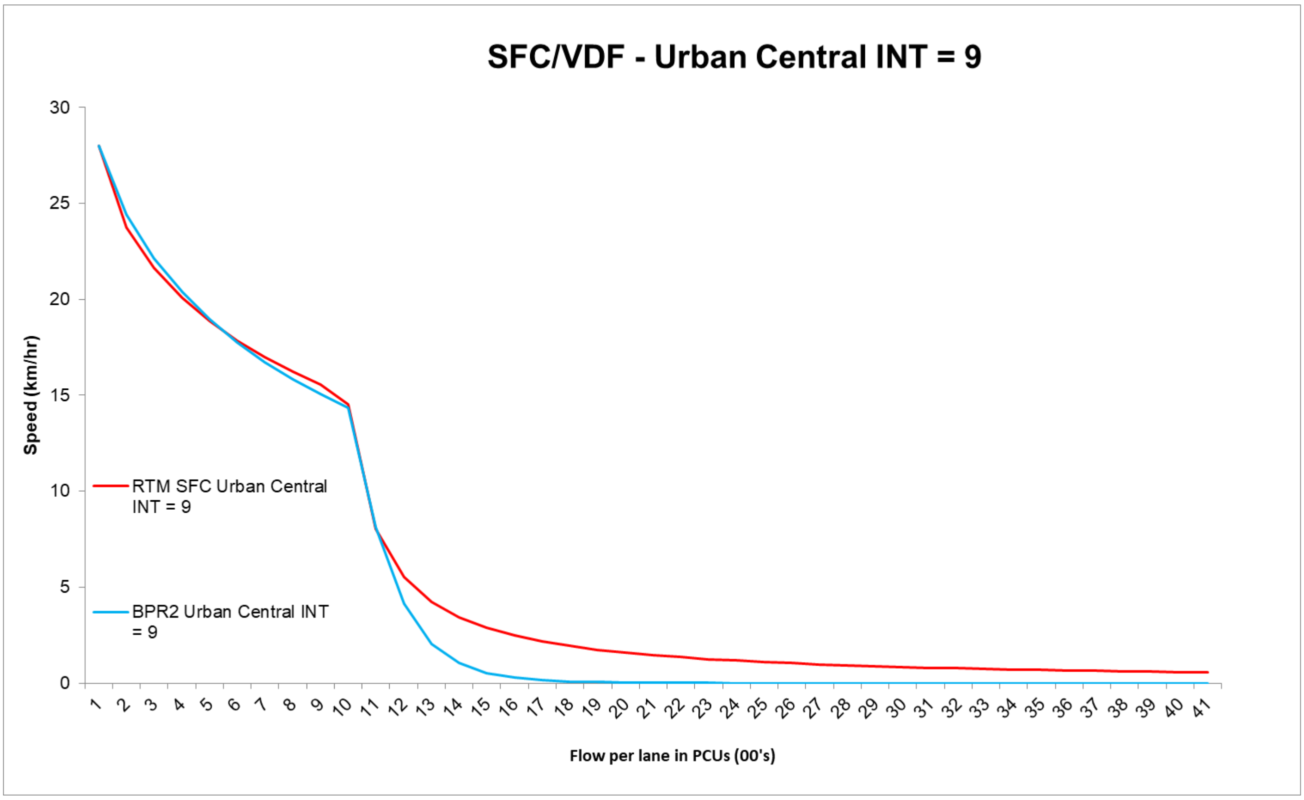
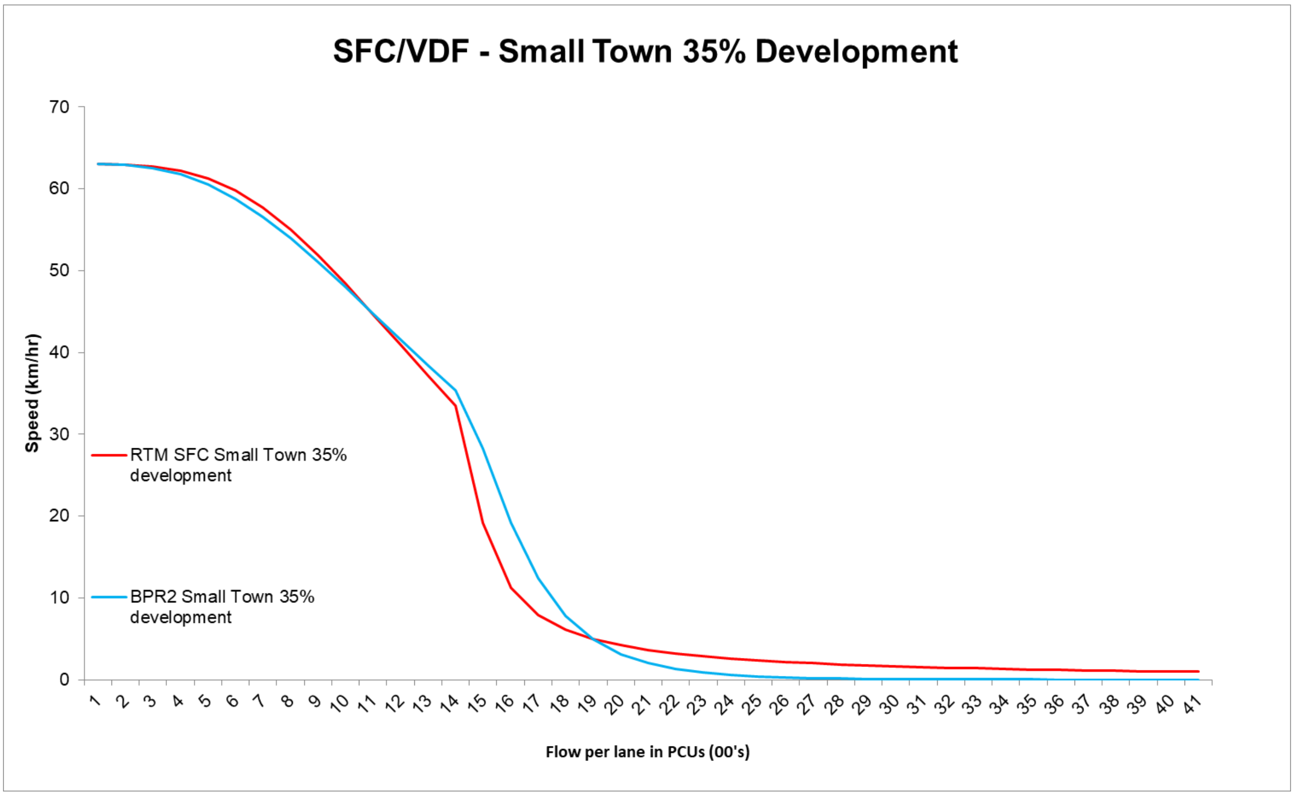
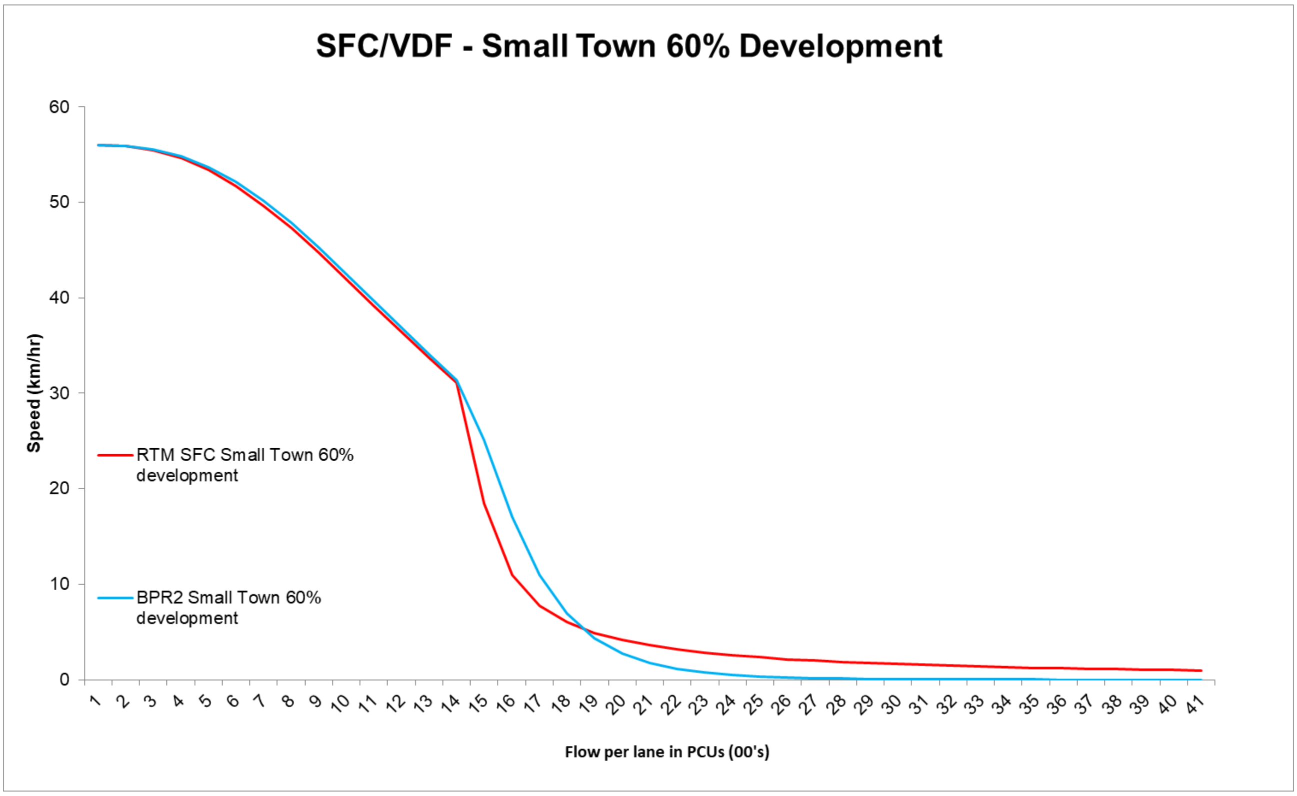
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41

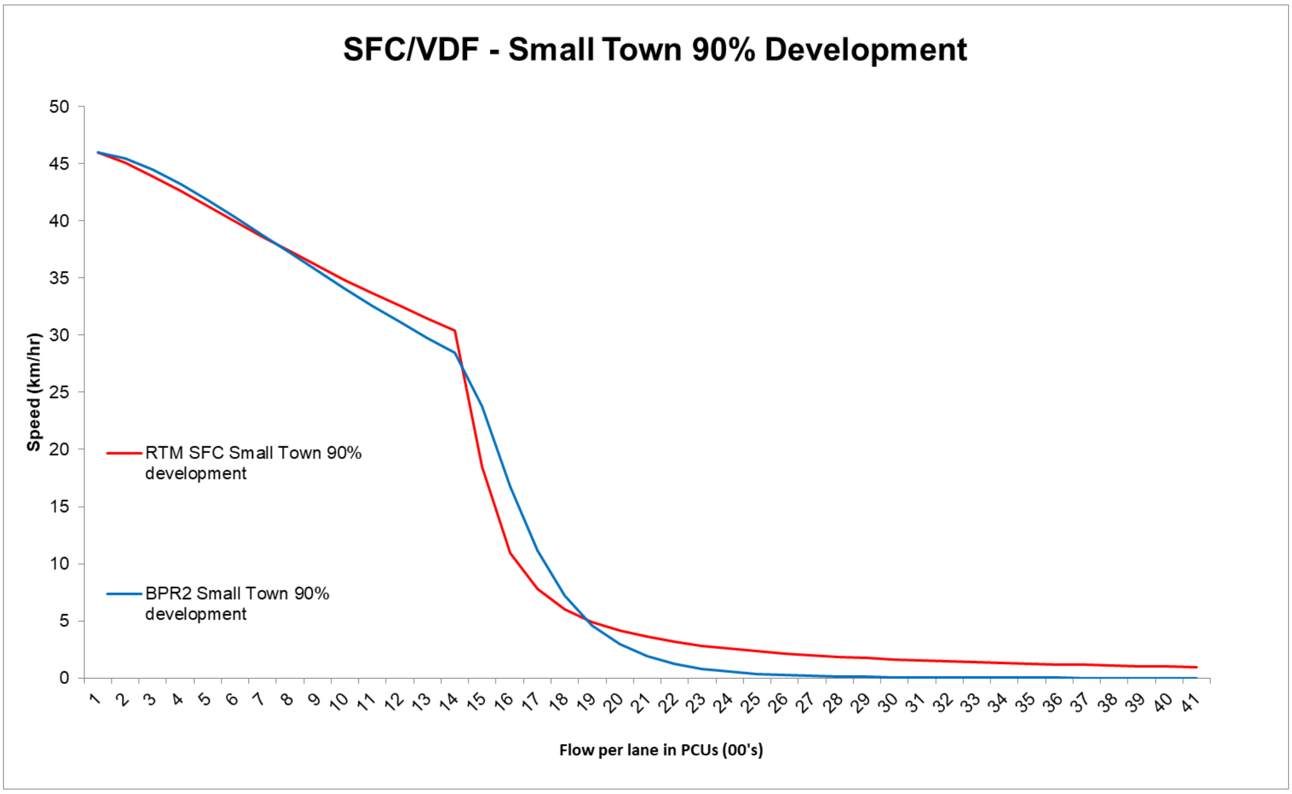


SFC/VDF - Urban Central INT = 9
Speed (km/hr)
RTM SFC Urban Central INT = 9
BPR2 Urban Central INT = 9
Flow per lane in PCUs (00's)



SFC/VDF - Small Town 35% Development
Speed (km/hr)
RTM SFC Small Town 35% development
BPR2 Small Town 35% development
Flow per lane in PCUs (00's)


SFC/VDF - Small Town 60% Development
Speed (km/hr)
RTM SFC Small Town 60% development
BPR2 Small Town 60% development
Flow per lane in PCUs (00's)


SFC/VDF - Small Town 90% Development
Speed (km/hr)
RTM SFC Small Town 90% development
BPR2 Small Town 90% development
Flow per lane in PCUs (00's)

Appendix B – Link Types and Parameters

Link type No.	Description	Available Transport System	No. Lanes	Cap (pcus/hr)	Free-flow speed (kph)	Volume Delay function Parameters			
						a	b	b1	c
1	Rural Motorway D6	B,Cc,Ce,Co,HGV,LGV	6	13980	113	0.39	2.78	9.00	0.80
2	Rural Motorway D5	B,Cc,Ce,Co,HGV,LGV	5	11650	113	0.39	2.78	9.00	0.80
3	Rural Motorway D4	B,Cc,Ce,Co,HGV,LGV	4	9320	113	0.39	2.78	9.00	0.80
4	Rural Motorway D3	B,Cc,Ce,Co,HGV,LGV	3	6990	113	0.39	2.78	9.00	0.80
5	Rural Motorway D2	B,Cc,Ce,Co,HGV,LGV	2	4659	113	0.52	2.78	9.00	0.80
8	Roundabout R4	B,Cc,Ce,Co,HGV,LGV,W	4	5000	48	1.00	1.00	9.00	1.00
9	Roundabout R3	B,Cc,Ce,Co,HGV,LGV,W	3	4680	48	1.00	1.00	9.00	1.00
10	Roundabout R2	B,Cc,Ce,Co,HGV,LGV,W	2	3780	48	1.00	1.00	9.00	1.00
11	Roundabout R1	B,Cc,Ce,Co,HGV,LGV,W	1	2250	48	1.00	1.00	9.00	1.00
13	Rural carriageway typical 3 lanes	B,Cc,Ce,Co,HGV,LGV	3	6300	112	0.41	2.86	9.00	0.90
14	Rural carriageway typical 2 lanes	B,Cc,Ce,Co,HGV,LGV	2	4200	112	0.55	2.86	9.00	0.90
15	Rural All-Purpose D4 (70mph)	B,Cc,Ce,Co,HGV,LGV	4	8400	112	0.41	2.86	9.00	0.70
16	Rural All-Purpose D4 (50mph)	B,Cc,Ce,Co,HGV,LGV	4	8400	80	0.31	2.35	9.00	0.70
17	Rural All-Purpose D3 (70mph)	B,Cc,Ce,Co,HGV,LGV	3	6300	112	0.41	2.86	9.00	0.70
18	Rural All-Purpose D3 (50mph)	B,Cc,Ce,Co,HGV,LGV	3	6300	80	0.31	2.35	9.00	0.70
19	Rural All-Purpose D2 (70 mph)	B,Cc,Ce,Co,HGV,LGV	2	4200	112	0.55	2.86	9.00	0.75
20	Rural All-Purpose D2 (50mph)	B,Cc,Ce,Co,HGV,LGV	2	4200	80	0.30	2.10	9.00	0.70
21	Rural All-Purpose S3/4 (60mph)	B,Cc,Ce,Co,HGV,LGV	2	4200	87	0.52	2.11	9.00	0.80
22	Rural All-Purpose D2 (60mph)	B,Cc,Ce,Co,HGV,LGV	2	4200	96	0.28	2.98	9.00	0.80
23	Rural single carriageway 10m good	B,Cc,Ce,Co,HGV,LGV,W	1	1900	105	0.70	2.20	9.00	0.90
24	Rural WS2 10.0m A Road	B,Cc,Ce,Co,HGV,LGV,W	1	1700	93	0.70	2.20	9.00	0.90
25	Rural single carriageway 7m typical	B,Cc,Ce,Co,HGV,LGV,W	1	1176	84	0.50	2.20	9.00	0.85
26	Rural S2 7.3m A Road (TD9/81)	B,Cc,Ce,Co,HGV,LGV,W	1	1300	87	0.50	2.20	9.00	0.85
27	Rural S2 6.5m Poor	B,Cc,Ce,Co,HGV,LGV,W	1	1000	67	0.50	1.90	9.00	1.00
28	Rural S2 Other Road (slow, narrow carriageway)	B,Cc,Ce,Co,HGV,LGV,W	1	900	54	0.55	1.70	9.00	0.40
29	Rural S2 Other Road (slow, narrow carriageway)+HGV ban	B,Cc,Ce,Co,LGV,W	1	900	54	0.55	1.70	9.00	0.40
30	Rural single carriageway 5m extremely bad+HGV ban	B,Cc,Ce,Co,LGV,W	1	250	32	0.55	1.70	9.00	0.40
31	Rural S2 7.3m A Road (TD9/81)+HGV Ban	B,Cc,Ce,Co,LGV,W	1	1300	87	0.50	2.20	9.00	0.85
32	Rural single carriageway 7m typical + HGV Ban	B,Cc,Ce,Co,LGV,W	1	1176	84	0.50	2.20	9.00	0.85
33	Rural carriageway typical 2 lanes (A12)	B,Cc,Ce,Co,HGV,LGV	2	4200	112	1.50	2.78	9.00	0.80
34	Suburban D4	B,Cc,Ce,Co,HGV,LGV,W	4	6720	65	1.52	2.45	9.00	1.00
35	Suburban dual 4 heavy development	B,Cc,Ce,Co,HGV,LGV,W	4	6720	58	1.29	1.01	9.00	1.00
36	Suburban D3	B,Cc,Ce,Co,HGV,LGV,W	3	5040	65	1.52	2.45	9.00	1.00
37	Suburban dual 3 heavy development	B,Cc,Ce,Co,HGV,LGV,W	3	5040	58	1.29	1.01	9.00	1.00
38	Suburban D2 (slight development)	B,Cc,Ce,Co,HGV,LGV	2	3360	65	1.52	2.45	9.00	1.00
39	Suburban D2 (typical development)	B,Cc,Ce,Co,HGV,LGV,W	2	3360	61	1.45	1.60	9.00	1.00
40	Suburban D2 (heavy development)	B,Cc,Ce,Co,HGV,LGV,W	2	3360	58	1.29	1.01	9.00	1.00
41	Suburban D2 (30mph)	B,Cc,Ce,Co,HGV,LGV,W	2	3360	48	0.65	1.24	9.00	1.00
42	Suburban S2 (light development)	B,Cc,Ce,Co,HGV,LGV	1	1680	65	1.52	2.45	9.00	1.00
43	Suburban S2 (light development)+HGV ban	B,Cc,Ce,Co,LGV,W	1	1680	65	1.52	2.45	9.00	1.00
44	Suburban S2 (typical development)	B,Cc,Ce,Co,HGV,LGV,W	1	1680	61	1.45	1.60	9.00	1.00
45	Suburban S2 (typical development)+HGV ban	B,Cc,Ce,Co,LGV,W	1	1680	61	1.45	1.60	9.00	1.00
46	Suburban S2 (heavy development)	B,Cc,Ce,Co,HGV,LGV,W	1	1680	58	1.29	1.01	9.00	1.00
47	Suburban S2 (heavy development)+HGV ban	B,Cc,Ce,Co,LGV,W	1	1680	58	1.29	1.01	9.00	1.00
48	Suburban S2 (heavy development) (30mph)	B,Cc,Ce,Co,HGV,LGV,W	1	1680	48	1.29	1.01	9.00	1.00
49	Suburban D2 (heavy development) (40mph)	B,Cc,Ce,Co,HGV,LGV	2	3360	65	1.52	2.45	9.00	1.00
50	A13 Roadworks 3 lanes	B,Cc,Ce,Co,HGV,LGV	3	5700	64	0.41	2.86	9.00	1.00
51	A13 Roadworks 2 lanes	B,Cc,Ce,Co,HGV,LGV	2	3800	64	0.55	2.86	9.00	1.00
52	A127_Fairglen_EB_D2 70	B,Cc,Ce,Co,HGV,LGV	2	4200	112	3.00	2.86	9.00	0.60
53	Urban Non-central 80% development 3 lanes	B,Cc,Ce,Co,HGV,LGV,W	3	2688	48	0.98	1.74	9.00	1.00
54	A127_Fairglen_EB_D2 50	B,Cc,Ce,Co,HGV,LGV	2	4200	80	0.90	2.10	9.00	0.70
55	Urban Non-central 80% development 2 lanes	B,Cc,Ce,Co,HGV,LGV,W	2	1792	48	0.98	1.74	9.00	1.00
56	Urban Non-central 80% development 2 lanes+HGV ban	B,Cc,Ce,Co,LGV,W	2	1792	48	0.98	1.74	9.00	1.00
57	Urban Non-central 100% development 2 lanes	B,Cc,Ce,Co,HGV,LGV,T,U,W	2	1792	46	0.89	1.25	9.00	1.00
60	Urban Non-central 50% development	B,Cc,Ce,Co,HGV,LGV,W	1	896	48	0.74	2.65	9.00	1.00
61	Urban Non-central 50% development+HGV ban	B,Cc,Ce,Co,LGV,W	1	896	48	0.74	2.65	9.00	1.00
62	Urban Non-central 80% development	B,Cc,Ce,Co,HGV,LGV,W	1	896	48	0.98	1.74	9.00	1.00
63	Urban Non-central 80% development+HGV ban	B,Cc,Ce,Co,LGV,W	1	896	48	0.98	1.74	9.00	1.00
64	Urban Non central 100% development	B,Cc,Ce,Co,HGV,LGV,W	1	896	46	0.89	1.25	9.00	1.00
65	Urban Non central 100% development+HGV ban	B,Cc,Ce,Co,LGV,W	1	896	46	0.89	1.25	9.00	1.00
69	Urban central INT = 2	B,Cc,Ce,Co,HGV,LGV,W	1	944	37	1.44	1.48	9.00	1.00
70	Urban central INT = 4.5	B,Cc,Ce,Co,HGV,LGV,W	1	944	33	1.35	1.24	9.00	1.00
71	Urban central INT = 9	B,Cc,Ce,Co,HGV,LGV,W	1	896	28	0.95	0.85	9.00	1.00
72	Urban central INT = 9+HGV ban	B,Cc,Ce,Co,LGV,W	1	896	28	0.95	0.85	9.00	1.00
77	Small Town 35% development	B,Cc,Ce,Co,HGV,LGV,W	1	1344	63	0.85	2.49	9.00	1.00
78	Small Town 60% development	B,Cc,Ce,Co,HGV,LGV,W	1	1344	56	0.85	2.46	9.00	1.00
79	Small Town 90% development	B,Cc,Ce,Co,HGV,LGV,W	1	1344	46	0.65	1.54	9.00	1.00
80	Residential Road+HGV ban	B,Cc,Ce,Co,LGV,W	1	944	33	1.35	1.24	9.00	1.00
81	Single Track Road+HGV ban	B,Cc,Ce,Co,LGV,W	1	200	32	0.55	1.70	9.00	0.40
84	Woolwich Ferry (no HGV)	Cc,Ce,Co,LGV	1	250	9	1.15	4.00	2.50	0.80
85	Silvertown Tunnel (no HGV)	B,Cc,Ce,Co,LGV	2	4000	48	1.15	4.00	2.50	0.80
86	Dartford Crossing/Tunnel Northbound	B,Cc,Ce,Co,HGV,LGV	4	7500	80	1.15	4.00	2.50	0.80
87	Dartford Crossing/Tunnel Southbound	B,Cc,Ce,Co,HGV,LGV	4	8000	80	1.15	4.00	2.50	0.80
89	Bus only	B,W	1	99999	48	1.15	4.00	2.50	0.80
90	Walk Links	W	0	99999	4	1.15	4.00	2.50	0.80
91	Rail Link	T	1	99999	55	1.15	4.00	2.50	0.80
92	LU Links	U	1	99999	40	1.15	4.00	2.50	0.80
98	External Links (30mph)	B,Cc,Ce,Co,HGV,LGV	1	99999	48	1.00	1.00	9.00	1.00
99	External Links (70mph)	B,Cc,Ce,Co,HGV,LGV	1	99999	113	1.00	1.00	9.00	1.00
100	Spigot	B,Cc,Ce,Co,HGV,LGV,W	1	99999	50	1.00	1.00	9.00	1.00

Appendix C – Kimber Guidance

Standard Dimensions to Adopt for TRL/Kimber Method

ARM		Approach half width (V) (m)	Entry width (E) (m)	Flare Length ('l) (m)	Entry Radius (R) (m)	Inscribed Roundabout Diameter (D) (m)	Entry Conflict Angle (PHI) (Deg)
Short flare /No flare length (<3 cars or 10m)	1 ln approach, no flare	3.65	4	5	15	User Defined	30
	2 ln approach, no flare	7.30	8	5	15		30
	3 ln approach, no flare	10.95	12	5	15		30
	1 ln approach, 2 ln entry	3.65	8	10	15		30
	2 ln approach, 3 ln entry	7.30	12	10	15		30
Long Flare length (<= 10 cars or 60m)	1 ln approach, 2 ln entry	3.65	8	30	15		30
	2 ln approach, 3 ln entry	7.30	12	30	15		30
Multi-Node Roundabout	Circulatory Arm	15	20	100	1000	200	0

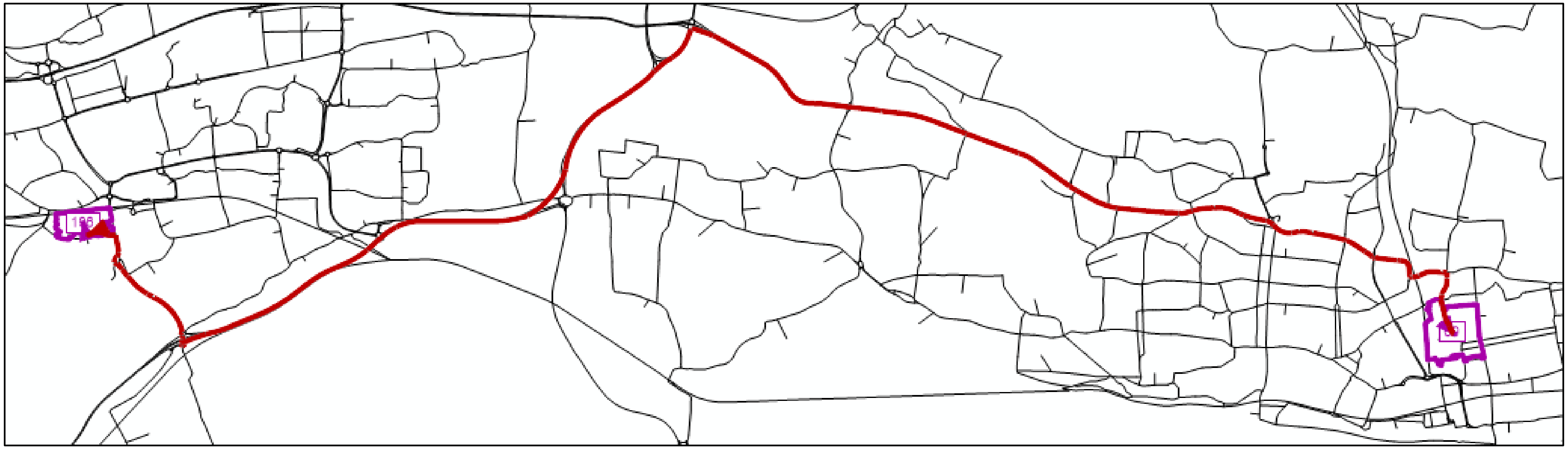
- For roundabouts with flare length >60m, assign as a new lane (i.e. for an approach with 1 lane with 100m flare, use dimensions for 2 lane, no flare)
- Modellers should measure roundabouts using google maps or a similar tool to measure Inscribed Roundabout Diameter, which is the largest diameter across the roundabout (from outside edge to outside edge)

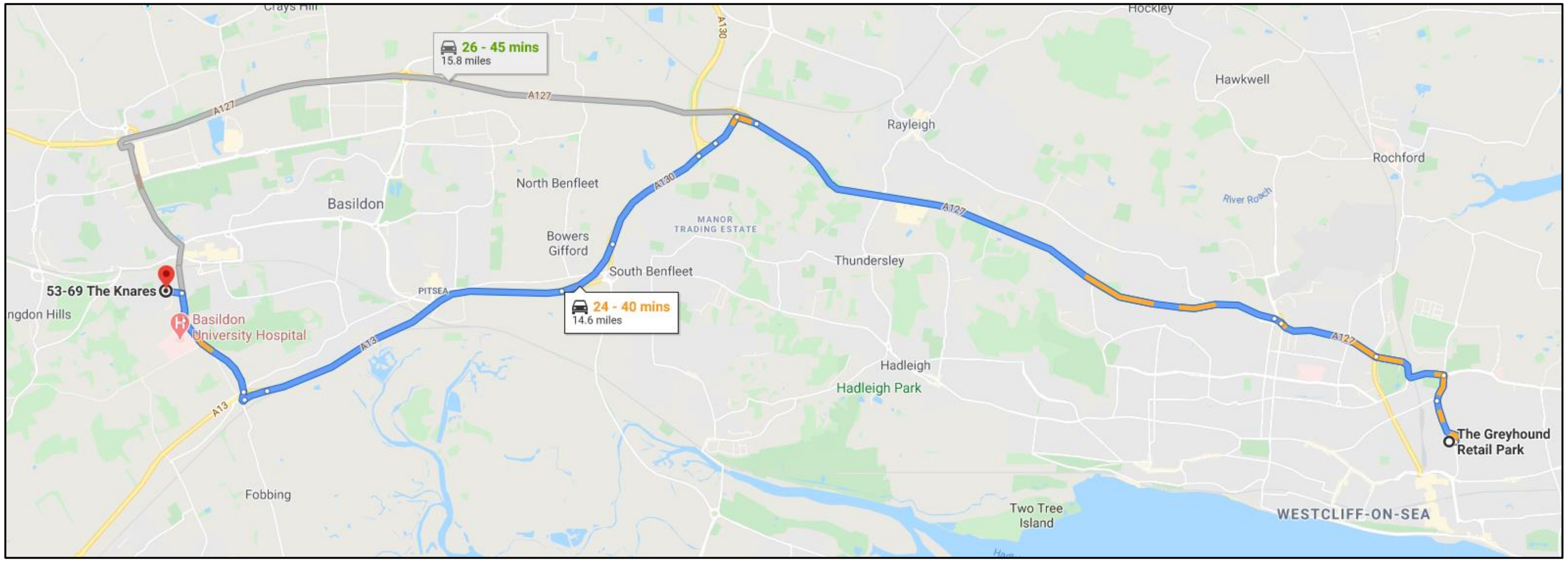
Appendix D – Network Checklist

<table>
<tr><th>Chelmsford Model VISUM checklist</th><th>Description</th><th>Checker RS</th><th>Reviewer TK</th><th>Comments RS</th><th>Based on version file:</th></tr>
<tr><td rowspan="3">Network settings</td><td>Network parameters
Scale, Units, direction of traffic, model periods, other settings all appropriate</td><td>ok</td><td>ok</td><td>Settings show left-hand traffic, metric units, all looks ok.</td><td rowspan="20">\\GBLON7VS01.europe.jacobs.com\Projects\UNIF\Projects\B355393A - Enhanced Countywide Model\2. Technical\Data\Base Model\VISUM\VER\AM\South_Essex_Base_AM_2019.ver</td></tr>
<tr><td>TSys/Modes/DSegs
Appropriate. Correct parameter and factor values. Correct PCU factors for private transport systems</td><td>ok</td><td>ok</td><td>The PCU factor for HGV is 2.50. The rest are 1.00.</td></tr>
<tr><td>Link types
Range of link types look sufficient
Parameter values are sensible</td><td>ok</td><td>ok</td><td>The majority of the link types have previously been used in Regional Transport models, which were used as a starting point.</td></tr>
<tr><td rowspan="6">General procedure settings - PrT settings</td><td>Volume-delay functions
Check attributes and assignment to link types</td><td>ok</td><td>ok</td><td>The volume-delay functions' (BPR2) parameters were calculated based on previous Regional Transport Models.</td></tr>
<tr><td>Impedance
Check calculation</td><td>ok</td><td>ok</td><td>Impedance values are based on "\\GBLON7VS01.europe.jacobs.com\Projects\UNIF\Projects\B355393A - Enhanced Countywide Model\2. Technical\Data\Base Model\VISUM\VER\VoT_and_VOC_from_TAG_Databook_1.13_May2020.xls" spreadsheet, which includes the following 2019 impedance values (length parameter):
<table>
<tr><th>2019 Impendance Values</th><th>AM</th><th>IP</th><th>PM</th></tr>
<tr><td>Commute</td><td>0.0186</td><td>0.0175</td><td>0.0185</td></tr>
<tr><td>Business</td><td>0.0262</td><td>0.0244</td><td>0.0258</td></tr>
<tr><td>Other</td><td>0.0270</td><td>0.0242</td><td>0.0258</td></tr>
<tr><td>LGV</td><td>0.0609</td><td>0.0577</td><td>0.0609</td></tr>
<tr><td>HGV</td><td>0.0398</td><td>0.0386</td><td>0.0398</td></tr>
</table></td></tr>
<tr><td>Assignment
Check preload calculations</td><td>ok</td><td>ok</td><td>No preloads ("Basic Volume") have been set.</td></tr>
<tr><td>Node impedances
Check correct settings in use and parameters plausible</td><td>ok</td><td>ok</td><td>Node Impedance is based on Intersection Capacity Analysis (ICA)</td></tr>
<tr><td>Signal cycle and split optimisation
Check if in use</td><td>ok</td><td>ok</td><td>Signal optimisation was not used.</td></tr>
<tr><td>Blocking back model
Check if in use</td><td>ok</td><td>ok</td><td>Setting are: 7m (average space required per car unit) and 20 (number of shares for the flow distribution). The model do NOT use the link capacity for the blocking back model and exploits capacities evenly (faster).</td></tr>
<tr><td rowspan="2">General procedure settings - PuT settings</td><td>Assignment
Check</td><td>ok</td><td>ok</td><td rowspan="2">Timetable-based</td></tr>
<tr><td>Revenues
Check if in use</td><td>ok</td><td>ok</td></tr>
<tr><td rowspan="2">General procesdure settings</td><td>Analysis time slots
Check appropriate</td><td>ok</td><td>ok</td><td>No calendar used in VISUM settings. The analysis period for each model corresponds to the time period for which the demand imported to the model is calculated, so either for AM Peak, Inter-Peak or PM Peak.</td></tr>
<tr><td>Volumes
Check</td><td>ok</td><td>ok</td><td></td></tr>
<tr><td rowspan="2">Zones</td><td>Zone boundaries
Have zone boundaries been correctly positioned and of appropriate size? Zones should generate similar numbers of trips and should not cover more than one land use if this can be avoided. Natural barriers such as rivers, motorways and railway lines should be used where possible. If the model is multi-modal, ensure that zoning takes into account of bus and rail catchments.</td><td>ok</td><td>ok</td><td>A new 332-zone system was created for South Essex Base Model. The demand calculation is based on the Essex Countywide Model matrices, which were converted into a new South Essex 332-zone system, following an automated procedure of disaggregation and aggregation through SATURN/VISUM softwares and VBA. Appropriate checks were done to ensure that the conversion was done correctly. Additional connectors and pre-set proportions were defined in some of the model's zones, in order to efficiency represent the distribution of trips.</td></tr>
<tr><td>Centroids and connection
Do zones load onto the network in appropriate places? If matrix estimation is to be used, then zones should not "straddle" count locations</td><td>ok</td><td>ok</td><td>Connectors load onto sensible places.</td></tr>
<tr><td>Links</td><td>Topography
Check layout matches map background, shaping reasonable; parameters correctly applied according to link type, link lengths have been correctly calculated by VISUM. Allowed modes correct.
L1:Visual check of topography only</td><td>ok</td><td>ok</td><td>Multiple checks have been done for the roads located within our simulation area (territory), using Google Maps or Google Earth street view tool for coding and checks.</td></tr>
<tr><td rowspan="2">Nodes</td><td>Turns
Check banned turns are appropriate - eg, no inappropriate turns on exploded roundabouts or grade separated junctions.
Specific banned turns match layout on ground</td><td>ok</td><td>ok</td><td>Multiple checks have been done for banned turns (roundabouts, slip roads, grade seperated junctions).</td></tr>
<tr><td>Junction layout and control
Matches layout on the ground with an appropriate degree of detail
Signal settings are correct</td><td>ok</td><td>ok</td><td>Junction layouts and control types represent the reality with an appropriate degree of detail within our simulation area. Google Maps or Google Earth street view tool was used for coding and checks.</td></tr>
</table>

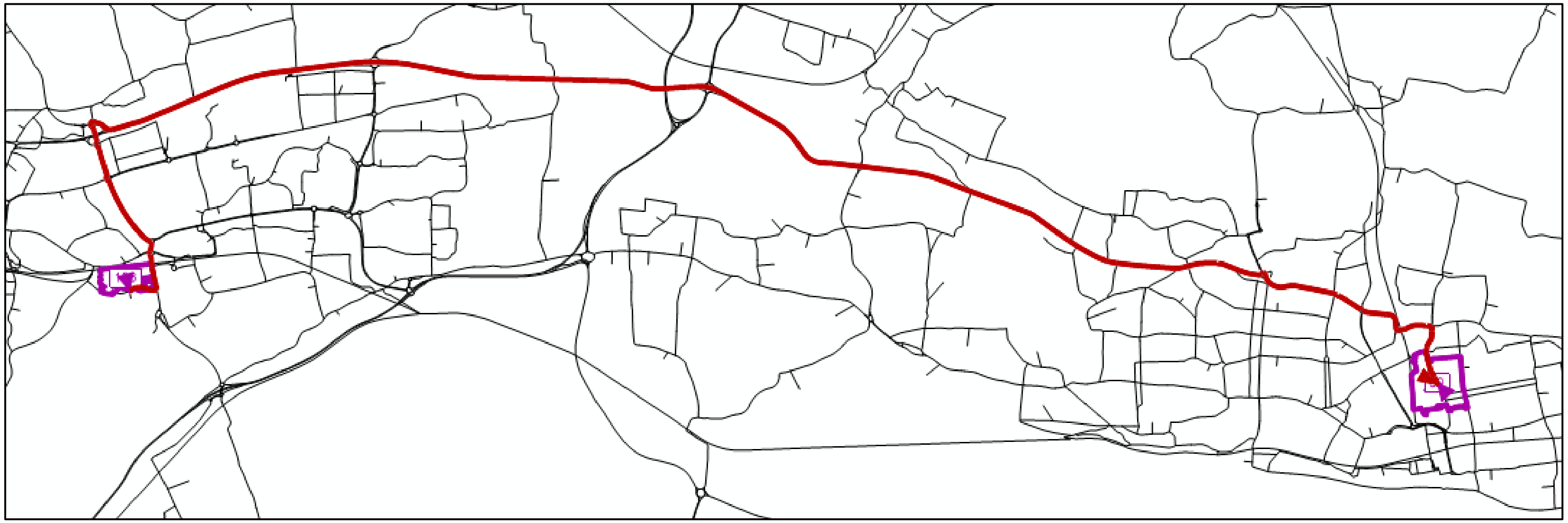
Appendix E – Route Checking

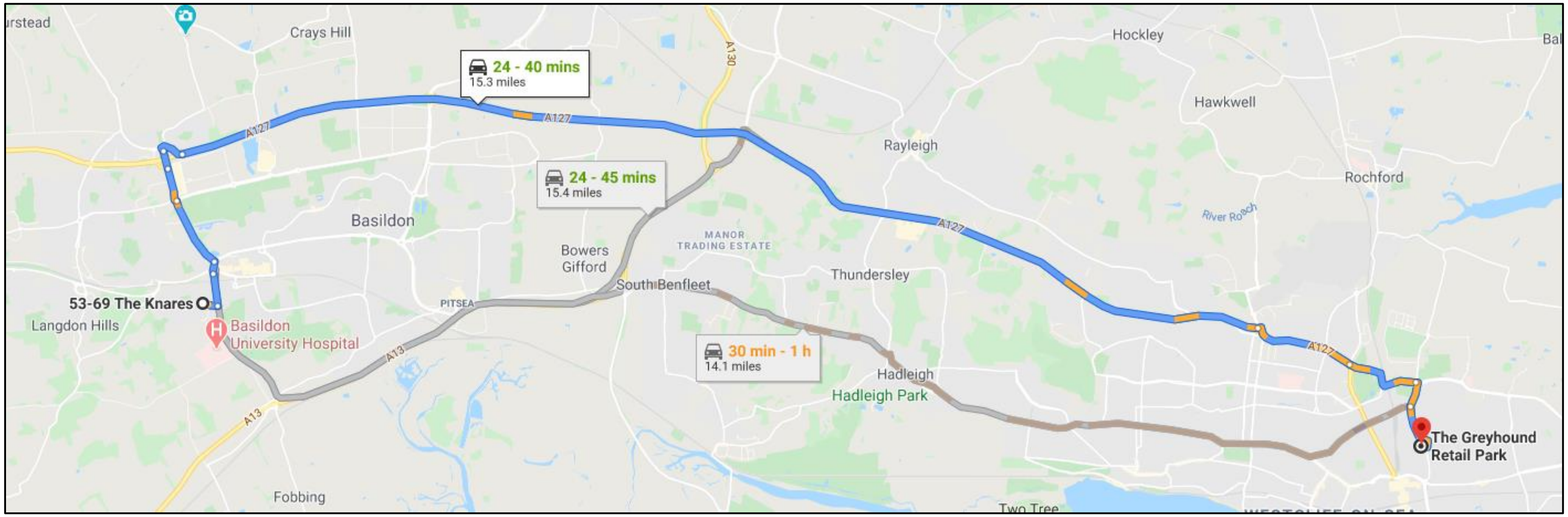
1. Zone 1068 to 1195 (Southend on Sea to Basildon)



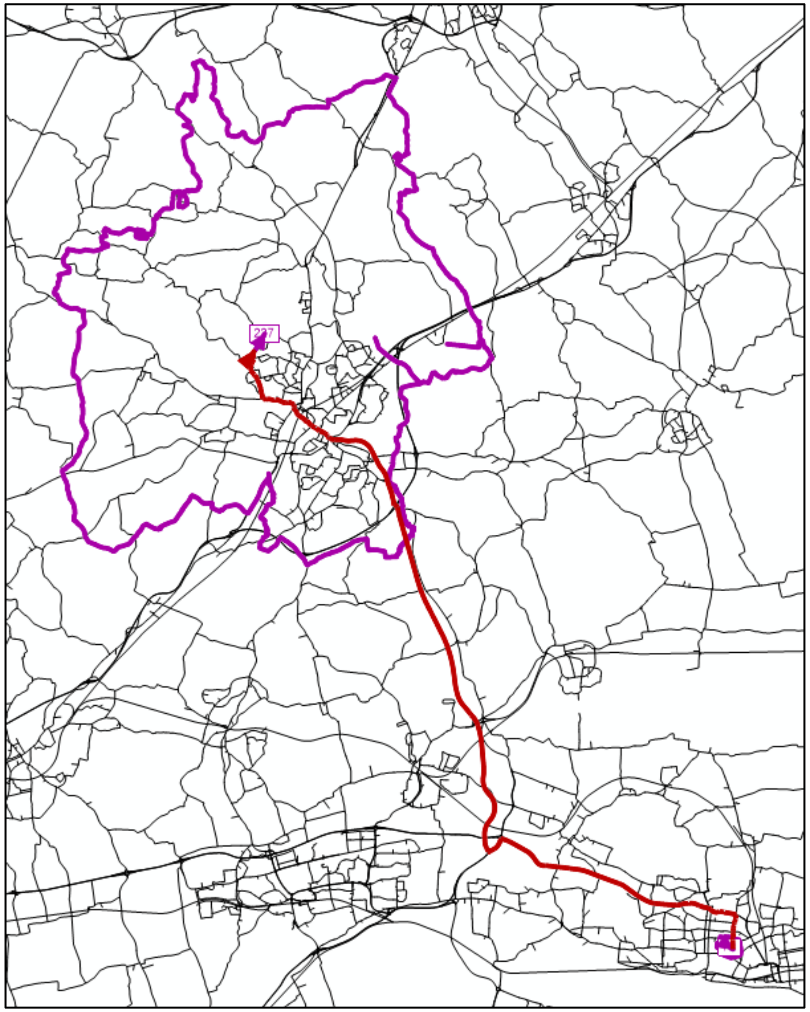


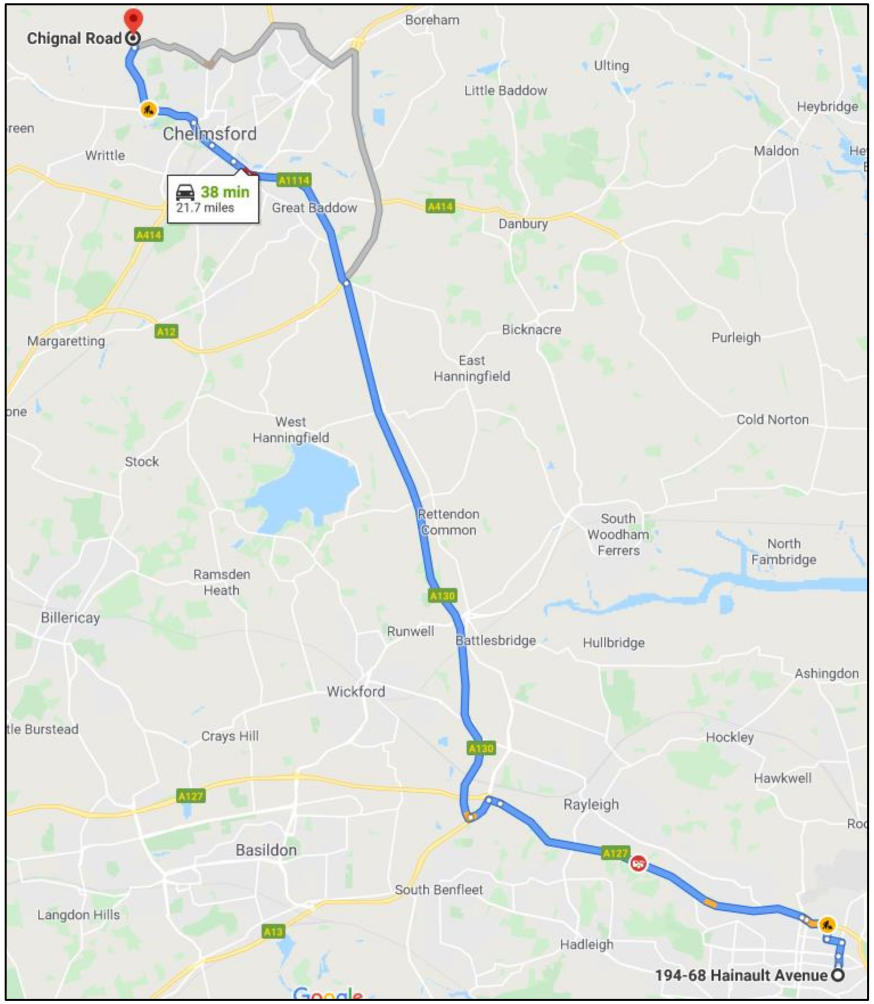
2. Zone 1195 to 1068 (Basildon to Southend on Sea)



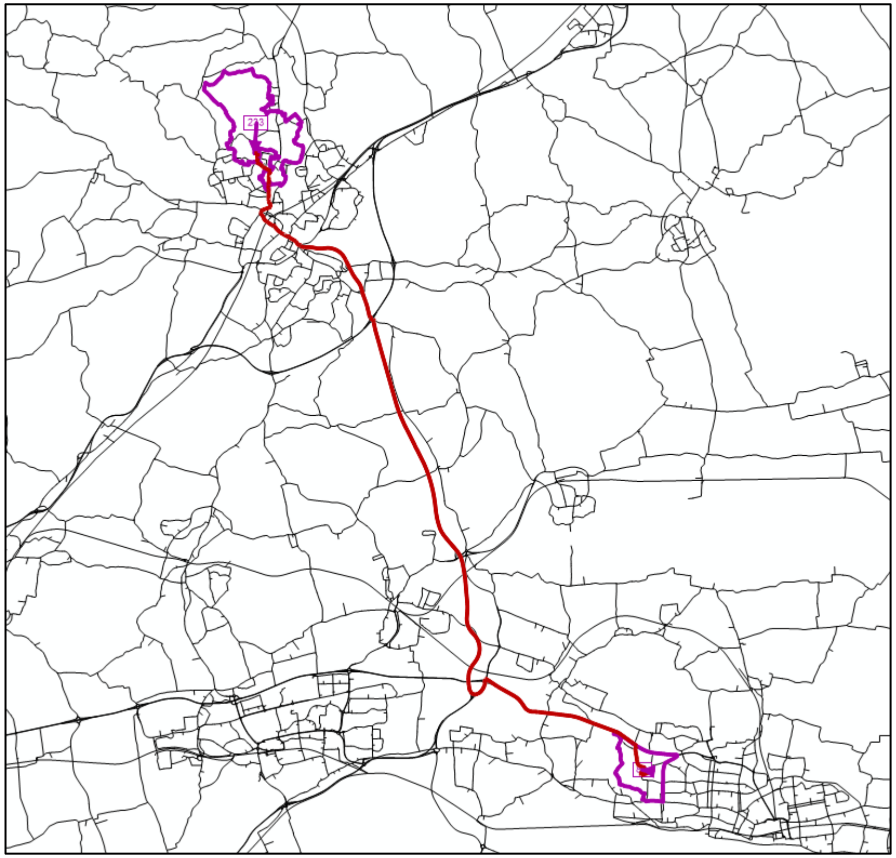


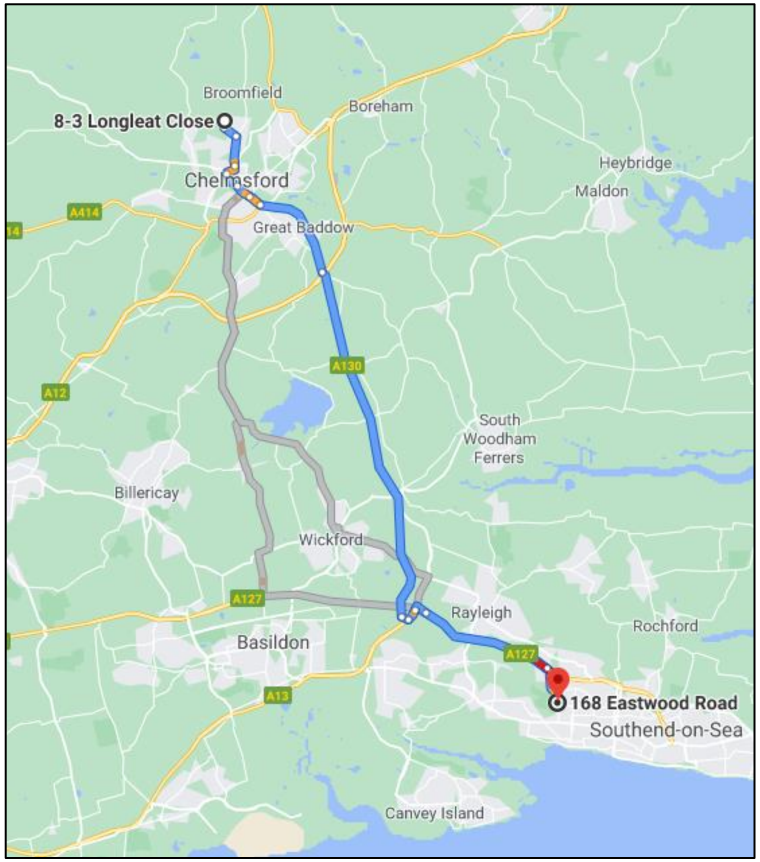
3. Zone 1071 to 2005 (Southend on Sea to Chelmsford)



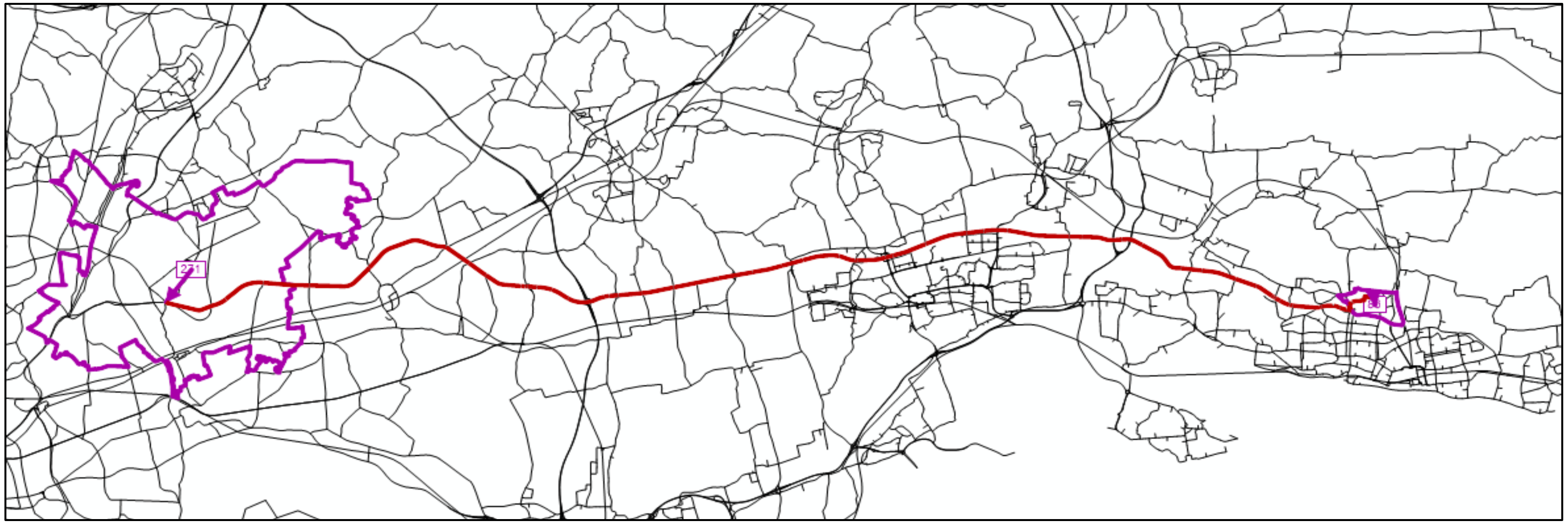


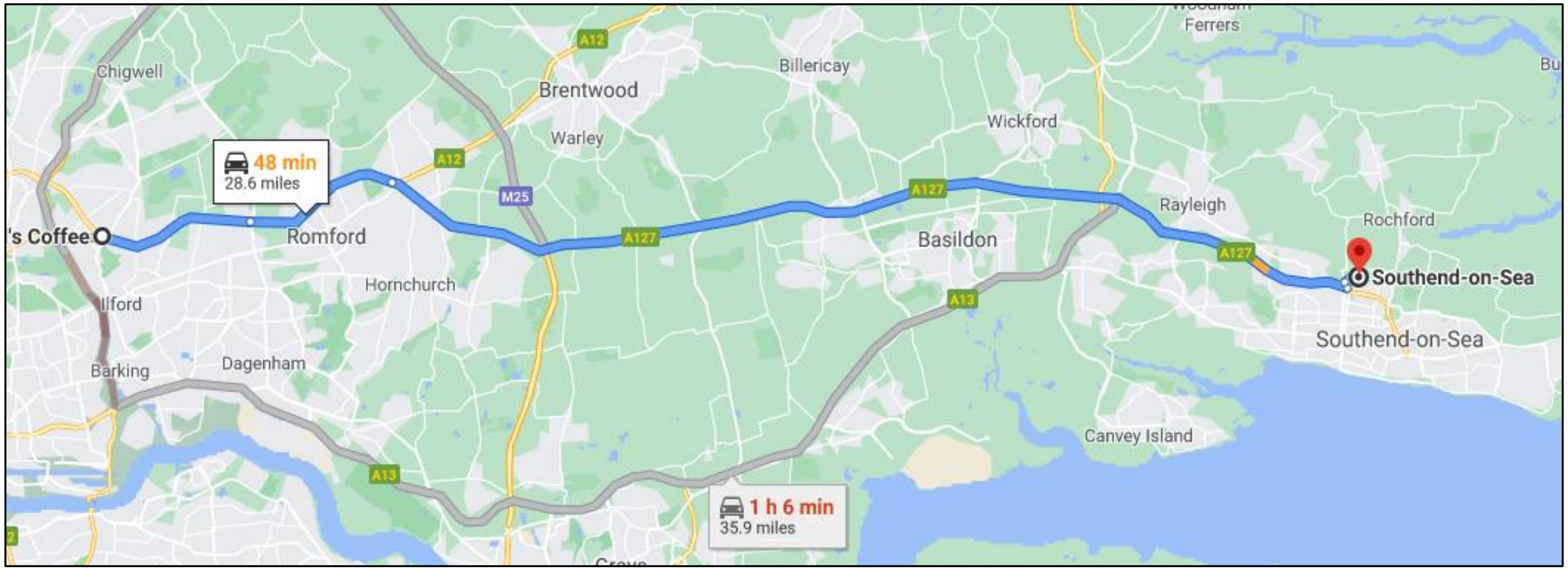
4. Zone 2005 to 1071 (Chelmsford to Southend on Sea)



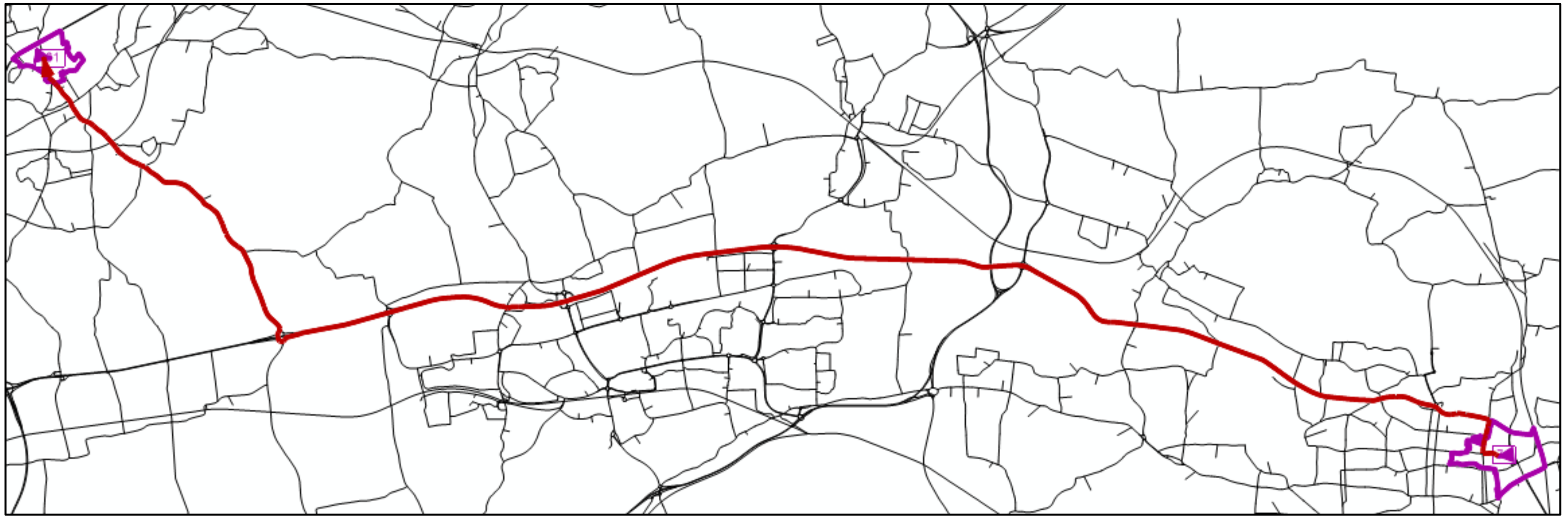


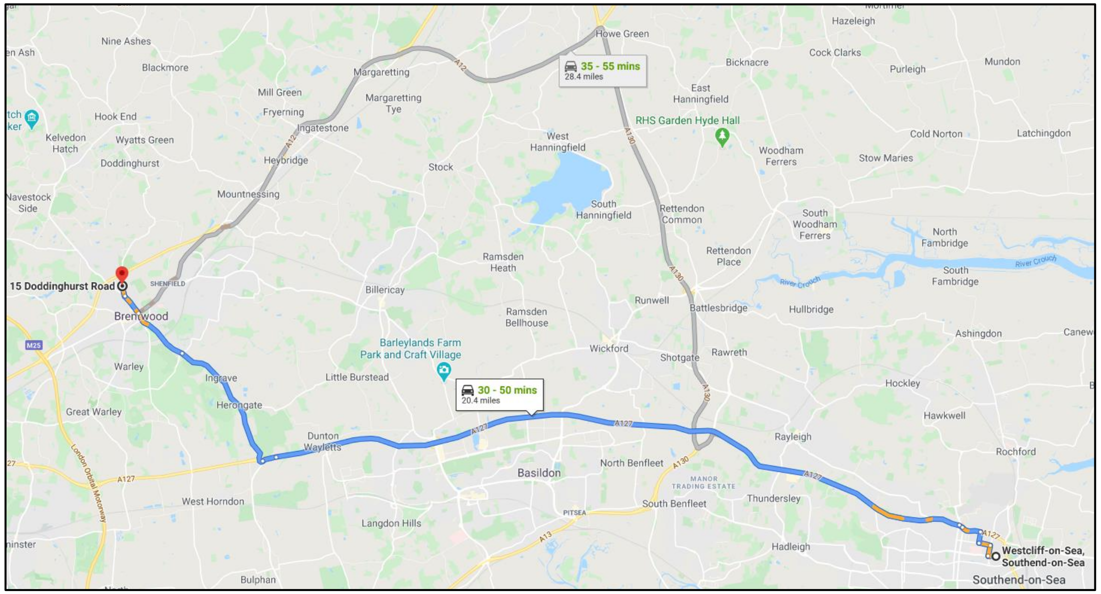
5. Zone 1068 to 3003 (Southend on Sea to Redbridge)



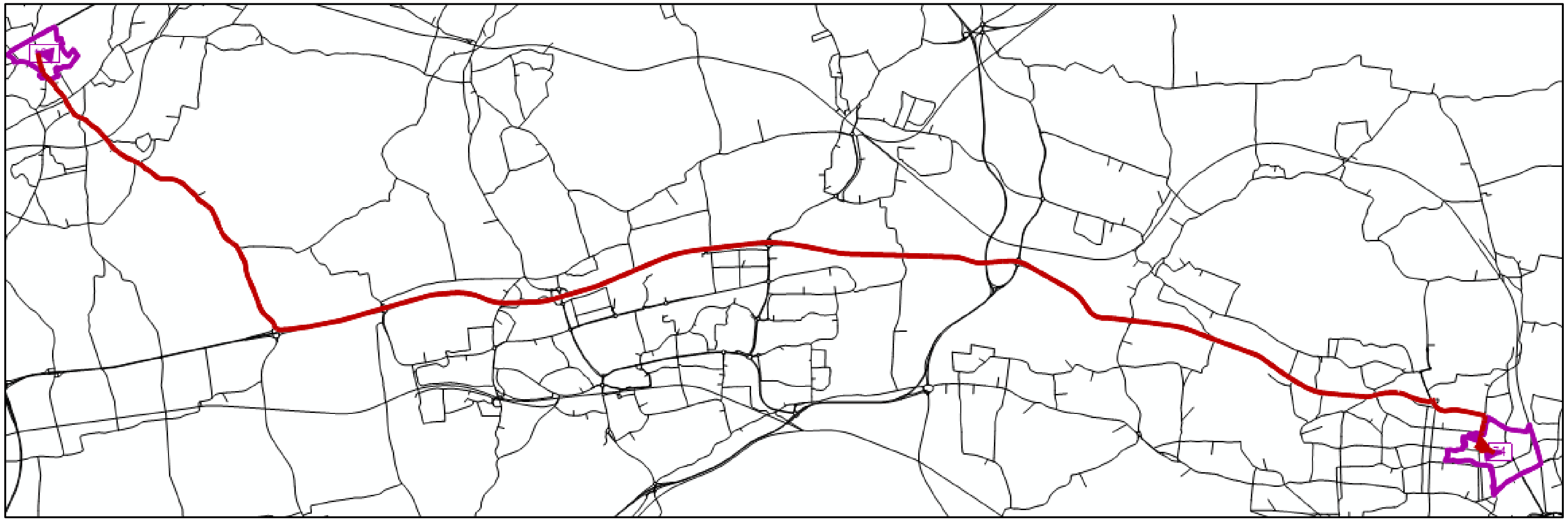


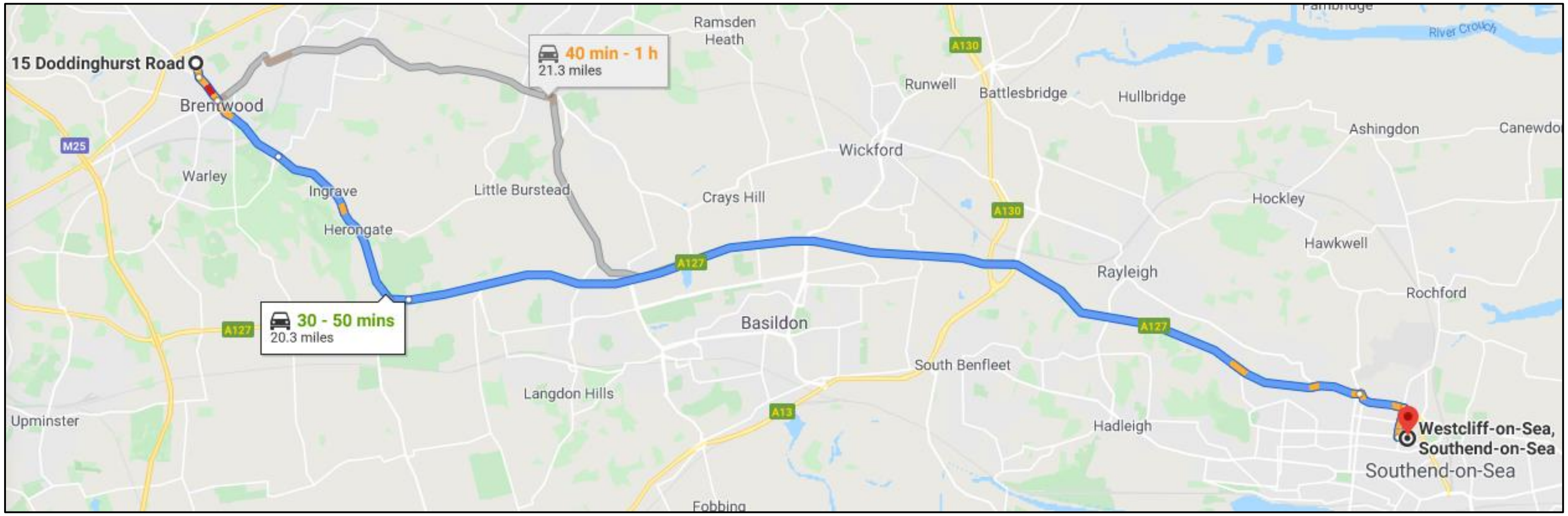
6. Zone 1073 to 1160 (Southend on Sea to Brentwood)



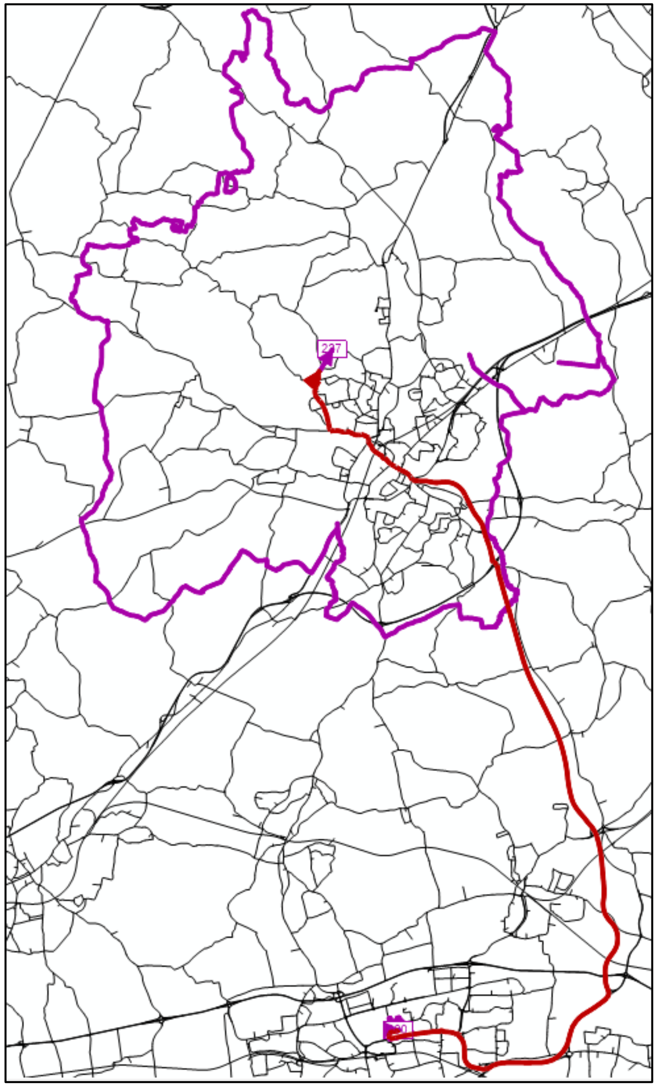


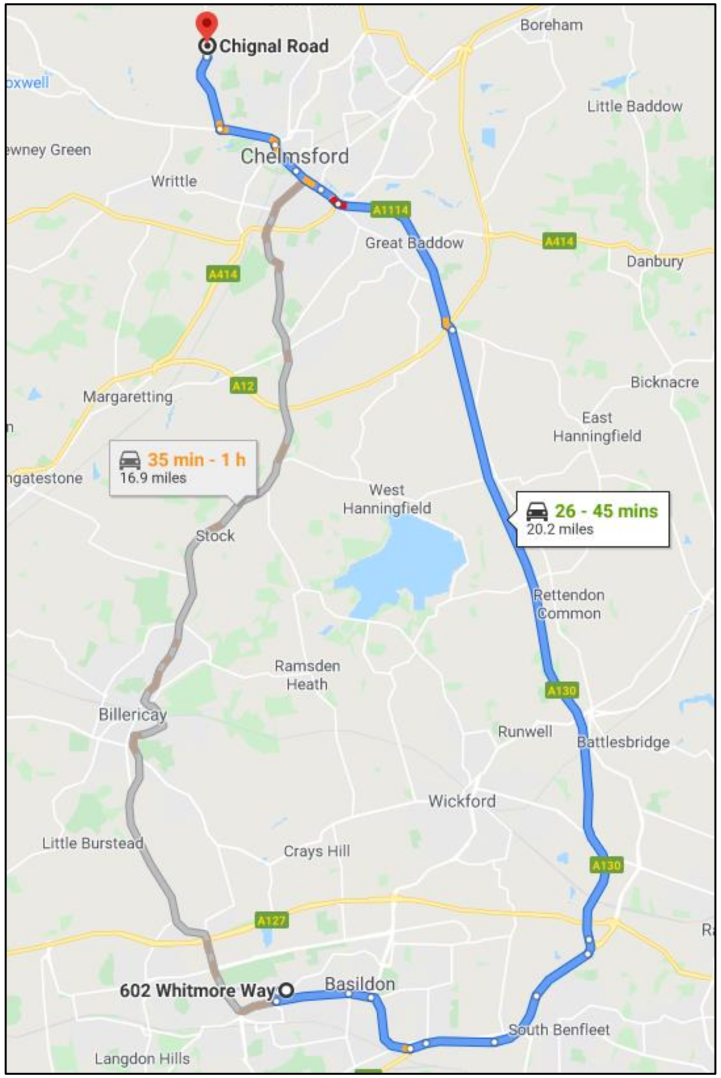
7. Zone 1160 to 1073 (Brentwood to Southend on Sea)



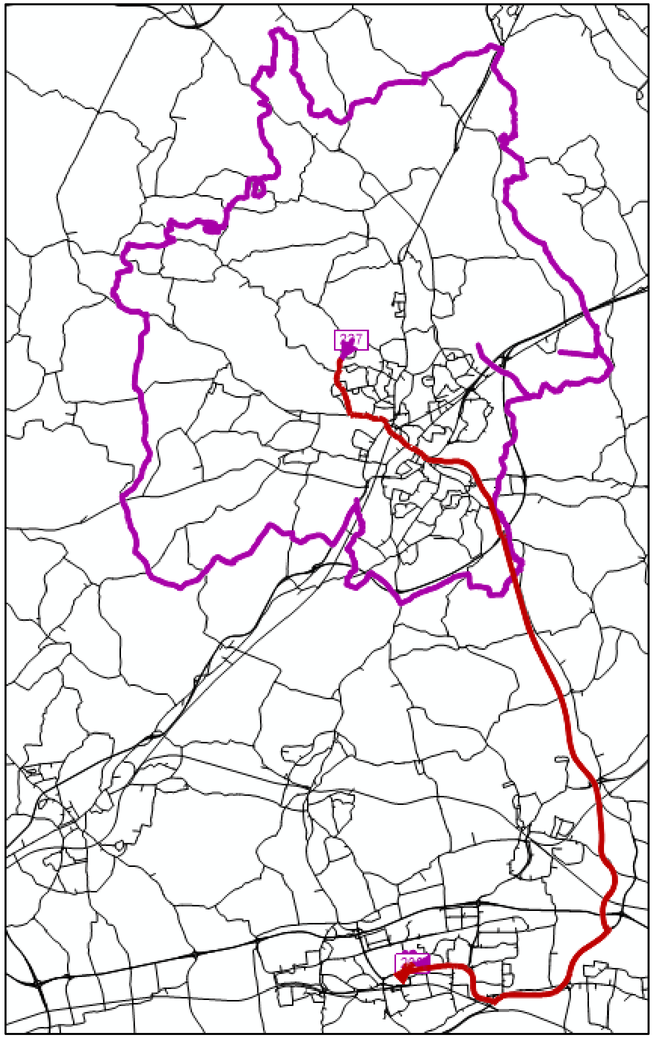


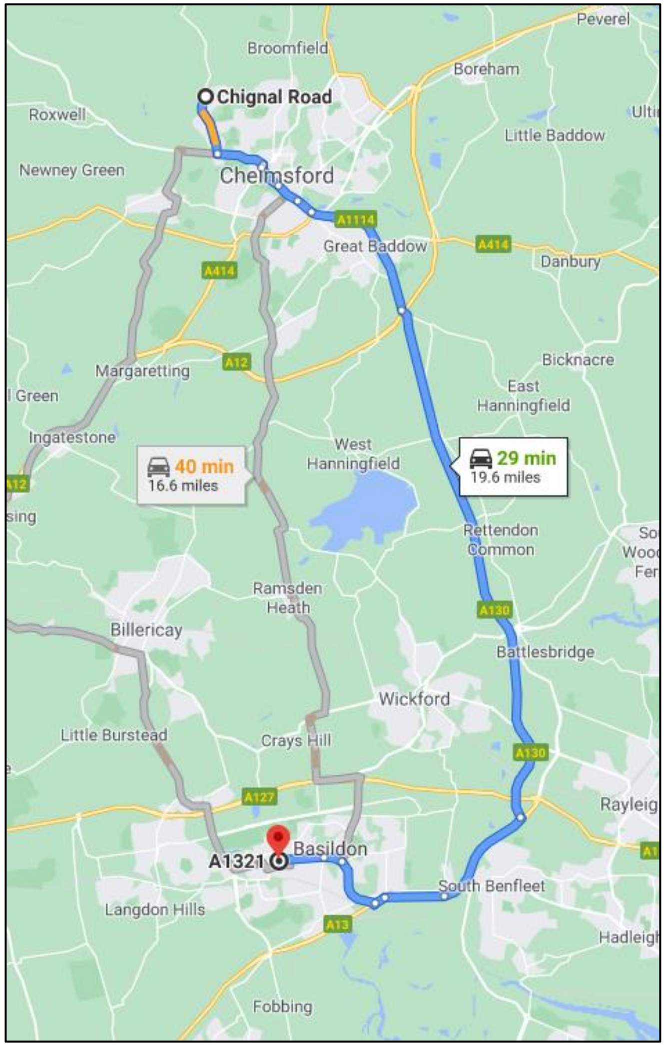
8. Zone 1199 to 2005 (Basildon to Chelmsford)





9. Zone 2005 to 1199 (Chelmsford to Basildon)





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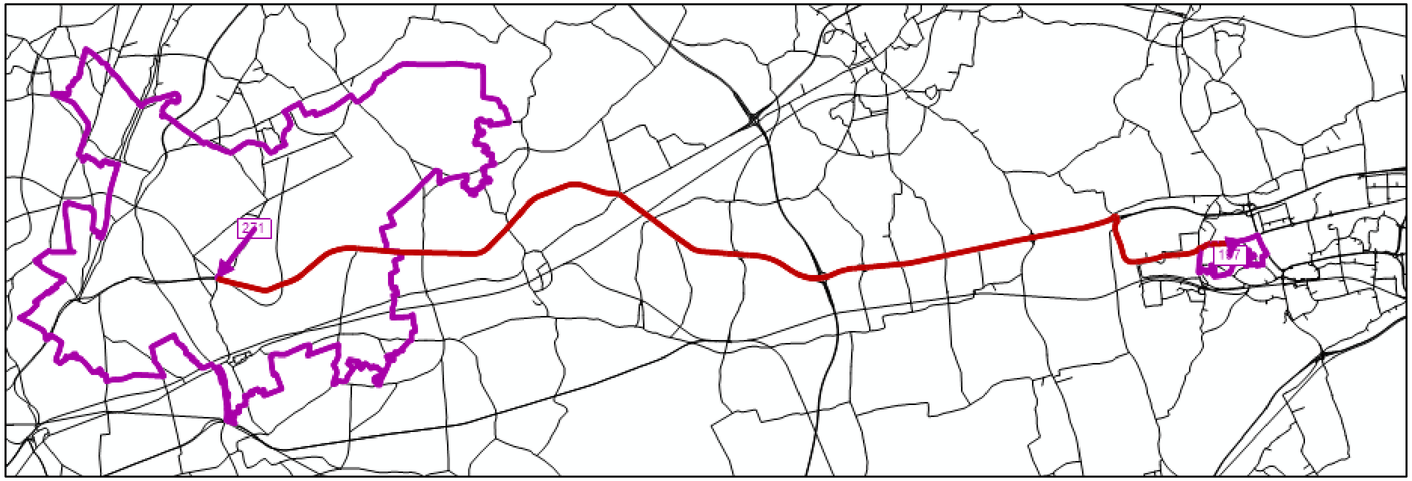

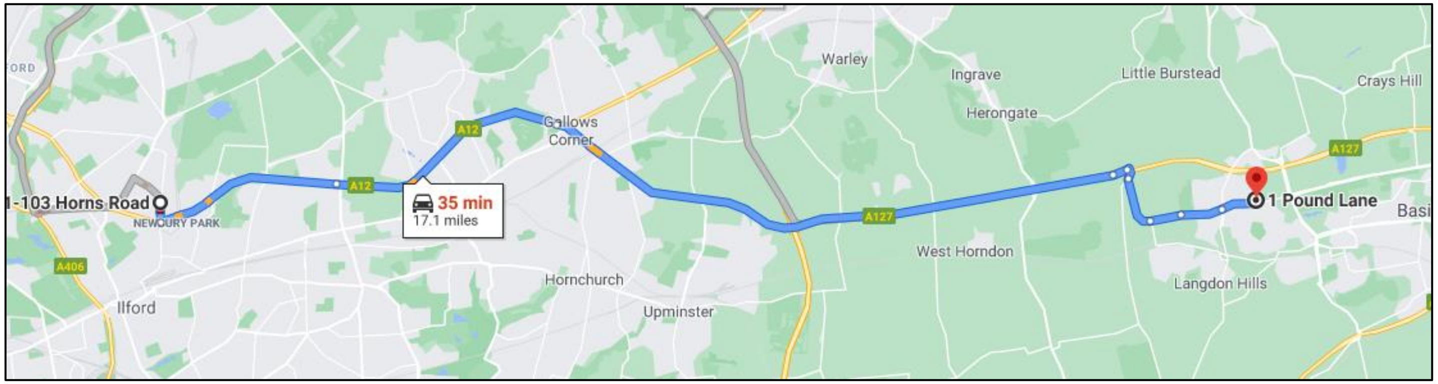

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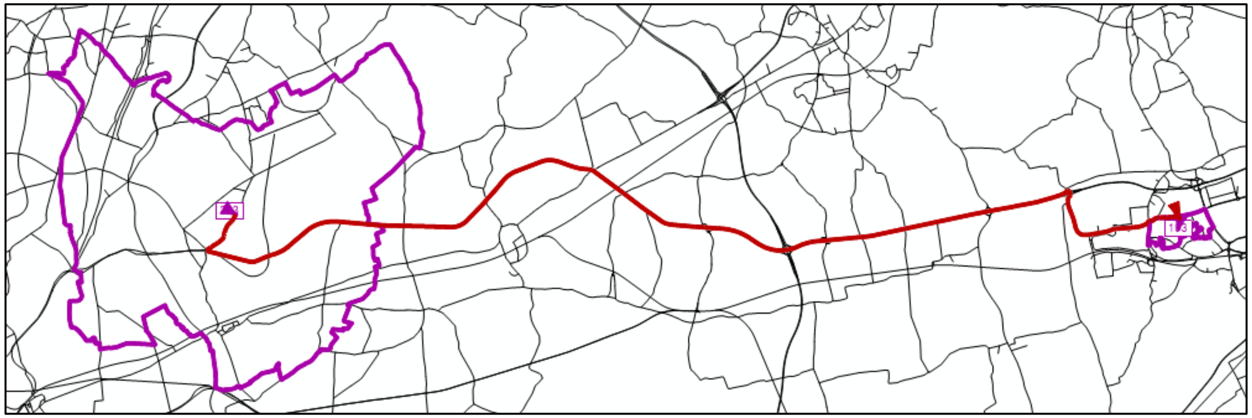

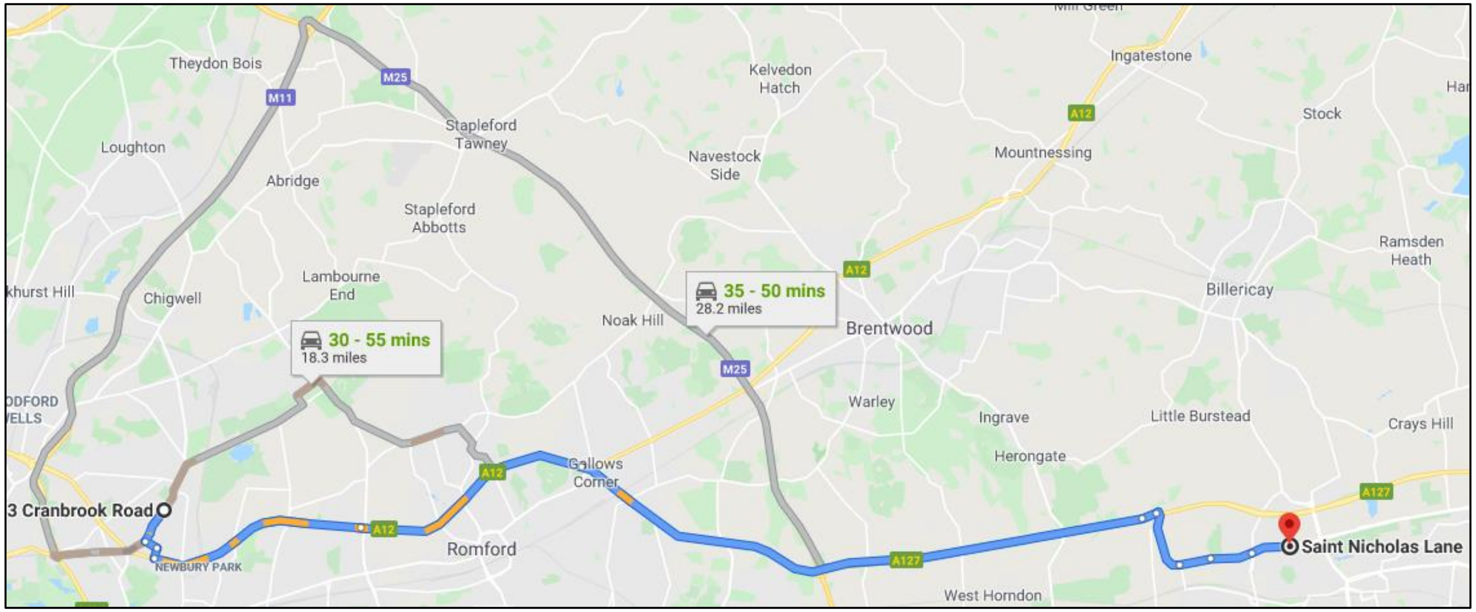

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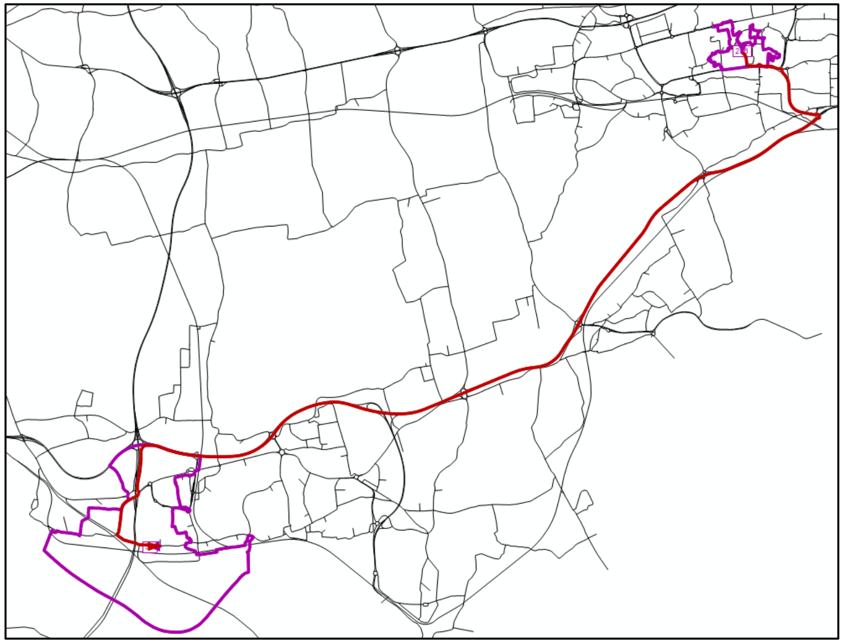
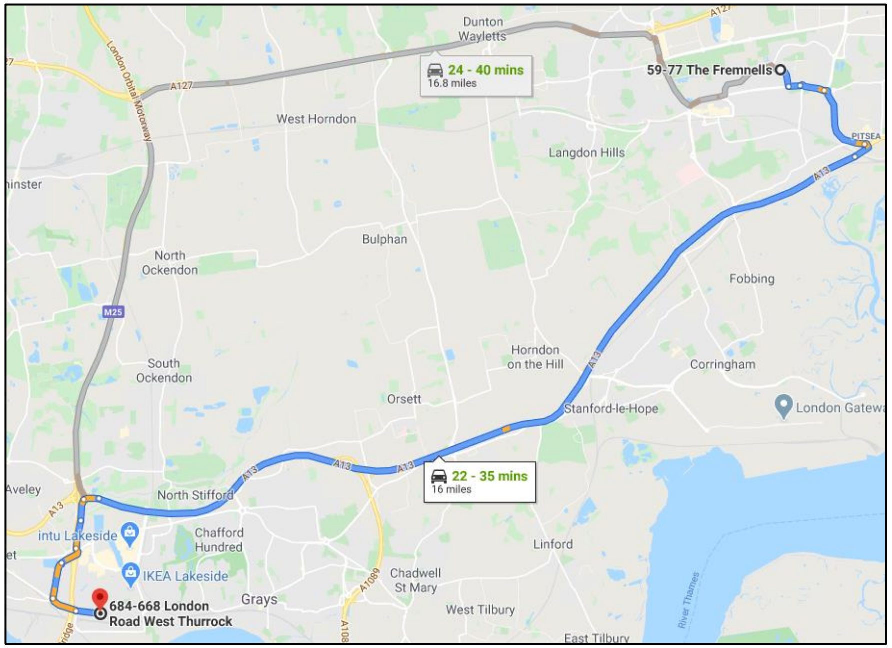
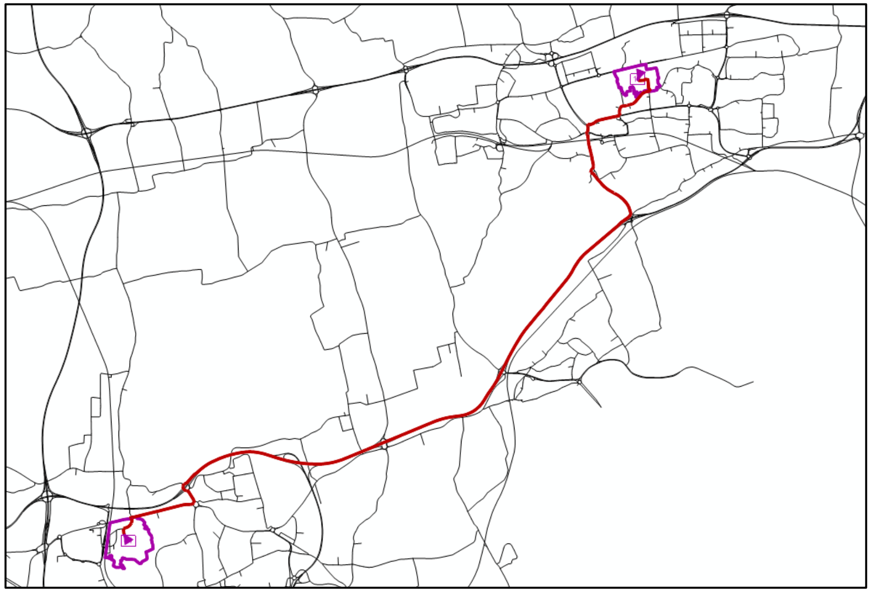
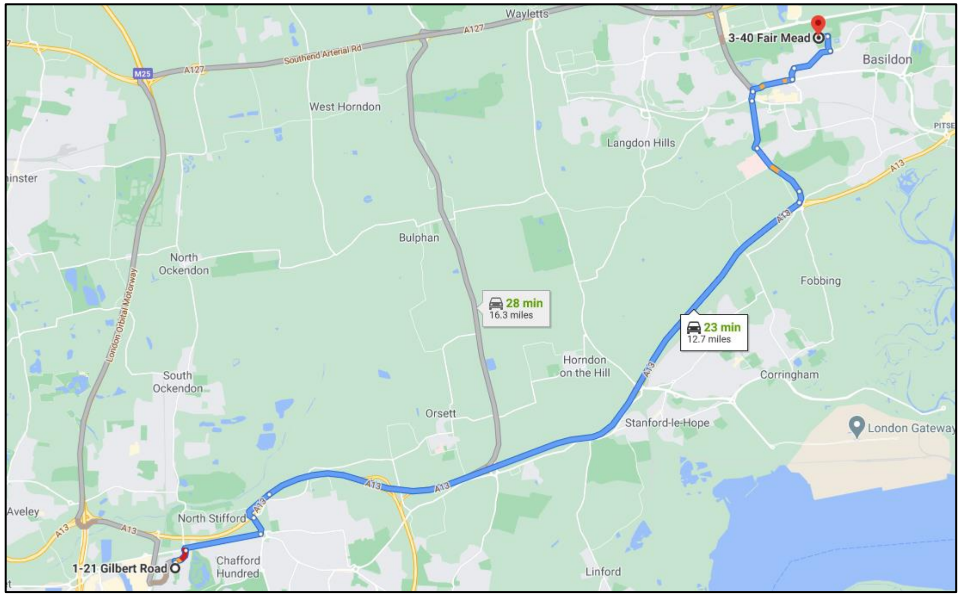




13. Zone 1035 to1205 (West Thurrock to Basildon)





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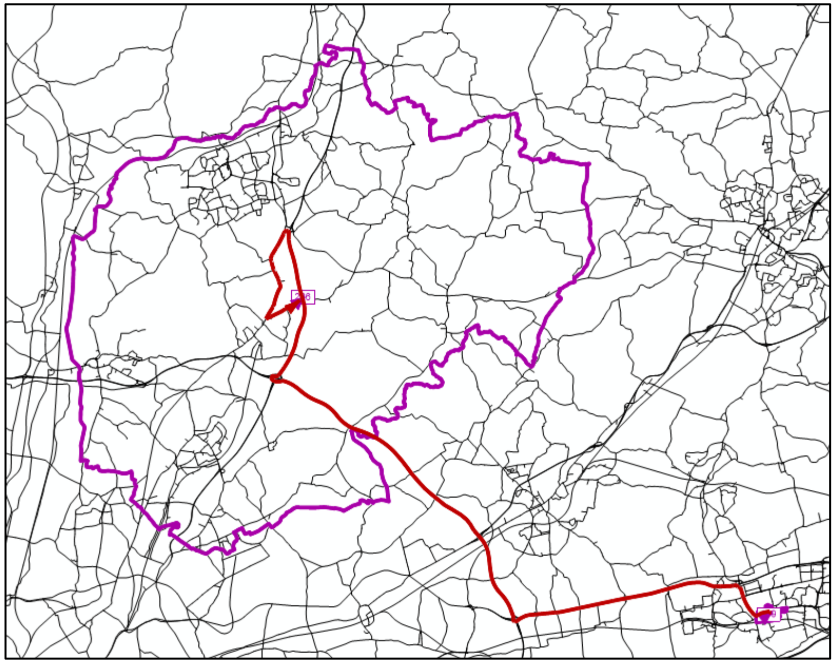
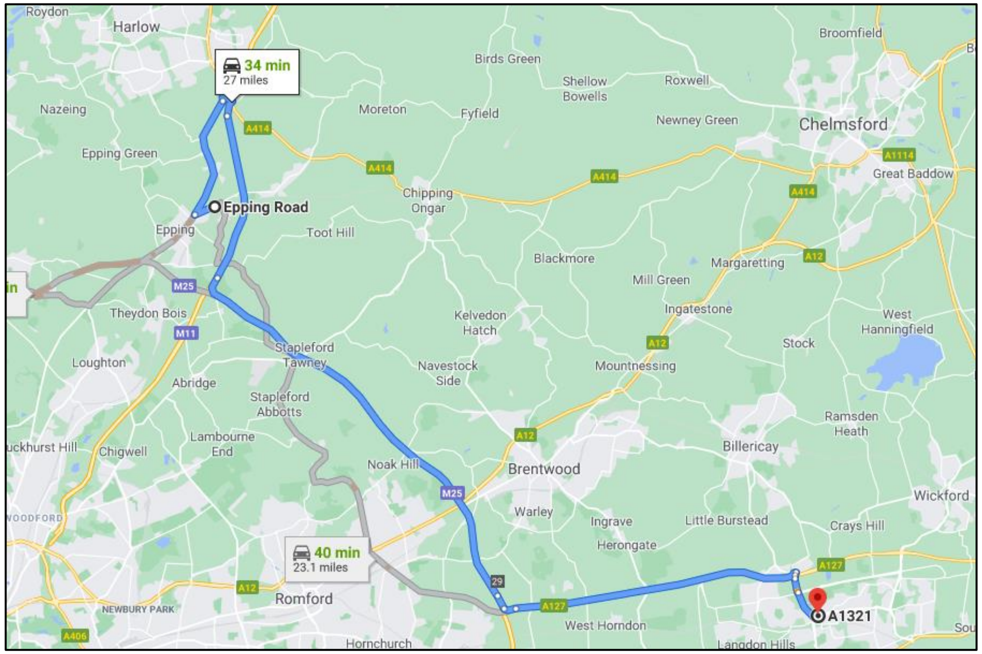
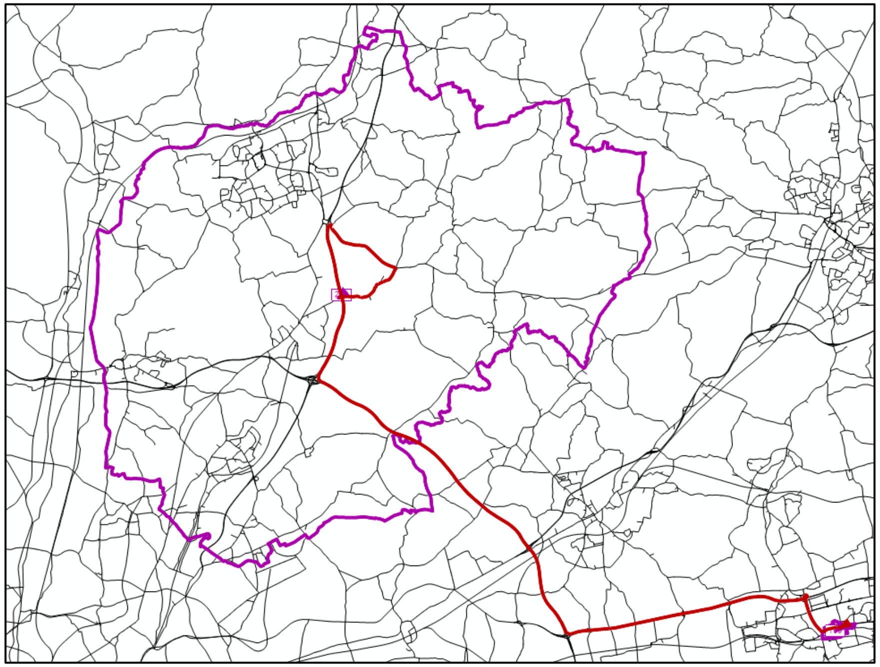
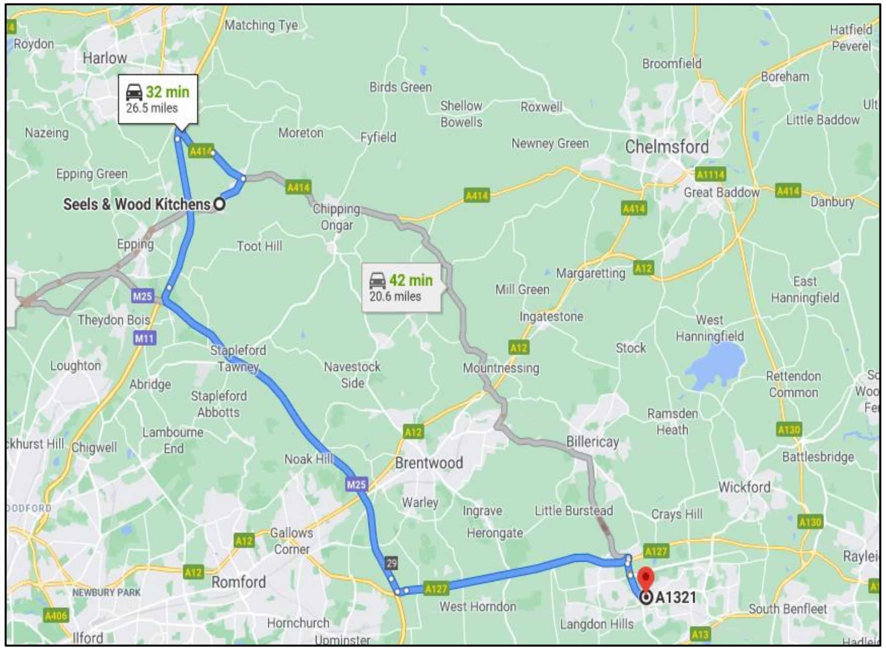


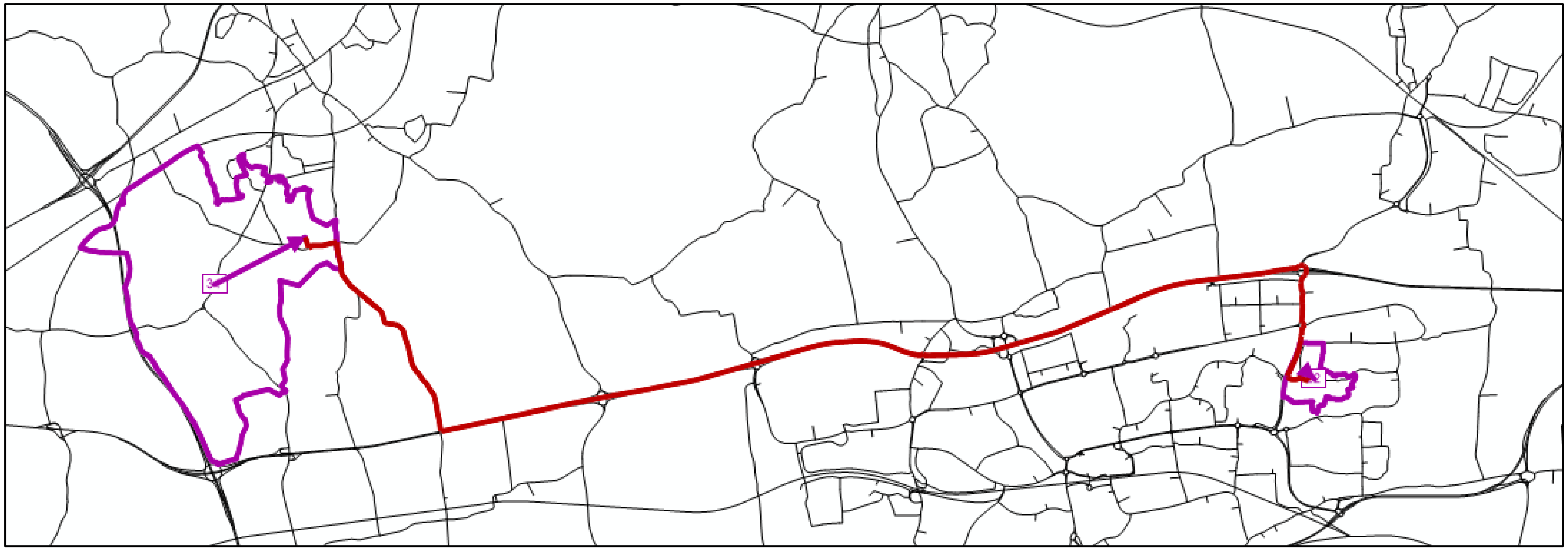


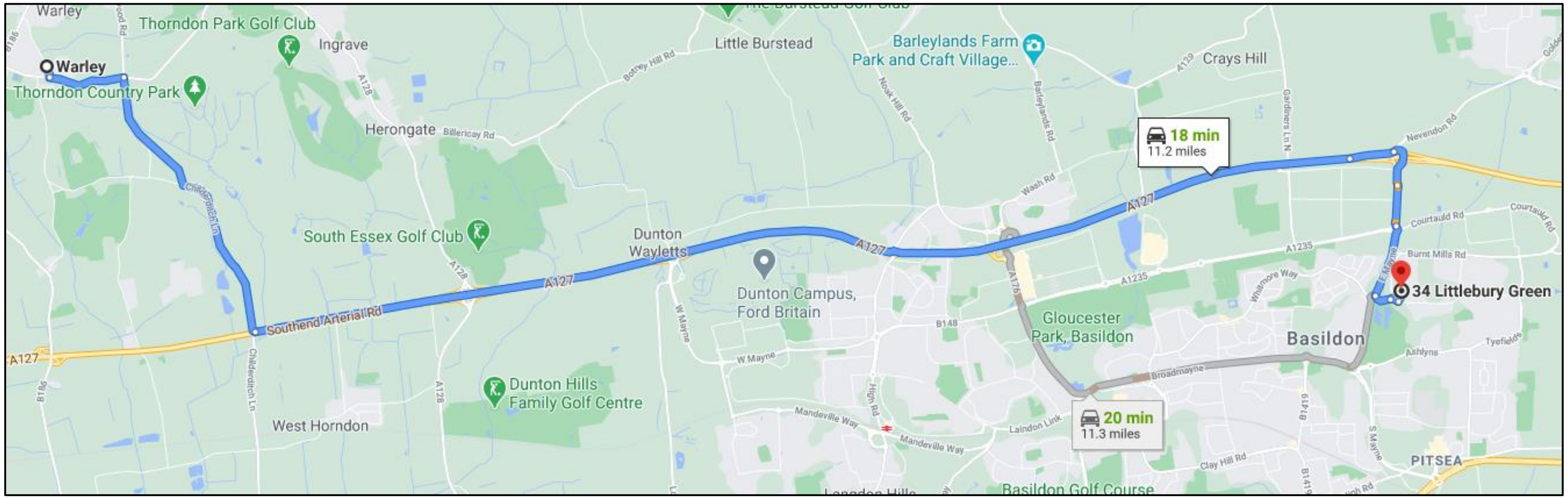
15. Zone 2004 to 1198 (Chipping Ongar to Basildon)



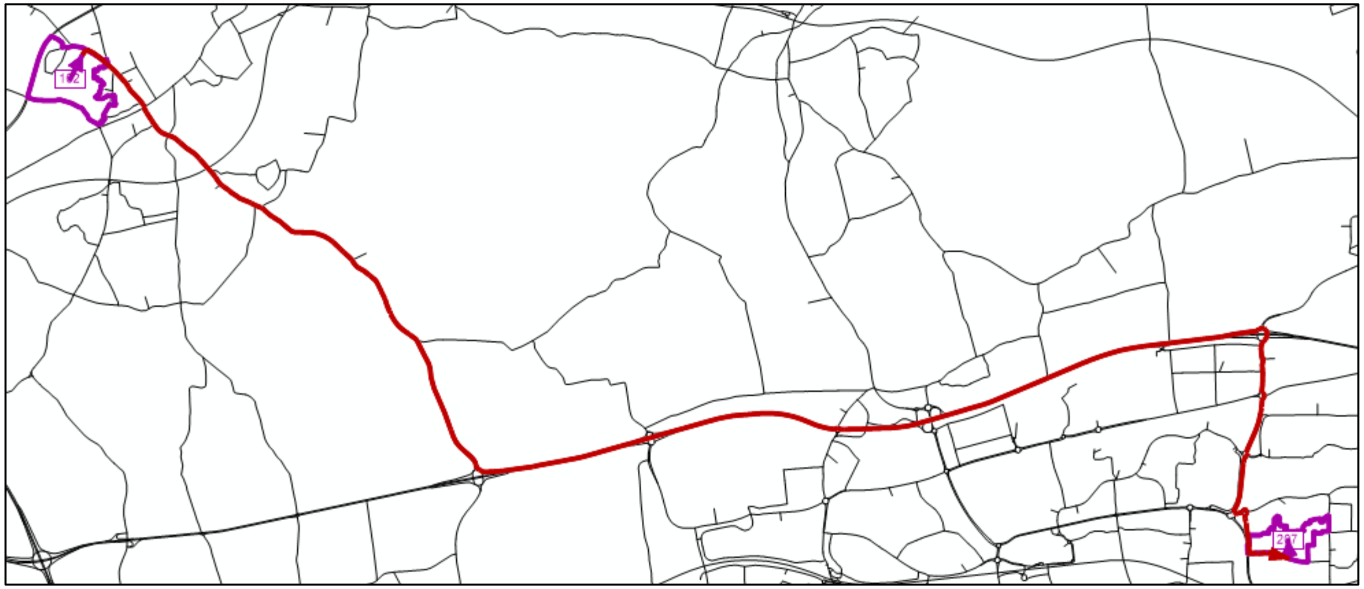


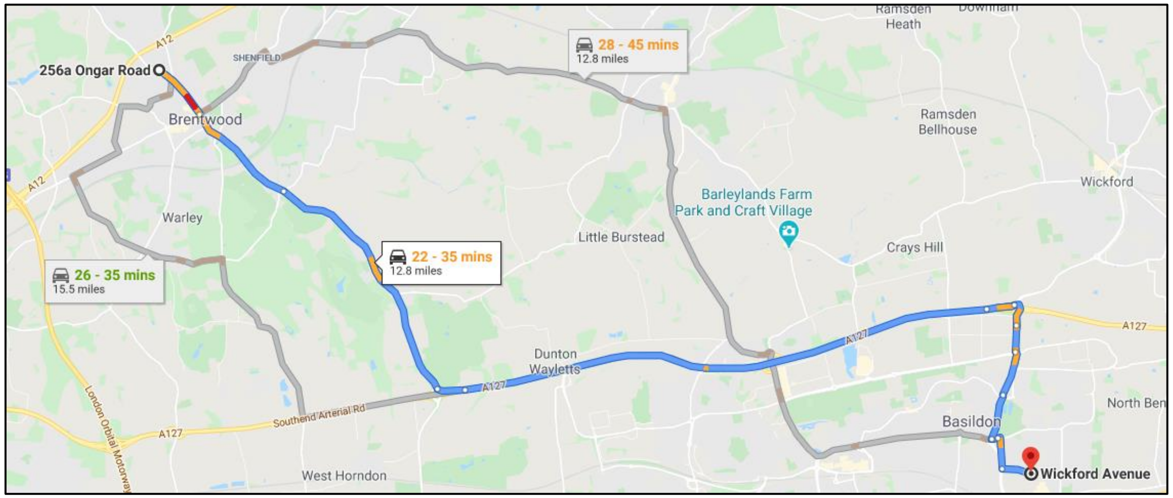
16. Zone 1206 to 1161 (Basildon to Brentwood)



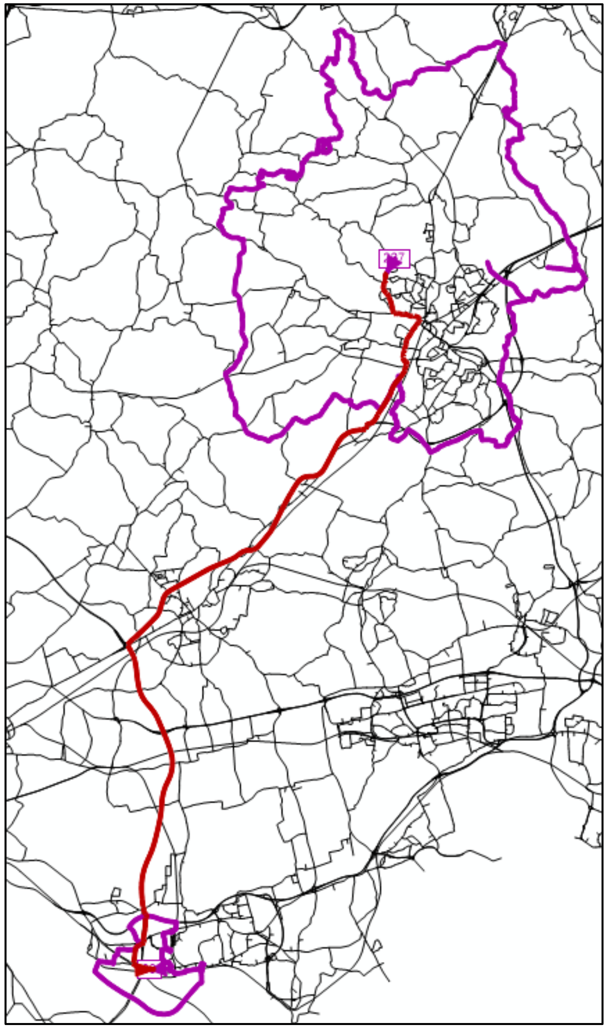


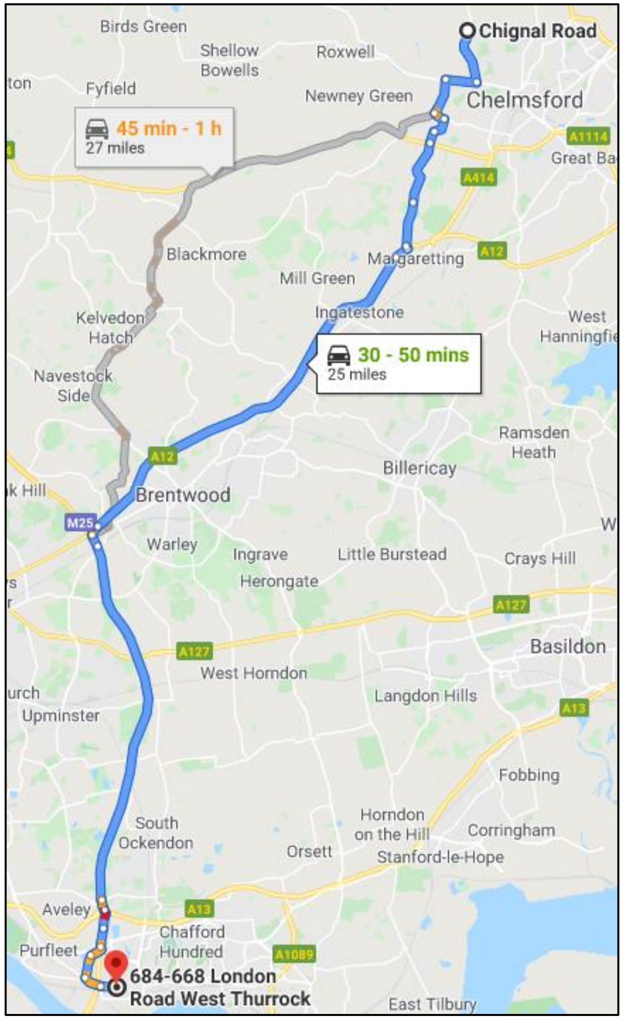
17. Zone 1161 to 1206 (Brentwood to Basildon)



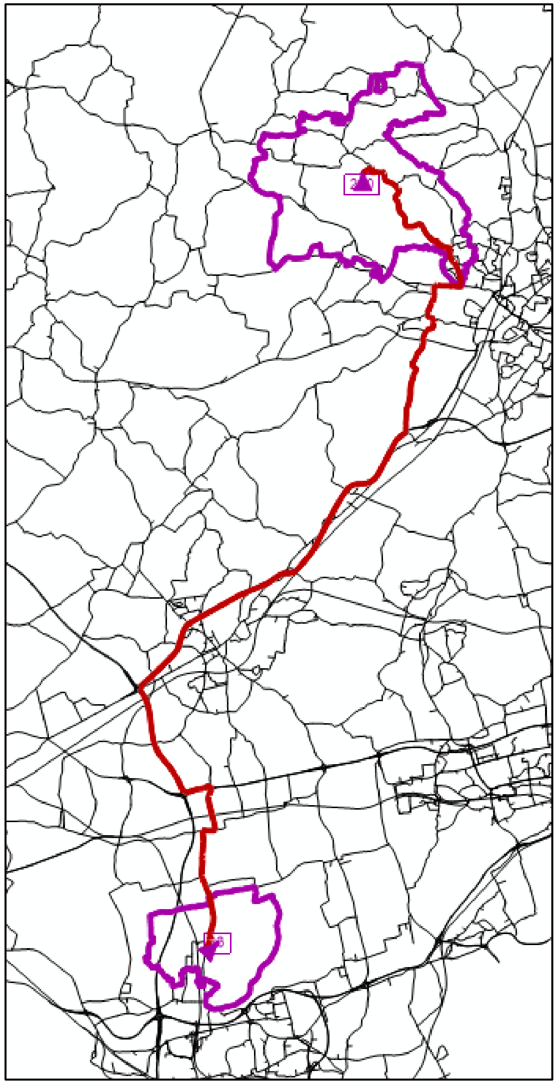


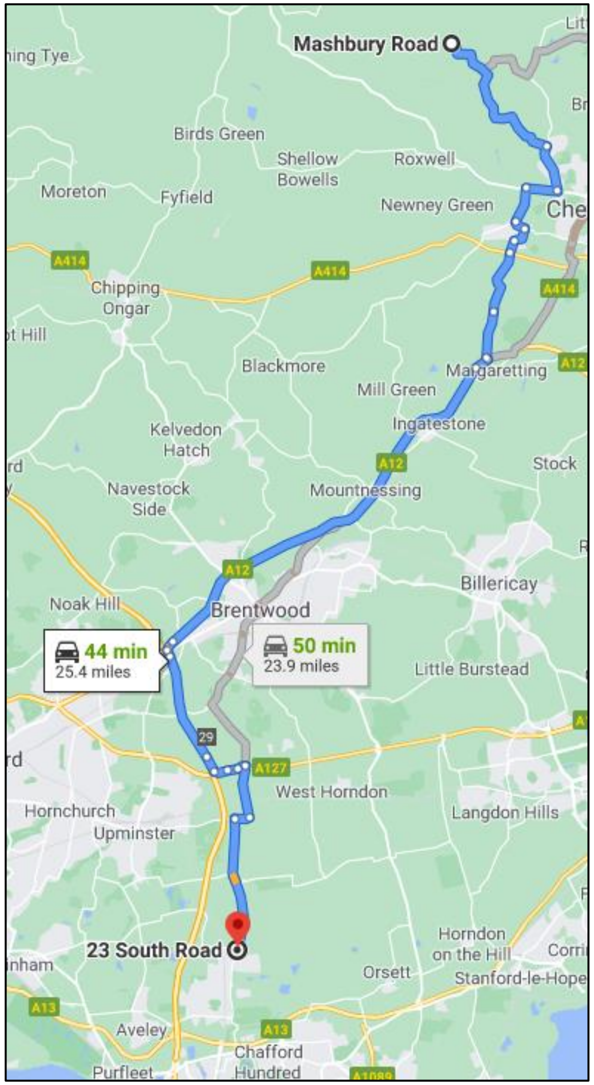
18. Zone 2005 to 1039 (Chelmsford to West Thurrock)



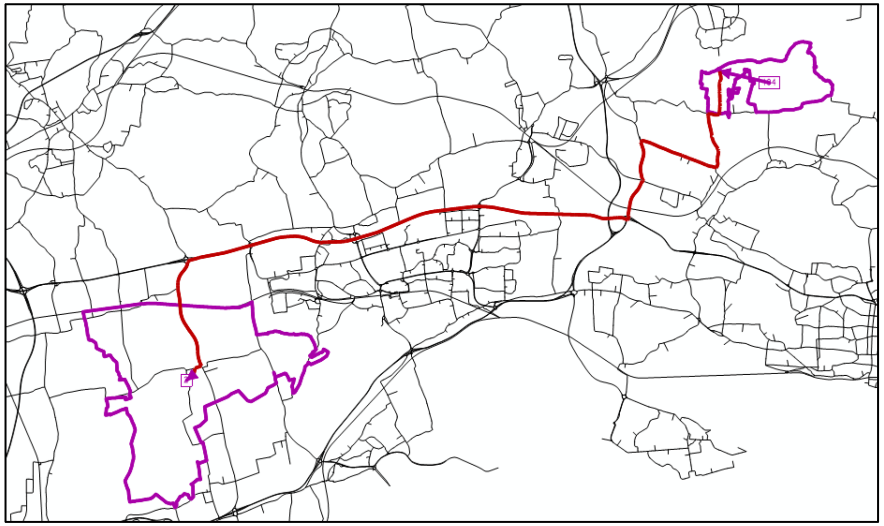


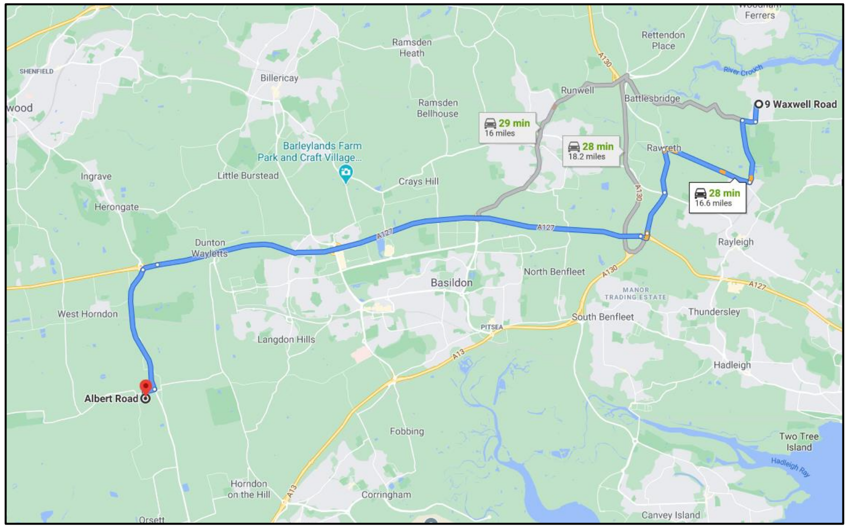
19. Zone 1039 to 2005 (West Thurrock to Chelmsford)





20. Zone 104 to 2 (Hullbridge to Basildon)





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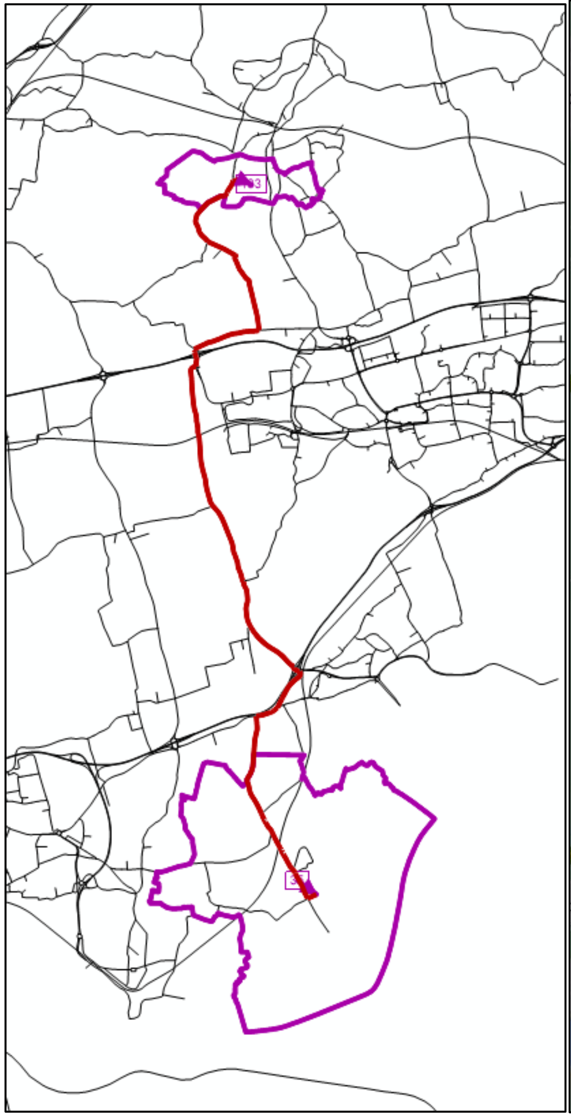
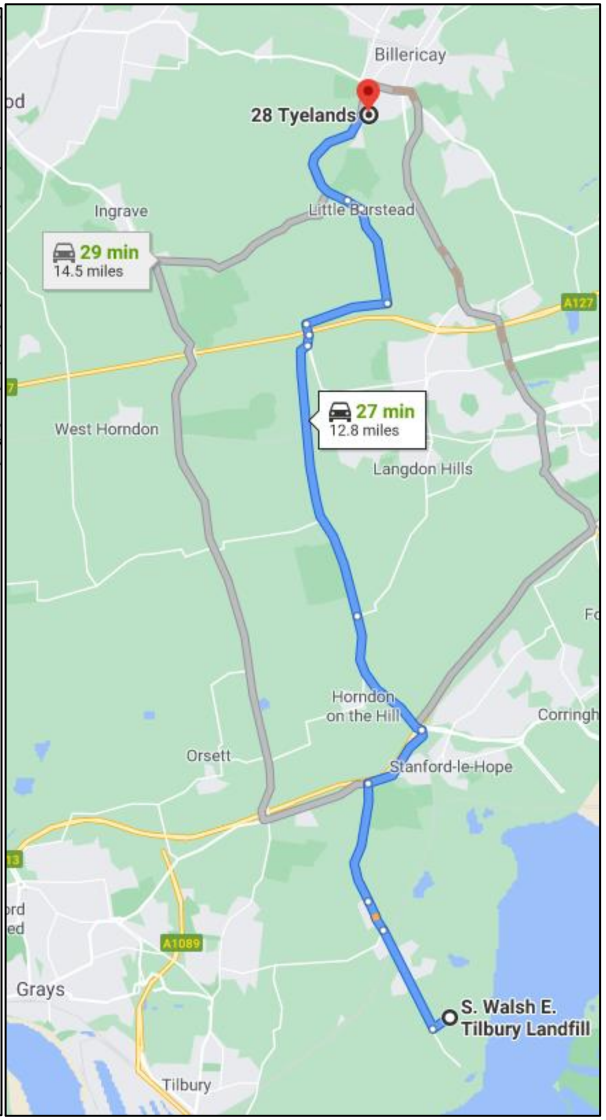
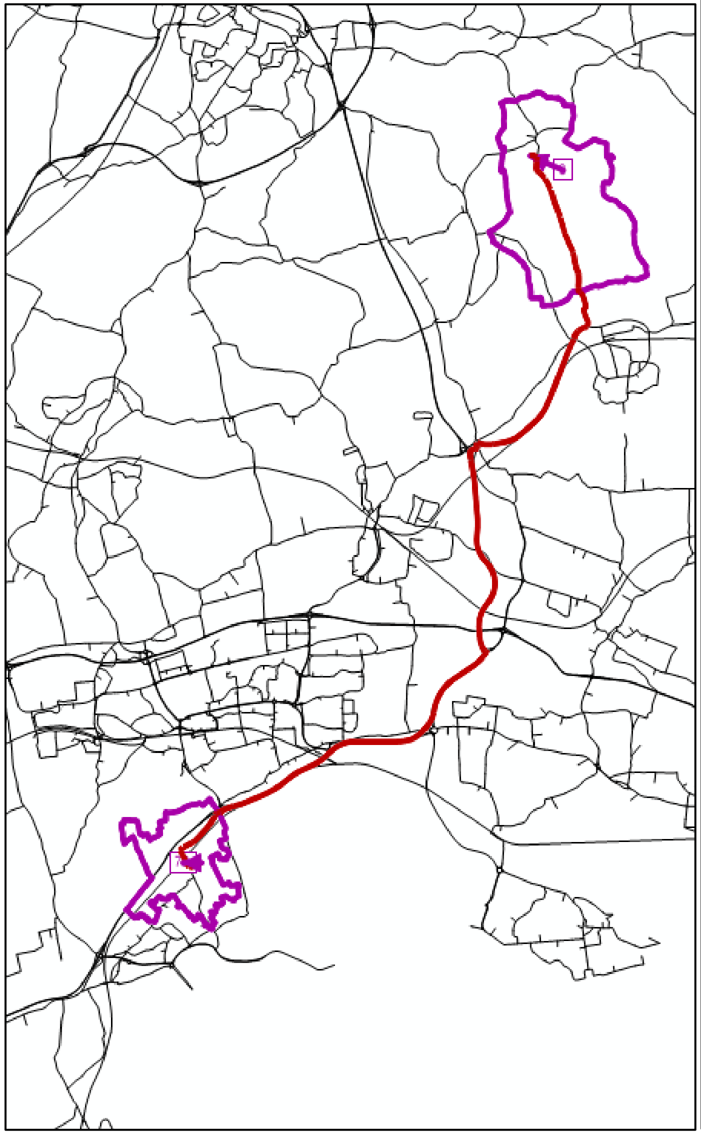
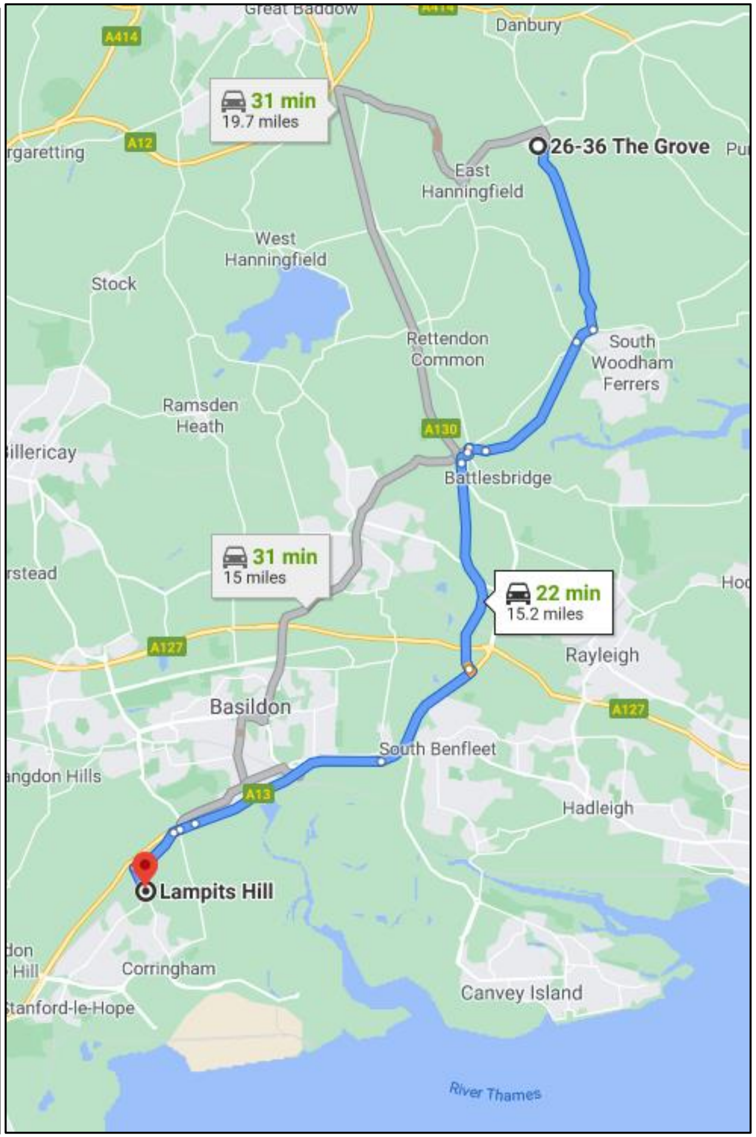




22. Zone 3 to 72 (Bicknarce to Basildon)





Appendix F – Essex Countywide Highway Matrix Development

Introduction

This chapter summarises the base year Essex countywide highway prior matrix development, and this section is taken from the Essex Countywide LMVR. This process was largely driven by the use of aggregated and anonymised mobile network data (MND) provided specifically for this study by Telefonica. Other data sources such as 2011 Census Journey to Work (JTW), National Travel Survey data (NTS), National Trip End Model (NTEM v7.2) and bespoke synthetic matrices were used to augment the MND and to correct for known biases. The education matrices were derived from the school survey data collected by ECC in 2016. The Heavy Goods Vehicle matrices (HGVs) were derived from the DfT's Base Year Freight Model (BYFM) with supplementary information for Light Goods Vehicle (LGV) movements obtained from TrafficMaster OD data.

This chapter details the MND verification methods, synthetic matrix building, and data merging approach.
WebTAG Guidance

Recognising that base year matrix building is a developing area of research, the DfT's guidance set out in WebTAG Unit M3 Appendix B is relatively flexible. The key recommendations are summarised below:

- The guidance advises to begin with a wholly synthetic model, which makes minimal, but reasonable, assumptions to produce initial Production/Attraction (P/A) matrices at the required level of detail.

- The initial synthetic model should start off with the all-day zonal productions and attractions implied by NTEM for each purpose (or, better, make use of the underlying car ownership and trip end functions applied to local data on population, households and employment).

- The matrix cells should then be filled by means of a standard gravity model that should be constrained to reproduce (at least) average trip length for the journey purpose (taken either from local sources or national sources such as NTS). Next, factors giving modal choice and time of day (again, available as part of the NTEM database, although local data is preferred where possible) can be applied. In this way the complete prior matrix is built up by mode and time period, distinguishing the outbound and return portions of home-based purposes.

- The process of "introducing observed data" must then make allowance for the statistical accuracy of that data and preserve key features of the prior matrix (e.g. the total productions and the average trip length). Therefore, there is often a need for an iterative process which attempts to re-impose some features as "constraints".

These broad principles were followed in the development of the Phase 2 Countywide demand matrices.

Although at the time when this work was undertaken, the use of MND in matrix development was becoming a relatively common practice, no formal guidance was available. Therefore, the approach adopted in the development of the Countywide trip matrices was informed by the experience gained by Jacobs and others from a number of flagship projects in the UK, such as Transport for London's Project Estimating Demand using Mobile Network Data (EDMoND) and Highways England's Trip Information System (TIS) database and Regional Traffic Models (RTMs). These were considered good examples of matrix development methods using various matrix verification and validation criteria. The existing data sources were used to establish biases in the MND matrices and to determine the best approach for correcting these through the use of the synthetic matrices.

Raw MND Processing

MND Specification

Telefonica (O2) is a mobile network operator with a UK market share of approximately 30%. It operates a network which provides continuous nationwide coverage to each customer phone (device). The devises generate “events” as they communicate with the national cell network. Telefonica collects these events to build valuable datasets which describe the movement and flow of O2 users across the UK. Devices are tracked anonymously and can be associated with attributes derived from the user’s contract (age, gender, contract type and billing address) or their observed behaviour (affluence, lifestyle, home and work location and other points of interest). In aggregate, therefore, mobile phone data provides an effective insight into the movement patterns of the UK population.

Compared to the traditional transport data sources MND has a higher sample size, wider geographical coverage, and the ability to capture day-to-day variability. However, to build transport model demand matrices it needs to be augmented by other data sources to overcome a number of known limitations related to the expansion of mobile phone data samples: detection of short distance trips, spatial resolution, identification of mode and purpose, vehicle type and vehicle occupancy.

The data collected for the Countywide Model included 32 days defined as “neutral” (i.e. Mondays to Thursdays, excluding bank holidays and school holidays) in March, April and May 2017. The resulting anonymised and aggregated dataset represented observed movements with one or both trip ends within the model study area (shown in the figure below) as well as all trips that penetrated the model study area cordon.

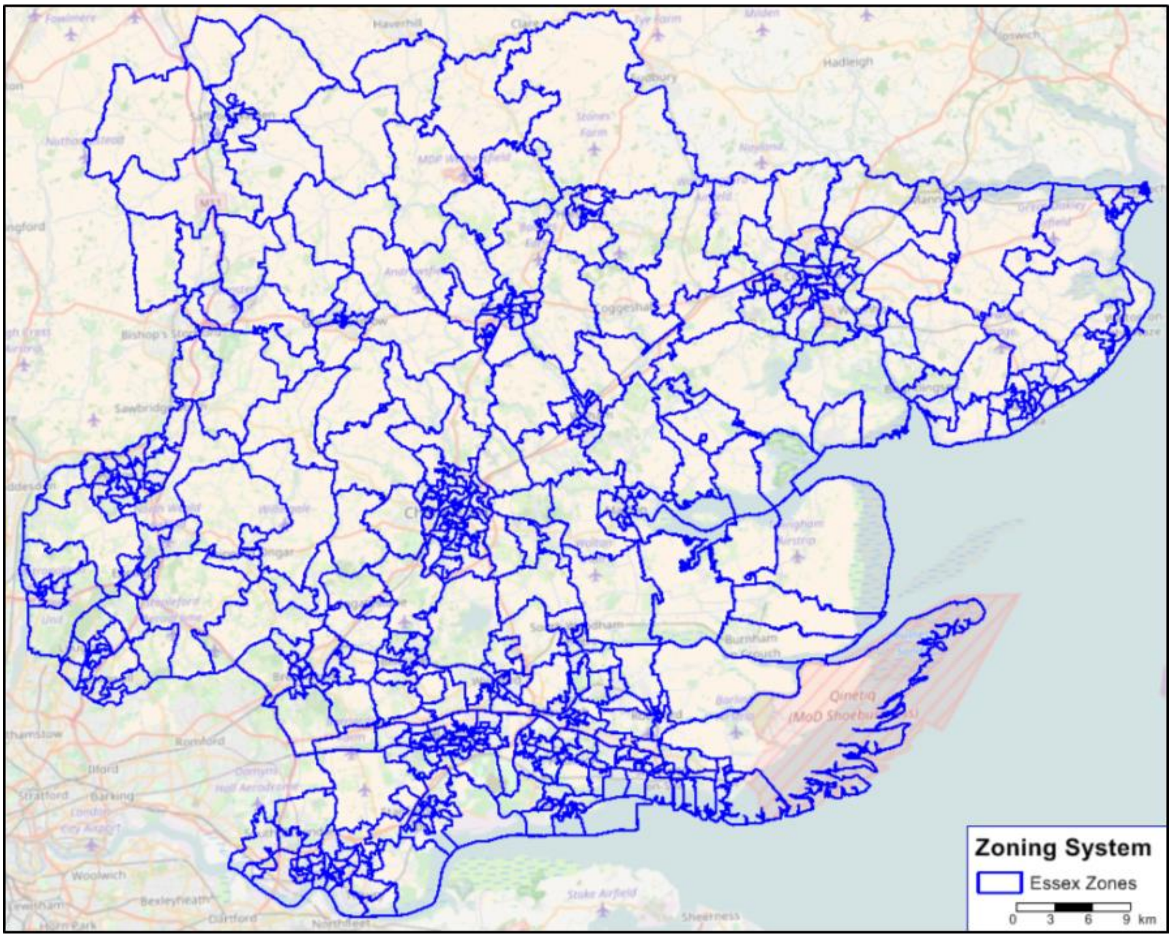


Figure F. 1: Zoning System – Essex

The matrices were supplied in expanded form, representing trips made by the whole UK population on an average weekday. The expansion was based on the ratio of Middle Layer Super Output Area (MSOA) population to the number of phones with a home location in that MSOA. All journeys were allocated a time, purpose, and mode and split into their individual legs to create the OD matrix outputs segmented by:

- Mode:
  - Road (car and van drivers and passengers, motorcyclists, taxi passengers, LGV drivers, bus, coach);
  - HGV; and
  - Rail.
- Trip Purpose:
  - Home-based work outbound (HBW_OB), i.e. commuting trips starting from home;
  - Home-based work inbound (HBW_IB), i.e. commuting trips returning home;

- Home-based other outbound (HBO+_OB), i.e. all non-work-related trips starting from home;
- Home-based other inbound (HBO+_IB), i.e. all non-work-related trips returning home;
- Non-home-based work (NHBW); i.e. trips that start in non-home location with one trip end identified as a work-related place of interest; and
- Non-Home-based other (NHBO), i.e. all other trips that start in non-home location.

- Time period (according to their start time or the time they entered the model cordon):
  - AM peak (07:00-10:00);
  - Inter-peak (10:00-16:00);
  - PM peak (16:00-19:00); and
  - Off-peak (19:00-07:00).

Data Processing

To process the data, Telefonica used its established bespoke methodologies to infer various aspects of travel demand from a series of mobile phone events. The processing steps involved a series of rules and assumptions which were informed by Telefonica's previous experience and verified through various checks described in section 0.

Once raw event data had been collected and verified, the records were converted to person trips, with a defined start time, end time and location. This was done using both the times of dwell (a time when a user was stationary in one distinct place) and times of movement. The dataset was then cleaned to remove invalid users and erroneous records.

The definition of basic trip purposes was primarily based on inferred home and work locations of mobile phone users using the information about their regular overnight and weekday dwells. This enabled a distinction to be made between home-based and non-home-based trips and allowed the identification of potential commuting trips showing repeat patterns of journeys between home and work. As it was not possible to define rules to infer other trip purposes such as employers' business, escort, shopping, and leisure trips, these were combined in a single ("other") category. This category is referred as "HBO+" in this report.

It was also not possible to identify Education trips as a separate category. Tertiary education trips are likely to be included in the home-based work category due to a similar pattern of travel. The majority of secondary and primary education trips were simply not captured by the data, either because they are too short or because they are made by users who do not carry phones.

The route and characteristics of each journey were also analysed to allocate the journey to one of the following modes:

- Air – journeys with a high speed between two airports. These trips were removed from the final matrix;
- Rail – journeys which followed the rail network, and which exhibited 'clustering';

- Walk/cycle – short and slow trips were allocated to walk/cycle and removed from the matrix. In general, most walk and some cycle trips were too short to detect using mobile data; and

- Road – any remaining trips were allocated to the road matrix, which also included coach, bus, HGV and LGV trips as well as car trips. The last step was to classify and segment HGV journeys.

It is important to point out that both purpose and mode classifications were based on a set of deterministic rules, which are subject to errors and uncertainty. Further errors were introduced through stochastic rounding to preserve personal data. In the context of an origin-destination matrix, this was achieved by creating an average result representing multiple days of observations, and by rounding results to integer values.

Provisional Data Checks

Prior to releasing the data, Telefonica carried out a range of validation checks which suggested that the mobile data provided is internally consistent. The home-based trips showed a reasonable degree of correlation with 2011 Census as well as a satisfactory symmetry between home-based outbound and return trips.

The process, however, highlighted a number of biases, all of which are recognised limitations of mobile phone data in representing short distance and education trips. These checks were not exhaustive and further comparisons were undertaken by the study team prior to using MND in the demand matrix building process.

The key findings from the provisional data checks are summarised below:

- A high-level comparison with the DfT's TEMPro data, shown in Figure F. 2, suggests that HBW and HBO+ road travel is underestimated in MND, whilst the number of non-home-based trips in MND is significantly higher than in TEMPro. As a result, the non-home-based travel represents a higher share of the overall demand compared to the DfT's forecast.

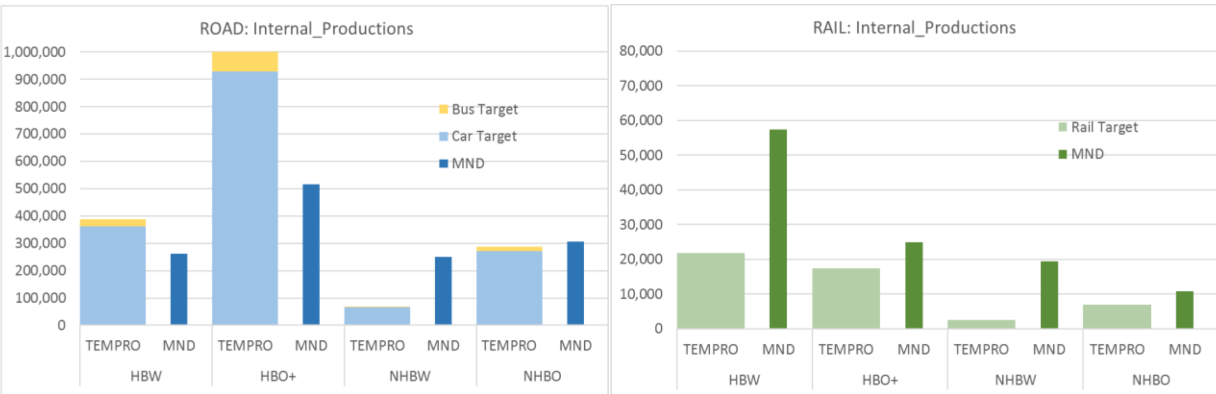


Figure F. 2: Comparison of Total Daily MND Demand Totals to TEMPro (Internal Productions)

Home-based trips tend to be shorter than non-home-based trips, and so they are more likely to be missing in the mobile phone data, which could explain these results. The difference in non-home-based demand could be due to under-reporting of non-home-based travel in NTS/TEMPro and due to the MND including LGV (and possibly HGV) trips which are not included in TEMPro but could be identified as HNBW road travel in MND.

A similar comparison for rail trips suggests a significantly higher number of rail trips in MND compared to TEMPro for all purposes. Due to TEMPro rail forecasts being subject to various limitations, MND was considered more reliable for the purpose of matrix building. Therefore, no TEMPro based constraints were considered necessary. The rail demand was subject to further validation against independent data as described in Appendix G of this report.

- Comparisons of the all-day road trip ends by MND purpose against the average weekday trip ends from TEMPro are shown (on the following pages) in Figure F. 3 for the internal productions by zones and in Figure F. 4 by sectors.

  As explained above, MND underrepresents short distance travel but includes LGVs. Therefore, MND is not directly comparable with TEMPro which covers all distance trips but not LGVs. However, assuming that the proportion of LGVs is relatively low, and the short distance demand is consistently underrepresented by zone/area, a comparison between the two data sources could identify and highlight significant errors or biases.

  Despite the MND demand being lower, the zonal regression plots show a good correlation to TEMPro trip ends for the home-based purposes with R^2 values being just under 0.95. Considering a lower level of confidence in TEMPro forecasts for non-home-based travel (especially at a zone level) and the limitations of the MND mode/purpose detection, it is not surprising to see lower R^2 values for NHBW and NHBO (i.e. 0.81 and 0.61 respectively). As the confidence in both MND and TEMPro forecasts increases at a more aggregate sector level, the correlation for all purposes improves with all R^2 values being above 0.90.

  The home-based trip ends were also checked for symmetry to verify that the amount of outbound travel from home was consistent with the inbound demand returning home on an average week day. As expected, this comparison demonstrated a high degree of correlation.

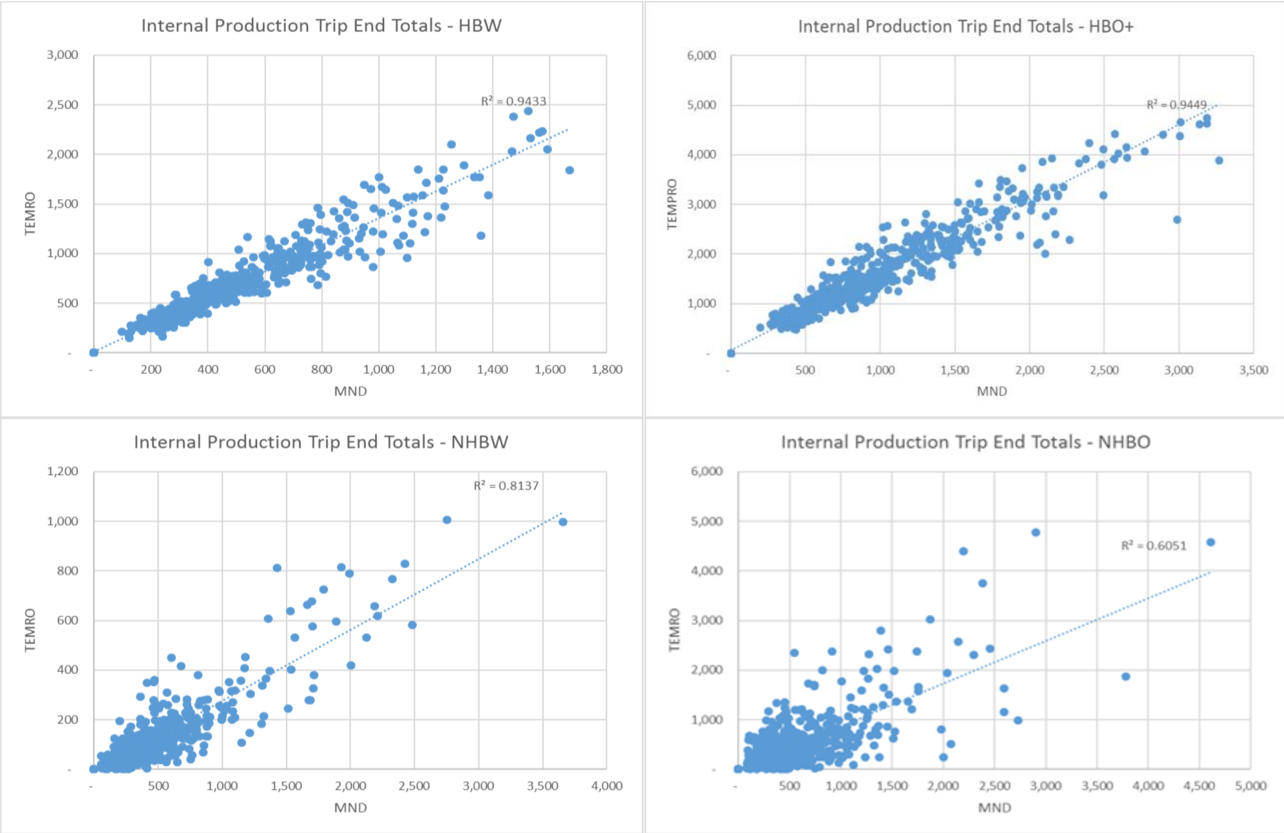


Figure F. 3: Comparison of MND Trip Ends to TEMPro (Internal Productions by Zone)

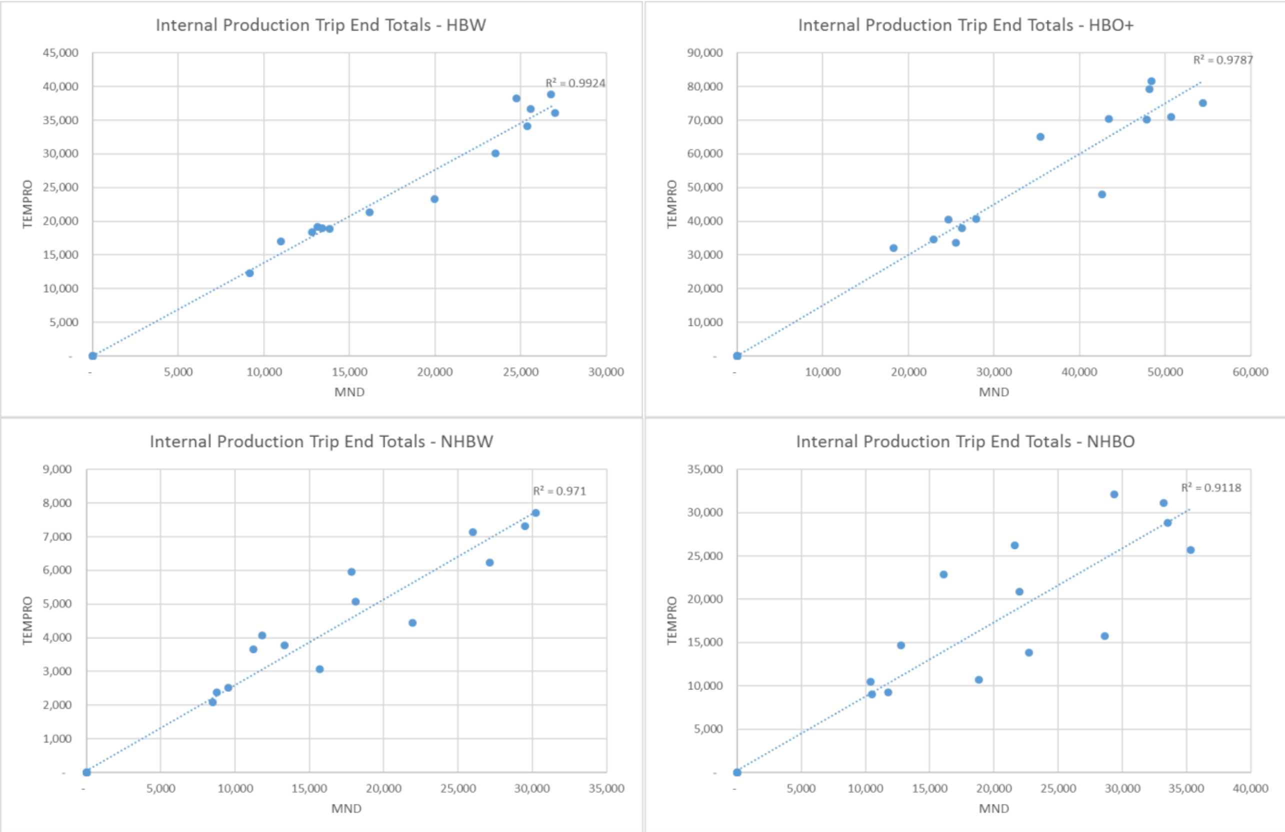


Figure F. 4: Comparison of MND Trip Ends to TEMPro (Internal Productions by Sector)

- Figure F. 5 compares the MND HBW trip distribution patterns against 2011 JTW census data for sector-to-sector movements. Figure F. 6 then shows the same data compared by sector production and attraction. Despite MND demand being lower than the JWT figures, the MND captures the overall pattern of commute travel suggested by the 2011 Census.

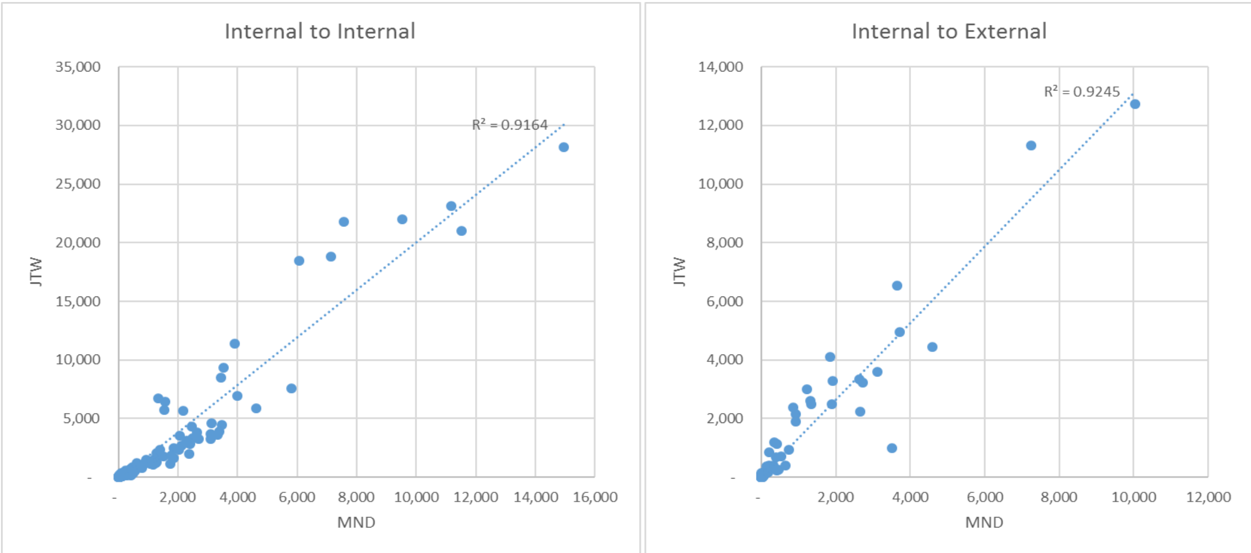


Figure F. 5: Comparison of MND Road Demand to JTW Car Demand (Sector to Sector Movements)

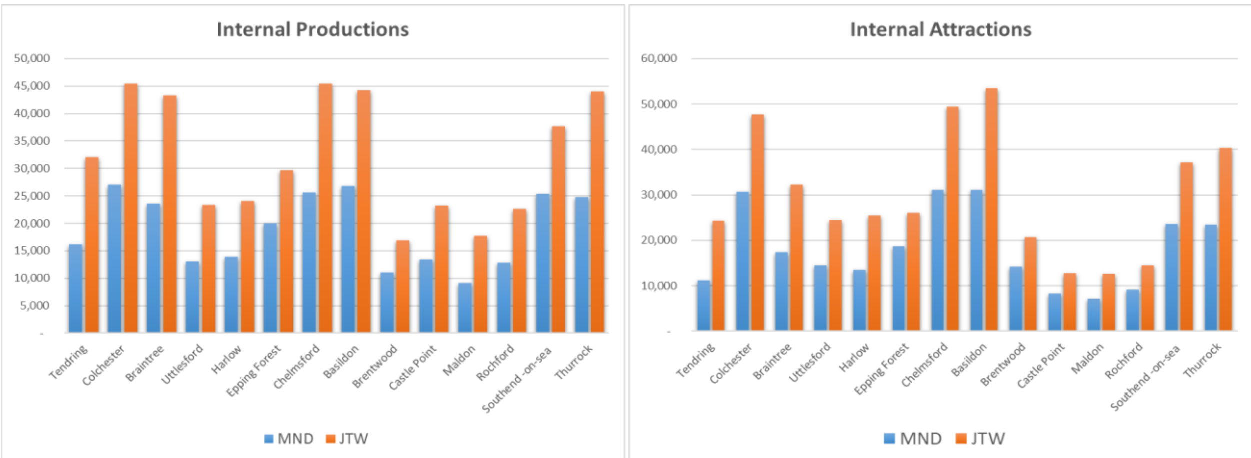


Figure F. 6: Comparison of MND Road Demand to JTW Car Demand (Internal Productions and Attractions)

- Figure F. 7 (on the following page) compares the MND road trip length distributions (TLDs) to NTS TLDs representing the total of car and bus travel by purpose. These confirm that short trips below a certain cut off (of approximately 5 miles) are underrepresented in the mobile phone data. This analysis was also repeated for the urban areas (using the NTS definitions) to determine if the distance cut off differed with the increased density of the mobile phone masts. However, the results were inconclusive, due to a low sample and spatial accuracy of the NTS data for Essex.

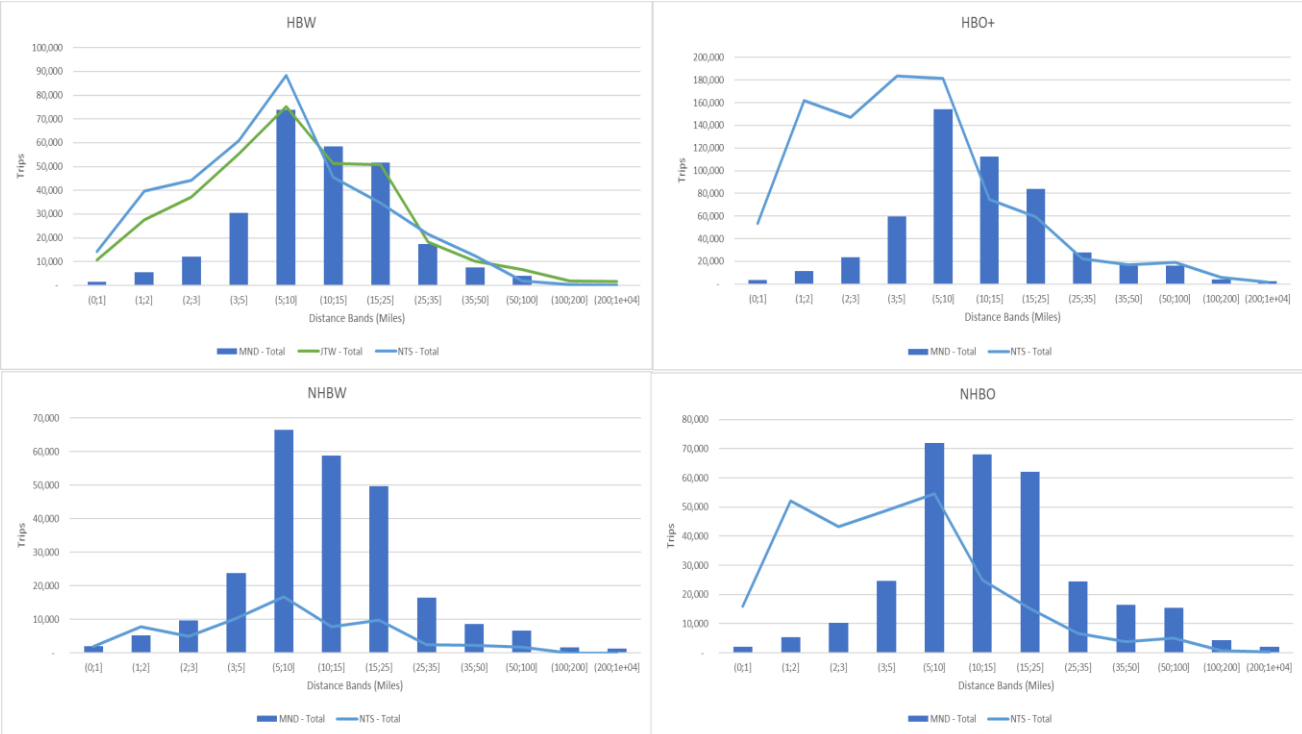


Figure F. 7: Comparison of MND Road Trip Length Distributions to NTS (Internal Productions)

- Finally, comparisons of time of day profiles to NTS showed an underestimation of travel between 8 and 9am in the morning and between 3 and 4pm in the interpeak. This could potentially be explained by education trips not being represented in the mobile phone data.

The provisional data check analysis described above confirmed that MND was representative of observed travel but was subject to a number of limitations such as underreporting of short and education trips. It also contained limited information on trip purposes and road modes. The identified issues and biases were corrected as part of the iterative matrix adjustment process described in section 0. After each round of adjustments, the verification tests were repeated to confirm that the issues were addressed and to determine if further adjustments were required. To inform this process, it was necessary to process secondary data for education trips, LGVs and HGVs and to develop synthetic matrices for personal travel made by car and bus.

Synthetic Car and Bus Matrices

Gravity Model Specification

Synthetic demand matrices were used to infill short distance trips missing from mobile phone data and to support the segmentation of the MND road matrices by vehicle type and trip purpose. The synthetic trip ends were also used to correct biases in MND at a detailed geographical level.

The synthetic matrix development followed a conventional approach of trip generation and trip distribution using a bespoke gravity model for personal car and public transport trips. In line with WebTAG, the matrices were built in the Production-Attraction (PA) form for all-day travel using the segmentation consistent with the

Countywide demand model as described in Section 4.7. The main principle of the gravity model was to obtain a trip matrix consistent with NTEM trip ends and the observed trip length distribution (TLD) from NTS. The gravity models developed in Phase 1 were updated to reflect the latest trip end estimates based on NTEM v7.2 (updated March 2017) and to include bus travel as a distinct mode to support further segmentation of the MND road demand into car and bus trips.

Only movements with one or both trip end in the study area were modelled in the gravity models. The external to external movements were omitted due to the lower level of zone and network details in the external area. The MND was expected to provide higher quality data for these longer distance movements. The production trip ends for the external movements were scaled down based on the aggregated JTW data for the HBW purpose and NTS data for all other purposes.

No rail gravity model was envisaged at the start of this project as the proportion of short distance travel made by rail is significantly lower compared to the proportion of short trips made by bus and car. Furthermore, TEMPro forecasts for rail were considered unreliable and therefore not suitable for generating synthetic demand. In the end, a simplified version of the rail gravity model was used to generate a starting point for short distance rail demand infilling. This process is discussed in Appendix G of this report.

The gravity model formulation, the preparation of inputs, and the resulting synthetic matrices are discussed in the following sections.

Gravity Model Formulation

The synthesised trips obtained from the gravity model have the general form:

$$T_{ij} = P_i A_j k_i l_j f(c_{ij})$$

Where:

- T_{ij} represents trips between production zone i and attraction zone j;
- P_i represents trip productions;
- A_i represents trip attractions;
- c_{ij} is the cost of the trip from production zone i to attraction zone j;
- k_i and l_j are 'balancing factors' which are calculated in matrix preparation and ensure that row and column totals of the matrix match the production and attraction targets; and
- $f(c_{ij})$ is a deterrence function.

The deterrence function is a function of travel costs and introduces disincentive to travel with increasing cost of travel. They have one or more parameters to be calibrated and the number of these defines their degree of freedom with more parameters making it easier to obtain a closer fit with the observed trip length distribution. While several different deterrence functions were tried in Phase 1, it was found that the log normal distribution (equation 1) performed best and, thus, was used in Phase 2:

$$f(c_{ij}) = \frac{1}{c_{ij}\sigma\sqrt{2\pi}} exp\left(-\frac{\left(ln(c_{ij}) - \mu\right)^2}{2\sigma^2}\right) \quad (1)$$

where μ and σ are calibration coefficients.

The parameters were determined by solving the log normal distribution formulae for the mean and the variance (equations 2 and 3 respectively):

$$\mu = exp\left(M + \frac{S^2}{2}\right) \quad (2)$$

$$\sigma^2 = exp(S^2 + 2M) * \left(e^{S^2} - 1\right) \quad (3)$$

where M and S were defined to be the mean number of trips weighted by the midpoint of the distance bands used in the TLDs and the square root of the variance of the TLDs, respectively.

Trip Ends

Production-Attraction (PA) trip end data from NTEM for the base year (2017) was extracted from TEMPro Version 7.2 for all modelled journey purposes listed in Table 4.3 except Home-based Education. Synthesised education matrices were obtained from school census travel data collected by ECC for schools in the county and those unitary authorities in the area (see Section 0 for more detail).

TEMPro car and bus data was obtained for MSOAs for the average weekday. Trip ends for the larger zones in the model were formed by aggregating values over constituent MSOAs. For smaller zones, which required splitting MSOAs, 2011 Census data (resident and workplace population) and the Code Point dataset (for November 2010, which gives splits for both domestic and non-domestic postcodes) were used, as detailed in the table below:

Purpose	Production Split Factors	Attraction Split Factors
HB Commute	Census – resident population	Census – workplace population
HB Employers Business	Census – resident population	Census – workplace population
HB Other	Code Point – domestic	Code Point – domestic & non-domestic
HB Shop	Census – resident population	Code Point – non-domestic
NHB Employers Business	Code Point – non-domestic	Census – workplace population
NHB Other	Code Point – non-domestic	Code Point – non-domestic

Table 1 – Factors Used in Splitting MSOA Trip-Ends to Smaller Zones

Generalised Costs

Car costs for the gravity model represented daily average costs taking account of outbound and return journeys. These were produced using the final Phase 1 model. The Phase 1 matrices for Commute, Employer Business and Other user classes were assigned to the road network in all time periods to calculate generalised costs including time, distance and Dartford Crossing toll components. A correlation between the demand model purposes and the assignment user classes is provided in Table 4.3. The OD pairs with no cost, e.g. intra-zonal, were set to be half the minimum cost for their production zone. Daily generalised cost skims (for use in the 24-hour PA demand model) were obtained by weighting the period-specific skims by their appropriate proportions to obtain a daily average. For home-based trips the outward and returning costs are averaged to give the cost used in demand modelling.

The bus skims used in the gravity model were based on perceived journey times derived from the Phase1 multimodal public transport assignment in VISUM. To identify OD pairs that had a bus option available to them, the probability of an individual using either bus or rail within each zone pair was obtained from VISUM skims. Each OD pair was classified into one of “Rail”, “Bus”, “Competitive” or “N/A”. If the proportion of trips taking Rail was greater than 0.95 the OD pair was classified as “Rail”. If the proportion of trips taking Bus was greater than 0.95 it was classified as “Bus”. If the probability of taking both Bus and Rail was 0 it was classified as “N/A”. Otherwise it was “Competitive”. As no bus network was modelled outside Essex, only internal to internal demand was represented in the bus gravity models.

Trip Length Distribution (TLD)

The NTS database was queried to produce observed TLDs with which to estimate the parameters of the deterrence function (equations (2) and (3)). For car these were generated for productions inside Essex to all attractions and for bus they were produced for Essex to Essex trips only.

Gravity Model Results

The coefficients of the deterrence function were revised to improve the fit to the observed NTS trip length patterns. The focus was on achieving a good match between the modelled and observed patterns for shorter distance bands while maintaining the overall TLDs as close as possible to the observed NTS values. It should be noted that the NTS data itself is subject to limitations and low data samples (especially for minor modes and purposes) and therefore was not considered fully reliable.

The comparisons of the modelled and observed TLDs for car are shown in Figure F. 8. They demonstrate a relatively close match for shorter distance bands especially for the home-based purposes.

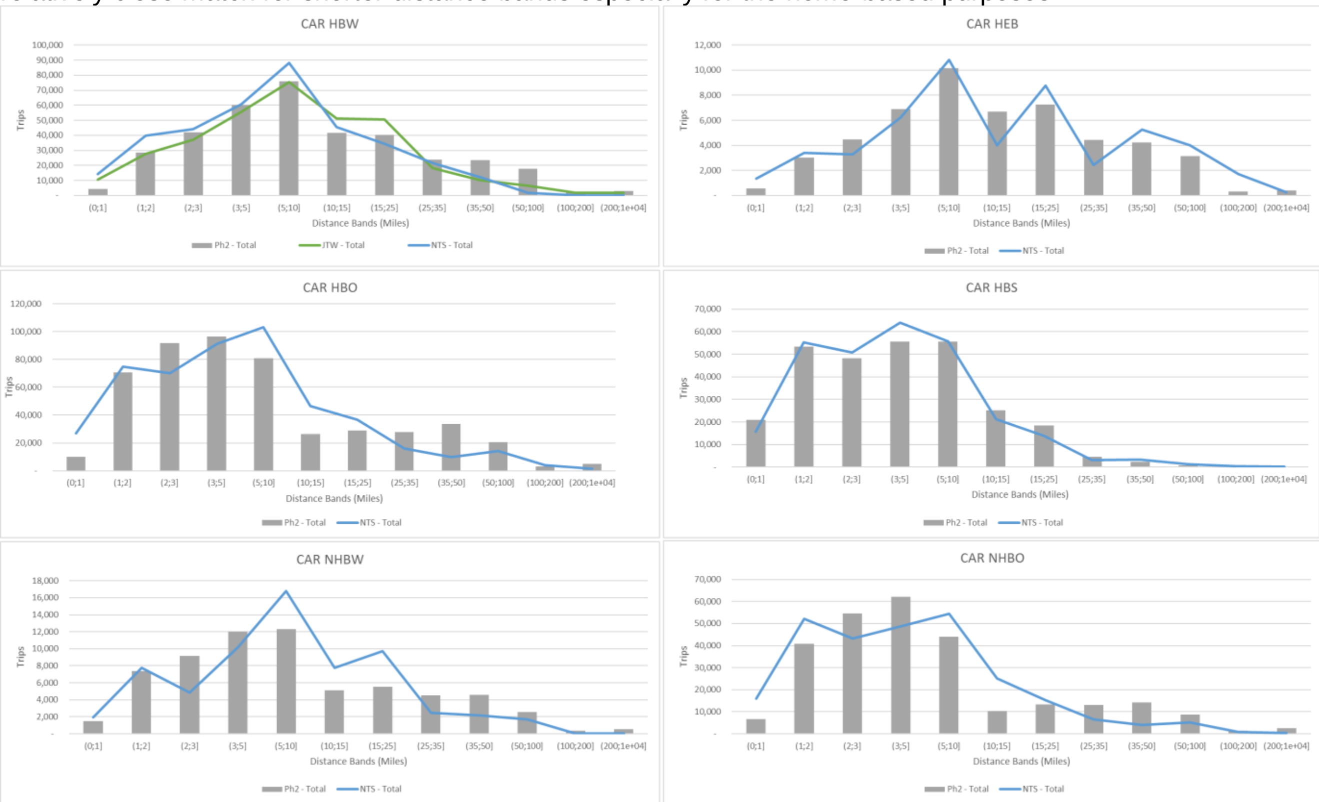


Figure F. 8: Synthetic Car TLDs vs NTS (Internal Productions)

The home-based work demand was also compared to 2011 Census JTW data at a sector level, as shown in Figure F. 9 on the following page. This comparison suggests a close correlation between the synthetic and observed sector-to-sector movements.

Figure F. 10 then compares the HBW synthetic demand by production and attraction to the corresponding JWT figures. Despite the overall patterns being similar, synthetic demand (based on TEMPro) suggests less HBW car travel than recorded in the Census. This could be explained by the reduction in car travel between 2011 and 2017 as well as by the differences in the data definitions.

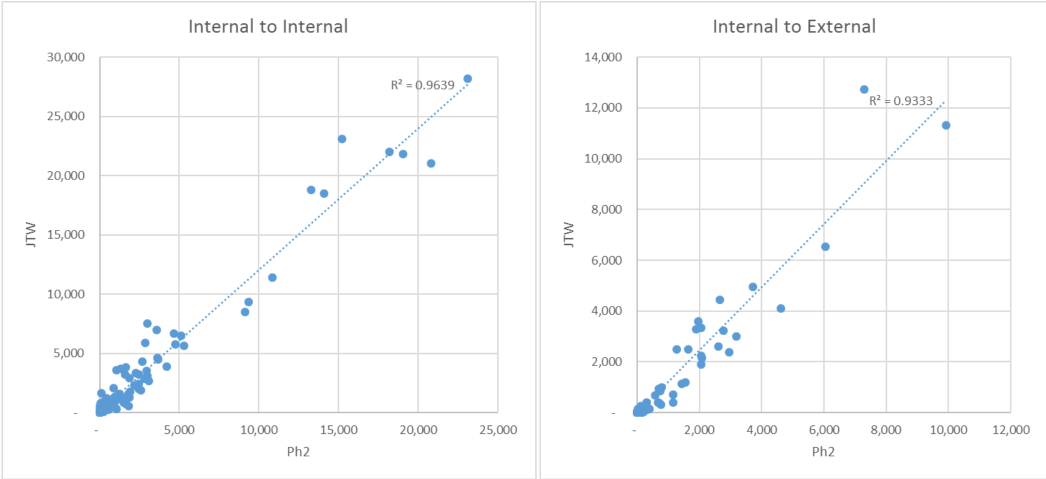


Figure F. 9: Comparison of Synthetic Car HBW Demand to JTW Car Demand (Sector to Sector Movements)

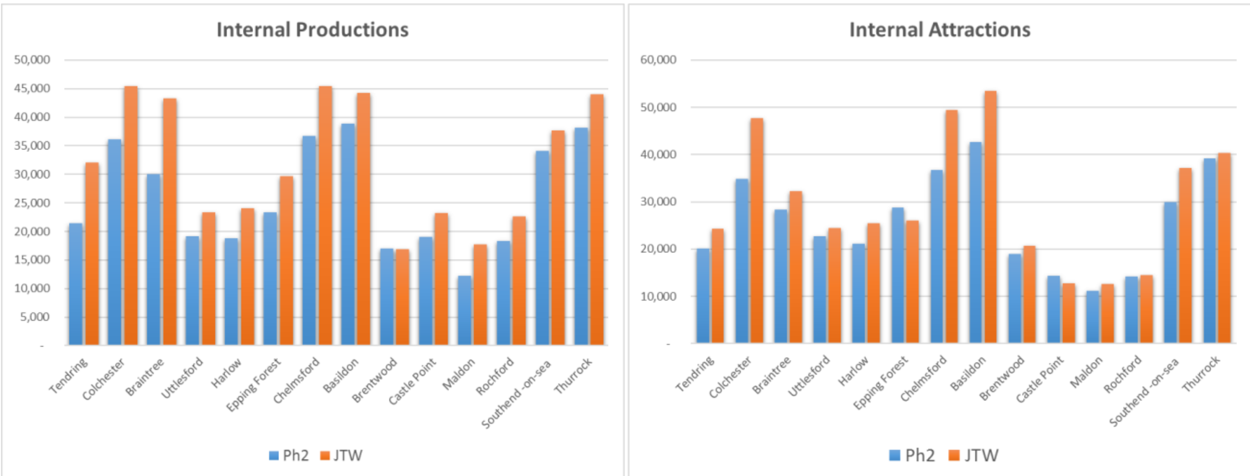


Figure F. 10: Comparison of Synthetic Car HBW Demand to JTW Car Demand (Internal Production and Attractions)

Education 24-hour Travel Patterns

Home-based educational car trips were based on the school survey data collected by Essex County Council. School trips were divided into two distinct sets, corresponding to primary and secondary education. The origin-destination patterns from the 2016 dataset formed the basis of pupil travel. Average mode splits were calculated for primary and for secondary school trips and were applied to the total trip matrices.

HGV Matrices

Although MND matrices were also available for HGVs, their quality was considered low. The use of TrafficMaster data for HGVs was also dismissed due to unacceptably low HGV samples. Consequently, the

HGV demand was created using the aggregated DfT's Base Year Freight Model (BYFM) data. The matrices were subsequently adjusted to match the observed link counts.

The BYFM dataset contained modelled freight movements for 2006, using a zoning system which included local authorities, ports, airports, and major distribution hubs. The matrices represented trips carrying goods on an average day and contained 996,000 HGV trips in total. Although the BYFM trip patterns do not reflect any changes in distribution hub locations since 2006, or take account of the new London Gateway container port, they were still considered to be the best source of data available for this study.

The BYFM trips were allocated to the Countywide model zones using simple proportions of origin zone in each district, and similarly for destination. The proportions were based on Workplace populations from the 2011 Census and calculated as the ratio of model zone to district totals. The ports, airports and distribution hubs were allocated to the model zone where they are located. Some allowances were made for growth in HGV movements between 2006 and 2016 and empty vehicle returning movements.

During the highway model calibration, a relatively large changes to the HGV prior matrices was found. This is not unusual for a strategic model and was considered acceptable due to low quality of the input data for goods vehicles. However, we recommend revisiting the HGV matrix development should new quality freight data become available in the future.

LGV Matrices

The LGV matrices were developed form the DfT's TrafficMaster dataset (October - November 2014 and March 2015) covering the South East region. This data was automatically collected from drivers of vehicles equipped with satellite navigation or anti-theft tracker devices that switch on when the engine is switched on and switch off when the engine is off. The start and end locations were available at MSOA level making it straightforward to convert the data into the Countywide zoning system.

It is recognised that the population of GPS-equipped vehicles may not be representative of the whole LGV vehicle fleet and the driving patterns of those owning GPS-equipped vehicles may also not be typical. While potential sample bias of the dataset is acknowledged as a limitation, alternative data sources were not available at the time of the Countywide model development and therefore TrafficMaster was considered to be the best source for the development of the prior matrices of LGVs.

The TrafficMaster data was cleaned to remove short trips below 1km to address the trip length bias and to remove short trips related to internal movements around depos. A comparison of the TrafficMaster raw and adjusted trip-length distributions to NTS is shown in Figure F. 11. It demonstrates a reasonable match between the two datasets. Although the NTS LGV data has its own limitations and is based on a low sample, it did not suggest any apparent bias in the TrafficMaster trip length distribution for longer trips. Therefore, no further adjustment to the trip length distribution was made.

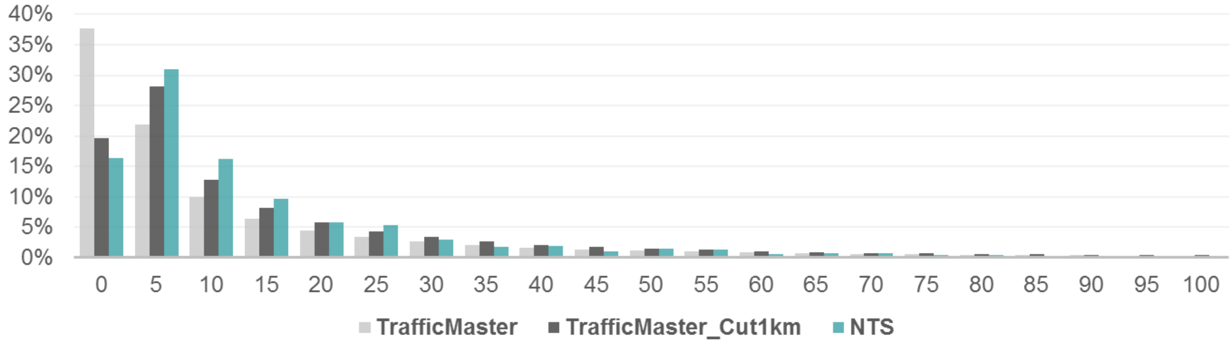


Figure F. 11: Comparison of Trip Length Distributions: TrafficMaster LGV (Before and After Data Cleaning) vs NTS LGV

The LGV data was supplemented by a portion of synthetic demand representing personal travel which was used as a proxy for self-employed and mobile (or flexible workplace) workers. From NTS it was found that 1.5% of HBW trips and 0.6% of HBO trips were LGVs rather than cars. As such, these proportions of car trips were moved to LGV for each purpose.

To enable the substitution of LGVs from the daily MND demand for road, the process of translating the TrafficMaster data into the LGV matrix was undertaken at 24hr level. These matrices were subsequently converted to the individual time periods using the time of day factors based on the LGV counts for the study area.

The resulting matrices were then assigned to the Phase 1 network and the modelled LGV flows were compared against counts along long screenlines. The matrices were adjusted using factors derived from the count data across a selection of screenlines to obtain the best match to observed flows.

Matrix Building through Data Merging

Summary of the Approach

Following the initial data verification checks, MND was chosen as a primary data source for the Countywide matrix building. This approach recognises MND's higher sample size, wider geographical coverage, and the ability to capture day-to-day variability. To infill the identified gaps, the MND matrices were combined with the synthetic demand and alternative data sources for education, LGV, and HGV trips.

The process also involved additional mode and purpose segmentation in order to create the demand segments required by the Essex Countywide demand model. To meet these requirements, and to maintain the link with land-use and demographic data, the prior MND-based matrices were first developed at an all-day level in a PA format and then converted to the time period OD format and – for car – from person trips to vehicles.

The verification checks were repeated throughout the process to ensure that the overall patterns of trips in the resulting matrices were consistent with TEMPro and NTS and to identify any further sources of bias to be addressed in the subsequent iterations. A comparison of the assignment results with the observed volumetric (e.g. traffic count survey) data was also introduced. The optimisation method was based on minimising the inconsistencies between the assigned prior matrix and the observed data through the modification of assumptions utilised in data merging and various conversions between daily PA and time period OD.

Figure F. 12 provides an overview of the matrix development exercise, which was an iterative process informed by extensive data verification checks. The following sections provide more details on the individual steps.

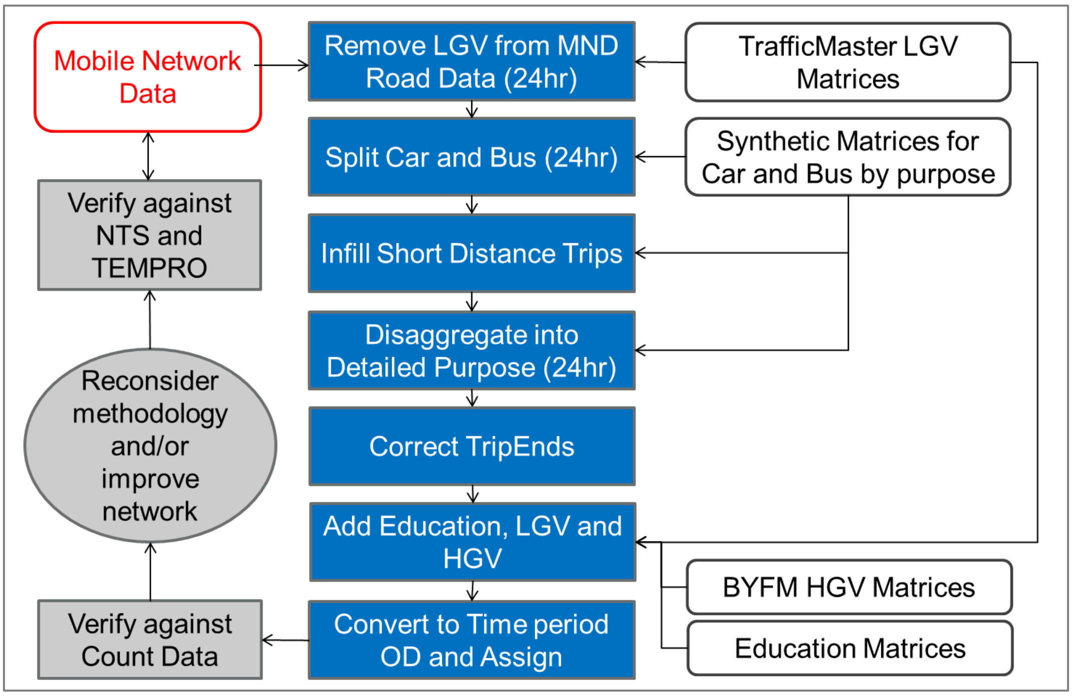


Figure F. 12: An Overview of the Final Matrix Building Process

Removal of LGV from MND Road

As described in Section 0, TrafficMaster (augmented with synthetic car data) was used to create prior demand matrices for LGVs. These matrices were also used to inform the removal of LGVs from the MND road demand into the combined car and bus travel and LGV trips.

Prior to the removal of LGVs, the matrix building process was run through all other steps to produce matrices of LGVs and Car combined into a single user class. These were assigned to check that the overall level of flows resulting from MND were sensible and to identify any issues related to time of day and person to vehicle conversions. The removal of LGVs was then performed at an MSOA level (consistent with the raw TrafficMaster data) for all movements with one or both trip ends in the internal area.

As explained in Section 0, the TrafficMaster LGV data only represents a small percentage of the national fleet, therefore an expansion of the dataset was required. The resulting “unadjusted” LGV matrix representing 3 months’ worth of data was found to be too high when compared to observed counts. As a result, the LGV matrix was scaled down to be more in line with the observed data. To factor the LGV matrix, the proportion of trips required to match prior matrices to post matrices was calculated at sector production level outside London and sector to sector inside London. These proportions were then applied to the raw LGV TrafficMaster matrix. The scaled TrafficMaster LGV data was used in the matrix building iterations to remove LGV data from MND while achieving the best possible validation results.

Inconsistencies in the data definition and the zoning systems between MND and TrafficMaster meant the TrafficMaster data could not be used to disaggregate MND for the external-to-external movements.

Therefore, for all areas except London to London, observed count data was used to determine the average vehicle type proportions. It was assumed the that proportion of LGV in the overall traffic was 10% with 2% of these bus trips and the remaining 98% being car. For London to London trips it was understood that the vehicle type proportions were likely to be different to areas in Essex. For example, one might expect to see higher public transport shares, especially where it involved crossing the River Thames. To determine these vehicle type shares London Travel Demand Survey (LTDS) data was used, taking into consideration whether the trips crossed the River Thames.

Split of Car and Bus

Following the removal of the LGVs from the MND matrices and scaling the external to external trips, the next step was to separate the remaining road trips into bus and car journeys. As the Countywide Model network does not contain bus routes outside of Essex, the bus matrices only included internal movements.

In order to remove bus trips from MND, an estimate of bus and rail mode shares for each OD movement was derived from the synthetic matrices. This approach took account of differences in mode share by area as well as accessibility effects. Checks were carried out to ensure that the distribution of shares is sensible (i.e. no outliers) and that the overall mode shares by sector were in line with those suggested by TEMPro trip ends.

Short Distance Corrections

When comparing MND to NTS, the trip length distribution highlighted an underrepresentation of short trips. An example comparison for HBW trip length distributions including JTW, NTS, synthetic (Phase 2) and MND is shown in Figure F. 13 on the following page. This bias was corrected by infilling short trips using the developed synthetic matrices. The infilling was undertaken separately for each mobile phone trip purpose and mode.

Following initial testing, the distance threshold for infilling was defined as 7km (including intrazonal distances) for all modes and purposes. To retain as much MND as possible, whilst increasing the amount of short distance travel, the available MND records were retained in infilling. It involved expanding MND to match the production trip end totals from the gravity model (which were normalised to NTS) and taking a proportion of MND and synthetic trips based on how much infilling was required. As there were no reliable estimates for the external production, those short distance trips were replaced with the synthetic estimates.

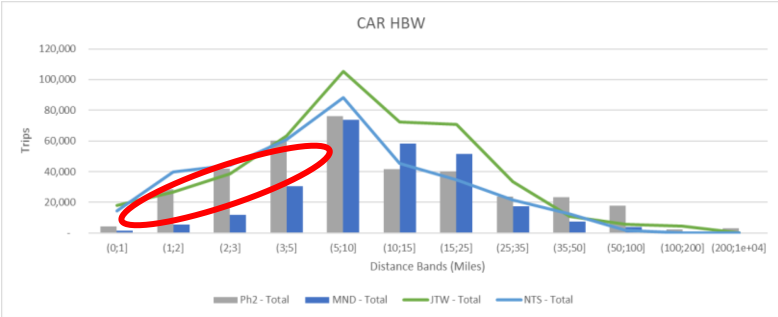


Figure F. 13: Comparison of Trip Length Distributions for HBW Showing the Underestimation of Short Trips in MND

Detailed Purpose Segmentation

The key objective of the detailed purpose segmentation was to create matrices compatible with the Countywide demand model segments (24hr PA) and with the assignment model user classes (time period OD). As described previously, the provisional MND was available for the following trip purposes: HBW, HBO+, NHBW and NHBO. As part of this step the HBO+ demand was segmented further into Other (HBO), Shopping (HBS) and Employer's Business (HBE) using the purpose shares based on the synthetic matrices for bus and car. The splits were applied at a zone level to reflect differences in trip length distribution by purpose whilst maintaining the purpose split at trip end level, reflecting planning data and land use. Whilst the resulting trip length distributions were different for each disaggregate trip purpose, the MND trip length distribution was retained at an aggregate level. For the external to external area NTS purpose splits were used.

The comparisons of the resulting TLDs to NTS data for car purposes can be seen in Figure F. 14.

Figure F. 14: Prior Car Demand TLDs vs NTS (Internal Productions)

Trip End Corrections

The spatial accuracy of MND is limited due to possible trip allocation and expansion errors. Therefore, some form of constraining to TEMPro trip ends was necessary to maintain consistency with land use and planning data. Recognising that TEMPro itself is subject to uncertainty and error, the constraining was applied to bring the trip end totals to within 10% of the target value.

The verification tests highlighted higher trip rates for the MND non-home-based travel compared to those implied by TEMPro/NTS. Following the assignment screenline validation checks (which suggested that the higher trip rates were producing better validation results) it was decided against scaling those to match TEMPro (as non-home-based travel could be underreported in NTS). Instead, the non-homebased trip ends were constrained to TEMPro trip end distributions keeping the overall number of trips as suggested by MND.

The resulting demand totals for the internal Essex productions are shown in Figure F. 15. These are compared to the synthetic demand and raw MND and plotted against the TEMPro targets for car and bus as well as TrafficMaster LGV values.

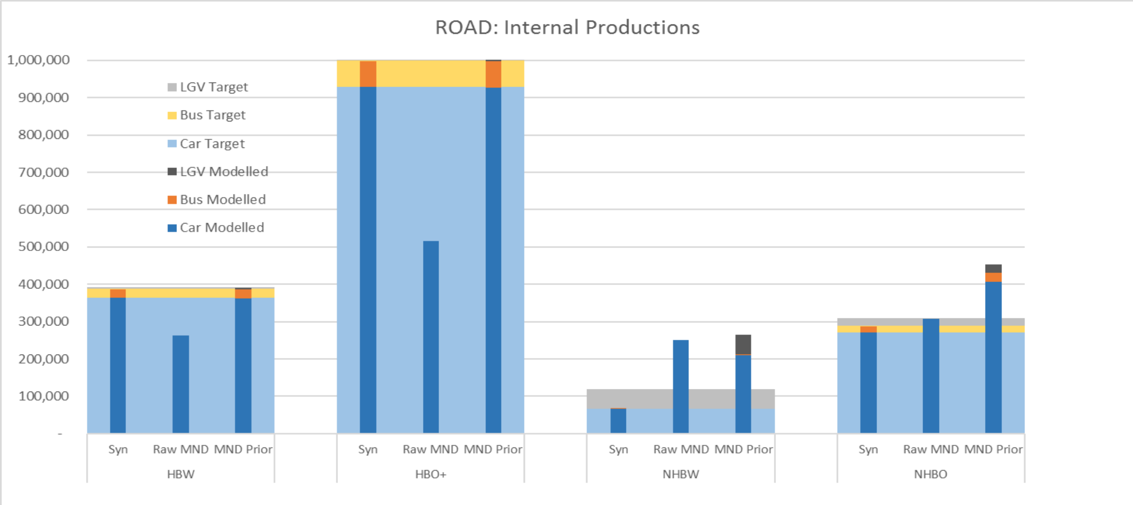


Figure F. 15: Total Daily Demand in Prior Matrices, Synthetic and MND (Internal Productions)

Comparisons of the trip ends in the resulting car matrices (by purpose) against the average weekday trip ends from TEMPro are shown in Figure F. 16 on the following page. Figure F. 17 then shows the same comparison for bus (all purposes combined).

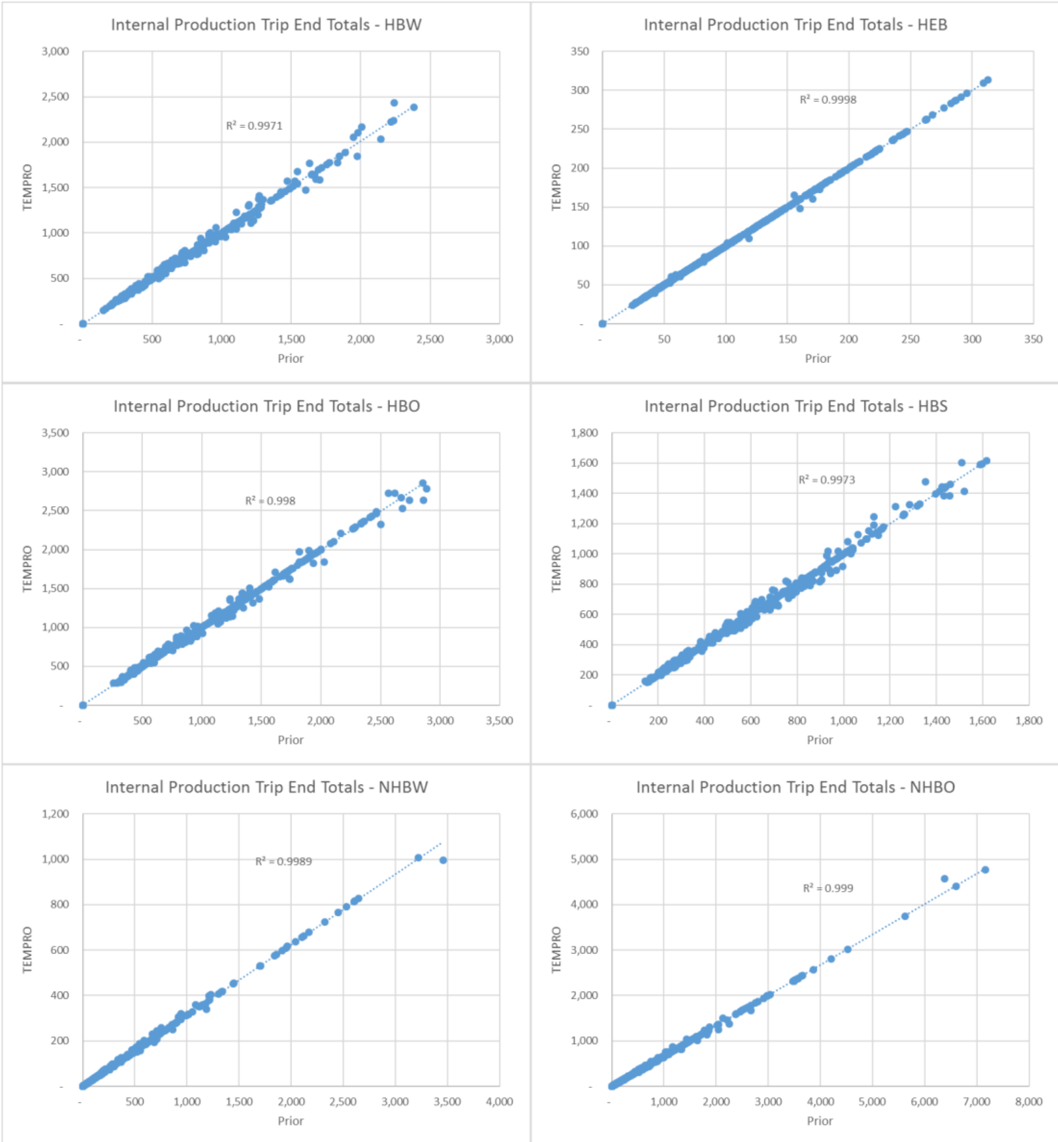


Figure F. 16: Comparison of Prior Car Demand Totals to TEMPro (Internal Productions by Zone)

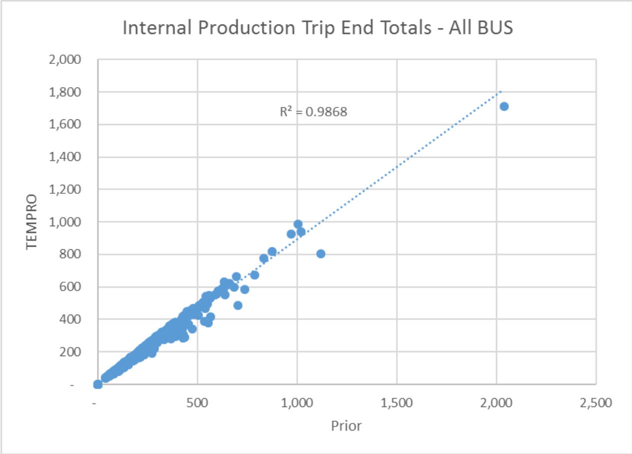


Figure F. 17: Comparison of Prior Bus Demand Totals to TEMPro (Internal Productions by Zone)

LGV, HGV and Education

Prior to assignment, LGV, HGV and Education matrices were included in the data set. The development of these matrices is discussed in Sections 0, 0 and 0 of this report.

PA to OD and Time Period Conversions

The assignment models consider the AM, Inter-peak and PM periods individually. Thus, there was a need to convert the resulting demand at 24-hour (PA) level to time period specific (OD) format.
The initial set of time period allocation factors for car was derived from MND records using their time period stamps and trip directions (outbound and inbound). The factors were calculated at 4x4 sector level (Internal, Buffer, London and External) and by the MND purpose (HBW, HBO+, HBE and NHB). The peak hour factors to convert time period demand to the highway assignment modelled peak hour were derived from traffic count data. The person trip to vehicle conversions used WebTAG Databook car occupancy factors by purpose.

To verify the time period allocation, the resulting car matrices were assigned and the modelled screenline flows were compared to the observed values by time period. The results from initial iterations showed that at a 12-hour level there was a general underestimation of flows over nearly all screenlines. This indicated that the MND time period allocation was overestimating the demand in the off-peak period (19:00-07:00). To improve the assignment results, the NTS global factors were used to adjust the MND factors and to reduce the proportion of travel allocated to the off-peak period. This was done by scaling the overall amount of travel in each time period while retaining the MND distributions at a sector level.

For public transport and non-home-based travel, the NTS proportions were used. The NTS information on the purpose splits within each time period was also used to disaggregate the time period conversion factors to enable conversions of the segmented HBO+ matrices. The approach ensured that the overall demand allocated to each time period remained the same as for the aggregate purpose with the individual sub-purpose factors reflecting time-period specific purpose splits.

The LGV and HGV time of day conversion factors were derived from the Essex traffic count database.

Final Prior Matrices

The verification process focussed on correcting for biases and inconsistencies with the secondary NTS and TEMPro data while keeping the integrity of the MND trip patterns and distributions. Further adjustments to the car matrices were necessary to improve the assignment performance at a local level.

A significant overestimation of car flows at the Dartford Crossing was evident in all time periods and was considered to be a false MND trip detection/allocation for the movements crossing the River Thames. Following the analysis, it was decided to scale the car matrix for trips going to and coming from Thurrock, London and Kent that used the Dartford Crossing. For OD pairs that travelled northbound a factor of 0.85 was used. For OD pairs that travelled southbound a factor of 0.7 was used.

The resulting car demand matrices represented a significant improvement upon the synthetic demand used in Phase 1 modelling. The difference between the observed and modelled car flows in the prior matrices were within 20% for all screenlines in all three time periods, as shown in Figure F. 18, Figure F. 19, and Figure F. 20 for the AM, Inter-peak and PM respectively.

In line with normal practice, a matrix estimation process was used to improve the quality of fit of flows to counts.

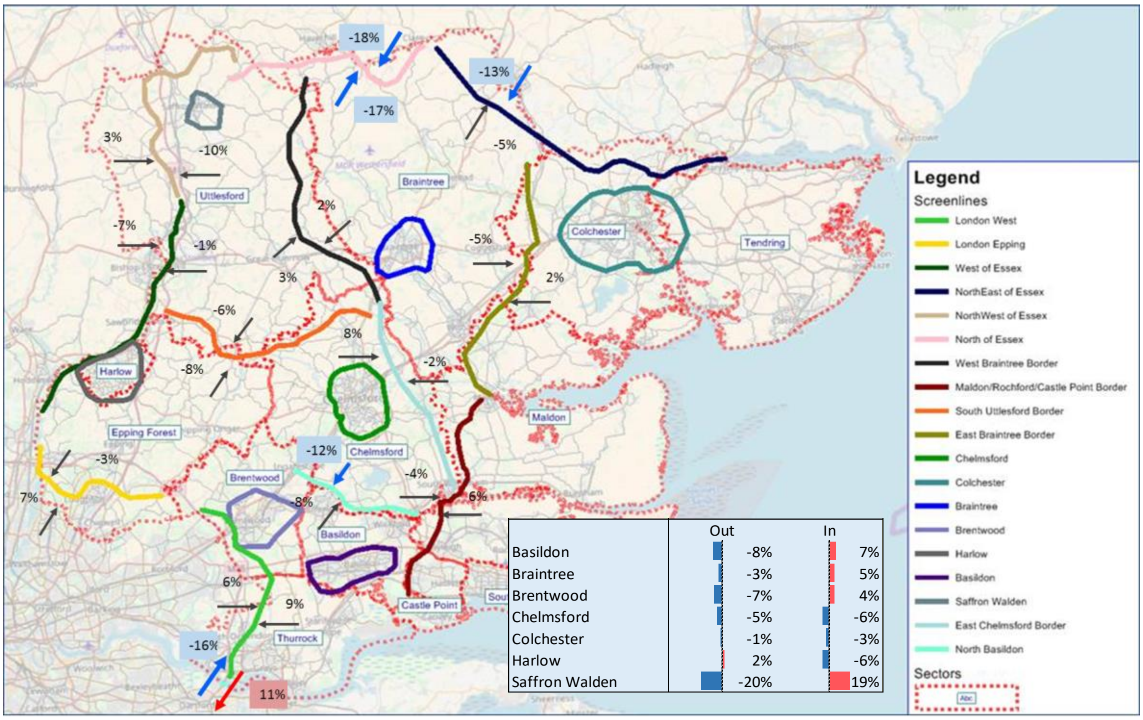


Figure F. 18: Validation Screenlines, Prior Car Demand vs Observed Counts (AM Peak Hour)

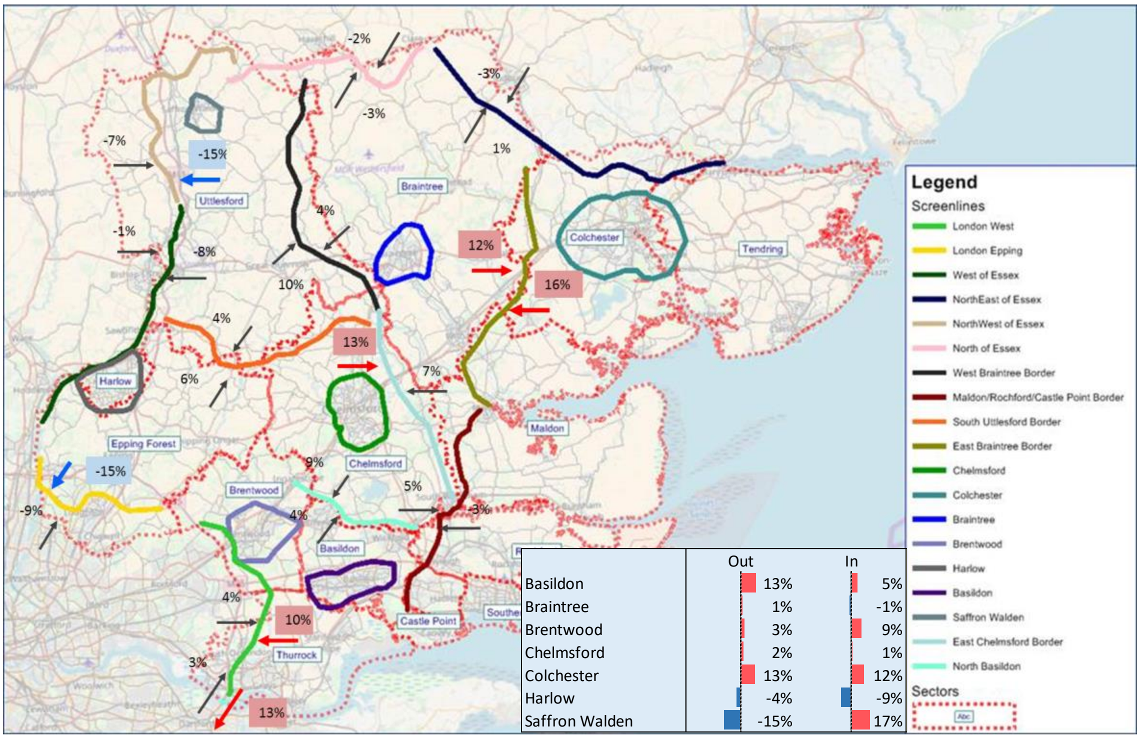


Figure F. 19: Validation Screenlines, Prior Car Demand vs Observed Counts (Inter-Peak Hour)

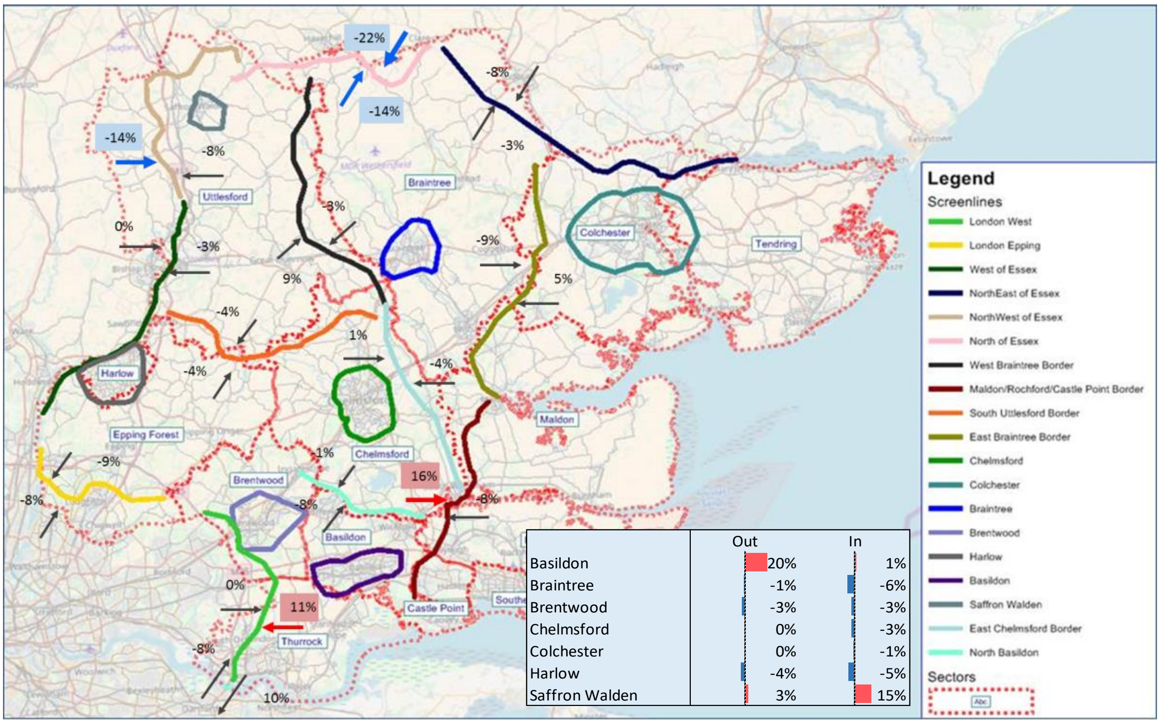


Figure F. 20: Validation Screenlines, Prior Car Demand vs Observed Counts (PM Peak Hour)

Appendix G – Essex Countywide PT Matrix Development

Overview

This chapter summarises the base year Essex countywide PT prior matrix development, and this section is taken from the Essex Countywide LMVR. The purpose of the public transport model (PT model) is to produce demand matrices and travel cost data (cost skims) for use in the Variable Demand Model (VDM). This function requires the model to provide information about in-vehicle travel time, access/egress time, wait time and interchange time for the AM, Inter-peak and PM peak periods.

VDM also requires the representation of the monetary cost of travel by public transport. Public transport fares are based on the travel distance output from the public transport model and estimated using observed relationships between the fare payed and distance travelled. This model functionality is appropriate for the purposes of the Essex Countywide model and follows industry standard for this type of models (Highways England (HE) adopted a similar approach in their Regional Traffic Models (RTMs)).

The Phase 2 Essex Countywide PT model builds on the networks developed as part of Phase 1. The primary focus of Phase 2 work was to incorporate new demand matrices derived from Mobile Network Data (MND). Following the update of the demand matrices, and small modifications of the assignment algorithm in Phase 2, benchmarks of the total public transport demand were completed to confirm the suitability of the model for use as part of the strategic variable demand model.

The remainder of this chapter describes:

- the review and minor updates of the Phase 1 model processes;
- the process of incorporating new matrices based on MND and initial review of the results;
- adjustments of the MND process to develop public transport matrices;
- benchmarks of the total public transport demand; and
- preparation of inputs into the demand model.

Review of the Phase 1 Model

The review of Phase 1 public transport model covered the assignment process used in the model. The purpose of the review was to understand if any refinements need to be made in the existing Phase 1 algorithm to improve the transparency of cost skims derived for input into the demand model.

The review considered elements of the generalised cost skimmed as part of the assignment process, their appropriateness, transparency of computation, impact on run times and their contribution to the overall modelling process. It identified that the assignment should be simplified in the following areas:

- estimation of fares for input into the demand model; and
- exclusion of capacity restraint in the public transport assignment.

The Phase 1 procedure to estimate fares relied on a complex set of passing points used to calculate the fare (a bespoke method used within the VISUM software). The method to set these points in VISUM is not easy to update or amend. Given that fare inputs are only necessary for VDM[1], fares can be estimated outside of the model in a more transparent and consistent way. The most common approach to modelling public transport fares is to estimate a relationship between the fare and distance, where the in-vehicle distance is derived from the assignment. The details of the derivation of fares are described later in this report.

The draft specification for the Countywide model considered capacity constraints on public transport services (crowding). However, crowding is only a major issue on rail services as they approach Central London, and this is not an important consideration in the context of the countywide models. Crowding on buses is also not an issue. Given limited value that the modelling of crowding would bring to the overall modelling system and considerable complexity associated with this procedure, its inclusion was not justified. Not only, the application of the evidence-based crowding penalties may be limited by the functionality of the VISUM software, the run times required for the model to achieve convergence would be prohibitive, given considerable run times needed for a single iteration of the VISUM PT assignment. Crowding procedure was therefore not added to the model.

The issue of model run times was also considered. The long run times of the current assignment procedure are driven by the detailed timetable-based assignment. A conversion of the procedure into a simpler frequency-based procedure was considered, but not implemented due to the complexity and technical risks associated with the conversion. The timetable-based assignment procedure was therefore retained, which is acceptable in the absence of crowding.

During the review of the assignment procedure some observations related to the format of the timetables were made: VISUM software calculates train journey times based on line speed. In case of the stopping and fast services sharing the same line (as is the case in Essex), the average speed may be weighted towards the slow trains, potentially overstating travel times on the fast, inter-city services. To mitigate this, rail journey times coded in Phase 1 for the main services groups (such as London-Norwich, London-Ipswich, London-Colchester, etc.) were compared with 2017 MOIRA timetables and adjusted where appropriate with factors based on average journey times for the key service groups extracted from the MOIRA timetables.

Mobile Network Data

The process of the development of demand matrices for highway and public transport models is described in Appendix F. In this section, only the key features of the public transport demand matrices derived from MND are summarised.

The public transport demand matrices were prepared separately for bus and rail[2] trips. This distinction was necessary as surface rail trips can be easily identified within mobile phone data, whilst bus trips are more difficult to distinguish from other road-based trips[3] and required a separate matrix building procedure. This separation also allows bus and rail demand growth to be applied independently.

However, the matrices are added together for assignment to the public transport network. This means that the assignment model determines whether the public transport demand uses rail or bus only services. Given that the rail network is relatively sparse (it is based on three main lines: Great Eastern Mainline, Essex Thameside lines and the Cambridge Line) and the bus services cover primarily networks within individual towns, the rail (longer-distance) and bus (primarily local) trips are distinct and the shape of the network does not offer many opportunities for a mis-allocation of demand between modes. This was verified by testing the

[1] Given the limited density of the public transport networks, fares are not expected to influence the choice of route.
[2] Where rail trips are those trips, which use rail as the main mode, but bus may still be used for access.
[3] The process of the development of bus trips is covered separately.

assignment of rail and bus demand individually, which confirmed that the allocation of the bus and rail demand to modes is sufficiently accurate.

Mode	Rail Matrix Assignment	Bus Matrix Assignment
Bus and Walk	2.07%	**90.98%**
Bus, Rail	5.72%	5.28%
Bus, Rail, Underground	9.82%	0.08%
Bus, Underground	4.22%	0.59%
Rail	24.72%	2.84%
Rail, Underground	45.47%	0.04%
Underground	7.99%	0.19%
Sum Rail	**97.94%**	N/A

Table G. 1: Results of Individual Assignment of Rail and Bus Demand

The Countywide demand model operates at daily (24-hour) Production-Attraction (PA) format (see the *Phase 2 Variable Demand Model Report*[4] for more details) and the public transport model provides cost skims for AM peak, Inter-peak and PM peak periods for input into the demand model. The demand model forecasts change in the allocation of demand between rail and car at the total daily level (mode choice) and it is important that the daily public transport demand input into the model is robust. Given that crowding is not modelled in the Countywide model it is not strictly necessary to assign public transport demand to the network.

Nevertheless, the demand model divides the daily PA public transport matrices into time period matrices in Origin-Destination (OD) format (the process of converting daily PA into time period OD matrices is described in a separate chapter). These include matrices for AM peak, Inter-peak and PM peak periods consistent with the public transport model time periods as well as the Off-Peak (OP) time period, broken down by Commute, Business and Other journey purposes. These matrices were assigned to the network to perform high-level checks of the total demand present on the public transport network across the day and formed part of matrix validation. In addition, high-level validation of sectored public transport matrices was performed. The independent data, initial comparisons, the process of matrix adjustments and the final comparisons are described in the following sections.

Independent Data

Independent observed data on the volume of passenger trips on bus and rail services is usually unavailable. In case of bus, the data is held by bus operators and not shared due to the commercial confidentiality of revenue estimates. Similarly, in case or rail data confidentiality clauses prevent sharing or collection of reliable data.

However, in case of rail, Essex County Council obtained a permission from Greater Anglia (GA) and c2c franchises to use their respective versions of MOIRA. These excluded revenue figures but provided estimates of passenger journeys derived from ticket sales for the period from September 2016 to September 2017. This data was used in two ways:

[4] *Essex Countywide Model – Phase 2 Variable Demand Model Report* v1.0, Jacobs (March 2019)

- Sum of journeys traversing certain points on the network across the day was used to benchmark total demand assigned to those links in the model in all tie periods; and

- Estimates of station-to-station journeys were converted into a sectored matrix, using the assumption that the demand using a station originates near this station. It is of course possible that passengers may reside in the neighbouring sectors but given their size the inaccuracy is expected to be negligible for the purposes of high-level comparisons.

In case of bus, Essex County Council is in a possession of high-level bus usage statistics, which include the total annual number of bus boardings and alightings in the town centres of Basildon, Harlow, Chelmsford, Colchester and Braintree. This data was used to benchmark modelled bus boardings with the same approximate coverage.

The next section summarises the initial comparisons of the MND matrices for rail and the subsequent adjustments of the rail matrix.

PT Matrix Adjustments

The daily PT matrix derived from MND was sectored using standard Essex Countywide sector definitions[5]. This data was compared to sectored MOIRA journeys described in the earlier sections. The comparison was performed at the daily (24 hour) OD (Origin-Destination) level as MOIRA flows cannot be broken down by time period or direction. For the purposes of the comparison, the two-way MOIRA flows are simply divided by two as they are expected to be symmetrical over the 24-hour period. The comparison is presented in Table G. 2 below.

Daily Trips	MOIRA	MND	Absolute Difference	% Difference
Essex to London	104,171	105,090	919	0.9%
London to Essex	104,171	102,459	-1,712	-1.6%
Within Essex	38,557	15,405	-23,152	-60.0%
TOTAL	**246,898**	**222,954**	**-23,944**	**-9.7%**

Table G. 2: Comparison Between Modelled and MOIRA Trips

The comparison shows that MND correctly estimates the volume of rail trips on the major flows between Essex and London (the difference between MND estimates and MOIRA is within 2%). This is expected as trips by rail to London follow a very distinct geographical pattern and should be easy to detect on the mobile network data.

However, MND shows a significant gap in the estimate of the number of rail journeys made within Essex. When compared with MOIRA, MND estimates show 60% fewer trips. Some of this difference may be attributable to the approximation of the location of the rail trips in MOIRA (assumptions about the home origin of trips, described in the previous section). However, these inaccuracies are likely to be small and would not explain such a large difference fully.

[5] Essex is divided into sectors based on District boundaries.

Another reason for such a large difference may be a mis-allocation between rail and other modes in areas where rural rail services have low speeds and run parallel to local roads (which means that they will be more difficult to distinguish from the road trips). Whilst any such potential mis-allocation is likely to be small in absolute terms and therefore negligible for the estimates of car trips it may be detectable on rail due to the generally smaller volume of rural rail trips. Other reasons may include general difficulties with estimating short trips by mobile phone data or assumptions about the expansion of rail trips detected in the mobile phone data sample to full population in rural areas.

To close this gap the MND matrices were infilled with short distance internal Essex trips. The estimates of these trips were derived with the use of a simplified gravity model. The gravity model used the following information:

- Travel times by public transport;
- Rail trip length distribution in Essex derived from the National Travel Survey (NTS); and
- NTEM rail trip ends and MOIRA journeys targets.

The cost skims from the PT model include travel time by both rail and bus. However, not all PT journey opportunities will be relevant to rail travel and these cost skims should be excluded from the gravity model (journeys likely to be taken solely by bus are assumed to have infinite costs and therefore would not attract any rail trips in the rail gravity model).

The NTS contains a relatively small sample of records containing information about the rail travel in Essex. To improve the reliability of the trip length distribution estimates, the data for all time periods and journey purposes (within Essex only) was combined into a single daily dataset. This allowed overcoming the small sample issue and, given that the analysis excluded large London-bound commuting flows, was judged to be appropriate for use in intra-Essex gravity model[6].

The gravity model was then applied to the rail trip ends derived from TEMPro. However, TEMPro is known to under-represent the volume of rail travel. The rail trips distributed using intra-Essex rail gravity model were therefore normalised the total of intra-Essex journeys estimated with the use of MOIRA outputs. The distribution of the normalised intra-Essex trips maintains the distribution achieved by the gravity model and calibrated to NTS data. This is depicted in Figure G. 1 below.

[6] The sparsity of the rail network in Essex and the limited distance over which intra-Essex trips can be made means that variations between journey purposes and time periods are not likely to be significant.

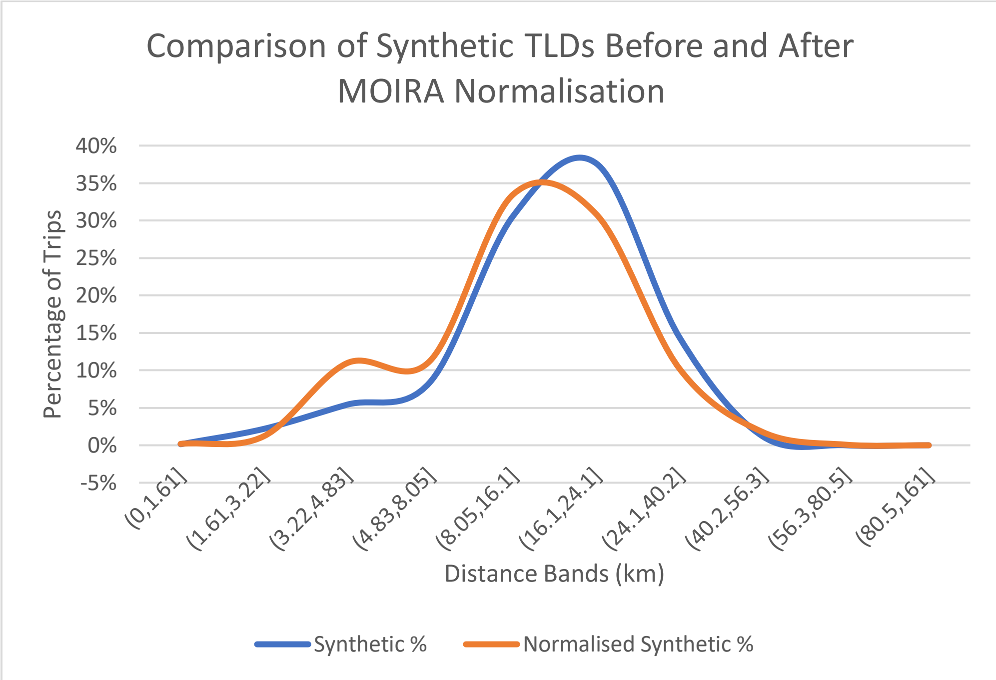


Figure G. 1: Comparison of Trip Length Distribution Between Synthetic Data and the Output from the Normalisation to MOIRA

Validation of the Rail Matrix

Following the amendments of the rail matrix described in the earlier section, the daily rail demand flows were validated in two steps:

- The sectored 24 OD rail matrix was compared with the sectored station-to-station journeys extracted from MOIRA to distribution of the main rail flows (particularly between Essex and London); and
- The assigned AM, IP, PM and OP demand flows traversing the cordon around London were compared with the two-way daily flows extracted from MOIRA.

At an aggregated level, the adjusted MND flows compared very well with the MOIRA data. Table G. 3: Comparison Between Modelled and MOIRA Trips Post Infill

and Table G. 4: Comparison of Moira and Adjusted MND for Origins and Destinations below shows the same key sectors presented in Table G. 3 before the adjustment. It shows a considerable improvement in the total number of rail trips modelled within a day between Essex and London as well as within Essex.

Daily Trips	MOIRA	MND	Absolute Difference	% Difference
Essex to London	104,171	105,090	919	0.9%
London to Essex	104,171	102,459	-1,712	-1.6%
Within Essex	38,557	38,514	-43	-0.1%
TOTAL	**246,898**	**246,063**	**-836**	**-0.3%**

Table G. 3: Comparison Between Modelled and MOIRA Trips Post Infill

Individual sector-to-sector flows show some differences in the distribution of the rail trips at a more granular level. However, the figures are small in absolute terms and presented in Appendix E for completeness. It is more instructive to compare sectored trip ends within Essex which show all flows that originate or have a destination in a particular sector (Table G. 4 below).

Sector	Sector Name	Origin			Destination		
		Moira	Adjusted MND	% Diff	Moira	Adjusted MND	% Diff
101	Tendring	6,147	8,185	33.16%	6,147	8,094	31.68%
102	Colchester	12,784	17,576	37.48%	12,784	18,346	43.50%
103	Braintree	9,124	8,109	-11.13%	9,124	7,336	-19.60%
104	Uttlesford	19,132	4,919	-74.29%	19,132	4,225	-77.92%
105	Harlow	4,239	5,994	41.40%	4,239	4,226	-0.31%
106	Epping Forest	261	114	-56.36%	261	94	-64.02%
107	Chelmsford	18,056	19,408	7.49%	18,056	18,872	4.52%
108	Basildon	23,867	22,566	-5.45%	23,867	23,804	-0.26%
109	Brentwood	15,615	22,587	44.65%	15,615	22,859	46.39%
110	Castle Point	7,628	4,225	-44.61%	7,628	3,888	-49.03%
111	Maldon	1,069	673	-37.04%	1,069	544	-49.11%
112	Rochford	7,425	6,501	-12.45%	7,425	5,444	-26.68%
113	Southend -on-sea	27,061	14,008	-48.24%	27,061	13,813	-48.96%
114	Thurrock	21,779	10,868	-50.10%	21,779	12,364	-43.23%
	Subtotal	**174,187**	**145,733**	**-16.34%**	**174,187**	**143,909**	**-17.38%**

Table G. 4: Comparison of Moira and Adjusted MND for Origins and Destinations

Table G. 4 shows a reasonable overall comparison, but there some differences between MND-based matrices with intra-Essex adjustment and MOIRA. Smaller differences are likely to arise from differences in the allocation of trips to sectors in MND (home origin) and MOIRA data (station location). Larger differences can be observed for sectors which lay just outside of the boundary of London (Epping Forest, Brentwood and Thurrock) and the Uttlesford and Southend-on-Sea sectors which contain airports (Stansted Airport and Southend Airport).

The MND for rail captures flows on London Underground and TfL Rail services, which cross the boundary of Greater London Authority into Essex, whilst MOIRA contains only National Rail flows. In these areas the comparison is not valid, but it should be noted that it is the intention of the Countywide model to capture trips by all public transport modes and this feature of the data is desirable.

The MND-based matrices do not capture all flows to the airports (Uttlesford and Southend-on-Sea sectors). This is because mobile phones registered to foreign users will not be picked up by this data. Whilst the number of journeys made by overseas visitors across the country is negligible, it tends to be concentrated on journeys to airports by public transport and results in differences when compared with MOIRA. However, as airport flows are not modelled within the Countywide variable demand model and crowding is not modelled the absence of overseas passenger airport flows has no consequence.

The analysis of the matrices against the only available independent source of data shows satisfactory correlation, but it should be noted that the comparisons have some limitation due to the nature of both datasets and assumptions that need to be made in undertaking the comparisons.

Following the comparison of the rail matrices, it was desirable to check the demand loads appropriately to rail corridors across the day. The AM, IP, PM and OP MND-based adjusted matrices were assigned to the VISUM network and link flows across a screenline around London depicted in Figure G. 2

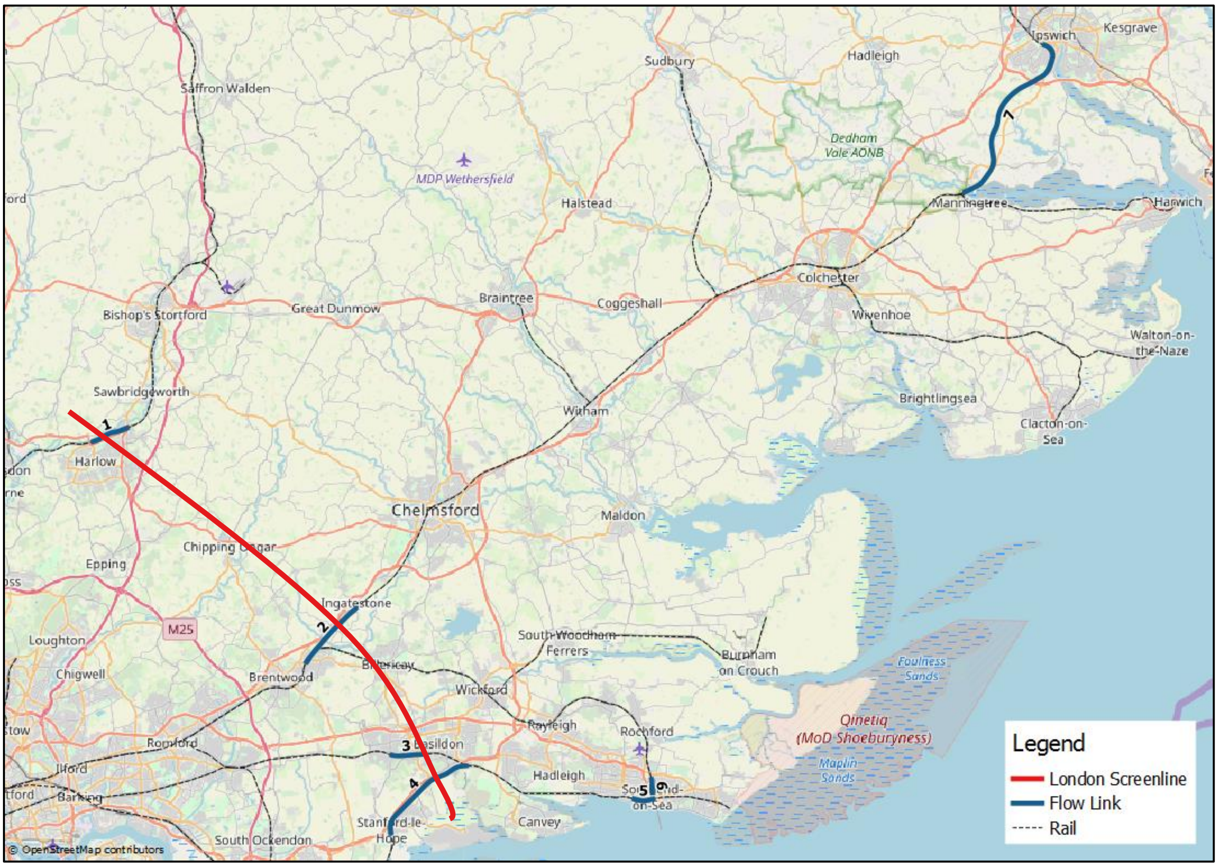


Figure G. 2: Rail Screenlines

The London screenline depicted in Figure G. 2 was chosen as it captures all demand crossing from Essex into London, which is approximately two-thirds of all rail demand modelled in the Essex Countywide Model. The purpose of the link flows is to validate the key strategic movements in the matrix rather than the assignment flows as only the daily two-way data was available from MOIRA. The comparison of the selected rail links on this screenline is presented in Table G. 5 below.

From	To	Flow Link	MOIRA demand	MND demand	Percentage difference	Operator
Harlow Mill	Harlow Town	1	42,964	28,761	49.38%	GA
Ingatestone	Shenfield	2	71,634	78,277	-8.49%	GA
Basildon	Laindon	3	45,420	49,653	-8.52%	c2c
Pitsea	Stanford-le-Hope	4	2,704	1,293	109.14%	c2c
Sum of Flow Across London Screenline			**162,722**	**157,984**	**2.00%**	

Table G. 5: Link Flow Validation Across London Screenline

The table shows very good comparison for flows on Great Eastern Mainline (Ingatestone to Shenfield) and Essex Thameside lines (Basildon to Laindon). The comparison is worse on the Cambridge (Harlow Mill to Harlow Town) lines, which is likely driven by the fact that this line is on the border between Essex, Hertfordshire and Cambridgeshire and carries some passenger flows not modelled in the Countywide Model. However, overall the comparison corroborates the findings from Table G. 3 and Table G. 4 showing sectored comparisons.

From	To	Flow Link	MOIRA demand	MND demand	Percentage difference	Operator
Westcliff	Southend Central	5	18,530	14,762	25.53%	c2c
Prittlewell	Southend Victoria	6	11,620	1,909	508.68%	GA
Manningtree	Ipswich	7	16,652	22,123	-24.73%	GA

Table G. 6: Non-London Link Flow Validation

In addition to the Essex to London screenline, a small number of links on other parts of the network were checked (Table G. 6). The performance is less good in areas where travel to airports may be a significant proportion of the rail travel (flows around Southend: Pitsea to Stanford Le Hope and Prittlewell to Southend Victoria and Westcliff to Southend Central (Table G. 5 and Table G. 6) where the low speed of the rail lines may contribute to difficulties with the detection of rail trips in the mobile phone data.

To further understand the performance of the MND-based matrix, the matrices were assigned to the network to enable the calculation of passengers boarding rail services (station entries) and passengers alighting the rail services (station exits). These were then compared with station usage data extracted from the Office of Rail and Road website.

The data comes as a total of entries and exits on weekdays across for a full year and it is assumed that the total number of entries and exits is symmetrical. The figures were divided by 252 to convert from annual weekday total to average day. For ease of comparisons the figures were aggregated to sector level (all stations located in the districts are taken as total). This is sufficient for strategic matrix comparisons as in most sectors, there is a dominant main rail station with best level-of-service, whilst smaller stations often feed demand to larger stations. The comparison is summarised in Table G. 4 and shows that there is a good fit between station usage and boarders and alighters for most sectors. However, notable differences can be seen in sectors that contain airports (Southend and Uttlesford) or flows from districts located close to London such as Harlow or Brentwood where MND is likely to be picking up TfL Rail passengers not included in the Station Usage data (which in turn is based on National Rail's LENNON database of ticket sales).

Other differences may suggest significant percentage differences but are small in absolute terms (it should be noted that these are all-day figures). The only exception is Thurrock, which shows low figures in MND when compared with Station Usage (related primarily to the southern branch of c2c). To fully understand the performance of the model in this part of Essex additional data collection would likely be required to verify if the difference is a feature of the ticket sales data (MOIRA) or MND whether further refinements to the model would be required.

High-Level Bus Validation

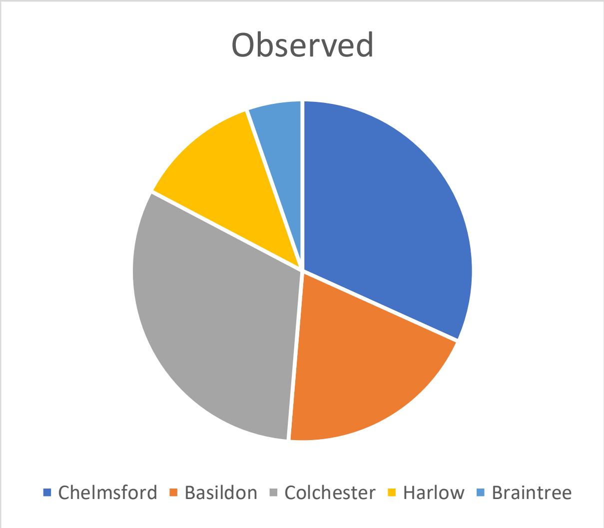
In addition to the assessment of the strategic flows in the rail matrix, the performance of the synthetic bus trip matrices was assessed against the available bus data. The synthetic bus matrices were assigned to the network, which allowed the extraction of bus boarders and alighters in the urban areas across Essex.

These figures were then compared, at high-level, with bus data obtained from Essex County Council. The availability of bus data is limited and the only figure available are annual bus boardings and alightings in town centres of Chelmsford, Basildon, Harlow, Colchester and Braintree. The counts were all-week annual total and were converted to average weekday with the assumed annualisation factor of 300.

The assigned data from areas corresponding to this data was extracted from the model and the figures compared against the observed data. The definition of geographic coverage for the observed high-level bus data is approximate and it is therefore difficult to make definite conclusions about the performance of the modelled data which is split into time periods and represent an average weekday. However, some comparisons are possible and are presented in Table G. 7 and Figure G. 3 below:

Annual Trips	‘Observed’	Modelled	Absolute Difference	% Difference
Chelmsford	8,810,725	8,115,000	-695,725	-7.90%
Basildon	5,422,664	6,356,100	933,436	17.21%
Colchester	8,711,144	8,689,500	-21,644	-0.25%
Harlow	3,324,686	4,999,200	1,674,514	50.37%
Braintree	1,470,976	2,125,500	654,524	44.50%

Table G. 7: Daily Trips - 'Observed' v Modelled



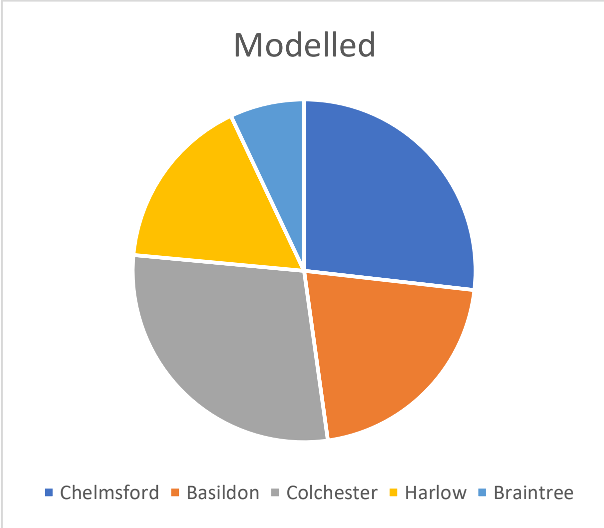
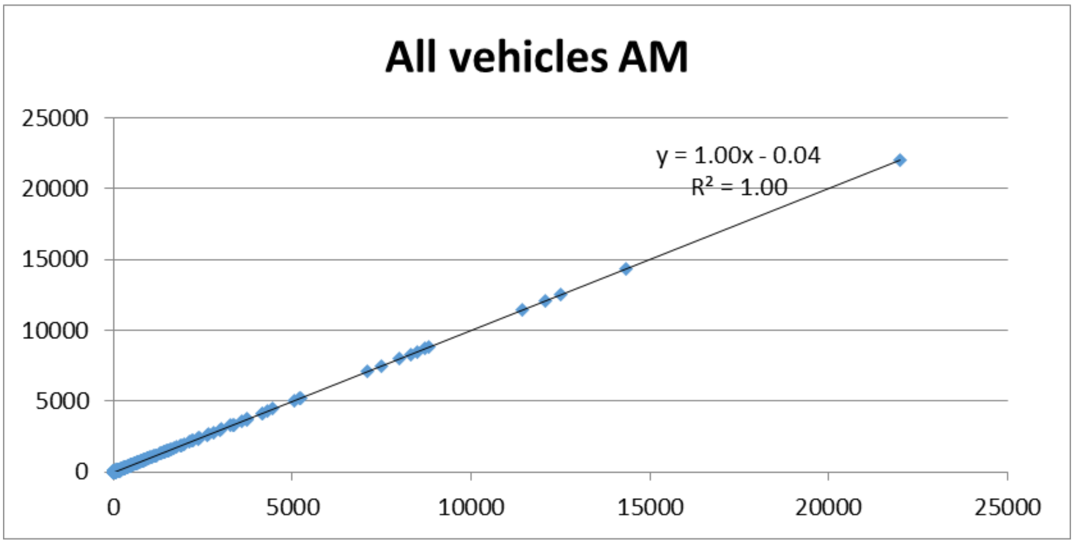


Figure G. 3: Daily Trips – 'Observed' v Modelled

The comparisons show that broadly the right level of bus demand is captured in Chelmsford, Basildon and Colchester. The modelled data appears to be higher than observed in Harlow and Braintree. However, it is difficult to determine the comparison of the comparisons without independent verification and comprehensive public transport surveys for these areas.

Appendix H – Matrix Zonal Cell Value Changes

AM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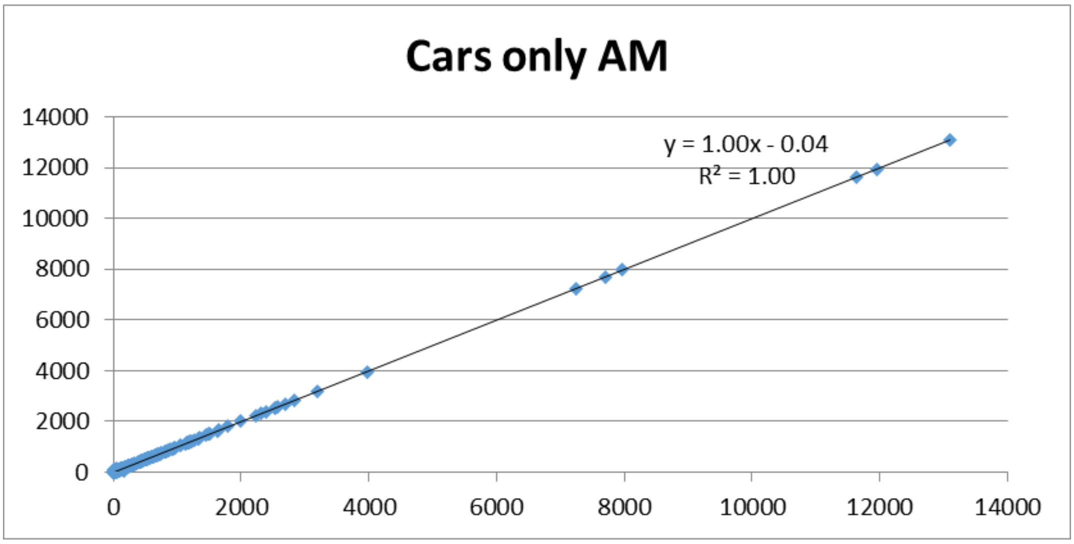
20000
25000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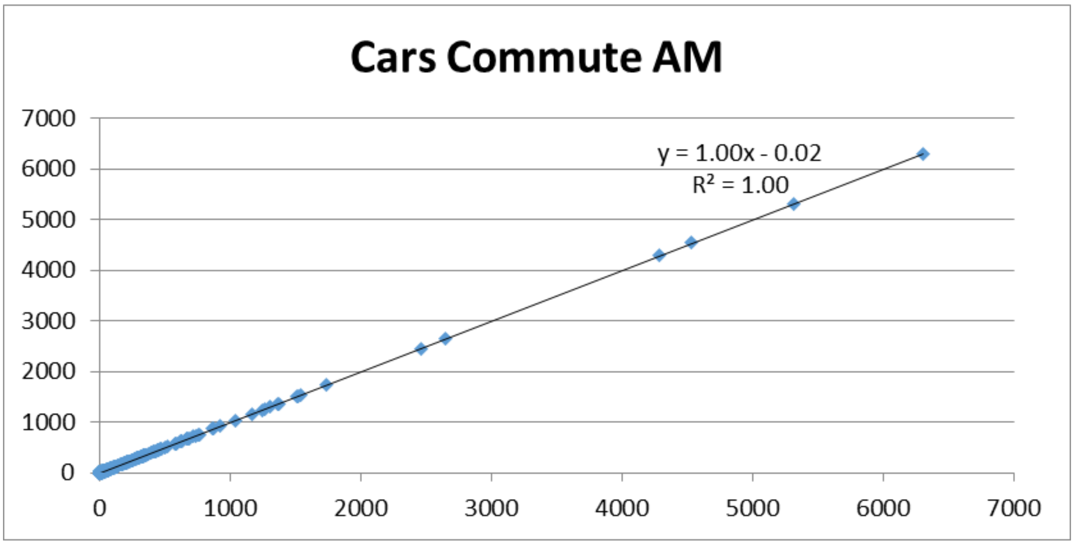
14000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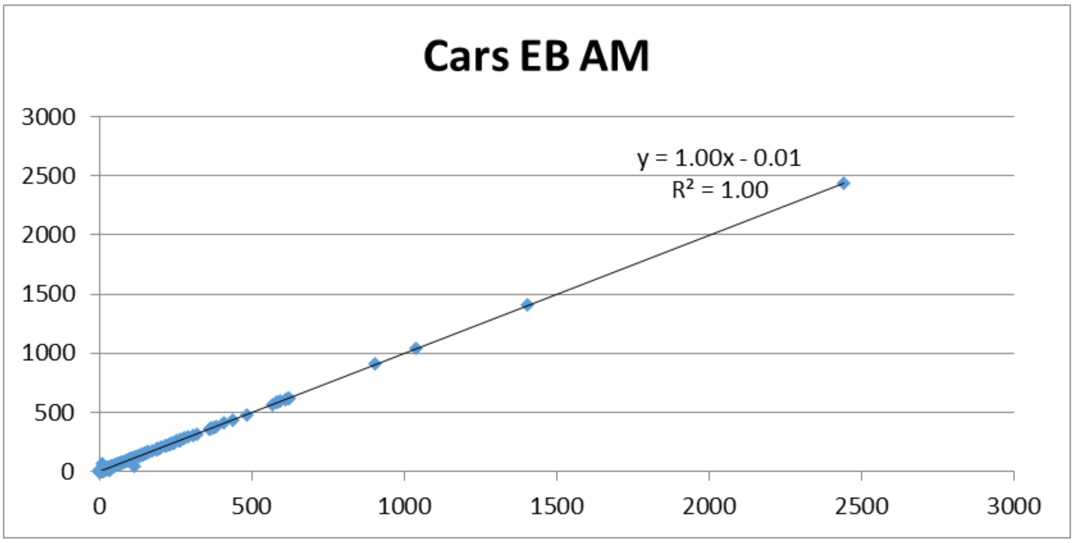
6000
7000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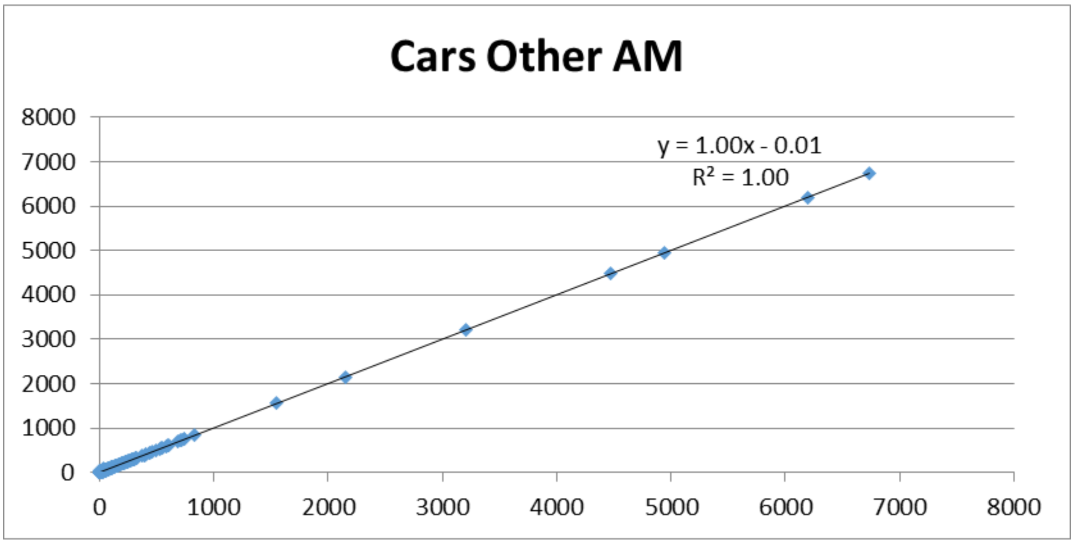
3000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7000
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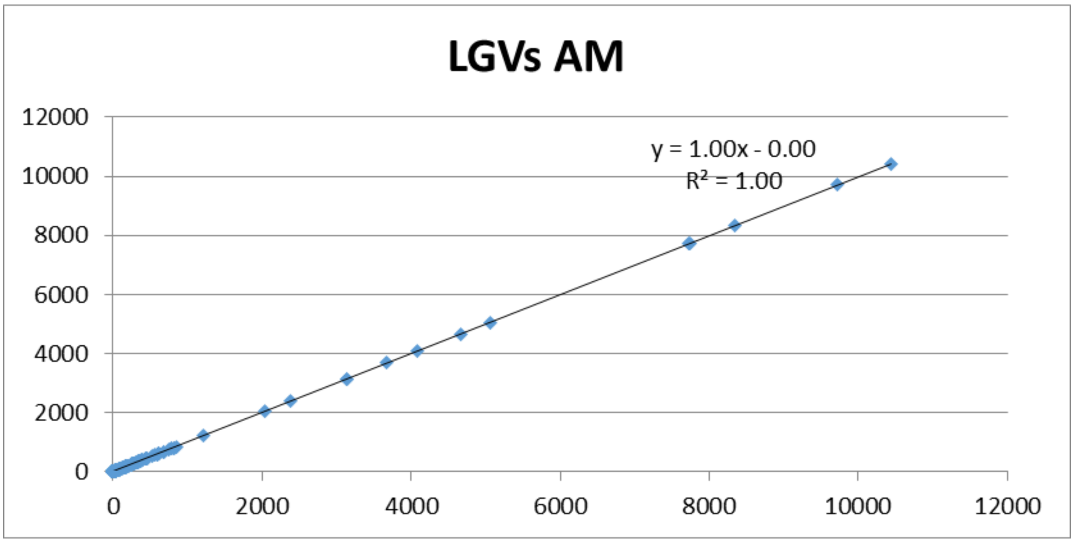
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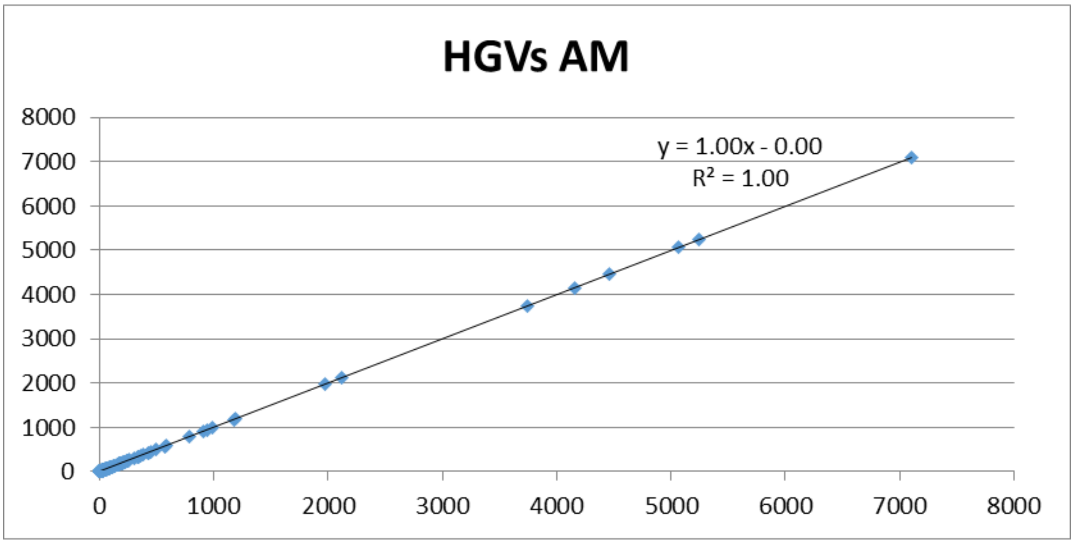
12000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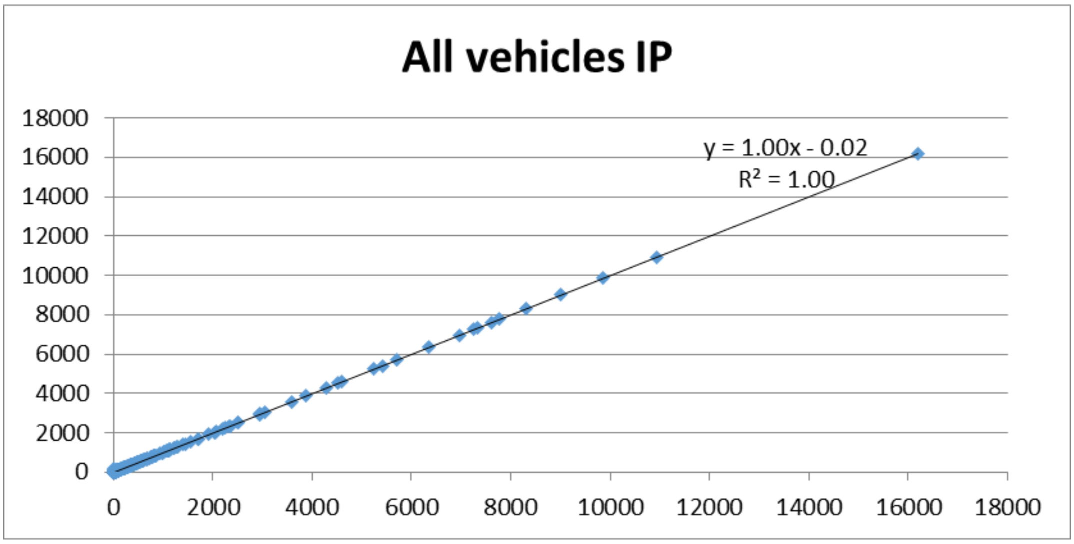
2000
3000
4000
5000
6000
7000
8000

IP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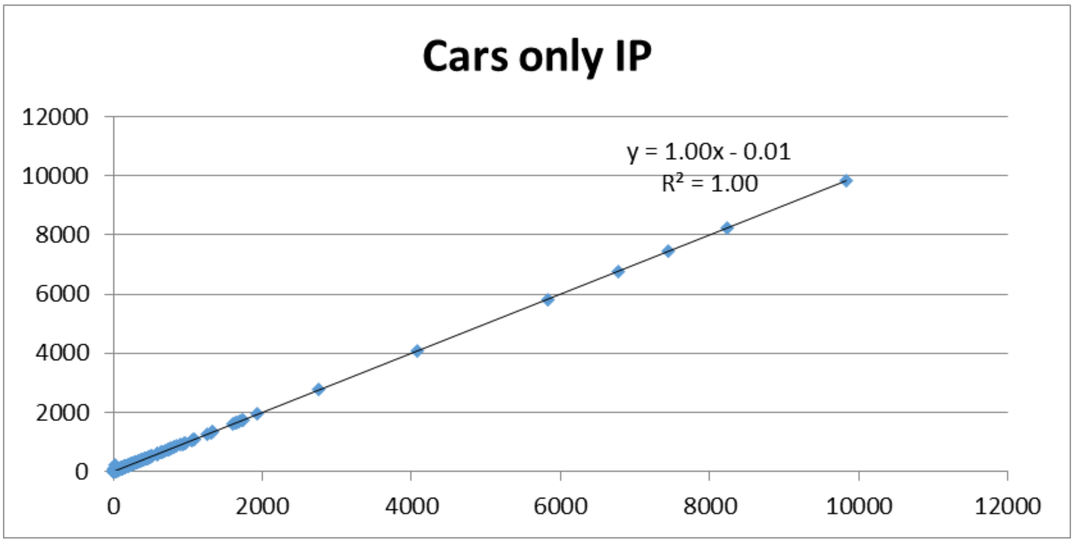
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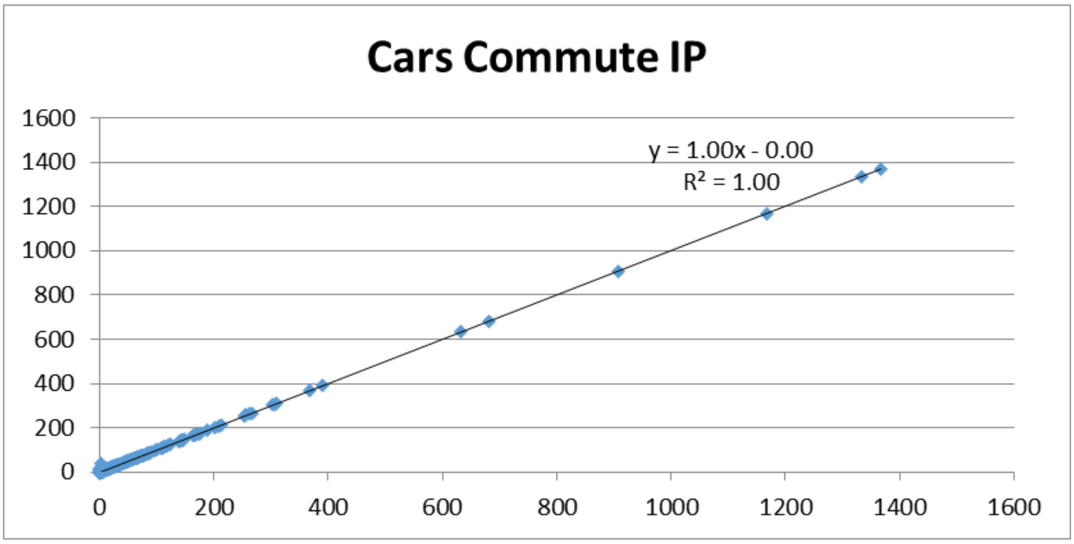
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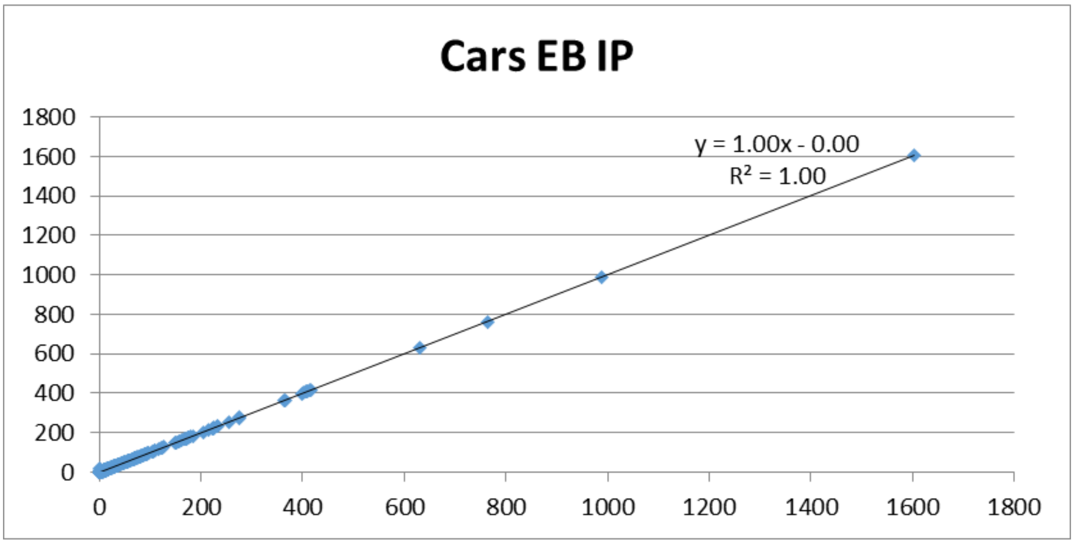
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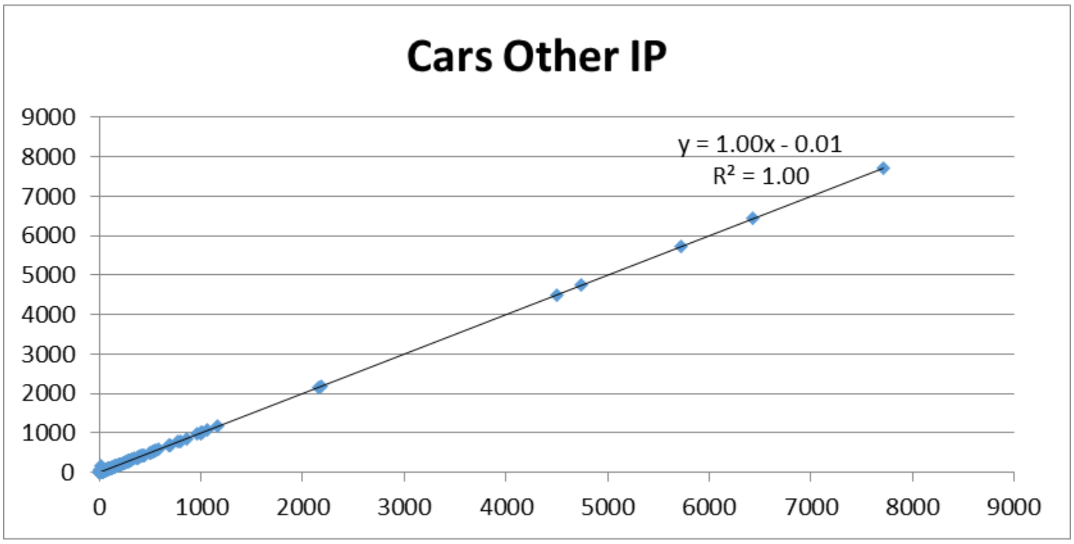
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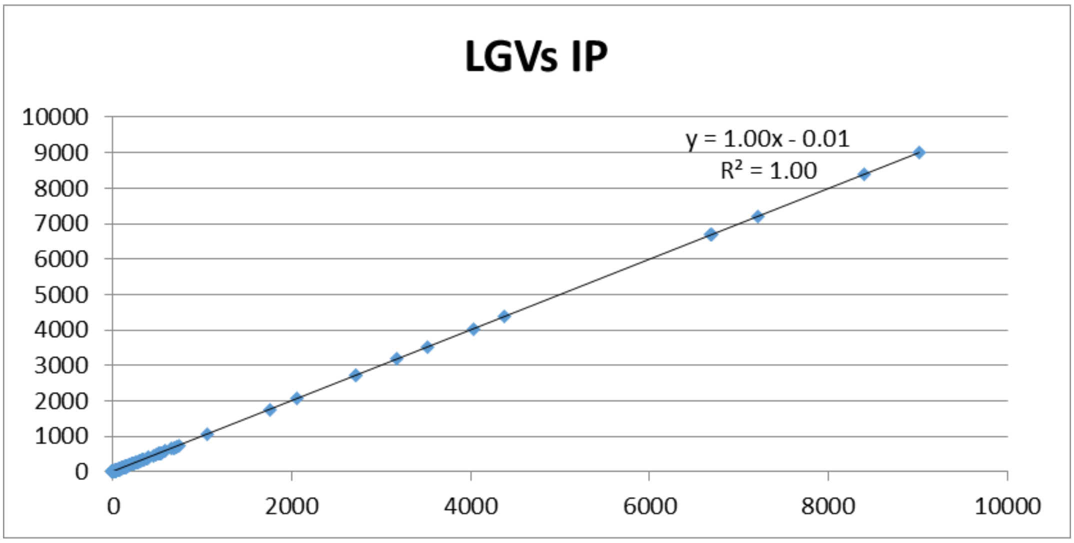

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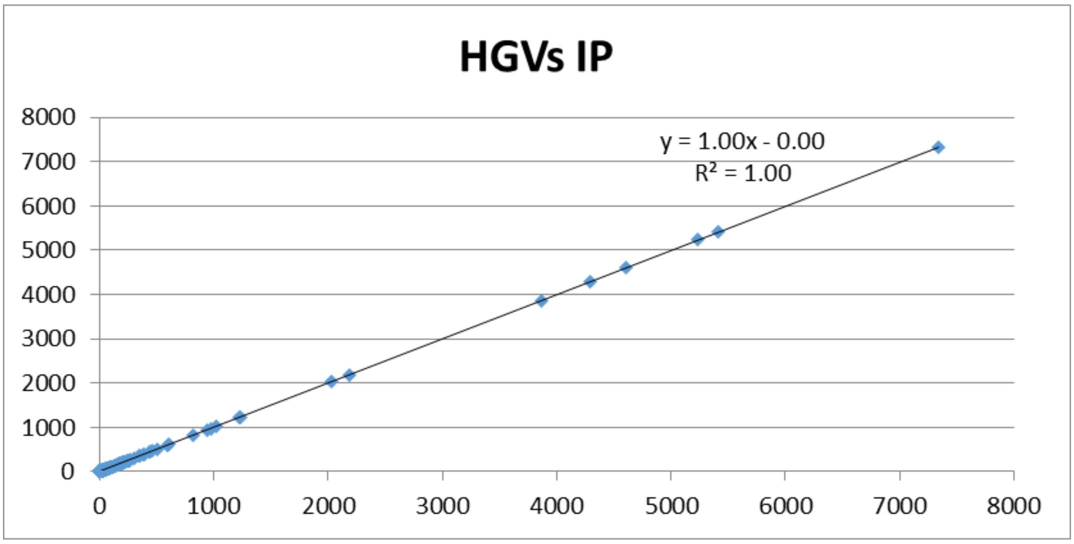

HGVs IP
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R² = 1.00
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5000
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2000
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4000
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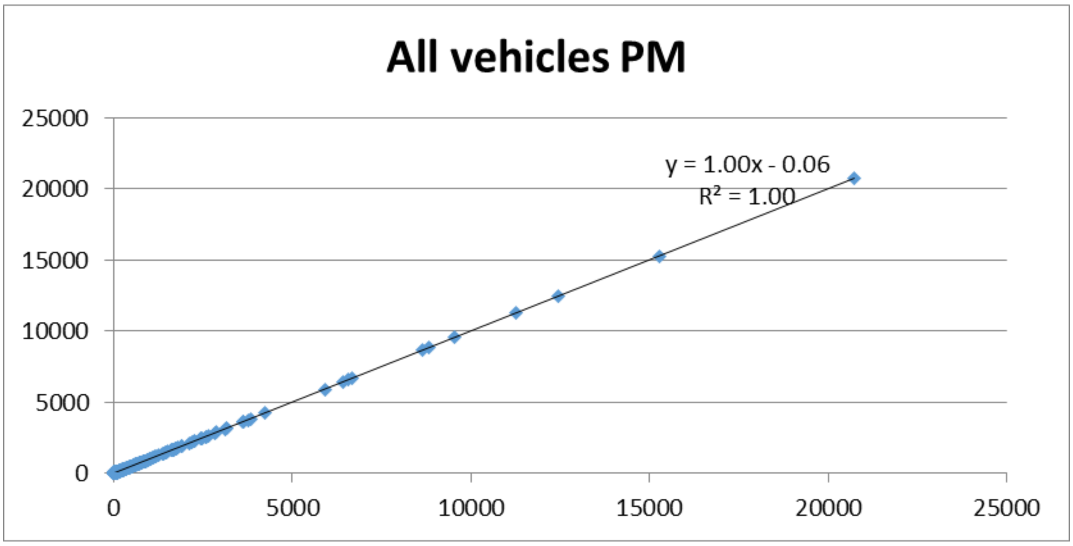
6000
7000
8000

PM



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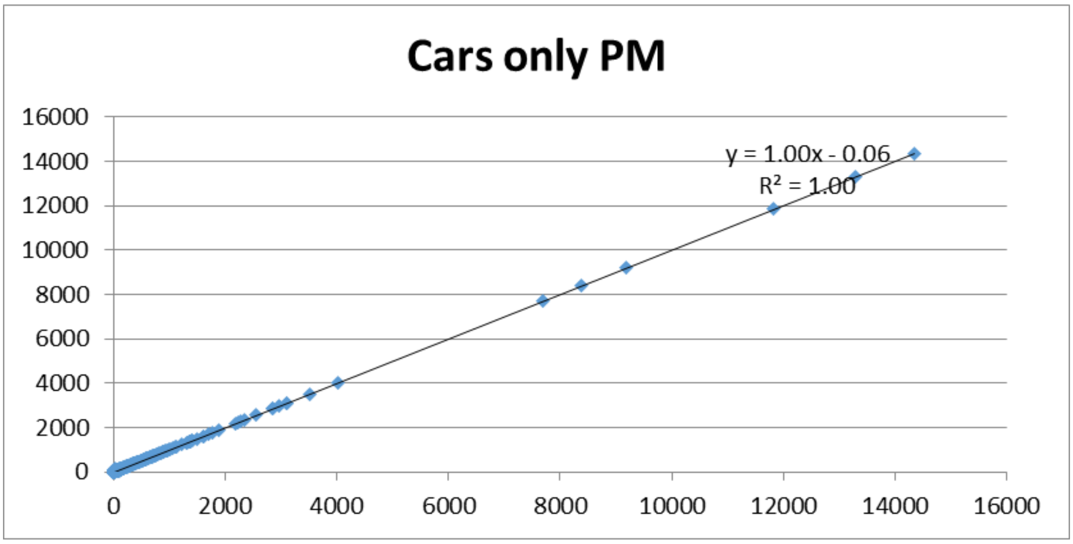
25000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14000
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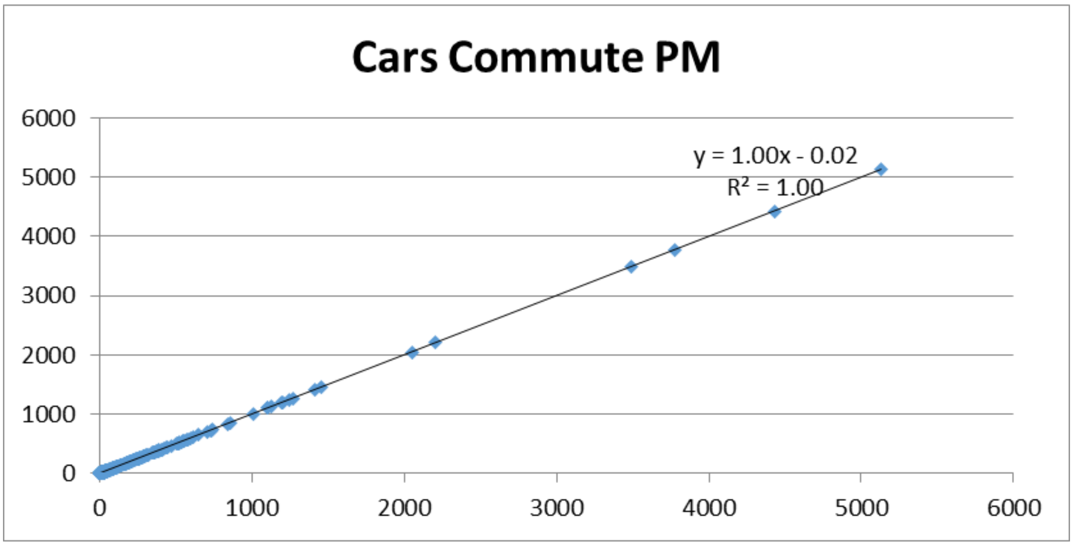
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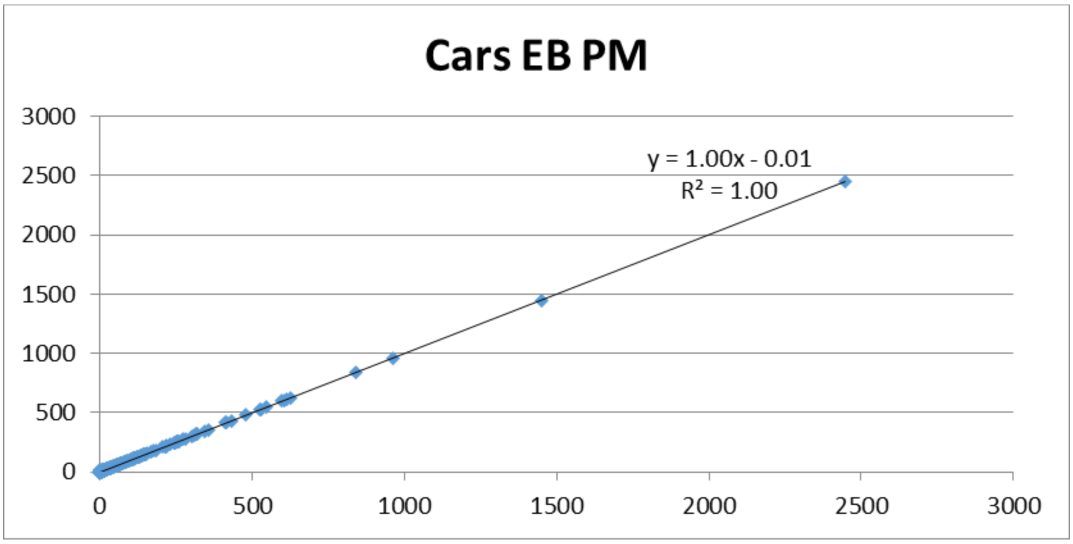
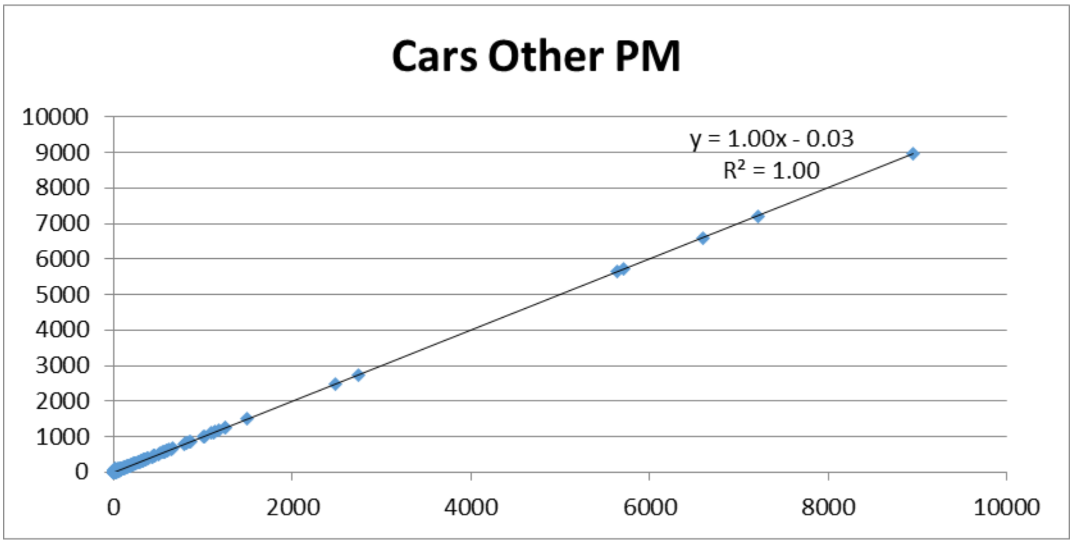
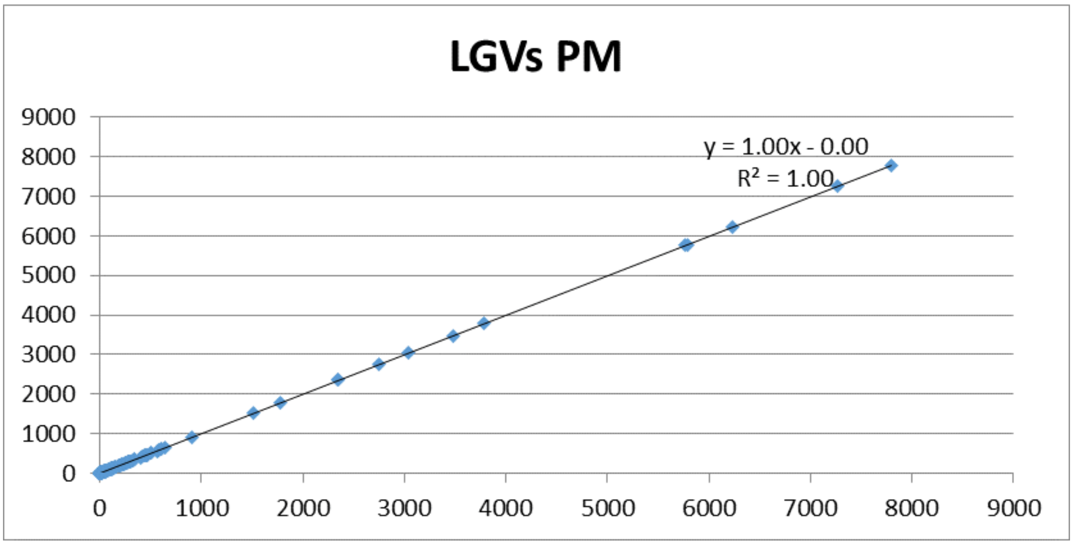
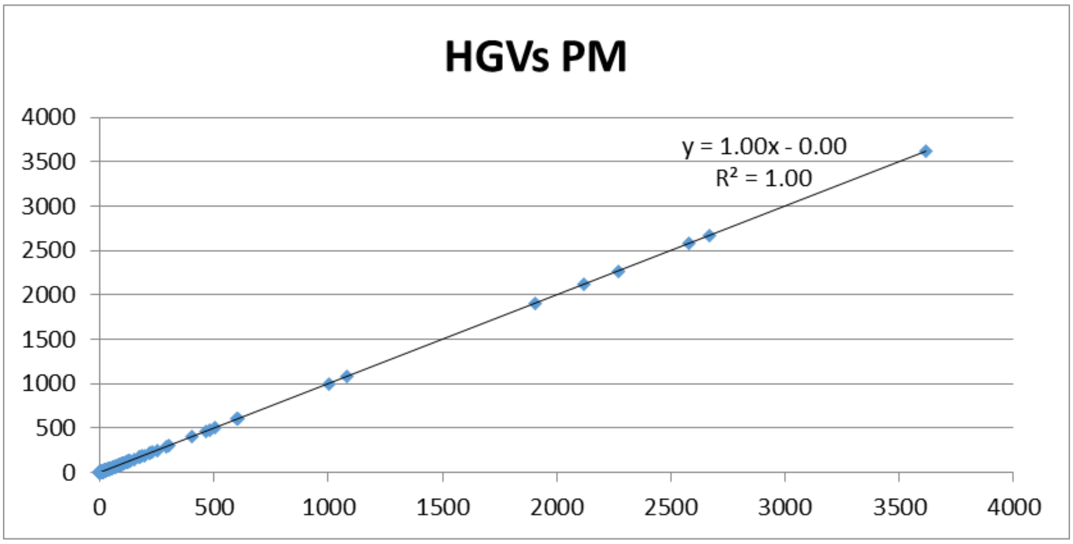
0
1000
2000
3000
4000
5000
6000


Cars EB PM
y = 1.00x - 0.01
R² = 1.00
3000
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
3000

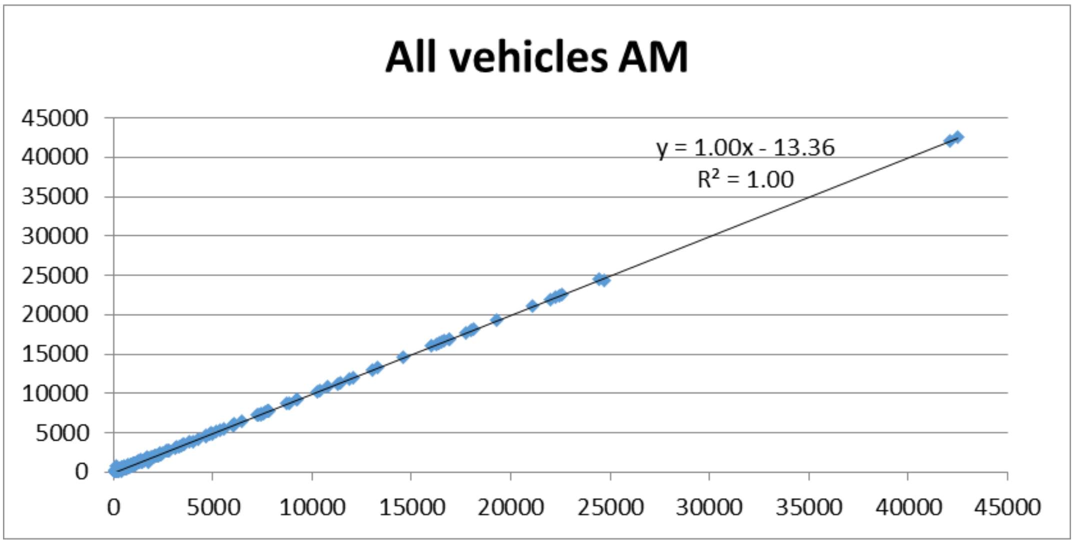

Cars Other PM
y = 1.00x - 0.03
R² = 1.00
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
2000
4000
6000
8000
10000

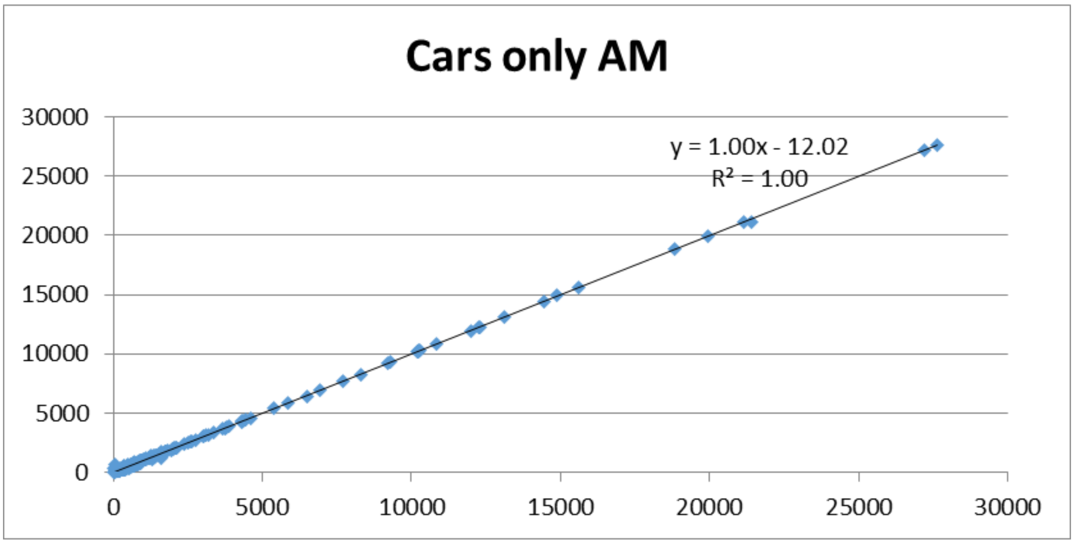

LGVs PM
y = 1.00x - 0.00
R² = 1.00
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000

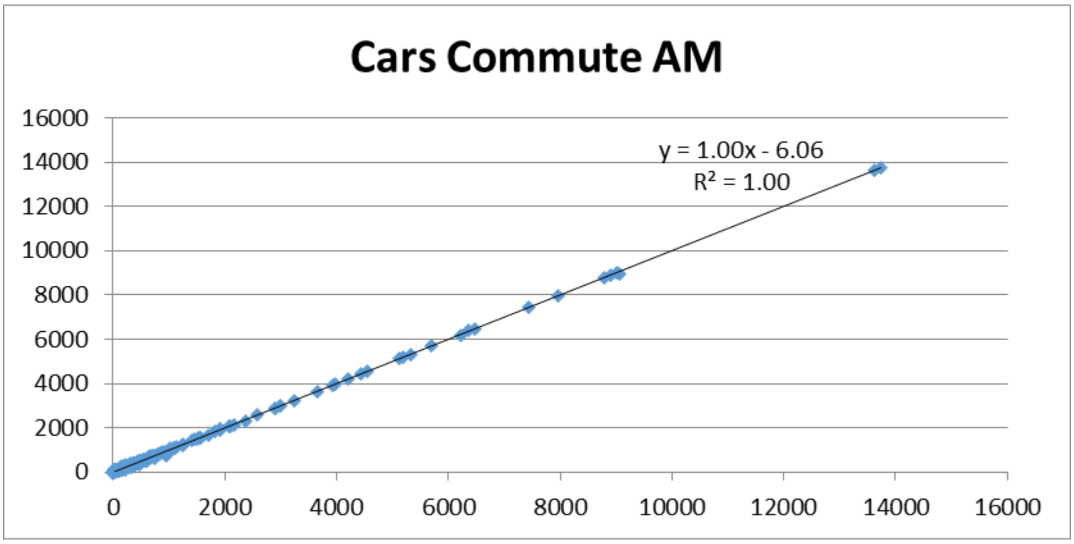

HGVs PM
y = 1.00x - 0.00
R² = 1.00
4000
3500
3000
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
3000
3500
4000

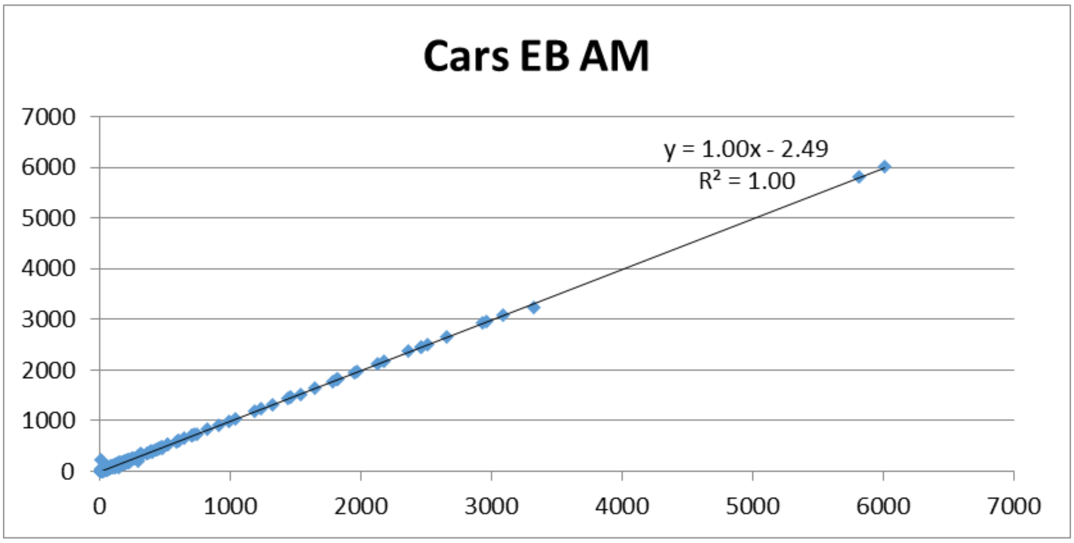
Appendix I – Matrix Trip End Changes

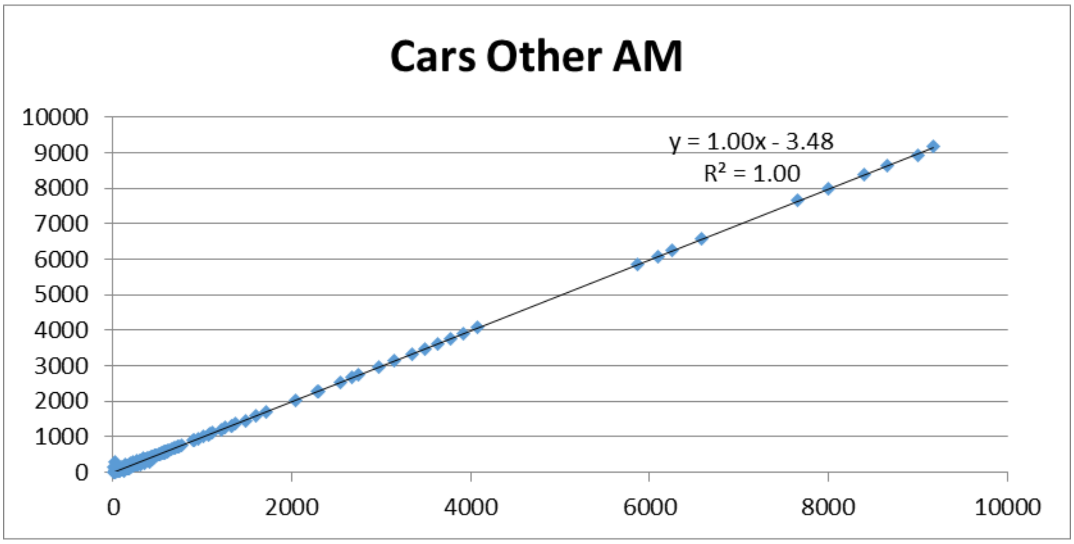
AM

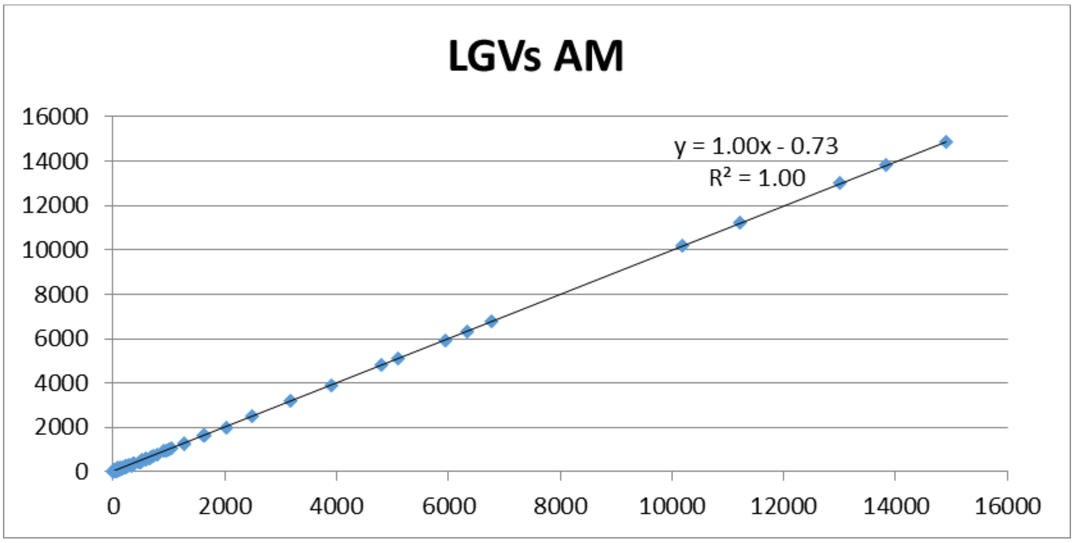

All vehicles AM
y = 1.00x - 13.36
R² = 1.00
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0
5000
10000
15000
20000
25000
30000
35000
40000
45000

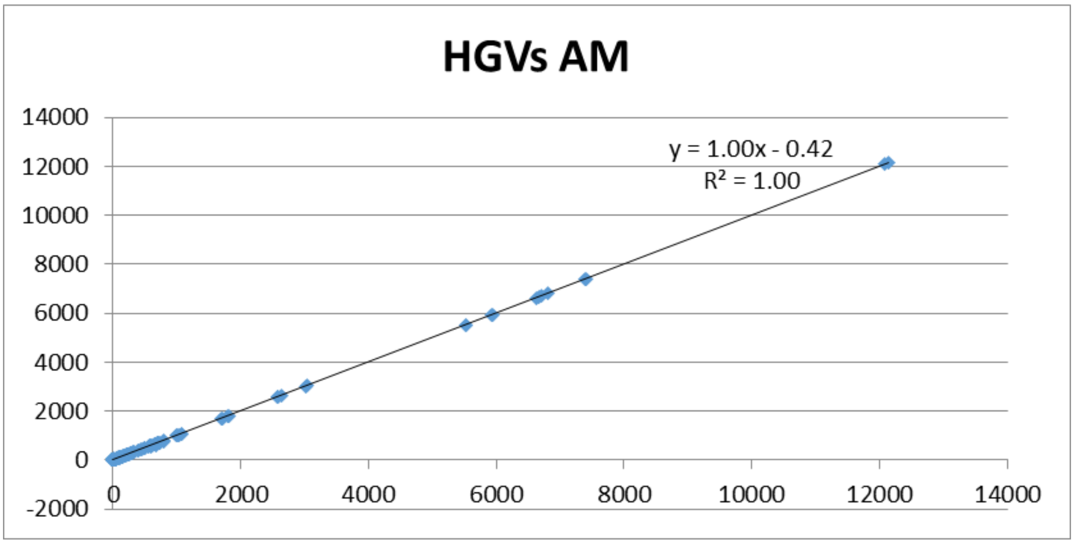

Cars only AM
y = 1.00x - 12.02
R² = 1.00
30000
25000
20000
15000
10000
5000
0
0
5000
10000
15000
20000
25000
30000


Cars Commute AM
y = 1.00x - 6.06
R² = 1.00
16000
14000
12000
10000
8000
6000
4000
2000
0
0
2000
4000
6000
8000
10000
12000
14000
16000

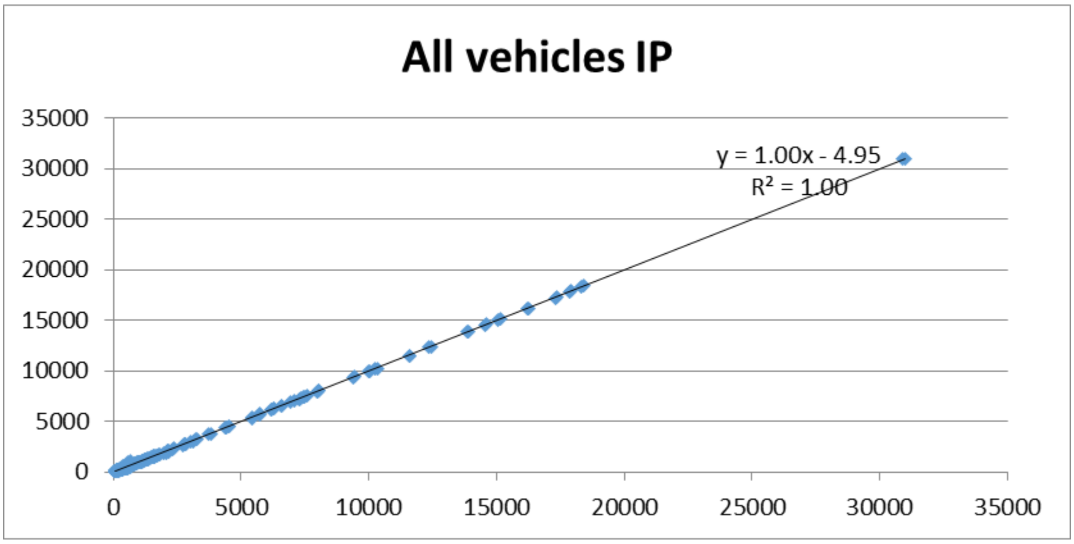

Cars EB AM
y = 1.00x - 2.49
R² = 1.00
7000
6000
5000
4000
3000
2000
1000
0
0
1000
2000
3000
4000
5000
6000
7000

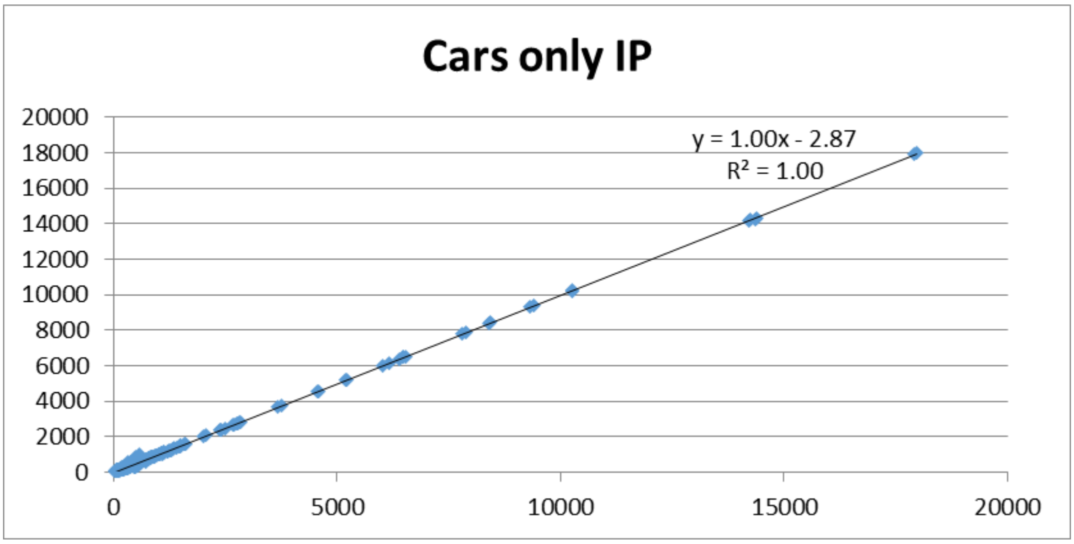

Cars Other AM
y = 1.00x - 3.48
R² = 1.00
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
2000
4000
6000
8000
10000

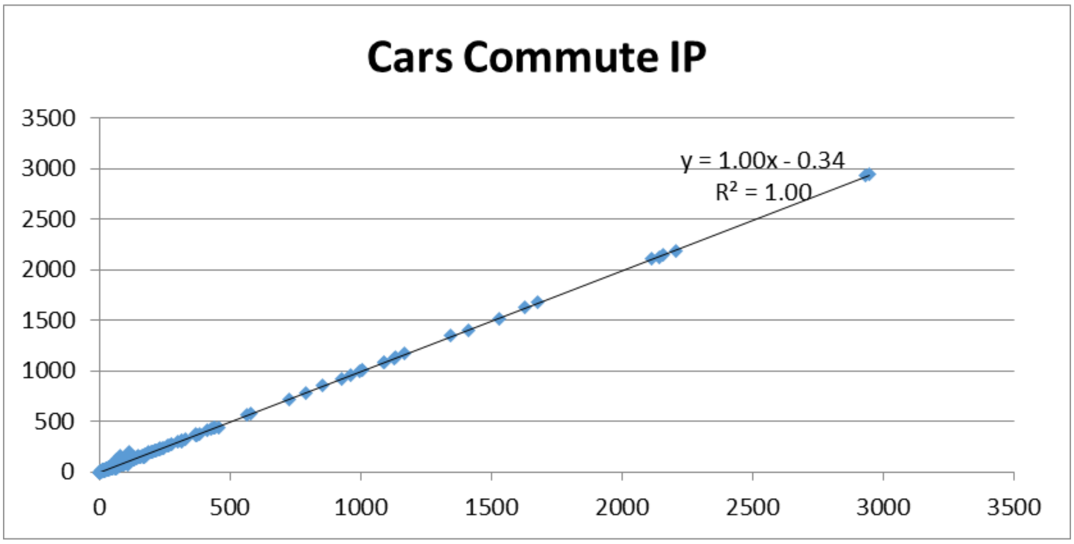

LGVs AM
y = 1.00x - 0.73
R² = 1.00
16000
14000
12000
10000
8000
6000
4000
2000
0
0
2000
4000
6000
8000
10000
12000
14000
16000

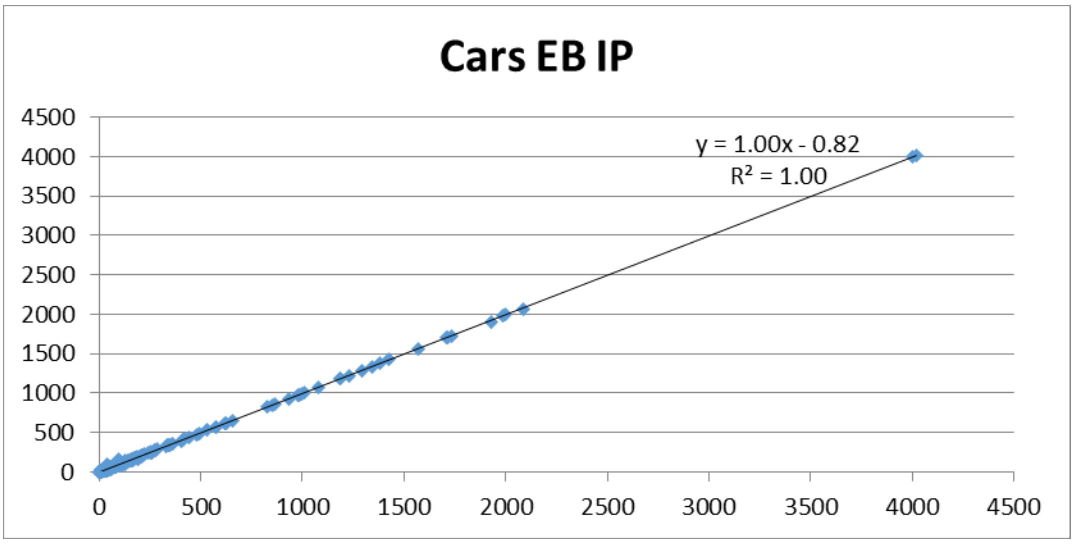

HGVs AM
14000
12000
10000
8000
6000
4000
2000
0
-2000
0
2000
4000
6000
8000
10000
12000
14000
y = 1.00x - 0.42
R² = 1.00

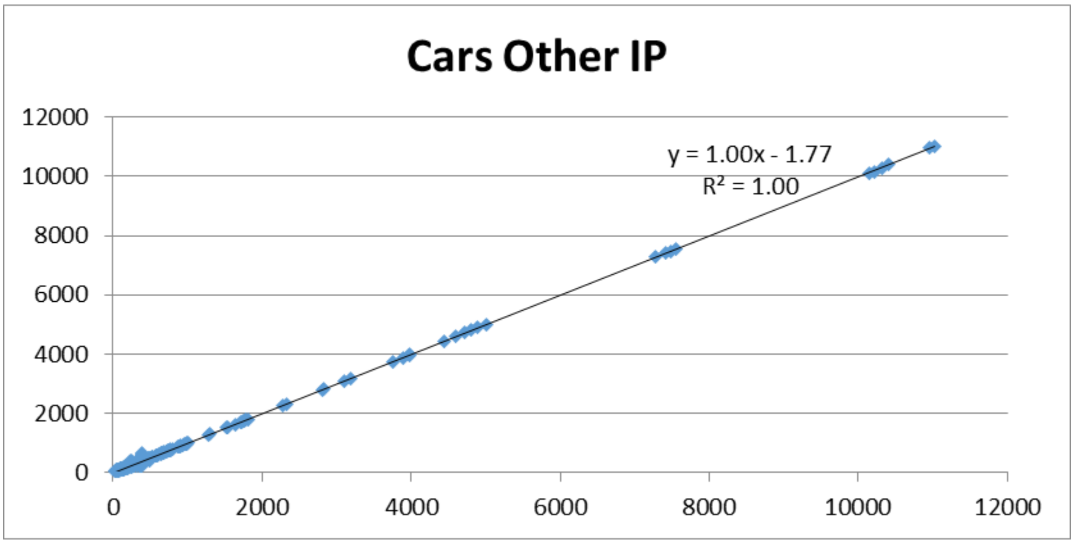
IP

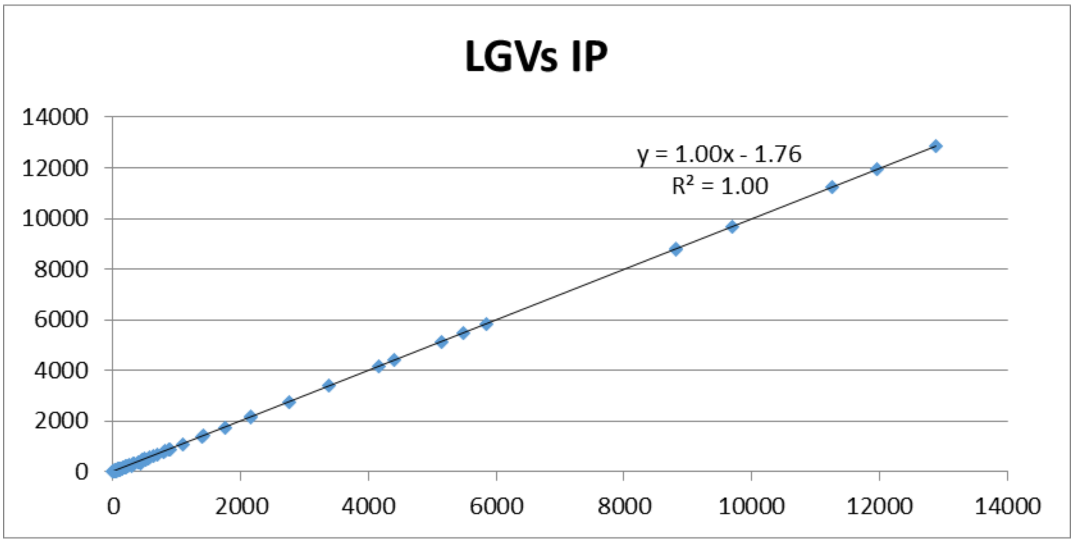

All vehicles IP
35000
30000
25000
20000
15000
10000
5000
0
0
5000
10000
15000
20000
25000
30000
35000
y = 1.00x - 4.95
R² = 1.00

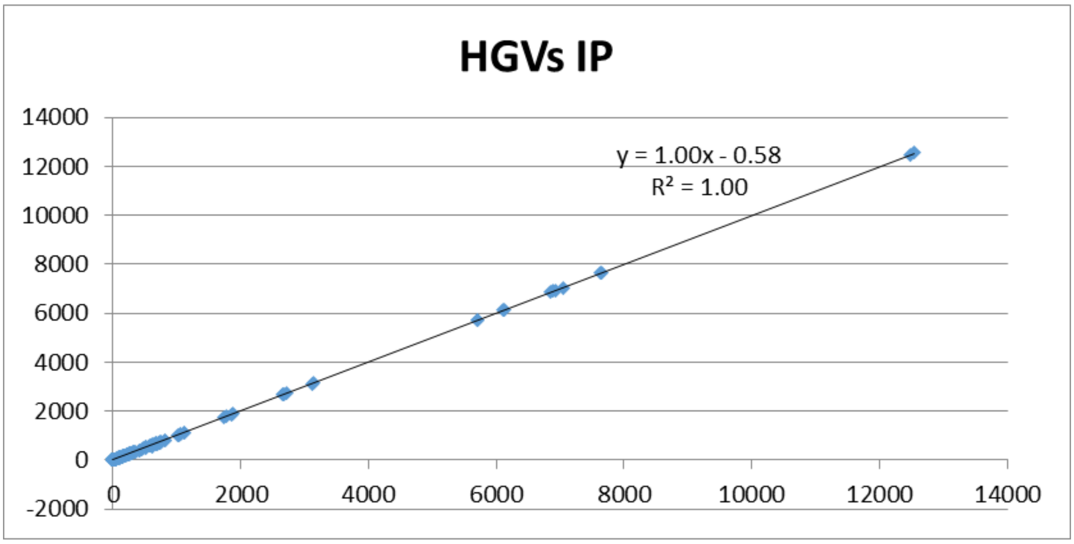

Cars only IP
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
5000
10000
15000
20000
y = 1.00x - 2.87
R² = 1.00


Cars Commute IP
y = 1.00x - 0.34
R² = 1.00
3500
3000
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
3000
3500

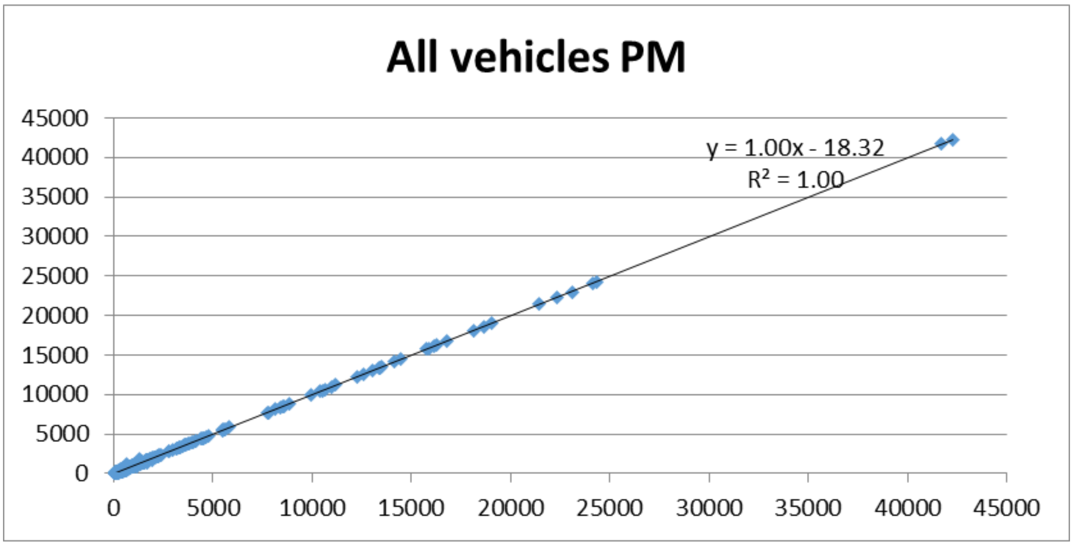

Cars EB IP
y = 1.00x - 0.82
R² = 1.00
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500

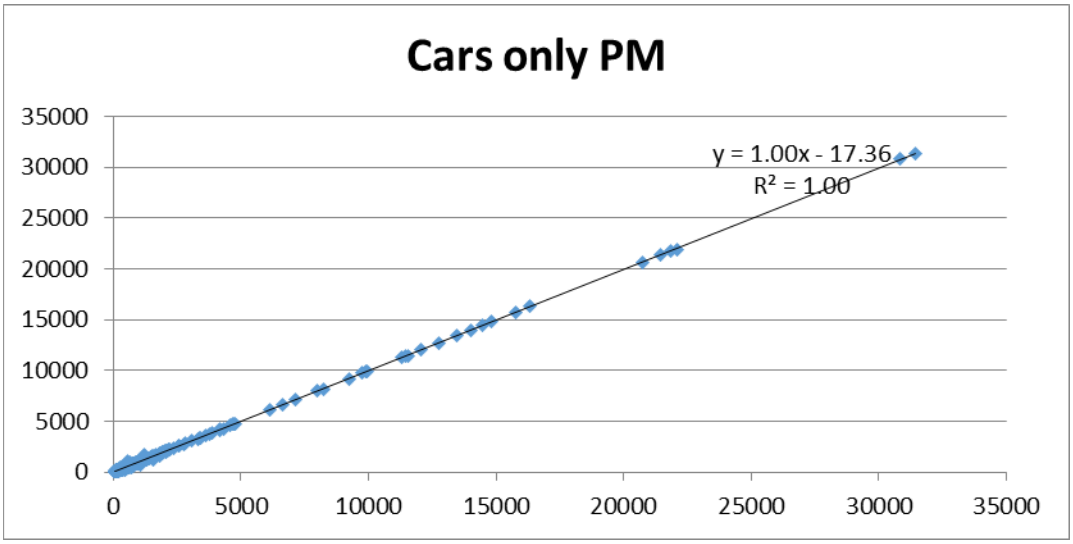

Cars Other IP
y = 1.00x - 1.77
R² = 1.00
12000
10000
8000
6000
4000
2000
0
0
2000
4000
6000
8000
10000
12000


LGVs IP
y = 1.00x - 1.76
R² = 1.00
14000
12000
10000
8000
6000
4000
2000
0
0
2000
4000
6000
8000
10000
12000
14000

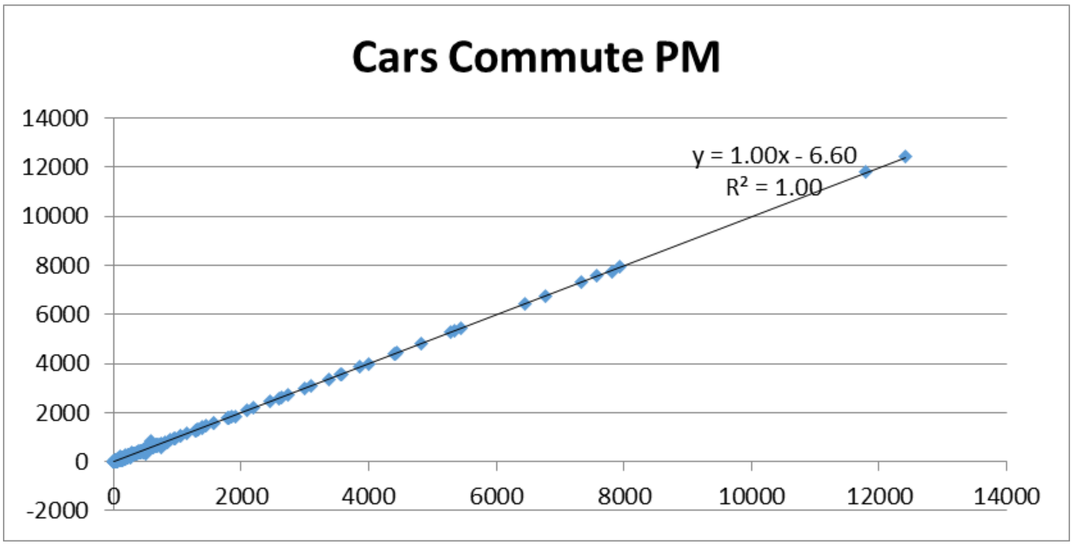

HGVs IP
y = 1.00x - 0.58
R² = 1.00
14000
12000
10000
8000
6000
4000
2000
0
-2000
0
2000
4000
6000
8000
10000
12000
14000

PM

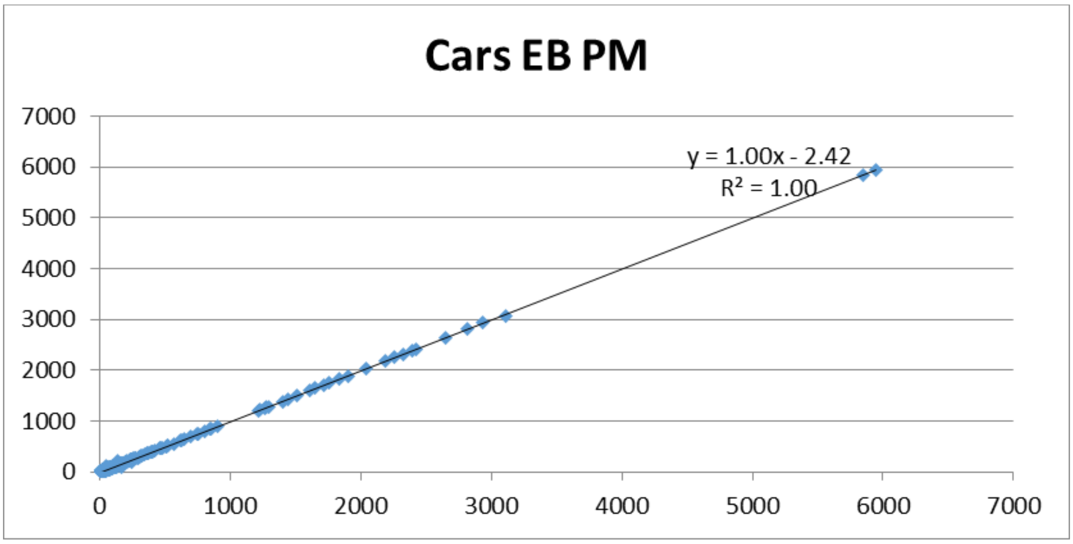

All vehicles PM
y = 1.00x - 18.32
R² = 1.00
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0
5000
10000
15000
20000
25000
30000
35000
40000
45000



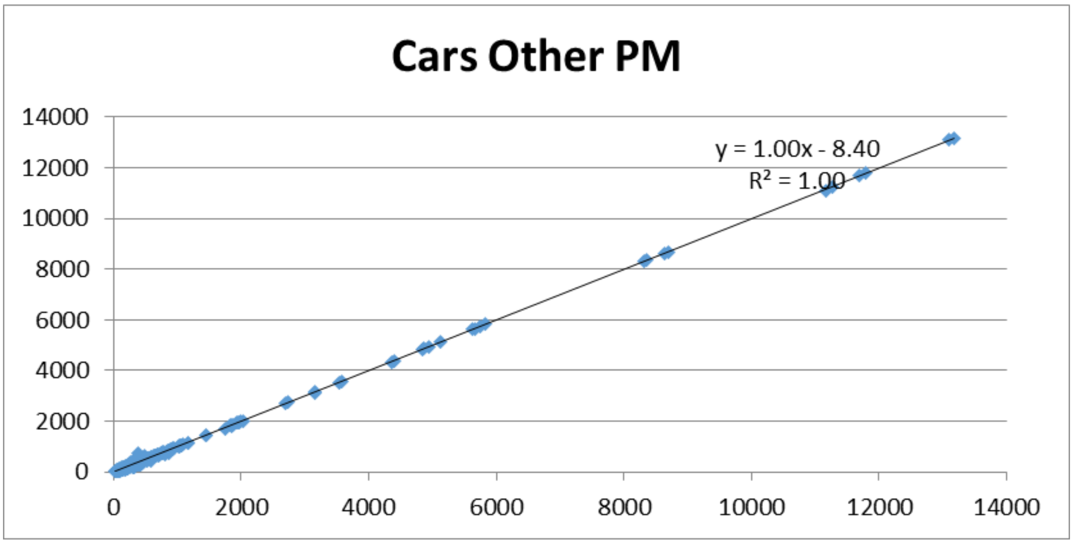
Cars only PM
y = 1.00x - 17.36
R² = 1.00
35000
30000
25000
20000
15000
10000
5000
0
0
5000
10000
15000
20000
25000
30000
35000

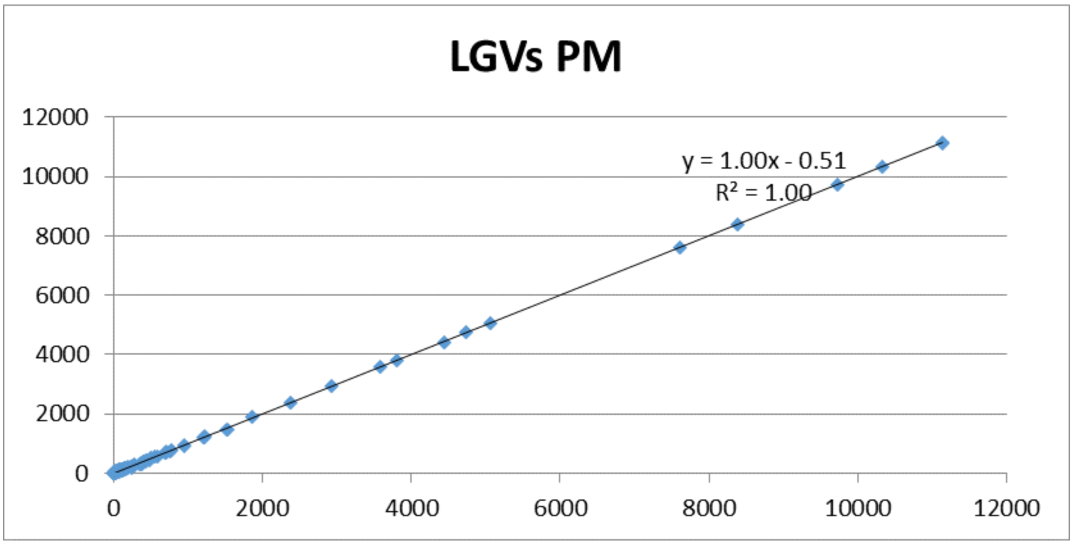


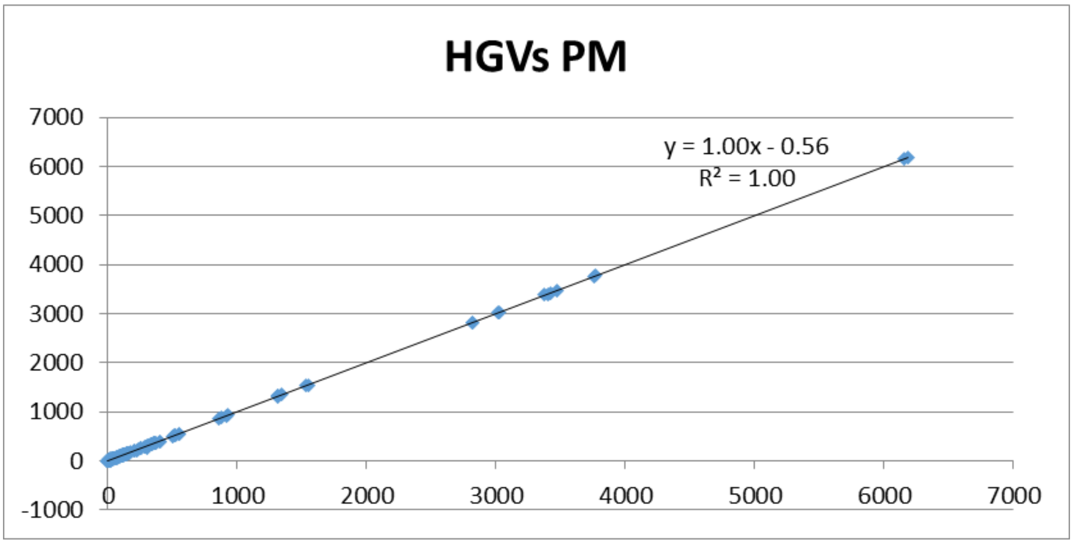
Cars Commute PM
y = 1.00x - 6.60
R² = 1.00
14000
12000
10000
8000
6000
4000
2000
0
-2000
0
2000
4000
6000
8000
10000
12000
14000



Cars EB PM
y = 1.00x - 2.42
R² = 1.00
7000
6000
5000
4000
3000
2000
1000
0
0
1000
2000
3000
4000
5000
6000
7000


Cars Other PM
y = 1.00x - 8.40
R² = 1.00
14000
12000
10000
8000
6000
4000
2000
0
0
2000
4000
6000
8000
10000
12000
14000


LGVs PM
y = 1.00x - 0.51
R² = 1.00
12000
10000
8000
6000
4000
2000
0
0
2000
4000
6000
8000
10000
12000


HGVs PM
y = 1.00x - 0.56
R² = 1.00
7000
6000
5000
4000
3000
2000
1000
0
-1000
0
1000
2000
3000
4000
5000
6000
7000

Appendix J – Matrix Trip Length Changes (Initial Prior vs Final Prior)

- AM

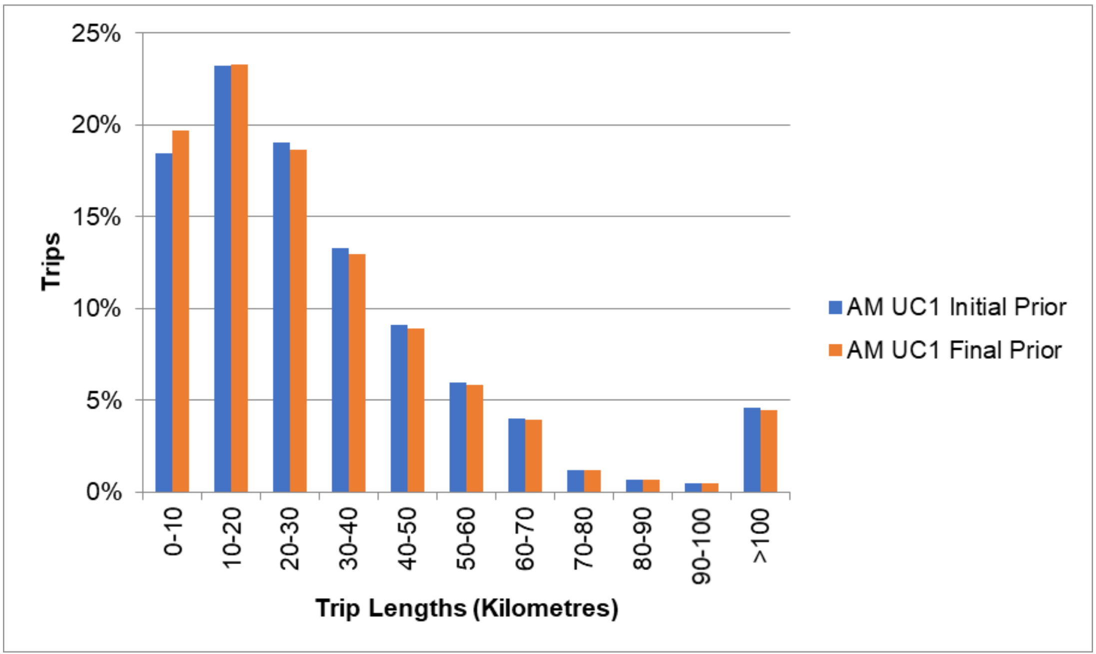


Figure R. 1: Matrix trip length changes, UC1 AM

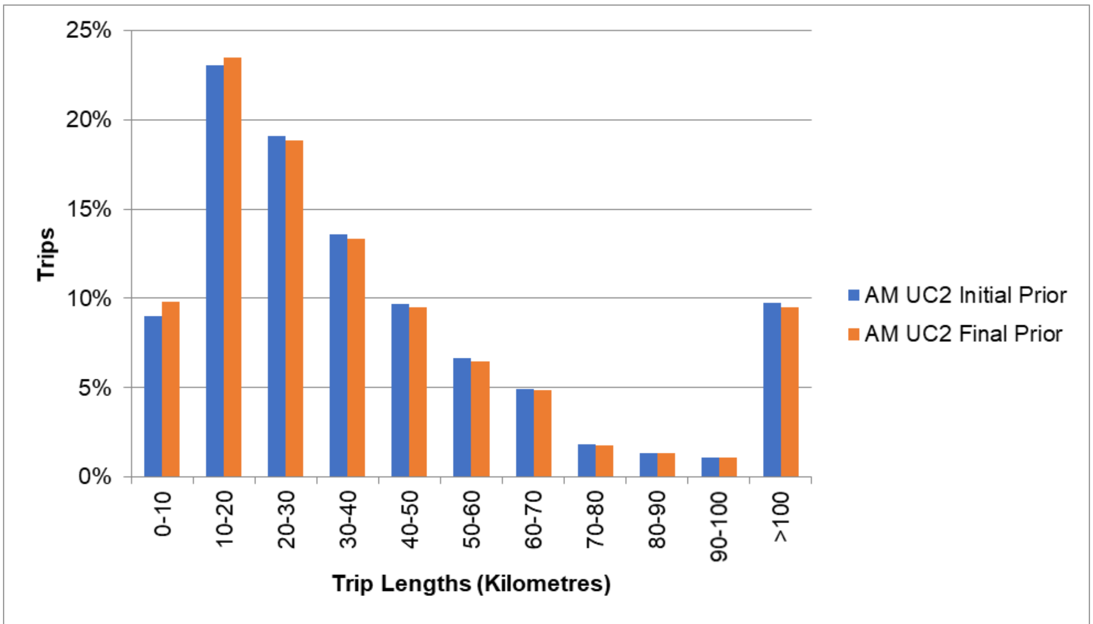


Figure R. 2: Matrix trip length changes, UC2 AM

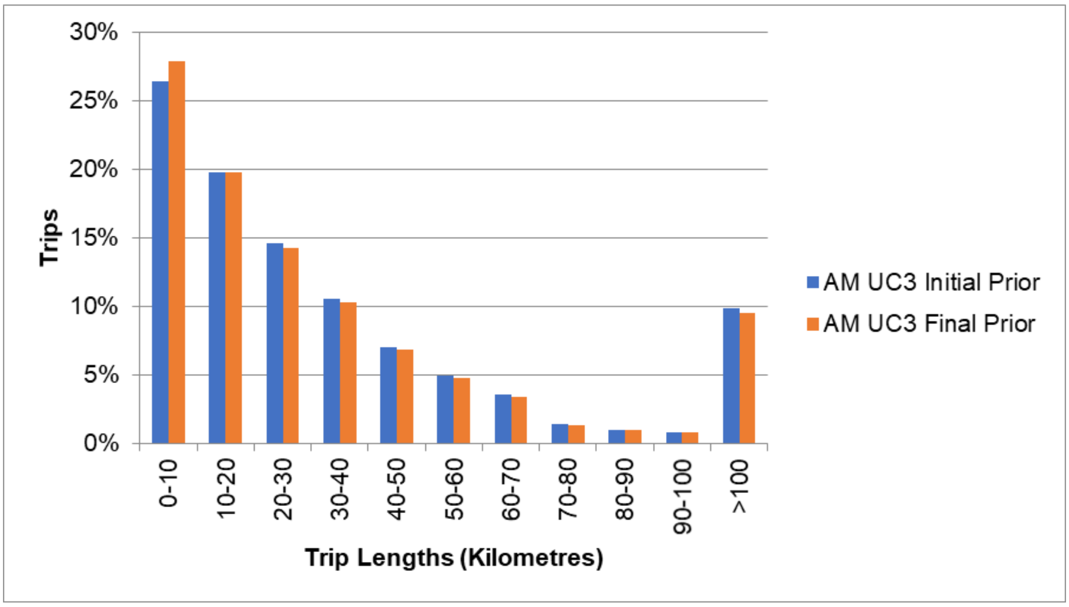


Figure R. 3: Matrix trip length changes, UC3 AM

- IP

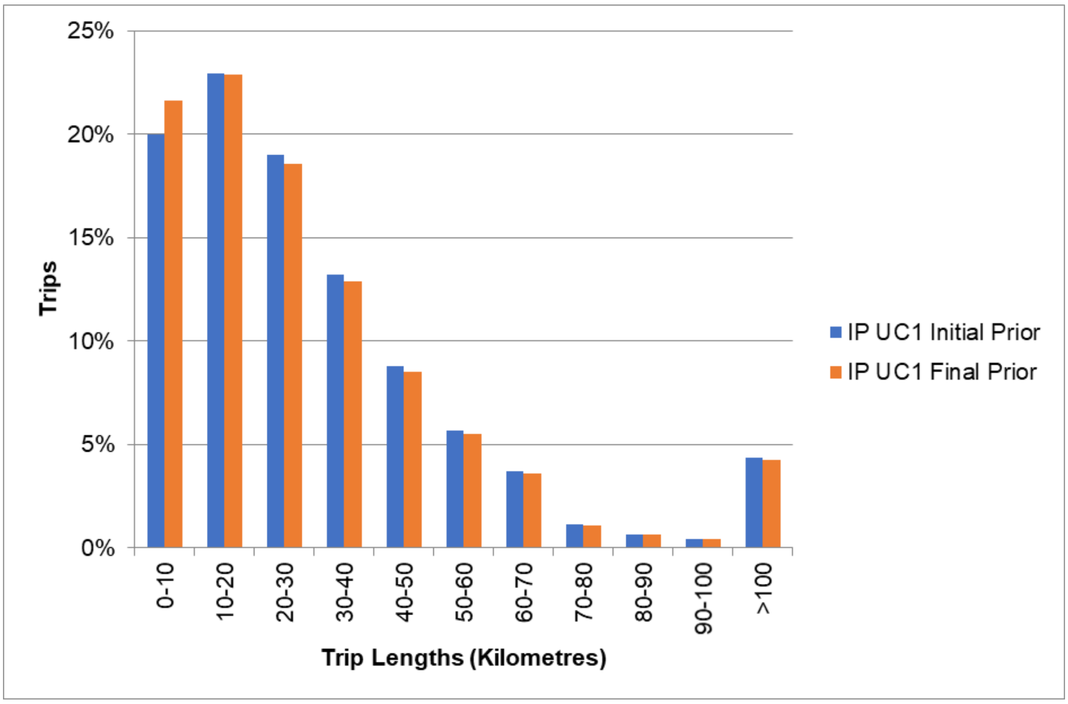


Figure R. 4: Matrix trip length changes, UC1 IP

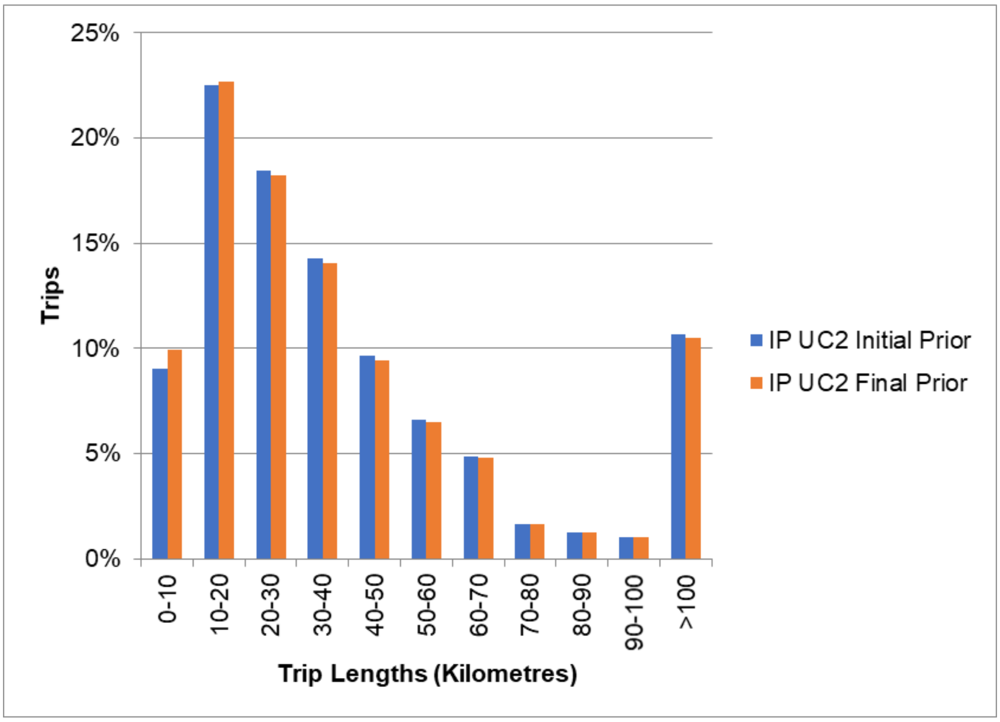


Figure R. 5: Matrix trip length changes, UC2 IP

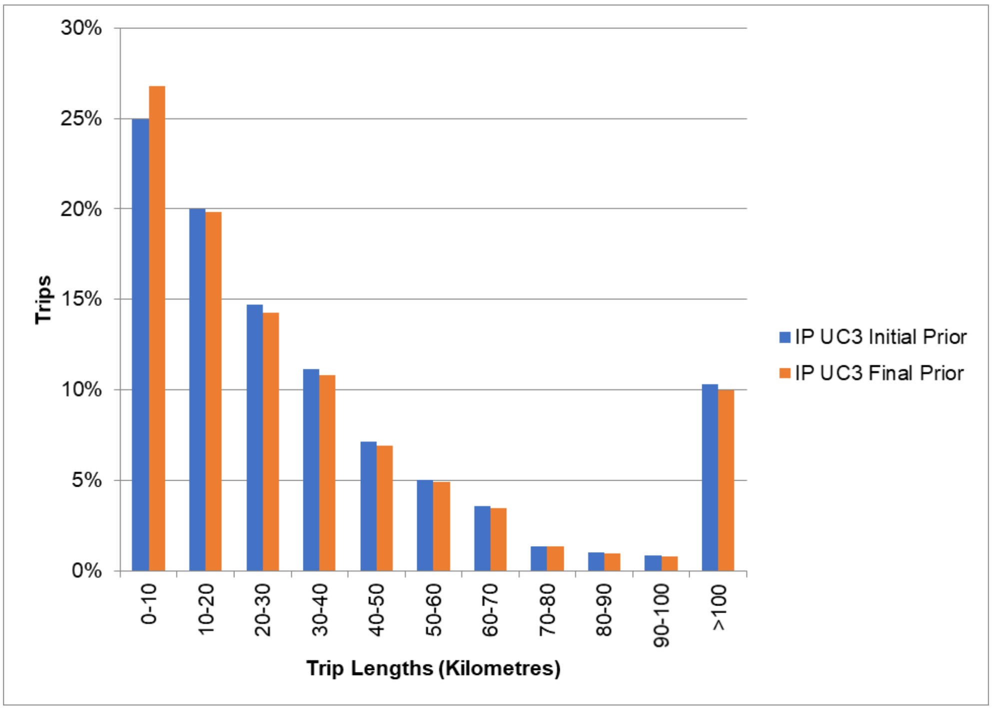


Figure R. 6: Matrix trip length changes, UC3 IP

- PM

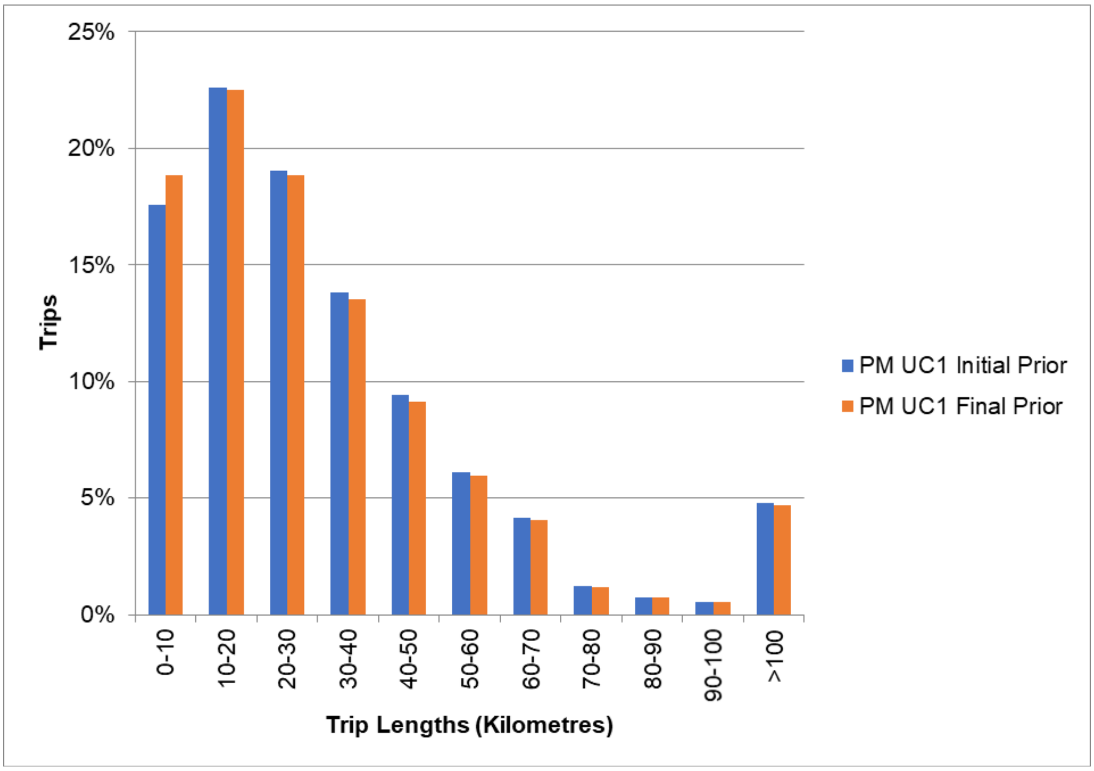


Figure R. 7: Matrix trip length changes, UC1 PM

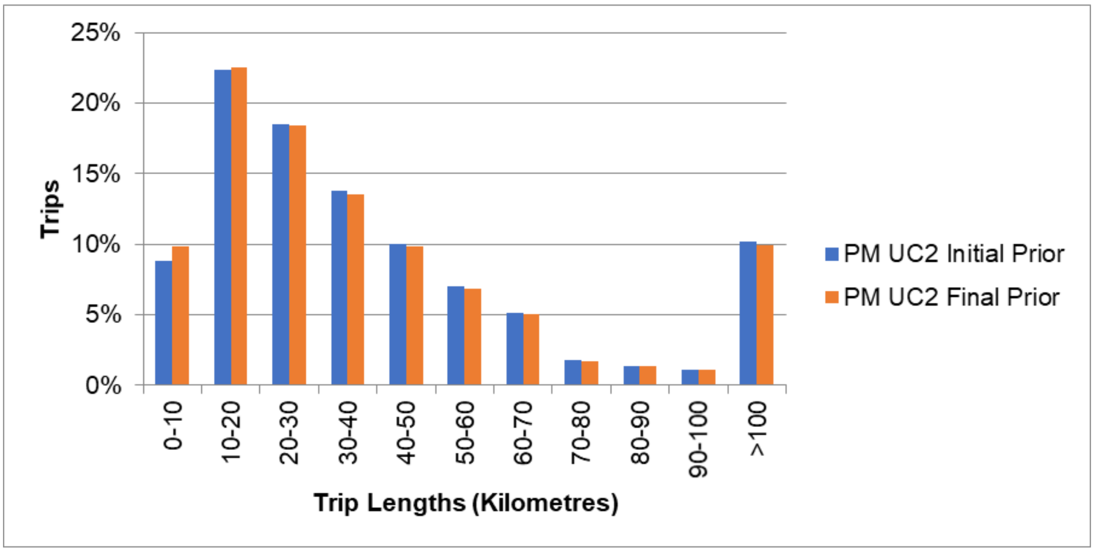


Figure R. 8: Matrix trip length changes, UC2 PM

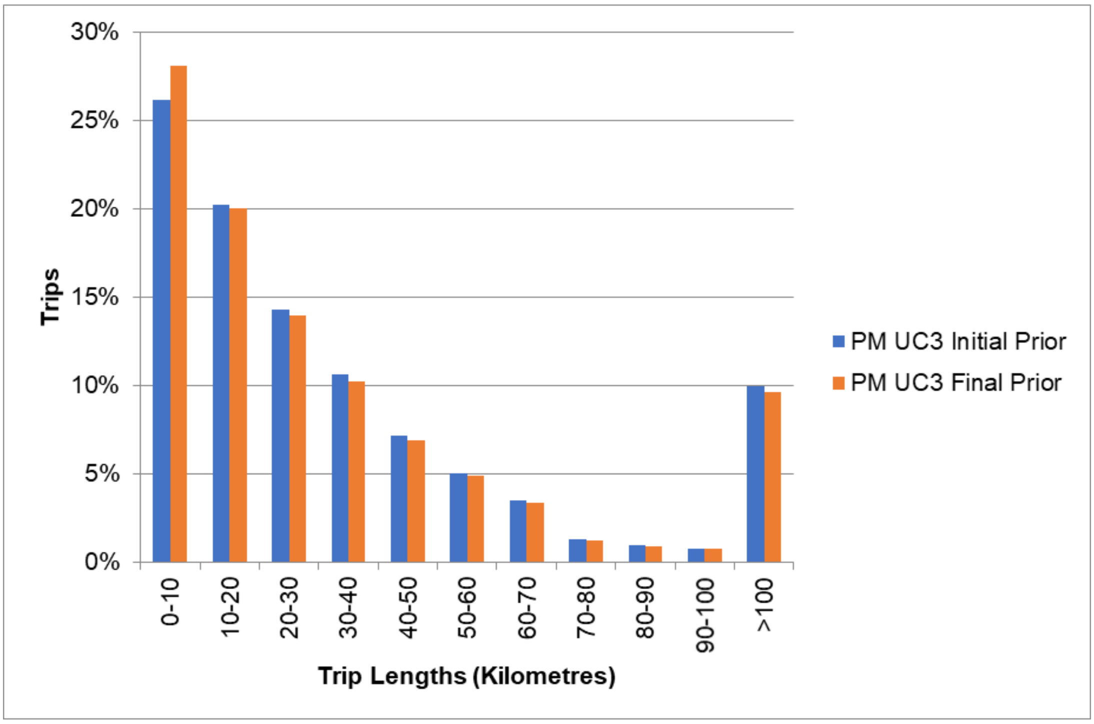


Figure R. 9: Matrix trip length changes, UC3 PM

Appendix K – Matrix Trip Length Changes (Pre ME vs Post ME)

- AM

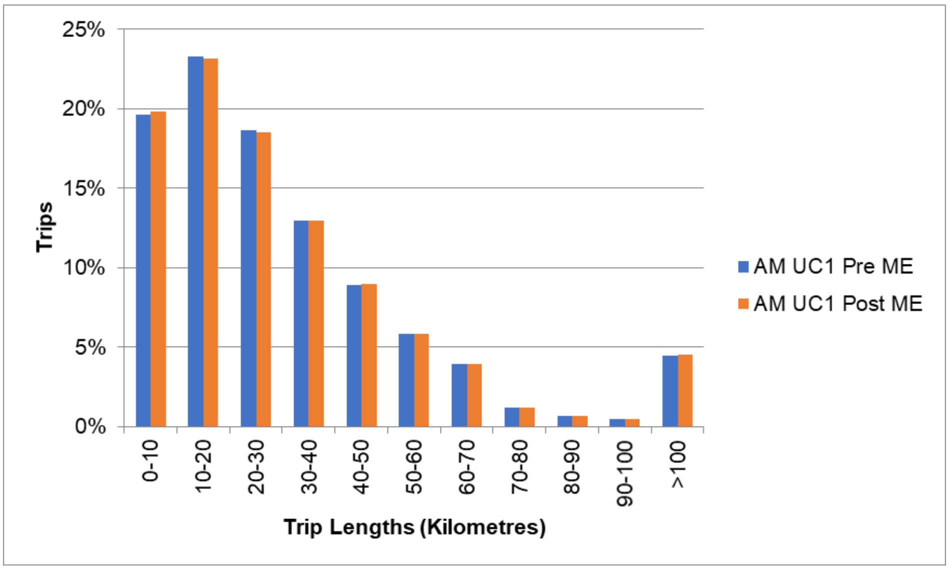


Figure R. 1: Matrix trip changes, UC1 AM

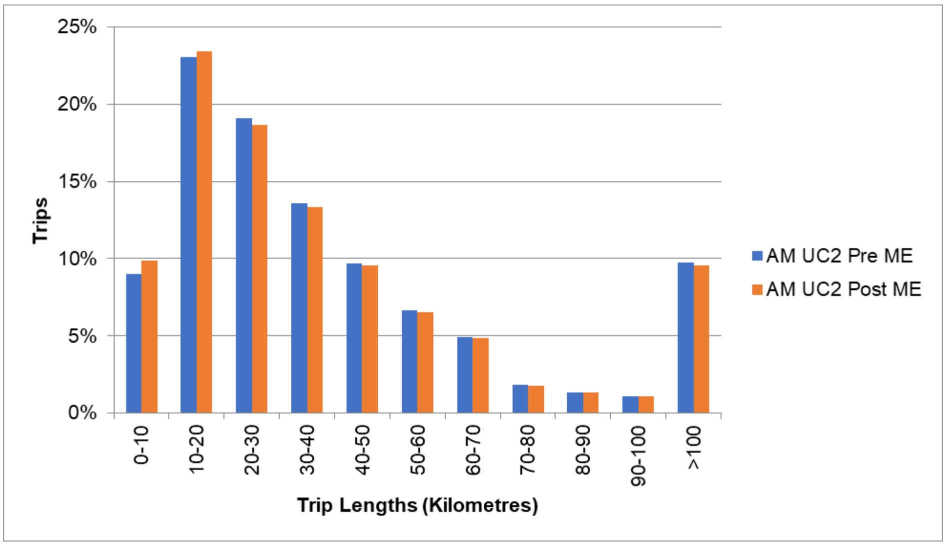


Figure R. 2: Matrix trip changes, UC2 AM

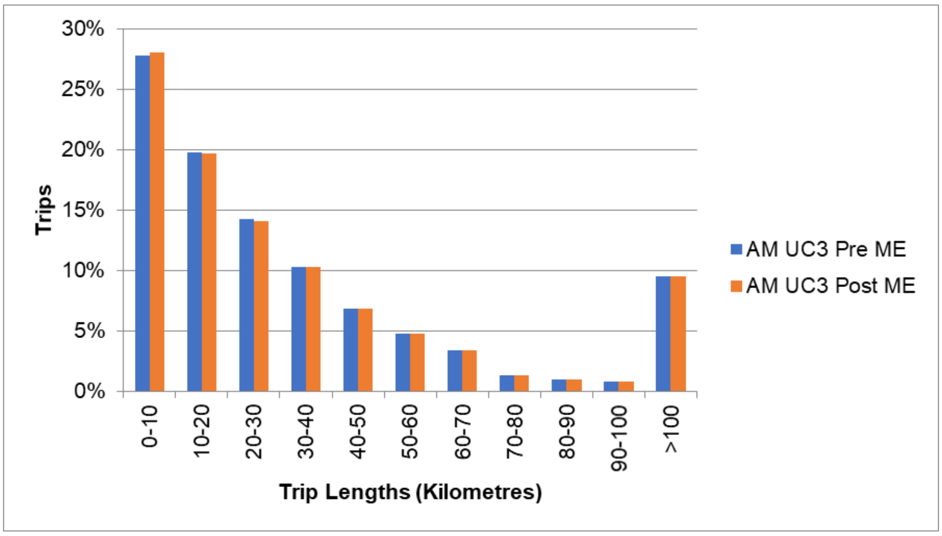


Figure R. 3: Matrix trip changes, UC3 AM

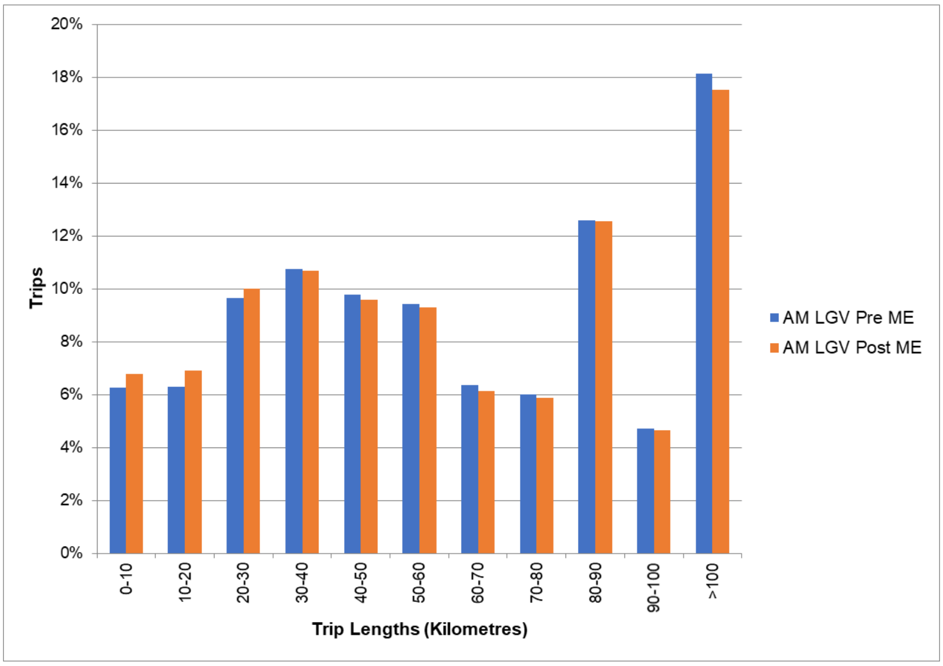


Figure R. 4: Matrix trip changes, LGV AM

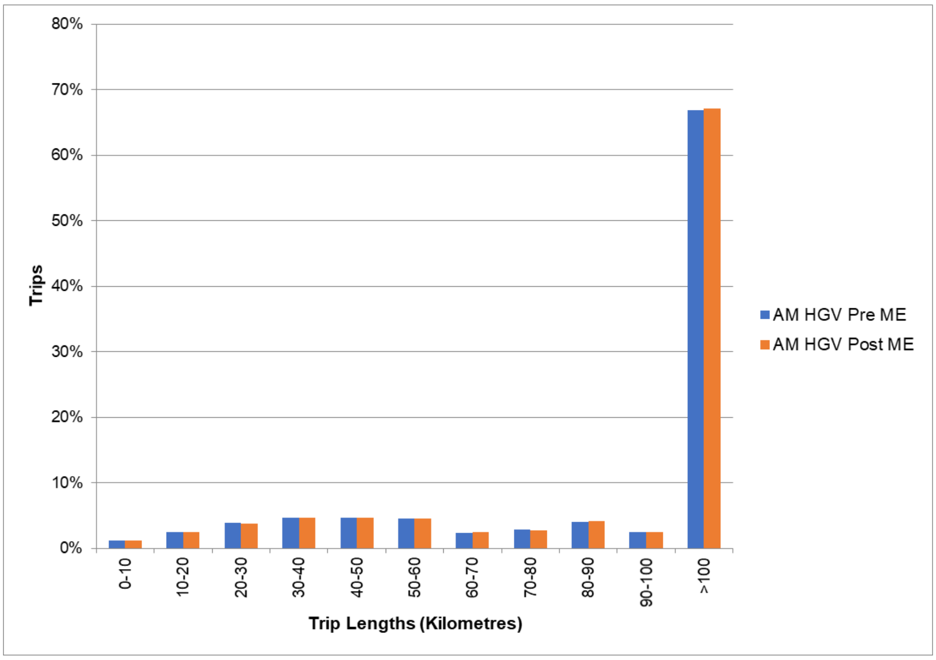


Figure R. 5: Matrix trip changes, HGV AM

- IP

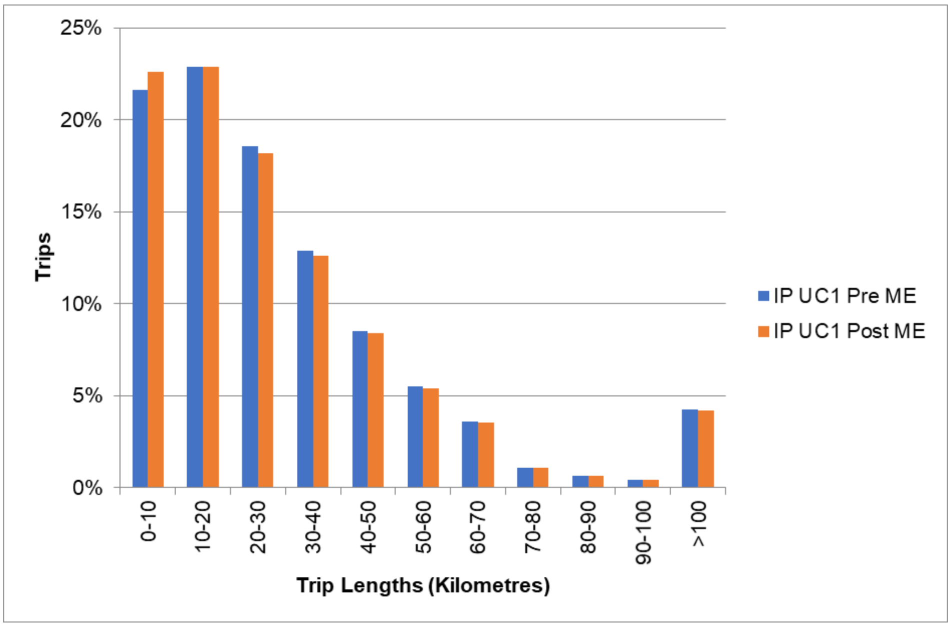


Figure R. 6: Matrix trip changes, UC1 IP

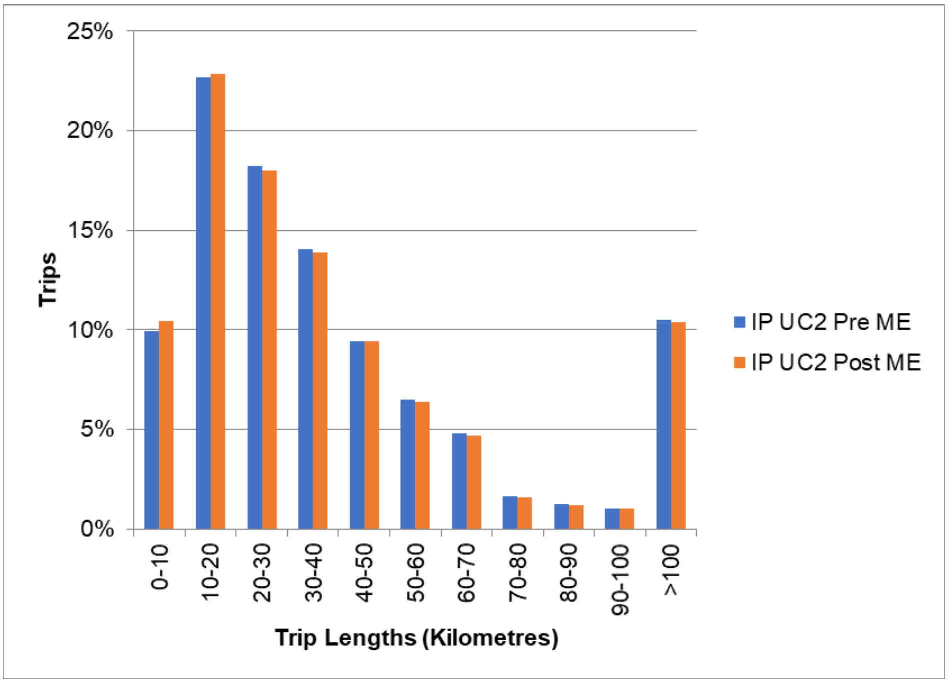


Figure R. 7: Matrix trip changes, UC2 IP

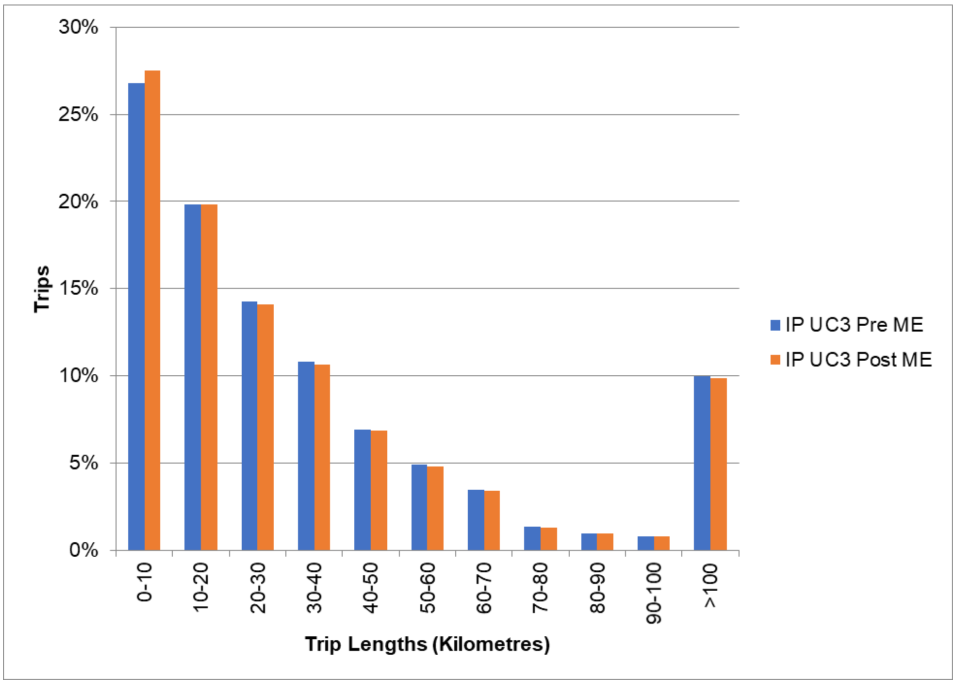


Figure R. 8: Matrix trip changes, UC3 IP

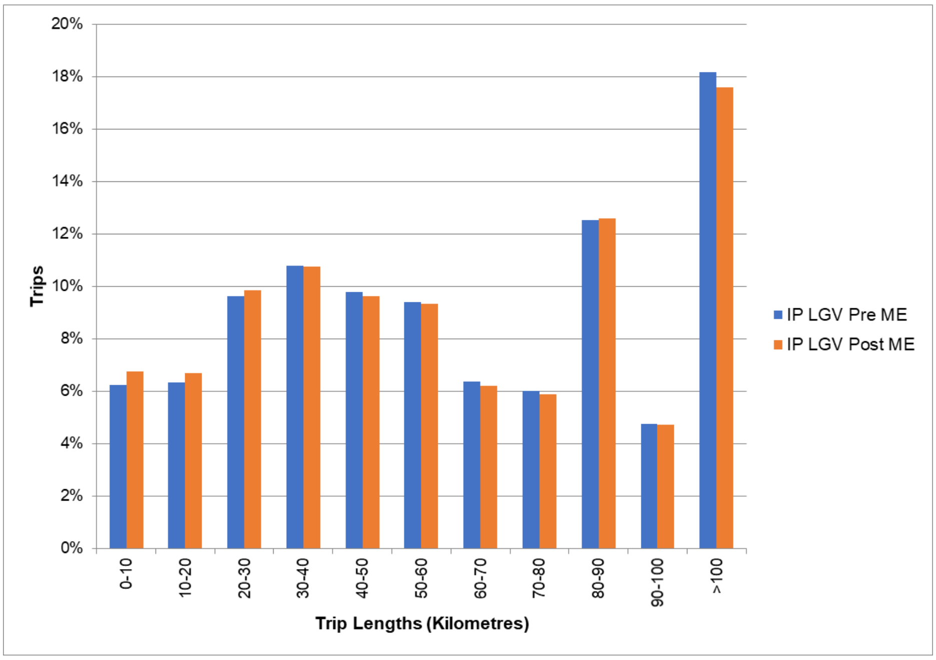


Figure R. 9: Matrix trip changes, LGV IP

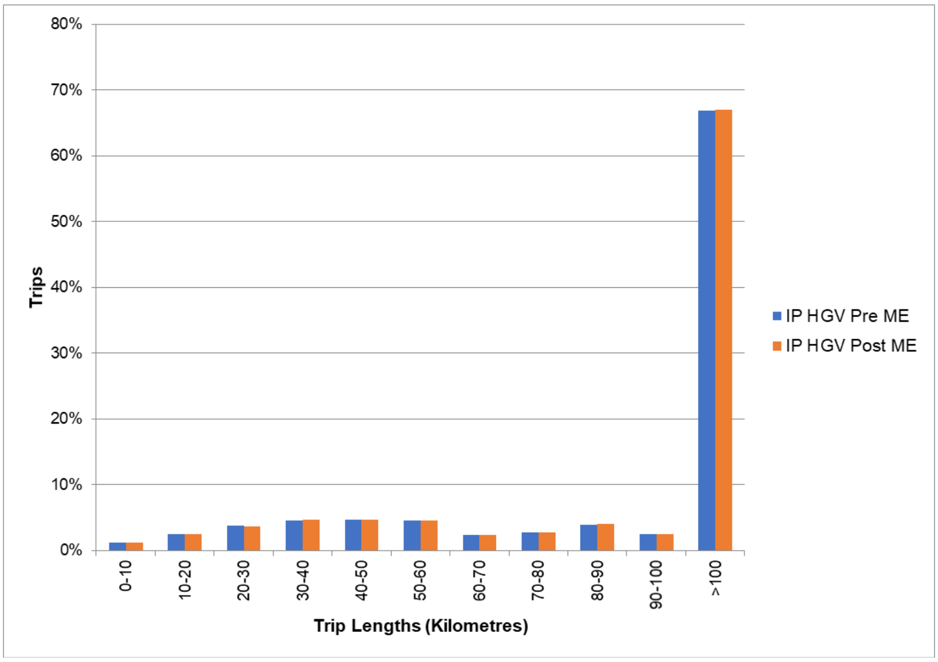


Figure R. 10: Matrix trip changes, HGV IP

- PM

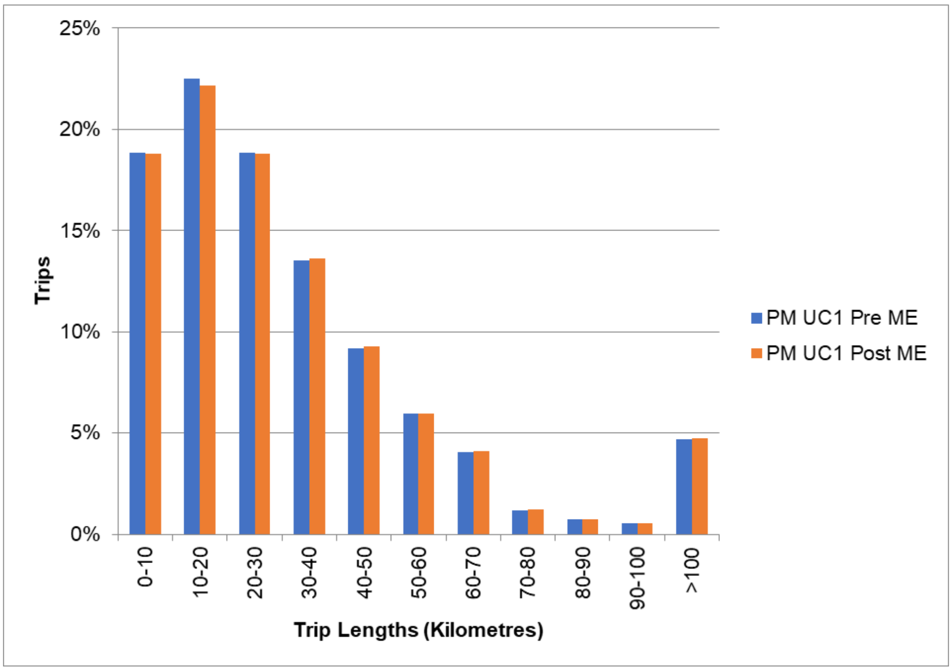


Figure R. 11: Matrix trip changes, UC1 PM

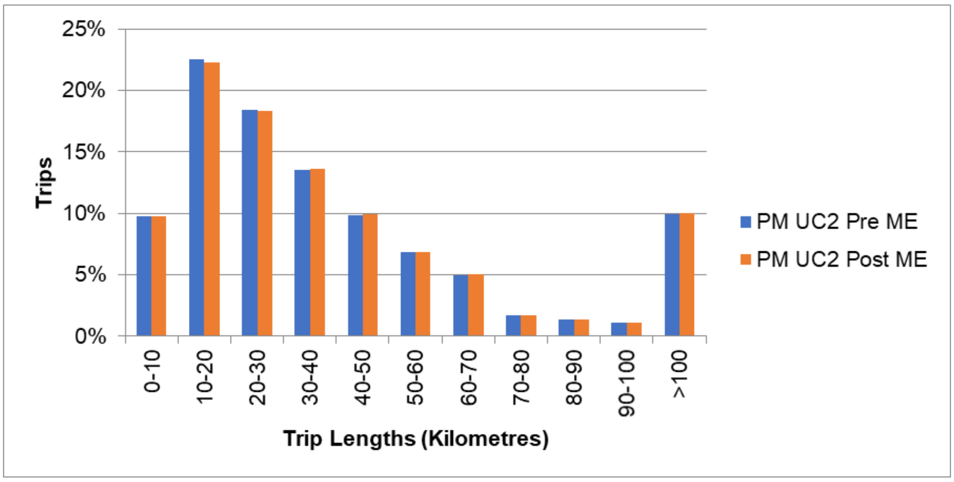


Figure R. 12: Matrix trip changes, UC2 PM

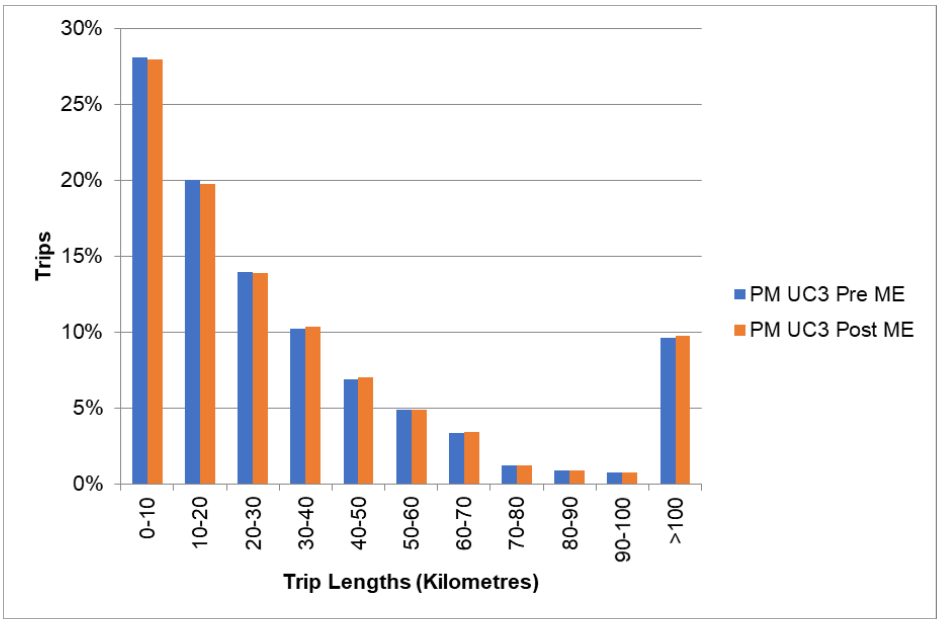


Figure R. 13: Matrix trip changes, UC3 PM

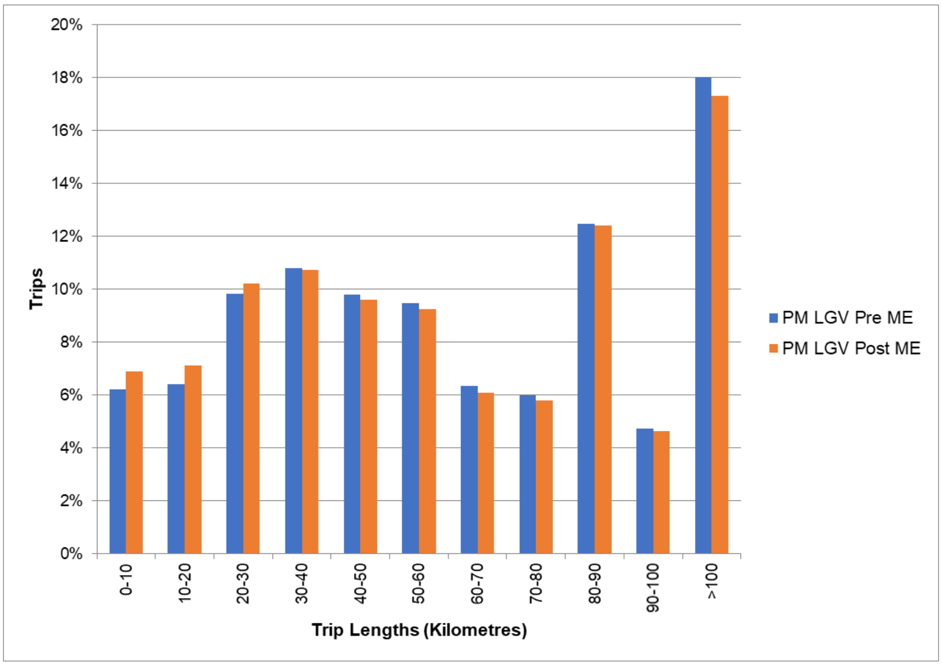


Figure R. 14: Matrix trip changes, LGV PM

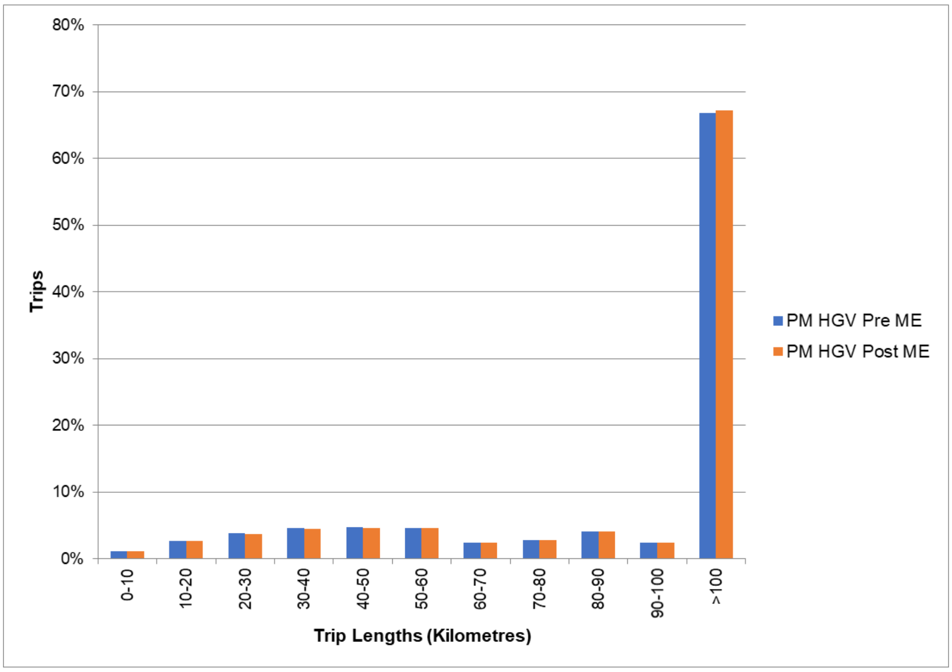


Figure R. 15: Matrix trip changes, HGV PM

Appendix L – % Changes Sector-To-Sector

% Change Commute	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	0.1%	-3.2%	-27.4%	-14.0%	-18.4%	-42.2%	-17.5%	-21.7%	-2.2%	-11.4%
Brentwood	-5.7%	3.3%	-47.7%	-16.8%	-16.3%	-79.9%	-49.9%	23.3%	2.8%	-15.0%
Castle Point	-7.9%	13.7%	5.2%	-25.5%	-26.0%	-4.2%	-2.7%	-36.5%	-18.0%	-8.8%
Chelmsford	16.8%	-0.4%	4.1%	-4.6%	-15.2%	-80.0%	1.0%	6.4%	-10.2%	-4.5%
Maldon	10.1%	-5.7%	-4.3%	-5.3%	0.0%	-115.0%	-4.6%	0.3%	-7.5%	-8.6%
Rochford	-27.6%	-18.4%	-2.8%	-34.4%	-36.5%	11.2%	7.5%	-38.9%	-42.3%	-15.8%
Southend	-35.6%	-43.4%	-5.0%	-51.2%	-46.2%	-5.2%	-3.6%	-38.8%	-49.6%	-28.4%
Thurrock	-3.0%	25.4%	-34.9%	-19.0%	-22.9%	-49.5%	-24.4%	-2.0%	-3.1%	-0.6%
London	4.1%	-2.8%	-33.7%	-3.7%	-9.5%	-58.9%	-36.5%	-1.5%	0.0%	-0.8%
External	15.4%	0.9%	-18.1%	0.0%	-3.1%	-100.4%	-15.2%	-0.7%	-0.6%	0.0%

Table 1: Percentage Change Commute AM

% Change Bussiness	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	3.4%	2.8%	-30.9%	9.7%	-29.5%	-37.4%	-13.4%	-24.1%	2.8%	-13.8%
Brentwood	-9.9%	4.9%	-34.5%	-11.8%	-12.0%	-85.0%	-53.1%	24.9%	1.9%	-9.6%
Castle Point	-2.6%	5.1%	7.2%	-60.2%	-13.8%	0.0%	0.9%	-26.4%	-18.9%	2.4%
Chelmsford	18.5%	0.0%	6.0%	-62.9%	-18.4%	-71.5%	-2.9%	4.4%	-7.6%	-4.9%
Maldon	11.0%	-0.7%	-5.0%	3.2%	0.0%	-88.2%	-8.4%	2.4%	-6.4%	-0.3%
Rochford	-23.0%	-12.3%	3.4%	-62.6%	-31.1%	21.9%	10.7%	-35.3%	-36.0%	-13.3%
Southend	-41.8%	-41.9%	-14.7%	-45.6%	-35.3%	2.6%	-4.2%	-51.7%	-56.4%	-31.6%
Thurrock	2.8%	23.9%	-36.8%	-20.8%	-17.6%	-38.2%	-19.7%	-2.6%	-3.5%	0.3%
London	7.5%	0.1%	-28.7%	-7.3%	-4.0%	-44.8%	-29.8%	-3.2%	0.0%	-1.1%
External	17.3%	-0.9%	-9.2%	1.3%	-0.6%	-74.8%	-14.1%	-1.9%	-1.0%	-0.1%

Table 2. Percentage Change Business AM

% Change Other	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	-0.2%	-6.9%	-39.1%	-9.7%	-24.2%	-45.6%	-19.7%	-28.1%	-2.5%	-12.0%
Brentwood	-7.6%	0.8%	-22.1%	-12.6%	-12.4%	-75.2%	-50.6%	21.7%	2.1%	-8.7%
Castle Point	-2.5%	-4.1%	2.6%	-31.5%	-26.1%	-2.2%	-0.4%	-21.3%	-18.6%	-9.2%
Chelmsford	11.4%	3.3%	11.1%	-4.5%	-11.2%	-82.0%	-12.0%	1.9%	-5.1%	-3.3%
Maldon	11.7%	-3.0%	4.1%	4.7%	0.0%	-91.7%	-16.6%	3.2%	-9.7%	-0.5%
Rochford	-30.4%	-11.3%	-3.2%	-42.1%	-47.1%	7.4%	2.9%	-34.1%	-33.6%	-17.0%
Southend	-47.3%	-45.0%	-14.5%	-45.5%	-44.0%	-0.9%	-4.0%	-46.9%	-49.2%	-38.1%
Thurrock	-4.4%	21.3%	-19.0%	-15.7%	-21.8%	-29.5%	-8.7%	-0.9%	-3.3%	0.6%
London	2.1%	-3.4%	-20.4%	-7.3%	-3.3%	-37.0%	-26.3%	-3.1%	0.0%	-0.4%
External	13.8%	-2.1%	-10.1%	0.5%	-0.8%	-66.0%	-18.3%	-1.7%	-0.7%	0.0%

Table 3. Percentage Change Other AM

% Change LGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	7.6%	20.0%	1.2%	24.5%	-9.7%	23.8%	5.0%	0.4%	-4.3%	9.8%
Brentwood	-0.5%	5.1%	-14.1%	30.4%	42.1%	10.8%	2.1%	18.6%	7.4%	9.5%
Castle Point	34.2%	21.1%	8.3%	-127.6%	-270.3%	-2.7%	29.4%	-53.4%	-33.2%	-44.7%
Chelmsford	33.6%	49.6%	-11.7%	8.8%	-6.1%	-3.6%	31.7%	13.2%	-50.7%	11.1%
Maldon	20.0%	38.5%	-53.2%	5.4%	0.0%	-40.1%	-13.5%	-31.4%	-124.7%	-7.0%
Rochford	11.7%	47.7%	17.0%	-6.6%	-47.6%	21.4%	31.7%	-68.0%	-4.3%	-10.7%
Southend	-23.2%	24.0%	12.7%	-32.8%	-122.5%	31.9%	20.6%	-139.4%	-65.4%	-77.4%
Thurrock	19.5%	45.9%	-69.5%	-30.0%	-181.2%	-65.8%	-88.0%	1.3%	4.0%	-1.2%
London	-24.5%	33.6%	-69.6%	-127.3%	-138.0%	-24.9%	-58.1%	-0.6%	0.0%	-1.7%
External	3.8%	31.4%	-92.9%	-16.0%	-12.9%	-56.0%	-66.8%	-2.8%	-1.9%	-0.3%

Table 4. Percentage Change LGV AM

% Change HGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	13.0%	-82.5%	44.7%	9.2%	-51.2%	17.0%	-19.7%	-51.4%	-8.6%	-14.4%
Brentwood	-67.4%	-4.1%	-26.9%	6.6%	44.7%	-21.7%	-43.4%	-165.8%	-86.7%	7.2%
Castle Point	32.7%	-131.1%	3.7%	31.2%	-33.4%	5.9%	20.8%	12.1%	12.9%	18.8%
Chelmsford	20.3%	23.8%	61.9%	3.0%	2.7%	-45.3%	13.9%	19.7%	-0.8%	14.3%
Maldon	21.7%	24.6%	54.0%	15.9%	0.0%	-80.1%	-151.9%	29.4%	12.8%	4.1%
Rochford	28.6%	-10.6%	7.8%	11.1%	-2.6%	13.7%	-1.5%	3.7%	12.1%	7.9%
Southend	13.5%	-78.4%	3.0%	19.1%	-16.5%	17.9%	16.0%	-23.6%	-2.8%	29.0%
Thurrock	-73.4%	-53.6%	56.9%	14.7%	-32.8%	38.8%	25.4%	-11.0%	-2.5%	-2.7%
London	3.7%	14.0%	62.6%	-52.5%	-51.0%	48.5%	38.2%	-3.4%	0.0%	-2.4%
External	-3.2%	12.0%	56.5%	-24.0%	-5.3%	10.5%	47.4%	-3.7%	0.2%	-0.1%

Table 5. Percentage Change HGV AM

% Diff Commute	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	3.8%	-5.8%	-9.3%	3.5%	4.8%	-42.8%	-27.3%	-6.0%	-0.7%	-3.5%
Brentwood	-4.4%	2.4%	-52.2%	5.6%	0.3%	-69.6%	-53.8%	2.3%	5.9%	6.2%
Castle Point	-9.0%	-40.4%	8.2%	-6.6%	3.2%	0.7%	20.7%	-37.7%	-36.6%	-17.1%
Chelmsford	-2.3%	-1.7%	-3.2%	-2.6%	-7.1%	-63.7%	-18.8%	-27.6%	-13.3%	-8.5%
Maldon	5.7%	-8.5%	14.4%	-1.4%	0.0%	-59.8%	-20.3%	-25.4%	-21.6%	-4.7%
Rochford	-19.8%	-74.4%	-0.2%	-64.7%	-79.8%	19.0%	14.5%	-32.8%	-40.4%	-74.7%
Southend	-21.7%	-100.6%	5.5%	-51.4%	-40.3%	18.7%	6.8%	-73.5%	-88.9%	-55.0%
Thurrock	-1.3%	10.5%	-19.4%	-11.9%	-5.5%	-24.6%	-14.2%	-2.1%	0.9%	-0.2%
London	1.5%	0.5%	-30.2%	2.9%	1.1%	-44.2%	-34.2%	-1.4%	0.0%	0.0%
External	-5.4%	0.4%	-4.0%	-2.5%	-6.0%	-57.5%	-26.9%	-2.9%	-1.2%	0.0%

Table 6. Percentage Change Commute IP

% Diff Bussiness	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	5.1%	-9.3%	-5.1%	4.4%	9.6%	-33.2%	-28.5%	2.5%	1.9%	0.3%
Brentwood	-2.5%	5.2%	-42.3%	0.1%	6.3%	-58.1%	-71.6%	2.7%	4.1%	5.0%
Castle Point	-14.2%	-32.8%	8.3%	-2.2%	12.6%	-5.1%	14.9%	-24.4%	-30.6%	-20.2%
Chelmsford	2.2%	-6.0%	-2.5%	-5.3%	-5.8%	-65.6%	-31.4%	-20.6%	-14.6%	-6.4%
Maldon	13.1%	-8.1%	2.1%	-7.0%	0.0%	-64.0%	-30.6%	-16.0%	-18.2%	-1.3%
Rochford	-14.3%	-59.1%	0.6%	-53.4%	-58.0%	29.2%	20.2%	-26.0%	-34.0%	-65.2%
Southend	-28.9%	-86.3%	10.1%	-19.6%	5.9%	20.1%	9.2%	-57.0%	-74.9%	-60.8%
Thurrock	-4.1%	9.5%	-18.8%	-6.2%	-1.7%	-24.3%	-17.4%	-2.4%	0.3%	-0.1%
London	1.2%	0.1%	-29.4%	2.3%	1.1%	-28.8%	-46.3%	-2.2%	0.0%	0.0%
External	-1.1%	2.4%	-8.4%	0.8%	-0.3%	-45.1%	-40.2%	-3.2%	-1.2%	-0.1%

Table 7. Percentage Change Business IP

% Diff Other	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	0.3%	-7.6%	-3.7%	1.2%	2.2%	-38.2%	-31.8%	-5.2%	-0.9%	-2.8%
Brentwood	-5.6%	1.6%	-38.5%	-0.2%	3.5%	-54.1%	-69.7%	3.7%	4.5%	2.6%
Castle Point	-9.3%	-44.0%	6.1%	-5.2%	-3.1%	-3.4%	7.1%	-29.1%	-36.1%	-21.9%
Chelmsford	-1.7%	-3.3%	6.4%	-0.7%	-0.7%	-70.4%	-26.3%	-24.3%	-17.8%	-4.9%
Maldon	10.5%	-3.6%	7.4%	3.3%	0.0%	-63.9%	-34.5%	-26.1%	-22.3%	-1.4%
Rochford	-20.6%	-71.2%	-1.7%	-66.2%	-79.6%	12.1%	13.6%	-30.1%	-32.0%	-61.6%
Southend	-23.6%	-101.8%	6.3%	-41.4%	-27.4%	14.7%	4.4%	-65.7%	-77.7%	-64.4%
Thurrock	-7.3%	8.1%	-16.4%	-7.8%	-10.0%	-18.9%	-20.3%	-1.2%	-0.2%	0.0%
London	0.3%	0.4%	-29.3%	0.6%	-0.4%	-27.9%	-50.9%	-2.2%	0.0%	0.1%
External	-3.8%	1.2%	-9.4%	-1.6%	-0.5%	-44.0%	-44.7%	-2.6%	-0.9%	-0.1%

Table 8. Percentage Change Other IP

% Diff LGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	8.4%	-6.7%	13.0%	5.0%	-12.9%	7.8%	-20.2%	-15.6%	-52.4%	-26.6%
Brentwood	-2.2%	0.9%	26.9%	35.3%	46.3%	35.3%	-1.8%	29.1%	10.0%	19.8%
Castle Point	1.3%	6.1%	4.3%	-4.2%	-20.3%	-4.1%	24.2%	-111.8%	-74.5%	-66.8%
Chelmsford	18.1%	20.2%	21.6%	4.6%	-0.8%	-14.1%	20.9%	-27.1%	-112.0%	-4.6%
Maldon	26.0%	22.0%	11.8%	2.8%	0.0%	-20.7%	-2.5%	-48.0%	-169.4%	-10.9%
Rochford	4.6%	17.0%	-4.2%	-16.8%	-34.6%	20.2%	30.9%	-65.6%	-24.8%	-30.1%
Southend	-6.5%	-14.8%	29.8%	8.3%	-14.4%	32.8%	17.3%	-119.7%	-80.4%	-72.9%
Thurrock	16.3%	13.6%	-70.0%	-18.6%	-59.6%	-50.4%	-120.4%	0.3%	-0.7%	-2.3%
London	-20.3%	21.1%	-22.1%	-71.0%	-95.7%	17.4%	-27.5%	0.3%	0.0%	-1.7%
External	5.8%	19.5%	-21.3%	-5.2%	-9.1%	-13.0%	-70.6%	-1.3%	-2.5%	-0.3%

Table 9. Percentage Change LGV IP

% Diff HGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	-9.5%	-111.7%	18.4%	-27.7%	-84.7%	5.7%	-19.0%	-83.5%	-30.0%	-30.9%
Brentwood	-122.0%	-6.6%	-110.3%	-10.9%	36.8%	-28.0%	-36.6%	-119.5%	-34.0%	0.9%
Castle Point	39.3%	-29.2%	3.3%	65.2%	24.3%	22.4%	2.5%	19.8%	33.1%	53.6%
Chelmsford	22.3%	-15.6%	67.4%	-12.2%	-7.6%	-26.9%	-44.8%	25.9%	-6.2%	7.6%
Maldon	18.9%	1.5%	56.7%	2.5%	0.0%	-68.0%	-93.6%	45.7%	10.4%	2.9%
Rochford	9.2%	-6.6%	19.7%	19.2%	-26.0%	20.6%	22.2%	9.1%	30.3%	23.1%
Southend	-12.3%	-20.1%	-11.7%	51.5%	18.2%	5.5%	10.4%	-17.9%	15.2%	48.1%
Thurrock	-42.5%	-97.3%	29.4%	-20.1%	-52.7%	49.8%	46.5%	-8.7%	-2.9%	-4.4%
London	2.3%	-13.6%	39.7%	-28.5%	-28.3%	51.4%	50.8%	-1.3%	0.0%	-1.6%
External	8.0%	-7.9%	56.2%	-10.4%	-4.0%	26.0%	32.8%	0.8%	-2.0%	-0.2%

Table 10. Percentage Change HGV IP

% Diff Commute	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	-4.6%	-12.5%	-47.8%	3.4%	7.4%	-26.6%	-11.0%	5.4%	2.6%	-4.7%
Brentwood	0.3%	0.5%	-36.6%	8.7%	-1.6%	-20.1%	16.4%	-2.3%	-10.2%	0.6%
Castle Point	-43.9%	-34.4%	0.1%	-32.3%	-28.8%	-1.2%	-7.7%	-62.7%	-29.0%	-65.5%
Chelmsford	-11.9%	-16.1%	-54.0%	-0.8%	-1.6%	-43.4%	-105.2%	16.2%	-17.5%	-12.4%
Maldon	-39.7%	-9.2%	-92.3%	-8.4%	0.0%	-82.0%	-147.5%	9.0%	-16.1%	-6.6%
Rochford	-54.3%	-115.4%	-22.6%	-34.2%	-46.3%	9.0%	0.7%	48.3%	-9.4%	-50.8%
Southend	-12.6%	-42.7%	-5.1%	14.5%	15.7%	9.3%	-2.4%	-57.9%	-2.6%	-7.0%
Thurrock	-11.0%	-1.6%	-42.7%	27.1%	24.3%	28.1%	8.9%	-2.7%	-2.3%	-0.9%
London	1.6%	-0.9%	-35.2%	9.1%	2.8%	0.4%	9.1%	-4.9%	0.0%	0.0%
External	-4.6%	-6.3%	-19.9%	-0.2%	-9.4%	-11.4%	-35.2%	3.2%	-1.4%	0.0%

Table 11. Percentage Change Commute PM

% Diff Bussiness	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	-6.1%	-17.8%	-38.5%	4.8%	8.1%	-17.1%	-15.9%	7.8%	2.7%	-2.0%
Brentwood	3.1%	2.1%	-38.5%	8.7%	5.4%	-10.0%	8.9%	-6.8%	-10.8%	2.0%
Castle Point	-44.1%	-53.0%	2.3%	-11.4%	-7.4%	3.9%	-6.2%	-48.6%	-33.8%	-39.9%
Chelmsford	-13.7%	-8.9%	-62.3%	-3.6%	-5.9%	-53.4%	-76.0%	3.6%	-17.1%	-9.8%
Maldon	-17.9%	-6.7%	-85.8%	1.8%	0.0%	-70.5%	-78.0%	-0.4%	-14.0%	-1.3%
Rochford	-39.0%	-102.5%	-25.2%	-50.0%	-54.2%	19.0%	5.7%	51.0%	-6.2%	-66.6%
Southend	-13.5%	-40.8%	0.7%	10.4%	10.9%	12.5%	-2.4%	-22.4%	-3.2%	-2.6%
Thurrock	-20.9%	1.6%	-63.6%	21.8%	24.4%	18.2%	-24.2%	-2.4%	-2.0%	0.4%
London	-6.4%	0.0%	-48.4%	8.8%	3.1%	-5.3%	4.6%	-4.4%	0.0%	0.0%
External	-4.5%	-3.8%	-26.8%	2.2%	0.1%	-6.1%	-23.2%	1.6%	-1.9%	-0.1%

Table 12. Percentage Change Business PM

% Diff Other	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	-6.5%	-10.9%	-50.1%	3.6%	5.7%	-16.6%	-27.3%	2.5%	-0.8%	-2.3%
Brentwood	-1.1%	0.2%	-19.2%	6.2%	2.4%	-7.0%	12.8%	-7.9%	-11.5%	-0.2%
Castle Point	-48.4%	-67.2%	0.8%	-20.2%	-17.1%	-5.1%	-8.9%	-23.7%	-32.9%	-41.9%
Chelmsford	-11.2%	-8.5%	-66.4%	-1.8%	-4.5%	-48.7%	-143.9%	21.2%	-14.7%	-7.2%
Maldon	-25.6%	-6.1%	-103.0%	-0.7%	0.0%	-67.4%	-171.7%	23.4%	-13.7%	-0.9%
Rochford	-50.2%	-115.3%	-22.9%	-66.4%	-67.3%	4.6%	2.1%	51.0%	10.1%	-43.6%
Southend	-18.6%	-44.7%	-2.0%	11.1%	11.4%	6.6%	-2.3%	-20.3%	-2.4%	0.2%
Thurrock	-29.4%	-0.3%	-40.1%	23.9%	26.0%	20.2%	-23.0%	-0.7%	-2.7%	0.0%
London	-7.9%	1.3%	-31.9%	7.3%	0.9%	-0.3%	4.6%	-4.3%	0.0%	0.0%
External	-7.5%	-4.8%	-28.8%	0.4%	0.1%	-4.9%	-4.1%	2.2%	-1.0%	-0.1%

Table 13. Percentage Change Other PM

% Diff LGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	12.2%	9.3%	44.3%	25.3%	32.8%	40.9%	7.7%	24.5%	-27.9%	-16.2%
Brentwood	30.4%	2.6%	42.7%	51.6%	55.2%	55.7%	17.2%	48.9%	30.4%	25.8%
Castle Point	-21.8%	-105.5%	12.3%	-61.5%	-88.3%	1.2%	27.2%	-118.5%	-166.7%	-166.8%
Chelmsford	25.3%	14.3%	3.3%	9.8%	17.2%	26.1%	-173.2%	3.6%	-108.1%	-13.9%
Maldon	8.2%	18.2%	-12.3%	-1.1%	0.0%	30.6%	-169.3%	-33.9%	-153.1%	-10.9%
Rochford	-16.2%	-22.2%	11.6%	3.3%	5.8%	26.2%	36.8%	-33.9%	-116.2%	-79.0%
Southend	-56.2%	-131.9%	26.3%	-123.1%	-238.9%	27.5%	19.1%	-87.8%	-188.5%	-159.4%
Thurrock	25.2%	22.6%	-17.8%	12.8%	-20.7%	-91.4%	-94.1%	1.5%	1.3%	-3.0%
London	-2.5%	42.3%	0.8%	-53.8%	-104.9%	-12.6%	-51.7%	2.4%	0.1%	-1.8%
External	8.8%	28.2%	-13.7%	3.0%	-6.7%	-30.3%	-88.1%	-1.1%	-1.7%	-0.3%

Table 14. Percentage Change LGV PM

% Diff HGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	8.2%	-87.5%	28.1%	16.3%	8.0%	35.0%	21.4%	-75.9%	-8.4%	-2.2%
Brentwood	-82.2%	-12.0%	-347.2%	-35.7%	-14.2%	-375.6%	-1069.8%	-112.7%	-30.4%	-35.1%
Castle Point	44.2%	-244.5%	-7.0%	-27.5%	-19.2%	-47.3%	-30.7%	13.4%	-22.1%	-28.8%
Chelmsford	41.4%	-41.3%	-51.8%	-4.2%	-0.9%	-120.0%	-341.3%	0.5%	-53.1%	-16.6%
Maldon	24.0%	-24.8%	-154.8%	9.5%	0.0%	-255.9%	-704.9%	-21.8%	-30.8%	-3.2%
Rochford	35.9%	-443.8%	-28.2%	-107.4%	-45.1%	-32.6%	-13.9%	-17.9%	-160.0%	-108.5%
Southend	23.1%	-660.9%	-40.0%	-153.8%	-98.2%	-43.2%	3.4%	-31.5%	-177.4%	-129.7%
Thurrock	-12.3%	-89.6%	26.9%	18.5%	19.3%	-81.2%	-83.6%	-5.6%	-11.9%	-9.9%
London	27.7%	-39.9%	13.6%	-38.8%	-19.3%	-143.5%	-160.6%	-1.9%	0.0%	-1.1%
External	34.4%	-29.5%	-8.3%	-14.2%	-2.4%	-97.6%	-168.9%	-1.2%	-1.5%	-0.1%

Table 15. Percentage Change HGV PM

Appendix M – Absolute Changes Sector-To-Sector

Absolute Change Commute	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	3	-21	-111	-32	-11	-102	-56	-103	-16	-79
Brentwood	-26	44	-8	-11	-3	-17	-17	50	26	-82
Castle Point	-77	18	59	-16	-6	-14	-19	-67	-42	-20
Chelmsford	82	-1	3	-19	-20	-51	2	4	-15	-58
Maldon	16	-3	-1	-9	0	-56	-4	0	-5	-73
Rochford	-180	-16	-9	-33	-31	122	86	-31	-63	-49
Southend	-177	-23	-27	-34	-18	-40	-187	-39	-78	-65
Thurrock	-27	93	-40	-7	-3	-24	-29	-81	-49	-4
London	25	-24	-17	-2	-3	-24	-36	-17	2	-41
External	143	6	-16	0	-24	-77	-26	-6	-41	-9

Table 1: Absolute Change Commute AM

Absolute Change Business	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	39	7	-56	14	-8	-55	-24	-44	8	-44
Brentwood	-18	9	-5	-4	-1	-9	-7	24	6	-24
Castle Point	-7	1	10	-23	-2	0	2	-14	-11	3
Chelmsford	24	0	2	-79	-7	-25	-1	1	-4	-16
Maldon	5	0	-1	2	0	-36	-4	0	-2	-1
Rochford	-46	-3	3	-28	-16	41	30	-9	-19	-17
Southend	-88	-9	-29	-18	-15	8	-38	-21	-52	-50
Thurrock	9	32	-22	-4	-2	-11	-10	-17	-19	1
London	24	1	-10	-3	-1	-14	-32	-22	2	-37
External	86	-3	-7	4	-2	-61	-27	-8	-34	-15

Table 2. Absolute Change Business AM

Absolute Change Other	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	-12	-26	-99	-21	-7	-65	-26	-75	-11	-47
Brentwood	-19	15	-2	-6	-1	-6	-6	29	13	-32
Castle Point	-11	-1	59	-13	-3	-4	-1	-21	-23	-13
Chelmsford	32	3	4	-55	-12	-37	-5	0	-5	-28
Maldon	6	0	1	7	0	-33	-6	0	-5	-3
Rochford	-70	-2	-5	-30	-21	156	17	-11	-28	-27
Southend	-69	-6	-41	-15	-10	-5	-153	-18	-47	-60
Thurrock	-17	37	-14	-3	-1	-7	-4	-26	-34	3
London	9	-23	-12	-4	-1	-16	-20	-31	2	-18
External	66	-9	-11	3	-4	-54	-30	-11	-38	-22

Table 3. Absolute Change Other AM

Absolute Change LGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	77	16	1	29	-2	20	3	0	-12	46
Brentwood	0	8	-1	9	5	1	0	5	10	21
Castle Point	49	2	29	-10	-6	-1	29	-9	-38	-53
Chelmsford	45	20	-2	19	-4	-1	6	2	-8	29
Maldon	5	4	-3	4	0	-3	-1	-2	-21	-12
Rochford	8	4	9	-1	-3	53	55	-4	-4	-9
Southend	-12	2	10	-3	-5	55	145	-8	-56	-95
Thurrock	28	20	-11	-3	-4	-4	-6	8	25	-12
London	-56	62	-63	-13	-22	-18	-52	-4	1	-90
External	17	93	-82	-32	-21	-35	-87	-29	-100	-298

Table 4. Absolute Change LGV AM

Absolute Change HGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	11	-2	8	0	-1	1	-1	-25	-3	-18
Brentwood	-2	-1	0	0	0	0	0	-14	-8	6
Castle Point	5	0	0	0	0	0	2	1	1	4
Chelmsford	1	1	1	0	0	-1	0	1	0	11
Maldon	1	0	0	1	0	0	0	1	0	2
Rochford	2	0	0	0	0	2	0	0	1	2
Southend	1	-1	0	0	0	3	6	-1	0	15
Thurrock	-31	-8	7	1	-1	8	2	-30	-7	-14
London	1	3	7	-7	-1	8	4	-9	0	-54
External	-4	10	21	-13	-2	3	30	-21	3	-69

Table 5. Absolute Change HGV AM

Abs Diff Commute	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	61	-7	-20	3	1	-53	-34	-12	-1	-6
Brentwood	-6	8	-8	2	0	-9	-7	1	11	10
Castle Point	-14	-4	25	-1	0	1	39	-13	-7	-6
Chelmsford	-2	0	-1	-3	-3	-12	-5	-3	-2	-19
Maldon	2	-1	1	-1	0	-11	-3	-1	-2	-10
Rochford	-20	-7	0	-12	-12	57	41	-5	-7	-25
Southend	-23	-8	10	-12	-6	59	104	-16	-17	-21
Thurrock	-2	6	-9	-2	0	-5	-5	-22	2	0
London	2	1	-11	1	0	-12	-12	-4	1	1
External	-11	1	-2	-7	-13	-29	-16	-5	-14	-2

Table 6. Absolute Change Commute IP

Abs Diff Bussiness	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	44	-13	-9	3	3	-39	-39	5	4	1
Brentwood	-3	6	-5	0	0	-6	-7	1	9	10
Castle Point	-21	-4	8	0	1	-3	26	-10	-9	-12
Chelmsford	1	-2	0	-2	-1	-13	-7	-2	-4	-13
Maldon	4	0	0	-2	0	-17	-8	-1	-2	-3
Rochford	-18	-6	0	-13	-16	39	44	-5	-10	-38
Southend	-46	-9	20	-6	2	54	68	-17	-40	-59
Thurrock	-7	6	-7	-1	0	-4	-5	-11	1	0
London	2	0	-7	1	0	-7	-21	-8	1	0
External	-3	5	-6	2	-1	-31	-45	-11	-27	-12

Table 7. Absolute Change Business IP

Abs Diff Other	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	27	-32	-22	4	2	-111	-77	-30	-5	-16
Brentwood	-22	29	-9	0	1	-11	-13	6	35	15
Castle Point	-53	-9	140	-3	-1	-9	42	-41	-35	-36
Chelmsford	-5	-3	4	-8	-1	-58	-17	-7	-15	-51
Maldon	9	-1	2	5	0	-45	-18	-4	-10	-11
Rochford	-65	-14	-5	-53	-50	231	135	-15	-26	-92
Southend	-62	-16	35	-23	-13	145	305	-36	-70	-116
Thurrock	-42	15	-24	-3	-1	-10	-14	-57	-3	0
London	2	3	-31	1	0	-25	-53	-27	5	4
External	-24	7	-19	-16	-4	-82	-110	-24	-59	-36

Table 8. Absolute Change Other IP

Abs Diff LGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	74	-3	12	4	-2	5	-9	-13	-85	-77
Brentwood	-1	1	2	10	5	2	0	8	12	43
Castle Point	1	0	12	-1	-1	-1	19	-12	-57	-59
Chelmsford	17	4	4	8	-1	-2	3	-2	-11	-9
Maldon	7	2	1	2	0	-1	0	-2	-20	-16
Rochford	3	1	-2	-3	-2	42	46	-4	-16	-20
Southend	-3	-1	25	1	-1	50	101	-6	-55	-79
Thurrock	19	3	-9	-2	-2	-3	-6	2	-3	-20
London	-42	28	-24	-9	-16	17	-27	2	-1	-77
External	23	42	-26	-10	-13	-10	-78	-12	-109	-259

Table 9. Absolute Change LGV IP

Abs Diff HGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	-7	-3	2	-1	-1	0	-1	-35	-9	-36
Brentwood	-3	-2	0	0	0	0	0	-12	-5	1
Castle Point	7	0	0	1	0	2	0	1	2	21
Chelmsford	1	-1	1	0	0	-1	0	1	-1	6
Maldon	1	0	0	0	0	0	0	3	0	1
Rochford	1	0	1	1	0	4	4	1	5	8
Southend	-1	0	-1	1	0	1	4	-1	1	35
Thurrock	-23	-12	2	-1	-1	13	5	-25	-8	-23
London	1	-2	3	-5	-1	10	7	-4	0	-36
External	12	-5	22	-7	-1	9	17	5	-45	-110

Table 10. Absolute Change HGV IP

Abs Diff Commute	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	-218	-44	-306	11	10	-118	-50	43	13	-28
Brentwood	1	6	-82	10	-1	-17	17	-9	-80	3
Castle Point	-123	-7	1	-11	-4	-3	-33	-48	-18	-37
Chelmsford	-24	-9	-24	-3	-2	-31	-45	7	-10	-75
Maldon	-18	-2	-11	-9	0	-43	-28	1	-4	-42
Rochford	-86	-21	-52	-24	-28	78	5	29	-5	-43
Southend	-32	-13	-28	14	9	87	-105	-4	-2	-6
Thurrock	-49	-3	-60	19	6	28	3	-90	-23	-6
London	12	-8	-110	15	2	1	19	-67	3	-3
External	-30	-32	-41	-2	-66	-31	-72	20	-73	-12

Table 11. Absolute Change Commute PM

Abs Diff Bussiness	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	-68	-32	-75	5	3	-28	-28	24	7	-7
Brentwood	5	3	-10	3	1	-3	3	-11	-32	5
Castle Point	-62	-7	3	-2	-1	3	-11	-25	-13	-22
Chelmsford	-10	-3	-9	-2	-2	-15	-17	1	-6	-24
Maldon	-5	-1	-7	1	0	-26	-22	0	-3	-4
Rochford	-45	-12	-17	-19	-25	32	15	20	-3	-48
Southend	-23	-7	2	4	4	38	-20	-1	-3	-3
Thurrock	-35	2	-22	4	3	5	-3	-14	-12	1
London	-13	0	-20	5	1	-2	4	-21	2	1
External	-15	-10	-23	7	0	-8	-32	7	-62	-27

Table 12. Absolute Change Business PM

Abs Diff Other	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	-608	-51	-249	15	5	-52	-51	18	-4	-14
Brentwood	-5	4	-8	8	1	-3	5	-25	-86	-1
Castle Point	-211	-12	21	-10	-3	-16	-48	-35	-34	-59
Chelmsford	-39	-9	-28	-22	-9	-52	-46	9	-13	-84
Maldon	-15	-1	-10	-1	0	-45	-35	4	-7	-7
Rochford	-109	-18	-60	-62	-46	98	21	37	10	-68
Southend	-35	-8	-12	7	5	68	-170	-2	-2	0
Thurrock	-159	-1	-52	12	5	13	-5	-37	-35	0
London	-41	11	-47	9	1	0	7	-58	4	1
External	-45	-29	-57	5	1	-13	-11	21	-65	-59

Table 13. Absolute Change Other PM

Abs Diff LGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	97	5	61	22	8	43	5	28	-47	-44
Brentwood	21	3	4	16	6	7	2	17	40	52
Castle Point	-14	-3	34	-5	-3	0	19	-11	-77	-82
Chelmsford	25	3	0	16	12	6	-7	0	-9	-21
Maldon	2	1	-1	-1	0	3	-4	-1	-17	-14
Rochford	-10	-1	4	1	0	51	51	-2	-48	-35
Southend	-26	-5	18	-6	-5	33	99	-5	-87	-106
Thurrock	29	5	-3	1	-1	-4	-5	7	6	-24
London	-5	67	1	-6	-14	-10	-45	12	2	-69
External	33	60	-16	5	-9	-18	-79	-10	-67	-237

Table 14. Absolute Change LGV PM

Abs Diff HGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	3	-1	3	0	0	5	3	-16	-2	-2
Brentwood	-1	-1	0	-1	0	0	-1	-6	-2	-10
Castle Point	8	0	0	0	0	-1	-1	0	0	-2
Chelmsford	1	-1	0	0	0	-1	0	0	-3	-5
Maldon	0	0	0	0	0	0	0	0	0	-1
Rochford	6	0	-1	-1	0	-2	-1	-1	-5	-8
Southend	3	-1	-1	0	0	-2	1	-1	-3	-12
Thurrock	-4	-6	1	0	0	-3	-1	-8	-15	-24
London	6	-2	0	-3	0	-4	-3	-3	0	-12
External	37	-8	-1	-4	0	-8	-14	-3	-17	-39

Table 15. Absolute Change HGV PM

Appendix N – Matrix Changes - GEH Values Sector-to-Sector

GEH Commute	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	0.0	0.8	5.2	2.0	1.4	6.0	3.0	4.5	0.6	2.9
Brentwood	1.2	1.2	1.8	1.3	0.7	3.2	2.6	3.6	0.9	3.4
Castle Point	2.4	1.6	1.8	1.9	1.2	0.7	0.7	4.6	2.6	1.3
Chelmsford	3.9	0.0	0.3	0.9	1.7	5.4	0.1	0.5	1.2	1.6
Maldon	1.3	0.4	0.2	0.7	0.0	6.4	0.4	0.0	0.6	2.5
Rochford	6.6	1.6	0.5	3.1	3.1	3.8	2.6	3.2	4.7	2.7
Southend	7.3	2.9	1.1	3.7	2.6	1.4	2.6	3.6	5.6	4.0
Thurrock	0.9	5.2	3.5	1.1	0.8	3.1	2.5	1.3	1.2	0.1
London	1.0	0.8	2.2	0.3	0.5	3.3	3.3	0.5	0.0	0.6
External	4.9	0.2	1.6	0.0	0.9	7.2	1.9	0.2	0.5	0.0

Table 1: GEH Change Commute AM

GEH Business	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	1.2	0.4	3.9	1.2	1.5	4.2	1.7	3.1	0.5	2.4
Brentwood	1.3	0.7	1.2	0.6	0.4	2.3	1.7	2.6	0.4	1.5
Castle Point	0.4	0.3	0.9	3.3	0.5	0.0	0.1	1.8	1.4	0.2
Chelmsford	2.2	0.0	0.3	6.1	1.1	3.6	0.2	0.2	0.5	0.9
Maldon	0.8	0.0	0.2	0.2	0.0	4.7	0.5	0.1	0.3	0.1
Rochford	3.1	0.6	0.3	3.7	2.1	3.2	1.9	1.7	2.4	1.4
Southend	5.5	1.8	2.0	2.6	2.1	0.5	1.3	2.9	4.8	3.7
Thurrock	0.5	2.9	2.6	0.8	0.5	1.9	1.3	0.7	0.8	0.1
London	1.4	0.0	1.6	0.5	0.2	2.2	2.9	0.8	0.0	0.6
External	4.0	0.2	0.8	0.2	0.1	5.8	1.9	0.4	0.6	0.1

Table 2. GEH Change Business AM

GEH Other	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	0.1	1.3	5.7	1.4	1.2	4.9	2.2	4.3	0.5	2.3
Brentwood	1.2	0.3	0.7	0.9	0.4	1.8	1.5	2.7	0.5	1.6
Castle Point	0.5	0.2	1.2	1.9	0.8	0.3	0.1	2.0	2.0	1.1
Chelmsford	2.0	0.3	0.7	1.6	1.1	4.7	0.8	0.1	0.5	1.0
Maldon	0.9	0.1	0.2	0.6	0.0	4.6	1.0	0.1	0.7	0.1
Rochford	4.3	0.5	0.4	3.2	2.8	3.5	0.7	1.8	2.8	2.1
Southend	5.1	1.5	2.4	2.4	1.9	0.2	2.4	2.6	4.3	4.4
Thurrock	0.9	3.0	1.6	0.6	0.5	1.4	0.6	0.5	1.0	0.1
London	0.4	0.9	1.5	0.5	0.2	2.2	2.2	1.0	0.0	0.3
External	3.1	0.4	1.0	0.1	0.2	5.2	2.3	0.4	0.5	0.1

Table 3. GEH Change Other AM

GEH LGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	2.5	1.9	0.1	2.8	0.4	2.3	0.4	0.0	0.7	2.2
Brentwood	0.0	0.7	0.3	1.8	1.6	0.3	0.1	1.1	0.9	1.5
Castle Point	4.5	0.6	1.6	2.8	2.6	0.2	3.2	2.0	3.3	4.4
Chelmsford	4.3	3.7	0.5	1.3	0.5	0.2	1.5	0.5	1.8	1.8
Maldon	1.1	1.4	1.1	0.5	0.0	0.9	0.4	0.6	4.0	0.9
Rochford	1.0	1.7	1.3	0.3	1.1	3.6	4.5	1.5	0.4	1.0
Southend	1.6	0.8	1.2	1.0	1.9	4.6	5.8	2.5	5.3	7.3
Thurrock	2.5	3.5	2.4	0.9	2.0	1.5	2.0	0.3	1.0	0.4
London	3.5	5.0	5.7	3.2	4.2	2.0	4.9	0.2	0.0	1.2
External	0.8	5.9	7.2	2.2	1.6	3.9	6.6	0.9	1.4	0.9

Table 4. GEH Change LGV AM

GEH HGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	1.2	1.1	2.2	0.2	0.6	0.5	0.4	3.2	0.5	1.6
Brentwood	1.0	0.2	0.2	0.1	0.5	0.2	0.4	3.5	2.2	0.7
Castle Point	1.4	0.6	0.0	0.3	0.1	0.2	0.6	0.3	0.3	0.9
Chelmsford	0.5	0.6	0.9	0.1	0.1	0.5	0.2	0.4	0.0	1.3
Maldon	0.4	0.2	0.4	0.4	0.0	0.4	0.5	0.7	0.2	0.3
Rochford	0.9	0.1	0.2	0.2	0.0	0.6	0.1	0.1	0.4	0.4
Southend	0.4	0.6	0.1	0.3	0.1	0.8	1.0	0.5	0.1	2.2
Thurrock	4.1	1.9	2.3	0.3	0.5	2.0	0.8	1.8	0.4	0.6
London	0.2	0.6	2.6	1.7	0.6	2.3	1.4	0.6	0.0	1.1
External	0.4	1.1	4.1	1.7	0.3	0.6	4.3	0.9	0.1	0.3

Table 5. GEH Change HGV AM

GEH Commute	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	1.5	0.6	1.3	0.3	0.3	4.3	2.9	0.8	0.1	0.5
Brentwood	0.5	0.4	1.8	0.3	0.0	2.1	1.7	0.2	0.8	0.8
Castle Point	1.1	1.1	1.5	0.3	0.1	0.1	3.0	2.1	1.5	1.0
Chelmsford	0.2	0.1	0.1	0.3	0.4	2.5	0.9	0.8	0.5	1.3
Maldon	0.3	0.2	0.4	0.1	0.0	2.2	0.7	0.5	0.6	0.7
Rochford	1.9	1.9	0.0	2.4	2.6	3.5	2.5	1.2	1.5	3.7
Southend	2.1	2.3	0.7	2.2	1.4	3.5	2.7	2.9	3.2	3.0
Thurrock	0.2	0.8	1.3	0.4	0.1	1.0	0.8	0.7	0.1	0.0
London	0.2	0.1	1.7	0.2	0.0	2.1	1.9	0.2	0.0	0.0
External	0.7	0.1	0.3	0.4	0.9	3.6	1.9	0.4	0.4	0.0

Table 6. GEH Change Commute IP

GEH Bussiness	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	1.5	1.1	0.7	0.4	0.5	3.3	3.1	0.3	0.3	0.0
Brentwood	0.3	0.6	1.3	0.0	0.2	1.6	1.9	0.2	0.6	0.7
Castle Point	1.7	1.1	0.8	0.1	0.4	0.4	2.0	1.5	1.6	1.5
Chelmsford	0.2	0.3	0.1	0.3	0.3	2.6	1.4	0.6	0.7	0.9
Maldon	0.8	0.2	0.1	0.3	0.0	2.9	1.4	0.4	0.6	0.2
Rochford	1.6	1.7	0.0	2.3	2.7	3.7	3.1	1.1	1.7	4.3
Southend	3.4	2.4	1.5	1.0	0.4	3.5	2.6	2.7	4.6	5.2
Thurrock	0.5	0.8	1.1	0.2	0.0	1.0	0.9	0.5	0.1	0.0
London	0.2	0.0	1.3	0.1	0.0	1.3	2.8	0.4	0.0	0.0
External	0.2	0.4	0.7	0.1	0.0	3.4	3.9	0.6	0.6	0.1

Table 7. GEH Change Business IP

GEH Other	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	0.3	1.5	0.9	0.2	0.2	6.0	4.6	1.2	0.2	0.7
Brentwood	1.1	0.7	1.7	0.0	0.2	2.2	2.6	0.5	1.3	0.6
Castle Point	2.2	1.8	3.0	0.4	0.1	0.6	1.8	3.2	3.3	2.7
Chelmsford	0.3	0.3	0.5	0.2	0.1	5.5	2.0	1.3	1.6	1.6
Maldon	1.0	0.2	0.4	0.4	0.0	4.7	2.3	0.9	1.4	0.4
Rochford	3.5	2.7	0.3	5.2	5.3	5.4	4.4	2.0	2.7	6.6
Southend	3.6	3.3	1.5	2.8	1.8	4.8	3.7	4.2	6.2	7.5
Thurrock	1.7	1.1	1.9	0.4	0.4	1.3	1.6	0.8	0.1	0.0
London	0.1	0.1	2.8	0.1	0.0	2.5	4.7	0.8	0.0	0.0
External	0.9	0.3	1.3	0.5	0.1	5.4	6.3	0.8	0.7	0.1

Table 8. GEH Change Other IP

GEH LGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	2.5	0.5	1.3	0.5	0.5	0.6	1.3	1.4	5.9	4.3
Brentwood	0.2	0.1	0.8	2.0	1.7	1.0	0.0	1.7	1.1	3.1
Castle Point	0.1	0.2	0.7	0.2	0.5	0.2	2.3	2.9	5.6	5.4
Chelmsford	1.8	1.0	1.0	0.6	0.1	0.5	0.9	0.8	2.8	0.6
Maldon	1.4	0.6	0.3	0.2	0.0	0.5	0.1	0.8	4.3	1.3
Rochford	0.4	0.4	0.2	0.6	0.8	3.1	4.1	1.4	1.9	2.3
Southend	0.5	0.3	3.0	0.3	0.4	4.4	4.4	2.2	5.6	6.5
Thurrock	1.9	0.7	2.2	0.5	1.0	1.1	2.2	0.1	0.2	0.7
London	2.8	2.6	2.2	2.1	3.2	1.8	2.5	0.1	0.0	1.1
External	1.2	3.0	2.2	0.7	1.1	1.1	6.4	0.4	1.6	0.8

Table 9. GEH Change LGV IP

GEH HGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	0.8	1.4	0.7	0.5	0.9	0.2	0.4	4.5	1.5	3.1
Brentwood	1.4	0.3	0.5	0.2	0.4	0.2	0.3	3.0	1.1	0.1
Castle Point	1.8	0.2	0.0	1.1	0.1	0.7	0.1	0.6	0.9	3.9
Chelmsford	0.5	0.3	1.1	0.2	0.2	0.4	0.4	0.6	0.3	0.7
Maldon	0.4	0.0	0.5	0.1	0.0	0.4	0.4	1.3	0.2	0.2
Rochford	0.2	0.1	0.6	0.3	0.2	1.0	1.0	0.3	1.3	1.4
Southend	0.3	0.2	0.3	1.0	0.1	0.2	0.7	0.4	0.4	4.7
Thurrock	2.8	2.8	0.9	0.3	0.8	3.0	1.8	1.4	0.5	1.0
London	0.1	0.5	1.2	1.1	0.4	2.6	2.1	0.2	0.0	0.7
External	1.0	0.6	4.1	0.8	0.2	1.7	2.6	0.2	0.9	0.4

Table 10. GEH Change HGV IP

GEH Commute	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	3.1	2.3	10.9	0.6	0.9	5.3	2.3	1.6	0.6	1.1
Brentwood	0.1	0.2	5.0	1.0	0.1	1.7	1.7	0.4	2.8	0.1
Castle Point	6.7	1.5	0.0	1.7	1.0	0.2	1.6	4.8	2.1	4.3
Chelmsford	1.6	1.2	3.2	0.1	0.2	3.3	5.6	1.1	1.3	3.0
Maldon	2.4	0.4	2.7	0.8	0.0	5.0	4.9	0.3	0.8	1.6
Rochford	6.1	3.9	3.3	2.6	3.2	2.7	0.2	4.3	0.7	4.2
Southend	2.0	2.2	1.2	1.5	1.2	2.9	1.6	1.3	0.2	0.7
Thurrock	2.2	0.2	4.6	2.4	1.3	3.0	0.5	1.6	0.7	0.2
London	0.4	0.3	5.7	1.2	0.2	0.1	1.3	1.8	0.0	0.0
External	1.2	1.4	2.7	0.1	2.4	1.8	4.6	0.8	1.0	0.1

Table 11. GEH Change Commute PM

GEH Bussiness	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	2.0	2.3	4.9	0.5	0.5	2.1	2.0	1.4	0.5	0.4
Brentwood	0.4	0.3	1.8	0.6	0.2	0.5	0.5	0.9	1.8	0.3
Castle Point	4.7	1.7	0.3	0.5	0.2	0.4	0.8	3.1	2.0	2.7
Chelmsford	1.1	0.5	2.1	0.3	0.3	2.5	3.1	0.2	1.0	1.5
Maldon	0.9	0.2	2.0	0.1	0.0	3.7	3.5	0.0	0.6	0.2
Rochford	3.8	2.8	2.0	2.7	3.3	2.6	0.9	3.7	0.4	4.9
Southend	1.7	1.6	0.1	0.7	0.7	2.3	0.7	0.5	0.3	0.3
Thurrock	2.6	0.2	3.3	1.0	0.9	1.0	0.8	0.6	0.5	0.1
London	0.9	0.0	2.8	0.7	0.1	0.4	0.4	1.0	0.0	0.0
External	0.8	0.6	2.3	0.4	0.0	0.7	2.6	0.3	1.1	0.2

Table 12. GEH Change Business PM

GEH Other	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	6.2	2.3	10.0	0.7	0.5	2.8	3.5	0.7	0.2	0.6
Brentwood	0.2	0.1	1.2	0.7	0.1	0.4	0.8	1.4	3.0	0.0
Castle Point	9.1	2.5	0.4	1.4	0.6	0.9	2.0	2.7	3.1	4.5
Chelmsford	2.0	0.9	3.8	0.6	0.6	4.5	6.2	1.5	1.3	2.4
Maldon	1.8	0.3	2.7	0.1	0.0	4.7	5.7	1.1	0.9	0.3
Rochford	6.6	3.7	3.5	5.5	4.8	2.1	0.7	5.0	1.0	4.9
Southend	2.4	1.8	0.5	0.9	0.8	2.2	2.0	0.6	0.2	0.0
Thurrock	6.4	0.1	4.2	1.8	1.3	1.7	1.0	0.5	1.0	0.0
London	1.8	0.4	3.6	0.8	0.1	0.0	0.6	1.6	0.0	0.0
External	1.8	1.2	3.8	0.1	0.0	0.8	0.7	0.7	0.8	0.2

Table 13. GEH Change Other PM

GEH LGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	3.5	0.7	5.9	2.5	1.8	4.7	0.6	2.8	3.4	2.6
Brentwood	2.7	0.3	1.5	3.4	2.2	2.4	0.6	3.3	3.8	3.9
Castle Point	1.7	1.4	2.1	1.5	1.3	0.1	2.5	2.8	8.4	8.6
Chelmsford	2.7	0.6	0.1	1.3	1.5	1.3	2.5	0.1	2.6	1.6
Maldon	0.4	0.5	0.3	0.1	0.0	1.1	1.9	0.6	3.8	1.2
Rochford	1.2	0.4	0.7	0.1	0.2	3.9	4.8	0.8	6.0	4.4
Southend	3.4	1.9	2.4	2.1	2.2	3.3	4.6	1.7	9.2	9.7
Thurrock	2.9	1.1	0.7	0.4	0.4	1.6	1.8	0.3	0.3	0.8
London	0.4	6.0	0.1	1.6	3.1	1.1	4.3	0.5	0.0	1.1
External	1.7	4.4	1.4	0.4	0.8	2.2	7.0	0.3	1.1	0.8

Table 14. GEH Change LGV PM

GEH HGV	Basildon	Brentwood	Castle Point	Chelmsford	Maldon	Rochford	Southend	Thurrock	London	External
Basildon	0.5	0.8	0.9	0.3	0.1	1.5	0.8	3.0	0.3	0.2
Brentwood	0.8	0.4	0.6	0.4	0.1	0.8	1.1	2.1	0.7	1.7
Castle Point	2.1	0.5	0.1	0.1	0.1	0.7	0.4	0.3	0.3	0.7
Chelmsford	0.9	0.5	0.2	0.1	0.0	0.7	0.8	0.0	1.1	0.9
Maldon	0.3	0.1	0.2	0.2	0.0	0.6	0.5	0.2	0.3	0.1
Rochford	1.6	0.8	0.4	0.6	0.2	0.7	0.3	0.4	2.0	2.3
Southend	0.9	1.0	0.5	0.6	0.3	0.9	0.1	0.5	1.6	3.1
Thurrock	0.7	1.9	0.6	0.3	0.3	1.3	0.9	0.7	1.3	1.5
London	1.4	0.9	0.2	1.0	0.2	1.9	1.7	0.2	0.0	0.4
External	3.9	1.5	0.2	0.8	0.1	2.3	3.6	0.2	0.5	0.2

Table 15. GEH Change HGV PM

Appendix O – Calibration Count Summary

AM

Screenline	ID	BOUND	DIR	AM Count Data Car	LGV	HGV	Total	AM Model Data Car	LGV	HGV	Total	Absolute differences Car	LGV	HGV	Total	%age Difference Car	LGV	HGV	Total	GEH or Criteria 1 Car	LGV	HGV	Total
Cal_11	C1.9_EB	E	2	111	10	6	127	86	3	2	91	-25	-7	-4	-36	-22%	-69%	-73%	-28%	Pass	Pass	Pass	Pass
Cal_11	C1.9_WB	W	1	68	7	7	82	59	3	1	63	-9	-4	-6	-19	-13%	-61%	-85%	-23%	Pass	Pass	Pass	Pass
Cal_11	C1.7_EB	E	2	173	24	3	200	165	20	1	186	-8	-4	-2	-14	-5%	-18%	-57%	-7%	Pass	Pass	Pass	Pass
Cal_11	C1.7_WB	W	1	223	25	5	253	201	21	2	224	-22	-4	-3	-29	-10%	-17%	-64%	-12%	Pass	Pass	Pass	Pass
Cal_8	C11.2_EB	E	2	562	69	21	652	558	72	22	652	-4	3	1	-0	-1%	4%	5%	0%	Pass	Pass	Pass	Pass
Cal_5	C5.1_NB	N	2	728	126	36	890	829	146	36	1011	101	20	-0	121	14%	16%	-1%	14%	Pass	Pass	Pass	Pass
Cal_5	C5.1_SB	S	1	865	160	27	1052	945	154	24	1123	80	-6	-3	71	9%	-4%	-13%	7%	Pass	Pass	Pass	Pass
	C7.2_NEB	NE		2362	188	244	2794	2385	245	293	2923	23	57	49	129	1%	30%	20%	5%	Pass	Pass	Pass	Pass
	C8.2_SWB	SW		2503	268	379	3150	2688	297	429	3414	185	29	50	264	7%	11%	13%	8%	Pass	Pass	Pass	Pass
Cal_4	C7.8_EB	E	1	842	111	12	965	792	121	21	935	-50	10	9	-30	-6%	9%	79%	-3%	Pass	Pass	Pass	Pass
Cal_4	C7.8_WB	W	2	509	78	12	599	563	124	15	702	54	46	3	103	11%	59%	26%	17%	Pass	Pass	Pass	Pass
Cal_2	C8.11_SB	S	1	197	23	4	224	217	19	9	245	20	-4	5	21	10%	-17%	125%	10%	Pass	Pass	Pass	Pass
	V13.8_NWB	NW		1193	145	5	1343	1142	132	17	1292	-51	-13	12	-51	-4%	-9%	245%	-4%	Pass	Pass	Pass	Pass
	V13.8_SEB	SE		615	75	3	693	733	78	15	825	118	3	12	132	19%	4%	387%	19%	Pass	Pass	Pass	Pass
Cal_6	C12.1_SWB	SW	2	1815	575	149	2539	2086	585	154	2825	271	10	5	286	15%	2%	3%	11%	Pass	Pass	Pass	Pass
Cal_6	C12.1_NEB	NE	1	1655	397	149	2201	1897	403	162	2462	242	6	13	261	15%	2%	9%	12%	Pass	Pass	Pass	Pass
Cal_8	C11.2_WB	W	1	1200	113	21	1334	1120	109	23	1253	-80	-4	2	-81	-7%	-3%	11%	-6%	Pass	Pass	Pass	Pass
Cal_7	C14.1_NB	N	1	1776	247	60	2083	1531	210	55	1796	-245	-37	-5	-287	-14%	-15%	-9%	-14%	Pass	Pass	Pass	Pass
Cal_8	C11.4_NEB	NE	2	2099	268	162	2529	2106	309	147	2562	7	41	-15	33	0%	15%	-9%	1%	Pass	Pass	Pass	Pass
Cal_6	C12.8_SB	S	2	448	99	33	580	613	109	36	758	165	10	3	178	37%	10%	10%	31%	Fail	Pass	Pass	Fail
Cal_6	C12.8_NB	N	1	1278	193	26	1497	1325	208	20	1553	47	15	-6	56	4%	8%	-22%	4%	Pass	Pass	Pass	Pass
Cal_5	C5.20_NB	0	2	1894	255	121	2270	1678	225	89	1992	-216	-30	-32	-278	-11%	-12%	-26%	-12%	Pass	Pass	Pass	Pass
Cal_9	C9.3_WB	W	1	3120	352	110	3582	3020	339	112	3472	-100	-13	2	-110	-3%	-4%	2%	-3%	Pass	Pass	Pass	Pass
Cal_9	C9.3_EB	E	2	2534	419	138	3091	2547	409	136	3092	13	-10	-2	1	1%	-2%	-1%	0%	Pass	Pass	Pass	Pass
Cal_10	C2.6_WB	W	2	401	36	1	438	444	30	0	474	43	-6	-1	36	11%	-16%	-100%	8%	Pass	Pass	Pass	Pass
Cal_10	C2.6_EB	E	1	287	41	1	329	269	50	0	318	-18	9	-1	-11	-6%	22%	-100%	-3%	Pass	Pass	Pass	Pass
Cal_10	C2.5_WB	W	1	1074	127	62	1263	1034	152	58	1243	-40	25	-4	-20	-4%	19%	-7%	-2%	Pass	Pass	Pass	Pass
Cal_8	C11.4_SWB	SW	1	2654	364	139	3157	2695	462	135	3292	41	98	-4	135	2%	27%	-3%	4%	Pass	Pass	Pass	Pass
Cal_2	C8.5_WB	W	2	194	29	2	225	159	26	1	186	-35	-3	-1	-39	-18%	-10%	-37%	-17%	Pass	Pass	Pass	Pass
Cal_2	C8.5_EB	E	1	103	25	4	132	98	26	2	126	-5	1	-2	-6	-5%	5%	-46%	-4%	Pass	Pass	Pass	Pass
Cal_5	C5.11_SEB	SE	1	457	56	9	522	433	66	8	507	-24	10	-1	-15	-5%	18%	-13%	-3%	Pass	Pass	Pass	Pass
Cal_5	C5.11_NWB	NW	2	546	58	2	606	569	46	7	622	23	-12	5	16	4%	-20%	231%	3%	Pass	Pass	Pass	Pass
Cal_2	C8.1_NB	N	2	2259	328	107	2694	1943	285	94	2322	-316	-43	-13	-372	-14%	-13%	-12%	-14%	Pass	Pass	Pass	Pass
Cal_2	C8.14_NB	N	2	113	12	2	127	128	22	1	150	15	10	-1	23	13%	82%	-67%	18%	Pass	Pass	Pass	Pass
Cal_2	C8.14_SB	S	1	200	15	2	217	197	27	4	228	-3	12	2	11	-1%	77%	111%	5%	Pass	Pass	Pass	Pass
Cal_2	C8.19_WB	W	2	439	45	7	491	438	58	15	511	-1	13	8	20	0%	30%	110%	4%	Pass	Pass	Pass	Pass
Cal_2	C8.19_EB	E	1	397	65	7	469	430	64	10	503	33	-1	3	34	8%	-2%	45%	7%	Pass	Pass	Pass	Pass
	V3.1_EB	E		1865	550	174	2589	2119	499	159	2777	254	-51	-15	188	14%	-9%	-9%	7%	Pass	Pass	Pass	Pass
	19324-01 . A130 (Sadlers Farm) (SW) _southwestbound	0		2312	374	145	2831	2181	338	111	2630	-131	-36	-34	-201	-6%	-10%	-23%	-7%	Pass	Pass	Pass	Pass
	V3.1_WB	W		3202	760	125	4087	3230	615	122	3967	28	-145	-3	-120	1%	-19%	-3%	-3%	Pass	Fail	Pass	Pass
Cal_3	C7.10_SB	S	2	209	20	7	236	189	21	32	242	-20	1	25	6	-10%	4%	354%	2%	Pass	Pass	Pass	Pass
Cal_3	C7.10_NB	N	1	433	54	7	494	428	52	19	500	-5	-2	12	6	-1%	-3%	169%	1%	Pass	Pass	Pass	Pass
Cal_3	C7.12_NB	N	1	38	6	10	54	37	6	6	49	-1	-0	-4	-5	-4%	-2%	-39%	-10%	Pass	Pass	Pass	Pass
Cal_3	C7.12_SB	S	2	28	2	8	38	32	4	5	41	4	2	-3	3	15%	114%	-38%	9%	Pass	Pass	Pass	Pass
Cal_7	C14.6_NB	N	1	140	12	7	159	124	12	3	138	-16	-0	-4	-21	-12%	-3%	-60%	-13%	Pass	Pass	Pass	Pass
Cal_7	C14.6_SB	S	2	7	4	15	26	4	10	3	18	-3	6	-12	-8	-39%	162%	-80%	-32%	Pass	Pass	Pass	Pass
	20110-03 Burches Basildon_E	0		690	61	8	759	607	54	10	671	-83	-7	2	-88	-12%	-11%	30%	-12%	Pass	Pass	Pass	Pass
	20110-03 Burches Basildon_W	0		311	46	6	363	258	41	9	308	-53	-5	3	-55	-17%	-11%	56%	-15%	Pass	Pass	Pass	Pass
Cal_6	C12.5_SB	S	2	399	58	5	462	425	55	0	480	26	-3	-5	18	6%	-4%	-100%	4%	Pass	Pass	Pass	Pass
Cal_6	C12.5_NB	N	1	617	98	8	723	627	96	0	724	10	-2	-8	1	2%	-2%	-100%	0%	Pass	Pass	Pass	Pass
Cal_6	C12.4_NB	N	1	699	100	61	860	608	88	57	753	-91	-12	-4	-107	-13%	-12%	-7%	-12%	Pass	Pass	Pass	Pass
Cal_6	C12.4_SB	S	2	497	81	52	630	408	66	49	523	-89	-15	-3	-107	-18%	-18%	-6%	-17%	Pass	Pass	Pass	Pass
Cal_10	C2.7_WB	W	1	263	25	1	289	270	21	0	292	7	-4	-1	3	3%	-16%	-50%	1%	Pass	Pass	Pass	Pass
Cal_10	C2.7_EB	E	2	347	27	1	375	362	25	1	389	15	-2	0	14	4%	-6%	22%	4%	Pass	Pass	Pass	Pass
Cal_6	C12.10_SB	S	2	351	43	12	406	321	40	0	361	-30	-3	-12	-45	-9%	-7%	-100%	-11%	Pass	Pass	Pass	Pass
Cal_6	C12.10_NB	N	1	657	49	5	711	726	45	0	771	69	-4	-5	60	10%	-8%	-100%	8%	Pass	Pass	Pass	Pass
Cal_6	C12.2_WB	W	2	637	71	5	713	635	70	6	710	-2	-1	1	-3	0%	-1%	12%	0%	Pass	Pass	Pass	Pass
Cal_6	C12.2_EB	E	1	864	74	6	944	866	72	7	945	2	-2	1	1	0%	-3%	18%	0%	Pass	Pass	Pass	Pass
Cal_5	C5.9_NB	N	2	815	81	11	907	795	43	29	867	-20	-38	18	-40	-2%	-47%	166%	-4%	Pass	Pass	Pass	Pass
Cal_5	C5.9_SB	S	1	645	80	19	744	645	91	23	759	0	11	4	15	0%	14%	19%	2%	Pass	Pass	Pass	Pass
Cal_2	C8.15_SB	S	1	262	57	9	328	312	75	4	390	50	18	-5	62	19%	31%	-60%	19%	Pass	Pass	Pass	Pass
Cal_2	C8.15_NB	N	2	380	57	9	446	414	65	14	494	34	8	5	48	9%	15%	57%	11%	Pass	Pass	Pass	Pass
Cal_11	C1.5_WB	W	1	497	30	2	529	479	31	4	514	-18	1	2	-15	-4%	3%	107%	-3%	Pass	Pass	Pass	Pass
Cal_11	C1.5_EB	E	2	325	33	10	368	335	43	7	385	10	10	-3	17	3%	31%	-30%	5%	Pass	Pass	Pass	Pass
Cal_5	C5.8_NB	N	2	371	54	12	437	360	47	8	415	-11	-7	-4	-22	-3%	-14%	-36%	-5%	Pass	Pass	Pass	Pass
Cal_5	C5.8_SB	S	1	420	47	13	480	458	38	7	503	38	-9	-6	23	9%	-20%	-46%	5%	Pass	Pass	Pass	Pass
Cal_5	C5.13_NB	N	2	733	52	10	795	751	56	8	815	18	4	-2	20	2%	8%	-22%	2%	Pass	Pass	Pass	Pass
Cal_5	C5.13_SB	S	1	569	62	3	634	582	74	9	666	13	12	6	32	2%	20%	209%	5%	Pass	Pass	Pass	Pass
Cal_5	C5.14_NEB	NE	2	340	33	4	377	276	23	0	299	-64	-10	-4	-78	-19%	-29%	-100%	-21%	Pass	Pass	Pass	Pass
Cal_5	C5.14_SWB	SW	1	409	24	2	435	355	7	0	362	-54	-17	-2	-73	-13%	-70%	-100%	-17%	Pass	Pass	Pass	Pass
Cal_2	C8.7_NB	N	2	85	13	1	99	80	11	1	92	-5	-2	0	-7	-6%	-16%	38%	-7%	Pass	Pass	Pass	Pass
Cal_2	C8.7_SB	S	1	292	26	1	319	220	24	1	245	-72	-2	-0	-74	-25%	-9%	-28%	-23%	Pass	Pass	Pass	Pass
Cal_3	C7.9_NEB	NE	1	1028	72	9	1109	896	64	17	978	-132	-8	8	-131	-13%	-11%	93%	-12%	Pass	Pass	Pass	Pass
Cal_3	C7.9_SWB	SW	2	592	54	5	651	584	49	13	647	-8	-5	8	-4	-1%	-9%	163%	-1%	Pass	Pass	Pass	Pass
Cal_10	C2.5_EB	E	2	1655	170	83	1908	1635	186	79	1900	-20	16	-4	-8	-1%	9%	-5%	0%	Pass	Pass	Pass	Pass
Cal_5	C5.18_NB	N	2	578	75	11	664	606	77	19	702	28	2	8	38	5%	2%	74%	6%	Pass	Pass	Pass	Pass
Cal_5	C5.18_SB	S	1	936	59	10	1005	820	50	9	878	-116	-9	-1	-127	-12%	-15%	-12%	-13%	Pass	Pass	Pass	Pass
Cal_7	C14.7_SB	0	2	838	113	53	1004	685	92	54	831	-153	-21	1	-173	-18%	-19%	2%	-17%	Fail	Pass	Pass	Fail
Cal_7	C14.7_NB	0	1	681	89	66	836	696	89	65	850	15	0	-1	14	2%	0%	-2%	2%	Pass	Pass	Pass	Pass
Cal_2	C8.10_SB	S	1	589	62	10	661	500	63	5	567	-89	1	-5	-94	-15%	1%	-49%	-14%	Pass	Pass	Pass	Pass
Cal_2	C8.10_NB	N	2	361	38	11	410	458	60	12	530	97	22	1	120	27%	57%	12%	29%	Pass	Pass	Pass	Fail
Cal_5	C5.4_NB	N	2	858	46	4	908	706	46	0	751	-152	-0	-4	-157	-18%	-1%	-100%	-17%	Fail	Pass	Pass	Fail
Cal_5	C5.4_SB	S	1	483	40	7	530	442	45	0	487	-41	5	-7	-43	-8%	12%	-100%	-8%	Pass	Pass	Pass	Pass
Cal_8	C11.5_WB	W	1	676	92	13	781	625	83	12	720	-51	-9	-1	-61	-7%	-10%	-9%	-8%	Pass	Pass	Pass	Pass
Cal_8	C11.5_EB	E	2	205	28	4	237	247	35	10	291	42	7	6	54	20%	24%	138%	23%	Pass	Pass	Pass	Pass
Cal_2	C8.13_NB	N	2	712	42	7	761	699	54	18	770	-13	12	11	9	-2%	29%	150%	1%	Pass	Pass	Pass	Pass
Cal_2	C8.13_SB	S	1	775	68	10	853	669	75	7	751	-106	7	-3	-102	-14%	11%	-32%	-12%	Pass	Pass	Pass	Pass
Cal_1	C15.1_WB	W	2	373	52	14	439	483	54	12	550	110	2	-2	111	29%	5%	-12%	25%	Fail	Pass	Pass	Fail
Cal_1	C15.1_EB	E	1	101	10	3	114	124	12	5	141	23	2	2	27	22%	20%	67%	23%	Pass	Pass	Pass	Pass
Cal_2	C8.17_NB	N	2	415	58	15	488	459	62	20	542	44	4	5	54	11%	7%	35%	11%	Pass	Pass	Pass	Pass
Cal_2	C8.17_SB	S	1	422	41	14	477	409	40	17	466	-13	-1	3	-11	-3%	-3%	22%	-2%	Pass	Pass	Pass	Pass
Cal_5	C5.10_EB	E	2	860	90	57	1007	879	101	53	1034	19	11	-4	27	2%	13%	-7%	3%	Pass	Pass	Pass	Pass
Cal_5	C5.10_WB	W	1	1261	97	30	1388	1194	128	43	1365	-67	31	13	-23	-5%	32%	44%	-2%	Pass	Pass	Pass	Pass
Cal_9	C9.1_WB	W	1	907	98	5	1010	1032	91	9	1132	125	-7	4	122	14%	-7%	76%	12%	Pass	Pass	Pass	Pass
Cal_9	C9.1_EB	E	2	533	76	19	628	567	104	18	690	34	28	-1	62	6%	37%	-5%	10%	Pass	Pass	Pass	Pass
Cal_10	C2.1_NWB	NW	1	520	54	11	585	455	49	4	509	-65	-5	-7	-76	-12%	-9%	-60%	-13%	Pass	Pass	Pass	Pass
Cal_10	C2.1_SEB	SE	2	801	67	4	872	713	63	3	779	-88	-4	-1	-93	-11%	-6%	-23%	-11%	Pass	Pass	Pass	Pass
Cal_5	C5.15_NB	N	2	116	17	1	134	139	20	5	163	23	3	4	29	20%	15%	388%	22%	Pass	Pass	Pass	Pass
Cal_5	C5.15_SB	S	1	282	34	1	317	291	29	4	324	9	-5	3	7	3%	-16%	325%	2%	Pass	Pass	Pass	Pass
Cal_11	C1.8_EB	E	2	87	16	3	106	79	12	3	93	-8	-4	-0	-13	-9%	-28%	-5%	-12%	Pass	Pass	Pass	Pass
Cal_11	C1.8_WB	W	1	192	19	3	214	173	16	2	191	-19	-3	-1	-23	-10%	-15%	-29%	-11%	Pass	Pass	Pass	Pass
Cal_10	C2.2_SB	S	2	298	36	7	341	362	34	10	405	64	-2	3	64	21%	-6%	38%	19%	Pass	Pass	Pass	Pass
Cal_10	C2.2_NB	N	1	575	45	11	631	599	43	10	652	24	-2	-1	21	4%	-3%	-13%	3%	Pass	Pass	Pass	Pass
Cal_2	C8.3_NB	N	2	312	58	20	390	298	66	33	398	-14	8	13	8	-4%	14%	67%	2%	Pass	Pass	Pass	Pass
Cal_2	C8.3_SB	S	1	489	54	14	557	505	82	15	601	16	28	1	44	3%	52%	4%	8%	Pass	Pass	Pass	Pass
Cal_7	C14.9_NB	0	1	357	46	9	412	308	42	7	356	-49	-4	-2	-56	-14%	-8%	-27%	-14%	Pass	Pass	Pass	Pass
Cal_7	C14.9_SB	0	2	290	34	2	326	132	28	4	165	-158	-6	2	-161	-54%	-16%	122%	-49%	Fail	Pass	Pass	Fail
Cal_7	C14.2_SB	S	2	1122	120	14	1256	1173	130	35	1337	51	10	21	81	5%	8%	149%	6%	Pass	Pass	Pass	Pass
Cal_8	C11.6_NEB	NE	2	218	31	2	251	213	22	2	236	-5	-9	-0	-15	-2%	-30%	-7%	-6%	Pass	Pass	Pass	Pass
Cal_8	C11.6_SWB	SW	1	346	52	3	401	391	41	2	435	45	-11	-1	34	13%	-21%	-25%	8%	Pass	Pass	Pass	Pass
Cal_8	C11.8_EB	E	2	544	46	17	607	646	66	23	735	102	20	6	128	19%	43%	36%	21%	Pass	Pass	Pass	Pass
Cal_8	C11.7_EB	E	2	366	22	1	389	310	26	2	338	-56	4	1	-51	-15%	16%	149%	-13%	Pass	Pass	Pass	Pass
Cal_8	C11.7_WB	W	1	259	16	0	275	348	23	4	375	89	7	4	100	34%	42%		36%	Pass	Pass	Pass	Pass
Cal_4	C7.5_NEB	NE	1	516	92	43	651	607	118	47	772	91	26	4	121	18%	28%	9%	19%	Pass	Pass	Pass	Pass
Cal_4	C7.5_SWB	SW	2	442	76	10	528	459	76	16	551	17	0	6	23	4%	0%	60%	4%	Pass	Pass	Pass	Pass
Cal_9	C9.4_WB	W	1	1817	188	22	2027	1794	206	17	2017	-23	18	-5	-10	-1%	9%	-21%	-1%	Pass	Pass	Pass	Pass
Cal_9	C9.4_EB	E	2	1058	172	31	1261	995	159	34	1188	-63	-13	3	-73	-6%	-8%	9%	-6%	Pass	Pass	Pass	Pass
Cal_6	C12.9_SB	S	2	690	76	5	771	481	69	7	557	-209	-7	2	-214	-30%	-9%	31%	-28%	Fail	Pass	Pass	Fail
Cal_6	C12.9_NB	N	1	611	67	4	682	552	65	4	621	-59	-2	0	-61	-10%	-3%	1%	-9%	Pass	Pass	Pass	Pass
Cal_2	C8.4_NWB	NW	2	53	7	0	60	40	3	2	45	-13	-4	2	-15	-24%	-55%		-25%	Pass	Pass	Pass	Pass
Cal_2	C8.4_SEB	SE	1	39	2	0	41	31	0	0	32	-8	-2	0	-9	-20%	-100%		-23%	Pass	Pass	Pass	Pass
Cal_6	C12.7_NB	N	1	101	13	1	115	49	7	0	56	-52	-6	-1	-59	-52%	-43%	-100%	-51%	Pass	Pass	Pass	Pass
Cal_6	C12.7_SB	S	2	106	14	1	121	105	7	0	112	-1	-7	-1	-9	-1%	-51%	-100%	-8%	Pass	Pass	Pass	Pass
Cal_7	C14.8_SB	0	2	561	70	10	641	507	116	14	638	-54	46	4	-3	-10%	66%	42%	-1%	Pass	Pass	Pass	Pass
Cal_7	C14.8_NB	0	1	838	77	13	928	695	73	14	782	-143	-4	1	-146	-17%	-5%	8%	-16%	Fail	Pass	Pass	Fail
Cal_7	C14.10_NB	0	1	451	46	10	507	495	47	11	553	44	1	1	46	10%	3%	8%	9%	Pass	Pass	Pass	Pass
Cal_7	C14.10_SB	0	2	16	47	11	74	17	42	12	71	1	-5	1	-3	8%	-11%	8%	-4%	Pass	Pass	Pass	Pass

Cal_5	C5.17_NB	N	2	429	63	4	496	379	43	4	426	-50	-20	0	-70	-12%	-32%	5%	-14%	Pass	Pass	Pass	Pass
Cal_5	C5.17_SB	S	1	202	32	10	244	196	17	4	217	-6	-15	-6	-27	-3%	-47%	-64%	-11%	Pass	Pass	Pass	Pass
Cal_1	C15.4_NWB	NW	2	201	42	8	251	110	21	5	136	-91	-21	-3	-115	-45%	-50%	-41%	-46%	Pass	Pass	Pass	Fail
Cal_1	C15.4_SEB	SE	1	83	17	3	103	78	15	8	101	-5	-2	5	-2	-6%	-10%	152%	-2%	Pass	Pass	Pass	Pass
Cal_8	C11.9_SEB	SE	2	91	12	2	105	129	16	0	145	38	4	-2	40	41%	37%	-100%	38%	Pass	Pass	Pass	Pass
Cal_8	C11.9_NWB	NW	1	61	2	2	65	42	1	0	43	-19	-1	-2	-22	-31%	-71%	-100%	-34%	Pass	Pass	Pass	Pass
Cal_2	C8.18_NEB	NE	2	138	17	3	158	121	26	2	149	-17	9	-1	-9	-13%	54%	-38%	-6%	Pass	Pass	Pass	Pass
Cal_2	C8.18_SWB	SW	1	195	11	5	211	188	26	3	217	-7	15	-2	6	-4%	132%	-31%	3%	Pass	Pass	Pass	Pass
Cal_8	C11.10_SWB	SW	1	441	103	11	555	412	100	8	520	-29	-3	-3	-35	-6%	-3%	-30%	-6%	Pass	Pass	Pass	Pass
Cal_8	C11.10_NEB	NE	2	185	43	4	232	193	47	5	245	8	4	1	13	4%	9%	17%	5%	Pass	Pass	Pass	Pass
Cal_7	C14.2_NB	N	1	1091	117	13	1221	1088	117	29	1234	-3	-0	16	13	0%	0%	126%	1%	Pass	Pass	Pass	Pass
Cal_11	C1.6_WB	W	1	352	38	6	396	314	26	2	342	-38	-12	-4	-54	-11%	-30%	-62%	-14%	Pass	Pass	Pass	Pass
Cal_11	C1.6_EB	E	2	246	44	6	296	186	21	2	209	-60	-23	-4	-87	-24%	-52%	-75%	-29%	Pass	Pass	Pass	Pass
Cal_11	C1.2_WB	W	1	605	80	4	689	538	64	2	604	-67	-16	-2	-85	-11%	-20%	-46%	-12%	Pass	Pass	Pass	Pass
Cal_11	C1.2_EB	E	2	470	47	2	519	388	28	2	419	-82	-19	-0	-100	-17%	-39%	-4%	-19%	Pass	Pass	Pass	Pass
Cal_11	C1.1_WB	W	1	209	9	2	220	273	16	1	290	64	7	-1	70	31%	79%	-32%	32%	Pass	Pass	Pass	Pass
Cal_11	C1.4_EB	E	2	138	12	2	152	149	17	1	167	11	5	-1	15	8%	38%	-43%	10%	Pass	Pass	Pass	Pass
Cal_10	C2.9_WB	W	1	398	67	11	476	269	22	7	298	-129	-45	-4	-178	-32%	-67%	-34%	-37%	Fail	Pass	Pass	Fail
Cal_10	C2.9_EB	E	2	377	52	14	443	338	37	1	377	-39	-15	-13	-66	-10%	-28%	-92%	-15%	Pass	Pass	Pass	Pass
	C2.8_NWB	NW		101	7	0	108	110	28	5	144	9	21	5	36	9%	296%		33%	Pass	Pass	Pass	Pass
	C2.8_SEB	SE		144	17	1	162	114	21	5	140	-30	4	4	-22	-21%	24%	404%	-14%	Pass	Pass	Pass	Pass
Cal_10	C2.3_NWB	NW	1	797	99	14	910	797	67	17	881	0	-32	3	-29	0%	-32%	20%	-3%	Pass	Pass	Pass	Pass
Cal_10	C2.3_SEB	SE	2	895	65	8	968	834	62	12	908	-61	-3	4	-60	-7%	-5%	51%	-6%	Pass	Pass	Pass	Pass
Cal_10	C2.11_WB	W	1	347	33	2	382	583	44	11	639	236	11	9	257	68%	35%	475%	67%	Fail	Pass	Pass	Fail
Cal_10	C2.11_EB	E	2	357	42	2	401	303	37	3	343	-54	-5	1	-58	-15%	-12%	43%	-14%	Pass	Pass	Pass	Pass
Cal_11	C1.3_WB	W	1	1061	132	20	1213	1085	128	24	1236	24	-4	4	23	2%	-3%	19%	2%	Pass	Pass	Pass	Pass
Cal_11	C1.3_EB	E	2	855	149	29	1033	823	135	27	986	-32	-14	-2	-47	-4%	-9%	-5%	-5%	Pass	Pass	Pass	Pass
Cal_3	C7.11_WB	W	2	271	23	1	295	295	28	8	330	24	5	7	35	9%	20%	703%	12%	Pass	Pass	Pass	Pass
Cal_3	C7.11_EB	E	1	167	19	6	192	174	33	6	213	7	14	0	21	4%	72%	2%	11%	Pass	Pass	Pass	Pass
Cal_6	C12.6_NB	N	1	559	88	17	664	546	82	19	647	-13	-6	2	-17	-2%	-7%	10%	-3%	Pass	Pass	Pass	Pass
Cal_6	C12.6_SB	S	2	289	34	5	328	329	40	10	379	40	6	5	51	14%	18%	108%	16%	Pass	Pass	Pass	Pass
Cal_7	C14.3_NB	N	1	369	72	14	455	466	63	9	538	97	-9	-5	83	26%	-13%	-34%	18%	Pass	Pass	Pass	Pass
Cal_7	C14.3_SB	S	2	165	39	12	216	248	32	6	286	83	-7	-6	70	50%	-18%	-47%	32%	Pass	Pass	Pass	Pass
Cal_4	C7.6_SB	S	2	527	78	3	608	470	61	2	534	-57	-17	-1	-74	-11%	-21%	-32%	-12%	Pass	Pass	Pass	Pass
Cal_4	C7.6_NB	N	1	429	51	5	485	354	70	8	433	-75	19	3	-52	-17%	38%	69%	-11%	Pass	Pass	Pass	Pass
Cal_2	C8.9_NB	N	2	21	5	2	28	32	10	0	42	11	5	-2	14	52%	109%	-100%	51%	Pass	Pass	Pass	Pass
Cal_2	C8.9_SB	S	1	52	5	1	58	84	13	0	97	32	8	-1	39	62%	157%	-100%	67%	Pass	Pass	Pass	Pass
Cal_8	C11.1_EB	E	2	1749	524	149	2422	1615	452	142	2209	-134	-72	-7	-213	-8%	-14%	-5%	-9%	Pass	Pass	Pass	Pass
Cal_5	C5.7_NB	N	2	55	20	1	76	22	0	0	22	-33	-20	-1	-54	-60%	-100%	-100%	-71%	Pass	Pass	Pass	Pass
Cal_5	C5.7_SB	S	1	104	17	1	122	75	5	0	81	-29	-12	-1	-41	-28%	-68%	-100%	-34%	Pass	Pass	Pass	Pass
Cal_8	C11.8_WB	W	1	1154	74	10	1238	1150	78	14	1243	-4	4	4	5	0%	6%	39%	0%	Pass	Pass	Pass	Pass
Cal_8	C11.1_WB	W	1	2468	647	116	3231	2399	524	115	3038	-69	-123	-1	-193	-3%	-19%	-1%	-6%	Pass	Fail	Pass	Pass
Cal_7	C14.4_NB	N	1	355	19	1	375	340	29	11	380	-15	10	10	5	-4%	52%	955%	1%	Pass	Pass	Pass	Pass
Cal_7	C14.4_SB	S	2	303	24	2	329	254	23	4	281	-49	-1	2	-48	-16%	-3%	92%	-15%	Pass	Pass	Pass	Pass
Cal_5	17101-36 . Dunton Rd BRENTWOOD_SE	SE	1	148	3	0	151	131	8	0	139	-17	5	0	-12	-11%	154%	0%	-8%	Pass	Pass	Pass	Pass
Cal_5	17101-36 . Dunton Rd BRENTWOOD_NW	NW	2	113	10	2	125	137	48	0	185	24	38	-2	60	21%	383%	-100%	48%	Pass	Pass	Pass	Pass
Cal_2	C8.6_NB	N	2	155	38	3	196	204	64	10	278	49	26	7	82	31%	69%	217%	42%	Pass	Pass	Pass	Pass
Cal_2	C8.6_SB	S	1	339	45	2	386	357	56	2	416	18	11	-0	30	5%	25%	0%	8%	Pass	Pass	Pass	Pass
Cal_4	C7.7_NEB	NE	1	15	6	0	21	22	15	2	39	7	9	2	18	48%	158%		88%	Pass	Pass	Pass	Pass
Cal_4	C7.7_SWB	SW	2	48	10	1	59	43	9	1	53	-5	-1	-0	-6	-10%	-11%	-25%	-10%	Pass	Pass	Pass	Pass
Cal_4	C7.3_NB	N	1	277	27	1	305	288	37	0	325	11	10	-1	20	4%	38%	-100%	7%	Pass	Pass	Pass	Pass
Cal_4	C7.3_SB	S	2	233	21	1	255	252	19	0	272	19	-2	-1	17	8%	-8%	-100%	7%	Pass	Pass	Pass	Pass
Cal_5	C5.5_SB	S	1	109	8	0	117	114	3	0	117	5	-5	0	0	5%	-61%	0%	0%	Pass	Pass	Pass	Pass
Cal_5	C5.5_NB	N	2	36	8	1	45	56	19	0	75	20	11	-1	30	55%	134%	-100%	66%	Pass	Pass	Pass	Pass
Cal_6	C12.3_SB	S	2	7	1	0	8	0	0	0	0	-7	-1	0	-8	-100%	-100%	0%	-100%	Pass	Pass	Pass	Pass
Cal_6	C12.3_NB	N	1	12	5	1	18	0	0	0	0	-12	-5	-1	-18	-100%	-100%	-100%	-100%	Pass	Pass	Pass	Pass
Cal_4	C7.1_SWB	SW	2	2664	208	319	3191	2713	250	404	3368	49	42	85	177	2%	20%	27%	6%	Pass	Pass	Pass	Pass
	19324-01 . A130 (Sadlers Farm) (SW)_northeastbound	0		1878	291	97	2266	2263	345	112	2720	385	54	15	454	20%	19%	16%	20%	Fail	Pass	Pass	Fail
Cal_2	C8.1_SB	S	1	1694	232	119	2045	1721	243	111	2075	27	11	-8	30	2%	5%	-7%	1%	Pass	Pass	Pass	Pass
Cal_2	C8.16_SB	S	1	91	16	0	107	84	20	0	104	-7	4	0	-3	-8%	27%	0%	-3%	Pass	Pass	Pass	Pass
Cal_2	C8.16_NB	N	2	252	18	0	270	179	28	0	206	-73	10	0	-64	-29%	54%	0%	-24%	Pass	Pass	Pass	Pass
Cal_1	C15.3_NB	N	2	306	64	12	382	321	57	13	392	15	-7	1	10	5%	-11%	11%	3%	Pass	Pass	Pass	Pass
Cal_1	C15.3_SB	S	1	164	34	7	205	155	37	4	196	-9	3	-3	-9	-6%	10%	-44%	-5%	Pass	Pass	Pass	Pass
Cal_2	C8.12_NB	N	2	76	13	0	89	88	26	11	125	12	13	11	36	16%	103%		41%	Pass	Pass	Pass	Pass
Cal_2	C8.12_SB	S	1	65	11	0	76	77	23	4	104	12	12	4	28	18%	111%		37%	Pass	Pass	Pass	Pass
Cal_4	C7.4_EB	E	1	287	40	0	327	321	52	0	373	34	12	0	46	12%	30%	0%	14%	Pass	Pass	Pass	Pass
Cal_4	C7.4_WB	W	2	303	42	0	345	300	35	0	335	-3	-7	0	-10	-1%	-16%	0%	-3%	Pass	Pass	Pass	Pass
Cal_5	C5.19_NB	N	2	351	33	6	390	363	32	0	395	12	-1	-6	5	3%	-5%	-100%	1%	Pass	Pass	Pass	Pass
Cal_5	C5.19_SB	S	1	358	15	8	381	360	14	0	374	2	-1	-8	-7	0%	-5%	-100%	-2%	Pass	Pass	Pass	Pass
Cal_5	C5.12_SB	S	2	137	19	1	157	87	12	2	102	-50	-7	1	-55	-36%	-35%	91%	-35%	Pass	Pass	Pass	Pass
Cal_5	C5.12_NB	N	1	106	15	3	124	71	8	4	83	-35	-7	1	-41	-33%	-44%	19%	-33%	Pass	Pass	Pass	Pass
Cal_9	C9.2_WB	W	1	427	39	2	468	351	26	3	380	-76	-13	1	-88	-18%	-33%	64%	-19%	Pass	Pass	Pass	Pass
Cal_9	C9.2_EB	E	2	116	22	3	141	147	31	13	190	31	9	10	49	27%	39%	328%	35%	Pass	Pass	Pass	Pass
Cal_9	C9.5_WB	W	1	774	83	29	886	778	111	21	910	4	28	-8	24	0%	34%	-27%	3%	Pass	Pass	Pass	Pass
Cal_9	C9.5_EB	E	2	443	75	23	541	428	65	11	504	-15	-10	-12	-37	-3%	-13%	-54%	-7%	Pass	Pass	Pass	Pass
Cal_1	C15.2_EB	E	1	29	6	1	36	26	6	0	32	-3	-0	-1	-4	-9%	-1%	-100%	-11%	Pass	Pass	Pass	Pass
Cal_1	C15.2_WB	W	2	67	14	3	84	85	26	0	111	18	12	-3	27	27%	87%	-100%	33%	Pass	Pass	Pass	Pass
Cal_7	C14.1_SB	S	2	1224	233	101	1558	1203	249	94	1546	-21	16	-7	-12	-2%	7%	-7%	-1%	Pass	Pass	Pass	Pass
Cal_10	C2.10_EB	E	2	537	39	4	580	573	44	7	623	36	5	3	43	7%	12%	71%	7%	Pass	Pass	Pass	Pass
Cal_10	C2.10_WB	W	1	435	39	6	480	456	68	2	525	21	29	-4	45	5%	74%	-63%	9%	Pass	Pass	Pass	Pass
Cal_8	C11.3_EB	E	2	15	2	0	17	9	2	0	12	-6	0	0	-5	-37%	6%	0%	-32%	Pass	Pass	Pass	Pass
Cal_8	C11.3_WB	W	1	14	4	0	18	18	3	0	21	4	-1	0	3	28%	-25%	0%	17%	Pass	Pass	Pass	Pass
	19324-01 . A1245 (Fairglen) (NE)_northeastbound	0		2280	338	121	2739	2370	265	101	2736	90	-73	-20	-3	4%	-22%	-16%	0%	Pass	Pass	Pass	Pass
	19324-01 . A1245 (Fairglen) (NE)_southwestbound	0		1697	230	86	2013	1842	240	74	2156	145	10	-12	143	9%	4%	-13%	7%	Pass	Pass	Pass	Pass
Cal_5	C5.20_SB	S	1	2071	285	118	2474	2124	245	115	2485	53	-40	-3	11	3%	-14%	-2%	0%	Pass	Pass	Pass	Pass
Cal_5	C5.16_SB	S	1	255	30	2	287	277	22	0	298	22	-8	-2	11	9%	-28%	-100%	4%	Pass	Pass	Pass	Pass
Cal_5	C5.16_NB	N	2	61	8	1	70	63	10	0	73	2	2	-1	3	3%	24%	-100%	4%	Pass	Pass	Pass	Pass
	C8.8_SB	S		23	3	0	26	13	1	0	14	-10	-2	0	-12	-43%	-53%	0%	-44%	Pass	Pass	Pass	Pass
	C8.8_NB	N		5	2	0	7	13	1	0	14	8	-1	0	7	161%	-37%	0%	105%	Pass	Pass	Pass	Pass
Cal_5	C5.6_NB	N	2	61	22	2	85	63	18	0	81	2	-4	-2	-4	3%	-17%	-100%	-5%	Pass	Pass	Pass	Pass
Cal_5	C5.6_SB	S	1	20	3	0	23	7	0	0	7	-13	-3	0	-16	-64%	-96%	0%	-68%	Pass	Pass	Pass	Pass
	61166117 A127 Southend Arterial Road Childerditch (2019)_EB	EB		2520	491	217	3228	2228	552	222	3002	-292	61	5	-226	-12%	12%	2%	-7%	Pass	Pass	Pass	Pass
	61166117 A127 Southend Arterial Road Childerditch (2019)_WB	WB		2644	576	200	3420	2478	551	185	3214	-166	-25	-15	-206	-6%	-4%	-8%	-6%	Pass	Pass	Pass	Pass
Cal_7	C14.5_NB	N	1	162	24	2	188	184	19	3	206	22	-5	1	18	13%	-22%	74%	10%	Pass	Pass	Pass	Pass
Cal_7	C14.5_SB	S	2	164	29	2	195	136	32	6	174	-28	3	4	-21	-17%	11%	195%	-11%	Pass	Pass	Pass	Pass

	Car	LGV	HGV	Total
GEH or Criteria 1	95%	99%	100%	95%
Fail	10	2	0	12
Pass	212	220	222	210

IP

Screenline	ID	BOUND	DIR	IP Count Data				IP Model Data				Absolute differences				%age Difference				GEH or Criteria 1			
				Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total
Cal_11	C1.9_EB	E	2	66	8	6	80	54	3	1	58	-12	-5	-5	-22	-18%	-63%	-83%	-28%	Pass	Pass	Pass	Pass
Cal_11	C1.9_WB	W	1	58	9	5	72	45	3	1	49	-13	-6	-4	-23	-22%	-67%	-80%	-32%	Pass	Pass	Pass	Pass
Cal_11	C1.7_EB	E	2	145	18	4	167	148	16	2	166	3	-2	-2	-1	2%	-11%	-50%	-1%	Pass	Pass	Pass	Pass
Cal_11	C1.7_WB	W	1	113	14	4	131	115	11	1	127	2	-3	-3	-4	2%	-21%	-75%	-3%	Pass	Pass	Pass	Pass
Cal_8	C11.2_EB	E	2	592	84	23	699	617	86	20	723	25	2	-3	24	4%	2%	-13%	3%	Pass	Pass	Pass	Pass
Cal_5	C5.1_NB	N	2	817	169	45	1031	746	152	48	946	-71	-17	3	-85	-9%	-10%	7%	-8%	Pass	Pass	Pass	Pass
Cal_5	C5.1_SB	S	1	749	158	38	945	725	140	38	903	-24	-18	0	-42	-3%	-11%	0%	-4%	Pass	Pass	Pass	Pass
	C7.2_NEB	NE		1860	187	315	2362	1944	243	362	2549	84	56	47	187	5%	30%	15%	8%	Pass	Pass	Pass	Pass
	C8.2_SWB	SW		1684	181	285	2150	1756	215	309	2280	72	34	24	130	4%	19%	8%	6%	Pass	Pass	Pass	Pass
Cal_4	C7.8_EB	E	1	412	65	17	494	455	84	22	561	43	19	5	67	10%	29%	29%	14%	Pass	Pass	Pass	Pass
Cal_4	C7.8_WB	W	2	362	51	17	430	387	72	19	478	25	21	2	48	7%	41%	12%	11%	Pass	Pass	Pass	Pass
Cal_2	C8.11_SB	S	1	138	20	5	163	134	13	8	155	-4	-7	3	-8	-3%	-35%	60%	-5%	Pass	Pass	Pass	Pass
	V13.8_NWB	NW		489	60	2	551	521	80	17	618	32	20	15	67	7%	33%	750%	12%	Pass	Pass	Pass	Pass
	V13.8_SEB	SE		543	66	2	611	544	67	12	623	1	1	10	12	0%	2%	500%	2%	Pass	Pass	Pass	Pass
Cal_6	C12.1_SWB	SW	2	1233	326	176	1735	1324	326	180	1830	91	0	4	95	7%	0%	2%	5%	Pass	Pass	Pass	Pass
Cal_6	C12.1_NEB	NE	1	1359	513	176	2048	1354	492	184	2030	-5	-21	8	-18	0%	-4%	5%	-1%	Pass	Pass	Pass	Pass
Cal_8	C11.2_WB	W	1	486	63	17	566	456	65	14	535	-30	2	-3	-31	-6%	3%	-18%	-5%	Pass	Pass	Pass	Pass
Cal_7	C14.1_NB	N	1	604	130	59	793	840	140	53	1033	236	10	-6	240	39%	8%	-10%	30%	Fail	Pass	Pass	Fail
Cal_8	C11.4_NEB	NE	2	1754	306	167	2227	1624	345	160	2129	-130	39	-7	-98	-7%	13%	-4%	-4%	Pass	Pass	Pass	Pass
Cal_6	C12.8_SB	S	2	734	152	35	921	772	172	34	978	38	20	-1	57	5%	13%	-3%	6%	Pass	Pass	Pass	Pass
Cal_6	C12.8_NB	N	1	628	115	34	777	701	124	30	855	73	9	-4	78	12%	8%	-12%	10%	Pass	Pass	Pass	Pass
Cal_5	C5.20_NB	0	2	992	196	132	1320	1025	194	122	1341	33	-2	-10	21	3%	-1%	-8%	2%	Pass	Pass	Pass	Pass
Cal_9	C9.3_WB	W	1	1865	372	153	2390	2067	384	155	2606	202	12	2	216	11%	3%	1%	9%	Pass	Pass	Pass	Pass
Cal_9	C9.3_EB	E	2	2070	415	139	2624	2234	464	147	2845	164	49	8	221	8%	12%	6%	8%	Pass	Pass	Pass	Pass
Cal_10	C2.6_WB	W	2	267	16	2	285	248	19	0	267	-19	3	-2	-18	-7%	19%	-100%	-6%	Pass	Pass	Pass	Pass
Cal_10	C2.6_EB	E	1	263	20	3	286	255	25	0	280	-8	5	-3	-6	-3%	25%	-100%	-2%	Pass	Pass	Pass	Pass
Cal_10	C2.5_WB	W	1	972	165	84	1221	1145	184	80	1409	173	19	-4	188	18%	12%	-5%	15%	Fail	Pass	Pass	Fail
Cal_8	C11.4_SWB	SW	1	1501	265	167	1933	1518	295	162	1975	17	30	-5	42	1%	11%	-3%	2%	Pass	Pass	Pass	Pass
Cal_2	C8.5_WB	W	2	108	16	3	127	94	14	2	110	-14	-2	-1	-17	-13%	-13%	-33%	-13%	Pass	Pass	Pass	Pass
Cal_2	C8.5_EB	E	1	103	17	5	125	99	16	4	119	-4	-1	-1	-6	-4%	-6%	-20%	-5%	Pass	Pass	Pass	Pass
Cal_5	C5.11_SEB	SE	1	322	40	5	367	262	36	9	307	-60	-4	4	-60	-19%	-10%	80%	-16%	Pass	Pass	Pass	Pass
Cal_5	C5.11_NWB	NW	2	338	38	5	381	300	38	9	347	-38	0	4	-34	-11%	0%	80%	-9%	Pass	Pass	Pass	Pass
Cal_2	C8.1_NB	N	2	1103	218	134	1455	1079	227	146	1452	-24	9	12	-3	-2%	4%	9%	0%	Pass	Pass	Pass	Pass
Cal_2	C8.14_NB	N	2	82	9	1	92	75	15	1	91	-7	6	0	-1	-9%	67%	0%	-1%	Pass	Pass	Pass	Pass
Cal_2	C8.14_SB	S	1	75	10	2	87	82	22	8	112	7	12	6	25	9%	120%	300%	29%	Pass	Pass	Pass	Pass
Cal_2	C8.19_WB	W	2	182	33	8	223	201	41	14	256	19	8	6	33	10%	24%	75%	15%	Pass	Pass	Pass	Pass
Cal_2	C8.19_EB	E	1	177	29	8	214	208	44	16	268	31	15	8	54	18%	52%	100%	25%	Pass	Pass	Pass	Pass
	V3.1_EB	E		1849	465	159	2473	1886	432	155	2473	37	-33	-4	0	2%	-7%	-3%	0%	Pass	Pass	Pass	Pass
	19324-01 . A130 (Sadlers Farm) (SW) _southwestbound	0		1395	266	153	1814	1425	276	158	1859	30	10	5	45	2%	4%	3%	2%	Pass	Pass	Pass	Pass
	V3.1_WB	W		1572	353	153	2078	1678	336	164	2178	106	-17	11	100	7%	-5%	7%	5%	Pass	Pass	Pass	Pass
Cal_3	C7.10_SB	S	2	264	38	6	308	259	33	10	302	-5	-5	4	-6	-2%	-13%	67%	-2%	Pass	Pass	Pass	Pass
Cal_3	C7.10_NB	N	1	258	37	5	300	266	36	25	327	8	-1	20	27	3%	-3%	400%	9%	Pass	Pass	Pass	Pass
Cal_3	C7.12_NB	N	1	26	9	10	45	25	7	7	39	-1	-2	-3	-6	-4%	-22%	-30%	-13%	Pass	Pass	Pass	Pass
Cal_3	C7.12_SB	S	2	30	7	11	48	24	6	7	37	-6	-1	-4	-11	-20%	-14%	-36%	-23%	Pass	Pass	Pass	Pass
Cal_7	C14.6_NB	N	1	25	6	11	42	44	9	2	55	19	3	-9	13	76%	50%	-82%	31%	Pass	Pass	Pass	Pass
Cal_7	C14.6_SB	S	2	46	6	13	65	48	7	1	56	2	1	-12	-9	4%	17%	-92%	-14%	Pass	Pass	Pass	Pass
	20110-03 Burches Basildon_E	0		506	50	10	566	316	46	18	380	-190	-4	8	-186	-38%	-8%	80%	-33%	Fail	Pass	Pass	Fail
	20110-03 Burches Basildon_W	0		536	45	8	589	459	36	9	504	-77	-9	1	-85	-14%	-20%	13%	-14%	Pass	Pass	Pass	Pass
Cal_6	C12.5_SB	S	2	247	38	6	291	283	42	0	325	36	4	-6	34	15%	11%	-100%	12%	Pass	Pass	Pass	Pass
Cal_6	C12.5_NB	N	1	256	50	6	312	258	51	0	309	2	1	-6	-3	1%	2%	-100%	-1%	Pass	Pass	Pass	Pass
Cal_6	C12.4_NB	N	1	339	60	71	470	312	55	62	429	-27	-5	-9	-41	-8%	-8%	-13%	-9%	Pass	Pass	Pass	Pass
Cal_6	C12.4_SB	S	2	361	74	60	495	322	69	58	449	-39	-5	-2	-46	-11%	-7%	-3%	-9%	Pass	Pass	Pass	Pass
Cal_10	C2.7_WB	W	1	189	14	1	204	202	24	1	227	13	10	0	23	7%	71%	0%	11%	Pass	Pass	Pass	Pass
Cal_10	C2.7_EB	E	2	194	16	1	211	289	16	2	307	95	0	1	96	49%	0%	100%	45%	Pass	Pass	Pass	Pass
Cal_6	C12.10_SB	S	2	322	24	4	350	311	22	0	333	-11	-2	-4	-17	-3%	-8%	-100%	-5%	Pass	Pass	Pass	Pass
Cal_6	C12.10_NB	N	1	339	30	5	374	418	30	0	448	79	0	-5	74	23%	0%	-100%	20%	Pass	Pass	Pass	Pass
Cal_6	C12.2_WB	W	2	511	59	5	575	547	58	6	611	36	-1	1	36	7%	-2%	20%	6%	Pass	Pass	Pass	Pass
Cal_6	C12.2_EB	E	1	520	52	4	576	544	53	7	604	24	1	3	28	5%	2%	75%	5%	Pass	Pass	Pass	Pass
Cal_5	C5.9_NB	N	2	441	70	18	529	480	76	29	585	39	6	11	56	9%	9%	61%	11%	Pass	Pass	Pass	Pass
Cal_5	C5.9_SB	S	1	467	71	18	556	466	75	23	564	-1	4	5	8	0%	6%	28%	1%	Pass	Pass	Pass	Pass
Cal_2	C8.15_SB	S	1	175	34	12	221	103	46	8	157	-72	12	-4	-64	-41%	35%	-33%	-29%	Pass	Pass	Pass	Pass
Cal_2	C8.15_NB	N	2	174	37	11	222	135	46	11	192	-39	9	0	-30	-22%	24%	0%	-14%	Pass	Pass	Pass	Pass
Cal_11	C1.5_WB	W	1	403	27	6	436	420	28	5	453	17	1	-1	17	4%	4%	-17%	4%	Pass	Pass	Pass	Pass
Cal_11	C1.5_EB	E	2	524	34	6	564	572	41	5	618	48	7	-1	54	9%	21%	-17%	10%	Pass	Pass	Pass	Pass
Cal_5	C5.8_NB	N	2	436	53	13	502	406	43	7	456	-30	-10	-6	-46	-7%	-19%	-46%	-9%	Pass	Pass	Pass	Pass
Cal_5	C5.8_SB	S	1	419	49	12	480	380	39	10	429	-39	-10	-2	-51	-9%	-20%	-17%	-11%	Pass	Pass	Pass	Pass
Cal_5	C5.13_NB	N	2	428	39	9	476	372	35	8	415	-56	-4	-1	-61	-13%	-10%	-11%	-13%	Pass	Pass	Pass	Pass
Cal_5	C5.13_SB	S	1	424	30	7	461	379	24	11	414	-45	-6	4	-47	-11%	-20%	57%	-10%	Pass	Pass	Pass	Pass
Cal_5	C5.14_NEB	NE	2	313	31	5	349	258	25	0	283	-55	-6	-5	-66	-18%	-19%	-100%	-19%	Pass	Pass	Pass	Pass
Cal_5	C5.14_SWB	SW	1	302	24	6	332	258	18	0	276	-44	-6	-6	-56	-15%	-25%	-100%	-17%	Pass	Pass	Pass	Pass
Cal_2	C8.7_NB	N	2	105	8	1	114	84	8	2	94	-21	0	1	-20	-20%	0%	100%	-18%	Pass	Pass	Pass	Pass
Cal_2	C8.7_SB	S	1	96	10	1	107	82	13	2	97	-14	3	1	-10	-15%	30%	100%	-9%	Pass	Pass	Pass	Pass
Cal_3	C7.9_NEB	NE	1	515	45	9	569	533	44	19	596	18	-1	10	27	3%	-2%	111%	5%	Pass	Pass	Pass	Pass
Cal_3	C7.9_SWB	SW	2	526	51	7	584	505	47	16	568	-21	-4	9	-16	-4%	-8%	129%	-3%	Pass	Pass	Pass	Pass
Cal_10	C2.5_EB	E	2	1028	137	83	1248	1362	188	87	1637	334	51	4	389	32%	37%	5%	31%	Fail	Pass	Pass	Fail
Cal_5	C5.18_NB	N	2	535	48	14	597	536	51	17	604	1	3	3	7	0%	6%	21%	1%	Pass	Pass	Pass	Pass
Cal_5	C5.18_SB	S	1	542	62	18	622	545	61	15	621	3	-1	-3	-1	1%	-2%	-17%	0%	Pass	Pass	Pass	Pass
Cal_7	C14.7_SB	0	2	449	86	54	589	422	87	60	569	-27	1	6	-20	-6%	1%	11%	-3%	Pass	Pass	Pass	Pass
Cal_7	C14.7_NB	0	1	458	83	49	590	431	78	56	565	-27	-5	7	-25	-6%	-6%	14%	-4%	Pass	Pass	Pass	Pass
Cal_2	C8.10_SB	S	1	187	26	5	218	183	37	10	230	-4	11	5	12	-2%	42%	100%	6%	Pass	Pass	Pass	Pass
Cal_2	C8.10_NB	N	2	284	40	6	330	276	38	12	326	-8	-2	6	-4	-3%	-5%	100%	-1%	Pass	Pass	Pass	Pass
Cal_5	C5.4_NB	N	2	277	33	9	319	272	38	0	310	-5	5	-9	-9	-2%	15%	-100%	-3%	Pass	Pass	Pass	Pass
Cal_5	C5.4_SB	S	1	239	28	10	277	245	38	0	283	6	10	-10	6	3%	36%	-100%	2%	Pass	Pass	Pass	Pass
Cal_8	C11.5_WB	W	1	311	42	6	359	308	44	9	361	-3	2	3	2	-1%	5%	50%	1%	Pass	Pass	Pass	Pass
Cal_8	C11.5_EB	E	2	297	41	6	344	296	42	13	351	-1	1	7	7	0%	2%	117%	2%	Pass	Pass	Pass	Pass
Cal_2	C8.13_NB	N	2	431	46	11	488	427	50	15	492	-4	4	4	4	-1%	9%	36%	1%	Pass	Pass	Pass	Pass
Cal_2	C8.13_SB	S	1	413	46	10	469	399	59	16	474	-14	13	6	5	-3%	28%	60%	1%	Pass	Pass	Pass	Pass
Cal_1	C15.1_WB	W	2	68	11	2	81	89	11	4	104	21	0	2	23	31%	0%	100%	28%	Pass	Pass	Pass	Pass
Cal_1	C15.1_EB	E	1	78	11	2	91	90	11	5	106	12	0	3	15	15%	0%	150%	16%	Pass	Pass	Pass	Pass
Cal_2	C8.17_NB	N	2	223	37	8	268	265	40	14	319	42	3	6	51	19%	8%	75%	19%	Pass	Pass	Pass	Pass
Cal_2	C8.17_SB	S	1	232	32	7	271	318	45	20	383	86	13	13	112	37%	41%	186%	41%	Pass	Pass	Pass	Fail
Cal_5	C5.10_EB	E	2	988	82	42	1112	925	95	50	1070	-63	13	8	-42	-6%	16%	19%	-4%	Pass	Pass	Pass	Pass
Cal_5	C5.10_WB	W	1	820	89	39	948	771	96	44	911	-49	7	5	-37	-6%	8%	13%	-4%	Pass	Pass	Pass	Pass
Cal_9	C9.1_WB	W	1	482	63	12	557	521	67	14	602	39	4	2	45	8%	6%	17%	8%	Pass	Pass	Pass	Pass
Cal_9	C9.1_EB	E	2	544	74	9	627	505	61	20	586	-39	-13	11	-41	-7%	-18%	122%	-7%	Pass	Pass	Pass	Pass
Cal_10	C2.1_NWB	NW	1	490	45	6	541	444	38	5	487	-46	-7	-1	-54	-9%	-16%	-17%	-10%	Pass	Pass	Pass	Pass
Cal_10	C2.1_SEB	SE	2	460	43	6	509	403	38	4	445	-57	-5	-2	-64	-12%	-12%	-33%	-13%	Pass	Pass	Pass	Pass
Cal_5	C5.15_NB	N	2	160	16	3	179	181	15	5	201	21	-1	2	22	13%	-6%	67%	12%	Pass	Pass	Pass	Pass
Cal_5	C5.15_SB	S	1	172	20	3	195	182	20	6	208	10	0	3	13	6%	0%	100%	7%	Pass	Pass	Pass	Pass
Cal_11	C1.8_EB	E	2	104	12	1	117	100	8	2	110	-4	-4	1	-7	-4%	-33%	100%	-6%	Pass	Pass	Pass	Pass
Cal_11	C1.8_WB	W	1	109	14	3	126	96	11	3	110	-13	-3	0	-16	-12%	-21%	0%	-13%	Pass	Pass	Pass	Pass
Cal_10	C2.2_SB	S	2	351	42	11	404	351	39	12	402	0	-3	1	-2	0%	-7%	9%	0%	Pass	Pass	Pass	Pass
Cal_10	C2.2_NB	N	1	343	35	9	387	345	36	10	391	2	1	1	4	1%	3%	11%	1%	Pass	Pass	Pass	Pass
Cal_2	C8.3_NB	N	2	356	47	15	418	348	58	23	429	-8	11	8	11	-2%	23%	53%	3%	Pass	Pass	Pass	Pass
Cal_2	C8.3_SB	S	1	340	45	12	397	352	57	20	429	12	12	8	32	4%	27%	67%	8%	Pass	Pass	Pass	Pass
Cal_7	C14.9_NB	0	1	515	45	6	566	380	27	5	412	-135	-18	-1	-154	-26%	-40%	-17%	-27%	Fail	Pass	Pass	Fail
Cal_7	C14.9_SB	0	2	519	35	3	557	235	20	3	258	-284	-15	0	-299	-55%	-43%	0%	-54%	Fail	Pass	Pass	Fail
Cal_7	C14.2_SB	S	2	857	92	11	960	886	102	27	1015	29	10	16	55	3%	11%	145%	6%	Pass	Pass	Pass	Pass
Cal_8	C11.6_NEB	NE	2	201	25	2	228	195	19	2	216	-6	-6	0	-12	-3%	-24%	0%	-5%	Pass	Pass	Pass	Pass
Cal_8	C11.6_SWB	SW	1	311	42	2	355	380	33	1	414	69	-9	-1	59	22%	-21%	-50%	17%	Pass	Pass	Pass	Pass
Cal_8	C11.8_EB	E	2	751	58	9	818	788	62	12	862	37	4	3	44	5%	7%	33%	5%	Pass	Pass	Pass	Pass
Cal_8	C11.7_EB	E	2	427	24	2	453	383	22	3	408	-44	-2	1	-45	-10%	-8%	50%	-10%	Pass	Pass	Pass	Pass
Cal_8	C11.7_WB	W	1	191	9	0	200	212	17	4	233	21	8	4	33	11%	89%		17%	Pass	Pass	Pass	Pass
Cal_4	C7.5_NEB	NE	1	520	96	21	637	518	109	29	656	-2	13	8	19	0%	14%	38%	3%	Pass	Pass	Pass	Pass
Cal_4	C7.5_SWB	SW	2	565	100	24	689	586	116	28	730	21	16	4	41	4%	16%	17%	6%	Pass	Pass	Pass	Pass
Cal_9	C9.4_WB	W	1	934	119	27	1080	842	116	25	983	-92	-3	-2	-97	-10%	-3%	-7%	-9%	Pass	Pass	Pass	Pass
Cal_9	C9.4_EB	E	2	1055	161	29	1245	1013	130	23	1166	-42	-31	-6	-79	-4%	-19%	-21%	-6%	Pass	Pass	Pass	Pass
Cal_6	C12.9_SB	S	2	503	55	3	561	409	36	5	450	-94	-19	2	-111	-19%	-35%	67%	-20%	Pass	Pass	Pass	Pass
Cal_6	C12.9_NB	N	1	508	56	4	568	389	50	6	445	-119	-6	2	-123	-23%	-11%	50%	-22%	Fail	Pass	Pass	Fail
Cal_2	C8.4_NWB	NW	2	22	4	0	26	11	0	1	12	-11	-4	1	-14	-50%	-100%		-54%	Pass	Pass	Pass	Pass
Cal_2	C8.4_SEB	SE	1	28	5	1	34	14	0	1	15	-14	-5	0	-19	-50%	-100%	0%	-56%	Pass	Pass	Pass	Pass
Cal_6	C12.7_NB	N	1	76	12	2	90	73	5	0	78	-3	-7	-2	-12	-4%	-58%	-100%	-13%	Pass	Pass	Pass	Pass
Cal_6	C12.7_SB	S	2	89	13	2	104	84	5	0	89	-5	-8	-2	-15	-6%	-62%	-100%	-14%	Pass	Pass	Pass	Pass
Cal_7	C14.8_SB	0	2	324	65	23	412	314	81	19	414	-10	16	-4	2	-3%	25%	-17%	0%	Pass	Pass	Pass	Pass
Cal_7	C14.8_NB	0	1	375	59	19	453	345	61	20	426	-30	2	1	-27	-8%	3%	5%	-6%	Pass	Pass	Pass	Pass
Cal_7	C14.10_NB	0	1	311	36	5	352	254	52	13	319	-57	16	8	-33	-18%	44%	160%	-9%	Pass	Pass	Pass	Pass
Cal_7	C14.10_SB	0	2	330	36	4	370	268	39	8	315	-62	3	4	-55	-19%	8%	100%	-15%	Pass	Pass	Pass	Pass

Cal_5	C5.17_NB	N	2	228	32	8	268	210	29	7	246	-18	-3	-1	-22	-8%	-9%	-13%	-8%	Pass	Pass	Pass	Pass
Cal_5	C5.17_SB	S	1	197	25	7	229	181	18	3	202	-16	-7	-4	-27	-8%	-28%	-57%	-12%	Pass	Pass	Pass	Pass
Cal_1	C15.4_NWB	NW	2	88	18	4	110	88	16	2	106	0	-2	-2	-4	0%	-11%	-50%	-4%	Pass	Pass	Pass	Pass
Cal_1	C15.4_SEB	SE	1	102	21	4	127	96	22	7	125	-6	1	3	-2	-6%	5%	75%	-2%	Pass	Pass	Pass	Pass
Cal_8	C11.9_SEB	SE	2	88	6	1	95	82	8	0	90	-6	2	-1	-5	-7%	33%	-100%	-5%	Pass	Pass	Pass	Pass
Cal_8	C11.9_NWB	NW	1	37	3	0	40	51	5	0	56	14	2	0	16	38%	67%	0%	40%	Pass	Pass	Pass	Pass
Cal_2	C8.18_NEB	NE	2	121	12	4	137	81	23	1	105	-40	11	-3	-32	-33%	92%	-75%	-23%	Pass	Pass	Pass	Pass
Cal_2	C8.18_SWB	SW	1	122	16	3	141	114	12	3	129	-8	-4	0	-12	-7%	-25%	0%	-9%	Pass	Pass	Pass	Pass
Cal_8	C11.10_SWB	SW	1	227	53	5	285	220	51	6	277	-7	-2	1	-8	-3%	-4%	20%	-3%	Pass	Pass	Pass	Pass
Cal_8	C11.10_NEB	NE	2	263	61	6	330	257	65	6	328	-6	4	0	-2	-2%	7%	0%	-1%	Pass	Pass	Pass	Pass
Cal_7	C14.2_NB	N	1	879	94	11	984	893	97	26	1016	14	3	15	32	2%	3%	136%	3%	Pass	Pass	Pass	Pass
Cal_11	C1.6_WB	W	1	308	28	3	339	284	19	2	305	-24	-9	-1	-34	-8%	-32%	-33%	-10%	Pass	Pass	Pass	Pass
Cal_11	C1.6_EB	E	2	315	29	2	346	264	16	1	281	-51	-13	-1	-65	-16%	-45%	-50%	-19%	Pass	Pass	Pass	Pass
Cal_11	C1.2_WB	W	1	483	45	3	531	389	33	2	424	-94	-12	-1	-107	-19%	-27%	-33%	-20%	Pass	Pass	Pass	Pass
Cal_11	C1.2_EB	E	2	405	38	2	445	359	27	2	388	-46	-11	0	-57	-11%	-29%	0%	-13%	Pass	Pass	Pass	Pass
Cal_11	C1.1_WB	W	1	150	11	1	162	196	15	1	212	46	4	0	50	31%	36%	0%	31%	Pass	Pass	Pass	Pass
Cal_11	C1.4_EB	E	2	197	13	0	210	188	9	1	198	-9	-4	1	-12	-5%	-31%		-6%	Pass	Pass	Pass	Pass
Cal_10	C2.9_WB	W	1	391	50	14	455	215	25	10	250	-176	-25	-4	-205	-45%	-50%	-29%	-45%	Fail	Pass	Pass	Fail
Cal_10	C2.9_EB	E	2	365	42	8	415	236	21	0	257	-129	-21	-8	-158	-35%	-50%	-100%	-38%	Fail	Pass	Pass	Fail
	C2.8_NWB	NW		60	6	1	67	127	8	3	138	67	2	2	71	112%	33%	200%	106%	Pass	Pass	Pass	Pass
	C2.8_SEB	SE		116	15	2	133	44	12	2	58	-72	-3	0	-75	-62%	-20%	0%	-56%	Pass	Pass	Pass	Pass
Cal_10	C2.3_NWB	NW	1	672	74	14	760	604	71	16	691	-68	-3	2	-69	-10%	-4%	14%	-9%	Pass	Pass	Pass	Pass
Cal_10	C2.3_SEB	SE	2	727	97	20	844	603	71	22	696	-124	-26	2	-148	-17%	-27%	10%	-18%	Pass	Pass	Pass	Fail
Cal_10	C2.11_WB	W	1	184	16	4	204	259	33	19	311	75	17	15	107	41%	106%	375%	52%	Pass	Pass	Pass	Fail
Cal_10	C2.11_EB	E	2	318	37	5	360	257	37	5	299	-61	0	0	-61	-19%	0%	0%	-17%	Pass	Pass	Pass	Pass
Cal_11	C1.3_WB	W	1	1020	121	27	1168	979	117	28	1124	-41	-4	1	-44	-4%	-3%	4%	-4%	Pass	Pass	Pass	Pass
Cal_11	C1.3_EB	E	2	950	101	26	1077	881	96	25	1002	-69	-5	-1	-75	-7%	-5%	-4%	-7%	Pass	Pass	Pass	Pass
Cal_3	C7.11_WB	W	2	132	18	4	154	134	23	6	163	2	5	2	9	2%	28%	50%	6%	Pass	Pass	Pass	Pass
Cal_3	C7.11_EB	E	1	153	22	5	180	162	26	4	192	9	4	-1	12	6%	18%	-20%	7%	Pass	Pass	Pass	Pass
Cal_6	C12.6_NB	N	1	319	37	14	370	308	38	18	364	-11	1	4	-6	-3%	3%	29%	-2%	Pass	Pass	Pass	Pass
Cal_6	C12.6_SB	S	2	318	46	13	377	311	42	16	369	-7	-4	3	-8	-2%	-9%	23%	-2%	Pass	Pass	Pass	Pass
Cal_7	C14.3_NB	N	1	137	36	8	181	182	42	6	230	45	6	-2	49	33%	17%	-25%	27%	Pass	Pass	Pass	Pass
Cal_7	C14.3_SB	S	2	214	41	12	267	286	37	5	328	72	-4	-7	61	34%	-10%	-58%	23%	Pass	Pass	Pass	Pass
Cal_4	C7.6_SB	S	2	220	32	3	255	212	39	5	256	-8	7	2	1	-4%	22%	67%	0%	Pass	Pass	Pass	Pass
Cal_4	C7.6_NB	N	1	213	28	4	245	212	42	7	261	-1	14	3	16	0%	50%	75%	7%	Pass	Pass	Pass	Pass
Cal_2	C8.9_NB	N	2	18	5	1	24	28	10	0	38	10	5	-1	14	56%	100%	-100%	58%	Pass	Pass	Pass	Pass
Cal_2	C8.9_SB	S	1	18	4	1	23	30	11	0	41	12	7	-1	18	67%	175%	-100%	78%	Pass	Pass	Pass	Pass
Cal_8	C11.1_EB	E	2	1511	502	130	2143	1723	467	129	2319	212	-35	-1	176	14%	-7%	-1%	8%	Pass	Pass	Pass	Pass
Cal_5	C5.7_NB	N	2	77	14	2	93	0	0	0	0	-77	-14	-2	-93	-100%	-100%	-100%	-100%	Pass	Pass	Pass	Pass
Cal_5	C5.7_SB	S	1	65	14	3	82	34	10	0	44	-31	-4	-3	-38	-48%	-29%	-100%	-46%	Pass	Pass	Pass	Pass
Cal_8	C11.8_WB	W	1	678	48	10	736	594	35	14	643	-84	-13	4	-93	-12%	-27%	40%	-13%	Pass	Pass	Pass	Pass
Cal_8	C11.1_WB	W	1	1549	452	129	2130	1591	427	123	2141	42	-25	-6	11	3%	-6%	-5%	1%	Pass	Pass	Pass	Pass
Cal_7	C14.4_NB	N	1	325	28	1	354	271	35	10	316	-54	7	9	-38	-17%	25%	900%	-11%	Pass	Pass	Pass	Pass
Cal_7	C14.4_SB	S	2	316	32	1	349	280	26	3	309	-36	-6	2	-40	-11%	-19%	200%	-11%	Pass	Pass	Pass	Pass
Cal_5	17101-36 . Dunton Rd BRENTWOOD_SE	SE	1	42	6	1	49	21	1	0	22	-21	-5	-1	-27	-50%	-83%	-100%	-55%	Pass	Pass	Pass	Pass
Cal_5	17101-36 . Dunton Rd BRENTWOOD_NW	NW	2	35	5	1	41	28	1	0	29	-7	-4	-1	-12	-20%	-80%	-100%	-29%	Pass	Pass	Pass	Pass
Cal_2	C8.6_NB	N	2	146	24	5	175	173	39	8	220	27	15	3	45	18%	63%	60%	26%	Pass	Pass	Pass	Pass
Cal_2	C8.6_SB	S	1	154	25	4	183	172	39	6	217	18	14	2	34	12%	56%	50%	19%	Pass	Pass	Pass	Pass
Cal_4	C7.7_NEB	NE	1	18	5	1	24	19	12	2	33	1	7	1	9	6%	140%	100%	38%	Pass	Pass	Pass	Pass
Cal_4	C7.7_SWB	SW	2	16	5	1	22	20	7	1	28	4	2	0	6	25%	40%	0%	27%	Pass	Pass	Pass	Pass
Cal_4	C7.3_NB	N	1	153	14	1	168	128	25	0	153	-25	11	-1	-15	-16%	79%	-100%	-9%	Pass	Pass	Pass	Pass
Cal_4	C7.3_SB	S	2	153	11	2	166	142	15	0	157	-11	4	-2	-9	-7%	36%	-100%	-5%	Pass	Pass	Pass	Pass
Cal_5	C5.5_SB	S	1	60	12	1	73	66	5	0	71	6	-7	-1	-2	10%	-58%	-100%	-3%	Pass	Pass	Pass	Pass
Cal_5	C5.5_NB	N	2	20	5	2	27	24	16	0	40	4	11	-2	13	20%	220%	-100%	48%	Pass	Pass	Pass	Pass
Cal_6	C12.3_SB	S	2	11	2	0	13	0	0	0	0	-11	-2	0	-13	-100%	-100%	0%	-100%	Pass	Pass	Pass	Pass
Cal_6	C12.3_NB	N	1	9	1	0	10	0	0	0	0	-9	-1	0	-10	-100%	-100%	0%	-100%	Pass	Pass	Pass	Pass
Cal_4	C7.1_SWB	SW	2	1656	154	291	2101	1721	198	301	2220	65	44	10	119	4%	29%	3%	6%	Pass	Pass	Pass	Pass
	19324-01 . A130 (Sadlers Farm) (SW)_northeastbound	0		1390	282	147	1819	1356	291	150	1797	-34	9	3	-22	-2%	3%	2%	-1%	Pass	Pass	Pass	Pass
Cal_2	C8.1_SB	S	1	1209	214	129	1552	1199	235	135	1569	-10	21	6	17	-1%	10%	5%	1%	Pass	Pass	Pass	Pass
Cal_2	C8.16_SB	S	1	101	14	2	117	86	21	0	107	-15	7	-2	-10	-15%	50%	-100%	-9%	Pass	Pass	Pass	Pass
Cal_2	C8.16_NB	N	2	88	8	2	98	80	17	0	97	-8	9	-2	-1	-9%	113%	-100%	-1%	Pass	Pass	Pass	Pass
Cal_1	C15.3_NB	N	2	115	24	5	144	101	21	8	130	-14	-3	3	-14	-12%	-13%	60%	-10%	Pass	Pass	Pass	Pass
Cal_1	C15.3_SB	S	1	114	24	5	143	121	24	6	151	7	0	1	8	6%	0%	20%	6%	Pass	Pass	Pass	Pass
Cal_2	C8.12_NB	N	2	49	8	0	57	55	15	10	80	6	7	10	23	12%	88%		40%	Pass	Pass	Pass	Pass
Cal_2	C8.12_SB	S	1	50	8	0	58	64	21	6	91	14	13	6	33	28%	163%		57%	Pass	Pass	Pass	Pass
Cal_4	C7.4_EB	E	1	158	22	0	180	187	35	0	222	29	13	0	42	18%	59%	0%	23%	Pass	Pass	Pass	Pass
Cal_4	C7.4_WB	W	2	153	21	0	174	129	24	0	153	-24	3	0	-21	-16%	14%	0%	-12%	Pass	Pass	Pass	Pass
Cal_5	C5.19_NB	N	2	164	15	4	183	170	17	0	187	6	2	-4	4	4%	13%	-100%	2%	Pass	Pass	Pass	Pass
Cal_5	C5.19_SB	S	1	125	15	4	144	122	15	0	137	-3	0	-4	-7	-2%	0%	-100%	-5%	Pass	Pass	Pass	Pass
Cal_5	C5.12_SB	S	2	85	11	2	98	77	5	2	84	-8	-6	0	-14	-9%	-55%	0%	-14%	Pass	Pass	Pass	Pass
Cal_5	C5.12_NB	N	1	78	9	3	90	75	9	3	87	-3	0	0	-3	-4%	0%	0%	-3%	Pass	Pass	Pass	Pass
Cal_9	C9.2_WB	W	1	76	34	12	122	98	50	11	159	22	16	-1	37	29%	47%	-8%	30%	Pass	Pass	Pass	Pass
Cal_9	C9.2_EB	E	2	85	28	8	121	146	42	8	196	61	14	0	75	72%	50%	0%	62%	Pass	Pass	Pass	Pass
Cal_9	C9.5_WB	W	1	422	57	23	502	301	38	15	354	-121	-19	-8	-148	-29%	-33%	-35%	-29%	Fail	Pass	Pass	Fail
Cal_9	C9.5_EB	E	2	420	64	21	505	317	44	17	378	-103	-20	-4	-127	-25%	-31%	-19%	-25%	Fail	Pass	Pass	Fail
Cal_1	C15.2_EB	E	1	30	6	1	37	11	5	0	16	-19	-1	-1	-21	-63%	-17%	-100%	-57%	Pass	Pass	Pass	Pass
Cal_1	C15.2_WB	W	2	27	6	1	34	22	5	0	27	-5	-1	-1	-7	-19%	-17%	-100%	-21%	Pass	Pass	Pass	Pass
Cal_7	C14.1_SB	S	2	812	109	41	962	873	124	45	1042	61	15	4	80	8%	14%	10%	8%	Pass	Pass	Pass	Pass
Cal_10	C2.10_EB	E	2	394	32	6	432	434	41	8	483	40	9	2	51	10%	28%	33%	12%	Pass	Pass	Pass	Pass
Cal_10	C2.10_WB	W	1	384	29	6	419	397	30	2	429	13	1	-4	10	3%	3%	-67%	2%	Pass	Pass	Pass	Pass
Cal_8	C11.3_EB	E	2	12	6	0	18	10	3	0	13	-2	-3	0	-5	-17%	-50%	0%	-28%	Pass	Pass	Pass	Pass
Cal_8	C11.3_WB	W	1	14	4	0	18	8	2	0	10	-6	-2	0	-8	-43%	-50%	0%	-44%	Pass	Pass	Pass	Pass
	19324-01 . A1245 (Fairglen) (NE)_northeastbound	0		1337	261	130	1728	1384	273	112	1769	47	12	-18	41	4%	5%	-14%	2%	Pass	Pass	Pass	Pass
	19324-01 . A1245 (Fairglen) (NE)_southwestbound	0		1220	244	112	1576	1340	236	113	1689	120	-8	1	113	10%	-3%	1%	7%	Pass	Pass	Pass	Pass
Cal_5	C5.20_SB	S	1	1079	223	143	1445	1138	215	129	1482	59	-8	-14	37	5%	-4%	-10%	3%	Pass	Pass	Pass	Pass
Cal_5	C5.16_SB	S	1	93	14	2	109	125	14	0	139	32	0	-2	30	34%	0%	-100%	28%	Pass	Pass	Pass	Pass
Cal_5	C5.16_NB	N	2	65	9	0	74	57	8	0	65	-8	-1	0	-9	-12%	-11%	0%	-12%	Pass	Pass	Pass	Pass
	C8.8_SB	S		8	2	0	10	13	1	0	14	5	-1	0	4	63%	-50%	0%	40%	Pass	Pass	Pass	Pass
	C8.8_NB	N		9	2	0	11	12	1	0	13	3	-1	0	2	33%	-50%	0%	18%	Pass	Pass	Pass	Pass
Cal_5	C5.6_NB	N	2	21	4	1	26	38	8	0	46	17	4	-1	20	81%	100%	-100%	77%	Pass	Pass	Pass	Pass
Cal_5	C5.6_SB	S	1	12	3	0	15	6	1	0	7	-6	-2	0	-8	-50%	-67%	0%	-53%	Pass	Pass	Pass	Pass
	61166117 A127 Southend Arterial Road Childerditch (2019)_EB	EB		1719	515	253	2487	1775	588	236	2599	56	73	-17	112	3%	14%	-7%	5%	Pass	Pass	Pass	Pass
	61166117 A127 Southend Arterial Road Childerditch (2019)_WB	WB		1570	409	193	2172	1651	474	197	2322	81	65	4	150	5%	16%	2%	7%	Pass	Pass	Pass	Pass
Cal_7	C14.5_NB	N	1	91	25	1	117	84	21	4	109	-7	-4	3	-8	-8%	-16%	300%	-7%	Pass	Pass	Pass	Pass
Cal_7	C14.5_SB	S	2	137	35	2	174	158	32	4	194	21	-3	2	20	15%	-9%	100%	11%	Pass	Pass	Pass	Pass

GEH or Criteria 1	Car	LGV	HGV	Total
	95%	100%	100%	94%
Fail	11	0	0	14
Pass	211	222	222	208

PM

Screenline	ID	BOUND	DIR	PM Count Data				PM Model Data				Absolute differences				%age Difference				GEH or Criteria 1			
				Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total
Cal_11	C1.9_EB	E	2	73	3	1	77	63	3	0	66	-10	0	-1	-11	-14%	0%	-100%	-14%	Pass	Pass	Pass	Pass
Cal_11	C1.9_WB	W	1	55	5	5	65	45	2	1	48	-10	-3	-4	-17	-18%	-60%	-80%	-26%	Pass	Pass	Pass	Pass
Cal_11	C1.7_EB	E	2	318	25	0	343	338	21	1	360	20	-4	1	17	6%	-16%		5%	Pass	Pass	Pass	Pass
Cal_11	C1.7_WB	W	1	132	10	1	143	124	8	0	132	-8	-2	-1	-11	-6%	-20%	-100%	-8%	Pass	Pass	Pass	Pass
Cal_8	C11.2_EB	E	2	971	82	14	1067	1230	105	18	1353	259	23	4	286	27%	28%	29%	27%	Fail	Pass	Pass	Fail
Cal_5	C5.1_NB	N	2	1274	115	11	1400	1314	157	13	1484	40	42	2	84	3%	37%	18%	6%	Pass	Pass	Pass	Pass
Cal_5	C5.1_SB	S	1	758	83	11	852	856	87	10	953	98	4	-1	101	13%	5%	-9%	12%	Pass	Pass	Pass	Pass
	C7.2_NEB	NE		2976	148	174	3298	3082	182	197	3461	106	34	23	163	4%	23%	13%	5%	Pass	Pass	Pass	Pass
	C8.2_SWB	SW		2342	165	157	2664	2451	188	166	2805	109	23	9	141	5%	14%	6%	5%	Pass	Pass	Pass	Pass
Cal_4	C7.8_EB	E	1	713	73	7	793	749	83	9	841	36	10	2	48	5%	14%	29%	6%	Pass	Pass	Pass	Pass
Cal_4	C7.8_WB	W	2	708	59	4	771	754	73	7	834	46	14	3	63	6%	24%	75%	8%	Pass	Pass	Pass	Pass
Cal_2	C8.11_SB	S	1	173	17	4	194	177	11	6	194	4	-6	2	0	2%	-35%	50%	0%	Pass	Pass	Pass	Pass
	V13.8_NWB	NW		893	109	4	1006	861	111	20	992	-32	2	16	-14	-4%	2%	400%	-1%	Pass	Pass	Pass	Pass
	V13.8_SEB	SE		965	118	4	1087	1010	92	10	1112	45	-26	6	25	5%	-22%	150%	2%	Pass	Pass	Pass	Pass
Cal_6	C12.1_SWB	SW	2	2067	294	63	2424	1924	301	62	2287	-143	7	-1	-137	-7%	2%	-2%	-6%	Pass	Pass	Pass	Pass
Cal_6	C12.1_NEB	NE	1	2266	578	71	2915	2468	535	74	3077	202	-43	3	162	9%	-7%	4%	6%	Pass	Pass	Pass	Pass
Cal_8	C11.2_WB	W	1	811	46	11	868	735	41	11	787	-76	-5	0	-81	-9%	-11%	0%	-9%	Pass	Pass	Pass	Pass
Cal_7	C14.1_NB	N	1	1154	186	98	1438	1508	191	82	1781	354	5	-16	343	31%	3%	-16%	24%	Fail	Pass	Pass	Fail
Cal_8	C11.4_NEB	NE	2	3164	316	62	3542	3022	363	56	3441	-142	47	-6	-101	-4%	15%	-10%	-3%	Pass	Pass	Pass	Pass
Cal_6	C12.8_SB	S	2	1011	124	11	1146	912	106	8	1026	-99	-18	-3	-120	-10%	-15%	-27%	-10%	Pass	Pass	Pass	Pass
Cal_6	C12.8_NB	N	1	559	68	9	636	708	81	10	799	149	13	1	163	27%	19%	11%	26%	Fail	Pass	Pass	Fail
Cal_5	C5.20_NB	0	2	1664	162	36	1862	1785	155	34	1974	121	-7	-2	112	7%	-4%	-6%	6%	Pass	Pass	Pass	Pass
Cal_9	C9.3_WB	W	1	2574	257	61	2892	2593	277	60	2930	19	20	-1	38	1%	8%	-2%	1%	Pass	Pass	Pass	Pass
Cal_9	C9.3_EB	E	2	3088	308	31	3427	2855	300	40	3195	-233	-8	9	-232	-8%	-3%	29%	-7%	Pass	Pass	Pass	Pass
Cal_10	C2.6_WB	W	2	343	29	0	372	338	21	0	359	-5	-8	0	-13	-1%	-28%	0%	-3%	Pass	Pass	Pass	Pass
Cal_10	C2.6_EB	E	1	352	17	1	370	318	13	0	331	-34	-4	-1	-39	-10%	-24%	-100%	-11%	Pass	Pass	Pass	Pass
Cal_10	C2.5_WB	W	1	1437	106	29	1572	1506	119	31	1656	69	13	2	84	5%	12%	7%	5%	Pass	Pass	Pass	Pass
Cal_8	C11.4_SWB	SW	1	2171	210	60	2441	2083	246	54	2383	-88	36	-6	-58	-4%	17%	-10%	-2%	Pass	Pass	Pass	Pass
Cal_2	C8.5_WB	W	2	135	10	0	145	115	13	1	129	-20	3	1	-16	-15%	30%		-11%	Pass	Pass	Pass	Pass
Cal_2	C8.5_EB	E	1	190	21	0	211	173	21	1	195	-17	0	1	-16	-9%	0%		-8%	Pass	Pass	Pass	Pass
Cal_5	C5.11_SEB	SE	1	536	51	0	587	523	80	4	607	-13	29	4	20	-2%	57%		3%	Pass	Pass	Pass	Pass
Cal_5	C5.11_NWB	NW	2	487	33	4	524	371	29	1	401	-116	-4	-3	-123	-24%	-12%	-75%	-23%	Fail	Pass	Pass	Fail
Cal_2	C8.1_NB	N	2	1432	120	50	1602	1528	131	51	1710	96	11	1	108	7%	9%	2%	7%	Pass	Pass	Pass	Pass
Cal_2	C8.14_NB	N	2	186	4	1	191	156	10	0	166	-30	6	-1	-25	-16%	150%	-100%	-13%	Pass	Pass	Pass	Pass
Cal_2	C8.14_SB	S	1	149	13	2	164	172	22	5	199	23	9	3	35	15%	69%	150%	21%	Pass	Pass	Pass	Pass
Cal_2	C8.19_WB	W	2	344	38	4	386	379	34	5	418	35	-4	1	32	10%	-11%	25%	8%	Pass	Pass	Pass	Pass
Cal_2	C8.19_EB	E	1	344	35	2	381	381	48	8	437	37	13	6	56	11%	37%	300%	15%	Pass	Pass	Pass	Pass
	V3.1_EB	E		3595	627	55	4277	3628	499	51	4178	33	-128	-4	-99	1%	-20%	-7%	-2%	Pass	Fail	Pass	Pass
	19324-01 . A130 (Sadlers Farm) (SW) _southwestbound	0		2180	248	43	2471	2036	270	46	2352	-144	22	3	-119	-7%	9%	7%	-5%	Pass	Pass	Pass	Pass
	V3.1_WB	W		2043	336	71	2450	2129	315	59	2503	86	-21	-12	53	4%	-6%	-17%	2%	Pass	Pass	Pass	Pass
Cal_3	C7.10_SB	S	2	445	50	3	498	383	40	3	426	-62	-10	0	-72	-14%	-20%	0%	-14%	Pass	Pass	Pass	Pass
Cal_3	C7.10_NB	N	1	295	30	0	325	221	16	31	268	-74	-14	31	-57	-25%	-47%		-18%	Pass	Pass	Pass	Pass
Cal_3	C7.12_NB	N	1	25	5	4	34	30	5	2	37	5	0	-2	3	20%	0%	-50%	9%	Pass	Pass	Pass	Pass
Cal_3	C7.12_SB	S	2	66	10	3	79	61	6	2	69	-5	-4	-1	-10	-8%	-40%	-33%	-13%	Pass	Pass	Pass	Pass
Cal_7	C14.6_NB	N	1	8	1	4	13	21	2	1	24	13	1	-3	11	163%	100%	-75%	85%	Pass	Pass	Pass	Pass
Cal_7	C14.6_SB	S	2	192	12	9	213	154	7	2	163	-38	-5	-7	-50	-20%	-42%	-78%	-23%	Pass	Pass	Pass	Pass
	20110-03 Burches Basildon_E	0		575	41	10	626	442	37	13	492	-133	-4	3	-134	-23%	-10%	30%	-21%	Fail	Pass	Pass	Fail
	20110-03 Burches Basildon_W	0		797	36	9	842	582	16	4	602	-215	-20	-5	-240	-27%	-56%	-56%	-29%	Fail	Pass	Pass	Fail
Cal_6	C12.5_SB	S	2	646	58	7	711	790	68	0	858	144	10	-7	147	22%	17%	-100%	21%	Fail	Pass	Pass	Fail
Cal_6	C12.5_NB	N	1	460	61	2	523	434	58	0	492	-26	-3	-2	-31	-6%	-5%	-100%	-6%	Pass	Pass	Pass	Pass
Cal_6	C12.4_NB	N	1	591	63	31	685	482	50	27	559	-109	-13	-4	-126	-18%	-21%	-13%	-18%	Pass	Pass	Pass	Fail
Cal_6	C12.4_SB	S	2	693	94	25	812	621	83	26	730	-72	-11	1	-82	-10%	-12%	4%	-10%	Pass	Pass	Pass	Pass
Cal_10	C2.7_WB	W	1	349	19	0	368	344	23	0	367	-5	4	0	-1	-1%	21%	0%	0%	Pass	Pass	Pass	Pass
Cal_10	C2.7_EB	E	2	256	12	1	269	248	13	0	261	-8	1	-1	-8	-3%	8%	-100%	-3%	Pass	Pass	Pass	Pass
Cal_6	C12.10_SB	S	2	540	38	0	578	507	30	0	537	-33	-8	0	-41	-6%	-21%	0%	-7%	Pass	Pass	Pass	Pass
Cal_6	C12.10_NB	N	1	425	21	0	446	468	28	0	496	43	7	0	50	10%	33%	0%	11%	Pass	Pass	Pass	Pass
Cal_6	C12.2_WB	W	2	759	64	1	824	791	61	2	854	32	-3	1	30	4%	-5%	100%	4%	Pass	Pass	Pass	Pass
Cal_6	C12.2_EB	E	1	702	51	0	753	712	50	2	764	10	-1	2	11	1%	-2%		1%	Pass	Pass	Pass	Pass
Cal_5	C5.9_NB	N	2	653	59	6	718	703	76	15	794	50	17	9	76	8%	29%	150%	11%	Pass	Pass	Pass	Pass
Cal_5	C5.9_SB	S	1	804	67	4	875	689	37	9	735	-115	-30	5	-140	-14%	-45%	125%	-16%	Pass	Pass	Pass	Pass
Cal_2	C8.15_SB	S	1	199	12	1	212	223	34	2	259	24	22	1	47	12%	183%	100%	22%	Pass	Pass	Pass	Pass
Cal_2	C8.15_NB	N	2	337	34	2	373	356	55	4	415	19	21	2	42	6%	62%	100%	11%	Pass	Pass	Pass	Pass
Cal_11	C1.5_WB	W	1	356	19	2	377	364	25	2	391	8	6	0	14	2%	32%	0%	4%	Pass	Pass	Pass	Pass
Cal_11	C1.5_EB	E	2	827	42	1	870	883	59	2	944	56	17	1	74	7%	40%	100%	9%	Pass	Pass	Pass	Pass
Cal_5	C5.8_NB	N	2	613	50	7	670	587	38	2	627	-26	-12	-5	-43	-4%	-24%	-71%	-6%	Pass	Pass	Pass	Pass
Cal_5	C5.8_SB	S	1	597	68	3	668	474	51	2	527	-123	-17	-1	-141	-21%	-25%	-33%	-21%	Fail	Pass	Pass	Fail
Cal_5	C5.13_NB	N	2	591	42	0	633	614	35	2	651	23	-7	2	18	4%	-17%		3%	Pass	Pass	Pass	Pass
Cal_5	C5.13_SB	S	1	490	32	2	524	593	51	5	649	103	19	3	125	21%	59%	150%	24%	Pass	Pass	Pass	Fail
Cal_5	C5.14_NEB	NE	2	439	40	0	479	283	38	0	321	-156	-2	0	-158	-36%	-5%	0%	-33%	Fail	Pass	Pass	Fail
Cal_5	C5.14_SWB	SW	1	316	22	1	339	272	20	0	292	-44	-2	-1	-47	-14%	-9%	-100%	-14%	Pass	Pass	Pass	Pass
Cal_2	C8.7_NB	N	2	209	15	0	224	171	9	0	180	-38	-6	0	-44	-18%	-40%	0%	-20%	Pass	Pass	Pass	Pass
Cal_2	C8.7_SB	S	1	123	6	0	129	112	9	1	122	-11	3	1	-7	-9%	50%		-5%	Pass	Pass	Pass	Pass
Cal_3	C7.9_NEB	NE	1	723	43	2	768	734	44	8	786	11	1	6	18	2%	2%	300%	2%	Pass	Pass	Pass	Pass
Cal_3	C7.9_SWB	SW	2	1078	54	2	1134	931	42	7	980	-147	-12	5	-154	-14%	-22%	250%	-14%	Pass	Pass	Pass	Pass
Cal_10	C2.5_EB	E	2	1761	134	26	1921	1925	166	27	2118	164	32	1	197	9%	24%	4%	10%	Pass	Pass	Pass	Pass
Cal_5	C5.18_NB	N	2	717	37	3	757	676	33	6	715	-41	-4	3	-42	-6%	-11%	100%	-6%	Pass	Pass	Pass	Pass
Cal_5	C5.18_SB	S	1	668	60	3	731	682	62	5	749	14	2	2	18	2%	3%	67%	2%	Pass	Pass	Pass	Pass
Cal_7	C14.7_SB	0	2	688	67	21	776	785	74	28	887	97	7	7	111	14%	10%	33%	14%	Pass	Pass	Pass	Pass
Cal_7	C14.7_NB	0	1	1063	108	42	1213	851	82	30	963	-212	-26	-12	-250	-20%	-24%	-29%	-21%	Fail	Pass	Pass	Fail
Cal_2	C8.10_SB	S	1	247	17	1	265	263	24	4	291	16	7	3	26	6%	41%	300%	10%	Pass	Pass	Pass	Pass
Cal_2	C8.10_NB	N	2	639	61	2	702	563	46	4	613	-76	-15	2	-89	-12%	-25%	100%	-13%	Pass	Pass	Pass	Pass
Cal_5	C5.4_NB	N	2	494	31	1	526	417	20	0	437	-77	-11	-1	-89	-16%	-35%	-100%	-17%	Pass	Pass	Pass	Pass
Cal_5	C5.4_SB	S	1	661	39	1	701	670	50	0	720	9	11	-1	19	1%	28%	-100%	3%	Pass	Pass	Pass	Pass
Cal_8	C11.5_WB	W	1	327	45	6	378	393	49	5	447	66	4	-1	69	20%	9%	-17%	18%	Pass	Pass	Pass	Pass
Cal_8	C11.5_EB	E	2	633	86	12	731	596	71	6	673	-37	-15	-6	-58	-6%	-17%	-50%	-8%	Pass	Pass	Pass	Pass
Cal_2	C8.13_NB	N	2	786	30	4	820	699	34	5	738	-87	4	1	-82	-11%	13%	25%	-10%	Pass	Pass	Pass	Pass
Cal_2	C8.13_SB	S	1	729	53	4	786	668	61	4	733	-61	8	0	-53	-8%	15%	0%	-7%	Pass	Pass	Pass	Pass
Cal_1	C15.1_WB	W	2	73	7	0	80	124	15	3	142	51	8	3	62	70%	114%		78%	Pass	Pass	Pass	Pass
Cal_1	C15.1_EB	E	1	345	32	2	379	439	33	6	478	94	1	4	99	27%	3%	200%	26%	Pass	Pass	Pass	Pass
Cal_2	C8.17_NB	N	2	366	35	1	402	348	26	5	379	-18	-9	4	-23	-5%	-26%	400%	-6%	Pass	Pass	Pass	Pass
Cal_2	C8.17_SB	S	1	406	38	3	447	444	52	12	508	38	14	9	61	9%	37%	300%	14%	Pass	Pass	Pass	Pass
Cal_5	C5.10_EB	E	2	1279	48	17	1344	1305	65	26	1396	26	17	9	52	2%	35%	53%	4%	Pass	Pass	Pass	Pass
Cal_5	C5.10_WB	W	1	938	83	28	1049	914	93	30	1037	-24	10	2	-12	-3%	12%	7%	-1%	Pass	Pass	Pass	Pass
Cal_9	C9.1_WB	W	1	397	37	3	437	446	46	5	497	49	9	2	60	12%	24%	67%	14%	Pass	Pass	Pass	Pass
Cal_9	C9.1_EB	E	2	993	85	2	1080	1036	123	7	1166	43	38	5	86	4%	45%	250%	8%	Pass	Pass	Pass	Pass
Cal_10	C2.1_NWB	NW	1	733	28	2	763	687	25	1	713	-46	-3	-1	-50	-6%	-11%	-50%	-7%	Pass	Pass	Pass	Pass
Cal_10	C2.1_SEB	SE	2	568	45	1	614	605	49	1	655	37	4	0	41	7%	9%	0%	7%	Pass	Pass	Pass	Pass
Cal_5	C5.15_NB	N	2	216	25	1	242	240	17	1	258	24	-8	0	16	11%	-32%	0%	7%	Pass	Pass	Pass	Pass
Cal_5	C5.15_SB	S	1	166	19	0	185	183	15	3	201	17	-4	3	16	10%	-21%		9%	Pass	Pass	Pass	Pass
Cal_11	C1.8_EB	E	2	121	6	2	129	124	7	1	132	3	1	-1	3	2%	17%	-50%	2%	Pass	Pass	Pass	Pass
Cal_11	C1.8_WB	W	1	92	8	0	100	78	7	1	86	-14	-1	1	-14	-15%	-13%		-14%	Pass	Pass	Pass	Pass
Cal_10	C2.2_SB	S	2	640	106	6	752	576	83	3	662	-64	-23	-3	-90	-10%	-22%	-50%	-12%	Pass	Pass	Pass	Pass
Cal_10	C2.2_NB	N	1	349	42	3	394	383	40	3	426	34	-2	0	32	10%	-5%	0%	8%	Pass	Pass	Pass	Pass
Cal_2	C8.3_NB	N	2	564	48	2	614	506	63	9	578	-58	15	7	-36	-10%	31%	350%	-6%	Pass	Pass	Pass	Pass
Cal_2	C8.3_SB	S	1	354	40	2	396	349	49	8	406	-5	9	6	10	-1%	23%	300%	3%	Pass	Pass	Pass	Pass
Cal_7	C14.9_NB	0	1	456	34	5	495	341	21	4	366	-115	-13	-1	-129	-25%	-38%	-20%	-26%	Fail	Pass	Pass	Fail
Cal_7	C14.9_SB	0	2	571	27	6	604	418	15	2	435	-153	-12	-4	-169	-27%	-44%	-67%	-28%	Fail	Pass	Pass	Fail
Cal_7	C14.2_SB	S	2	1179	126	15	1320	1295	131	24	1450	116	5	9	130	10%	4%	60%	10%	Pass	Pass	Pass	Pass
Cal_8	C11.6_NEB	NE	2	273	27	1	301	335	20	2	357	62	-7	1	56	23%	-26%	100%	19%	Pass	Pass	Pass	Pass
Cal_8	C11.6_SWB	SW	1	479	57	1	537	497	40	2	539	18	-17	1	2	4%	-30%	100%	0%	Pass	Pass	Pass	Pass
Cal_8	C11.8_EB	E	2	1108	72	2	1182	1305	94	11	1410	197	22	9	228	18%	31%	450%	19%	Fail	Pass	Pass	Fail
Cal_8	C11.7_EB	E	2	608	45	0	653	624	44	3	671	16	-1	3	18	3%	-2%		3%	Pass	Pass	Pass	Pass
Cal_8	C11.7_WB	W	1	196	9	0	205	260	17	3	280	64	8	3	75	33%	89%		37%	Pass	Pass	Pass	Pass
Cal_4	C7.5_NEB	NE	1	794	113	8	915	772	134	11	917	-22	21	3	2	-3%	19%	38%	0%	Pass	Pass	Pass	Pass
Cal_4	C7.5_SWB	SW	2	620	60	6	686	760	74	10	844	140	14	4	158	23%	23%	67%	23%	Fail	Pass	Pass	Fail
Cal_9	C9.4_WB	W	1	877	79	9	965	822	74	10	906	-55	-5	1	-59	-6%	-6%	11%	-6%	Pass	Pass	Pass	Pass
Cal_9	C9.4_EB	E	2	1619	319	20	1958	1825	282	11	2118	206	-37	-9	160	13%	-12%	-45%	8%	Pass	Pass	Pass	Pass
Cal_6	C12.9_SB	S	2	692	76	5	773	667	74	3	744	-25	-2	-2	-29	-4%	-3%	-40%	-4%	Pass	Pass	Pass	Pass
Cal_6	C12.9_NB	N	1	630	69	4	703	441	59	2	502	-189	-10	-2	-201	-30%	-14%	-50%	-29%	Fail	Pass	Pass	Fail
Cal_2	C8.4_NWB	NW	2	31	3	0	34	22	2	0	24	-9	-1	0	-10	-29%	-33%	0%	-29%	Pass	Pass	Pass	Pass
Cal_2	C8.4_SEB	SE	1	58	5	0	63	50	0	0	50	-8	-5	0	-13	-14%	-100%	0%	-21%	Pass	Pass	Pass	Pass
Cal_6	C12.7_NB	N	1	87	13	0	100	100	5	0	105	13	-8	0	5	15%	-62%	0%	5%	Pass	Pass	Pass	Pass
Cal_6	C12.7_SB	S	2	132	14	0	146	120	5	0	125	-12	-9	0	-21	-9%	-64%	0%	-14%	Pass	Pass	Pass	Pass
Cal_7	C14.8_SB	0	2	615	54	8	677	596	67	6	669	-19	13	-2	-8	-3%	24%	-25%	-1%	Pass	Pass	Pass	Pass
Cal_7	C14.8_NB	0	1	546	36	5	587	497	43	7	547	-49	7	2	-40	-9%	19%	40%	-7%	Pass	Pass	Pass	Pass
Cal_7	C14.10_NB	0	1	388	26	6	420	408	30	12	450	20	4	6	30	5%	15%	100%	7%	Pass	Pass	Pass	Pass
Cal_7	C14.10_SB	0	2	539	22	6	567	616	28	8	652	77	6	2	85	14%	27%	33%	15%	Pass	Pass	Pass	Pass

Cal_5	C5.17_NB	N	2	370	17	1	388	413	30	2	445	43	13	1	57	12%	76%	100%	15%	Pass	Pass	Pass	Pass
Cal_5	C5.17_SB	S	1	278	11	2	291	245	9	1	255	-33	-2	-1	-36	-12%	-18%	-50%	-12%	Pass	Pass	Pass	Pass
Cal_1	C15.4_NWB	NW	2	92	19	4	115	79	8	0	87	-13	-11	-4	-28	-14%	-58%	-100%	-24%	Pass	Pass	Pass	Pass
Cal_1	C15.4_SEB	SE	1	206	43	8	257	210	37	8	255	4	-6	0	-2	2%	-14%	0%	-1%	Pass	Pass	Pass	Pass
Cal_8	C11.9_SEB	SE	2	133	8	0	141	107	10	0	117	-26	2	0	-24	-20%	25%	0%	-17%	Pass	Pass	Pass	Pass
Cal_8	C11.9_NWB	NW	1	42	2	0	44	51	5	0	56	9	3	0	12	21%	150%	0%	27%	Pass	Pass	Pass	Pass
Cal_2	C8.18_NEB	NE	2	195	16	0	211	196	25	0	221	1	9	0	10	1%	56%	0%	5%	Pass	Pass	Pass	Pass
Cal_2	C8.18_SWB	SW	1	132	11	1	144	90	24	2	116	-42	13	1	-28	-32%	118%	100%	-19%	Pass	Pass	Pass	Pass
Cal_8	C11.10_SWB	SW	1	246	58	6	310	255	59	3	317	9	1	-3	7	4%	2%	-50%	2%	Pass	Pass	Pass	Pass
Cal_8	C11.10_NEB	NE	2	412	96	10	518	350	88	5	443	-62	-8	-5	-75	-15%	-8%	-50%	-14%	Pass	Pass	Pass	Pass
Cal_7	C14.2_NB	N	1	1277	137	16	1430	1092	105	18	1215	-185	-32	2	-215	-14%	-23%	13%	-15%	Pass	Pass	Pass	Fail
Cal_11	C1.6_WB	W	1	373	25	3	401	296	13	1	310	-77	-12	-2	-91	-21%	-48%	-67%	-23%	Pass	Pass	Pass	Pass
Cal_11	C1.6_EB	E	2	455	23	4	482	388	13	1	402	-67	-10	-3	-80	-15%	-43%	-75%	-17%	Pass	Pass	Pass	Pass
Cal_11	C1.2_WB	W	1	560	44	1	605	480	28	1	509	-80	-16	0	-96	-14%	-36%	0%	-16%	Pass	Pass	Pass	Pass
Cal_11	C1.2_EB	E	2	534	39	1	574	469	16	1	486	-65	-23	0	-88	-12%	-59%	0%	-15%	Pass	Pass	Pass	Pass
Cal_11	C1.1_WB	W	1	191	10	0	201	215	12	0	227	24	2	0	26	13%	20%	0%	13%	Pass	Pass	Pass	Pass
Cal_11	C1.4_EB	E	2	292	17	0	309	324	10	0	334	32	-7	0	25	11%	-41%	0%	8%	Pass	Pass	Pass	Pass
Cal_10	C2.9_WB	W	1	484	29	2	515	333	13	2	348	-151	-16	0	-167	-31%	-55%	0%	-32%	Fail	Pass	Pass	Fail
Cal_10	C2.9_EB	E	2	460	46	0	506	383	29	0	412	-77	-17	0	-94	-17%	-37%	0%	-19%	Pass	Pass	Pass	Pass
	C2.8_NWB	NW		115	8	0	123	199	7	1	207	84	-1	1	84	73%	-13%		68%	Pass	Pass	Pass	Pass
	C2.8_SEB	SE		166	14	0	180	187	21	2	210	21	7	2	30	13%	50%		17%	Pass	Pass	Pass	Pass
Cal_10	C2.3_NWB	NW	1	911	53	1	965	857	52	2	911	-54	-1	1	-54	-6%	-2%	100%	-6%	Pass	Pass	Pass	Pass
Cal_10	C2.3_SEB	SE	2	765	65	2	832	754	58	4	816	-11	-7	2	-16	-1%	-11%	100%	-2%	Pass	Pass	Pass	Pass
Cal_10	C2.11_WB	W	1	357	19	0	376	461	32	2	495	104	13	2	119	29%	68%		32%	Fail	Pass	Pass	Fail
Cal_10	C2.11_EB	E	2	391	30	0	421	323	27	1	351	-68	-3	1	-70	-17%	-10%		-17%	Pass	Pass	Pass	Pass
Cal_11	C1.3_WB	W	1	1058	74	8	1140	1090	77	9	1176	32	3	1	36	3%	4%	13%	3%	Pass	Pass	Pass	Pass
Cal_11	C1.3_EB	E	2	1269	99	11	1379	1142	89	10	1241	-127	-10	-1	-138	-10%	-10%	-9%	-10%	Pass	Pass	Pass	Pass
Cal_3	C7.11_WB	W	2	178	16	2	196	239	18	3	260	61	2	1	64	34%	13%	50%	33%	Pass	Pass	Pass	Pass
Cal_3	C7.11_EB	E	1	272	22	0	294	352	35	6	393	80	13	6	99	29%	59%		34%	Pass	Pass	Pass	Pass
Cal_6	C12.6_NB	N	1	368	36	3	407	379	36	6	421	11	0	3	14	3%	0%	100%	3%	Pass	Pass	Pass	Pass
Cal_6	C12.6_SB	S	2	506	54	1	561	557	51	5	613	51	-3	4	52	10%	-6%	400%	9%	Pass	Pass	Pass	Pass
Cal_7	C14.3_NB	N	1	109	11	7	127	253	26	4	283	144	15	-3	156	132%	136%	-43%	123%	Fail	Pass	Pass	Fail
Cal_7	C14.3_SB	S	2	459	25	6	490	707	47	3	757	248	22	-3	267	54%	88%	-50%	54%	Fail	Pass	Pass	Fail
Cal_4	C7.6_SB	S	2	481	51	0	532	342	44	2	388	-139	-7	2	-144	-29%	-14%		-27%	Fail	Pass	Pass	Fail
Cal_4	C7.6_NB	N	1	384	36	1	421	353	43	2	398	-31	7	1	-23	-8%	19%	100%	-5%	Pass	Pass	Pass	Pass
Cal_2	C8.9_NB	N	2	56	6	0	62	64	11	0	75	8	5	0	13	14%	83%	0%	21%	Pass	Pass	Pass	Pass
Cal_2	C8.9_SB	S	1	28	4	0	32	56	10	0	66	28	6	0	34	100%	150%	0%	106%	Pass	Pass	Pass	Pass
Cal_8	C11.1_EB	E	2	2863	477	41	3381	2620	384	42	3046	-243	-93	1	-335	-8%	-19%	2%	-10%	Pass	Pass	Pass	Pass
Cal_5	C5.7_NB	N	2	171	22	0	193	67	0	0	67	-104	-22	0	-126	-61%	-100%	0%	-65%	Fail	Pass	Pass	Fail
Cal_5	C5.7_SB	S	1	73	15	1	89	40	2	0	42	-33	-13	-1	-47	-45%	-87%	-100%	-53%	Pass	Pass	Pass	Pass
Cal_8	C11.8_WB	W	1	578	44	0	622	533	38	6	577	-45	-6	6	-45	-8%	-14%		-7%	Pass	Pass	Pass	Pass
Cal_8	C11.1_WB	W	1	2329	367	49	2745	2335	344	49	2728	6	-23	0	-17	0%	-6%	0%	-1%	Pass	Pass	Pass	Pass
Cal_7	C14.4_NB	N	1	423	24	1	448	326	27	5	358	-97	3	4	-90	-23%	13%	400%	-20%	Pass	Pass	Pass	Pass
Cal_7	C14.4_SB	S	2	404	30	0	434	378	20	4	402	-26	-10	4	-32	-6%	-33%		-7%	Pass	Pass	Pass	Pass
Cal_5	17101-36 . Dunton Rd BRENTWOOD_SE	SE	1	195	11	0	206	253	32	0	285	58	21	0	79	30%	191%	0%	38%	Pass	Pass	Pass	Pass
Cal_5	17101-36 . Dunton Rd BRENTWOOD_NW	NW	2	69	12	0	81	57	1	0	58	-12	-11	0	-23	-17%	-92%	0%	-28%	Pass	Pass	Pass	Pass
Cal_2	C8.6_NB	N	2	282	28	0	310	309	40	2	351	27	12	2	41	10%	43%		13%	Pass	Pass	Pass	Pass
Cal_2	C8.6_SB	S	1	185	23	0	208	241	40	2	283	56	17	2	75	30%	74%		36%	Pass	Pass	Pass	Pass
Cal_4	C7.7_NEB	NE	1	49	8	0	57	52	16	0	68	3	8	0	11	6%	100%	0%	19%	Pass	Pass	Pass	Pass
Cal_4	C7.7_SWB	SW	2	18	5	0	23	19	6	0	25	1	1	0	2	6%	20%	0%	9%	Pass	Pass	Pass	Pass
Cal_4	C7.3_NB	N	1	247	12	0	259	232	24	0	256	-15	12	0	-3	-6%	100%	0%	-1%	Pass	Pass	Pass	Pass
Cal_4	C7.3_SB	S	2	275	24	0	299	237	25	0	262	-38	1	0	-37	-14%	4%	0%	-12%	Pass	Pass	Pass	Pass
Cal_5	C5.5_SB	S	1	240	8	0	248	293	4	0	297	53	-4	0	49	22%	-50%	0%	20%	Pass	Pass	Pass	Pass
Cal_5	C5.5_NB	N	2	43	2	1	46	111	22	0	133	68	20	-1	87	158%	1000%	-100%	189%	Pass	Pass	Pass	Pass
Cal_6	C12.3_SB	S	2	30	5	0	35	0	0	0	0	-30	-5	0	-35	-100%	-100%	0%	-100%	Pass	Pass	Pass	Pass
Cal_6	C12.3_NB	N	1	10	1	0	11	0	0	0	0	-10	-1	0	-11	-100%	-100%	0%	-100%	Pass	Pass	Pass	Pass
Cal_4	C7.1_SWB	SW	2	2305	133	161	2599	2364	170	167	2701	59	37	6	102	3%	28%	4%	4%	Pass	Pass	Pass	Pass
	19324-01 . A130 (Sadlers Farm) (SW)_northeastbound	0		2294	260	46	2600	2439	296	42	2777	145	36	-4	177	6%	14%	-9%	7%	Pass	Pass	Pass	Pass
Cal_2	C8.1_SB	S	1	2495	171	64	2730	2354	182	59	2595	-141	11	-5	-135	-6%	6%	-8%	-5%	Pass	Pass	Pass	Pass
Cal_2	C8.16_SB	S	1	309	28	0	337	205	33	0	238	-104	5	0	-99	-34%	18%	0%	-29%	Fail	Pass	Pass	Pass
Cal_2	C8.16_NB	N	2	77	7	0	84	63	8	0	71	-14	1	0	-13	-18%	14%	0%	-15%	Pass	Pass	Pass	Pass
Cal_1	C15.3_NB	N	2	129	27	5	161	107	28	4	139	-22	1	-1	-22	-17%	4%	-20%	-14%	Pass	Pass	Pass	Pass
Cal_1	C15.3_SB	S	1	198	41	8	247	153	36	3	192	-45	-5	-5	-55	-23%	-12%	-63%	-22%	Pass	Pass	Pass	Pass
Cal_2	C8.12_NB	N	2	54	9	0	63	63	19	2	84	9	10	2	21	17%	111%		33%	Pass	Pass	Pass	Pass
Cal_2	C8.12_SB	S	1	86	14	0	100	113	24	5	142	27	10	5	42	31%	71%		42%	Pass	Pass	Pass	Pass
Cal_4	C7.4_EB	E	1	293	41	0	334	343	50	0	393	50	9	0	59	17%	22%	0%	18%	Pass	Pass	Pass	Pass
Cal_4	C7.4_WB	W	2	279	39	0	318	303	44	0	347	24	5	0	29	9%	13%	0%	9%	Pass	Pass	Pass	Pass
Cal_5	C5.19_NB	N	2	396	11	6	413	396	14	0	410	0	3	-6	-3	0%	27%	-100%	-1%	Pass	Pass	Pass	Pass
Cal_5	C5.19_SB	S	1	212	15	5	232	248	16	0	264	36	1	-5	32	17%	7%	-100%	14%	Pass	Pass	Pass	Pass
Cal_5	C5.12_SB	S	2	171	13	0	184	142	4	0	146	-29	-9	0	-38	-17%	-69%	0%	-21%	Pass	Pass	Pass	Pass
Cal_5	C5.12_NB	N	1	110	8	0	118	70	6	1	77	-40	-2	1	-41	-36%	-25%		-35%	Pass	Pass	Pass	Pass
Cal_9	C9.2_WB	W	1	151	36	3	190	181	28	3	212	30	-8	0	22	20%	-22%	0%	12%	Pass	Pass	Pass	Pass
Cal_9	C9.2_EB	E	2	472	41	1	514	363	31	3	397	-109	-10	2	-117	-23%	-24%	200%	-23%	Fail	Pass	Pass	Fail
Cal_9	C9.5_WB	W	1	524	44	4	572	441	45	4	490	-83	1	0	-82	-16%	2%	0%	-14%	Pass	Pass	Pass	Pass
Cal_9	C9.5_EB	E	2	718	72	5	795	830	78	4	912	112	6	-1	117	16%	8%	-20%	15%	Pass	Pass	Pass	Pass
Cal_1	C15.2_EB	E	1	86	18	3	107	41	16	0	57	-45	-2	-3	-50	-52%	-11%	-100%	-47%	Pass	Pass	Pass	Pass
Cal_1	C15.2_WB	W	2	20	4	1	25	19	4	0	23	-1	0	-1	-2	-5%	0%	-100%	-8%	Pass	Pass	Pass	Pass
Cal_7	C14.1_SB	S	2	1164	174	106	1444	1220	185	92	1497	56	11	-14	53	5%	6%	-13%	4%	Pass	Pass	Pass	Pass
Cal_10	C2.10_EB	E	2	485	31	1	517	528	33	2	563	43	2	1	46	9%	6%	100%	9%	Pass	Pass	Pass	Pass
Cal_10	C2.10_WB	W	1	497	35	0	532	565	45	1	611	68	10	1	79	14%	29%		15%	Pass	Pass	Pass	Pass
Cal_8	C11.3_EB	E	2	30	4	0	34	22	4	0	26	-8	0	0	-8	-27%	0%	0%	-24%	Pass	Pass	Pass	Pass
Cal_8	C11.3_WB	W	1	15	2	0	17	9	2	0	11	-6	0	0	-6	-40%	0%	0%	-35%	Pass	Pass	Pass	Pass
	19324-01 . A1245 (Fairglen) (NE)_northeastbound	0		1668	199	30	1897	1774	211	22	2007	106	12	-8	110	6%	6%	-27%	6%	Pass	Pass	Pass	Pass
	19324-01 . A1245 (Fairglen) (NE)_southwestbound	0		1827	193	23	2043	1852	200	23	2075	25	7	0	32	1%	4%	0%	2%	Pass	Pass	Pass	Pass
Cal_5	C5.20_SB	S	1	1712	190	47	1949	1397	145	40	1582	-315	-45	-7	-367	-18%	-24%	-15%	-19%	Fail	Pass	Pass	Fail
Cal_5	C5.16_SB	S	1	134	22	0	156	229	25	0	254	95	3	0	98	71%	14%	0%	63%	Pass	Pass	Pass	Pass
Cal_5	C5.16_NB	N	2	130	8	1	139	73	6	0	79	-57	-2	-1	-60	-44%	-25%	-100%	-43%	Pass	Pass	Pass	Pass
	C8.8_SB	S		11	0	0	11	16	1	0	17	5	1	0	6	45%		0%	55%	Pass	Pass	Pass	Pass
	C8.8_NB	N		18	3	0	21	14	1	0	15	-4	-2	0	-6	-22%	-67%	0%	-29%	Pass	Pass	Pass	Pass
Cal_5	C5.6_NB	N	2	13	2	0	15	32	15	0	47	19	13	0	32	146%	650%	0%	213%	Pass	Pass	Pass	Pass
Cal_5	C5.6_SB	S	1	7	1	0	8	16	1	0	17	9	0	0	9	129%	0%	0%	113%	Pass	Pass	Pass	Pass
	61166117 A127 Southend Arterial Road Childerditch (2019)_EB	EB		2525	373	128	3026	2677	446	112	3235	152	73	-16	209	6%	20%	-13%	7%	Pass	Pass	Pass	Pass
	61166117 A127 Southend Arterial Road Childerditch (2019)_WB	WB		2558	305	87	2950	2540	350	90	2980	-18	45	3	30	-1%	15%	3%	1%	Pass	Pass	Pass	Pass
Cal_7	C14.5_NB	N	1	118	9	1	128	129	29	15	173	11	20	14	45	9%	222%	1400%	35%	Pass	Pass	Pass	Pass
Cal_7	C14.5_SB	S	2	228	19	1	248	252	25	3	280	24	6	2	32	11%	32%	200%	13%	Pass	Pass	Pass	Pass

GEH or Criteria 1	Car	LGV	HGV	Total
	89%	100%	100%	88%
Fail	24	1	0	26
Pass	198	221	222	196

Appendix P – Validation Count Summary

AM

Screenline	ID	BOUND	DIR	AM Count Data				AM Model Data				Absolute differences				%age Difference				GEH or Criteria 1			
				Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total
Val_1	V4.13_NB	N	1	427	25	5	457	477	39	8	524	50	14	3	67	12%	57%	56%	15%	Pass	Pass	Pass	Pass
Val_1	V4.13_SB	S	2	604	37	5	646	700	35	1	736	96	-2	-4	90	16%	-7%	-79%	14%	Pass	Pass	Pass	Pass
Val_1	V4.6_SB	S	2	583	63	6	652	425	145	14	584	-158	82	8	-68	-27%	130%	138%	-10%	Fail	Pass	Pass	Pass
Val_1	V4.6_NB	N	1	462	56	12	530	499	85	13	597	37	29	1	67	8%	52%	11%	13%	Pass	Pass	Pass	Pass
Val_6	V13.1_EB	E	1	2314	477	318	3109	2393	522	189	3104	79	45	-129	-5	3%	10%	-40%	0%	Pass	Pass	Fail	Pass
Val_6	V13.1_WB	W	2	2476	682	240	3398	2424	663	190	3277	-52	-19	-50	-121	-2%	-3%	-21%	-4%	Pass	Pass	Pass	Pass
Val_1	V4.4_NB	N	1	621	37	2	660	628	33	6	668	7	-4	4	8	1%	-9%	215%	1%	Pass	Pass	Pass	Pass
Val_1	V4.10_SB	S	2	441	67	16	524	619	20	3	642	178	-47	-13	118	40%	-70%	-80%	23%	Fail	Pass	Pass	Pass
Val_1	V4.8_SB	S	2	618	86	61	765	632	108	46	786	14	22	-15	21	2%	25%	-25%	3%	Pass	Pass	Pass	Pass
Val_4	V6.1_EB	E	2	1199	335	77	1611	1182	168	49	1400	-17	-167	-28	-211	-1%	-50%	-36%	-13%	Pass	Fail	Pass	Pass
Val_3	V3.3_EB	E	2	353	53	16	422	354	39	2	395	1	-14	-14	-27	0%	-26%	-87%	-6%	Pass	Pass	Pass	Pass
Val_3	V3.3_WB	W	1	509	66	4	579	672	59	5	736	163	-7	1	157	32%	-10%	26%	27%	Fail	Pass	Pass	Fail
Val_1	V4.12_NB	N	1	354	24	2	380	293	39	3	335	-61	15	1	-45	-17%	63%	33%	-12%	Pass	Pass	Pass	Pass
Val_1	V4.12_SB	S	2	227	18	1	246	272	22	1	295	45	4	-0	49	20%	21%	-8%	20%	Pass	Pass	Pass	Pass
Val_1	V4.9_NEB	NE	1	414	72	7	493	333	112	4	449	-81	40	-3	-44	-19%	55%	-38%	-9%	Pass	Pass	Pass	Pass
Val_1	V4.9_SWB	SW	2	376	65	6	447	401	93	5	499	25	28	-1	52	7%	43%	-15%	12%	Pass	Pass	Pass	Pass
Val_4	V6.3_WB	W	1	98	9	0	107	171	12	0	184	73	3	0	77	75%	37%		72%	Pass	Pass	Pass	Pass
Val_4	V6.3_EB	E	2	203	12	3	218	391	22	8	422	188	10	5	204	93%	83%	183%	93%	Fail	Pass	Pass	Fail
Val_1	V4.3_NB	N	1	1138	74	23	1235	1012	90	27	1129	-126	16	4	-106	-11%	21%	17%	-9%	Pass	Pass	Pass	Pass
Val_1	V4.3_SB	S	2	1118	101	19	1238	1077	68	30	1175	-41	-33	11	-63	-4%	-32%	58%	-5%	Pass	Pass	Pass	Pass
Val_1	V4.14_NB	N	1	363	25	4	392	331	32	3	365	-32	7	-1	-27	-9%	26%	-32%	-7%	Pass	Pass	Pass	Pass
Val_1	V4.14_SB	S	2	413	52	7	472	379	56	4	440	-34	4	-3	-32	-8%	7%	-38%	-7%	Pass	Pass	Pass	Pass
Val_6	V13.5_WB	W	2	206	13	2	221	183	35	0	219	-23	22	-2	-2	-11%	173%	-100%	-1%	Pass	Pass	Pass	Pass
Val_6	V13.5_EB	E	1	41	9	2	52	125	20	0	146	84	11	-2	94	206%	125%	-100%	180%	Pass	Pass	Pass	Pass
Val_1	V4.5_WB	W	2	356	51	4	411	408	86	7	502	52	35	3	91	15%	69%	74%	22%	Pass	Pass	Pass	Pass
Val_1	V4.5_EB	E	1	157	15	5	177	167	55	13	236	10	40	8	59	6%	269%	168%	33%	Pass	Pass	Pass	Pass
Val_2	V10.3_NB	N	2	578	54	11	643	563	72	17	652	-15	18	6	9	-3%	33%	56%	1%	Pass	Pass	Pass	Pass
Val_2	V10.3_SB	S	1	814	48	9	871	780	41	7	828	-34	-7	-2	-43	-4%	-14%	-25%	-5%	Pass	Pass	Pass	Pass
Val_2	V10.4_SB	S	1	498	40	10	548	419	39	10	468	-79	-1	0	-80	-16%	-2%	1%	-15%	Pass	Pass	Pass	Pass
Val_2	V10.4_NB	N	2	591	61	39	691	549	59	6	614	-42	-2	-33	-77	-7%	-3%	-83%	-11%	Pass	Pass	Pass	Pass
Val_2	V10.2_SB	S	1	144	21	1	166	190	30	4	224	46	9	3	58	32%	43%	320%	35%	Pass	Pass	Pass	Pass
Val_2	V10.2_NB	N	2	173	20	1	194	160	25	9	194	-13	5	8	0	-8%	26%	815%	0%	Pass	Pass	Pass	Pass
Val_2	V10.1_EB	E	1	180	25	2	207	192	21	3	216	12	-4	1	9	7%	-15%	58%	4%	Pass	Pass	Pass	Pass
Val_2	V10.1_WB	W	2	420	56	2	478	417	25	4	447	-3	-31	2	-31	-1%	-54%	125%	-6%	Pass	Pass	Pass	Pass
Val_5	V13.2_EB	E	1	574	38	6	618	619	39	5	663	45	1	-1	45	8%	2%	-12%	7%	Pass	Pass	Pass	Pass
Val_5	V13.2_WB	W	2	743	101	14	858	769	46	9	824	26	-55	-5	-34	4%	-54%	-34%	-4%	Pass	Pass	Pass	Pass
Val_3	V3.4_NWB	NW	1	842	87	23	952	632	40	8	680	-210	-47	-15	-272	-25%	-53%	-66%	-29%	Fail	Pass	Pass	Fail
Val_3	V3.4_SEB	SE	2	409	76	14	499	327	36	6	369	-82	-40	-8	-130	-20%	-53%	-54%	-26%	Pass	Pass	Pass	Fail
Val_4	V6.2_EB	E	2	477	60	6	543	536	38	3	578	59	-22	-3	35	12%	-36%	-42%	6%	Pass	Pass	Pass	Pass
Val_4	V6.2_WB	W	1	496	59	4	559	522	62	2	586	26	3	-2	27	5%	5%	-47%	5%	Pass	Pass	Pass	Pass
Val_4	V6.4_EB	E	2	530	69	12	611	367	19	2	387	-163	-50	-10	-224	-31%	-72%	-85%	-37%	Fail	Pass	Pass	Fail
Val_4	V6.4_WB	W	1	466	82	12	560	328	24	2	354	-138	-58	-10	-206	-30%	-71%	-83%	-37%	Fail	Pass	Pass	Fail
Val_4	V6.1_WB	W	1	1309	250	67	1626	1293	157	50	1500	-16	-93	-17	-126	-1%	-37%	-26%	-8%	Pass	Pass	Pass	Pass
Val_4	V6.6_EB	E	2	800	31	6	837	926	44	10	980	126	13	4	143	16%	43%	65%	17%	Pass	Pass	Pass	Pass
Val_4	V6.6_WB	W	1	577	33	2	612	551	50	10	611	-26	17	8	-1	-5%	52%	381%	0%	Pass	Pass	Pass	Pass
Val_4	V6.7_EB	E	2	364	16	3	383	303	12	5	320	-61	-4	2	-63	-17%	-23%	70%	-16%	Pass	Pass	Pass	Pass
Val_4	V6.7_WB	W	1	123	9	1	133	75	2	0	77	-48	-7	-1	-56	-39%	-79%	-63%	-42%	Pass	Pass	Pass	Pass
Val_4	V6.5_WB	W	1	143	13	0	156	173	12	1	186	30	-1	1	30	21%	-11%		19%	Pass	Pass	Pass	Pass
Val_4	V6.5_EB	E	2	312	28	0	340	241	17	2	260	-71	-11	2	-80	-23%	-39%		-24%	Pass	Pass	Pass	Pass
Val_4	V6.8_WB	W	1	461	43	5	509	399	45	22	466	-62	2	17	-43	-13%	5%	332%	-9%	Pass	Pass	Pass	Pass
Val_4	V6.8_EB	E	2	471	48	4	523	541	32	16	589	70	-16	12	66	15%	-34%	311%	13%	Pass	Pass	Pass	Pass
Val_1	V4.11_SB	S	2	469	73	42	584	498	55	50	603	29	-18	8	19	6%	-25%	18%	3%	Pass	Pass	Pass	Pass
Val_1	V4.11_NB	N	1	860	103	66	1029	713	64	57	834	-147	-39	-9	-195	-17%	-38%	-14%	-19%	Fail	Pass	Pass	Fail
Val_5	V13.3_EB	E	1	1616	477	166	2259	1582	475	178	2234	-34	-2	12	-25	-2%	0%	7%	-1%	Pass	Pass	Pass	Pass
Val_5	V13.3_WB	W	2	2083	537	148	2768	2115	517	140	2771	32	-20	-8	3	2%	-4%	-5%	0%	Pass	Pass	Pass	Pass
Val_3	V3.5_WB	W	1	803	120	26	949	763	103	25	891	-40	-17	-1	-58	-5%	-14%	-3%	-6%	Pass	Pass	Pass	Pass
Val_3	V3.5_EB	E	2	696	78	24	798	796	148	16	961	100	70	-8	163	14%	90%	-33%	20%	Pass	Pass	Pass	Fail
Val_3	V3.2_EB	E	2	1694	424	133	2251	1653	326	72	2050	-41	-98	-61	-201	-2%	-23%	-46%	-9%	Pass	Pass	Pass	Pass
Val_3	V3.2_WB	W	1	2766	395	90	3251	2759	276	61	3095	-7	-119	-29	-156	0%	-30%	-32%	-5%	Pass	Fail	Pass	Pass
Val_1	V4.15_SB	S	2	200	38	4	242	111	13	0	123	-89	-25	-4	-119	-45%	-66%	-100%	-49%	Pass	Pass	Pass	Fail
Val_1	V4.15_NB	N	1	249	38	5	292	198	29	0	227	-51	-9	-5	-65	-21%	-24%	-100%	-22%	Pass	Pass	Pass	Pass
Val_5	V13.7_SWB	SW	2	285	30	4	319	235	25	7	267	-50	-5	3	-52	-17%	-17%	77%	-16%	Pass	Pass	Pass	Pass
Val_5	V13.7_NEB	NE	1	94	12	1	107	136	18	8	162	42	6	7	55	45%	52%	656%	52%	Pass	Pass	Pass	Pass
Val_6	V13.6_EB	E	1	50	6	1	57	108	15	0	123	58	9	-1	66	116%	156%	-100%	116%	Pass	Pass	Pass	Pass
Val_6	V13.6_WB	W	2	289	48	3	340	187	16	0	203	-102	-32	-3	-137	-35%	-67%	-100%	-40%	Fail	Pass	Pass	Fail
Val_1	V4.7_NB	N	1	131	4	0	135	100	8	0	109	-31	4	0	-26	-23%	102%		-19%	Pass	Pass	Pass	Pass
Val_1	V4.7_SB	S	2	110	7	1	118	124	8	0	133	14	1	-1	15	13%	19%	-54%	13%	Pass	Pass	Pass	Pass
Val_1	V4.8_NB	N	1	987	129	46	1162	1070	124	21	1216	83	-5	-25	54	8%	-3%	-53%	5%	Pass	Pass	Pass	Pass
Val_5	V13.4_EB	E	1	280	34	3	317	245	38	0	283	-35	4	-3	-34	-12%	12%	-100%	-11%	Pass	Pass	Pass	Pass
Val_5	V13.4_WB	W	2	646	46	1	693	547	30	0	576	-99	-16	-1	-117	-15%	-35%	-100%	-17%	Pass	Pass	Pass	Pass

GEH or Criteria 1	Car	LGV	HGV	Total
	87%	97%	99%	86%
Fail	9	2	1	10
Pass	61	68	69	60

IP

Screenline	ID	BOUND	DIR	IP Count Data				IP Model Data				Absolute differences				%age Difference				GEH or Criteria 1			
				Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total
Val_1	V4.13_NB	N	1	334	27	3	364	388	29	8	425	54	2	5	61	16%	7%	167%	17%	Pass	Pass	Pass	Pass
Val_1	V4.13_SB	S	2	332	22	3	357	312	23	1	336	-20	1	-2	-21	-6%	5%	-67%	-6%	Pass	Pass	Pass	Pass
Val_1	V4.6_SB	S	2	444	47	11	502	543	74	17	634	99	27	6	132	22%	57%	55%	26%	Pass	Pass	Pass	Fail
Val_1	V4.6_NB	N	1	493	51	10	554	447	73	17	537	-46	22	7	-17	-9%	43%	70%	-3%	Pass	Pass	Pass	Pass
Val_6	V13.1_EB	E	1	1863	524	309	2696	1790	550	216	2556	-73	26	-93	-140	-4%	5%	-30%	-5%	Pass	Pass	Pass	Pass
Val_6	V13.1_WB	W	2	1607	388	262	2257	1547	396	209	2152	-60	8	-53	-105	-4%	2%	-20%	-5%	Pass	Pass	Pass	Pass
Val_1	V4.4_NB	N	1	419	30	3	452	310	16	7	333	-109	-14	4	-119	-26%	-47%	133%	-26%	Fail	Pass	Pass	Fail
Val_1	V4.10_SB	S	2	453	51	11	515	476	24	6	506	23	-27	-5	-9	5%	-53%	-45%	-2%	Pass	Pass	Pass	Pass
Val_1	V4.8_SB	S	2	653	75	56	784	569	77	21	667	-84	2	-35	-117	-13%	3%	-63%	-15%	Pass	Pass	Pass	Pass
Val_4	V6.1_EB	E	2	971	229	92	1292	1005	146	51	1202	34	-83	-41	-90	4%	-36%	-45%	-7%	Pass	Pass	Pass	Pass
Val_3	V3.3_EB	E	2	349	50	7	406	283	38	4	325	-66	-12	-3	-81	-19%	-24%	-43%	-20%	Pass	Pass	Pass	Pass
Val_3	V3.3_WB	W	1	263	45	5	313	317	57	1	375	54	12	-4	62	21%	27%	-80%	20%	Pass	Pass	Pass	Pass
Val_1	V4.12_NB	N	1	198	19	2	219	139	18	2	159	-59	-1	0	-60	-30%	-5%	0%	-27%	Pass	Pass	Pass	Pass
Val_1	V4.12_SB	S	2	200	18	2	220	210	20	1	231	10	2	-1	11	5%	11%	-50%	5%	Pass	Pass	Pass	Pass
Val_1	V4.9_NEB	NE	1	427	74	7	508	324	63	5	392	-103	-11	-2	-116	-24%	-15%	-29%	-23%	Fail	Pass	Pass	Fail
Val_1	V4.9_SWB	SW	2	440	76	8	524	231	49	6	286	-209	-27	-2	-238	-48%	-36%	-25%	-45%	Fail	Pass	Pass	Fail
Val_4	V6.3_WB	W	1	94	9	0	103	132	9	0	141	38	0	0	38	40%	0%	0%	37%	Pass	Pass	Pass	Pass
Val_4	V6.3_EB	E	2	110	6	1	117	321	11	2	334	211	5	1	217	192%	83%	100%	185%	Fail	Pass	Pass	Fail
Val_1	V4.3_NB	N	1	942	95	22	1059	831	122	31	984	-111	27	9	-75	-12%	28%	41%	-7%	Pass	Pass	Pass	Pass
Val_1	V4.3_SB	S	2	995	98	27	1120	844	45	26	915	-151	-53	-1	-205	-15%	-54%	-4%	-18%	Pass	Pass	Pass	Fail
Val_1	V4.14_NB	N	1	332	27	3	362	281	39	4	324	-51	12	1	-38	-15%	44%	33%	-10%	Pass	Pass	Pass	Pass
Val_1	V4.14_SB	S	2	311	22	2	335	243	24	4	271	-68	2	2	-64	-22%	9%	100%	-19%	Pass	Pass	Pass	Pass
Val_6	V13.5_WB	W	2	53	4	1	58	89	26	0	115	36	22	-1	57	68%	550%	-100%	98%	Pass	Pass	Pass	Pass
Val_6	V13.5_EB	E	1	67	11	1	79	95	26	0	121	28	15	-1	42	42%	136%	-100%	53%	Pass	Pass	Pass	Pass
Val_1	V4.5_WB	W	2	86	21	4	111	155	27	7	189	69	6	3	78	80%	29%	75%	70%	Pass	Pass	Pass	Pass
Val_1	V4.5_EB	E	1	114	22	6	142	180	51	9	240	66	29	3	98	58%	132%	50%	69%	Pass	Pass	Pass	Pass
Val_2	V10.3_NB	N	2	468	46	15	529	512	48	14	574	44	2	-1	45	9%	4%	-7%	9%	Pass	Pass	Pass	Pass
Val_2	V10.3_SB	S	1	524	58	19	601	515	58	13	586	-9	0	-6	-15	-2%	0%	-32%	-2%	Pass	Pass	Pass	Pass
Val_2	V10.4_SB	S	1	388	42	11	441	415	38	7	460	27	-4	-4	19	7%	-10%	-36%	4%	Pass	Pass	Pass	Pass
Val_2	V10.4_NB	N	2	413	35	7	455	347	41	9	397	-66	6	2	-58	-16%	17%	29%	-13%	Pass	Pass	Pass	Pass
Val_2	V10.2_SB	S	1	120	14	2	136	101	23	6	130	-19	9	4	-6	-16%	64%	200%	-4%	Pass	Pass	Pass	Pass
Val_2	V10.2_NB	N	2	124	16	2	142	66	13	9	88	-58	-3	7	-54	-47%	-19%	350%	-38%	Pass	Pass	Pass	Pass
Val_2	V10.1_EB	E	1	169	20	3	192	138	16	4	158	-31	-4	1	-34	-18%	-20%	33%	-18%	Pass	Pass	Pass	Pass
Val_2	V10.1_WB	W	2	165	18	2	185	148	16	4	168	-17	-2	2	-17	-10%	-11%	100%	-9%	Pass	Pass	Pass	Pass
Val_5	V13.2_EB	E	1	428	29	4	461	429	34	7	470	1	5	3	9	0%	17%	75%	2%	Pass	Pass	Pass	Pass
Val_5	V13.2_WB	W	2	380	52	7	439	447	34	8	489	67	-18	1	50	18%	-35%	14%	11%	Pass	Pass	Pass	Pass
Val_3	V3.4_NWB	NW	1	394	84	29	507	430	34	18	482	36	-50	-11	-25	9%	-60%	-38%	-5%	Pass	Pass	Pass	Pass
Val_3	V3.4_SEB	SE	2	369	78	27	474	416	41	6	463	47	-37	-21	-11	13%	-47%	-78%	-2%	Pass	Pass	Pass	Pass
Val_4	V6.2_EB	E	2	440	36	3	479	406	31	3	440	-34	-5	0	-39	-8%	-14%	0%	-8%	Pass	Pass	Pass	Pass
Val_4	V6.2_WB	W	1	418	33	4	455	438	36	3	477	20	3	-1	22	5%	9%	-25%	5%	Pass	Pass	Pass	Pass
Val_4	V6.4_EB	E	2	495	59	8	562	175	7	2	184	-320	-52	-6	-378	-65%	-88%	-75%	-67%	Fail	Pass	Pass	Fail
Val_4	V6.4_WB	W	1	468	57	14	539	192	7	2	201	-276	-50	-12	-338	-59%	-88%	-86%	-63%	Fail	Pass	Pass	Fail
Val_4	V6.1_WB	W	1	995	274	77	1346	1185	167	59	1411	190	-107	-18	65	19%	-39%	-23%	5%	Fail	Fail	Pass	Pass
Val_4	V6.6_EB	E	2	503	32	8	543	566	41	11	618	63	9	3	75	13%	28%	38%	14%	Pass	Pass	Pass	Pass
Val_4	V6.6_WB	W	1	456	27	7	490	488	38	16	542	32	11	9	52	7%	41%	129%	11%	Pass	Pass	Pass	Pass
Val_4	V6.7_EB	E	2	195	17	4	216	199	6	1	206	4	-11	-3	-10	2%	-65%	-75%	-5%	Pass	Pass	Pass	Pass
Val_4	V6.7_WB	W	1	94	8	1	103	66	2	1	69	-28	-6	0	-34	-30%	-75%	0%	-33%	Pass	Pass	Pass	Pass
Val_4	V6.5_WB	W	1	104	9	1	114	190	14	2	206	86	5	1	92	83%	56%	100%	81%	Pass	Pass	Pass	Pass
Val_4	V6.5_EB	E	2	220	20	2	242	234	13	2	249	14	-7	0	7	6%	-35%	0%	3%	Pass	Pass	Pass	Pass
Val_4	V6.8_WB	W	1	393	33	5	431	307	38	21	366	-86	5	16	-65	-22%	15%	320%	-15%	Pass	Pass	Pass	Pass
Val_4	V6.8_EB	E	2	419	43	5	467	343	33	23	399	-76	-10	18	-68	-18%	-23%	360%	-15%	Pass	Pass	Pass	Pass
Val_1	V4.11_SB	S	2	377	69	63	509	354	69	57	480	-23	0	-6	-29	-6%	0%	-10%	-6%	Pass	Pass	Pass	Pass
Val_1	V4.11_NB	N	1	362	68	51	481	374	52	55	481	12	-16	4	0	3%	-24%	8%	0%	Pass	Pass	Pass	Pass
Val_5	V13.3_EB	E	1	1650	544	154	2348	1598	518	175	2291	-52	-26	21	-57	-3%	-5%	14%	-2%	Pass	Pass	Pass	Pass
Val_5	V13.3_WB	W	2	1546	405	148	2099	1421	422	151	1994	-125	17	3	-105	-8%	4%	2%	-5%	Pass	Pass	Pass	Pass
Val_3	V3.5_WB	W	1	414	62	13	489	465	119	32	616	51	57	19	127	12%	92%	146%	26%	Pass	Pass	Pass	Fail
Val_3	V3.5_EB	E	2	509	57	17	583	580	108	18	706	71	51	1	123	14%	89%	6%	21%	Pass	Pass	Pass	Pass
Val_3	V3.2_EB	E	2	1553	412	124	2089	1587	357	81	2025	34	-55	-43	-64	2%	-13%	-35%	-3%	Pass	Pass	Pass	Pass
Val_3	V3.2_WB	W	1	1491	368	132	1991	1444	296	78	1818	-47	-72	-54	-173	-3%	-20%	-41%	-9%	Pass	Pass	Pass	Pass
Val_1	V4.15_SB	S	2	105	21	4	130	98	14	0	112	-7	-7	-4	-18	-7%	-33%	-100%	-14%	Pass	Pass	Pass	Pass
Val_1	V4.15_NB	N	1	93	20	4	117	100	15	0	115	7	-5	-4	-2	8%	-25%	-100%	-2%	Pass	Pass	Pass	Pass
Val_5	V13.7_SWB	SW	2	54	9	1	64	56	15	9	80	2	6	8	16	4%	67%	800%	25%	Pass	Pass	Pass	Pass
Val_5	V13.7_NEB	NE	1	80	10	2	92	88	18	11	117	8	8	9	25	10%	80%	450%	27%	Pass	Pass	Pass	Pass
Val_6	V13.6_EB	E	1	43	8	1	52	38	4	0	42	-5	-4	-1	-10	-12%	-50%	-100%	-19%	Pass	Pass	Pass	Pass
Val_6	V13.6_WB	W	2	32	6	1	39	34	6	0	40	2	0	-1	1	6%	0%	-100%	3%	Pass	Pass	Pass	Pass
Val_1	V4.7_NB	N	1	93	4	0	97	48	5	0	53	-45	1	0	-44	-48%	25%	0%	-45%	Pass	Pass	Pass	Pass
Val_1	V4.7_SB	S	2	113	7	0	120	135	6	1	142	22	-1	1	22	19%	-14%		18%	Pass	Pass	Pass	Pass
Val_1	V4.8_NB	N	1	523	92	59	674	562	32	27	621	39	-60	-32	-53	7%	-65%	-54%	-8%	Pass	Pass	Pass	Pass
Val_5	V13.4_EB	E	1	177	26	2	205	192	34	0	226	15	8	-2	21	8%	31%	-100%	10%	Pass	Pass	Pass	Pass
Val_5	V13.4_WB	W	2	184	26	2	212	196	27	0	223	12	1	-2	11	7%	4%	-100%	5%	Pass	Pass	Pass	Pass

GEH or Criteria 1	Car	LGV	HGV	Total
	90%	99%	100%	87%
Fail	7	1	0	9
Pass	63	69	70	61

PM

Screenline	ID	BOUND	DIR	PM Count Data Car	LGV	HGV	Total	PM Model Data Car	LGV	HGV	Total	Absolute differences Car	LGV	HGV	Total	%age Difference Car	LGV	HGV	Total	GEH or Criteria 1 Car	LGV	HGV	Total
Val_1	V4.13_NB	N	1	529	45	2	576	591	21	10	622	62	-24	8	46	12%	-53%	400%	8%	Pass	Pass	Pass	Pass
Val_1	V4.13_SB	S	2	527	32	1	560	569	27	1	597	42	-5	0	37	8%	-16%	0%	7%	Pass	Pass	Pass	Pass
Val_1	V4.6_SB	S	2	776	79	2	857	774	96	6	876	-2	17	4	19	0%	22%	200%	2%	Pass	Pass	Pass	Pass
Val_1	V4.6_NB	N	1	685	64	3	752	576	74	9	659	-109	10	6	-93	-16%	16%	200%	-12%	Pass	Pass	Pass	Pass
Val_6	V13.1_EB	E	1	2952	725	131	3808	2866	746	88	3700	-86	21	-43	-108	-3%	3%	-33%	-3%	Pass	Pass	Pass	Pass
Val_6	V13.1_WB	W	2	2337	328	166	2831	2138	390	85	2613	-199	62	-81	-218	-9%	19%	-49%	-8%	Pass	Pass	Pass	Pass
Val_1	V4.4_NB	N	1	634	20	2	656	539	38	4	581	-95	18	2	-75	-15%	90%	100%	-11%	Pass	Pass	Pass	Pass
Val_1	V4.10_SB	S	2	796	57	2	855	808	35	3	846	12	-22	1	-9	2%	-39%	50%	-1%	Pass	Pass	Pass	Pass
Val_1	V4.8_SB	S	2	1037	66	21	1124	889	77	11	977	-148	11	-10	-147	-14%	17%	-48%	-13%	Pass	Pass	Pass	Pass
Val_4	V6.1_EB	E	2	1419	212	20	1651	1311	142	17	1470	-108	-70	-3	-181	-8%	-33%	-15%	-11%	Pass	Pass	Pass	Pass
Val_3	V3.3_EB	E	2	509	49	2	560	547	120	6	673	38	71	4	113	7%	145%	200%	20%	Pass	Pass	Pass	Pass
Val_3	V3.3_WB	W	1	185	23	2	210	287	26	1	314	102	3	-1	104	55%	13%	-50%	50%	Fail	Pass	Pass	Fail
Val_1	V4.12_NB	N	1	267	31	0	298	338	23	2	363	71	-8	2	65	27%	-26%		22%	Pass	Pass	Pass	Pass
Val_1	V4.12_SB	S	2	315	30	0	345	354	24	0	378	39	-6	0	33	12%	-20%	0%	10%	Pass	Pass	Pass	Pass
Val_1	V4.9_NEB	NE	1	506	88	9	603	486	94	4	584	-20	6	-5	-19	-4%	7%	-56%	-3%	Pass	Pass	Pass	Pass
Val_1	V4.9_SWB	SW	2	476	83	8	567	304	57	3	364	-172	-26	-5	-203	-36%	-31%	-63%	-36%	Fail	Pass	Pass	Fail
Val_4	V6.3_WB	W	1	175	14	0	189	256	10	1	267	81	-4	1	78	46%	-29%		41%	Pass	Pass	Pass	Pass
Val_4	V6.3_EB	E	2	165	11	0	176	319	21	3	343	154	10	3	167	93%	91%		95%	Fail	Pass	Pass	Fail
Val_1	V4.3_NB	N	1	1301	63	5	1369	1234	87	18	1339	-67	24	13	-30	-5%	38%	260%	-2%	Pass	Pass	Pass	Pass
Val_1	V4.3_SB	S	2	1115	62	18	1195	1378	50	14	1442	263	-12	-4	247	24%	-19%	-22%	21%	Fail	Pass	Pass	Fail
Val_1	V4.14_NB	N	1	457	34	0	491	388	48	3	439	-69	14	3	-52	-15%	41%		-11%	Pass	Pass	Pass	Pass
Val_1	V4.14_SB	S	2	473	21	0	494	329	31	3	363	-144	10	3	-131	-30%	48%		-27%	Fail	Pass	Pass	Fail
Val_6	V13.5_WB	W	2	69	3	0	72	88	11	0	99	19	8	0	27	28%	267%	0%	38%	Pass	Pass	Pass	Pass
Val_6	V13.5_EB	E	1	236	32	1	269	196	30	0	226	-40	-2	-1	-43	-17%	-6%	-100%	-16%	Pass	Pass	Pass	Pass
Val_1	V4.5_WB	W	2	165	21	0	186	253	40	4	297	88	19	4	111	53%	90%		60%	Pass	Pass	Pass	Fail
Val_1	V4.5_EB	E	1	299	41	9	349	367	68	4	439	68	27	-5	90	23%	66%	-56%	26%	Pass	Pass	Pass	Pass
Val_2	V10.3_NB	N	2	597	28	2	627	671	32	5	708	74	4	3	81	12%	14%	150%	13%	Pass	Pass	Pass	Pass
Val_2	V10.3_SB	S	1	727	72	4	803	678	60	5	743	-49	-12	1	-60	-7%	-17%	25%	-7%	Pass	Pass	Pass	Pass
Val_2	V10.4_SB	S	1	560	41	0	601	633	51	3	687	73	10	3	86	13%	24%		14%	Pass	Pass	Pass	Pass
Val_2	V10.4_NB	N	2	557	25	0	582	391	18	2	411	-166	-7	2	-171	-30%	-28%		-29%	Fail	Pass	Pass	Fail
Val_2	V10.2_SB	S	1	151	16	0	167	147	27	4	178	-4	11	4	11	-3%	69%		7%	Pass	Pass	Pass	Pass
Val_2	V10.2_NB	N	2	148	12	0	160	151	18	1	170	3	6	1	10	2%	50%		6%	Pass	Pass	Pass	Pass
Val_2	V10.1_EB	E	1	338	23	1	362	345	19	2	366	7	-4	1	4	2%	-17%	100%	1%	Pass	Pass	Pass	Pass
Val_2	V10.1_WB	W	2	243	18	0	261	250	15	1	266	7	-3	1	5	3%	-17%		2%	Pass	Pass	Pass	Pass
Val_5	V13.2_EB	E	1	678	45	7	730	645	40	5	690	-33	-5	-2	-40	-5%	-11%	-29%	-5%	Pass	Pass	Pass	Pass
Val_5	V13.2_WB	W	2	495	68	10	573	568	23	2	593	73	-45	-8	20	15%	-66%	-80%	3%	Pass	Pass	Pass	Pass
Val_3	V3.4_NWB	NW	1	507	100	4	611	534	22	3	559	27	-78	-1	-52	5%	-78%	-25%	-9%	Pass	Pass	Pass	Pass
Val_3	V3.4_SEB	SE	2	560	41	1	602	539	35	2	576	-21	-6	1	-26	-4%	-15%	100%	-4%	Pass	Pass	Pass	Pass
Val_4	V6.2_EB	E	2	535	41	0	576	559	20	1	580	24	-21	1	4	4%	-51%		1%	Pass	Pass	Pass	Pass
Val_4	V6.2_WB	W	1	538	24	1	563	541	31	1	573	3	7	0	10	1%	29%	0%	2%	Pass	Pass	Pass	Pass
Val_4	V6.4_EB	E	2	617	58	1	676	391	14	1	406	-226	-44	0	-270	-37%	-76%	0%	-40%	Fail	Pass	Pass	Fail
Val_4	V6.4_WB	W	1	604	40	1	645	293	10	1	304	-311	-30	0	-341	-51%	-75%	0%	-53%	Fail	Pass	Pass	Fail
Val_4	V6.1_WB	W	1	1353	170	43	1566	1531	109	18	1658	178	-61	-25	92	13%	-36%	-58%	6%	Pass	Pass	Pass	Pass
Val_4	V6.6_EB	E	2	538	39	2	579	650	31	2	683	112	-8	0	104	21%	-21%	0%	18%	Pass	Pass	Pass	Pass
Val_4	V6.6_WB	W	1	798	25	0	823	723	38	5	766	-75	13	5	-57	-9%	52%		-7%	Pass	Pass	Pass	Pass
Val_4	V6.7_EB	E	2	269	23	1	293	251	11	1	263	-18	-12	0	-30	-7%	-52%	0%	-10%	Pass	Pass	Pass	Pass
Val_4	V6.7_WB	W	1	124	0	0	124	162	4	1	167	38	4	1	43	31%			35%	Pass	Pass	Pass	Pass
Val_4	V6.5_WB	W	1	152	10	0	162	188	6	0	194	36	-4	0	32	24%	-40%	0%	20%	Pass	Pass	Pass	Pass
Val_4	V6.5_EB	E	2	328	31	1	360	320	10	1	331	-8	-21	0	-29	-2%	-68%	0%	-8%	Pass	Pass	Pass	Pass
Val_4	V6.8_WB	W	1	473	20	1	494	520	30	9	559	47	10	8	65	10%	50%	800%	13%	Pass	Pass	Pass	Pass
Val_4	V6.8_EB	E	2	611	46	2	659	507	29	7	543	-104	-17	5	-116	-17%	-37%	250%	-18%	Pass	Pass	Pass	Pass
Val_1	V4.11_SB	S	2	797	67	34	898	699	67	26	792	-98	0	-8	-106	-12%	0%	-24%	-12%	Pass	Pass	Pass	Pass
Val_1	V4.11_NB	N	1	591	66	30	687	560	44	28	632	-31	-22	-2	-55	-5%	-33%	-7%	-8%	Pass	Pass	Pass	Pass
Val_5	V13.3_EB	E	1	2604	516	68	3188	2610	397	74	3081	6	-119	6	-107	0%	-23%	9%	-3%	Pass	Fail	Pass	Pass
Val_5	V13.3_WB	W	2	2138	296	67	2501	2071	316	66	2453	-67	20	-1	-48	-3%	7%	-1%	-2%	Pass	Pass	Pass	Pass
Val_3	V3.5_WB	W	1	740	111	24	875	788	79	23	890	48	-32	-1	15	6%	-29%	-4%	2%	Pass	Pass	Pass	Pass
Val_3	V3.5_EB	E	2	866	97	29	992	862	70	18	950	-4	-27	-11	-42	0%	-28%	-38%	-4%	Pass	Pass	Pass	Pass
Val_3	V3.2_EB	E	2	2942	378	47	3367	2486	293	37	2816	-456	-85	-10	-551	-15%	-22%	-21%	-16%	Fail	Pass	Pass	Fail
Val_3	V3.2_WB	W	1	1790	306	63	2159	1664	202	52	1918	-126	-104	-11	-241	-7%	-34%	-17%	-11%	Pass	Fail	Pass	Pass
Val_1	V4.15_SB	S	2	237	21	1	259	197	25	0	222	-40	4	-1	-37	-17%	19%	-100%	-14%	Pass	Pass	Pass	Pass
Val_1	V4.15_NB	N	1	186	24	2	212	169	15	0	184	-17	-9	-2	-28	-9%	-38%	-100%	-13%	Pass	Pass	Pass	Pass
Val_5	V13.7_SWB	SW	2	73	7	1	81	150	14	3	167	77	7	2	86	105%	100%	200%	106%	Pass	Pass	Pass	Pass
Val_5	V13.7_NEB	NE	1	239	28	3	270	159	14	6	179	-80	-14	3	-91	-33%	-50%	100%	-34%	Pass	Pass	Pass	Pass
Val_6	V13.6_EB	E	1	233	38	1	272	257	15	0	272	24	-23	-1	0	10%	-61%	-100%	0%	Pass	Pass	Pass	Pass
Val_6	V13.6_WB	W	2	47	5	0	52	112	18	0	130	65	13	0	78	138%	260%	0%	150%	Pass	Pass	Pass	Pass
Val_1	V4.7_NB	N	1	99	4	0	103	45	5	0	50	-54	1	0	-53	-55%	25%	0%	-51%	Pass	Pass	Pass	Pass
Val_1	V4.7_SB	S	2	171	11	0	182	158	7	0	165	-13	-4	0	-17	-8%	-36%	0%	-9%	Pass	Pass	Pass	Pass
Val_1	V4.8_NB	N	1	568	69	24	661	525	32	17	574	-43	-37	-7	-87	-8%	-54%	-29%	-13%	Pass	Pass	Pass	Pass
Val_5	V13.4_EB	E	1	428	37	0	465	359	25	0	384	-69	-12	0	-81	-16%	-32%	0%	-17%	Pass	Pass	Pass	Pass
Val_5	V13.4_WB	W	2	297	26	2	325	250	22	0	272	-47	-4	-2	-53	-16%	-15%	-100%	-16%	Pass	Pass	Pass	Pass

GEH or Criteria 1	Car	LGV	HGV	Total
	87%	97%	100%	86%
Fail	9	2	0	10
Pass	61	68	70	60

Appendix Q – Screenline Summary

AM	Car

	AM	Screenline Modelled vs Observed by Direction			Car	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	377	382	1.4%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	947	1000	5.6%	Fail	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	6201	6100	-1.6%	Pass	Pass	Pass	Pass	17
	Calibration	Cal_2-2	5965	5739	-3.8%	Pass	Pass	Pass	Pass	16
C3	Calibration	Cal_3-1	1666	1535	-7.8%	Fail	Fail	Pass	Fail	4
	Calibration	Cal_3-2	1100	1100	0.0%	Pass	Pass	Pass	Pass	4
C4	Calibration	Cal_4-1	2366	2385	0.8%	Pass	Pass	Pass	Pass	6
	Calibration	Cal_4-2	4726	4802	1.6%	Pass	Pass	Pass	Pass	7
C5	Calibration	Cal_5-1	9700	9522	-1.8%	Pass	Pass	Pass	Pass	19
	Calibration	Cal_5-2	9082	8758	-3.6%	Pass	Pass	Pass	Pass	19
C6	Calibration	Cal_6-1	7053	7196	2.0%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_6-2	5239	5402	3.1%	Pass	Pass	Pass	Pass	10
C7	Calibration	Cal_7-1	6220	5926	-4.7%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	4690	4360	-7.0%	Fail	Pass	Pass	Fail	10
C8	Calibration	Cal_8-1	9273	9202	-0.8%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_8-2	6034	6025	-0.1%	Pass	Pass	Pass	Pass	10
C9	Calibration	Cal_9-1	7045	6974	-1.0%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	4684	4684	0.0%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	4696	4732	0.8%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	5668	5564	-1.8%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	3207	3121	-2.7%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_11-2	2405	2212	-8.0%	Fail	Fail	Pass	Fail	8
V1	Validation	Val_1-1	6163	5821	-5.5%	Fail	Pass	Pass	Fail	12
	Validation	Val_1-2	5515	5647	2.4%	Pass	Pass	Pass	Pass	12
V2	Validation	Val_2-1	1636	1580	-3.4%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	1762	1689	-4.1%	Pass	Pass	Pass	Pass	4
V3	Validation	Val_3-1	4920	4826	-1.9%	Pass	Pass	Pass	Pass	4
	Validation	Val_3-2	3152	3130	-0.7%	Pass	Pass	Pass	Pass	4
V4	Validation	Val_4-1	3673	3513	-4.4%	Pass	Pass	Pass	Pass	8
	Validation	Val_4-2	4356	4487	3.0%	Pass	Pass	Pass	Pass	8
V5	Validation	Val_5-1	2564	2583	0.7%	Pass	Pass	Pass	Pass	4
	Validation	Val_5-2	3757	3666	-2.4%	Pass	Pass	Pass	Pass	4
V6	Validation	Val_6-1	2405	2626	9.2%	Fail	Fail	Pass	Pass	3
	Validation	Val_6-2	2971	2795	-5.9%	Fail	Pass	Pass	Pass	3

Calibration	108344	106722	-1.5%	Pass	Pass	Pass	Pass
Validation	42874	42361	-1.2%	Pass	Pass	Pass	Pass
TOTAL	151218	149083	-1.4%	Pass	Pass	Pass	Pass

Fail	7	3	0	4
Pass	27	31	34	30
Total	34	34	34	34
%	79%	91%	100%	88%

AM	Total

	AM	Screenline Modelled vs Observed by Direction			Total	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	458	469	2.4%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	1156	1189	2.8%	Pass	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	7161	7169	0.1%	Pass	Pass	Pass	Pass	17
	Calibration	Cal_2-2	6932	6841	-1.3%	Pass	Pass	Pass	Pass	16
C3	Calibration	Cal_3-1	1849	1738	-6.0%	Fail	Pass	Pass	Pass	4
	Calibration	Cal_3-2	1220	1260	3.3%	Pass	Pass	Pass	Pass	4
C4	Calibration	Cal_4-1	2754	2878	4.5%	Pass	Pass	Pass	Pass	6
	Calibration	Cal_4-2	5585	5814	4.1%	Pass	Pass	Pass	Pass	7
C5	Calibration	Cal_5-1	11030	10774	-2.3%	Pass	Pass	Pass	Pass	19
	Calibration	Cal_5-2	10439	10030	-3.9%	Pass	Pass	Pass	Pass	19
C6	Calibration	Cal_6-1	8415	8532	1.4%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_6-2	6558	6705	2.2%	Pass	Pass	Pass	Pass	10
C7	Calibration	Cal_7-1	7164	6834	-4.6%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	5625	5347	-4.9%	Pass	Pass	Pass	Pass	10
C8	Calibration	Cal_8-1	11055	10939	-1.0%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_8-2	7441	7424	-0.2%	Pass	Pass	Pass	Pass	10
C9	Calibration	Cal_9-1	7973	7910	-0.8%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	5662	5663	0.0%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	5345	5358	0.2%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	6326	6198	-2.0%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	3596	3465	-3.7%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_11-2	2801	2535	-9.5%	Fail	Fail	Pass	Fail	8
V1	Validation	Val_1-1	6942	6688	-3.7%	Pass	Pass	Pass	Pass	12
	Validation	Val_1-2	6345	6517	2.7%	Pass	Pass	Pass	Pass	12
V2	Validation	Val_2-1	1792	1736	-3.1%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	2006	1908	-4.9%	Pass	Pass	Pass	Pass	4
V3	Validation	Val_3-1	5731	5403	-5.7%	Fail	Pass	Pass	Pass	4
	Validation	Val_3-2	3970	3776	-4.9%	Pass	Pass	Pass	Pass	4
V4	Validation	Val_4-1	4262	3963	-7.0%	Fail	Pass	Pass	Fail	8
	Validation	Val_4-2	5066	4936	-2.6%	Pass	Pass	Pass	Pass	8
V5	Validation	Val_5-1	3301	3343	1.3%	Pass	Pass	Pass	Pass	4
	Validation	Val_5-2	4638	4440	-4.3%	Pass	Pass	Pass	Pass	4
V6	Validation	Val_6-1	3218	3373	4.8%	Pass	Pass	Pass	Pass	3
	Validation	Val_6-2	3959	3699	-6.6%	Fail	Pass	Pass	Pass	3

Calibration	126545	125074	-1.2%	Pass	Pass	Pass	Pass
Validation	51230	49782	-2.8%	Pass	Pass	Pass	Pass
TOTAL	177775	174855	-1.6%	Pass	Pass	Pass	Pass

Fail	5	1	0	2
Pass	29	33	34	32
Total	34	34	34	34
%	85%	97%	100%	94%

IP	Car

	IP	Screenline Modelled vs Observed by Direction			Car	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	324	318	-1.9%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	298	300	0.7%	Pass	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	3618	3639	0.6%	Pass	Pass	Pass	Pass	17
	Calibration	Cal_2-2	3492	3412	-2.3%	Pass	Pass	Pass	Pass	16
C3	Calibration	Cal_3-1	952	986	3.6%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_3-2	952	922	-3.2%	Pass	Pass	Pass	Pass	4
C4	Calibration	Cal_4-1	1474	1519	3.1%	Pass	Pass	Pass	Pass	6
	Calibration	Cal_4-2	3125	3197	2.3%	Pass	Pass	Pass	Pass	7
C5	Calibration	Cal_5-1	6207	5981	-3.6%	Pass	Pass	Pass	Pass	19
	Calibration	Cal_5-2	6420	6105	-4.9%	Pass	Pass	Pass	Pass	19
C6	Calibration	Cal_6-1	4353	4357	0.1%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_6-2	4329	4363	0.8%	Pass	Pass	Pass	Pass	10
C7	Calibration	Cal_7-1	3720	3724	0.1%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	4004	3770	-5.8%	Fail	Pass	Pass	Fail	10
C8	Calibration	Cal_8-1	5305	5338	0.6%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_8-2	5896	5975	1.3%	Pass	Pass	Pass	Pass	10
C9	Calibration	Cal_9-1	3779	3829	1.3%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	4174	4215	1.0%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	3888	3866	-0.6%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	4104	4183	1.9%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	2644	2524	-4.5%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_11-2	2706	2566	-5.2%	Fail	Pass	Pass	Fail	8
V1	Validation	Val_1-1	4330	3984	-8.0%	Fail	Fail	Pass	Fail	12
	Validation	Val_1-2	4509	4170	-7.5%	Fail	Fail	Pass	Fail	12
V2	Validation	Val_2-1	1201	1169	-2.7%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	1170	1073	-8.3%	Fail	Fail	Pass	Fail	4
V3	Validation	Val_3-1	2562	2656	3.7%	Pass	Pass	Pass	Pass	4
	Validation	Val_3-2	2780	2866	3.1%	Pass	Pass	Pass	Pass	4
V4	Validation	Val_4-1	3022	2998	-0.8%	Pass	Pass	Pass	Pass	8
	Validation	Val_4-2	3353	3249	-3.1%	Pass	Pass	Pass	Pass	8
V5	Validation	Val_5-1	2335	2307	-1.2%	Pass	Pass	Pass	Pass	4
	Validation	Val_5-2	2164	2120	-2.0%	Pass	Pass	Pass	Pass	4
V6	Validation	Val_6-1	1973	1923	-2.5%	Pass	Pass	Pass	Pass	3
	Validation	Val_6-2	1692	1670	-1.3%	Pass	Pass	Pass	Pass	3

Calibration	75764	75089	-0.9%	Pass	Pass	Pass	Pass
Validation	31091	30185	-2.9%	Pass	Pass	Pass	Pass
TOTAL	106855	105274	-1.5%	Pass	Pass	Pass	Pass

Fail	5	3	0	5
Pass	29	31	34	29
Total	34	34	34	34
%	85%	91%	100%	85%

IP	Total

	IP	Screenline Modelled vs Observed by Direction			Total	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	398	398	0.0%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	369	367	-0.5%	Pass	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	4380	4593	4.9%	Pass	Pass	Pass	Pass	17
	Calibration	Cal_2-2	4254	4313	1.4%	Pass	Pass	Pass	Pass	16
C3	Calibration	Cal_3-1	1094	1154	5.5%	Fail	Pass	Pass	Pass	4
	Calibration	Cal_3-2	1094	1070	-2.2%	Pass	Pass	Pass	Pass	4
C4	Calibration	Cal_4-1	1748	1886	7.9%	Fail	Fail	Pass	Fail	6
	Calibration	Cal_4-2	3837	4022	4.8%	Pass	Pass	Pass	Pass	7
C5	Calibration	Cal_5-1	7419	7107	-4.2%	Pass	Pass	Pass	Pass	19
	Calibration	Cal_5-2	7605	7255	-4.6%	Pass	Pass	Pass	Pass	19
C6	Calibration	Cal_6-1	5595	5562	-0.6%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_6-2	5422	5434	0.2%	Pass	Pass	Pass	Pass	10
C7	Calibration	Cal_7-1	4432	4481	1.1%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	4705	4500	-4.4%	Pass	Pass	Pass	Pass	10
C8	Calibration	Cal_8-1	6622	6645	0.3%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_8-2	7355	7439	1.1%	Pass	Pass	Pass	Pass	10
C9	Calibration	Cal_9-1	4651	4704	1.1%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	5122	5171	1.0%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	4477	4475	0.0%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	4708	4793	1.8%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	2965	2804	-5.4%	Fail	Pass	Pass	Pass	8
	Calibration	Cal_11-2	3006	2821	-6.2%	Fail	Pass	Pass	Fail	8
V1	Validation	Val_1-1	5029	4664	-7.3%	Fail	Pass	Pass	Fail	12
	Validation	Val_1-2	5227	4769	-8.8%	Fail	Fail	Pass	Fail	12
V2	Validation	Val_2-1	1370	1334	-2.6%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	1311	1227	-6.4%	Fail	Pass	Pass	Pass	4
V3	Validation	Val_3-1	3300	3291	-0.3%	Pass	Pass	Pass	Pass	4
	Validation	Val_3-2	3552	3519	-0.9%	Pass	Pass	Pass	Pass	4
V4	Validation	Val_4-1	3581	3413	-4.7%	Pass	Pass	Pass	Pass	8
	Validation	Val_4-2	3918	3632	-7.3%	Fail	Pass	Pass	Fail	8
V5	Validation	Val_5-1	3106	3104	-0.1%	Pass	Pass	Pass	Pass	4
	Validation	Val_5-2	2814	2786	-1.0%	Pass	Pass	Pass	Pass	4
V6	Validation	Val_6-1	2827	2719	-3.8%	Pass	Pass	Pass	Pass	3
	Validation	Val_6-2	2354	2307	-2.0%	Pass	Pass	Pass	Pass	3

Calibration	91258	90994	-0.3%	Pass	Pass	Pass	Pass
Validation	38389	36765	-4.2%	Pass	Pass	Pass	Pass
TOTAL	129647	127759	-1.5%	Pass	Pass	Pass	Pass

Fail	8	2	0	5
Pass	26	32	34	29
Total	34	34	34	34
%	76%	94%	100%	85%

PM	Car

	PM	Screenline Modelled vs Observed by Direction			Car	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	835	843	1.0%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	314	329	4.8%	Pass	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	6207	6071	-2.2%	Pass	Pass	Pass	Pass	17
	Calibration	Cal_2-2	5693	5538	-2.7%	Pass	Pass	Pass	Pass	16
C3	Calibration	Cal_3-1	1315	1337	1.7%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_3-2	1767	1614	-8.7%	Fail	Fail	Pass	Fail	4
C4	Calibration	Cal_4-1	2480	2501	0.8%	Pass	Pass	Pass	Pass	6
	Calibration	Cal_4-2	4686	4779	2.0%	Pass	Pass	Pass	Pass	7
C5	Calibration	Cal_5-1	8895	8647	-2.8%	Pass	Pass	Pass	Pass	19
	Calibration	Cal_5-2	9790	9586	-2.1%	Pass	Pass	Pass	Pass	19
C6	Calibration	Cal_6-1	6098	6192	1.5%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_6-2	7076	6889	-2.6%	Pass	Pass	Pass	Pass	10
C7	Calibration	Cal_7-1	5542	5426	-2.1%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	6039	6421	6.3%	Fail	Pass	Pass	Fail	10
C8	Calibration	Cal_8-1	7194	7151	-0.6%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_8-2	10195	10211	0.2%	Pass	Pass	Pass	Pass	10
C9	Calibration	Cal_9-1	4523	4483	-0.9%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	6890	6909	0.3%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	5469	5454	-0.3%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	5669	5680	0.2%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	2817	2692	-4.4%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_11-2	3889	3731	-4.1%	Pass	Pass	Pass	Pass	8
V1	Validation	Val_1-1	6122	5818	-5.0%	Pass	Pass	Pass	Pass	12
	Validation	Val_1-2	6885	6712	-2.5%	Pass	Pass	Pass	Pass	12
V2	Validation	Val_2-1	1776	1803	1.5%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	1545	1463	-5.3%	Fail	Pass	Pass	Pass	4
V3	Validation	Val_3-1	3222	3273	1.6%	Pass	Pass	Pass	Pass	4
	Validation	Val_3-2	4877	4434	-9.1%	Fail	Fail	Pass	Fail	4
V4	Validation	Val_4-1	4217	4214	-0.1%	Pass	Pass	Pass	Pass	8
	Validation	Val_4-2	4482	4308	-3.9%	Pass	Pass	Pass	Pass	8
V5	Validation	Val_5-1	3949	3773	-4.5%	Pass	Pass	Pass	Pass	4
	Validation	Val_5-2	3003	3039	1.2%	Pass	Pass	Pass	Pass	4
V6	Validation	Val_6-1	3421	3319	-3.0%	Pass	Pass	Pass	Pass	3
	Validation	Val_6-2	2453	2338	-4.7%	Pass	Pass	Pass	Pass	3

Calibration	113383	112484	-0.8%	Pass	Pass	Pass	Pass
Validation	45952	44494	-3.2%	Pass	Pass	Pass	Pass
TOTAL	159335	156978	-1.5%	Pass	Pass	Pass	Pass

Fail	4	2	0	3
Pass	30	32	34	31
Total	34	34	34	34
%	88%	94%	100%	91%

PM	Total

	PM	Screenline Modelled vs Observed by Direction			Total	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	990	982	-0.8%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	381	391	2.6%	Pass	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	6799	6834	0.5%	Pass	Pass	Pass	Pass	17
	Calibration	Cal_2-2	6223	6152	-1.1%	Pass	Pass	Pass	Pass	16
C3	Calibration	Cal_3-1	1421	1484	4.4%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_3-2	1907	1735	-9.0%	Fail	Fail	Pass	Fail	4
C4	Calibration	Cal_4-1	2779	2873	3.4%	Pass	Pass	Pass	Pass	6
	Calibration	Cal_4-2	5228	5401	3.3%	Pass	Pass	Pass	Pass	7
C5	Calibration	Cal_5-1	9808	9543	-2.7%	Pass	Pass	Pass	Pass	19
	Calibration	Cal_5-2	10614	10443	-1.6%	Pass	Pass	Pass	Pass	19
C6	Calibration	Cal_6-1	7179	7215	0.5%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_6-2	8010	7774	-2.9%	Pass	Pass	Pass	Pass	10
C7	Calibration	Cal_7-1	6299	6160	-2.2%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	6773	7192	6.2%	Fail	Pass	Pass	Fail	10
C8	Calibration	Cal_8-1	8167	8125	-0.5%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_8-2	11550	11537	-0.1%	Pass	Pass	Pass	Pass	10
C9	Calibration	Cal_9-1	5056	5035	-0.4%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	7774	7788	0.2%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	5855	5858	0.1%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	6204	6197	-0.1%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	3032	2879	-5.0%	Fail	Pass	Pass	Pass	8
	Calibration	Cal_11-2	4163	3965	-4.8%	Pass	Pass	Pass	Pass	8
V1	Validation	Val_1-1	6757	6466	-4.3%	Pass	Pass	Pass	Pass	12
	Validation	Val_1-2	7522	7319	-2.7%	Pass	Pass	Pass	Pass	12
V2	Validation	Val_2-1	1933	1974	2.1%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	1630	1555	-4.6%	Pass	Pass	Pass	Pass	4
V3	Validation	Val_3-1	3855	3681	-4.5%	Pass	Pass	Pass	Pass	4
	Validation	Val_3-2	5521	5015	-9.2%	Fail	Fail	Pass	Fail	4
V4	Validation	Val_4-1	4566	4488	-1.7%	Pass	Pass	Pass	Pass	8
	Validation	Val_4-2	4970	4619	-7.1%	Fail	Pass	Pass	Fail	8
V5	Validation	Val_5-1	4653	4334	-6.9%	Fail	Pass	Pass	Pass	4
	Validation	Val_5-2	3480	3485	0.1%	Pass	Pass	Pass	Pass	4
V6	Validation	Val_6-1	4349	4198	-3.5%	Pass	Pass	Pass	Pass	3
	Validation	Val_6-2	2955	2842	-3.8%	Pass	Pass	Pass	Pass	3

Calibration	126212	125563	-0.5%	Pass	Pass	Pass	Pass
Validation	52191	49976	-4.2%	Pass	Pass	Pass	Pass
TOTAL	178403	175539	-1.6%	Pass	Pass	Pass	Pass

Fail	6	2	0	4
Pass	28	32	34	30
Total	34	34	34	34
%	82%	94%	100%	88%

Screenline summary wihout high-flow roads - AM Car

AM	Car

	AM	Screenline Modelled vs Observed by Direction			Car	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	377	382	1.4%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	947	1000	5.6%	Fail	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	4507	4379	-2.8%	Pass	Pass	Pass	Pass	16
	Calibration	Cal_2-2	3706	3796	2.4%	Pass	Pass	Pass	Pass	15
C3	Calibration	Cal_3-1	1666	1535	-7.8%	Fail	Fail	Pass	Fail	4
	Calibration	Cal_3-2	1100	1100	0.0%	Pass	Pass	Pass	Pass	4
C4	Calibration	Cal_4-1	2366	2385	0.8%	Pass	Pass	Pass	Pass	6
	Calibration	Cal_4-2	2062	2088	1.3%	Pass	Pass	Pass	Pass	6
C5	Calibration	Cal_5-1	7629	7398	-3.0%	Pass	Pass	Pass	Pass	18
	Calibration	Cal_5-2	7188	7081	-1.5%	Pass	Pass	Pass	Pass	18
C6	Calibration	Cal_6-1	5398	5299	-1.8%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_6-2	3424	3316	-3.2%	Pass	Pass	Pass	Pass	9
C7	Calibration	Cal_7-1	6220	5926	-4.7%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	4690	4360	-7.0%	Fail	Pass	Pass	Fail	10
C8	Calibration	Cal_8-1	4151	4108	-1.0%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_8-2	2186	2304	5.4%	Fail	Pass	Pass	Fail	8
C9	Calibration	Cal_9-1	7045	6974	-1.0%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	4684	4684	0.0%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	4696	4732	0.8%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	5668	5564	-1.8%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	3207	3121	-2.7%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_11-2	2405	2212	-8.0%	Fail	Fail	Pass	Fail	8
V1	Validation	Val_1-1	6163	5821	-5.5%	Fail	Pass	Pass	Fail	12
	Validation	Val_1-2	5515	5647	2.4%	Pass	Pass	Pass	Pass	12
V2	Validation	Val_2-1	1636	1580	-3.4%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	1762	1689	-4.1%	Pass	Pass	Pass	Pass	4
V3	Validation	Val_3-1	2154	2067	-4.0%	Pass	Pass	Pass	Pass	3
	Validation	Val_3-2	1458	1477	1.3%	Pass	Pass	Pass	Pass	3
V4	Validation	Val_4-1	3673	3513	-4.4%	Pass	Pass	Pass	Pass	8
	Validation	Val_4-2	4356	4487	3.0%	Pass	Pass	Pass	Pass	8
V5	Validation	Val_5-1	948	1001	5.6%	Fail	Pass	Pass	Pass	3
	Validation	Val_5-2	1674	1551	-7.3%	Fail	Pass	Pass	Pass	3
V6	Validation	Val_6-1	2405	2626	9.2%	Fail	Fail	Pass	Pass	3
	Validation	Val_6-2	2971	2795	-5.9%	Fail	Pass	Pass	Pass	3

Calibration	85322	83745	-1.8%	Pass	Pass	Pass	Pass
Validation	34715	34253	-1.3%	Pass	Pass	Pass	Pass
TOTAL	120037	117998	-1.7%	Pass	Pass	Pass	Pass

Fail	10	3	0	5
Pass	24	31	34	29
Total	34	34	34	34
%	71%	91%	100%	85%

Screenline summary wihout high-flow roads - AM Total

AM	Total

	AM	Screenline Modelled vs Observed by Direction			Total	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	458	469	2.4%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	1156	1189	2.8%	Pass	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	5116	5094	-0.4%	Pass	Pass	Pass	Pass	16
	Calibration	Cal_2-2	4238	4518	6.6%	Fail	Pass	Pass	Fail	15
C3	Calibration	Cal_3-1	1849	1738	-6.0%	Fail	Pass	Pass	Pass	4
	Calibration	Cal_3-2	1220	1260	3.3%	Pass	Pass	Pass	Pass	4
C4	Calibration	Cal_4-1	2754	2878	4.5%	Pass	Pass	Pass	Pass	6
	Calibration	Cal_4-2	2394	2447	2.2%	Pass	Pass	Pass	Pass	6
C5	Calibration	Cal_5-1	8556	8289	-3.1%	Pass	Pass	Pass	Pass	18
	Calibration	Cal_5-2	8169	8038	-1.6%	Pass	Pass	Pass	Pass	18
C6	Calibration	Cal_6-1	6214	6070	-2.3%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_6-2	4019	3881	-3.4%	Pass	Pass	Pass	Pass	9
C7	Calibration	Cal_7-1	7164	6834	-4.6%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	5625	5347	-4.9%	Pass	Pass	Pass	Pass	10
C8	Calibration	Cal_8-1	4667	4609	-1.2%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_8-2	2490	2653	6.5%	Fail	Pass	Pass	Fail	8
C9	Calibration	Cal_9-1	7973	7910	-0.8%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	5662	5663	0.0%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	5345	5358	0.2%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	6326	6198	-2.0%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	3596	3465	-3.7%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_11-2	2801	2535	-9.5%	Fail	Fail	Pass	Fail	8
V1	Validation	Val_1-1	6942	6688	-3.7%	Pass	Pass	Pass	Pass	12
	Validation	Val_1-2	6345	6517	2.7%	Pass	Pass	Pass	Pass	12
V2	Validation	Val_2-1	1792	1736	-3.1%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	2006	1908	-4.9%	Pass	Pass	Pass	Pass	4
V3	Validation	Val_3-1	2480	2308	-6.9%	Fail	Pass	Pass	Pass	3
	Validation	Val_3-2	1719	1725	0.4%	Pass	Pass	Pass	Pass	3
V4	Validation	Val_4-1	4262	3963	-7.0%	Fail	Pass	Pass	Fail	8
	Validation	Val_4-2	5066	4936	-2.6%	Pass	Pass	Pass	Pass	8
V5	Validation	Val_5-1	1042	1109	6.4%	Fail	Pass	Pass	Pass	3
	Validation	Val_5-2	1870	1668	-10.8%	Fail	Fail	Fail	Fail	3
V6	Validation	Val_6-1	3218	3373	4.8%	Pass	Pass	Pass	Pass	3
	Validation	Val_6-2	3959	3699	-6.6%	Fail	Pass	Pass	Pass	3

Calibration	97792	96443	-1.4%	Pass	Pass	Pass	Pass
Validation	40701	39630	-2.6%	Pass	Pass	Pass	Pass
TOTAL	138493	136073	-1.7%	Pass	Pass	Pass	Pass

Fail	9	2	1	5
Pass	25	32	33	29
Total	34	34	34	34
%	74%	94%	97%	85%

Screenline summary wihout high-flow roads - IP Car

IP	Car

	IP	Screenline Modelled vs Observed by Direction			Car	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	324	318	-1.9%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	298	300	0.7%	Pass	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	2409	2440	1.3%	Pass	Pass	Pass	Pass	16
	Calibration	Cal_2-2	2389	2333	-2.3%	Pass	Pass	Pass	Pass	15
C3	Calibration	Cal_3-1	952	986	3.6%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_3-2	952	922	-3.2%	Pass	Pass	Pass	Pass	4
C4	Calibration	Cal_4-1	1474	1519	3.1%	Pass	Pass	Pass	Pass	6
	Calibration	Cal_4-2	1469	1476	0.5%	Pass	Pass	Pass	Pass	6
C5	Calibration	Cal_5-1	5128	4843	-5.6%	Fail	Pass	Pass	Fail	18
	Calibration	Cal_5-2	5428	5080	-6.4%	Fail	Pass	Pass	Fail	18
C6	Calibration	Cal_6-1	2994	3003	0.3%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_6-2	3096	3039	-1.8%	Pass	Pass	Pass	Pass	9
C7	Calibration	Cal_7-1	3720	3724	0.1%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	4004	3770	-5.8%	Fail	Pass	Pass	Fail	10
C8	Calibration	Cal_8-1	2255	2229	-1.2%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_8-2	2631	2628	-0.1%	Pass	Pass	Pass	Pass	8
C9	Calibration	Cal_9-1	3779	3829	1.3%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	4174	4215	1.0%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	3888	3866	-0.6%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	4104	4183	1.9%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	2644	2524	-4.5%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_11-2	2706	2566	-5.2%	Fail	Pass	Pass	Fail	8
V1	Validation	Val_1-1	4330	3984	-8.0%	Fail	Fail	Pass	Fail	12
	Validation	Val_1-2	4509	4170	-7.5%	Fail	Fail	Pass	Fail	12
V2	Validation	Val_2-1	1201	1169	-2.7%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	1170	1073	-8.3%	Fail	Fail	Pass	Fail	4
V3	Validation	Val_3-1	1071	1212	13.2%	Fail	Fail	Fail	Fail	3
	Validation	Val_3-2	1227	1279	4.2%	Pass	Pass	Pass	Pass	3
V4	Validation	Val_4-1	3022	2998	-0.8%	Pass	Pass	Pass	Pass	8
	Validation	Val_4-2	3353	3249	-3.1%	Pass	Pass	Pass	Pass	8
V5	Validation	Val_5-1	685	709	3.5%	Pass	Pass	Pass	Pass	3
	Validation	Val_5-2	618	699	13.1%	Fail	Fail	Fail	Fail	3
V6	Validation	Val_6-1	1973	1923	-2.5%	Pass	Pass	Pass	Pass	3
	Validation	Val_6-2	1692	1670	-1.3%	Pass	Pass	Pass	Pass	3

Calibration	60818	59793	-1.7%	Pass	Pass	Pass	Pass
Validation	24851	24135	-2.9%	Pass	Pass	Pass	Pass
TOTAL	85669	83928	-2.0%	Pass	Pass	Pass	Pass

Fail	9	5	2	9
Pass	25	29	32	25
Total	34	34	34	34
%	74%	85%	94%	74%

Screenline summary wihout high-flow roads - IP Total

IP	Total

	IP	Screenline Modelled vs Observed by Direction			Total	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	398	398	0.0%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	369	367	-0.5%	Pass	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	2828	3024	6.9%	Fail	Pass	Pass	Fail	16
	Calibration	Cal_2-2	2799	2861	2.2%	Pass	Pass	Pass	Pass	15
C3	Calibration	Cal_3-1	1094	1154	5.5%	Fail	Pass	Pass	Pass	4
	Calibration	Cal_3-2	1094	1070	-2.2%	Pass	Pass	Pass	Pass	4
C4	Calibration	Cal_4-1	1748	1886	7.9%	Fail	Fail	Pass	Fail	6
	Calibration	Cal_4-2	1736	1802	3.8%	Pass	Pass	Pass	Pass	6
C5	Calibration	Cal_5-1	5974	5625	-5.8%	Fail	Pass	Pass	Fail	18
	Calibration	Cal_5-2	6285	5914	-5.9%	Fail	Pass	Pass	Fail	18
C6	Calibration	Cal_6-1	3547	3532	-0.4%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_6-2	3687	3604	-2.3%	Pass	Pass	Pass	Pass	9
C7	Calibration	Cal_7-1	4432	4481	1.1%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	4705	4500	-4.4%	Pass	Pass	Pass	Pass	10
C8	Calibration	Cal_8-1	2559	2529	-1.2%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_8-2	2985	2991	0.2%	Pass	Pass	Pass	Pass	8
C9	Calibration	Cal_9-1	4651	4704	1.1%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	5122	5171	1.0%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	4477	4475	0.0%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	4708	4793	1.8%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	2965	2804	-5.4%	Fail	Pass	Pass	Pass	8
	Calibration	Cal_11-2	3006	2821	-6.2%	Fail	Pass	Pass	Fail	8
V1	Validation	Val_1-1	5029	4664	-7.3%	Fail	Pass	Pass	Fail	12
	Validation	Val_1-2	5227	4769	-8.8%	Fail	Fail	Pass	Fail	12
V2	Validation	Val_2-1	1370	1334	-2.6%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	1311	1227	-6.4%	Fail	Pass	Pass	Pass	4
V3	Validation	Val_3-1	1309	1473	12.5%	Fail	Fail	Fail	Fail	3
	Validation	Val_3-2	1463	1494	2.1%	Pass	Pass	Pass	Pass	3
V4	Validation	Val_4-1	3581	3413	-4.7%	Pass	Pass	Pass	Pass	8
	Validation	Val_4-2	3918	3632	-7.3%	Fail	Pass	Pass	Fail	8
V5	Validation	Val_5-1	758	813	7.3%	Fail	Pass	Pass	Pass	3
	Validation	Val_5-2	715	792	10.8%	Fail	Fail	Fail	Fail	3
V6	Validation	Val_6-1	2827	2719	-3.8%	Pass	Pass	Pass	Pass	3
	Validation	Val_6-2	2354	2307	-2.0%	Pass	Pass	Pass	Pass	3

Calibration	71169	70506	-0.9%	Pass	Pass	Pass	Pass
Validation	29862	28637	-4.1%	Pass	Pass	Pass	Pass
TOTAL	101031	99143	-1.9%	Pass	Pass	Pass	Pass

Fail	14	4	2	10
Pass	20	30	32	24
Total	34	34	34	34
%	59%	88%	94%	71%

Screenline summary wihout high-flow roads - PM Car

PM	Car

	PM	Screenline Modelled vs Observed by Direction			Car	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	835	843	1.0%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	314	329	4.8%	Pass	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	3712	3717	0.1%	Pass	Pass	Pass	Pass	16
	Calibration	Cal_2-2	4261	4010	-5.9%	Fail	Pass	Pass	Fail	15
C3	Calibration	Cal_3-1	1315	1337	1.7%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_3-2	1767	1614	-8.7%	Fail	Fail	Pass	Fail	4
C4	Calibration	Cal_4-1	2480	2501	0.8%	Pass	Pass	Pass	Pass	6
	Calibration	Cal_4-2	2381	2415	1.4%	Pass	Pass	Pass	Pass	6
C5	Calibration	Cal_5-1	7183	7250	0.9%	Pass	Pass	Pass	Pass	18
	Calibration	Cal_5-2	8126	7801	-4.0%	Pass	Pass	Pass	Pass	18
C6	Calibration	Cal_6-1	3832	3724	-2.8%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_6-2	5009	4965	-0.9%	Pass	Pass	Pass	Pass	9
C7	Calibration	Cal_7-1	5542	5426	-2.1%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	6039	6421	6.3%	Fail	Pass	Pass	Fail	10
C8	Calibration	Cal_8-1	2694	2733	1.4%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_8-2	4168	4569	9.6%	Fail	Fail	Pass	Fail	8
C9	Calibration	Cal_9-1	4523	4483	-0.9%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	6890	6909	0.3%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	5469	5454	-0.3%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	5669	5680	0.2%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	2817	2692	-4.4%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_11-2	3889	3731	-4.1%	Pass	Pass	Pass	Pass	8
V1	Validation	Val_1-1	6122	5818	-5.0%	Pass	Pass	Pass	Pass	12
	Validation	Val_1-2	6885	6712	-2.5%	Pass	Pass	Pass	Pass	12
V2	Validation	Val_2-1	1776	1803	1.5%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	1545	1463	-5.3%	Fail	Pass	Pass	Pass	4
V3	Validation	Val_3-1	1432	1609	12.4%	Fail	Fail	Fail	Fail	3
	Validation	Val_3-2	1935	1948	0.7%	Pass	Pass	Pass	Pass	3
V4	Validation	Val_4-1	4217	4214	-0.1%	Pass	Pass	Pass	Pass	8
	Validation	Val_4-2	4482	4308	-3.9%	Pass	Pass	Pass	Pass	8
V5	Validation	Val_5-1	1345	1163	-13.5%	Fail	Fail	Fail	Fail	3
	Validation	Val_5-2	865	968	11.9%	Fail	Fail	Fail	Fail	3
V6	Validation	Val_6-1	3421	3319	-3.0%	Pass	Pass	Pass	Pass	3
	Validation	Val_6-2	2453	2338	-4.7%	Pass	Pass	Pass	Pass	3

Calibration	88915	88604	-0.3%	Pass	Pass	Pass	Pass
Validation	36478	35663	-2.2%	Pass	Pass	Pass	Pass
TOTAL	125393	124267	-0.9%	Pass	Pass	Pass	Pass

Fail	8	5	3	7
Pass	26	29	31	27
Total	34	34	34	34
%	76%	85%	91%	79%

Screenline summary wihout high-flow roads - PM Total

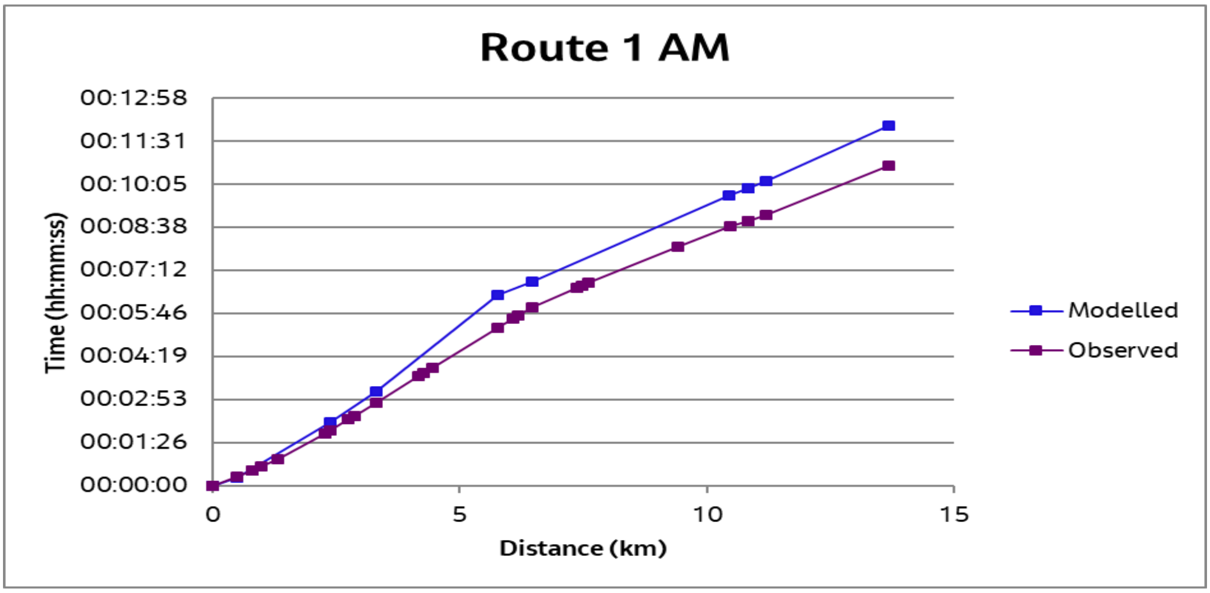
PM	Total

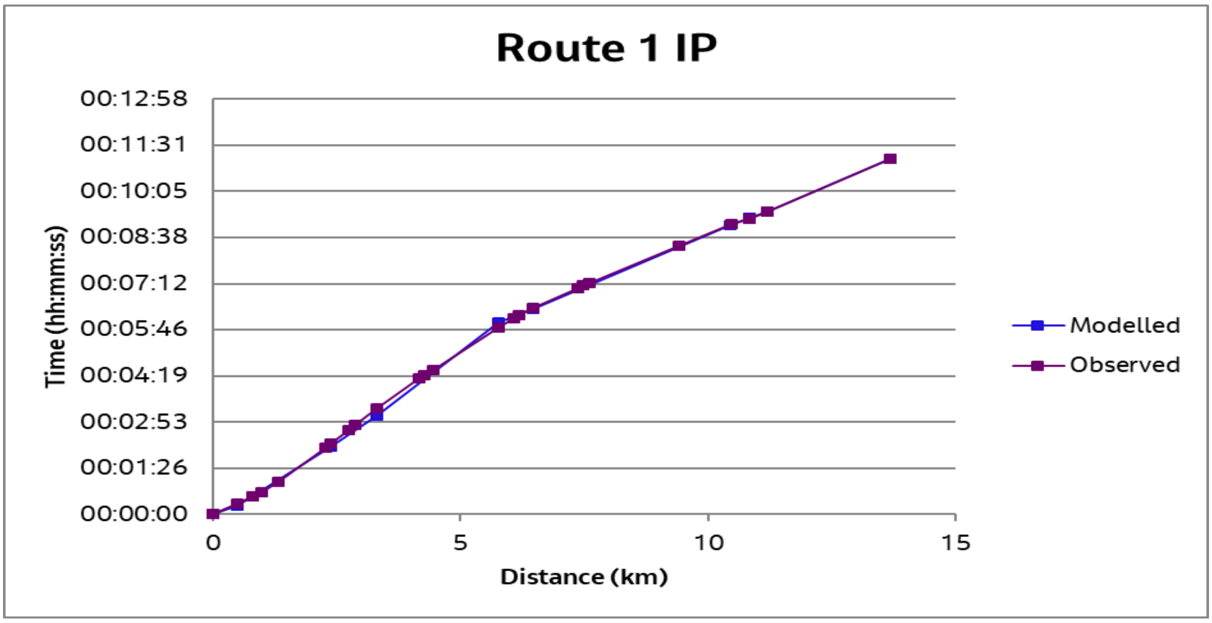
	PM	Screenline Modelled vs Observed by Direction			Total	% (Actual Flow)				
Screenline ID	Purpose	Screenline Name	AM Count Data	AM Model Data	Diff	< 5%	< 7.5%	< 10%	% Criteria	No. of Counts
C1	Calibration	Cal_1-1	990	982	-0.8%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_1-2	381	391	2.6%	Pass	Pass	Pass	Pass	4
C2	Calibration	Cal_2-1	4069	4239	4.2%	Pass	Pass	Pass	Pass	16
	Calibration	Cal_2-2	4621	4442	-3.9%	Pass	Pass	Pass	Pass	15
C3	Calibration	Cal_3-1	1421	1484	4.4%	Pass	Pass	Pass	Pass	4
	Calibration	Cal_3-2	1907	1735	-9.0%	Fail	Fail	Pass	Fail	4
C4	Calibration	Cal_4-1	2779	2873	3.4%	Pass	Pass	Pass	Pass	6
	Calibration	Cal_4-2	2629	2700	2.7%	Pass	Pass	Pass	Pass	6
C5	Calibration	Cal_5-1	7859	7961	1.3%	Pass	Pass	Pass	Pass	18
	Calibration	Cal_5-2	8752	8469	-3.2%	Pass	Pass	Pass	Pass	18
C6	Calibration	Cal_6-1	4264	4138	-3.0%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_6-2	5586	5487	-1.8%	Pass	Pass	Pass	Pass	9
C7	Calibration	Cal_7-1	6299	6160	-2.2%	Pass	Pass	Pass	Pass	10
	Calibration	Cal_7-2	6773	7192	6.2%	Fail	Pass	Pass	Fail	10
C8	Calibration	Cal_8-1	2981	3014	1.1%	Pass	Pass	Pass	Pass	8
	Calibration	Cal_8-2	4627	5050	9.1%	Fail	Fail	Pass	Fail	8
C9	Calibration	Cal_9-1	5056	5035	-0.4%	Pass	Pass	Pass	Pass	5
	Calibration	Cal_9-2	7774	7788	0.2%	Pass	Pass	Pass	Pass	5
C10	Calibration	Cal_10-1	5855	5858	0.1%	Pass	Pass	Pass	Pass	9
	Calibration	Cal_10-2	6204	6197	-0.1%	Pass	Pass	Pass	Pass	9
C11	Calibration	Cal_11-1	3032	2879	-5.0%	Fail	Pass	Pass	Pass	8
	Calibration	Cal_11-2	4163	3965	-4.8%	Pass	Pass	Pass	Pass	8
V1	Validation	Val_1-1	6757	6466	-4.3%	Pass	Pass	Pass	Pass	12
	Validation	Val_1-2	7522	7319	-2.7%	Pass	Pass	Pass	Pass	12
V2	Validation	Val_2-1	1933	1974	2.1%	Pass	Pass	Pass	Pass	4
	Validation	Val_2-2	1630	1555	-4.6%	Pass	Pass	Pass	Pass	4
V3	Validation	Val_3-1	1696	1763	4.0%	Pass	Pass	Pass	Pass	3
	Validation	Val_3-2	2154	2199	2.1%	Pass	Pass	Pass	Pass	3
V4	Validation	Val_4-1	4566	4488	-1.7%	Pass	Pass	Pass	Pass	8
	Validation	Val_4-2	4970	4619	-7.1%	Fail	Pass	Pass	Fail	8
V5	Validation	Val_5-1	1465	1253	-14.5%	Fail	Fail	Fail	Fail	3
	Validation	Val_5-2	979	1032	5.4%	Fail	Pass	Pass	Pass	3
V6	Validation	Val_6-1	4349	4198	-3.5%	Pass	Pass	Pass	Pass	3
	Validation	Val_6-2	2955	2842	-3.8%	Pass	Pass	Pass	Pass	3

Calibration	98022	98039	0.0%	Pass	Pass	Pass	Pass
Validation	40976	39708	-3.1%	Pass	Pass	Pass	Pass
TOTAL	138998	137747	-0.9%	Pass	Pass	Pass	Pass

Fail	7	3	1	5
Pass	27	31	33	29
Total	34	34	34	34
%	79%	91%	97%	85%

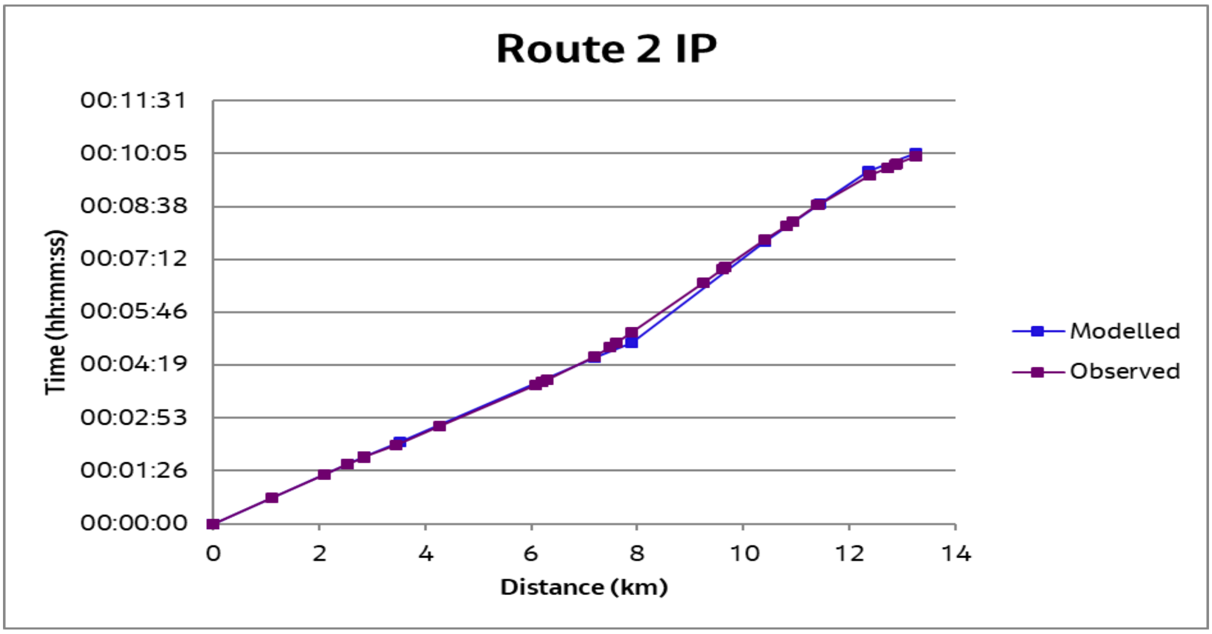
Appendix R – Journey Time Validation

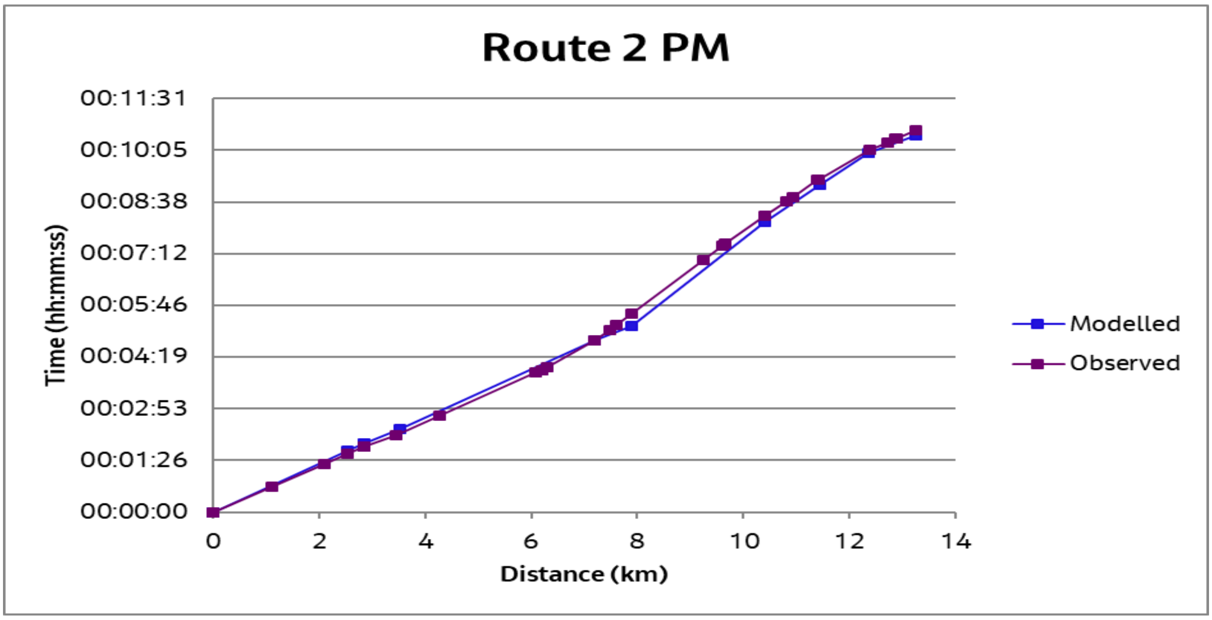

Route 1 AM
00:12:58
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
5
10
15
Distance (km)
Modelled
Observed


Route 1 IP
00:12:58
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
5
10
15
Distance (km)
Modelled
Observed


Route 1 PM
00:20:10
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
5
10
15
Distance (km)
Modelled
Observed


Route 2 AM
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 2 IP
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 2 PM
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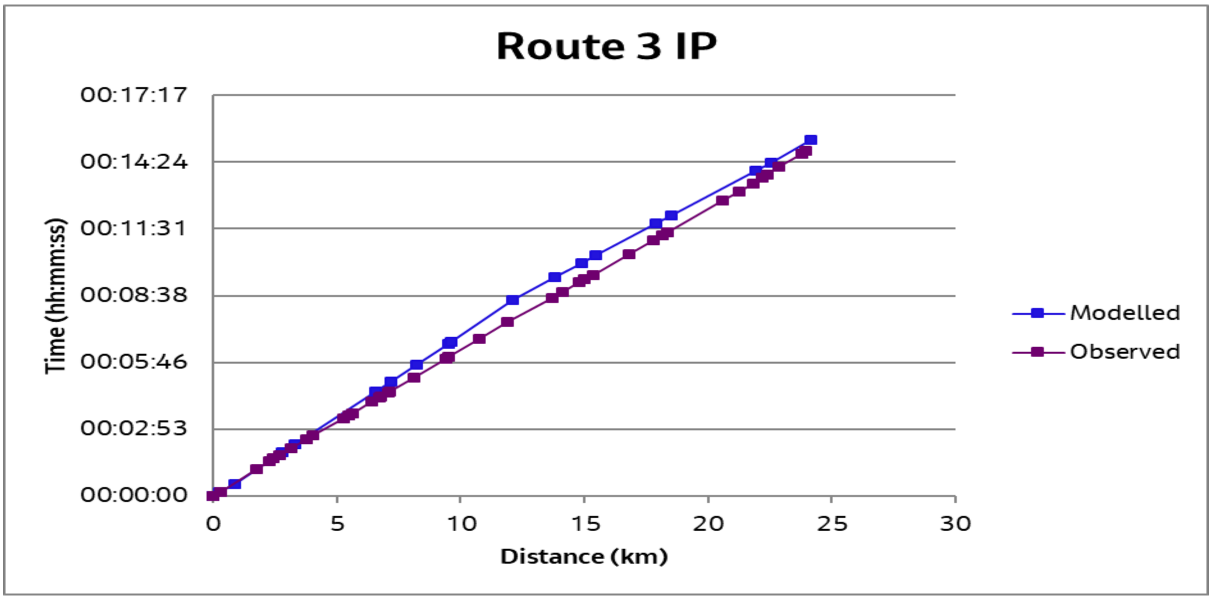
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 3 AM
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
5
10
15
20
25
30
Distance (km)
Modelled
Observed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00:05:46
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Time (hh:mm:ss)
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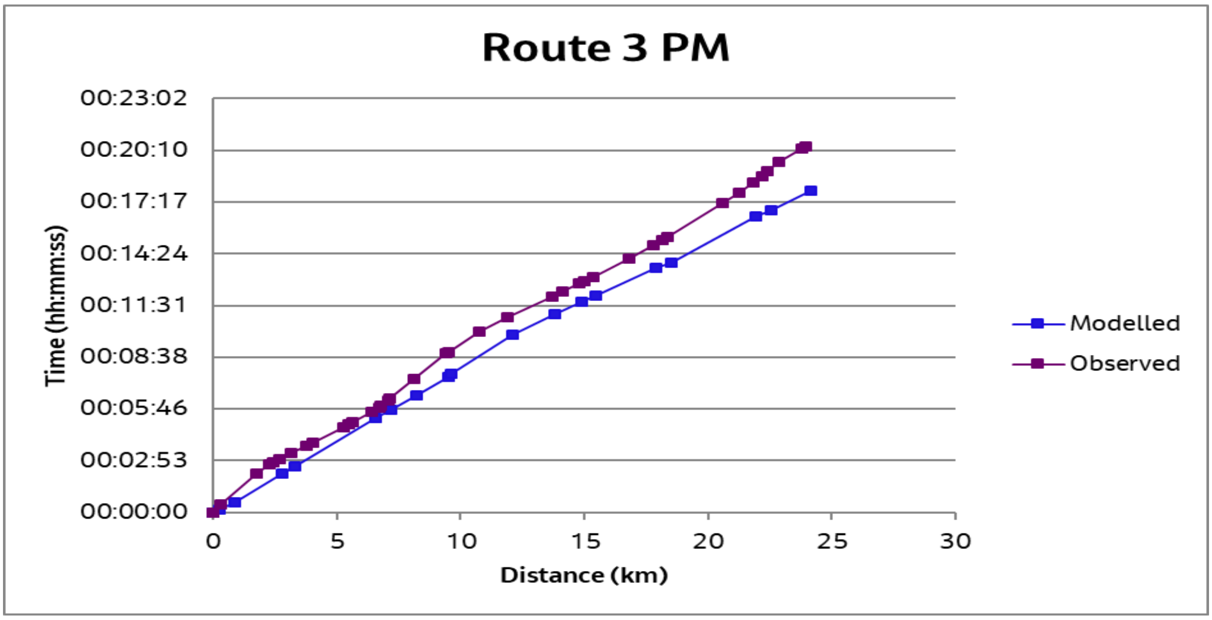
15
20
25
30
Distance (km)
Modelled
Observed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00:05:46
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Time (hh:mm:ss)
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5
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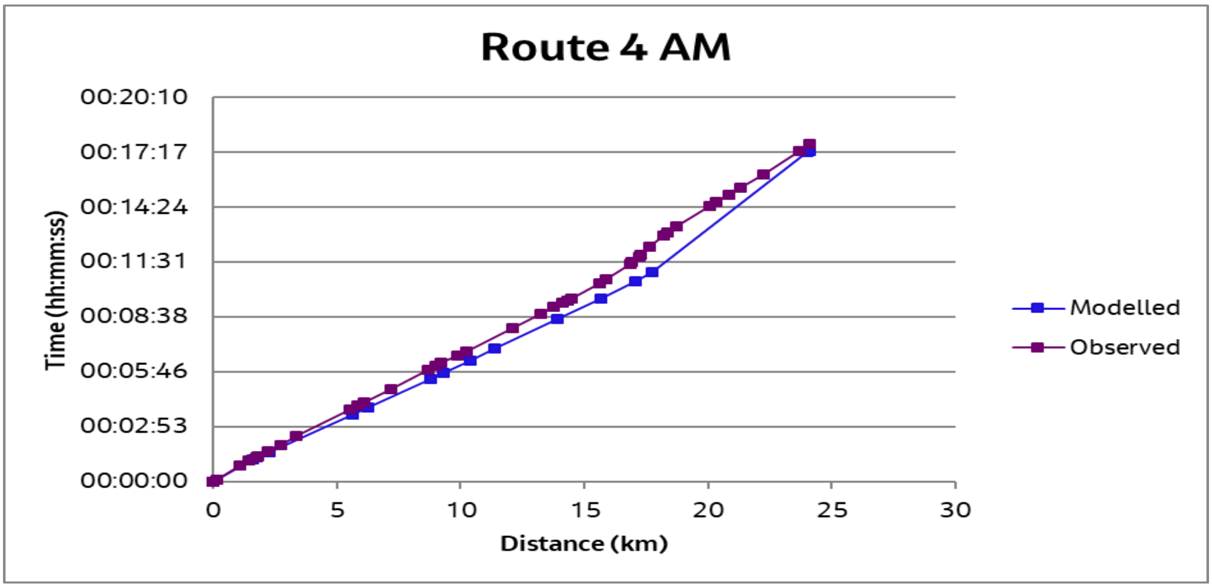
15
20
25
30
Distance (km)
Modelled
Observed


Route 4 AM
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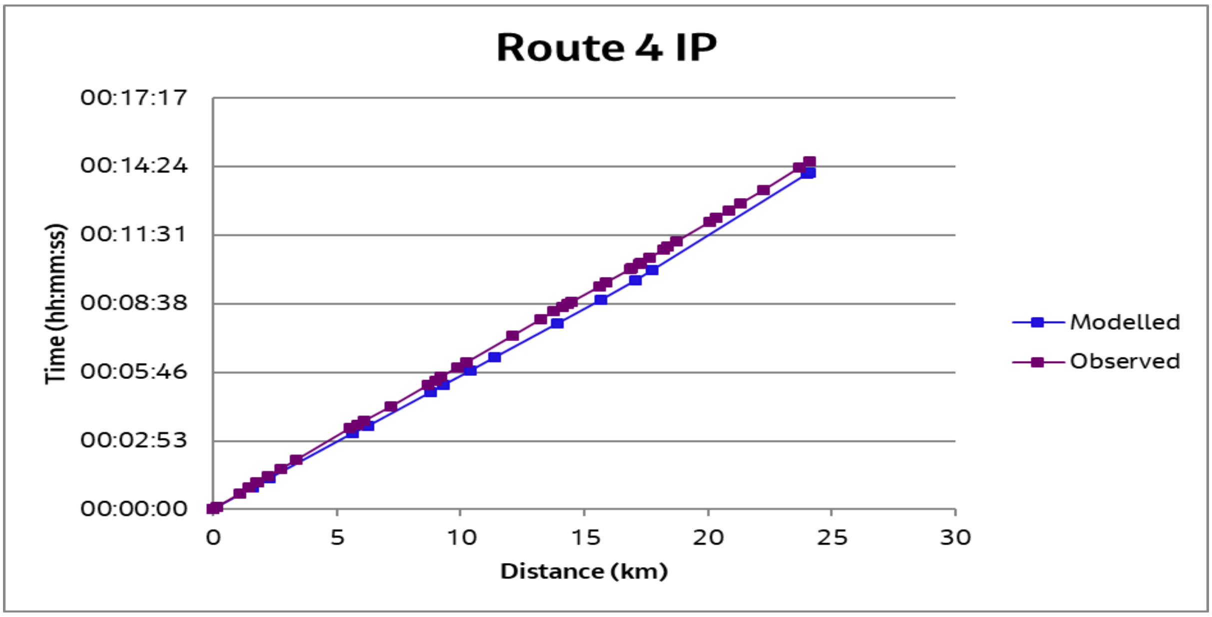
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
5
10
15
20
25
30
Distance (km)
Modelled
Observed


Route 4 IP
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00:08:38
00:05:46
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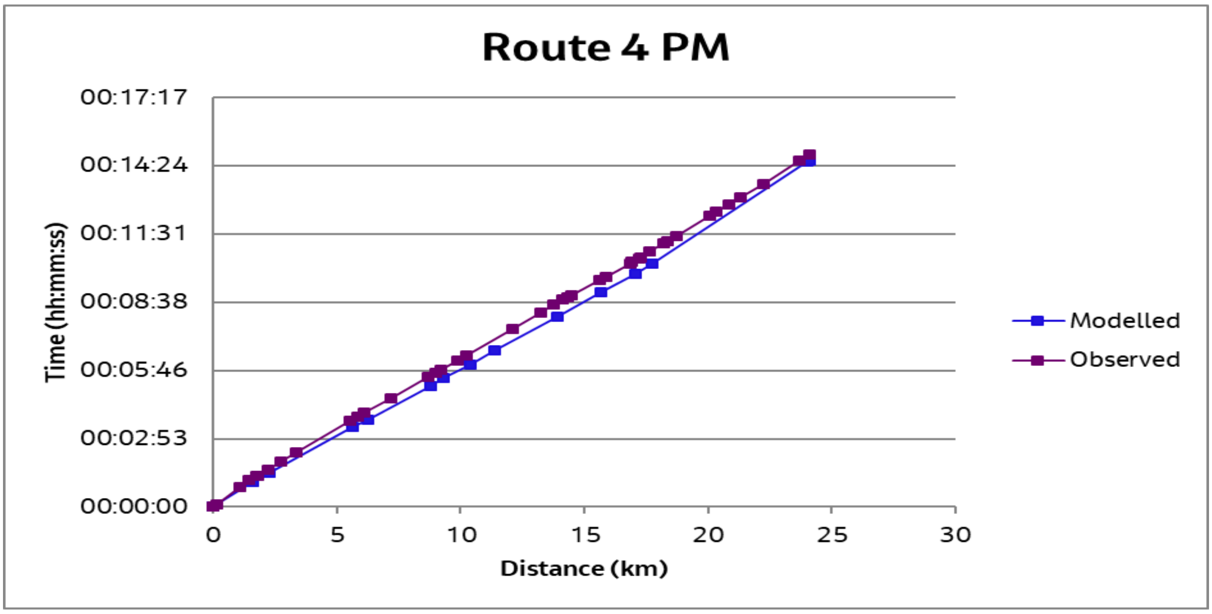
Time (hh:mm:ss)
0
5
10
15
20
25
30
Distance (km)
Modelled
Observed


Route 4 PM
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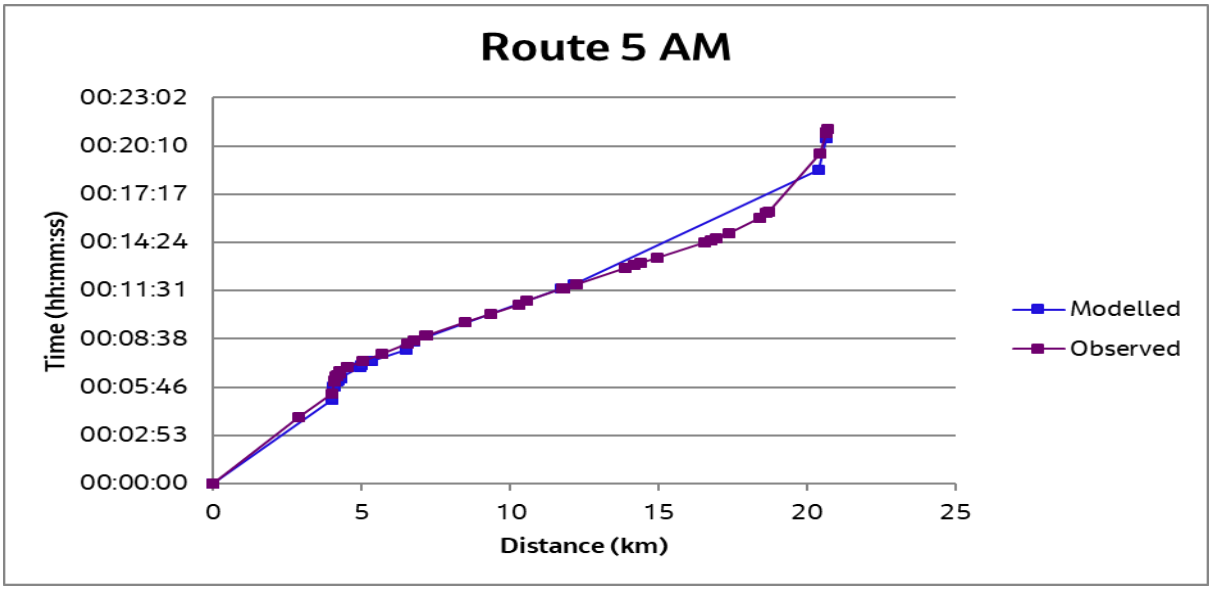
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
5
10
15
20
25
30
Distance (km)
Modelled
Observed


Route 5 AM
Time (hh:mm:ss)
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00:17:17
00:14:24
00:11:31
00:08:38
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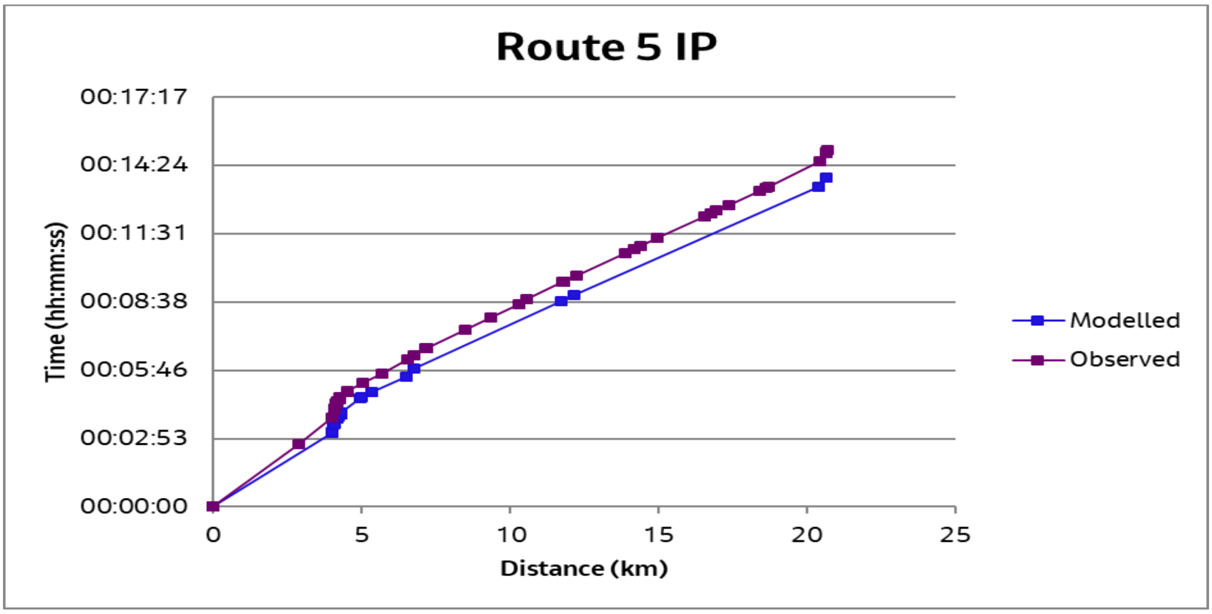
00:02:53
00:00:00
0
5
10
15
20
25
Distance (km)
Modelled
Observed


Route 5 IP
Time (hh:mm:ss)
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00:14:24
00:11:31
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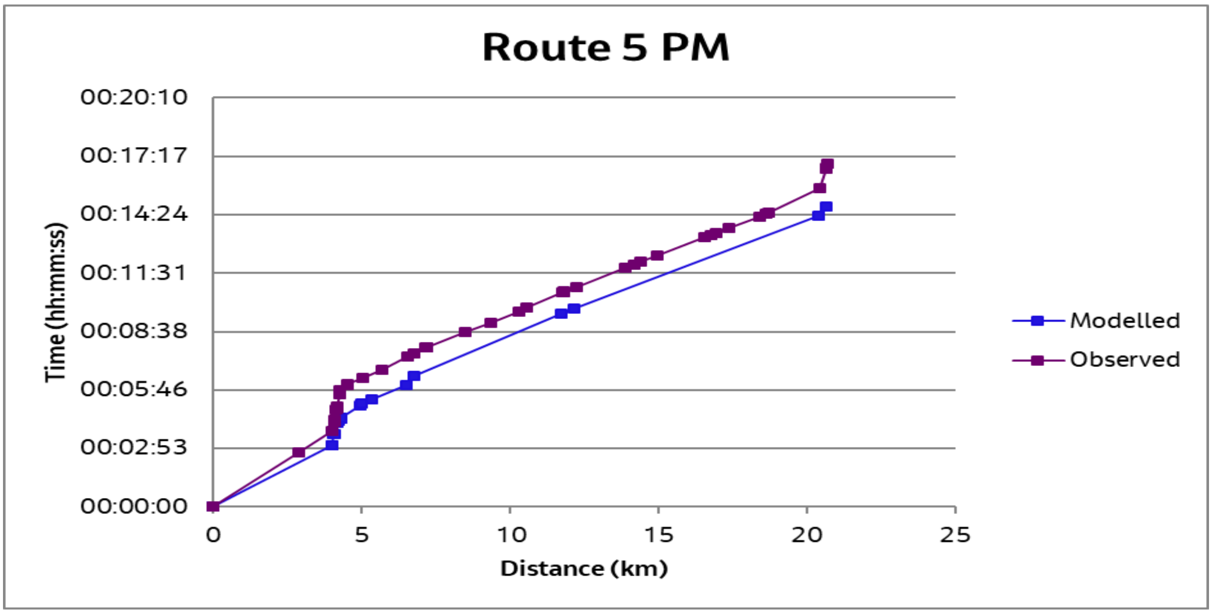
00:02:53
00:00:00
0
5
10
15
20
25
Distance (km)
Modelled
Observed


Route 5 PM
Time (hh:mm:ss)
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00:17:17
00:14:24
00:11:31
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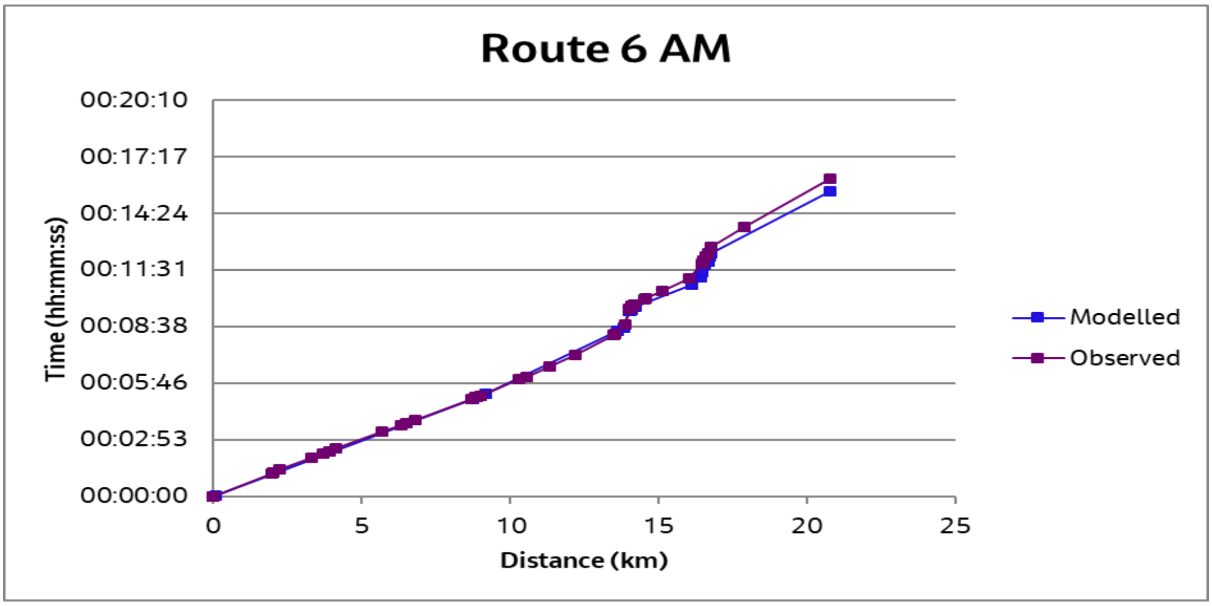
00:02:53
00:00:00
0
5
10
15
20
25
Distance (km)
Modelled
Observed


Route 6 AM
Time (hh:mm:ss)
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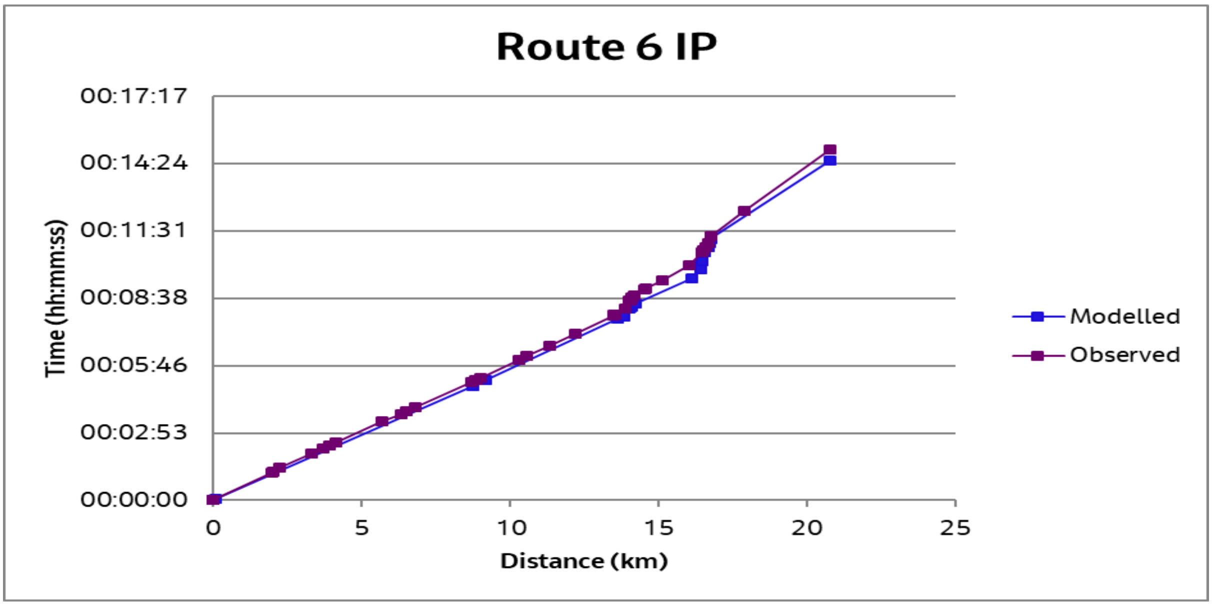
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
0
5
10
15
20
25
Distance (km)
Modelled
Observed


Route 6 IP
Time (hh:mm:ss)
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00:14:24
00:11:31
00:08:38
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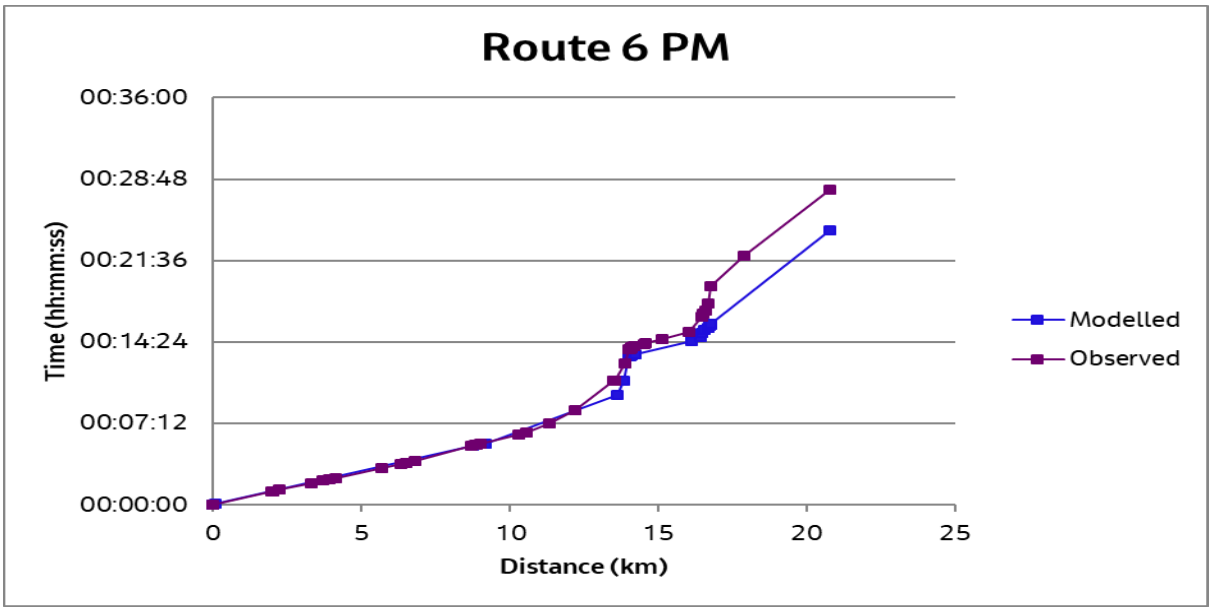
00:02:53
00:00:00
0
5
10
15
20
25
Distance (km)
Modelled
Observed


Route 6 PM
Time (hh:mm:ss)
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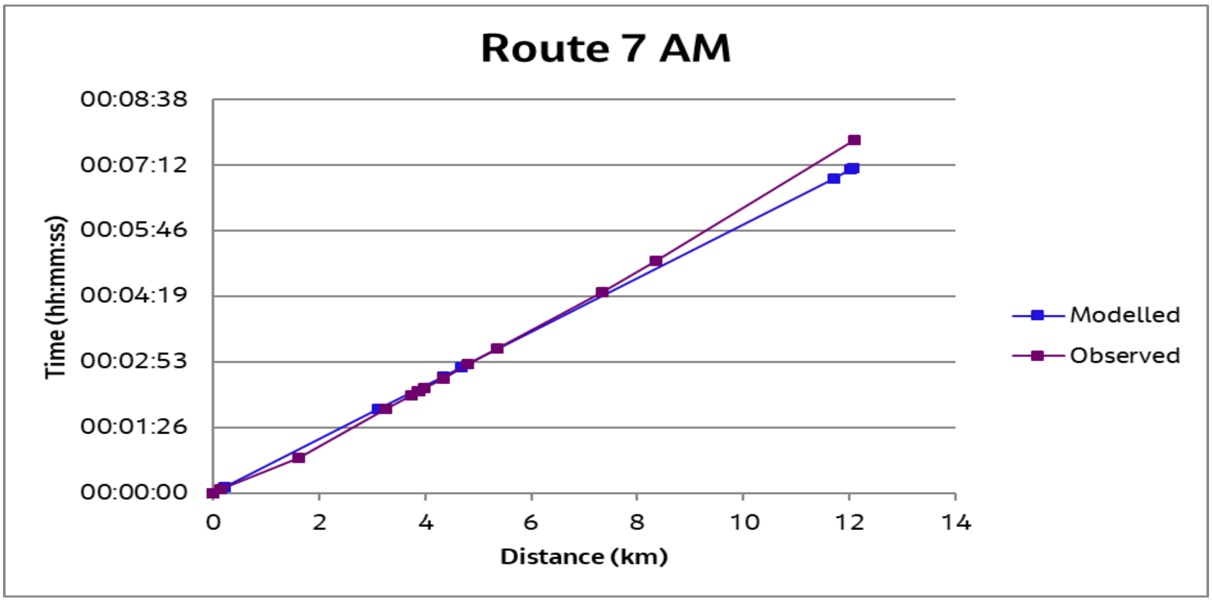
00:00:00
0
5
10
15
20
25
Distance (km)
Modelled
Observed


Route 7 AM
Time (hh:mm:ss)
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
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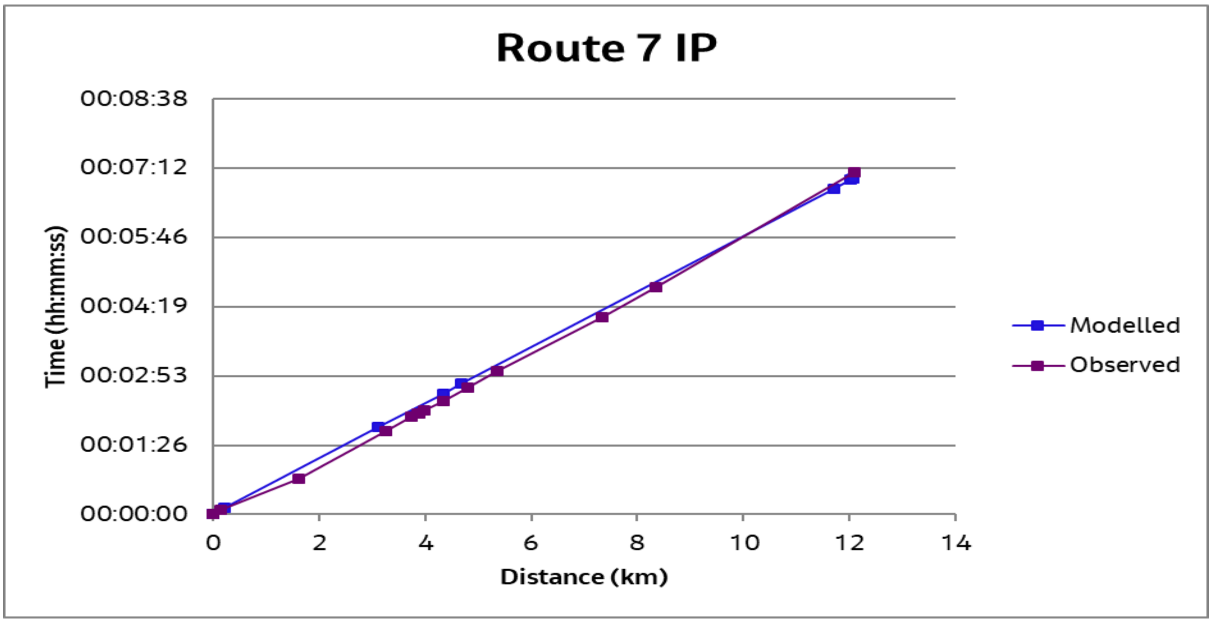
00:00:00
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 7 IP
Time (hh:mm:ss)
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00:07:12
00:05:46
00:04:19
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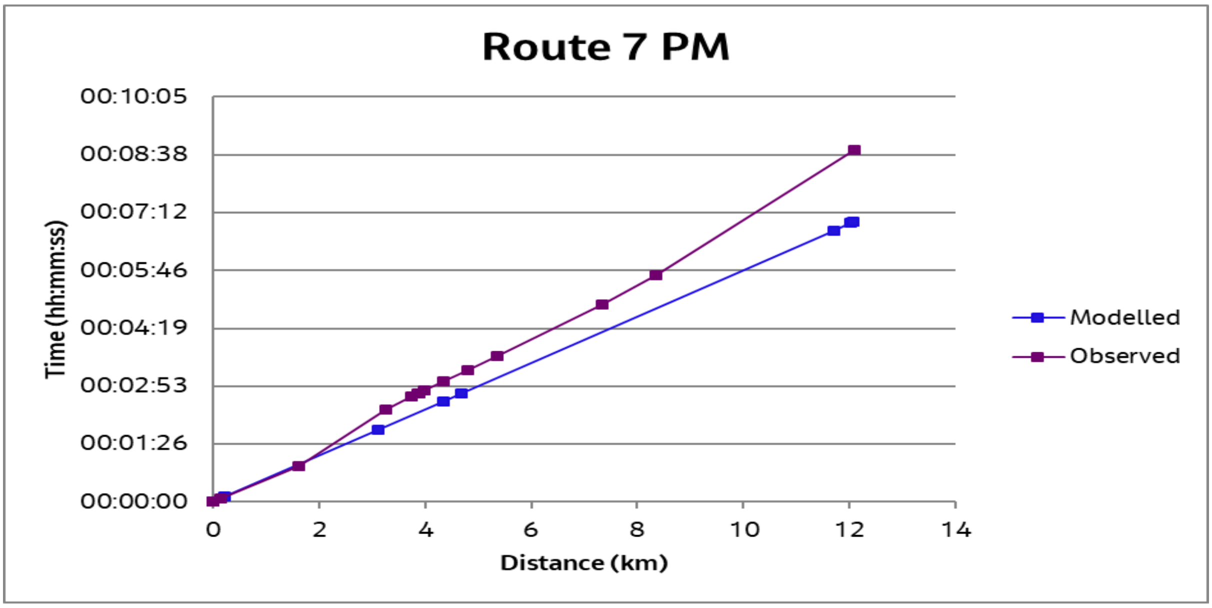
00:00:00
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 7 PM
Time (hh:mm:ss)
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
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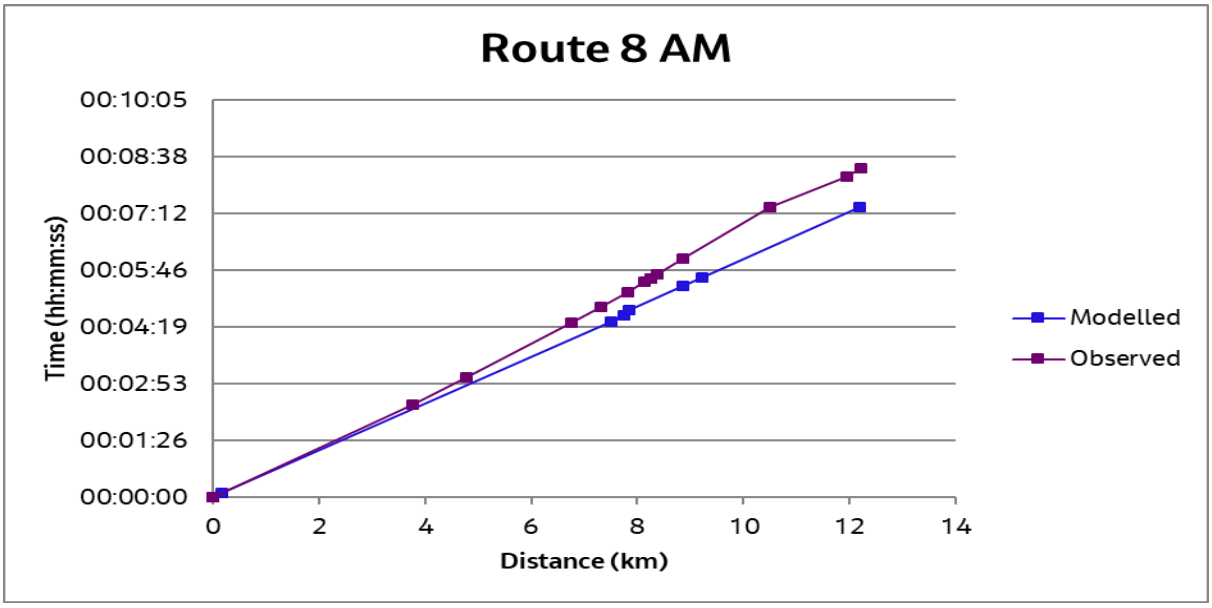
00:01:26
00:00:00
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 8 AM
Time (hh:mm:ss)
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00:07:12
00:05:46
00:04:19
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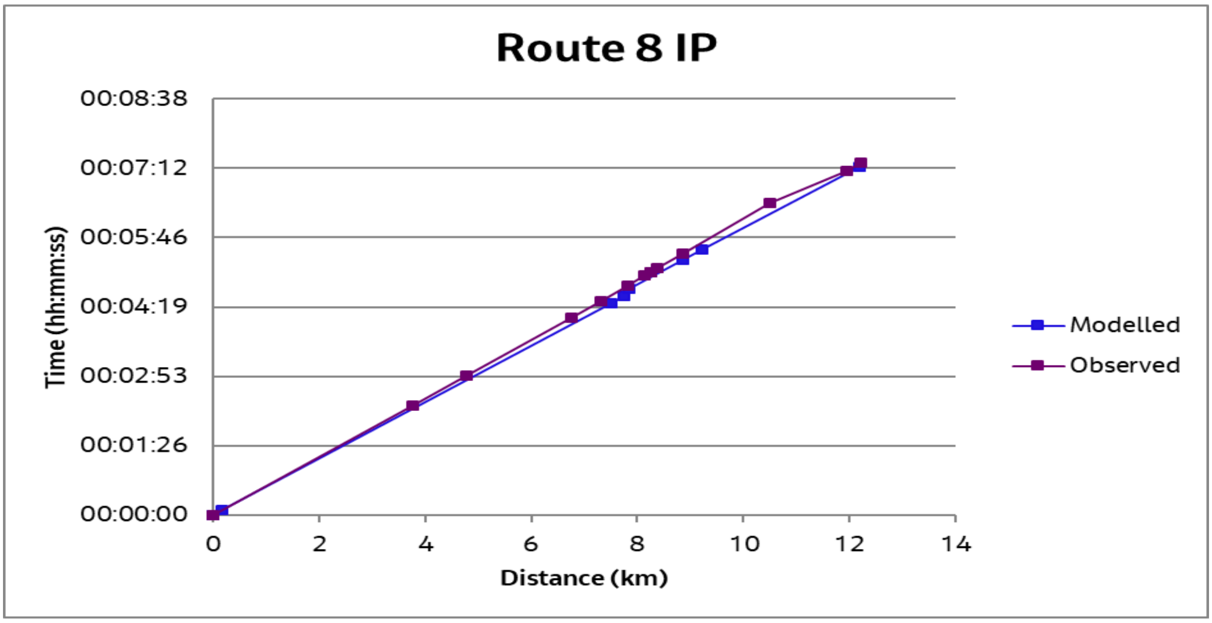
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 8 IP
Time (hh:mm:ss)
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00:07:12
00:05:46
00:04:19
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0
2
4
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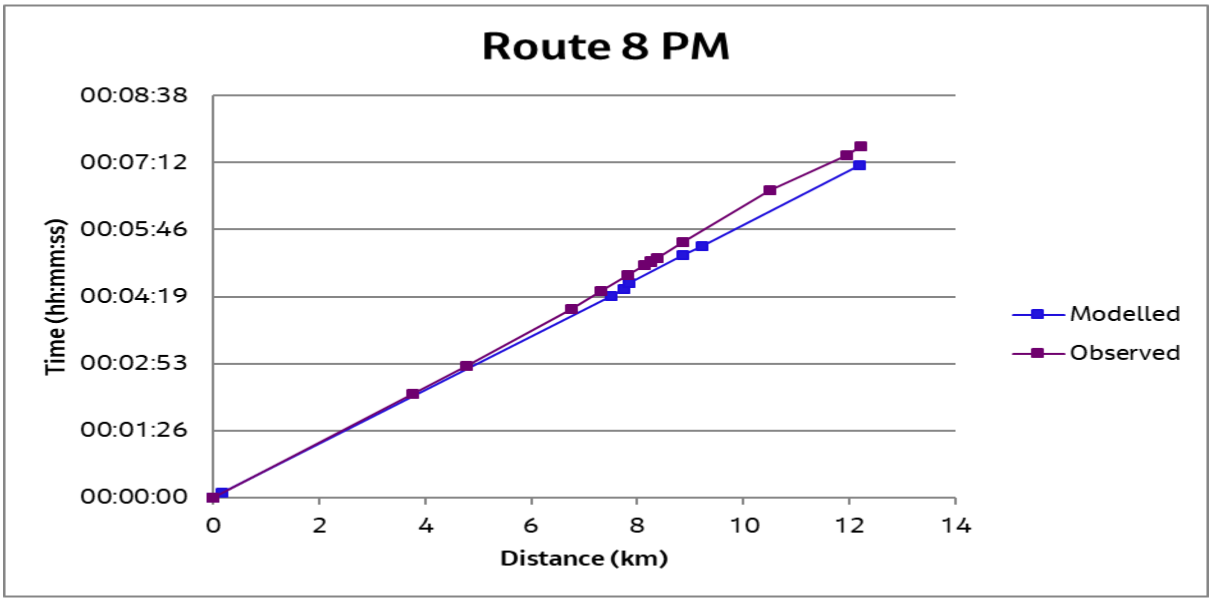
8
10
12
14
Distance (km)
Modelled
Observed


Route 8 PM
Time (hh:mm:ss)
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 9 AM
Time (hh:mm:ss)
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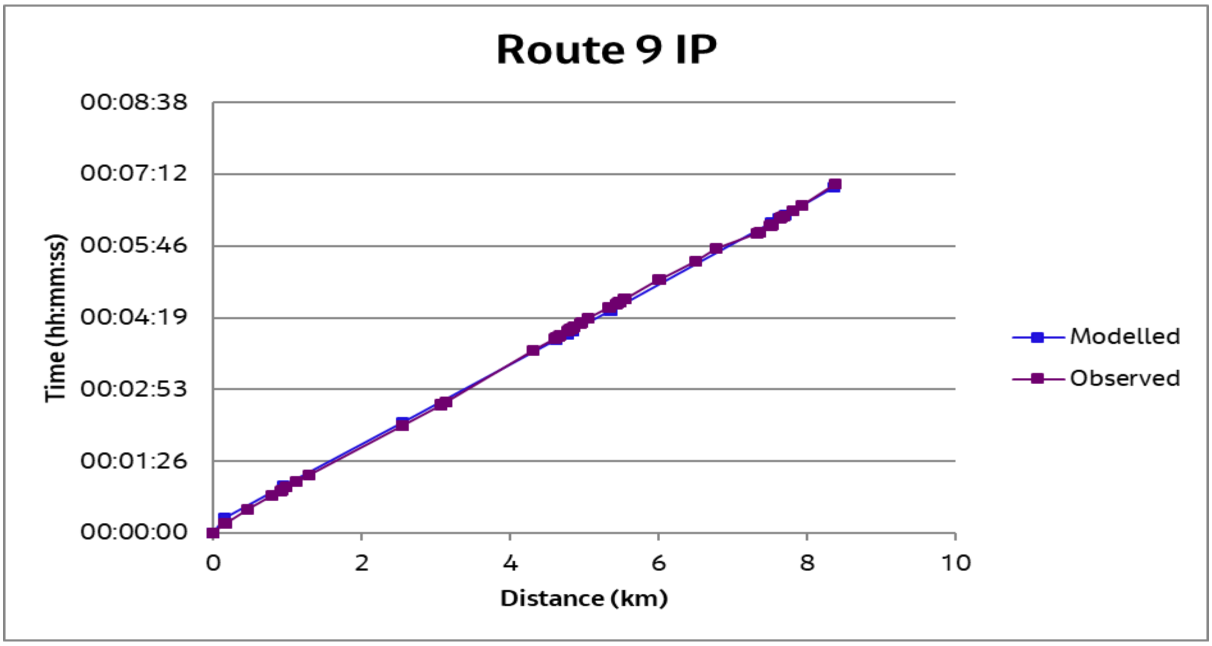
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
0
2
4
6
8
10
Distance (km)
Modelled
Observed


Route 9 IP
Time (hh:mm:ss)
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00:05:46
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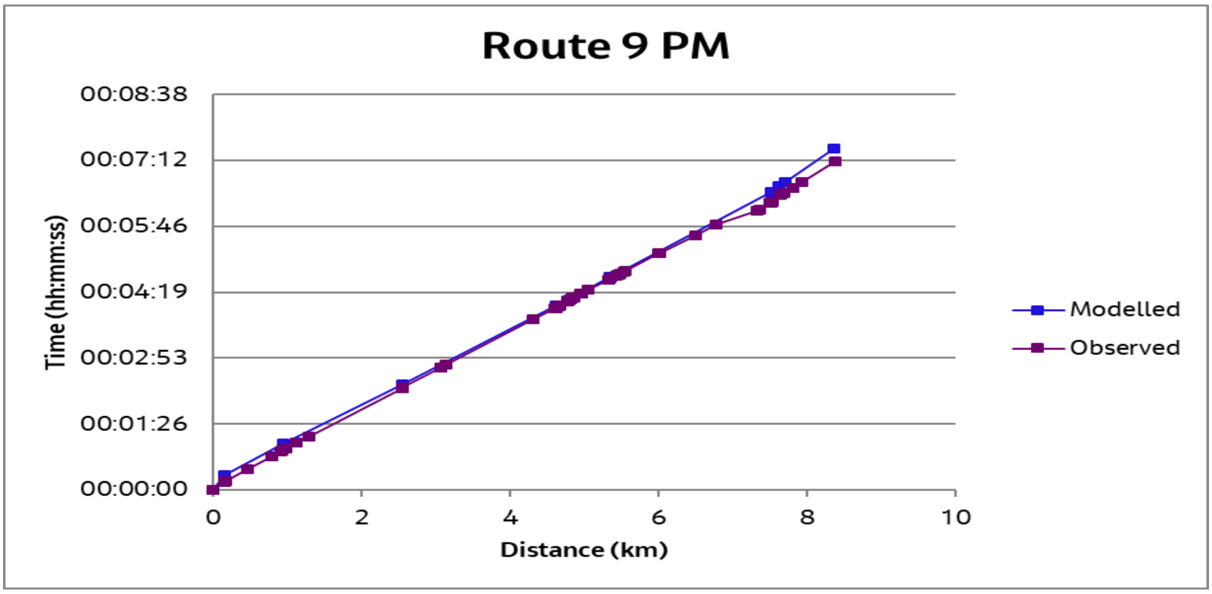
00:02:53
00:01:26
00:00:00
0
2
4
6
8
10
Distance (km)
Modelled
Observed


Route 9 PM
Time (hh:mm:ss)
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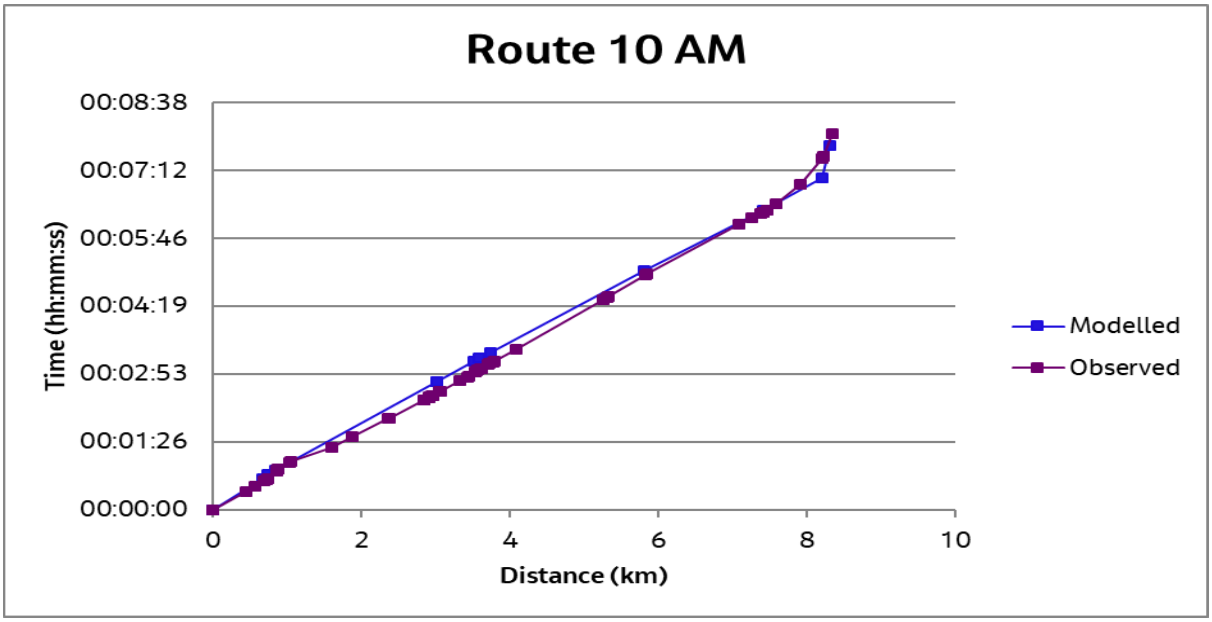
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
0
2
4
6
8
10
Distance (km)
Modelled
Observed


Route 10 AM
Time (hh:mm:ss)
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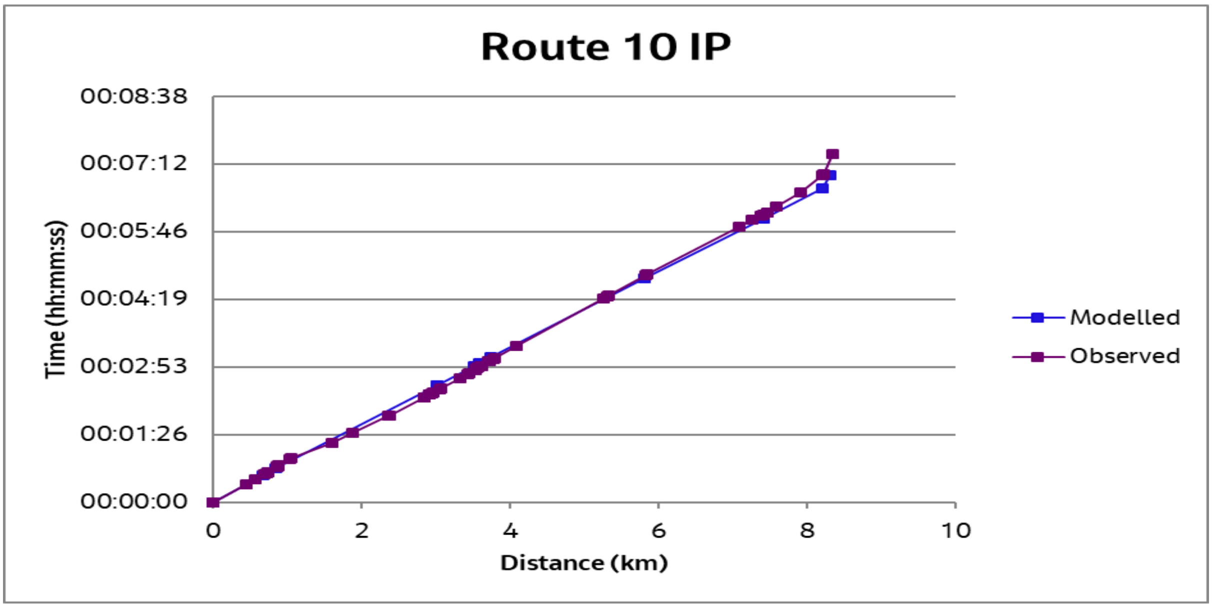
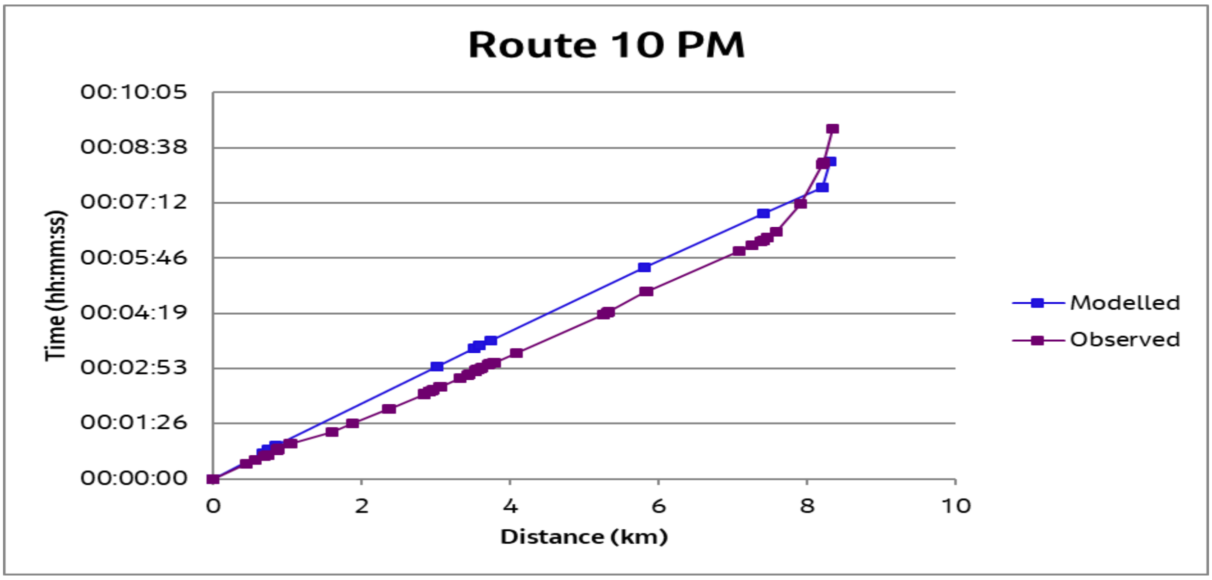
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
0
2
4
6
8
10
Distance (km)
Modelled
Observed


Route 10 IP
Time (hh:mm:ss)
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
0
2
4
6
8
10
Distance (km)
Modelled
Observed


Route 10 PM
Time (hh:mm:ss)
00:10:05
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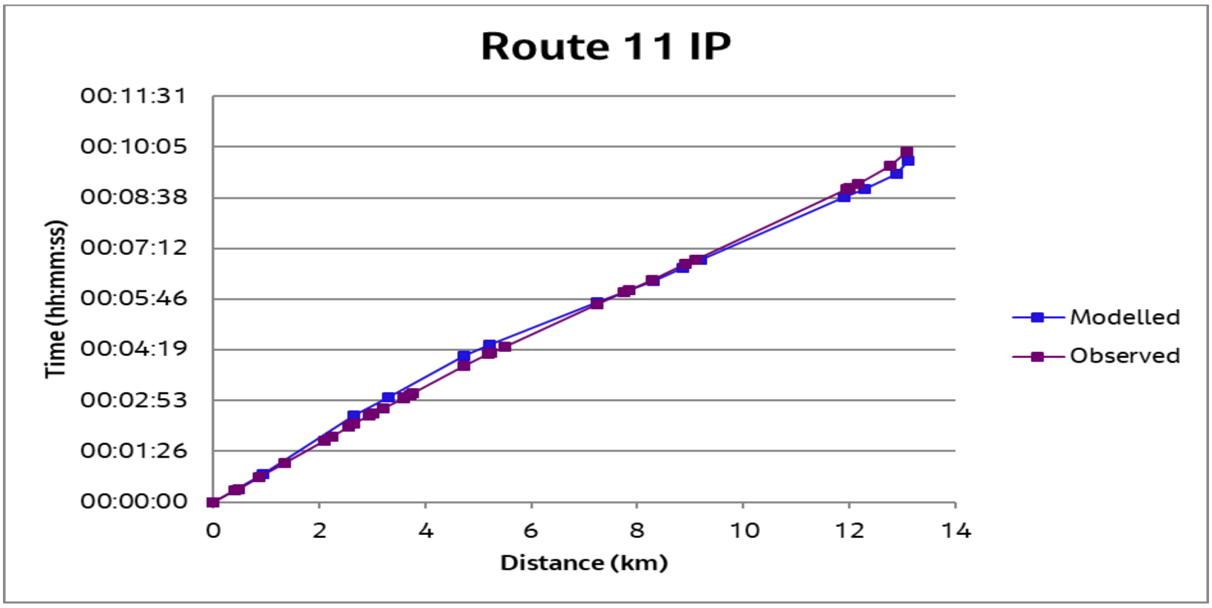
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
0
2
4
6
8
10
Distance (km)
Modelled
Observed


Route 11 AM
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 11 IP
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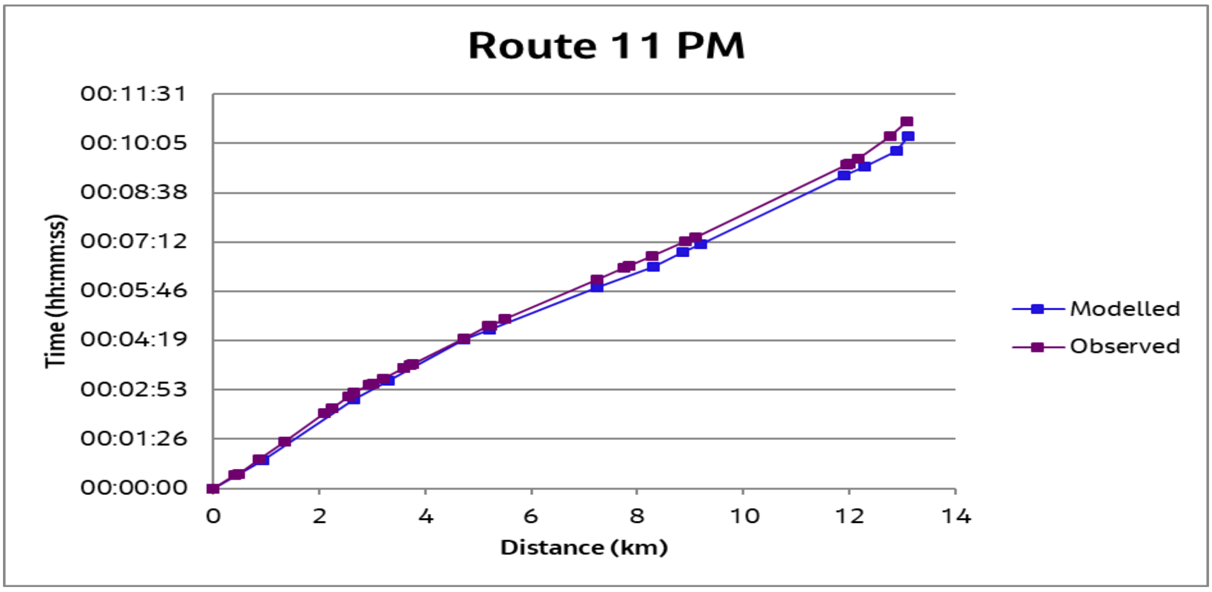
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 11 PM
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
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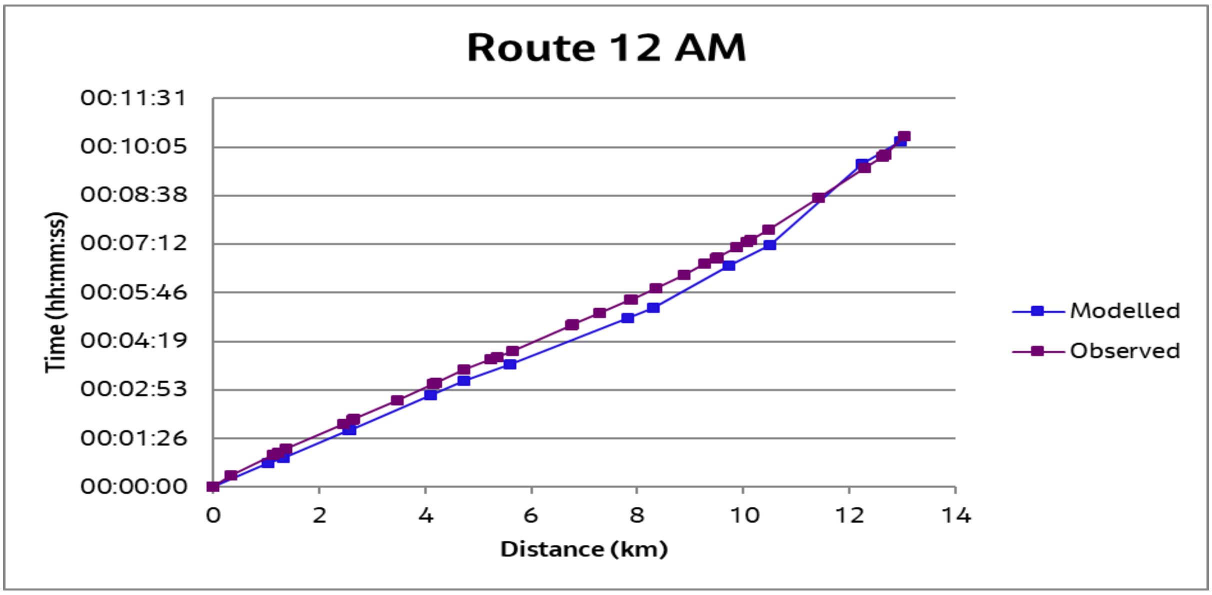
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 12 AM
Time (hh:mm:ss)
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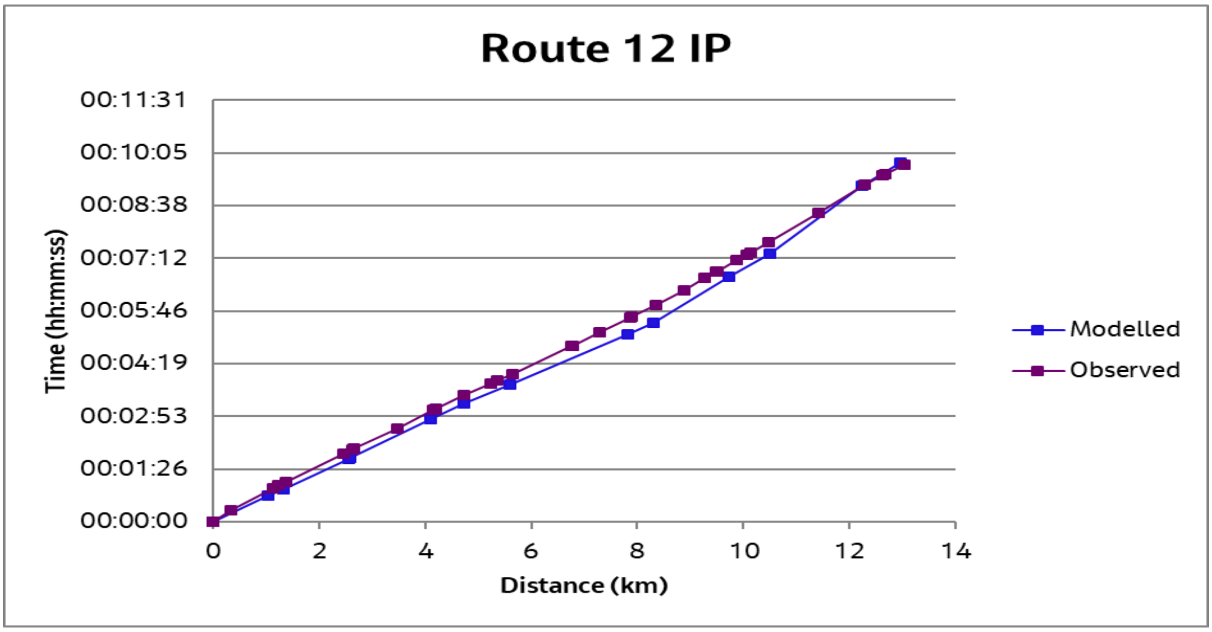
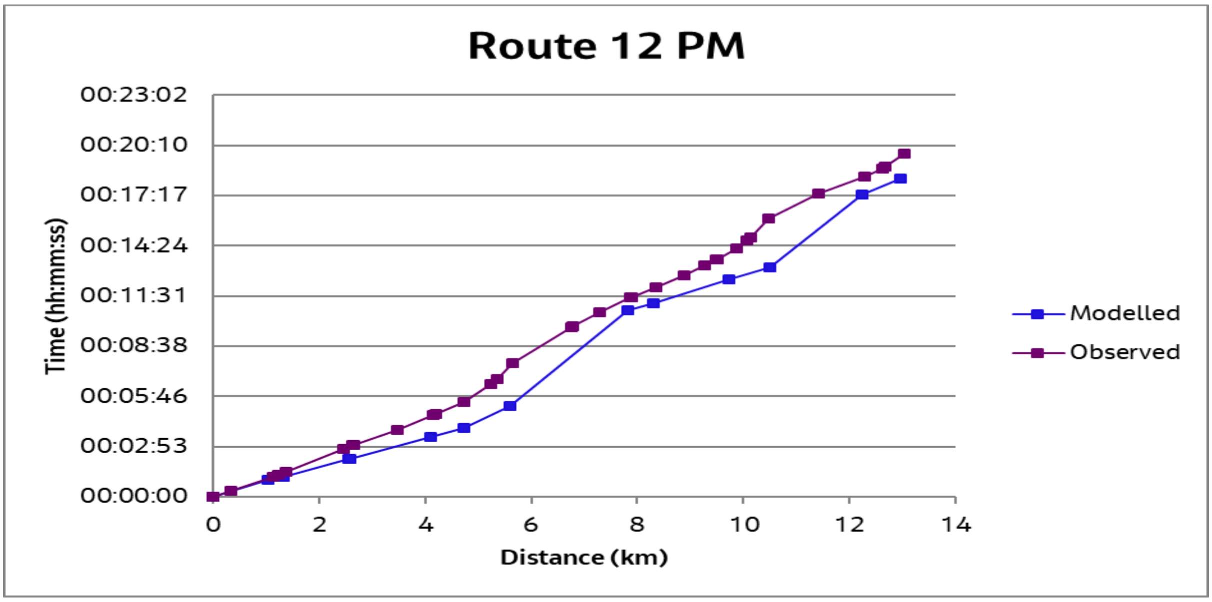
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 12 IP
Time (hh:mm:ss)
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 12 PM
Time (hh:mm:ss)
00:23:02
00:20:10
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed

Route 13 AM
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed

Route 13 IP
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
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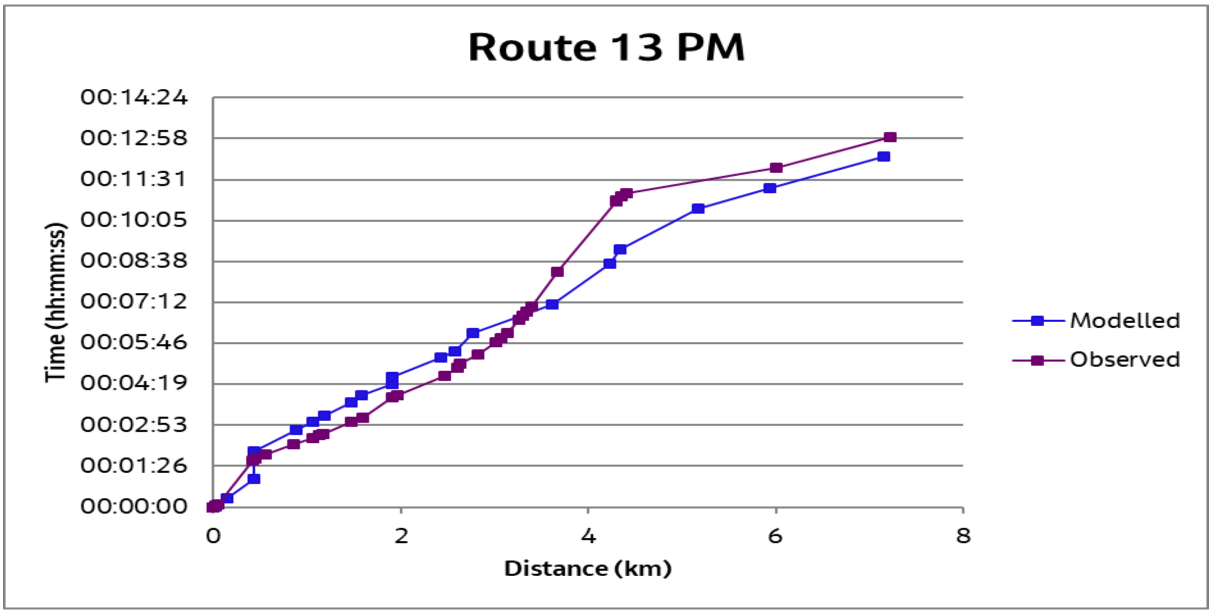
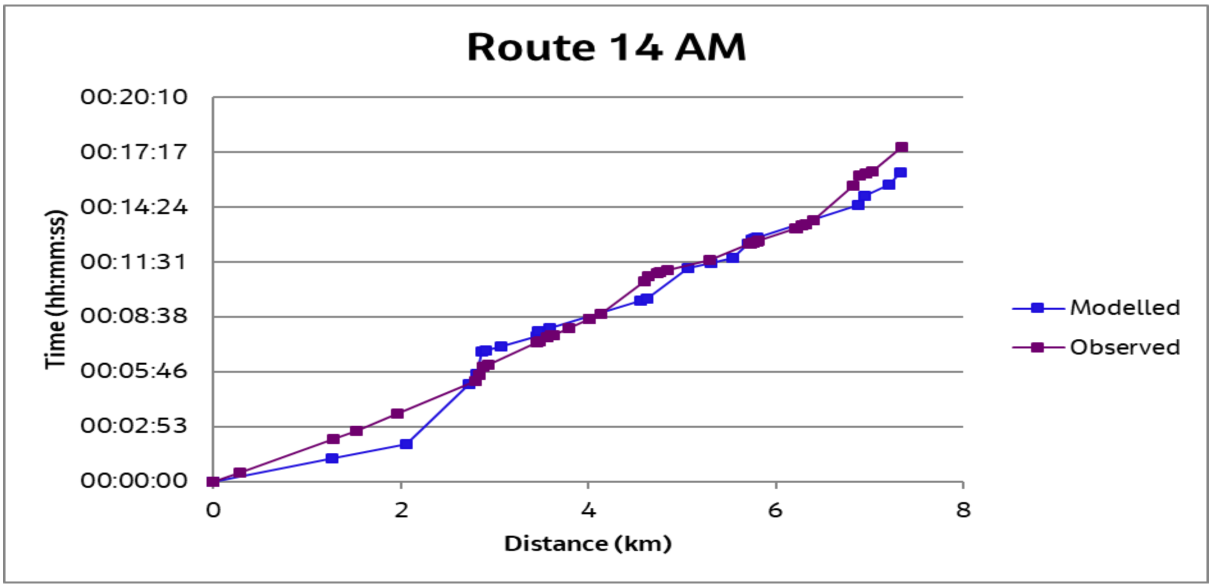
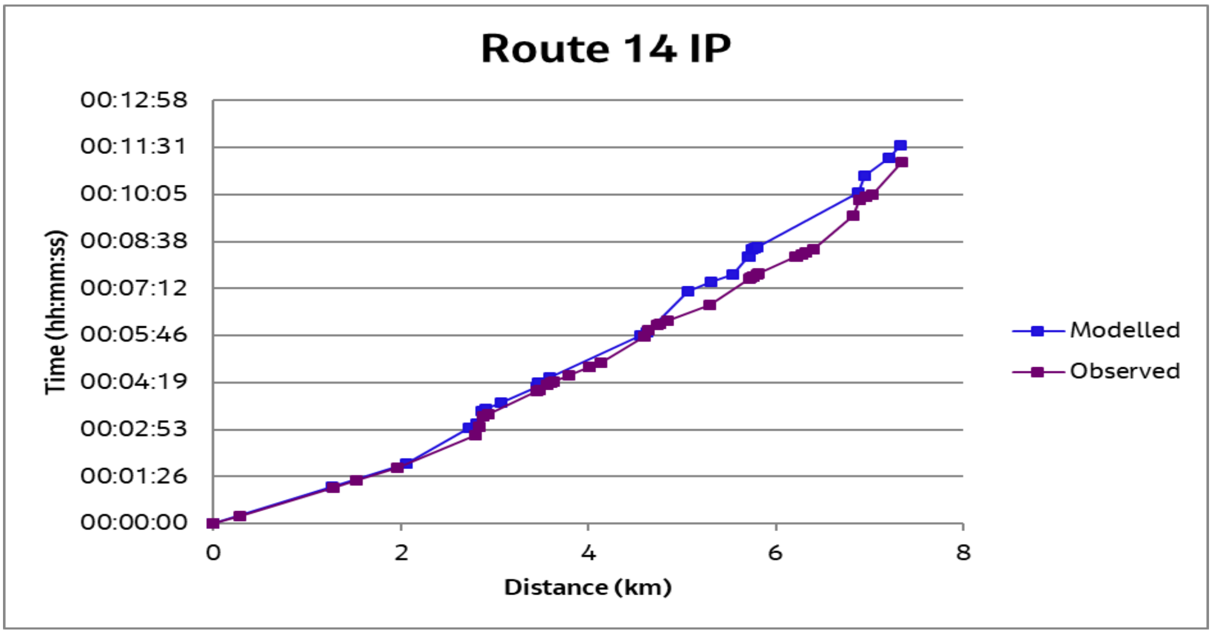
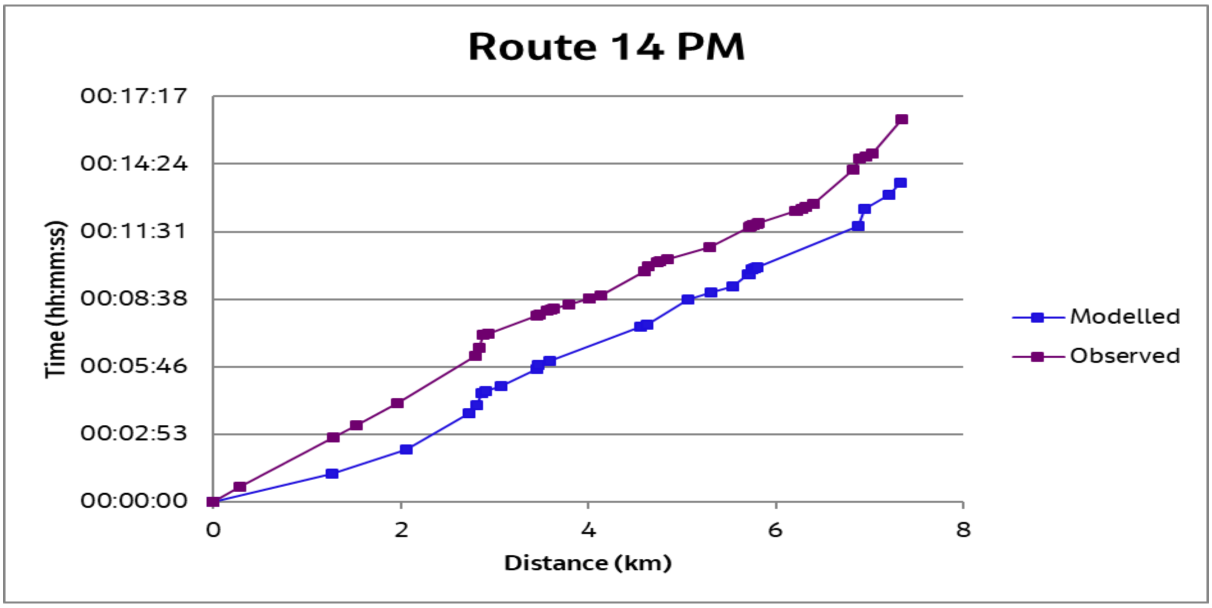
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed



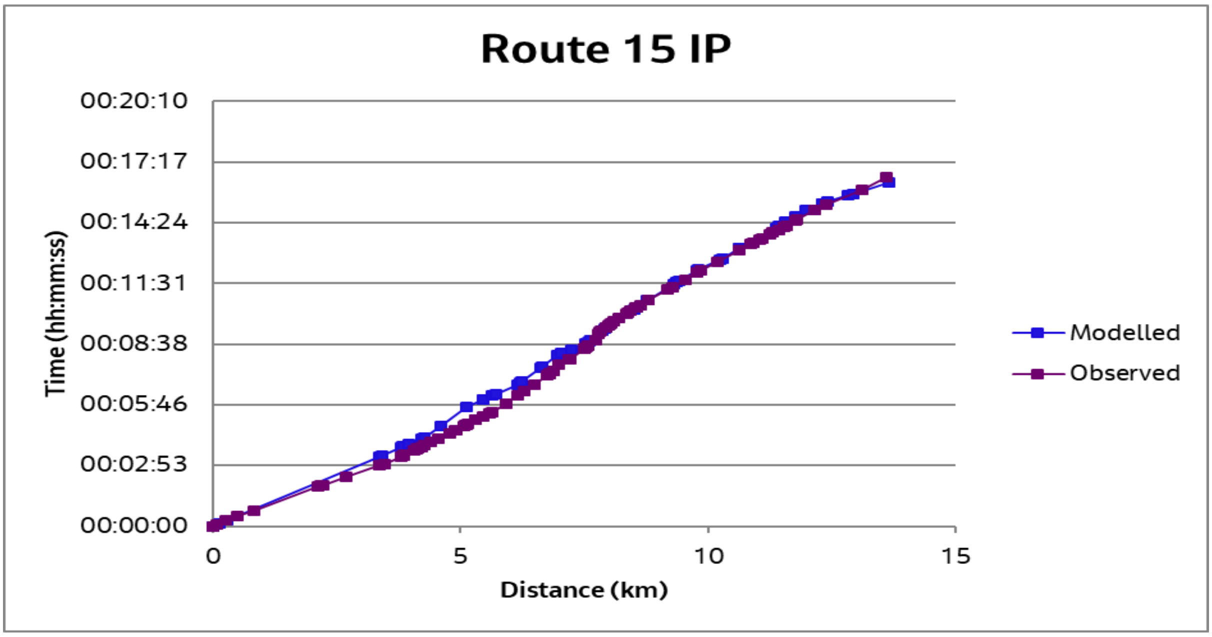
Route 13 PM
00:14:24
00:12:58
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed

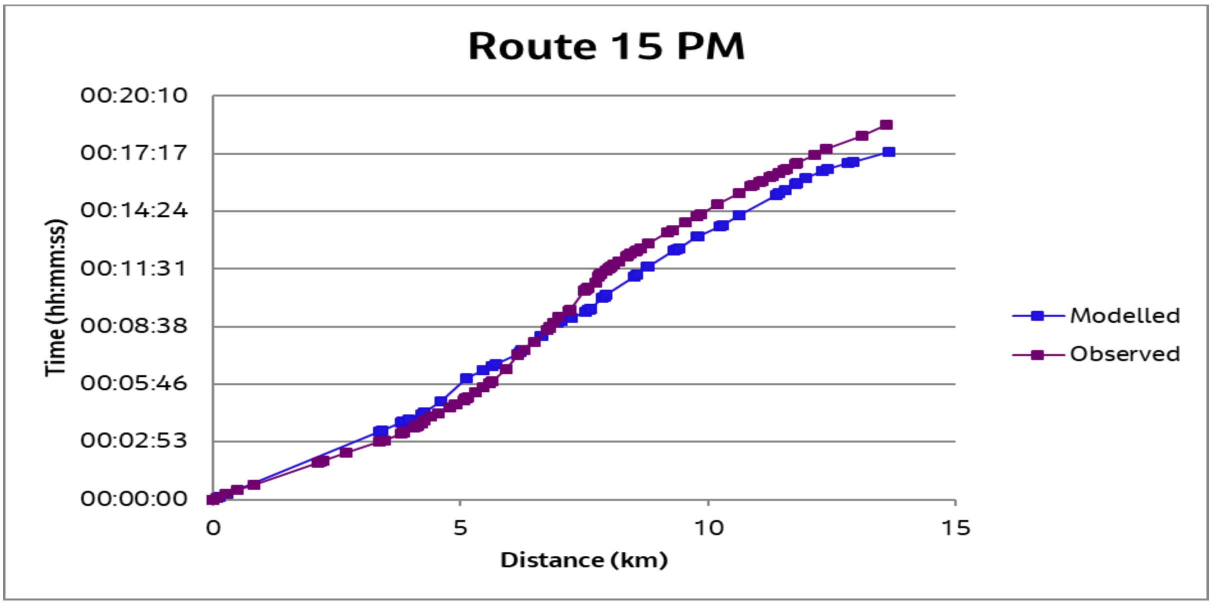

Route 14 AM
00:20:10
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed

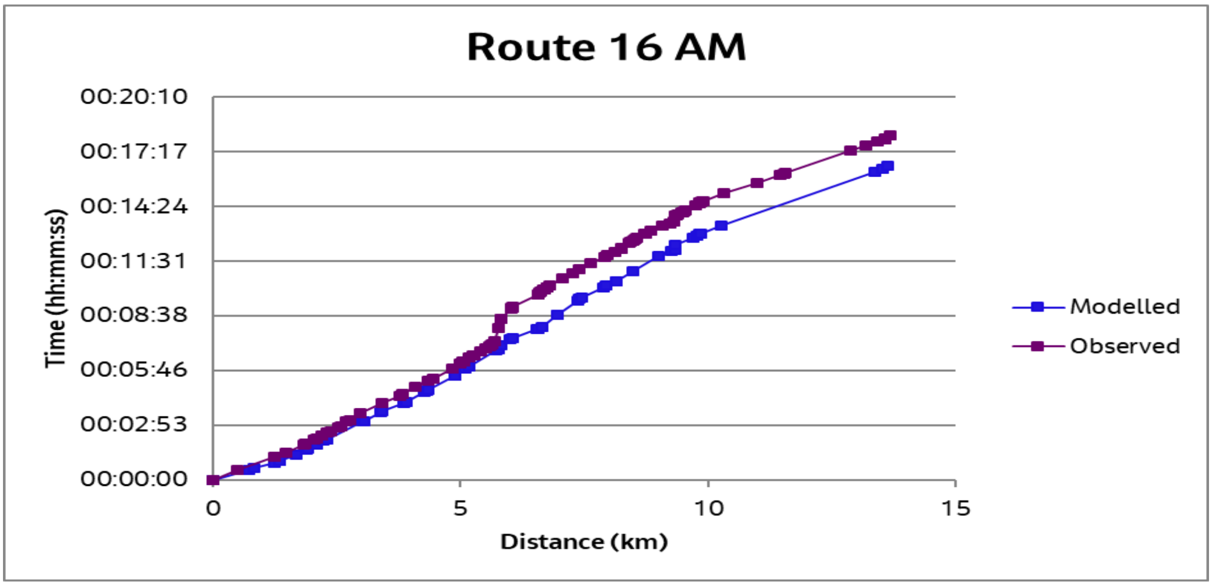

Route 14 IP
00:12:58
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed


Route 14 PM
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed


Route 15 AM
00:23:02
00:20:10
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
5
10
15
Distance (km)
Modelled
Observed


Route 15 IP
00:20:10
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
5
10
15
Distance (km)
Modelled
Observed


Route 15 PM
00:20:10
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
5
10
15
Distance (km)
Modelled
Observed


Route 16 AM
Time (hh:mm:ss)
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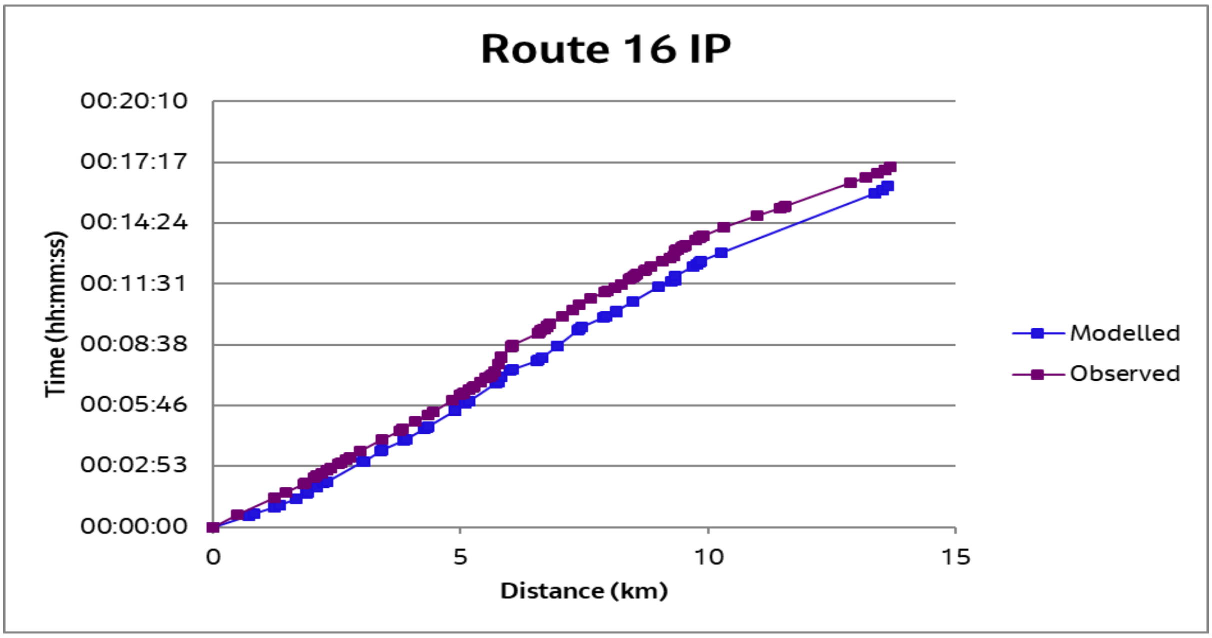
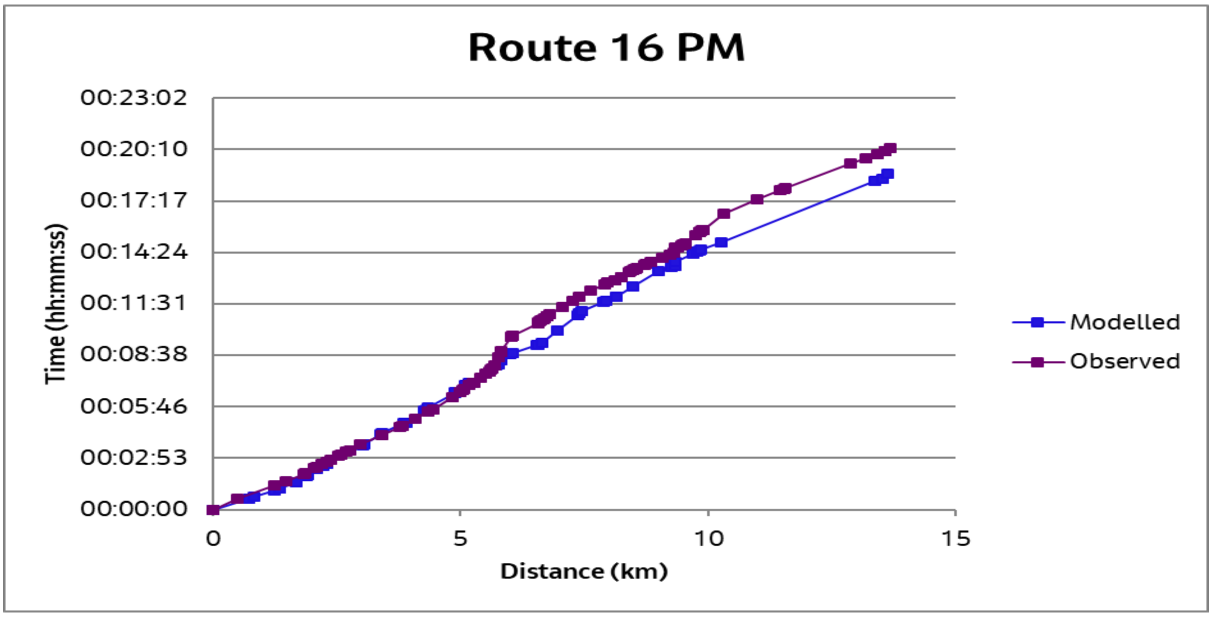
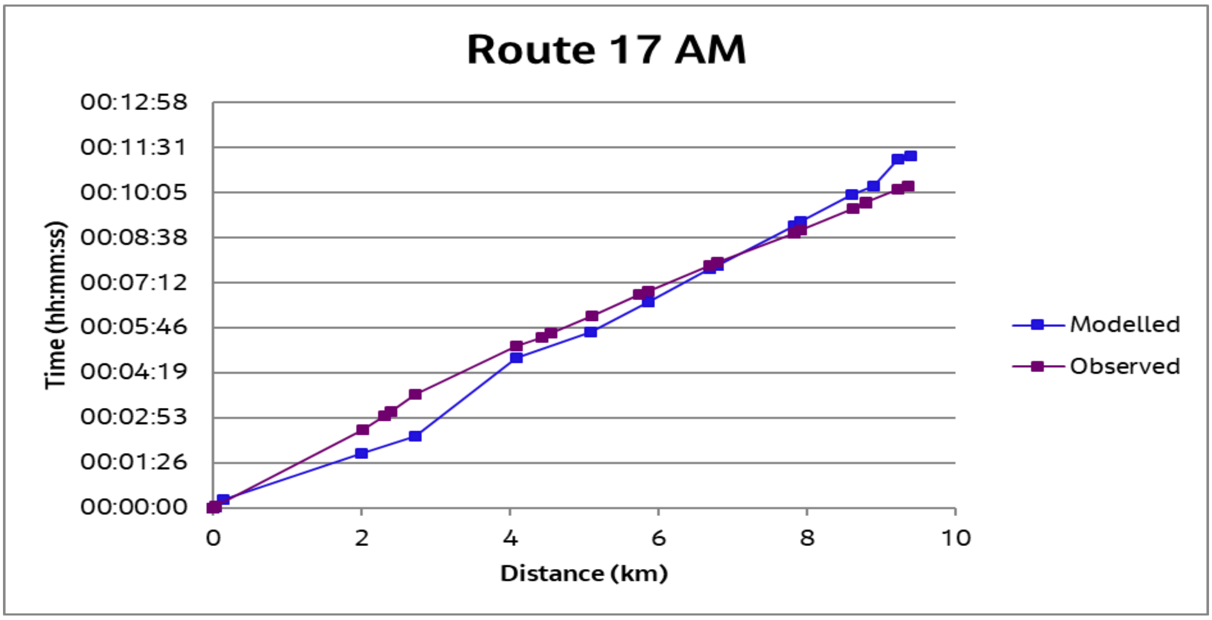
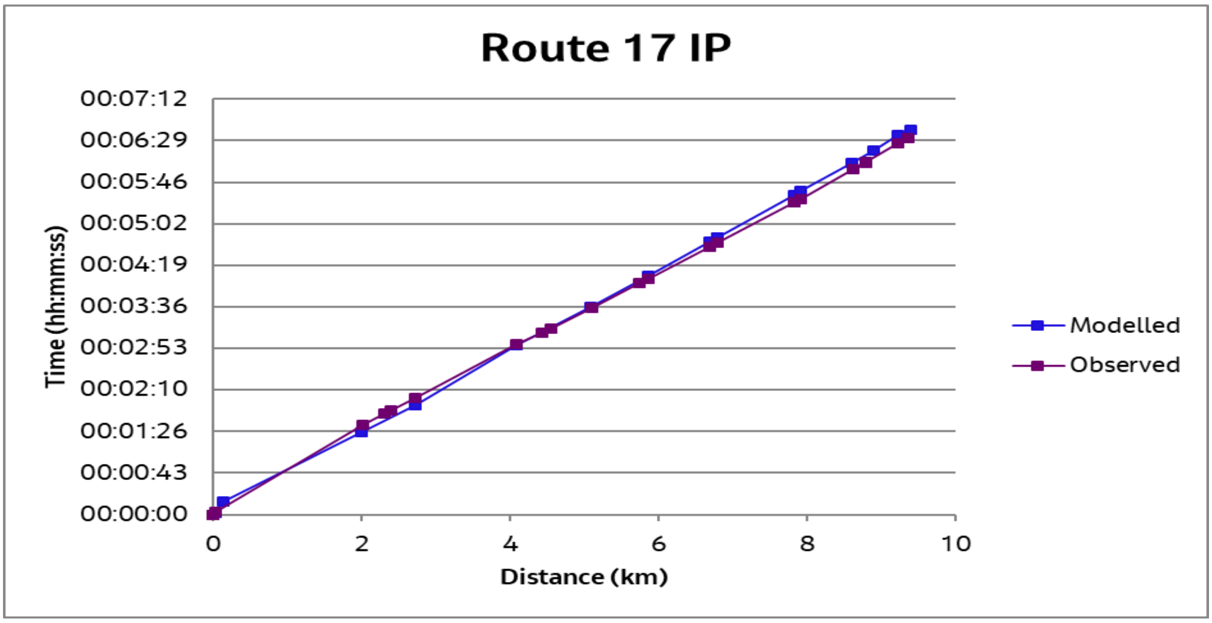
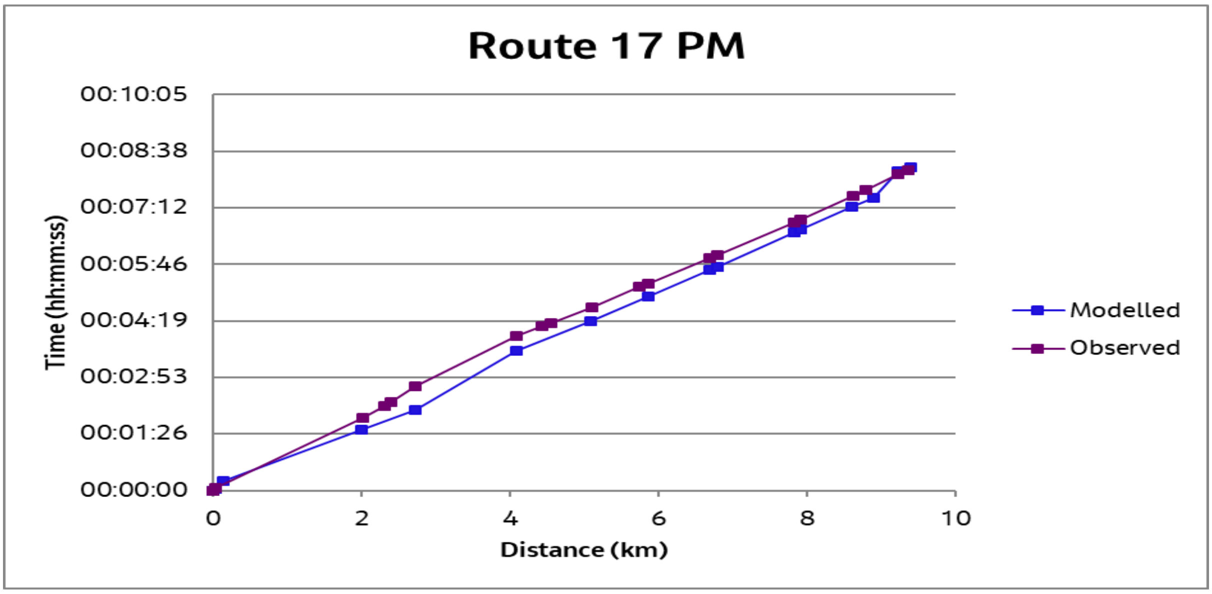
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
0
5
10
15
Distance (km)
Modelled
Observed

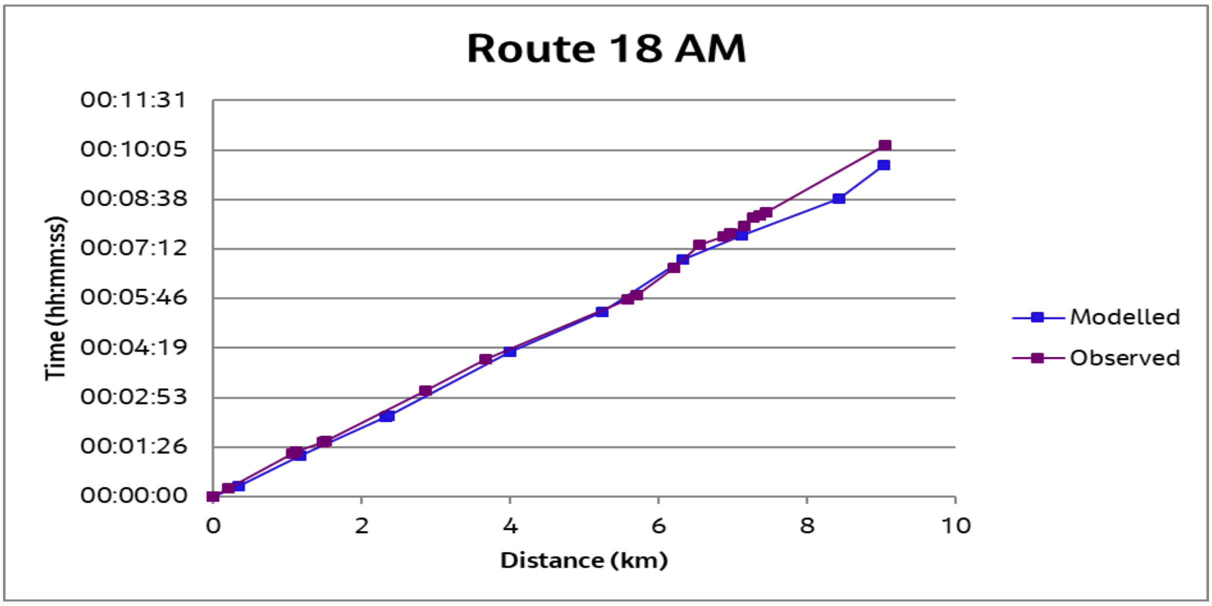

Route 16 IP
Time (hh:mm:ss)
00:20:10
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
0
5
10
15
Distance (km)
Modelled
Observed

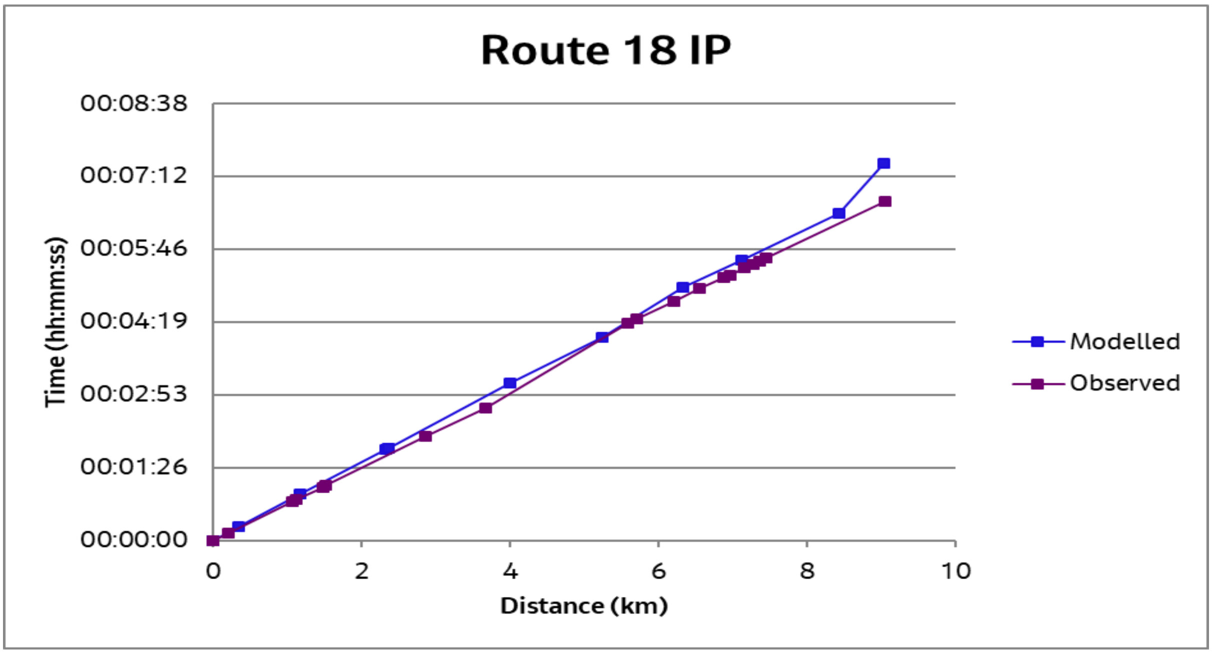

Route 16 PM
Time (hh:mm:ss)
00:23:02
00:20:10
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
0
5
10
15
Distance (km)
Modelled
Observed

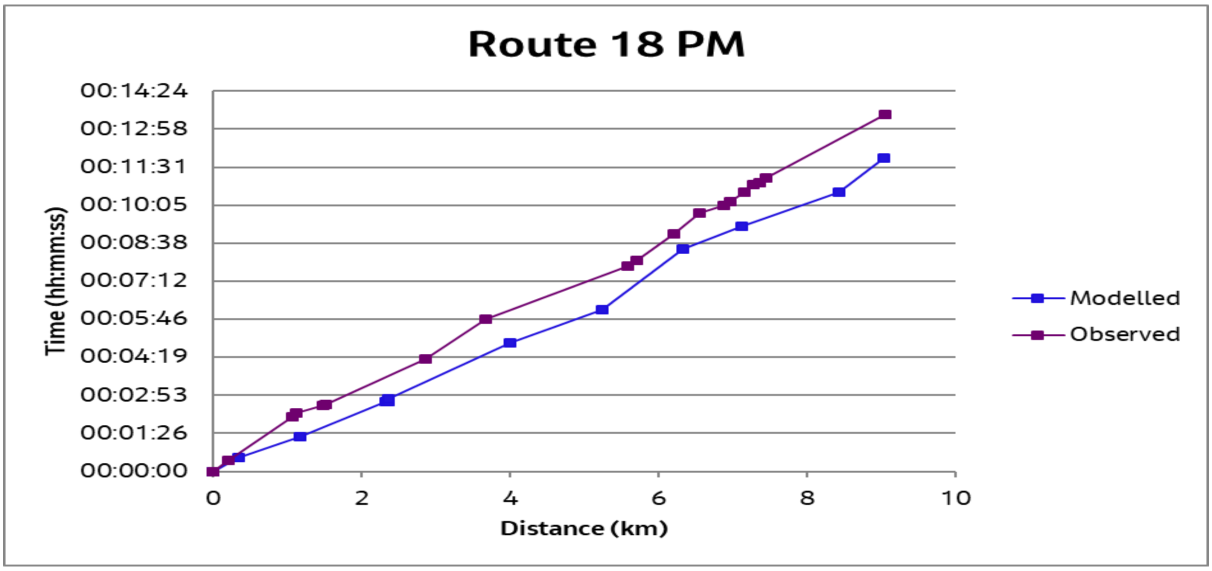

Route 17 AM
00:12:58
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
Distance (km)
Modelled
Observed

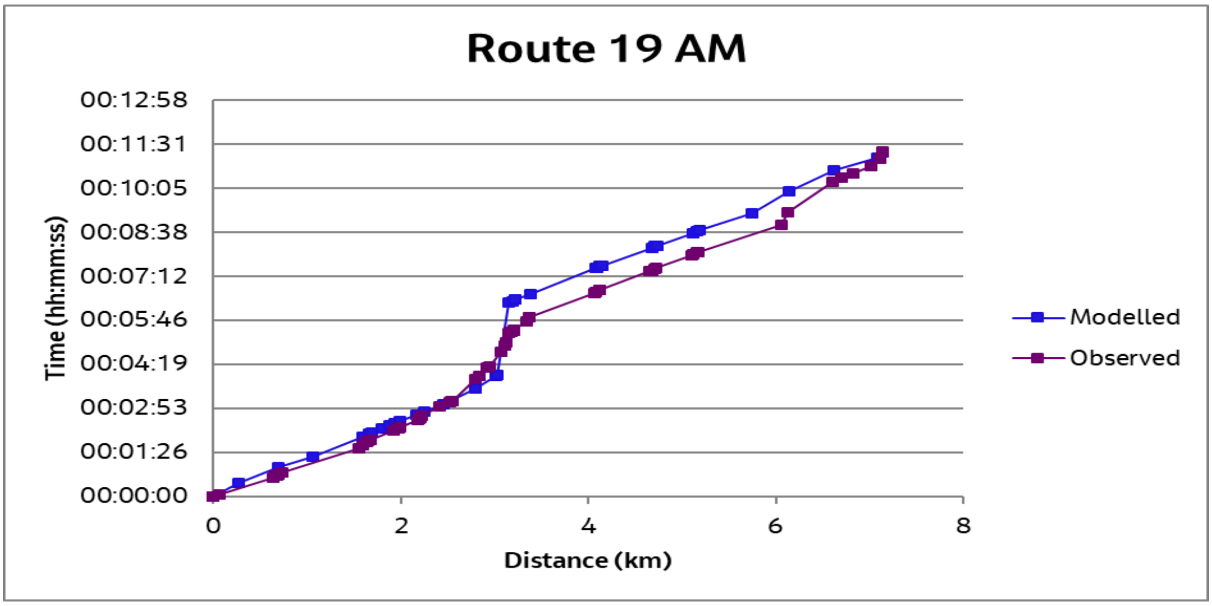

Route 17 IP
00:07:12
00:06:29
00:05:46
00:05:02
00:04:19
00:03:36
00:02:53
00:02:10
00:01:26
00:00:43
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
Distance (km)
Modelled
Observed

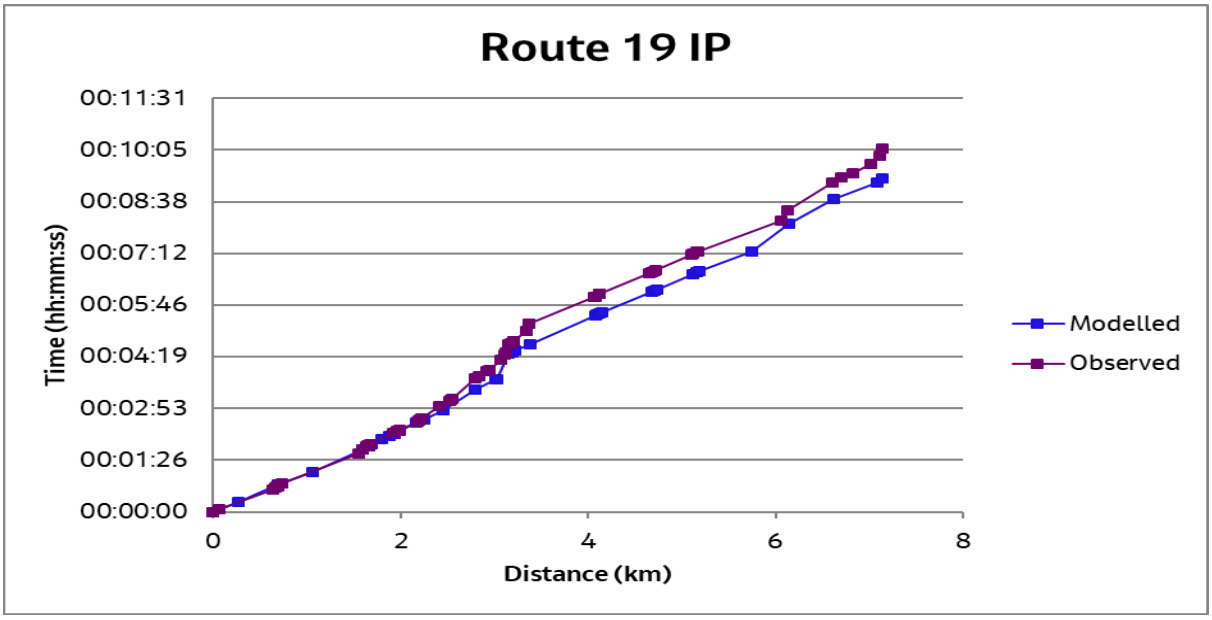

Route 17 PM
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
Distance (km)
Modelled
Observed


Route 18 AM
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
Distance (km)
Modelled
Observed

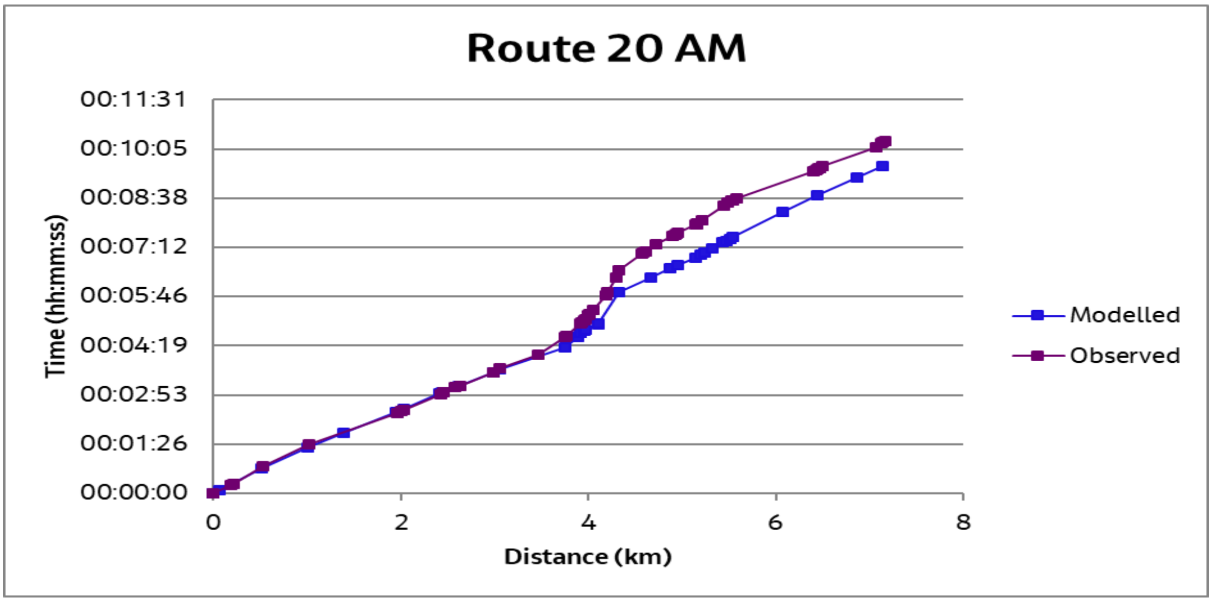

Route 18 IP
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
Distance (km)
Modelled
Observed

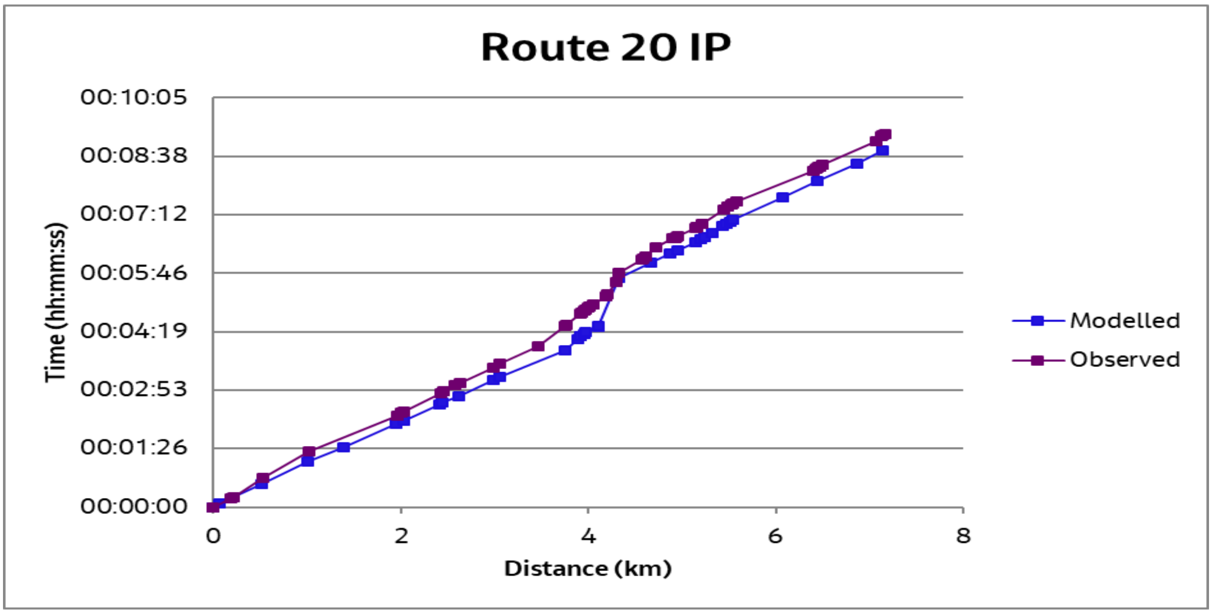

Route 18 PM
00:14:24
00:12:58
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
Distance (km)
Modelled
Observed

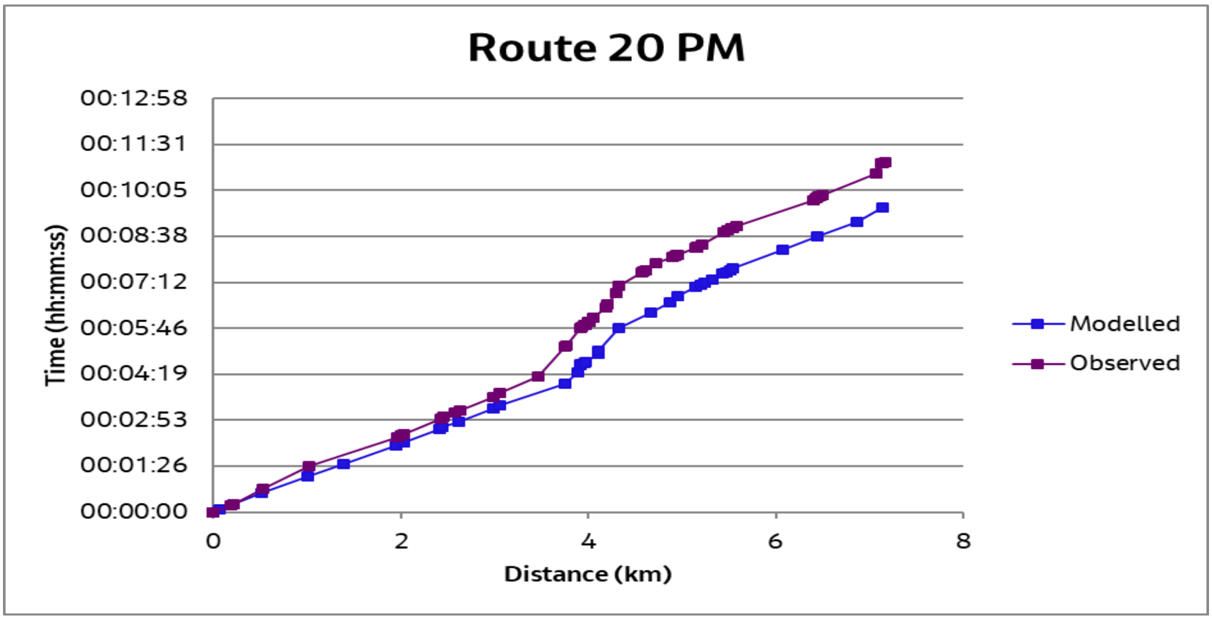

Route 19 AM
00:12:58
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed


Route 19 IP
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed

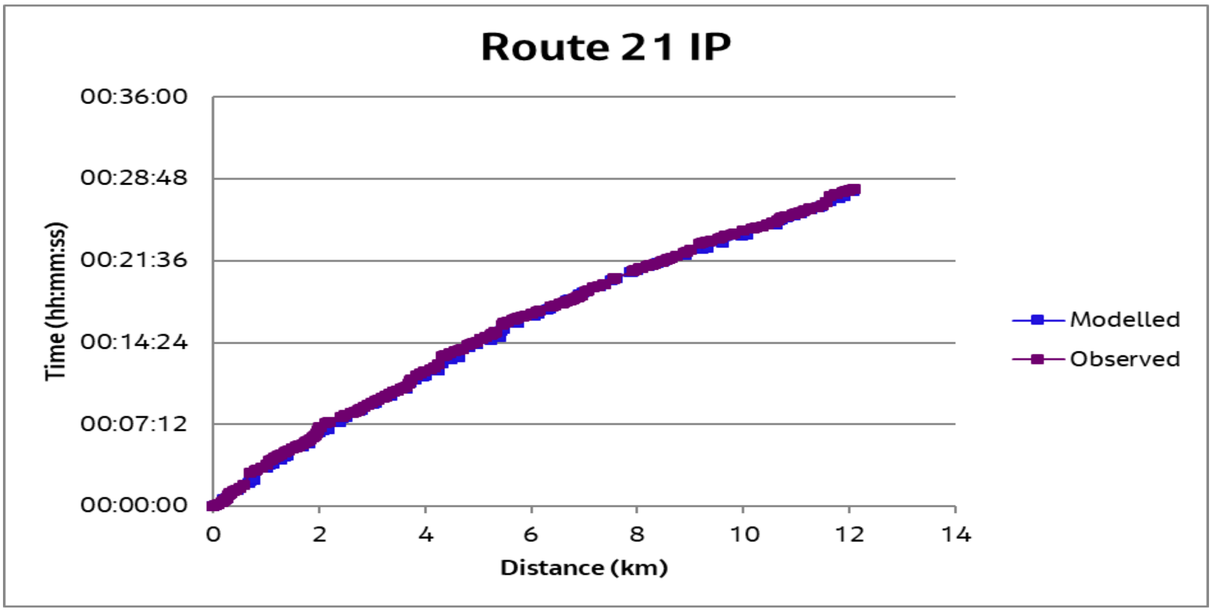

Route 19 PM
00:17:17
00:14:24
00:11:31
00:08:38
00:05:46
00:02:53
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed

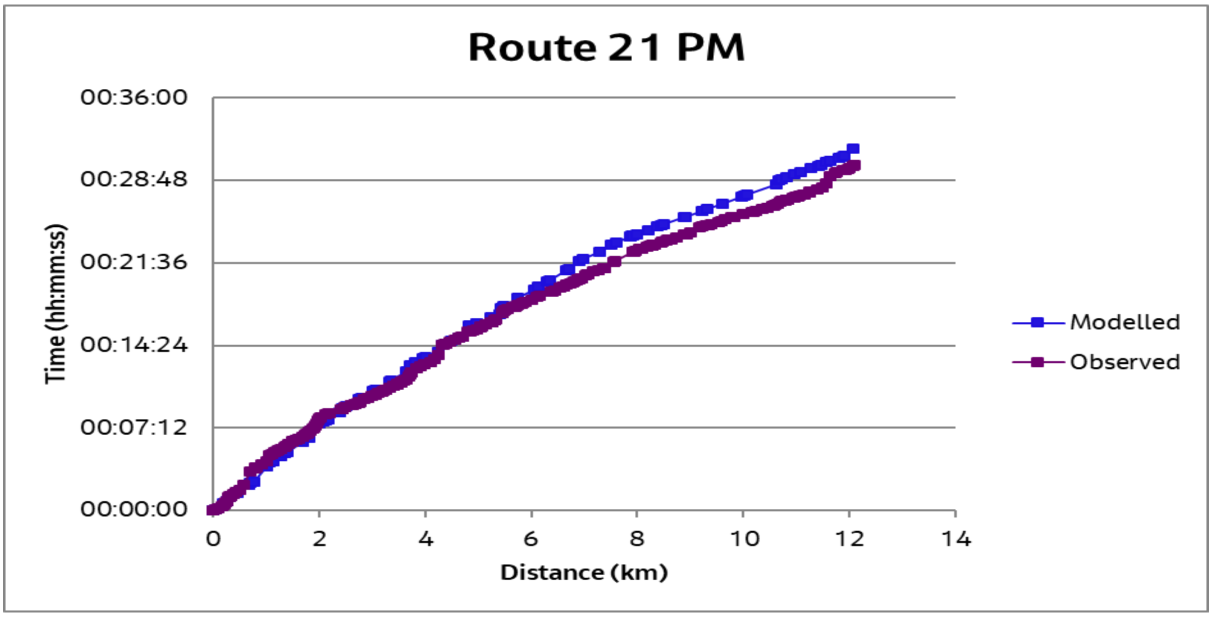

Route 20 AM
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed


Route 20 IP
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed

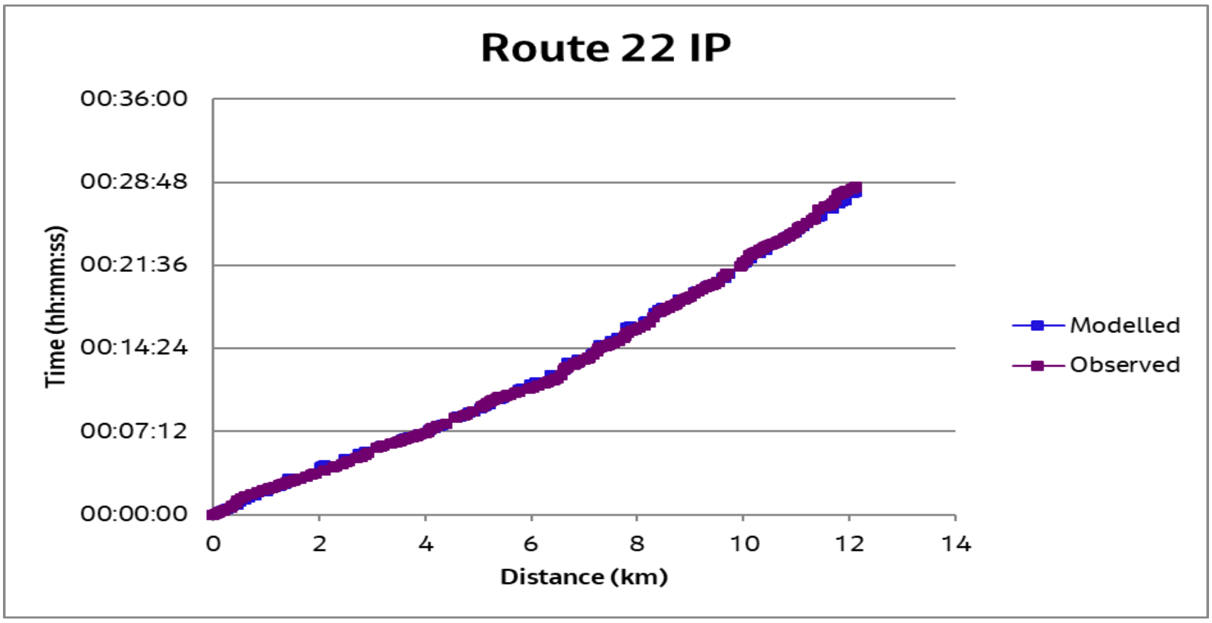

Route 20 PM
00:12:58
00:11:31
00:10:05
00:08:38
00:07:12
00:05:46
00:04:19
00:02:53
00:01:26
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
Distance (km)
Modelled
Observed


Route 21 AM
00:43:12
00:36:00
00:28:48
00:21:36
00:14:24
00:07:12
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed

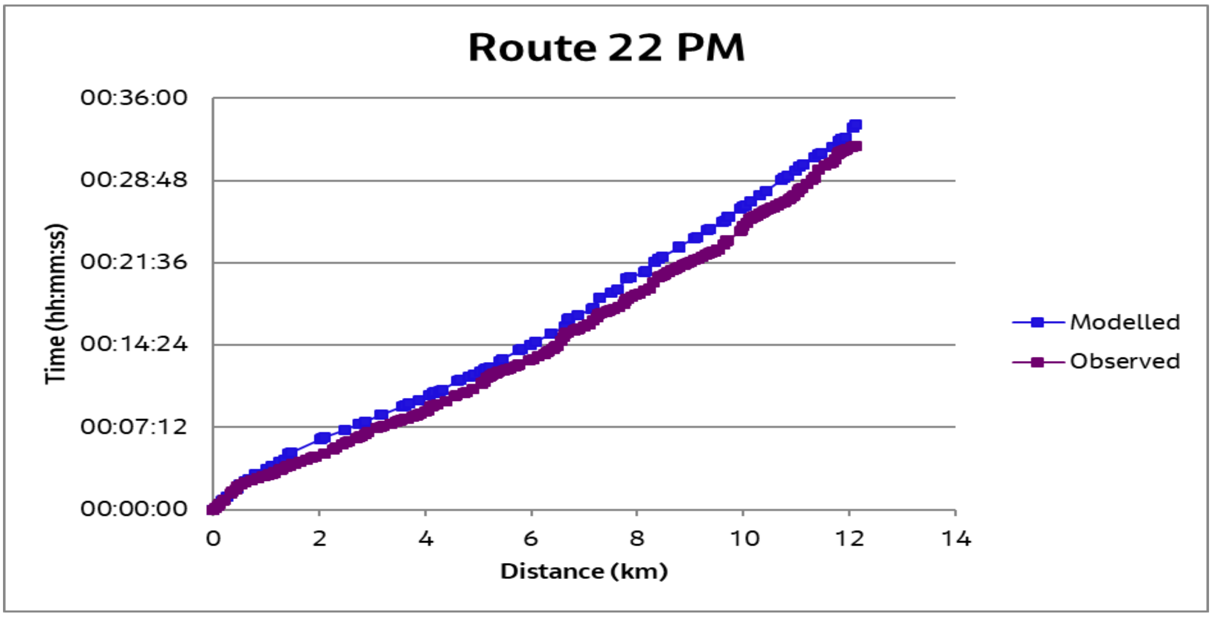

Route 21 IP
00:36:00
00:28:48
00:21:36
00:14:24
00:07:12
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed


Route 21 PM
00:36:00
00:28:48
00:21:36
00:14:24
00:07:12
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed

Route 22 AM
00:43:12
00:36:00
00:28:48
00:21:36
00:14:24
00:07:12
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed



Route 22 IP
00:36:00
00:28:48
00:21:36
00:14:24
00:07:12
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed



Route 22 PM
00:36:00
00:28:48
00:21:36
00:14:24
00:07:12
00:00:00
Time (hh:mm:ss)
0
2
4
6
8
10
12
14
Distance (km)
Modelled
Observed