Appendix C – LMVR

Lincoln Eastern Bypass

Local Model Validation Report
(Revised August 2012)

November 2012

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Contents

List of Appendices

List of Figures

List of Tables

1 Introduction

1.1 Background

In 2011, Mouchel was commissioned under the Lincolnshire County Council Technical Services Partnership (LCC) to undertake traffic forecasting and scheme appraisal work in support of the Best and Final Bid (BaFB) Business Case for the Lincoln Eastern Bypass. This followed earlier studies prepared by another consultancy to support the original Major Scheme Business Case (MSBC) submission for the scheme in 2009. The scheme was successful in obtaining Programme Entry status in 2011.

1.2 Purpose of this Report

This Local Model Validation Report (LMVR) describes the development of the Greater Lincoln Transport Model and its validation against observed traffic data for 2006, based on criteria set out by the Department for Transport (DfT) in Transport Appraisal Guidance (TAG) unit 3.19 on Highway Assignment Modelling. It is to be read in conjunction with the GLTM Traffic Survey Report (July 2011), which describes the observed traffic datasets that have been used to build the model.

This report seeks to demonstrate that the model provides an accurate representation of highway travel patterns in the Greater Lincoln area. This document explains the improvements that have been made to the model and also describes the criteria that were adopted during model re-calibration.

1.3 Structure of this Report

This report is structured as follows:

- **Section 2 – Model Overview:** provides a brief summary of the main features of the highway model and also how it has been developed.
- **Section 3 – Traffic Data:** describes the traffic datasets that have been used to develop the model. Further detail on these is provided in the Traffic Survey Report.
- **Section 4 – Network Development:** describes the extent of the highway network included in the model and how it has been developed.
- **Section 5 – Matrix Development:** describes how the trip matrices, which represent travel patterns in the Greater Lincoln area, have been developed. A separate report, GLTM Matrix Build Report, provides fuller details of this process. As part of the recalibration work, factors were applied to certain elements of the BaFB prior matrices to enhance the modelling work and create a more realistic model.
- **Section 6 – Model Calibration:** describes the improvements that were made to the model during the recalibration. It also details the processes that

have been undertaken to adjust the transport model so that it reflects travel patterns and conditions in the Greater Lincoln area.

- **Section 7 – Model Validation:** summarises the work undertaken to demonstrate that the model provides an accurate representation of travel patterns in the Greater Lincoln area, including details of comparisons made with independent datasets and its accordance with TAG Unit 3.19 criteria.

2 Model Overview

2.1 Introduction

This section of the report provides a brief overview of the Greater Lincoln Transport Model (GLTM), developed to support the design and evaluation of the Lincoln Eastern Bypass.

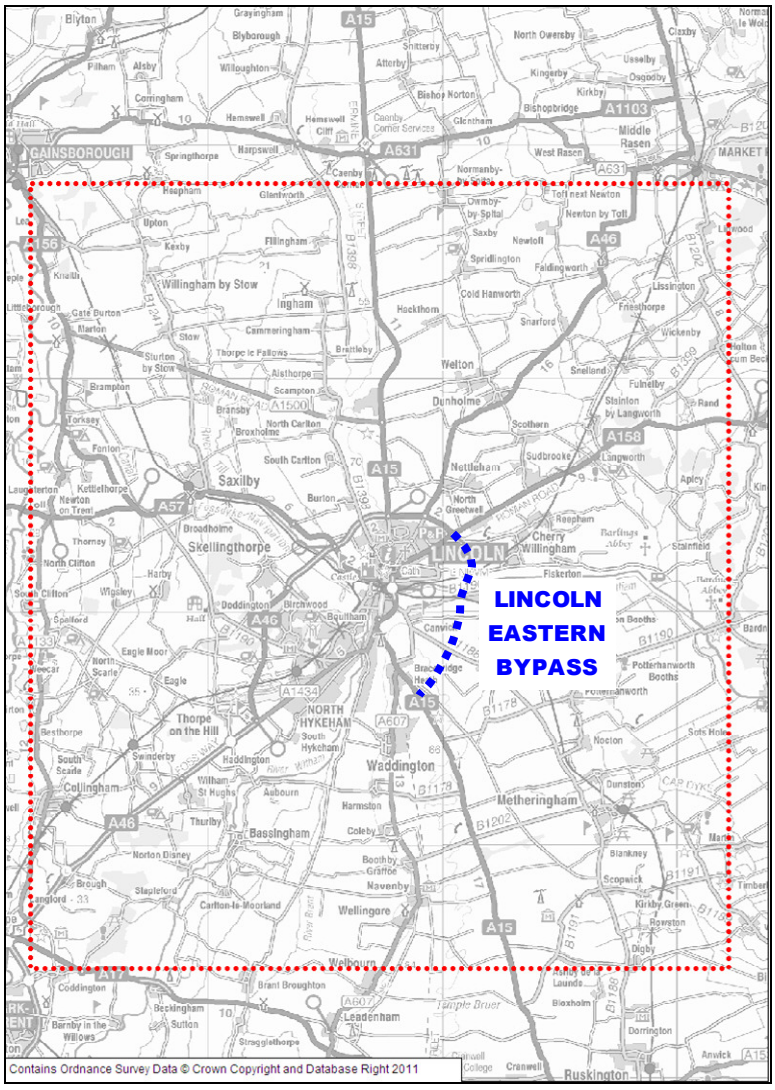
2.2 Modelling Software

The Greater Lincoln Transport Model was developed using PTV VISUM software V12.01-09.

2.3 Study Area

The model covers the urban area of Lincoln and surrounding countryside and broadly aligns with the Lincoln Planning Area (LPA), as shown in Table 2.1**Error! Reference source not found.**.

Figure 2-1 – Study Area



2.4 Zoning System

A zoning system has been developed which covers the whole of the UK. The study area is defined by the Lincoln Planning Area (LPA) and zones within this area are generally much smaller than those outside the LPA. Zones within the study area are known as internal zones and zones covering areas outside the LPA are known as external zones. The zoning system designed for the Greater Lincoln Transport model comprises 174 zones, of which 139 are internal zones and 35 are external zones.

2.5 Modelled Time Periods

Three time periods have been modelled in order to represent the different travel patterns that exist during a typical weekday:

- AM Peak hour (08:00 – 09:00);
- PM Peak hour (17:00 – 18:00);
- Average Inter Peak hour (10:00 – 16:00).

The above AM and PM Peak hours were identified through the analysis of Automatic Traffic Count (ATC) data described in the Traffic Survey Report.

2.6 Vehicle Classes

Three vehicle classes have been modelled; Cars, Light Goods Vehicles (LGVs) and Other Goods Vehicles (OGVs).

2.7 Modelled Highway Network

The study area, known as the simulation area includes junction coding to a high level of detail whilst the network outside the simulation area, known as the buffer network, is less detailed in terms of junction coding and only included links that carry strategic trips.

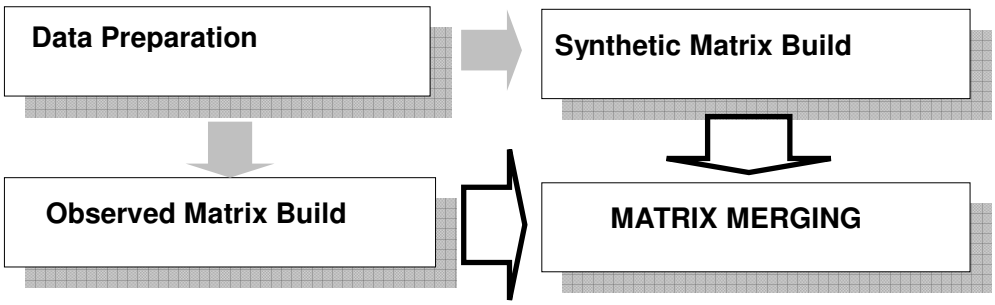
The simulation network includes all ‘A’ and ‘B’ class roads and most minor roads. Within Lincoln, residential roads that act as distributor routes or rat-runs have also been included in the model. The network has been coded in detail to reproduce the effects of traffic queues and delays on vehicle routing patterns.

The buffer area comprises a coarse network of links have been defined to include all major ‘A’ roads; from the A1 in the west to the A153 in the east, and from the M180 in the north to the A52 south. This ensures that all long distance traffic is properly routed into and around the Lincoln area.

2.8 Matrix Development

The process of demand modelling was essentially the same as in the earlier version of the model, albeit based on a comprehensive review of available data sources and their application. Construction of the base year matrices is therefore as illustrated below.

Following analysis of available survey data and other data sources, the principle task included construction of the observed trip matrices, largely from the Lincoln cordon survey, and development of complementary, synthetic matrices to represent the unobserved demand components. The observed and synthetic matrices were merged to form the final base year model demand matrices.



2.9 Model Calibration

The calibration of the Base Year (2006) traffic models was undertaken using an approach where the network was adjusted to ensure that the model realistically replicated routeing and vehicle speeds through the study area. Matrix estimation was then incorporated in the model calibration process in order to improve overall model validation.

2.10 Model Validation

Network validation was undertaken to establish that the network structure was accurate and that characteristics of the network are suitably represented in the model. A number of range and logic checks were undertaken, including routeing checks. Assignment validation was then undertaken for traffic flows (links and turns) and journey times. In all cases, the model compared extremely well with the observed situation, and met the TAG Unit 3.19 validation criteria.

3 Traffic Data

3.1 Introduction

This section provides a summary of the observed data that has been used to develop the model and the analysis that has been undertaken. Fuller details of the traffic data are provided in the Traffic Survey Report (Mouchel, July 2011).

3.2 Overview of Data

This subsection provides a brief overview of the observed traffic data used to build the Greater Lincoln Transport Model. Further detail on this data is provided in Chapter 2 of the Traffic Survey Report.

3.2.1 Postcard Interview Surveys

Postcard Interview Surveys were carried out at 18 locations for a 12 hour period, between 7:00 and 19:00, on one weekday between Monday 2nd October 2006 and Wednesday 29th October 2006. At each site, postcards were distributed to drivers travelling in the inbound direction, with the exception of sites 13 and 14 in the city centre where postcards were distributed to drivers travelling in both directions.

The locations of the interview sites are shown in Figure 3-1. In this plot, Interview sites 1-12 have been used to form a cordon around Lincoln. However, the cordon was not watertight and a number of links cross the cordon but were not included in the interview survey. The analysis of these non-interview sites is described in Chapter 5 of this report. Concurrent 12 hour Manual Classified Link Counts and 2-week, 24 hour ATC Counts were undertaken at each of these sites, with the exception of site 6 where no ATC count is available.

Postcard questionnaires contain the following information:

- Where/ when the postcard is received
- Vehicle occupancy
- Vehicle type
- Purpose of travel
- Origin and destination of the trip
- Household Income

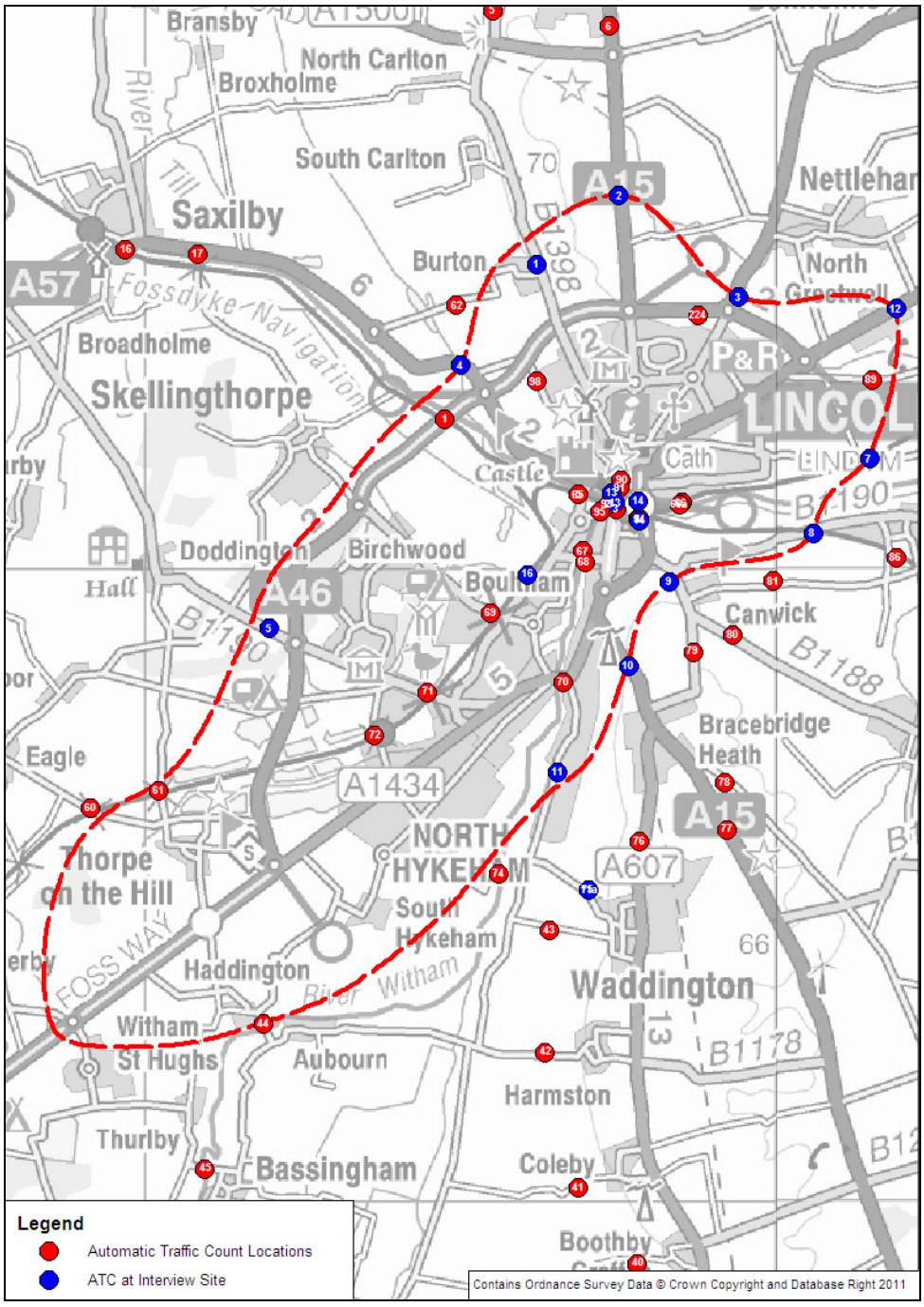
Figure 3-1 – Postcard Interview Sites

3.2.2 *Automatic Traffic Count Surveys*

Automatic Traffic Count (ATC) surveys were undertaken in September and October 2006 at 93 locations in the Greater Lincoln area, 17 of which were at Postcard

Interview sites. Each survey collected 24 hour data in both directions and lasted for a period of 14 days. The locations of the ATC surveys in the immediate vicinity of Lincoln are shown in Figure ***3-2***. This data has been supplemented by an additional 6 ATC sites in the centre of Lincoln, provided by LCC, carried out between 07:00 and 19:00 on one weekday in October/November 2006.

Figure 3-2 – Automatic Traffic Count Surveys

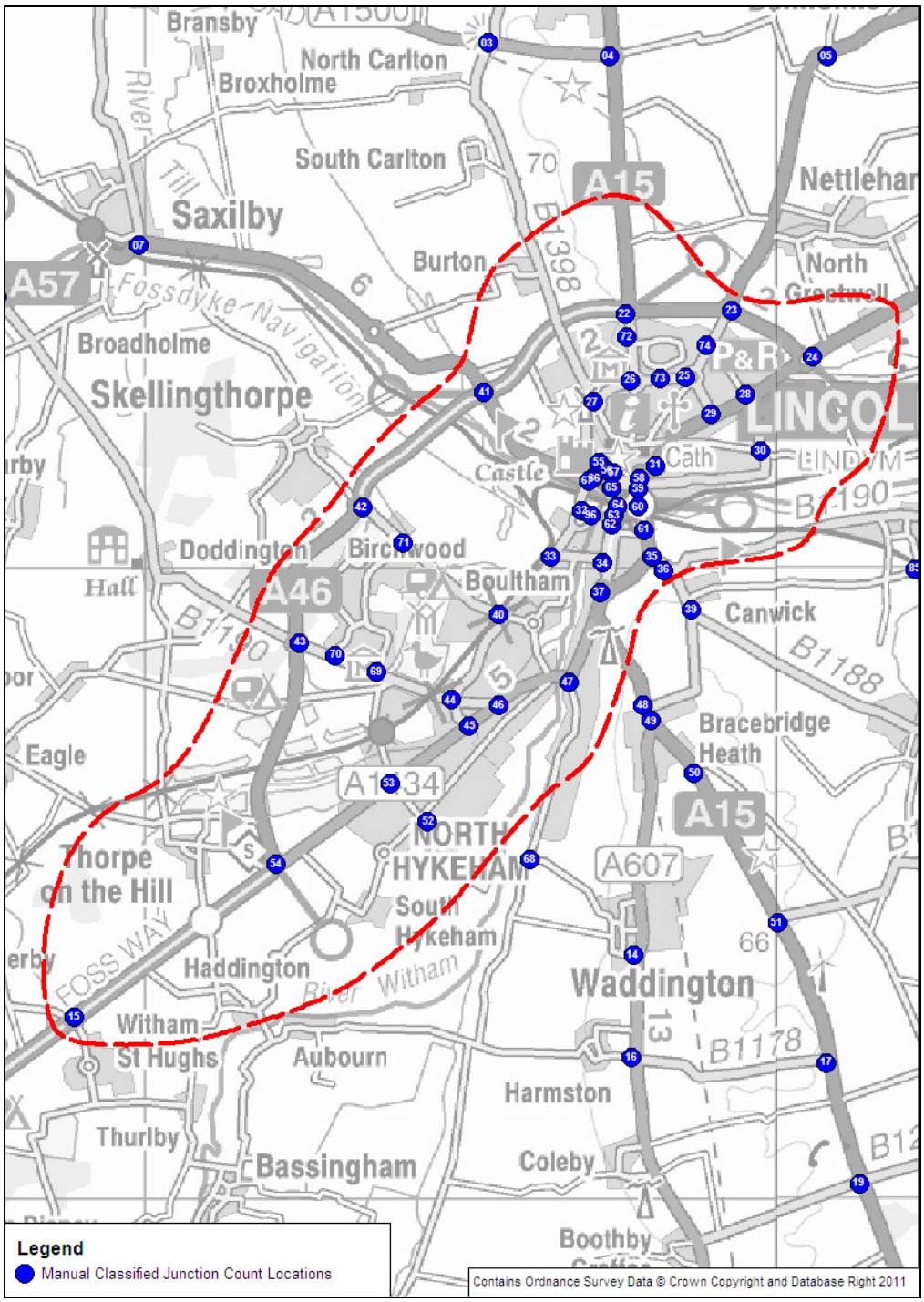


3.2.3 *Manual Classified Junction Count Surveys*

Manual Classified Junction Count (MCJC) surveys were undertaken at 76 junctions within the Greater Lincoln area. Each survey was undertaken on one day in

September, October or November 2006, between 07:00-19:00. The locations of those surveys in the immediate vicinity of Lincoln are shown in Figure 3-3. This data has been supplemented by 13 MCJC surveys carried out in 2006, 2008 and 2011, which have been provided by LCC.

Figure 3-3 – Manual Classified Junction Count Surveys

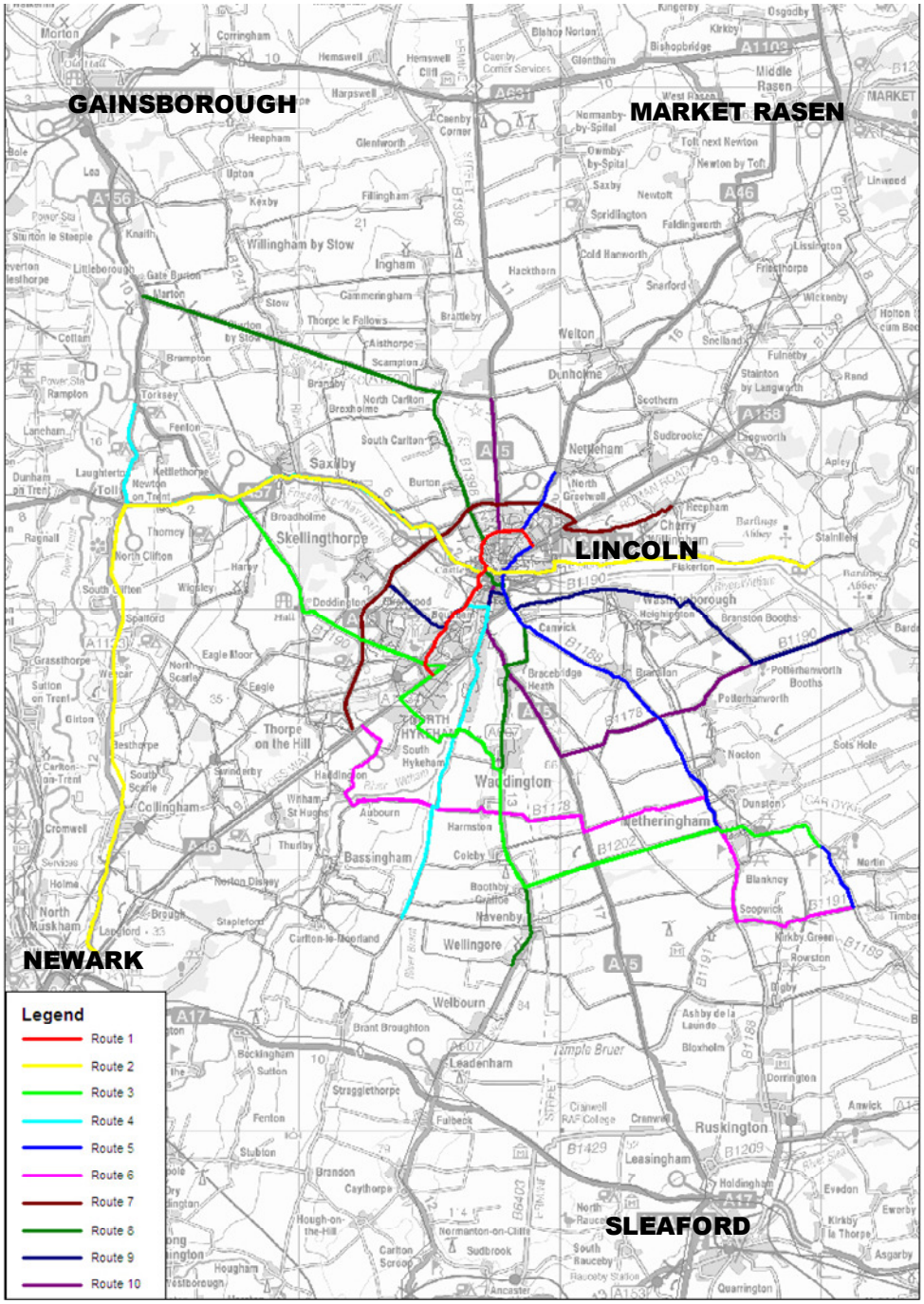


3.2.4 *Journey Time Surveys*

Trafficmaster journey time data for the year September 2009 to August 2010 was obtained and analysed to extract average journey times in both directions for ten

routes described below in Figure 3.4. Travel time data obtained from journey time surveys undertaken in 2006 were available from the original model commission, however, this data was analysed and it was found that the timings on some routes suggested unrealistic speeds, particularly through the city centre. On this basis, it was decided to instead use Trafficmaster data as this data is gathered from a larger and hence more reliable set of observations.

Figure 3-4 – Journey Time Routes



3.3 Overview of Data Analysis

This subsection provides an overview of the processing and analysis of the observed traffic data. More detail on this is provided in Chapter 3 of the Traffic Survey Report.

The processing and analysis carried out is summarised as follows:

- All traffic count data has been standardised into three classifications; Cars, LGVs and OGVs (aggregated to Light Vehicles and Total Vehicles), and each link and turning count has then been allocated to an Anode, Bnode and (where appropriate) Cnode to enable comparison with the model.
- All traffic count data has also been normalised, using a set of Day, Month and Year factors derived from TRADS data, to an “average weekday” in an “average month” in 2006.
- The accuracy of ATC data has been analysed in accordance with TAG UNIT 3.19 12.2.1 and found to have an acceptable level of accuracy. (Further details of this analysis are provided in the Traffic Survey Report).
- ATC average weekday profiles have also been created, which confirm that the AM and PM Peak hours are 8:00-9:00 and 17:00-18:00 respectively.
- Analysis has also been undertaken to produce plots that illustrate traffic flows across screenlines and at junctions.
- The validity of Journey Time data has been checked and average travel times for each route in each direction have been calculated.

3.4 Rationalisation of Traffic Count Data

In order to produce a set of traffic counts that could be used in the model building process, analysis of the count database was undertaken to identify and resolve inconsistencies between multiple traffic counts carried out at similar locations.

The locations of each count were overlaid on the coded model network and a map base and the data compared at common sites. In total, 83 instances were identified where alternative sources of count data were available. In many cases, flow estimates vary from one source to another, so an exercise was then undertaken to analyse the differences in flows and to determine how best to resolve these anomalies.

Adjustments included using average traffic flows across the common sites, using total traffic flows from one survey and classification/ turning proportions from another or selecting one survey over another because of its higher level of reliability. These actions were guided by the following general principles (in order of importance):

- Total traffic flows from ATC sites are more reliable than total traffic flows from MCC sites as they are an average over 8 days as opposed to 1 day.

- Vehicle type proportions from MCC sites are more reliable than those from ATC sites due to the limitations of pneumatic tubes.

- Counts from neutral months in 2006 are considered to be more reliable than counts from other months due to the need to apply larger normalisation factors in the latter cases.

In some instances, up to three data sources are available, for example three turning count surveys at junctions connected by two links. These added an additional layer of complexity to the calculation. In such situations, the reliability of the alternative data sources was afforded the highest rating.

Of the 83 instances of alternative counts data, 19 (~20%) where found to have differences in flow with GEH values greater than 5. However most of these 19 instances involved comparisons between single day surveys and it is therefore considered that, with daily fluctuations and potential survey errors, a degree of inconsistency is to be expected.

A list of the sites with alternative data sources is attached at Appendix A together with descriptions of how each has been resolved.

3.5 Calibration and Validation Counts

Table 3.1 below provides a summary of the allocation of the traffic count datasets to either model calibration or validation. Detailed tables are presented in Appendix B.

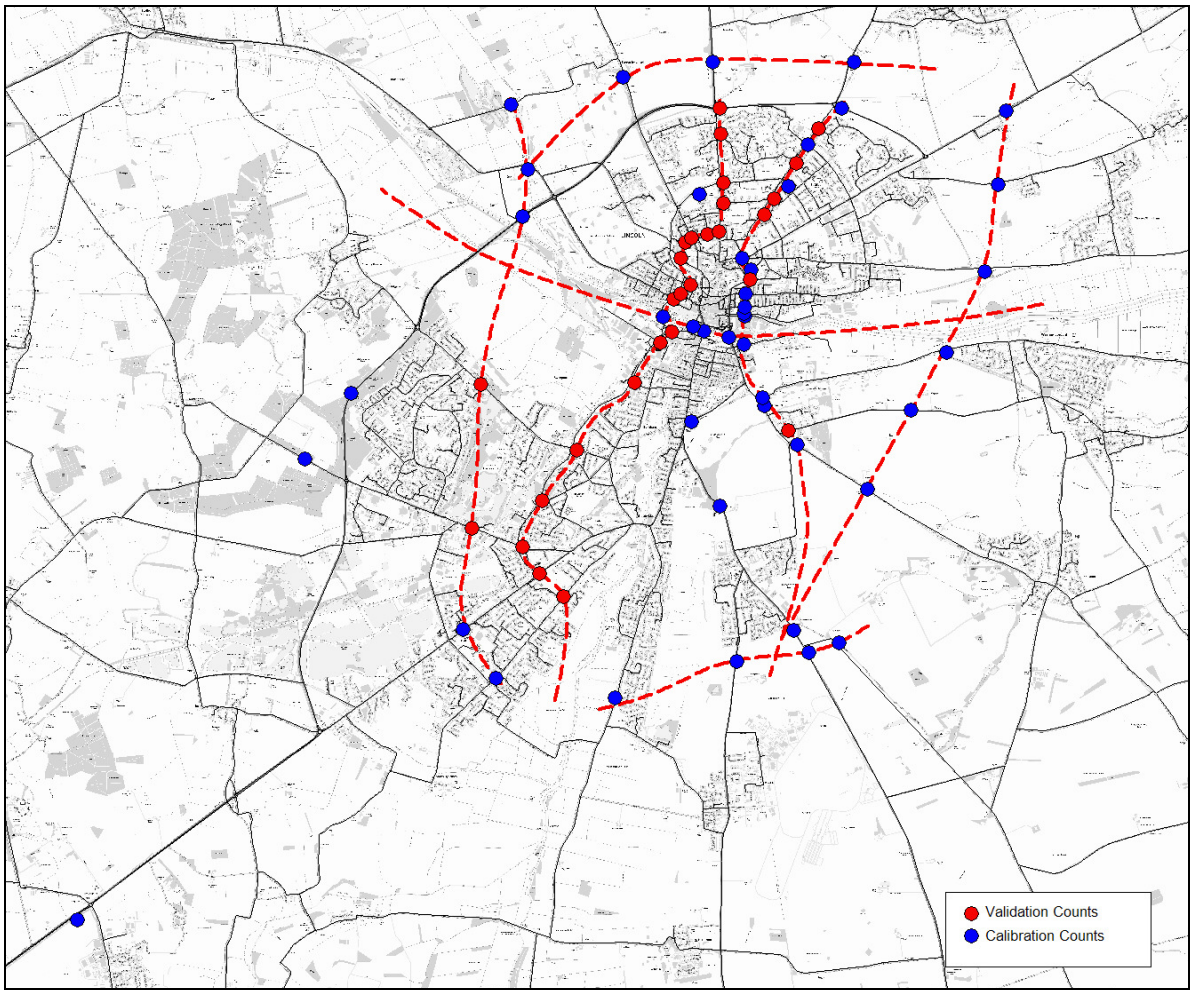
Figure 3.5 and Figure 3.6 show the locations of the calibration and validation counts respectively. A small number of turning counts have been used in both calibration and validation, with individual movements split between the two.

It should be noted that during recalibration of the model, comparisons of observed / modelled flows were focussed mainly on screenline totals and so not all count data was used during recalibration / validation. Further details are provided in Chapters 6 and 7.

Table 3-1 – Calibration and Validation Counts

Type	Count Type	Number
Calibration Counts	Link count	77 **(66%)**
(Validation Counts)	Link count	39 **(34%)**
All Counts	**Total Counts**	**116**

Figure 3-5 –Location of Calibration and Validation Counts and Screenlines



4 Network Development

4.1 Introduction

The road network represents the supply side of the modelling process, i.e. what the transport system offers to satisfy the movement needs of trip makers in the study area. The network is a system of nodes, representing junctions, which are connected by a number of links, which represent homogeneous stretches of road between junctions.

This section of the report describes the steps that have been taken to develop the highway network for the Greater Lincoln Transport Model.

4.2 Highway Network Definition

The modelled network provides an accurate representation of the existing highway network in Lincoln and its surrounding area.

Inside the study area it includes all 'A' and 'B' class roads and most of the minor roads within Lincoln. Residential roads that act as distributor routes have also been included. All junctions within the study area have been coded in detail in order to reproduce the effects of traffic queues and delays on vehicle routing patterns.

Outside the study area, a coarse network of buffer links has been defined to include all major 'A' roads; from the A1 in the west to the A153 in the east, and from the M180 in the north to the A52 in the south. This ensures that all long distance traffic is properly routed into and around the Lincoln area. The coverage of the Highway Network is shown in Figure 4.1 below.

4.3 Network Inventory

The network was developed using a combination of aerial photographs and site surveys. Junction layouts, number of lanes and turn priority markers were coded using aerial photographs.

As part of the model review/ update in 2012, all links included in the networks were reviewed and street level imagery used to determine whether each link is likely to carry traffic volumes significant enough to be included in the traffic model. This resulted in changes to the configuration of the network, particularly in rural areas where certain narrow lanes that were previously included in the network were removed. Conversely, certain links deemed likely to carry high volumes of traffic were added to the network.

4.4 Node / Link Coding and Speed Flow Curves

All nodes were geo-coded using 1:10K raster maps. All link lengths for the model were checked from OS mapping with scale of 1:10,000. Roads are modelled as links in VISUM and links were assigned correct distances. A suitable speed-flow curve was also assigned for each link based on road type, number of lanes, speed limits, etc.

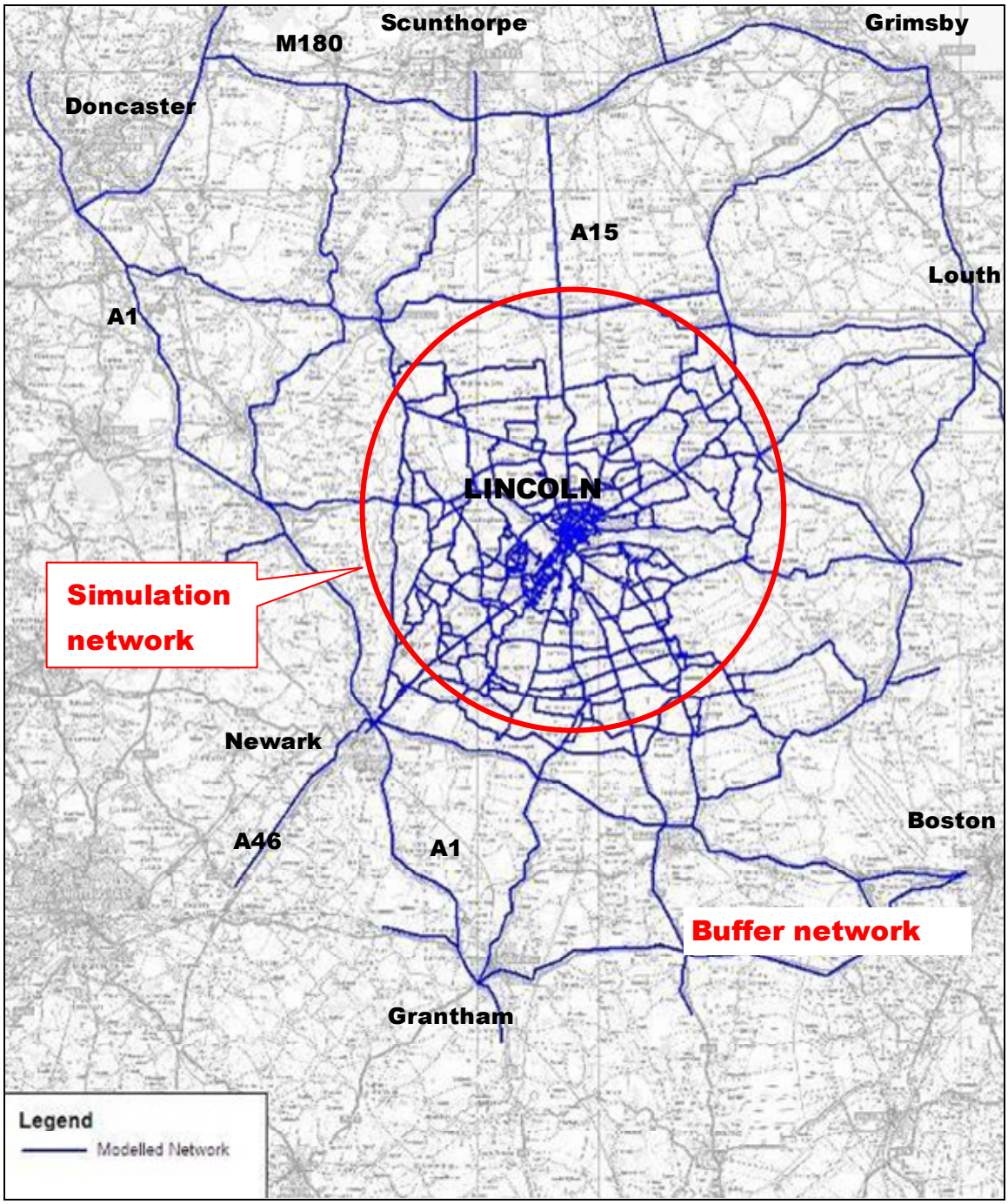
Information about all roads within the study area was gathered from the network inventory. This information included; type of road (urban, suburban, or rural, etc.), road classification (single, dual carriageway), speed limits and number of lanes of all the roads within the study area. The information was used to allocate the appropriate speed-flow curves to all the modelled links. A list of the speed-flow curves used for GLTM is presented in Appendix C.

The network coverage includes all the main roads to and from Lincoln. The wider network extends from Louth in the east to Retford in the west and from Boston and Grantham in the south to Grimsby and Doncaster in the north.

Major routes into Lincoln city centre include the A1434 Newark Rd and A15 Sleaford Rd to the south of Lincoln; A15 Riseholme Rd and A46 Lincoln Rd to the north; A57 Saxilby Rd to the west; and A158 Wragby Rd to the north east.

The network contains two main parts: simulation network in which junction/delay is modelled in detail and buffer network in which links are modelled only. Simulation network and buffer network are marked in Figure 4-1.

Figure 4-1 – Highway Network Coverage



4.5 Junction Modelling

In order to represent the effects of traffic delays and queues at junctions, junctions have been modelled in detail to take into account traffic flows and conflicting movements. Each junction has been coded using detailed information from the highway network, which includes:

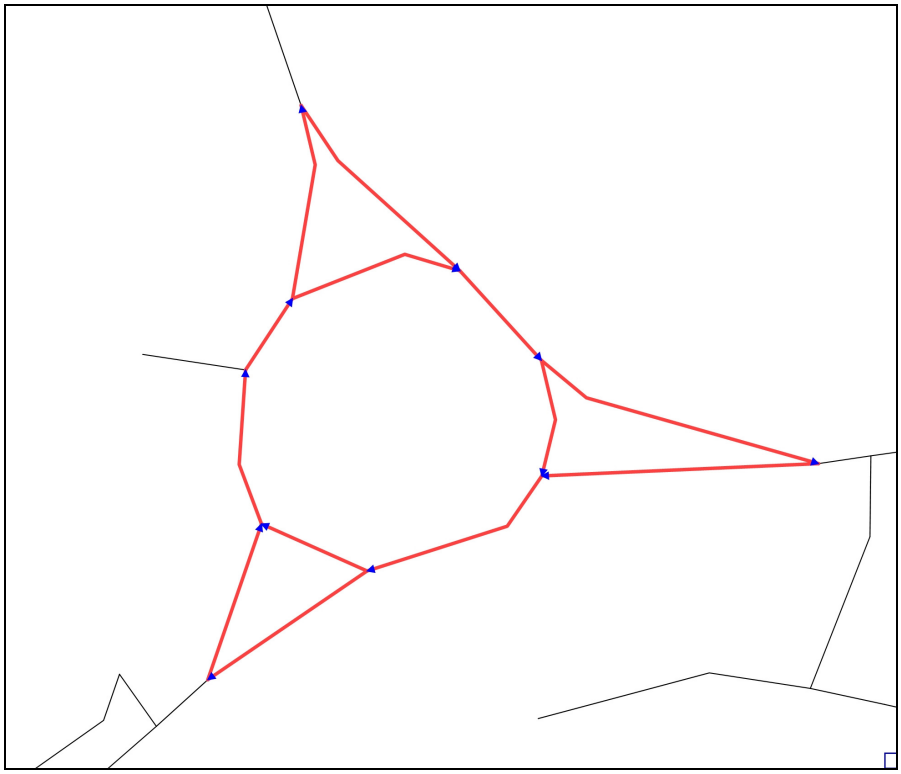
- **Priority Junction Modelling:** Priority junctions were modelled using the node impedance function (ICA function) within the study area network. Within the VISUM software, there are several methods of modelling junction

performance but the ICA method involves calculation of junction capacity to the highest level of detail (i.e. it includes consideration of opposing turns).

- **Network Checking:** 'Network Check' function within the VISUM suite was used to ensure that junctions were correctly coded for the ICA function to work correctly. Junction geometries were adjusted during the calibration/validation process taking into account attributes such as lane widths, number of lanes and lane marking of the junction.

- **Roundabout Modelling:** All roundabouts within the study area were modelled in detail. Capacities of roundabouts were calculated on the basis of the geometry of the roundabouts using the ICA junction modelling function. Large roundabouts and gyratory were coded using the composite nodes. The "Main Nodes" function within VISUM was applied to large roundabouts so that their capacities were calculated as if they were a single junction. An example of a roundabout modelled using composite nodes is shown in Figure 4.2.

Figure 4-2 Example of a modelled roundabout junction



4.6 Signalised Junction Modelling

All signalised junctions inside the study area have been modelled in detail. Signal specifications, which contained details of phase, stages and inter-green timings, have been provided by Lincolnshire County Council and converted into the format required by VISUM for the three model time periods (AM, Inter Peak and PM).

In VISUM signal timings are entered using a number Signal Groups, which are created to represent the individual movements that occur at a junction. The starting

and ending green time for each signal group must then be specified along with a total cycle time and offset should it be required. An example signalised junction is shown in Figure 4-3.

The locations of signalised junctions in Lincoln are shown in Figure 4-4.

Outside the city centre all signalised junction are much further apart and so have been assumed to operate independently. Initial starting and ending green times and a cycle time have therefore been calculated for each junction under the assumption that phases run to their maximum allowed green times in the AM and PM Peak hours and to their average green times in the Inter Peak.

Figure 4-3 – An example of signalised junction coded in VISUM

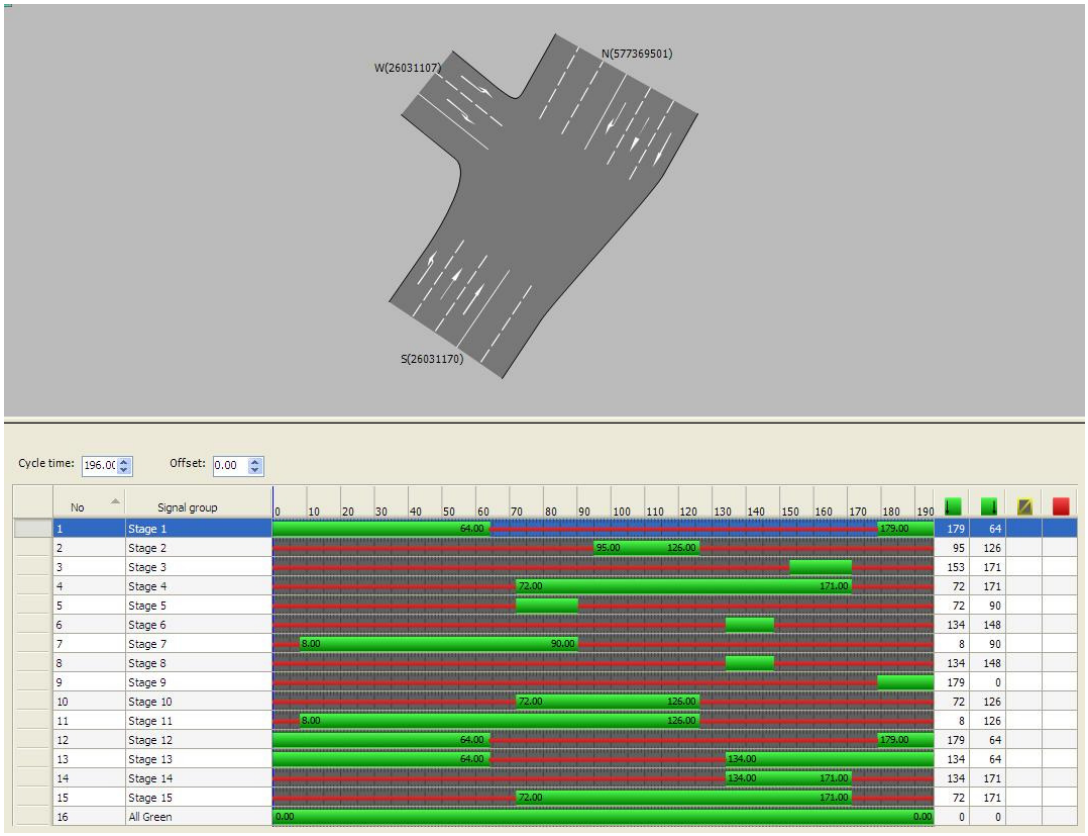


Figure 4-4 – Signalised junction Locations in Lincoln

4.7 Enabling of Blocking Back Function

In the previous version of the calibrated base model, the blocking back function was not activated. Blocking back models the effect that queues from a congested junctions have on traffic flows at junctions upstream of the congested junction. When blocking back is activated, queues are prevalent in the network and it is possible to compare the modelled queue patterns against the local knowledge as an independent realism check. Blocking back has now been activated and the model displays queues along congested roads.

In the recalibrated model, blocking back has been calculated taking into account two limiting capacities:

- Link capacity
- Turn capacity (final capacity from junction modelling)

The average space required per car unit is set at 7m.

4.8 Zone (Centroid) Connectors

The loading of traffic onto the network from zones is achieved through centroid connectors at appropriate locations.

The loading points and types were reviewed carefully for each zone. The distance for the connector was calculated from plans/maps. The appropriate speed was then assigned based on the network characteristics of the zone.

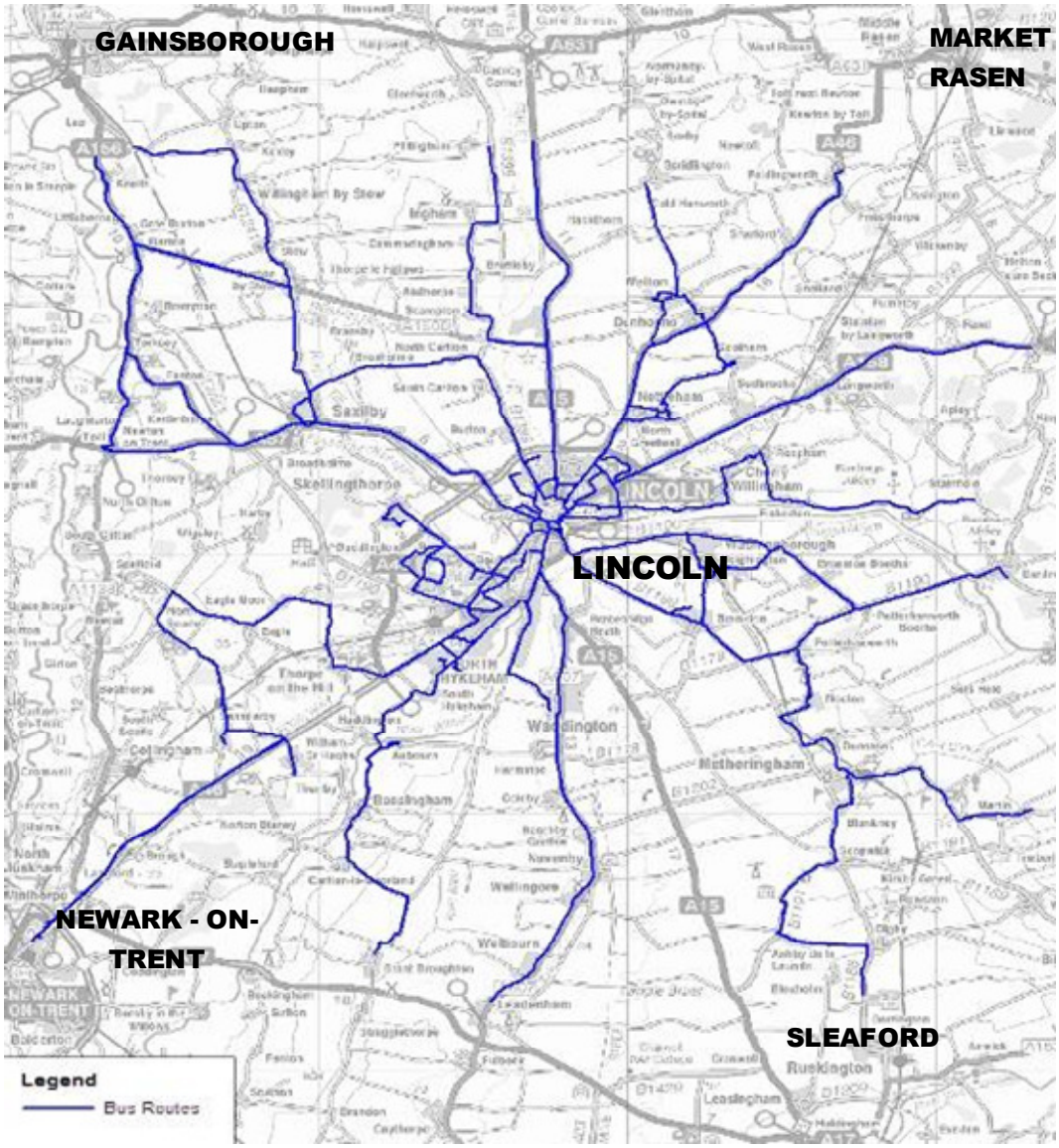
For external zones (outside the simulation area), loading points were attached to the appropriate locations at the edge of the buffer network. The distance and speed for these connectors have been estimated using GIS. Fuller details of the zoning system are provided in Appendix D.

4.9 Bus Routes

Public bus services have been represented in the model so that the effect of buses on link and junction capacities can be taken into account. Bus routes and frequencies for each time period (AM, IP, PM) have been coded into the network using data from the Public Transport Information Section of the Lincolnshire County Council website. Buses were assigned as a fixed preload prior to the assignment of other vehicle matrices.

Figure 4-5 shows the coverage of bus routes. Detailed bus routes are shown in Appendix E.

Figure 4-5 – Bus Routes Coverage



4.10 Inclusion of Effects of Level Crossings

A rail line runs through of the centre of Lincoln, which dissects several links in the network at level crossings but the previous version of the base model did not include the effect that the level crossings have on the network capacity. During the recalibration, level crossings have been coded at the following seven links in the network:

- B1378 Skellingthorpe Road
- B1190 Doddington Road
- Station Rd, Hykeham
- Thorpe Road
- Thorpe Lane
- Swinderby Road
- A1133 High St

The level crossings were coded into the network as signalised junctions with two stages; all green to represent the crossing being open and all red to represent the crossings being closed to traffic. Junctions representing level crossings were given consistent signal timings to simulate the effects of the rail line. Signal timings were adjusted so that modelled traffic flows reflected observed traffic flows along links with level crossings.

4.11 Network Checks

The previous model included a large number of unnecessary nodes, arising from the use of NAVTEQ tiles to build the original Jacobs model. The number of nodes was reduced from 4,160 to 1,498 and the number of links reduced from 6,298 to 3,788. Reducing the number of links and nodes results in a tidier network, makes the network easier to edit and reduces the model assignment time.

In coding the network, a number of checks were carried out on the network in order to demonstrate its robustness in replicating the highway network. These checks included:

- Checking the routes through the network, produced by a standard path building algorithm by assigning a unity matrix;
- Checking the physical characteristics of the coded network (junction type, number of arms and lanes, lane usage);
- Checking of properties assigned to the network (distances, speeds, saturation flow for each turning movement, speed flow curves);
- Checking the loading points of every zone;
- Checking zone to zone distances;
- Checking that bus routes/ bus frequencies are coded properly;
- Comparing the observed and modelled distances of the journey time routes (see Appendix H);
- Range of network routeing forests (see Appendix J)

5 Matrix Development

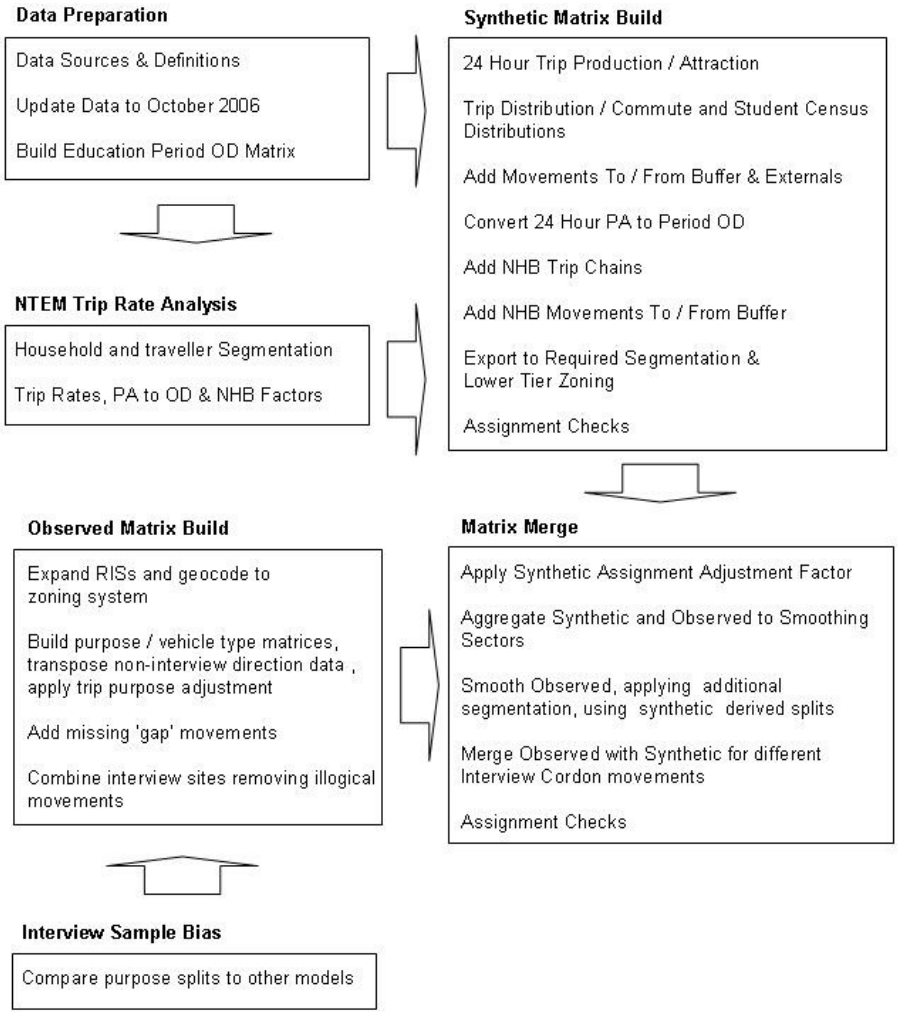
5.1 Introduction

The process of rebuilding the Base Year matrices is illustrated in Figure 5-1 and included the following principal stages:

- Data preparation and analysis
- Synthetic matrix build
- Observed matrix build; and
- Matrix merging.

This chapter discusses the matrix building steps briefly. Greater details of the matrix building process are provided in the GLTM Matrix Build Report, June 2011.

Figure 5-1 - Matrix Build Process



5.2 Data Preparation and Analysis

The synthetic build used established procedures and datasets. Key to this process was the preparation of data to represent GLTM zoning. This included considering a number of key boundaries. For the synthetic matrices the Internal area used the Lincoln Policy Area (LPA) and included 139 zones. Within the Internal area detailed land use data was prepared. This area represented an area where productions and attractions were assumed largely self-contained with regards to general daily trip making and included ODs that may be significantly affected by the proposed Lincoln Eastern Bypass (LEB). The Internal area also contained the main highway network detail.

Within the Internal area the Interview Cordon represents the cordon around the Lincoln conurbation defined by the location of interview surveys. This is an important boundary for the merging of observed and synthetic matrices.

The Internal area was surrounded by a number of Buffer zones that had finite boundaries and contained areas that are expected to be influenced by the introduction of LEB. This Buffer area included only strategic highway network. Around the Buffer network are a number of External zones that represent the rest of the UK. These zones only connect to the strategic highway network and have no network of their own. They represent assumed strategic highway movement catchments, for example the A1 South to North.

The previous work included the data collection of all required interview records, traffic counts and journey time data. Interview records were subject to a rigorous checking and cleaning process. Also, all traffic counts were normalised to a neutral 2006 average weekday, checked for outliers where multiple observations were available, and checked for consistency with adjacent counts.

As well as 2001 Census data and data from the National Trip End Model (NTEM), reported through TEMPRO, new datasets used in the matrix build, including:

- Census Area Statistics (CAS) household and population data;
- NTEM 6.2 trip rates;
- Pupil Level Annual Student Census (PLASC), college and university student data including home postcode and mode of travel;
- total employment and retail employment Annual Business Inquiry (ABI) data; and
- DfT freight annual tonnage data.

The majority of the effort in data cleaning has been associated with the interview data. This included the following tasks:

- interview data coded using Land Use Segmentation indexing;

- sample manual checks on interview records;
- missing postcodes derived from address or location details where possible;
- range checks on answer indexing;
- interview records converted to database format;
- trip origins and destinations converted from postcodes to OSGRs and plotted in MapInfo with illogical points checked and corrected or removed as required; and
- manual classified counts compared to ATCs and converted to database format.

All traffic count data has been normalised to a neutral 2006 month, assumed as November 2006 where necessary, and reformatted into a Microsoft (MS) Excel spreadsheet that contains the cordon / screenline / key junction reference, the Highway Assignment Model (HAM) node numbers, a location description and the Travel Segmentation model hour based vehicle flows. For ATC data the counts were reformatted to allow them to be imported into a MS Access database and averaged as necessary.

5.3 Observed Matrix Build

In order to model the trip patterns of vehicles entering the Lincoln Planning Area (LPA), postcard interview surveys were undertaken at several of the main routes into the study area, forming the basis of the interview cordon. This section describes the analysis that was involved in developing observed matrices from the postcard interview data. The cordon also includes minor road links for which postcard interviews were not conducted and their analysis is also described in this section.

The sites that formed the interview cordon are shown below in Figure 5-2 below.

Figure 5-2 – Postcard Interview Locations

5.3.1 Postcard Interview Data – Cleaning Process

The postcard interview data consisted of respondent's answers to the interview questions plus Ordinance Survey Grid References (OSGR) for the trip origin and destination locations. The OSGR data was used to append a set of zone numbers and analysis cordons to each postcard record. The initial stage in the interview analysis was to process and clean the interview and count data. This process began by importing the postcard interview data supplied by LCC to MS Access.

The initial process of cleaning the data involved removing any records that had blank origin or destination data. Any records where the origin and destination postcodes were identical were also discarded. Records with an illogical purpose were also discarded, e.g. where origin purpose and destination purpose were both stated as home.

Records with a vehicle type listed as pedal cycle or motorcycle were not to be included in the highway assignment model and so were discarded. Any records with a missing interview time or with an illogical journey direction (e.g. a home based trip with vehicle type equal to OGV) were also discarded.

Crow fly distances were calculated between origin point to destination point (O-D) and also between origin point to interview site point to destination point (O-I-D). It was considered that where the O-I-D distance was greater than three times the O-D distance, then this signified some illogical routing and records were discarded.

Zones within the GLTM have been aggregated to create analysis cordons. Analysis cordons 1 to 15 represent zones in the LPA, whilst analysis cordons 16 to 20 largely represent zones in the rest of Lincolnshire and analysis cordon 21 represents the rest of the UK. Any illogical cordon-to-cordon movements were identified and those records were removed from the data set. Table 5-1 shows the number of interview records discarded during each stage of the cleaning process.

Table 5-1 – Breakdown of Records Lost through Cleaning Process

Initial Interview Records	**9,055**
Interviews discarded due to missing origin details	278
Interviews discarded due to missing destination details	385
Interviews discarded due to identical origin and destination details	289
Interviews discarded due to error in purpose	25
Interviews discarded due to error in vehicle type	23
Interviews discarded due to error in time element	8
Interviews discarded due to error in distance factor	3
Interviews discarded due to record having distance factor >3	103
Interviews discarded due to Illogical movement relative to interview direction	718
Total Percentage of Interview Data Discarded	**20.2%**
Interview Records After Cleaning Process	**7,223**

5.3.2 Expansion and Transposition of Postcard Interviews

At each of the postcard interview sites, ATC data and MCLC data was collected in both directions. For each site, the ATC data consisted of at least two weeks of data, whilst for the MCLC data usually a single classified 12-hour count was available. All the counts were normalised to a neutral 2006 count, based on day and month.

The counts that were used in the expansion process adopted the vehicle proportions observed through MCLC data but the counts were ultimately controlled to the normalised ATC counts. In order to avoid using count data from faulty ATC equipment, any ATC counts that were more than two standard deviations from the mean were identified and excluded when calculating averages.

Due to a low rate of postcard return across all vehicle types, expansion of the postcode records was undertaken for the period from 0700 to 1000 hours for the AM peak, and from 1600 to 1900 hours for the PM peak.

Low return rates for LGVs and HGVs were especially prevalent at interview sites 6, 9 and 12 and so records from the full 12-hour interview period were used in the AM and PM peaks. All interview direction purpose splits were controlled back to the hour-specific purpose split.

Postcard interviews were distributed in the inbound (to the city centre) direction at the Lincoln cordon. To expand interview records to counts in the outbound direction, interview records were transposed by swapping origin and destination zones and adjusting time periods. Records collected in the AM period were assigned to the PM period for the non-interview direction and vice versa. Records collected in the inter-peak only had their origin and destination zones swapped.

The transposed interview data was adjusted so that the specific hour purpose splits were correct according to the interview direction splits. Table 5-2 presents a comparison between the observed purpose split across the cordon and the adjusted transposed purpose split.

Note - In the table below, HB stands for Home Based refers to a trip where either the origin or destination is residential in purpose. Any trip with an origin or destination which is not residential in purpose is termed Non Home Base (NHB).

Table 5-2 – Cordon Wide Purpose Split (Interview/Non-Interview Direction)

Modelled Hour	Purpose	Purpose Split Interview Direction	Purpose Split Non-Interview Direction
AM Peak Period			
1	HB Commute	0.495	0.471
2	HB Education	0.032	0.037
3	HB Shopping	0.094	0.090
4	HB Other	0.054	0.057
5	HB Emp Bus	0.058	0.063
6	NHB Emp Bus	0.055	0.051

Modelled Hour	Purpose	Purpose Split Interview Direction	Purpose Split Non-Interview Direction
7	NHB Other	0.071	0.072
8	LGV	0.103	0.110
9	OGV	0.034	0.044
	AM Peak Period Total	**1.000**	**1.000**
	Inter Peak Period		
1	HB Commute	0.106	0.108
2	HB Education	0.011	0.011
3	HB Shopping	0.230	0.227
4	HB Other	0.146	0.146
5	HB Emp Bus	0.056	0.057
6	NHB Emp Bus	0.091	0.091
7	NHB Other	0.121	0.121
8	LGV	0.144	0.144
9	OGV	0.091	0.092
	Inter-Peak Period Total	**1.000**	**1.000**
	PM Peak Period		
1	HB Commute	0.362	0.361
2	HB Education	0.012	0.008
3	HB Shopping	0.058	0.062
4	HB Other	0.166	0.189
5	HB Emp Bus	0.094	0.086
6	NHB Emp Bus	0.023	0.022
7	NHB Other	0.112	0.109
8	LGV	0.128	0.124
9	OGV	0.040	0.034
	PM Peak Period Total	**1.000**	**1.000**

Table 5-3 below summarises the average expansion factors that were derived during each model period.

Table 5-3 – Average Expansion Factors derived for Interview Data

Time Period	Vehicle Type	Expansion Factor	
		Interview Direction	Non Interview Direction
AM Peak	Car	3.4	3.0
	LGV	7.0	9.4
	OGV	9.2	9.6
Inter Peak	Car	1.3	1.4
	LGV	6.2	6.5
	OGV	6.5	6.8
PM Peak	Car	3.8	3.4

	LGV	8.3	7.3
	OGV	7.8	5.7

5.3.3 *Non-Interview Sites*

The Lincoln cordon is made up of a total of 25 links, 12 of which were included in the postcard interview survey and the remainder were non-interview sites. Traffic count data was available for 9 of these non-interview sites and further 4 minor roads were judged to carry insignificant levels of flow and were not therefore included in the original survey coverage. Vehicles on the non-interviewed links represent a relatively small proportion of trips crossing the cordon, as shown in Table 5-4 below.

Table 5-4 – Summary of Count Data on Interview Cordon

Site Type	AM Peak hour		Average Inter Peak hour		PM Peak hour	
	Flow	%	Flow	%	Flow	%
Interview Site	13,211	82%	9,858	86%	13,996	82%
Non-Interview Site	2,986	18%	1,570	14%	2,981	18%
Total	16,197		11,428		16,977	

For each non-interview site with count data available, trips were in-filled by creating all-vehicle select link analysis (SLA) matrices at each link and in both directions using the previous incarnation of the base model. These have then been cleaned in a similar fashion to the postcard interview data to discard any illogical movements. The matrices were then segmented by purpose by applying the observed cordon-wide purpose splits from the observed records. Segmented matrices were then controlled to the normalised count data and person trips were calculated by applying the average vehicle occupancy for each purpose.

Count data was unavailable for four of the sites shown as gaps in Figure 5-2. However, Lincolnshire CC confirmed the flows on these links were considered to be low (in the region of 600 vehicles per week) and so omitting them from the matrix building process would have an insignificant effect on trip patterns crossing the cordon.

5.3.4 *Merging of Expanded Postcard Records and SLA Matrices*

A factor was applied to each record that removed the potential for double counting. If a trip is fully observed and only crosses the cordon once, it maintains a factor of 1.0. Any trips that are partially observed or are likely to cross the cordon twice or three times were assigned a factor of 0.5 or 0.333 respectively. The analysis cordons and road layouts were used to assign factors to each analysis cordon to analysis cordon movement.

Once the postcards interview records and SLA matrices had been expanded they were merged to create one matrix of cordon crossing movements for each of the three modelled hour periods; 0800 to 0900, 1000 to 1600 average hour and 1700 to 1800. Table 5-5 shows the person trip and vehicle trip totals by modelled hour and direction.

Table 5-5 – Merged Vehicle & Person Trip Totals

Direction	Time Period	Vehicle Trips	Person Trips
Interview Direction	AM	7,321	9,355
	IP	4,226	6,299
	PM	4,593	6,298
Non-interview Direction	AM	4,118	5,709
	IP	4,334	6,438
	PM	7,080	9,608

5.3.5 Assignment Check of Observed Matrices

In order to check the accuracy of the observed matrices described in the sections above, these matrices were assigned to the highway model network. With only partially observed study area matrices, the network will be relatively uncongested and speeds unrealistically high. However, the assignment does provide an initial indication of how well the observed trips assign to the links on which they were recorded.

The results of these assignments are summarised in Tables 5-6 and 5-7 which compare modelled and observed flows in each modelled period and for inbound and outbound cordon flows. These show that the modelled flow crossing the cordon is lower than that observed. This is to be expected as some of the assigned traffic will not cross the cordon but seek alternative routes when the network is not fully unloaded.

Table 5-6 - Assignment Check of Observed Matrices (Inbound direction)

Site Number	AM				IP				PM			
	Observed counts (veh)	Modelled counts (veh)	Diff	% Difference	Observed counts (veh)	Modelled counts (veh)	Diff	% Difference	Observed counts (veh)	Modelled counts (veh)	Diff	% Difference
RSI01	641	249	-392	-61.2	186	111	-75	-40.3	276	171	-105	-38.0
RSI02	758	626	-132	-17.4	392	188	-204	-52.0	502	302	-200	-39.8
RSI03	1036	1559	523	50.5	549	947	398	72.5	563	992	429	76.2
ATC62	110	39	-71	-64.5	41	6	-35	-85.4	110	10	-100	-90.9
NA	41	41	0	0.0	1	1	0	0.0	1	0	-1	-100.0
RSI07	561	484	-77	-13.7	169	280	111	65.7	120	172	52	43.3
RSI08	441	363	-78	-17.7	224	196	-28	-12.5	290	186	-104	-35.9
RSI09	1117	999	-118	-10.6	608	630	22	3.6	579	673	94	16.2
RSI10	454	756	302	66.5	432	445	13	3.0	446	612	166	37.2
RSI11	415	409	-6	-1.4	306	187	-119	-38.9	400	217	-183	-45.8
RSI11a	328	136	-192	-58.5	206	88	-118	-57.3	379	180	-199	-52.5
RSI12	607	583	-24	-4.0	513	211	-302	-58.9	511	291	-220	-43.1
near 12	491	91	-400	-81.5	490	37	-453	-92.4	54	54	0	0.0
ATC74	438	327	-111	-25.3	202	212	10	5.0	343	251	-92	-26.8
ATC44	413	382	-31	-7.5	128	160	32	25.0	216	241	25	11.6
ATC45	71	86	15	21.1	34	69	35	102.9	48	94	46	95.8
NA	1	0	-1	-100.0	1	0	-1	-100.0	1	0	-1	-100.0
RSI04	642	739	97	15.1	487	357	-130	-26.7	556	508	-48	-8.6
RSI05	326	395	69	21.2	192	255	63	32.8	261	354	93	35.6
RSI06	1290	811	-479	-37.1	815	557	-258	-31.7	1244	889	-355	-28.5
TC15	101	0	-101	-100.0	77	33	-44	-57.1	104	0	-104	-100.0
ATC60	37	35	-2	-5.4	32	31	-1	-3.1	42	43	1	2.4
ATC61	106	49	-57	-53.8	50	10	-40	-80.0	96	18	-78	-81.3
L115	154	22	-132	-85.7	1	3	2	200.0	91	16	-75	-82.4
TC42	422	420	-2	-0.5	214	253	39	18.2	274	260	-14	-5.1
	11001	**9601**	**-1400**	**-12.7**	**6350**	**5267**	**-1083**	**-17.1**	**7507**	**6534**	**-973**	**-13.0**

Table 5-7 Assignment Check of Observed Matrices (Outbound direction)

Site Number	AM				IP				PM			
	Observed counts (veh)	Modelled counts (veh)	Diff	% Difference	Observed counts (veh)	Modelled counts (veh)	Diff	% Difference	Observed counts (veh)	Modelled counts (veh)	Diff	% Difference
RSI01	166	98	-68	-41.0	180	112	-68	-37.8	573	268	-305	-53.2
RSI02	436	228	-208	-47.7	412	181	-231	-56.1	436	228	-208	-47.7
RSI03	652	959	307	47.1	525	929	404	77.0	652	959	307	47.1
ATC62	1036	1559	523	50.5	549	947	398	72.5	1036	1559	523	50.5
NA	1	0	-1	-100.0	1	1	0	0.0	1	0	-1	-100.0
RSI07	122	177	55	45.1	188	268	80	42.6	122	177	55	45.1
RSI08	123	185	62	50.4	166	198	32	19.3	123	185	62	50.4
RSI09	572	642	70	12.2	719	646	-73	-10.2	572	642	70	12.2
RSI10	310	427	117	37.7	404	499	95	23.5	310	427	117	37.7
RSI11	268	115	-153	-57.1	303	150	-153	-50.5	268	115	-153	-57.1
RSI11a	374	137	-237	-63.4	214	108	-106	-49.5	374	137	-237	-63.4
RSI12	471	223	-248	-52.7	530	224	-306	-57.7	471	223	-248	-52.7
near 12	247	55	-192	-77.7	576	53	-523	-90.8	247	55	-192	-77.7
ATC74	271	179	-92	-33.9	213	173	-40	-18.8	271	179	-92	-33.9
ATC44	196	242	46	23.5	123	141	18	14.6	196	242	46	23.5
ATC45	33	93	60	181.8	44	53	9	20.5	33	93	60	181.8
NA	1	0	-1	-100.0	1	0	-1	-100.0	1	0	-1	-100.0
RSI04	340	429	89	26.2	499	381	-118	-23.6	340	429	89	26.2
RSI05	228	382	154	67.5	210	245	35	16.7	228	382	154	67.5
RSI06	1235	800	-435	-35.2	849	583	-266	-31.3	1235	800	-435	-35.2
TC15	115	122	7	6.1	65	70	5	7.7	115	122	7	6.1
ATC60	46	45	-1	-2.2	30	29	-1	-3.3	46	45	-1	-2.2
ATC61	121	81	-40	-33.1	50	38	-12	-24.0	121	81	-40	-33.1
L115	68	5	-63	-92.6	1	0	-1	-100.0	68	5	-63	-92.6
TC42	212	199	-13	-6.1	229	251	22	9.6	212	199	-13	-6.1
	7644	**7382**	**-262**	**-3.4**	**7081**	**6280**	**-801**	**-11.3**	**8051**	**7552**	**-499**	**-6.2**

5.3.6 *Interview Sample Bias*

The potential for response bias was considered with the self-completion postcard interviews. Whilst there was concern over the personal details given by a number of respondents, the primary concern was the validity of the trip purpose descriptions.

Any bias with the interview returns could have the effect of misrepresenting business travel (EB) in particular as the type of person making such trips is less likely to have time available to return a completed questionnaire.

The interview questionnaires did not include data describing the respondent which might have been used to allow re-weighting the sample to the true make-up of the resident population. Hence the main focus on checking response bias was in checking the trip purpose splits. The trip purpose splits reported in the observed matrices are shown below in Table 5-9.

5.3.7 *Bias checks*

The interview purpose splits provided have been checked against a number of different data sources as discussed below.

The first check was made against the National Trip End Model (NTEM) 6.2, as reported through TEMPRO and 2006 average weekday productions by purpose for the Lincoln urban area. Table 5-9 shows the comparison of the NTEM data against the observed matrix totals from the Lincoln surveys.

Table 5-8 – Matrix Comparisons

Purpose	GLTM Trips	GLTM Splits	Shrews-bury	Shrews-bury %	Heysham	Heysham %	NTEM Productions	NTEM Splits
HB Commute	34,525	28.2%	12,216	24.2%	33,829	24.6%	24,927	17.9%
HB Employers Business	7,258	5.9%	7,115	14.1%	10,989	8.0%	3,836	2.8%
HB Other	52,667	43.1%	19,929	39.5%	62,981	45.8%	88,007	63.4%
NHB Employers Business	8,105	6.6%	6,073	12.0%	11,194	8.1%	4,208	3.0%
NHB Other	19,737	16.1%	5,130	10.2%	18,561	13.5%	17,907	12.9%
All Purpose Total	**122,292**	**100.0%**	**50,462**	**100.0%**	**137,553**	**100.0%**	**138,885**	**100.0%**
Commute + EB Total	49,888	40.8%	25,404	50.3%	56,012	40.7%	32,971	23.7%
All Other Total	79,662	59.2%	32,174	49.7%	92,531	59.3%	109,750	76.3%

It appears that the GLTM Commute and EB purpose proportions are overstated when compared to NTEM. The purpose HB Other also seems underrepresented

compared to NTEM. This is believed to be a direct result of comparing the GLTM interview cordon data with NTEM productions, which are representative of the entire urban area - the interview cordon can be expect to include significantly longer distance commuting and EB and fewer local trips, for example education and shopping.

It was therefore decided to compare the interview cordon observed matrices with data from other projects where these involved face-to-face roadside interviews. The second check available was therefore against a study in Lancaster, as shown in Table 5-9.

This table shows a closer match to the interview data but the model has the Irish Sea to the West and is effectively a 'cul-de-sac' for trips.

The third check available was from a study in Shrewsbury that used roadside interviews. Shrewsbury is a free standing town of a similar size and nature to Lincoln. This again shows a much closer comparison to the GLTM purpose splits but surprisingly higher EB proportions. This may mean that the returns in Lincoln were low for this journey purpose but ultimately this is likely to 'undervalue' the scheme as this purposes tends to represents above average benefits.

When the observed total Commute and EB are compared to similar models with RIS observed matrices, the splits are similar to the GLTM splits. It has therefore been concluded that GLTM interviews do not show any bias in terms of interview purpose.

Table 5-9 – Observed Matrix Totals

Time Period	Journey Purpose	Person Matrix Total	% Split	Vehicle Matrix Total	% Split
AM	HB Commute	6,419	50.3%	5,719	50.3%
	HB Education	707	5.5%	414	5.5%
	HB Employers Business	679	5.3%	635	5.3%
	HB Other	2,721	21.3%	1,709	21.3%
	NHB Employers Business	728	5.7%	627	5.7%
	NHB Other	1,510	11.8%	835	11.8%
	Total	**12,763**	**100.0%**	**9,939**	**100.0%**
IP	HB Commute	1,038	10.9%	953	10.9%
	HB Education	137	1.4%	97	1.4%
	HB Employers Business	494	5.2%	444	5.2%
	HB Other	5,236	55.1%	3,283	55.1%
	NHB Employers Business	909	9.6%	802	9.6%
	NHB Other	1,685	17.7%	1,067	17.7%
	Total	**9,499**	**100.0%**	**6,646**	**100.0%**
PM	HB Commute	4,900	36.7%	4,381	36.7%
	HB Education	203	1.5%	134	1.5%
	HB Employers Business	1,040	7.8%	955	7.8%

Time Period	Journey Purpose	Person Matrix Total	% Split	Vehicle Matrix Total	% Split
	HB Other	4,540	34.0%	2,782	34.0%
	NHB Employers Business	332	2.5%	278	2.5%
	NHB Other	2,342	17.5%	1,350	17.5%
	Total	**13,357**	**100.0%**	**9,880**	**100.0%**
12 Hour	HB Commute	34,525	28.2%	30,965	28.2%
	HB Education	3,098	2.5%	1,952	2.5%
	HB Employers Business	7,258	5.9%	6,640	5.9%
	HB Other	49,569	40.5%	30,923	40.5%
	NHB Employers Business	8,105	6.6%	7,076	6.6%
	NHB Other	19,737	16.1%	11,864	16.1%
	Total	**122,292**	**100.0%**	**89,421**	**100.0%**
12 Hour	Commute	34,525	28.2%	30,965	28.2%
	Education	3,098	2.5%	1,952	2.5%
	Employers Business	15,363	12.6%	13,716	12.6%
	Other	69,306	56.7%	42,787	56.7%
	Total	**122,292**	**100.0%**	**89,421**	**100.0%**

5.4 Synthetic Matrix Build

Synthetic matrices are required in order to represent the full extent of the Internal area and for external trips with a potential to cross this area. The synthetic matrices are required for unobserved movements and to provide additional segmentation and spatial 'smoothing' not available from travel interview data.

The synthetic data is also likely to be the only source of information for bus, walk and cycle trips.

The trip production and attraction information required for the synthetic matrix build can only realistically be prepared for the Internal area, which in itself is a significant task. Therefore the main scope for the synthetic matrix build is the Internal area alone, and zones within this area are referred to as Internal zones.

5.4.1 Scope

If the large External zones were included in the attraction data, then the trip distributions using the 'gravity models' would be skewed towards these large zones. This is because the distribution function used is doubly constraint to ensure that the distribution replicates input production and attraction totals. It is therefore important that the productions and attractions are specified in a consistent manner for different geographical areas. For example if an attraction in Newark within the External area was fully specified, but the production excluded, the distribution model would have to satisfy the attraction from other productions, thus skewing the distribution to Newark, which had no production specified.

However, it is important that all relevant External to External movements that have the potential to cross the Internal area are also synthesised. Therefore, Commute and Employer's Business (EB) trip productions have been derived for England and Wales and then distributed directly from Journey to Work (J2W) census data, with External catchments being defined as passing through or not passing through the Internal area. This also includes trips using the strategic highway network around the Internal area, for example the A1, to ensure that there are realistic levels of traffic on these roads. This therefore provides an estimate of External to External strategic movements for the Commute and EB purposes. Other External area trip purposes are synthesised from the J2W data, as discussed below.

The synthetic matrix process operates at the twenty four hour level and full Land Use Segmentation for trip Production / Attraction (PA) analysis, and then the Land Use Segmentation aggregated by household composition and car ownership for the trip distribution analysis. Both these processes use a PA format. The later stages of the process convert from twenty four hour PA to period Origin / Destination (OD) formats and finally the Travel Segmentation. The synthetic process works independently for the following modes of travel:

- Car;
- Bus;
- Rail;
- Walk/Cycle;
- LGV; and
- OGV.

It also works independently of journey purpose for the following:

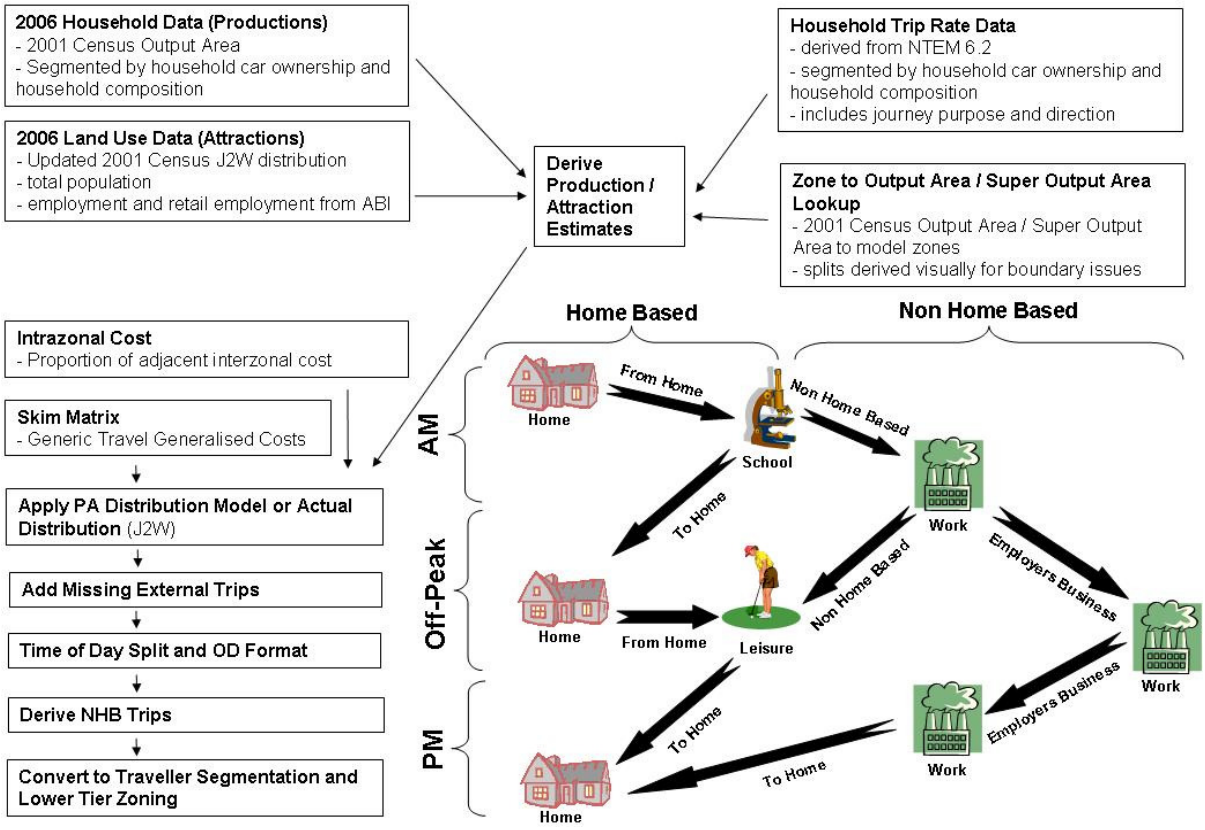
- Home Based (HB) Commute;
- HB Education;
- HB Shopping;
- HB Other;
- HB Employers Business (EB);
- Non Home Based (NHB) EB; and
- NHB Other.

Whilst intrazonal movements are developed from the distribution process none are assigned within the assignment models and no cost information is Available from the assignment models. However, intrazonal movements are required for the Demand Model and for forecasting. Intrazonal costs are therefore synthesised using proportions from adjacent interzonal movements.

5.4.2 *Method Overview*

The synthetic matrix build is focused on HB trip production / attraction and then trip distribution, all of which is undertaken separately by mode. Figure 5-3 provides an overview of the synthetic matrix build process, and includes an example 'graphic' of typical daily trips represented.

Figure 5-3 – Synthetic Matrix Build



The overview shows the HB production analysis is based on the product of households and trip rates. The trip attractions are controlled by the totals implied by the trip productions and use a variety of data sources to indicate the attraction of zones for different journey purposes. Retail employment Annual Business Inquiry (ABI) data are used for Shopping attractions, and Other is based on total populations. No HB attractions are required for Commute and EB as the J2W distributions are used directly. Also, no attractions are required for Education as the distributions are taken directly from school PLASC, and college and university student data.

Figure 5-3 then shows the process post production / attraction calculations as consisting of the derivation of interzonal and intrazonal travel costs for input to the trip distribution process.

The output from the distribution process is twenty four hour PA matrices. These then have missing trips associated with External movements added in based on scaling and re-weighting the distribution of Commute trips. These include relevant External to External trips, and Internal to External and External to Internal movements. The

PA matrices are then rescaled so that the attractions associated with each Internal zones are as originally calculated. This is followed by a similar process with the Internal productions, thus leaving the matrices with the correct Internal productions and small, but acceptable, discrepancies with the Internal attractions.

These PA matrices are then converted to an OD time period format. The time periods used at this stage represent 3 hour morning and evening periods, a 6 hour inter-peak period and a 12 hour off-peak / overnight period.

The process then derives estimates of NHB movements from the product of the destination totals of HB trips and NHB trip rates, derived from travel diary analysis.

No reliable method was available for constructing LGV and OGV freight movements. Therefore the LGV and OGV freight matrices are simply built from the total employment as a production and attraction, and then Furnessed with a unitary matrix. In addition the OGV matrices are then attracted to district level and controlled to the DfT trip movements, derived from annual tonnages. It should be noted that freight movements are longer distance movements and are expected to be mostly observed following Phase C when RIS data is combined with the synthetic matrices.

Initial assignments of the synthetic matrices are used for checking and to prepare a global factor Car, LGV and OGV matrix adjustment factor derived from the total of observed counts / modelled flows for these three vehicle types. These factors are applied directly to the LGV and OGV synthetic matrices to produce the final version. However, Car Adjustment is applied to the trip rates and the synthetic matrices rebuilt. This is necessary as the trip rates can be expected to require a certain amount of local adjustment and they could be useful for future forecasts, although not used in the LEB model application. This factoring is important as when merging the synthetic matrices with the observed RIS matrices the synthetic needs to have reasonably similar volumes to the observed, which is controlled to counts at each interview site. A summary of the trip totals for the synthetic HAM matrices is shown in Table 5-10.

Table 5-10 – Synthetic Matrix Trip Totals by Vehicle Type

Flow Group	Time Period		
	AM	IP	PM
Commute	99,901	14,077	66,286
Other	58,941	68,679	62,779
EB	19,435	8,651	13,344
GV	4,421	2,537	3,116
OGV	2,464	1,812	1,304

5.5 Observed and Synthetic Matrix Merge

The two different private vehicle matrix builds of synthetic and observed needed to be merged together. This not only allows missing observed movements to be added but also allows the observed matrices to be 'smoothed', additional segmentation to be added and improves the connection of observed matrices to land use data. The final matrices are held at the entire Lower Tier zoning system, and provide the level of detail necessary for Variable Demand Modelling (VDM). Public transport, Walk and Cycle matrices only exist as synthetic.

5.5.1 Smoothing and Additional Segmentation

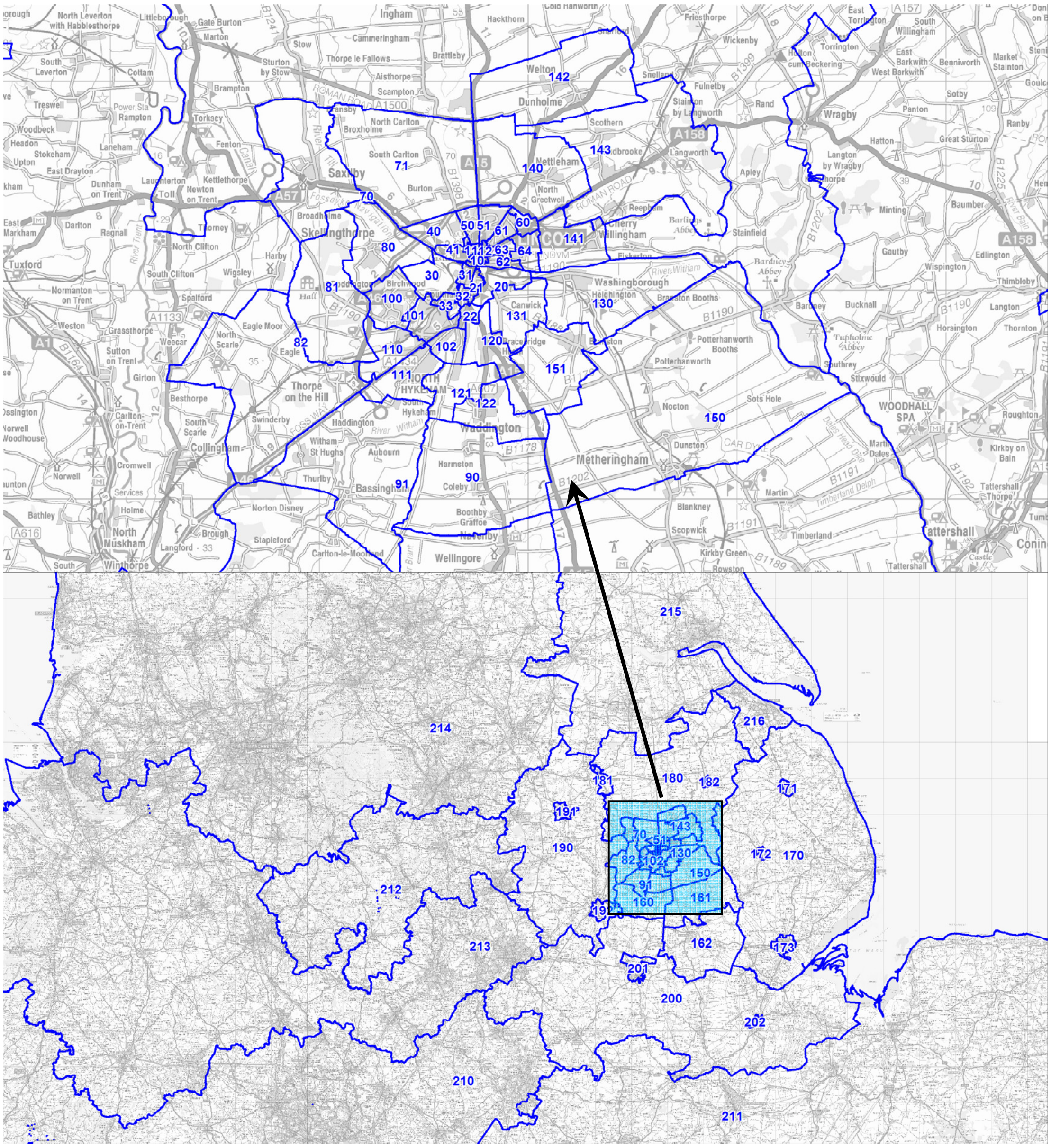
Smoothing was only applied to the Car matrices as the synthetic freight was not considered sufficiently reliable plus segmentation of freight matrices is not necessary.

The process to smooth and further segment the observed matrix required a set of smoothing sectors to be prepared. A key point of smoothing the observed matrices is to remove any sampling issues that may exist in the interview data. It is likely that respondents will correctly state the broad area to which they have travelled from and are travelling to. Therefore the smoothing sectors split the analysis cordons into conurbation areas, built by aggregating Lower Tier zones.

Another important function of the smoothing is to ensure a better connection with land use data. One issue can be where interview postcode coordinate accuracy could allocate an origin or destination to the wrong zone. This is likely to be more prevalent with specific locations for example schools or shopping areas. By arranging the smoothing sectors to wholly encompass such areas the smoothing process better realigns the trips to the underlying land uses. The additional segmentation of Household Income and Car Availability has also been added by smoothing sector.

Figure 5-4 shows the smoothing sectors and there index, which is built from the constituent analysis cordon * 10. The smoothing sectors are smaller within the interview cordon and adjacent to it as that represents a concentration of observed movements. Further from the interview cordon the observations are more parse and therefore the smoothing sectors become larger. As the GLTM zones are relatively large outside of the LPA area the smoothing sectors are mostly a copy of the Lower Tier zones.

Figure 5-4 – Smoothing Sectors



The vast majority of the 31,705 observed car vehicle trips were smoothed at the first attempt using smoothing sector to smoothing sector synthetic data. This process aggregated to the observed matrices at the trip level by smoothing sector origin and smoothing sector destination. To achieve this the synthetic matrices were aggregated to the same level and a set of splitting factors were then derived to disaggregate the observed sector movements to Lower Tier origin and destination, and Household Income and Car Availability.

From this initial process 28,800 observed vehicle trips were smoothed. To cater for the unsmoothed trips splitting factors were derived for all synthetic trips associated with each origin sector and associated with each destination sector. The unsmoothed observed sector to sector movements were then smoothed by applying

these splitting factors to the observed origin and the observed destination. This increase the total smoothed trips to 30,356 vehicles.

After this second process there were still observed vehicle trips that had not been smoothed. These were added by smoothing using the synthetic aggregated to the Report Cordons (see model specification for details). Household Income and Car Availability splitting factors were derived from cordon to cordon synthetic movements and applied to the missing observed movements. This increase the total adjusted trips to 31,607 vehicles.

Dealing with the final missing observed trips involved again retaining the original observed origin and destination and applying global Household Income and Car Availability splits. This increase the total adjusted trips to the complete 31,697 vehicles.

A small number of additional illogical movements were also removed from the smoothed observed matrices but these only reduced the total trips to 31,705 vehicles.

The smoothing process adds substantially more segmentation. The original 11,458 observed records were increased to 113,211 records with the inclusion of select link matrices for interview cordon gaps. When smoothed this increases to 984,571 records which include the additional Household Income and Car Availability segmentation. This level of segmentation is important to allow VDM. When the matrices are converted to a format for use in the HAM most of the detailed segmentation is aggregated and the HAM matrices contain more feasible numbers for use in the assignment process

5.5.2 Merging process

The smoothing process disaggregates the observed matrices to the same level of segmentation available in the synthetic matrices. The two sets of data can therefore be combined directly. However, the substantial buffer model network that surrounds the interview cordon means that many interview cordon movements will be partial.

To assist in understanding partial interview cordon movements ODs were categorised using the interview cordon, and local routing knowledge and judgement, into the following movement indices:

1. Fully Observed Interviews;
2. Internal To Interview Cordon;
3. External To Interview Cordon;
4. Irrelevant;
5. Partially Observed Interviews - Short Distance;
6. Partially Observed Interviews - Medium Distance; and

7. Partially Observed Interviews - Long Distance.

Movements categorised as 1 included trips with an origin or destination within the interview cordon. These observed trips were combined directly with synthetic movements wholly within the interview cordon (category 2).

Movements categorised as 3 were not expected to travel through the interview cordon and therefore have been added directly. Also, the volume correction added to improve the synthetic flow to count comparison was removed if the trip was without an origin or destination within the LPA, as discussed previously.

Movements categorised as 4 were removed from the matrices.

Movements categorised as 5, 6 and 7 were dealt with in two stages: firstly for the movements with an observed record; and secondly for potentially unobserved movements. The definition of movements categorised as 5, 6 and 7 had been prepared through local routing knowledge. As such it was possible that some of the OD pairs may have been miscoded and may not have potential to travel through the interview cordon. Furthermore, an assumed proportion of an OD movement that had been observed travelling through the interview cordon was used to calibrate the merged matrices. This proportion was specified for three different OD distance categories of:

1. Short (< 31 km) = 100%;
2. Medium (< 51 km) = 70%; and
3. Long (< 110 km) = 10%.

These proportions assume that the further away from the interview cordon the more likely that OD movements will route around the cordon, thus a lower proportion can be expected to pass through the cordon.

The first stage in dealing with these partial cordon movements was to merge all observed movements categorised as 5, 6 and 7, and divide them by the percentages listed above. However, this clearly is not applicable for movements that have not been sampled. Therefore, for any missing analysis cordon aggregated movements categorised as 5, 6 and 7 the synthetic OD movement was used, with the volume correction removed if without an origin or destination within the LPA, as discussed previously.

Table 5-11 below shows a breakdown of the trips as they were merged for the different types of movements. The fully observed totals only include trips with an origin or destination within the interview cordon and as such they don't match the smoothed observed trip totals. These trips do account for some 85% of observed car movements, with the remaining 15% representing through trips some of which are assumed to be partial. These 15% are factored by around 1.89 to account for the missing trips that are expected to divert around the interview cordon.

Table 5-11 – Merging of Different Types of Movements

Merged Data	AM Peak Hour			IP Peak Hour			PM Peak Hour			Total
	Car	LGV	OGV	Car	LGV	OGV	Car	LGV	OGV	
1: Fully Observed Car	10,511	0	0	6,567	0	0	9,963	0	0	27,041
Plus 1: Fully Observed Freight	10,511	1,162	313	6,567	1,166	589	9,963	1,511	355	32,137
Plus 2: Internal Synthetic Car	22,837	1,162	313	12,852	1,166	589	19,313	1,511	355	60,099
Plus 2: Internal Synthetic Freight	22,837	4,227	2,021	12,852	2,924	1,845	19,313	3,672	1,259	70,950
Plus 3: External Synthetic Car	144,751	4,227	2,021	85,863	2,924	1,845	150,769	3,672	1,259	397,331
Plus 3: External Synthetic Freight	144,751	18,148	5,177	85,863	14,536	8,350	150,769	15,775	3,489	446,858
Plus 5/6/7. Partially Observed Car	146,924	18,148	5,177	87,364	14,536	8,350	153,391	15,775	3,489	453,154
Plus 5/6/7. Partially Observed Freight	146,924	18,419	5,390	87,364	14,750	8,512	153,391	16,211	3,700	454,661
Plus 5/6/7. Partially Observed Synthetic Car	147,262	18,419	5,390	87,472	14,750	8,512	153,627	16,211	3,700	455,343
Plus 5/6/7. Partially Observed Synthetic Freight	147,262	18,448	5,396	87,472	14,775	8,526	153,627	16,236	3,705	455,447
Final Merged	**147,262**	**18,448**	**5,396**	**87,472**	**14,775**	**8,526**	**153,627**	**16,236**	**3,705**	**455,447**

5.6 Model Recalibration

Following the BaFB submission in 2011, the VISUM model was reviewed as it became apparent that a number of enhancements were required for the model in order to make the model more robust. Activation of the blocking back function revealed a high level of queuing on links that connected external zones which was deemed to be unrealistic. This was apparent in all three modelled time periods and so factors were applied that reduced the volume of trips between zones outside the Lincoln Planning Area (LPA). These factors were applied at a sector level, using the ten reporting sectors previously described in this chapter. Zones outside of the LPA are contained in sectors numbered 5 to 10 inclusive.

In additional to this some factors were applied to trips with origins and/or destinations within the LPA. During the calibration process modelled flow volumes were compared against observed flow volumes at screenline levels and factors were manually applied to sector to sector movements in order to reduce the trip adjustment that was required in the matrix estimation process. The factors that were applied are shown in Tables 5.12 to 5.14. The overall matrix sizes of the prior

matrices for the BaFB model and the prior matrices that were produced by applying the factors are shown in Table 5.15.

Table 5-12 – Manual Factors Applied to BaFB Prior Matrices – AM Peak

Origin Sector	Destination Sector									
	1	2	3	4	5	6	7	8	9	10
1	0.85	-	-	-	-	-	-	-	1.8	1.2
2	1	-	-	-	-	-	-	-	1.8	1.2
3	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	0.1	0.1	0.1	0.1	0.1	0.1
6	-	-	-	-	0.1	0.1	0.1	0.1	0.1	0.1
7	-	-	-	-	0.1	0.1	0.1	0.1	0.1	0.1
8	-	-	-	-	0.1	0.1	0.1	0.1	0.1	0.1
9	1.4	1.4	-	-	0.1	1	0.1	0.1	0.1	0.1
10	0.9	0.9	-	-	0.4	0.4	0.4	0.4	0.4	0.4

Table 5-13 – Manual Factors Applied to BaFB Prior Matrices - Interpeak

Origin Sector	Destination Sector									
	1	2	3	4	5	6	7	8	9	10
1	-	-	-	-	-	-	-	-	-	-
2	0.8	-	-	-	-	-	-	-	-	-
3	0.8	-	-	-	-	-	-	-	-	-
4	0.8	-	-	-	-	-	-	-	-	-
5	0.8	-	-	-	0.4	0.4	0.4	0.4	0.4	0.4
6	0.8	-	-	-	0.4	0.4	0.4	0.4	0.4	0.4
7	0.8	-	-	-	0.4	0.4	0.4	0.4	0.4	0.4
8	0.8	-	-	-	0.4	0.4	0.4	0.4	0.4	0.4
9	0.8	-	-	-	0.4	0.4	0.4	0.4	0.4	0.4
10	0.8	-	-	-	0.4	0.4	0.4	0.4	0.4	0.2

Table 5-14 – Manual Factors Applied to BaFB Prior Matrices – PM Peak

Origin Sector	Destination Sector									
	1	2	3	4	5	6	7	8	9	10
1	0.85	1	-	-	-	-	-	-	1.4	0.9
2	-	-	-	-	-	-	-	-	1.4	0.9
3	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	0.1	0.1	0.1	0.1	0.1	0.4
6	-	-	-	-	0.1	0.1	0.1	0.1	1	0.4
7	-	-	-	-	0.1	0.1	0.1	0.1	0.1	0.4
8	-	-	-	-	0.1	0.1	0.1	0.1	0.1	0.4
9	1.8	1.8	-	-	0.1	0.1	0.1	0.1	0.1	0.4
10	1.2	1.2	-	-	0.1	0.1	0.1	0.1	0.1	0.4

Table 5-15 – Prior Matrix Totals – BaFB Totals against Factored

Time Period	Trip Purpose		Prior Matrices (veh)	
			BaFB	Factored
AM	1	Commute	80,937	26,970
	2	Other	49,859	16,915
	3	Work	16,465	5,605
	4	LGV	18,448	8,180
	5	OGV	5,396	2,951
	Total		**171,106**	**60,622**
IP	1	Commute	12,863	6,127
	2	Other	65,579	31,153
	3	Work	9,030	4,570
	4	LGV	14,775	6,736
	5	OGV	8,526	4,018
	Total		**110,773**	**52,603**
PM	1	Commute	69,637	21,260
	2	Other	68,738	21,186
	3	Work	15,252	5,214
	4	LGV	16,236	7,351
	5	OGV	3,705	2,010
	Total		**173,568**	**57,023**

6 Model Calibration

6.1 Introduction

The plan to enhance the model involved improvements to the network in the short term but in the longer term, building a new set of demand matrices using a more recent set of interview data. The recalibration work carried out so far has reflects the first stage of these upgrades and has involved implementing changes to the assignment procedure as well as carrying out a review and altering various aspects of network coding.

The model had been recalibrated using the improved network but using prior matrices derived from those produced in 2011 for the BaFB. The changes made to the prior matrices from the BaFB are detailed in the previous chapter.

The recalibrated base model is very much an interim model and will form the basis of a set of forecast models that will support a planning application for LEB. It will also be used to inform the highway design team of likely flows along various sections of the LEB.

During the recalibration work, greater emphasis has been placed on screenline flow totals rather than on individual roads. In addition to this, journey time validation, routing checks and congestion plots have been produced to ensure that the model is representative of the existing network conditions.

6.2 Calibration Process

The calibration of the model was undertaken whereby the network was adjusted to ensure that the model realistically replicated routeing and vehicle speeds within the study area. Matrix estimation was incorporated in the model calibration process in order to obtain matrices based on the routeing patterns to which the network was calibrated.

The calibration process involved a number of tasks, as follows:

- Checks on the basic structure of the network, including link lengths, junction configuration and banned turns;
- Checks on speed-flow curves to ensure that they reflect the existing situation;
- Checks to ensure that link speeds and journey times are reasonable;
- Checks to ensure that vehicle routeings are realistic and appropriate; and
- Use of matrix estimation procedures to adjust and ‘fit’ the prior trip matrices to observed traffic flows.

Any observed traffic flows used in the calibration process, for matrix estimation, cannot be considered as independent for validation purposes. Under these circumstances, TAG Unit 3.19 advises that some count data should be retained and used only at the validation stage. Therefore, a number of traffic counts from different parts of the network were retained as independent counts and were not used in the matrix estimation.

Successful calibration entails matching the observed traffic counts (used in matrix estimation) with modelled flows. The matching is monitored using statistical procedures as recommended in TAG Unit 3.19. The recommended statistic is the GEH statistic, a form of chi-squared statistic, and is defined as:

$$GEH = \sqrt{\frac{(M-C)^2}{0.5(C+M)}}$$

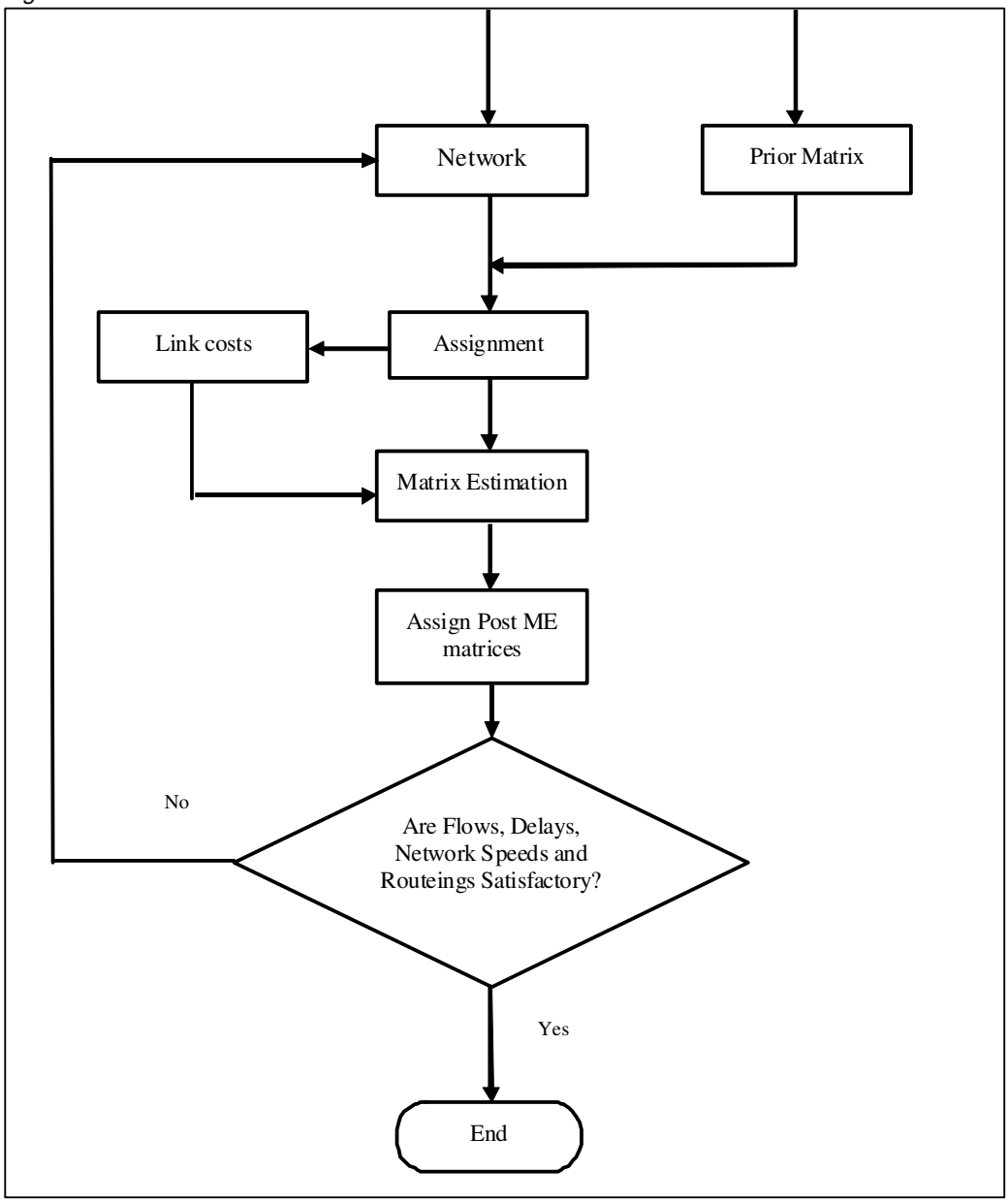
Where: M = modelled flow; and

C = observed flow (count)

Based on TAG Unit 3.19 guidance, a GEH value of less than 5, which indicates a satisfactory fit between modelled flows and independent observed data, (whatever the level of flow) should be achieved on 85% of individual links. For screenlines, or other combinations of links, a GEH value of less than 4 is required in all, or nearly all, cases. The acceptability guidelines set out for validation in TAG Unit 3.19 were adopted as criteria against which to gauge the results of the model calibration process.

Figure 6-1 provides a schematic representation of the main steps involved in the model calibration process. It can be seen that it is an iterative process where network and junction properties are adjusted until a point is reached where network speeds, flows, delays and routeings are deemed to be representative of the observed conditions.

Figure 6-1 – Model Calibration Process



6.3 Acceptability Guidelines

The acceptability guidelines set out for validation in TAG Unit 3.19 Section 3.2.8 were adopted as criteria against which to gauge the results of the model calibration process. These are shown in Table 6-1.

Table 6-1 – TAG Unit 3.19 Acceptability Guidelines for Assignment Validation

Criteria and Measure	Acceptability Guidelines	
1. Assigned Model Hourly Flows compared with Observed Flows		
i. Observed Flows < 700 vph	Modelled flow within ± 100	> 85% of links
ii. Observed Flows between 700 – 2,700 vph	Modelled flow within ± 15%	> 85% of links
iii. Observed Flows > 2,700 vph	Modelled flow within ± 400	> 85% of links
iv. Screenline Flow Totals (normally > 5 links)	Modelled flow within ± 5%	All (or nearly all) screenlines
2. GEH Statistic		
i. Individual Flows	GEH < 5	> 85% of links

Note - Guidelines for model calibration/validation stated in TAG Unit 3.19 do not suggest using the GEH criteria along screenline totals, which is a departure from the superseded DMRB (Design Manual for Roads & Bridges) guidance. GEH statistics along screenlines have been included in this report and have been used as an additional check during the model calibration/validation.

6.4 Assignment Parameters

Assignment of the O/D matrices to the Lincoln road network was undertaken using the Equilibrium_Lohse iterative assignment procedure in VISUM. Equilibrium_Lohse1 combines elements of both standard Equilibrium (Wardrop) and 'all-or-nothing' assignment methodologies. The procedure models the 'learning process' of users on the network over a number of iterations, where information gained on the previous trip is used for the next route search.

For each O/D pair, the least impeded route is initially calculated via the Intersection Capacity Analysis (ICA) module and traffic assigned to it in an all-or-nothing approach. Impedance is then recalculated and factored into the cost of the route for the next iteration which subsequently loads a proportion of traffic onto the next least impeded route. With successive iterations the most cost-effective route per O/D pair is optimised. The process ends when the shift of vehicles between routes is minimal.

6.5 Generalised Cost Parameters

The cost of travel is expressed in terms of generalised cost minutes, which can be related to the value of time and out of pocket costs. A multiple user class assignment method was used that allows Cars, LGV's and HGV's to be assigned simultaneously to the same network but using different generalised cost functions.

The components of the generalised cost function used in the traffic model were based on the Transport Economics Note (TEN 2007) with assumptions provided from WebTAG 3.5.6 (2007). WebTAG calculates the costs of travel based on the

assumptions of the value of money which a traveller is willing to pay to compensate for the time spent driving on the road.

For modelling purposes, generalised costs were calculated based on the assumptions of average travel speed on the road, vehicle fuel consumption, values of time, and average vehicle occupancies of each trip purpose. Non-fuel vehicle operating costs, such as maintenance or insurance etc., were not taken into account as drivers generally only perceive the fuel and time elements of their journey in making route choices.

The average travel speed on the network was obtained from the observed journey time surveys which were carried out in the study area in 2006. The average travel speeds derived from these surveys were 52.6kph in the AM Peak, 56kph in the Inter Peak, and 52.1kph in the PM Peak.

Based on the above and the WebTAG guidance, values of pence per kilometre (PPK) and pence per minute (PPM) for three vehicle classes (Car, LGV, HGV) by purpose type (Work, Commute, Other) were calculated for all three time periods. Monetary time (PPM) and distance (PPK) costs were then converted into generalised costs and used in VISUM. They are shown in Table 6-2.

Table 6-2 – Generalised Cost Parameters

User Class	Time Period	Monetary Values		Generalised Cost	
		Time (pence per minute)	Distance (pence per kilometre)	Time	Distance
Car Commute	AM Peak	11.56	6.03	1.00	0.52
	Inter Peak	11.56	6.03	1.00	0.52
	PM Peak	11.56	6.03	1.00	0.52
Car Other	AM Peak	15.76	6.03	1.00	0.38
	Inter Peak	15.76	6.03	1.00	0.38
	PM Peak	15.76	6.03	1.00	0.38
Car Employed Business	AM Peak	51.08	12.21	1.00	0.24
	Inter Peak	51.08	12.21	1.00	0.24
	PM Peak	51.08	12.21	1.00	0.24
LGV	AM Peak	21.20	13.25	1.00	0.62
	Inter Peak	21.20	13.25	1.00	0.62
	PM Peak	21.20	13.25	1.00	0.62
HGV	AM Peak	17.22	38.68	1.00	2.25
	Inter Peak	17.22	38.68	1.00	2.25
	PM Peak	17.22	38.68	1.00	2.25

6.6 Matrix Estimation

The matrix estimation (ME) process was an integral part of the development of the base year model matrices and designed to provide greater local detail to the local traffic model and enhance the precision of the matrices.

The matrix estimation process employed within the calibration was designed to adjust the travel pattern to the observed traffic counts. This process adjusted trips using available observed traffic counts to give the best-fit matrix. This process is dependent on several factors including the quality of the prior matrix, traffic routeing and the order and consistency of the observed traffic counts. Thus it is essential that the process is monitored closely to ensure the following:

- The trip matrix is converging to a stable solution;
- Travel patterns at a sector level are reasonable;
- Trip length distributions are reasonable.

The matrix estimation was undertaken within VISUM, using the TFlowFuzzy element of the suite. Trips were adjusted in the matrix to produce estimated matrices consistent with the observed traffic counts.

The equation used in the matrix estimation procedure may be written as:

$$T_{ij} = t_{ij} \prod_a X_a^{Pija}$$

where:

T_{ij} is the output post matrix of OD 'ij-pairs';

t_{ij} is the input prior matrix of OD 'ij-pairs';

$\prod_a$ is the product over all counted links a;

X_a is the balancing factor associated with counted link a;

^{Pija} is the fraction of trips from i to j using link a.

The process starts with the assignment of the prior trip matrices. Trip movements using the target links (for which counts are available – see Figure 3.5) are then identified and factored to match the target flows, as closely as possible given that several movements may go through any one site and individual movements may go through several sites. The resultant post-ME2 matrices may then be reassigned to start a subsequent iteration of the matrix estimation process, to further fine tune the prior trip matrices. There are no specific convergence criteria for matrix estimation, but the aim of the procedure is to improve the goodness of fit between modelled flows and counts.

For the Lincoln Eastern bypass Traffic Model, the procedure achieved a satisfactory level of fit between modelled and observed flows in 4 to 6 iterations.

Comparisons between traffic counts and modelled flows used in the matrix estimation process were undertaken during each iteration of the process. The calibration procedure was monitored by reviewing the changes to the trip matrices resulting from matrix estimation and the comparison of observed traffic counts and modelled traffic flows.

The changes in travel patterns were also monitored at a sector level during the calibration process

6.7 Effects of Matrix Estimation on Prior Matrices

The effects of matrix estimation (ME) on the trip matrices were monitored by comparing movement totals at sector level. The study area was compressed into 10 sectors as shown in Figure 6-2, defined as follows:

Internal sector (Main Lincoln, inside RSI cordon),

LPA sectors (sector 2, 3 and 4, surrounding RSI cordon)

External sectors (5, 6, 7, 8, 9 and 10).

In total, the all-vehicle trip matrices changed in size between the prior and post-estimation stages as follows:

- AM Peak hour: -1%;
- Inter Peak hour: +6%;
- PM Peak hour: -12%.

These changes are shown at individual sector level and by time period in Table 6-3 to Table 6-5. At a sector to sector level, absolute differences between prior and post matrices are small across all time periods. This indicates that the matrix estimation process has not significantly affected the prior matrices and the post ME matrices will maintain a strong correlation to land use.

Key changes at a more aggregate level are summarised in Tables 6-6 to 6-8.The important movements are between sector 1 and LPA sectors 2-4. Matrix estimation changed these movements by less than 4% in the AM peak, by less than 30% in the interpeak and less that 16% in the PM peak.

Figure 6-2 – Sector Map

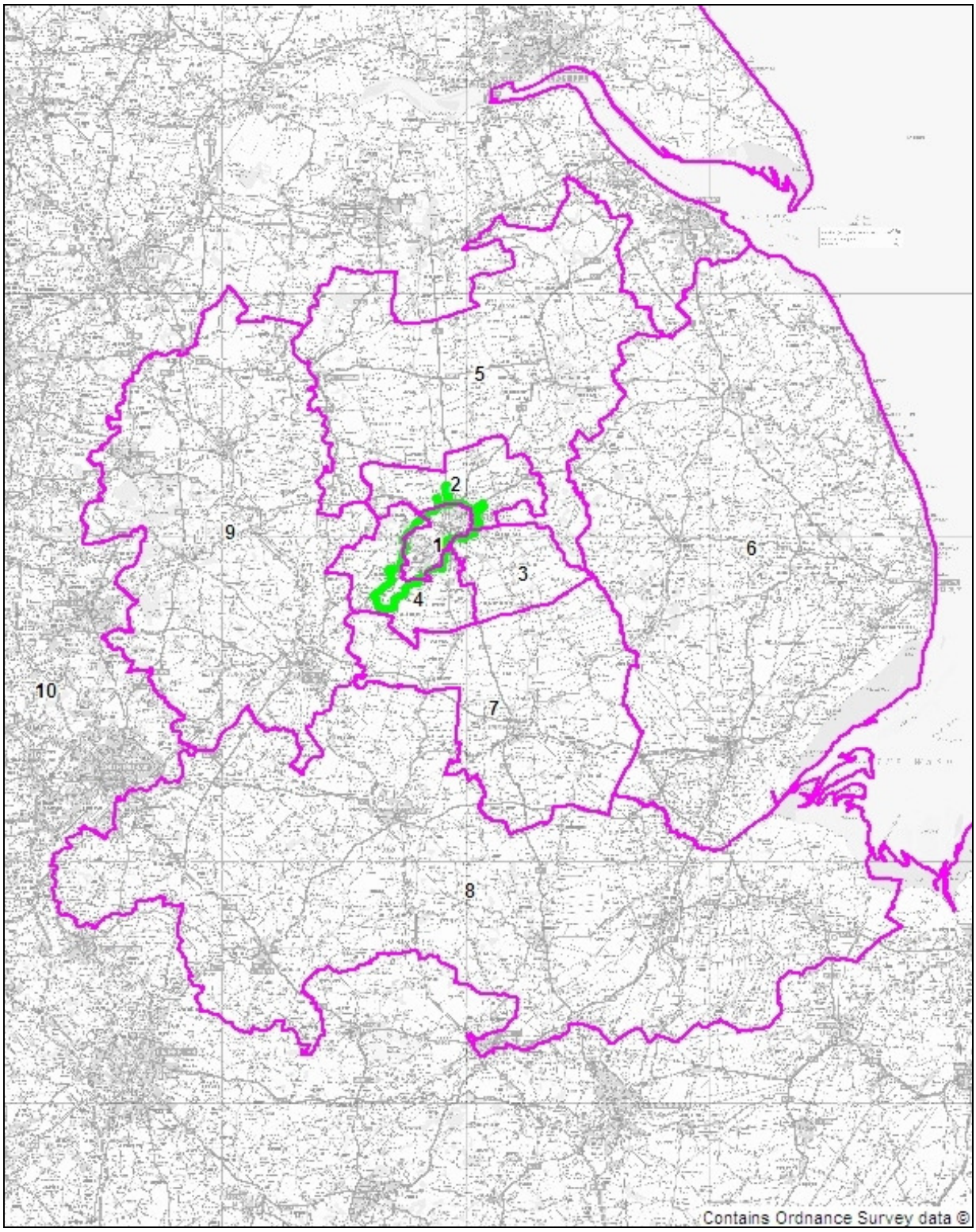


Table 6-3 – Effects of Matrix Estimation on Prior Matrix – AM Peak (updated)

Origin Sector	Matrix	Destination Sector										
		1	2	3	4	5	6	7	8	9	10	Total
	Prior	9,580	524	332	2,256	461	265	198	152	591	613	14,972
	Post	9,378	648	301	2,263	317	254	148	122	498	490	14,418
1	***%Diff***	-2%	24%	-9%	0%	-31%	-4%	-25%	-20%	-16%	-20%	-4%
	Prior	1,506	1,491	41	187	405	99	41	41	122	586	4,518
	Post	1,580	1,503	22	194	414	96	32	23	118	550	4,531
2	***%Diff***	5%	1%	-47%	4%	2%	-3%	-22%	-43%	-3%	-6%	0%
	Prior	776	21	1,002	254	29	83	262	53	99	147	2,726
	Post	797	22	1,004	433	17	83	262	54	63	110	2,843
3	***%Diff***	3%	3%	0%	70%	-41%	0%	0%	0%	-36%	-26%	4%
	Prior	2,736	135	138	2,596	171	81	365	182	256	236	6,895
	Post	2,639	146	152	2,728	135	91	385	192	225	181	6,874
4	***%Diff***	-4%	9%	10%	5%	-21%	13%	5%	6%	-12%	-23%	0%
	Prior	1,049	476	31	175	472	26	2	6	2	96	2,334
	Post	893	483	17	141	472	26	1	4	1	94	2,133
5	***%Diff***	-15%	1%	-44%	-20%	0%	-3%	-31%	-33%	-9%	-1%	-9%
	Prior	405	101	37	101	26	2,256	32	104	3	181	3,246
	Post	382	101	37	106	26	2,256	32	104	3	181	3,228
6	***%Diff***	-6%	1%	0%	5%	-1%	0%	0%	0%	0%	0%	-1%
	Prior	358	31	134	361	3	48	450	68	21	18	1,492
	Post	329	46	135	386	1	48	450	68	20	17	1,501
7	***%Diff***	-8%	50%	0%	7%	-44%	0%	0%	0%	-6%	-4%	1%
	Prior	304	39	17	208	1	63	45	3,230	61	549	4,519
	Post	292	32	17	252	1	63	45	3,230	61	548	4,542
8	***%Diff***	-4%	-18%	0%	21%	-56%	0%	0%	0%	0%	0%	1%
	Prior	611	83	28	307	1	61	13	77	1,581	283	3,044
	Post	691	76	28	317	1	64	12	77	1,581	283	3,130
9	***%Diff***	13%	-9%	0%	3%	0%	5%	-3%	0%	0%	0%	3%
	Prior	567	143	7	197	242	361	59	1,478	931	9,940	13,925
	Post	588	104	7	200	237	358	57	1,472	931	9,909	13,863
10	***%Diff***	4%	-27%	-8%	1%	-2%	-1%	-3%	0%	0%	0%	0%
Total	Prior	17,890	3,043	1,767	6,643	1,810	3,343	1,466	5,392	3,668	12,649	57,671
	Post	17,570	3,161	1,720	7,019	1,621	3,339	1,423	5,347	3,501	12,363	57,064
	%Diff	-2%	4%	-3%	6%	-10%	0%	-3%	-1%	-5%	-2%	-1%

Notes:

(i) Trips are in vehicles
(ii) Sectors are shown in Figure 6.3, and defined below

- Sector 1 - Interview Cordon (including all Lincoln District and part North Kesteven District)
- Sector 2 – Lincoln Planning Area North (within West Lindsey District)
- Sector 3 – Lincoln Planning Area South East (within North Kesteven District)
- Sector 4 – Lincoln Planning Area South West (within North Kesteven District)
- Sector 5 – West Lindsey District
- Sector 6 – East Lindsey and Boston Districts
- Sector 7 – North Kesteven District
- Sector 8 – Rushcliffe, Melton, South Kesteven and South Holland Districts
- Sector 9 – Bassetlaw and Newark & Sherwood Districts
- Sector 10 – Rest of England, Wales and Scotland

Table 6-4 – Effects of Matrix Estimation on Prior Matrix – Inter Peak (updated)

Origin Sector	Matrix	Destination Sector										
		1	2	3	4	5	6	7	8	9	10	Total
	Prior	5,982	680	408	1,300	402	274	256	140	198	388	10,029
	Post	7,046	826	372	1,596	391	296	201	107	222	393	11,450
1	***%Diff***	18%	22%	-9%	23%	-3%	8%	-22%	-23%	12%	1%	14%
	Prior	541	705	17	106	232	28	33	20	20	188	1,891
	Post	750	714	18	131	228	30	30	21	23	187	2,132
2	***%Diff***	39%	1%	3%	24%	-2%	4%	-9%	6%	14%	-1%	13%
	Prior	322	17	415	103	14	17	90	13	7	117	1,116
	Post	353	12	417	164	7	16	90	13	10	86	1,168
3	***%Diff***	10%	-29%	0%	59%	-49%	-1%	0%	0%	36%	-27%	5%
	Prior	1,099	101	103	1,358	130	54	179	113	148	230	3,516
	Post	1,425	123	130	1,613	113	63	187	145	171	255	4,225
4	***%Diff***	30%	22%	26%	19%	-13%	16%	4%	28%	15%	11%	20%
	Prior	317	204	15	81	1,155	33	7	17	8	182	2,019
	Post	373	201	9	67	1,155	31	4	14	6	174	2,035
5	***%Diff***	18%	-1%	-35%	-17%	0%	-5%	-39%	-20%	-31%	-4%	1%
	Prior	211	23	17	60	32	5,164	48	129	15	330	6,029
	Post	268	23	17	74	30	5,164	48	129	19	327	6,099
6	***%Diff***	27%	-3%	0%	24%	-4%	0%	0%	0%	24%	-1%	1%
	Prior	193	31	90	139	7	49	1,109	77	60	48	1,803
	Post	231	23	90	152	4	49	1,108	77	59	45	1,837
7	***%Diff***	20%	-27%	0%	9%	-48%	0%	0%	0%	-2%	-6%	2%
	Prior	99	20	14	86	6	127	71	7,782	99	1,342	9,645
	Post	108	18	14	106	3	127	71	7,782	99	1,336	9,664
8	***%Diff***	9%	-7%	1%	23%	-57%	0%	0%	0%	0%	0%	0%
	Prior	144	19	6	194	8	14	40	105	4,316	761	5,605
	Post	188	22	8	239	6	15	40	105	4,316	760	5,699
9	***%Diff***	30%	19%	35%	24%	-28%	11%	1%	0%	0%	0%	2%
	Prior	300	181	114	227	157	295	48	1,278	741	3,592	6,933
	Post	369	207	94	270	154	292	46	1,273	741	3,573	7,018
10	***%Diff***	23%	14%	-17%	19%	-3%	-1%	-4%	0%	0%	-1%	1%
Total	Prior	9,206	1,981	1,200	3,654	2,144	6,055	1,882	9,674	5,614	7,177	48,585
	Post	11,110	2,170	1,169	4,412	2,091	6,084	1,826	9,665	5,664	7,137	51,327
	%Diff	21%	10%	-3%	21%	-2%	0%	-3%	0%	1%	-1%	6%

Notes: ***(i) Trips are in vehicles***

(ii) Sectors are shown in Figure 6.4, and defined below

- Sector 1 - Interview Cordon (including all Lincoln District and part North Kesteven District)
- Sector 2 – Lincoln Planning Area North (within West Lindsey District)
- Sector 3 – Lincoln Planning Area South East (within North Kesteven District)
- Sector 4 – Lincoln Planning Area South West (within North Kesteven District)
- Sector 5 – West Lindsey District
- Sector 6 – East Lindsey and Boston Districts
- Sector 7 – North Kesteven District
- Sector 8 – Rushcliffe, Melton, South Kesteven and South Holland Districts
- Sector 9 – Bassetlaw and Newark & Sherwood Districts
- Sector 10 – Rest of England, Wales and Scotland

Table 6-5 – Effects of Matrix Estimation on Prior Matrix – PM Peak (updated)

Origin Sector	Matrix	Destination Sector										
		1	2	3	4	5	6	7	8	9	10	Total
	Prior	7,215	1,416	670	2,360	872	368	409	261	490	502	14,562
	Post	6,117	1,440	624	2,128	630	298	350	167	524	434	12,712
1	***%Diff***	-15%	2%	-7%	-10%	-28%	-19%	-14%	-36%	7%	-14%	-13%
	Prior	587	873	51	151	263	71	47	48	51	233	2,374
	Post	446	866	59	145	256	64	20	25	53	205	2,139
2	***%Diff***	-24%	-1%	17%	-4%	-3%	-9%	-57%	-47%	4%	-12%	-10%
	Prior	425	60	546	142	35	27	104	16	25	6	1,385
	Post	342	23	547	220	11	25	100	12	23	0	1,303
3	***%Diff***	-20%	-61%	0%	55%	-69%	-7%	-4%	-20%	-7%	-100%	-6%
	Prior	1,821	238	219	1,907	238	80	359	176	211	183	5,432
	Post	1,622	187	278	1,921	159	82	314	186	203	123	5,074
4	***%Diff***	-11%	-21%	27%	1%	-33%	2%	-13%	6%	-4%	-33%	-7%
	Prior	507	282	33	109	454	22	3	7	1	258	1,677
	Post	378	256	24	76	447	21	1	5	1	217	1,424
5	***%Diff***	-25%	-9%	-28%	-31%	-2%	-7%	-68%	-37%	-21%	-16%	-15%
	Prior	287	58	53	89	20	2,165	42	63	73	432	3,282
	Post	290	54	52	107	19	2,113	41	56	59	314	3,104
6	***%Diff***	1%	-7%	-3%	20%	-7%	-2%	-2%	-11%	-20%	-27%	-5%
	Prior	289	72	191	213	1	31	427	39	18	67	1,348
	Post	235	41	187	198	1	29	424	37	16	43	1,211
7	***%Diff***	-19%	-43%	-2%	-7%	-38%	-4%	-1%	-5%	-10%	-36%	-10%
	Prior	158	44	38	186	4	90	58	3,258	69	1,840	5,746
	Post	108	32	35	170	2	83	55	3,141	63	1,407	5,096
8	***%Diff***	-31%	-26%	-9%	-9%	-59%	-8%	-4%	-4%	-9%	-24%	-11%
	Prior	575	116	68	198	2	4	21	62	1,965	1,152	4,162
	Post	549	83	65	178	2	2	20	55	1,926	875	3,755
9	***%Diff***	-5%	-28%	-4%	-10%	-20%	-50%	-6%	-10%	-2%	-24%	-10%
	Prior	606	699	268	303	97	177	20	626	329	11,918	15,043
	Post	512	603	219	187	86	148	14	516	261	9,920	12,464
10	***%Diff***	-16%	-14%	-18%	-38%	-12%	-16%	-32%	-17%	-21%	-17%	-17%
Total	Prior	12,472	3,859	2,136	5,657	1,988	3,034	1,488	4,555	3,232	16,590	55,012
	Post	10,598	3,585	2,089	5,329	1,611	2,864	1,338	4,201	3,129	13,538	48,282
	%Diff	-15%	-7%	-2%	-6%	-19%	-6%	-10%	-8%	-3%	-18%	-12%

Notes: ***(i) Trips are in vehicles***

(ii) Sectors are shown in Figure 6.5, and defined below

- Sector 1 - Interview Cordon (including all Lincoln District and part North Kesteven District)
- Sector 2 – Lincoln Planning Area North (within West Lindsey District)
- Sector 3 – Lincoln Planning Area South East (within North Kesteven District)
- Sector 4 – Lincoln Planning Area South West (within North Kesteven District)
- Sector 5 – West Lindsey District
- Sector 6 – East Lindsey and Boston Districts
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- Sector 9 – Bassetlaw and Newark & Sherwood Districts
- Sector 10 – Rest of England, Wales and Scotland

Table 6-6 – Aggregated Sector movements changes AM Peak

Origin Sector	Matrix	Destination Sectors			
		1	2 to 4	5 to 10	Total
1	Prior	9,580	3,112	2,281	14,972
	Post	9,378	3,212	1,829	14,418
	%Diff	**-2%**	**3%**	**-20%**	**-4%**
2 to 4	Prior	5,017	5,864	3,258	14,140
	Post	5,016	6,202	3,030	14,249
	%Diff	***0%***	***6%***	***-7%***	***1%***
5 to 10	Prior	3,293	2,477	22,790	28,559
	Post	3,176	2,485	22,736	28,397
	%Diff	**-4%**	**0%**	**0%**	**-1%**
Total	Prior	17,890	11,453	28,328	57,671
	Post	17,570	11,899	27,595	57,064
	%Diff	***-2%***	***4%***	***-3%***	***-1%***

Table 6-7 – Aggregated Sector movements changes inter peak

Origin Sector	Matrix	Destination Sectors			
		1	2 to 4	5 to 10	Total
1	Prior	5,982	2,388	1,658	10,029
	Post	7,046	2,795	1,610	11,450
	%Diff	***18%***	***17%***	***-3%***	***14%***
2 to 4	Prior	1,961	2,926	1,635	6,523
	Post	2,528	3,320	1,676	7,525
	%Diff	***29%***	***13%***	***2%***	***15%***
5 to 10	Prior	1,263	1,520	29,251	32,034
	Post	1,536	1,636	29,181	32,353
	%Diff	***22%***	***8%***	***0%***	***1%***
Total	Prior	9,206	6,834	32,545	48,585
	Post	11,110	7,751	32,467	51,327
	%Diff	***21%***	***13%***	***0%***	***6%***

Table 6-8 – Aggregated Sector movements changes PM Peak

Origin Sector	Matrix	Destination Sectors			
		1	2 to 4	5 to 10	Total
1	Prior	7,215	4,445	2,901	14,562
	Post	6,117	4,192	2,403	12,712
	%Diff	***-15%***	***-6%***	***-17%***	***-13%***
2 to 4	Prior	2,833	4,186	2,172	9,191
	Post	2,410	4,247	1,860	8,516
	%Diff	***-15%***	***1%***	***-14%***	***-7%***
5 to 10	Prior	2,423	3,021	25,815	31,259
	Post	2,071	2,565	22,418	27,054
	%Diff	***-15%***	***-15%***	***-13%***	***-13%***
Total	Prior	12,472	11,652	30,888	55,012
	Post	10,598	11,003	26,681	48,282
	%Diff	***-15%***	***-6%***	***-14%***	***-12%***

6.8 Effects of Matrix Estimation on Trip Ends

Comparisons of prior and post matrix estimation matrices in terms of origin and destination trip ends totals are presented in Figure 6-3 to Figure 6-14. It can be seen that, in most cases, differences in trip-end totals between prior and post matrices are small.

Figure 6-3 – Effects of ME on Origin Trip Ends - AM Peak (Zones In Sector 1)

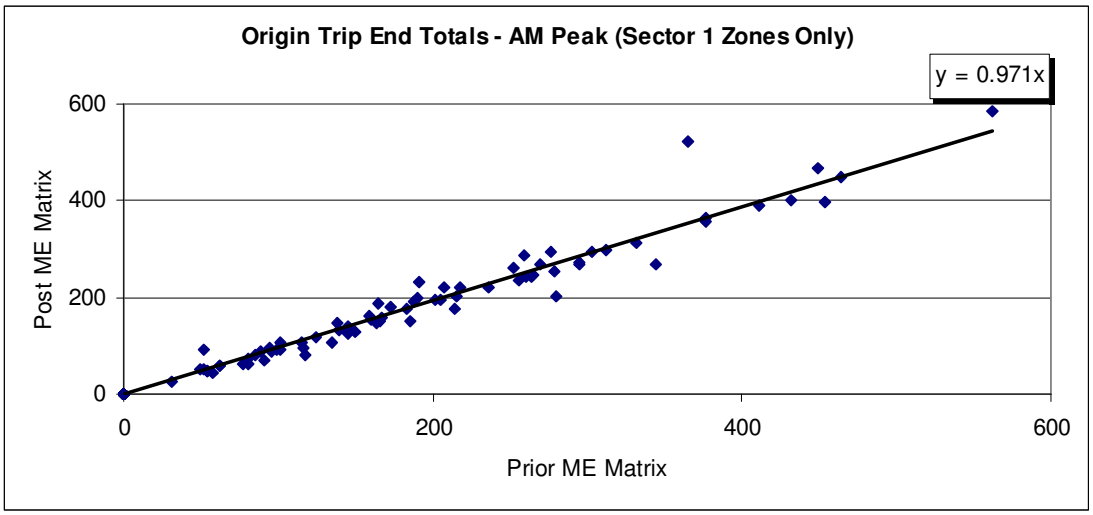


Figure 6-4 – Effects of ME on Dest. Trip Ends - AM Peak (Zones In Sector 1)

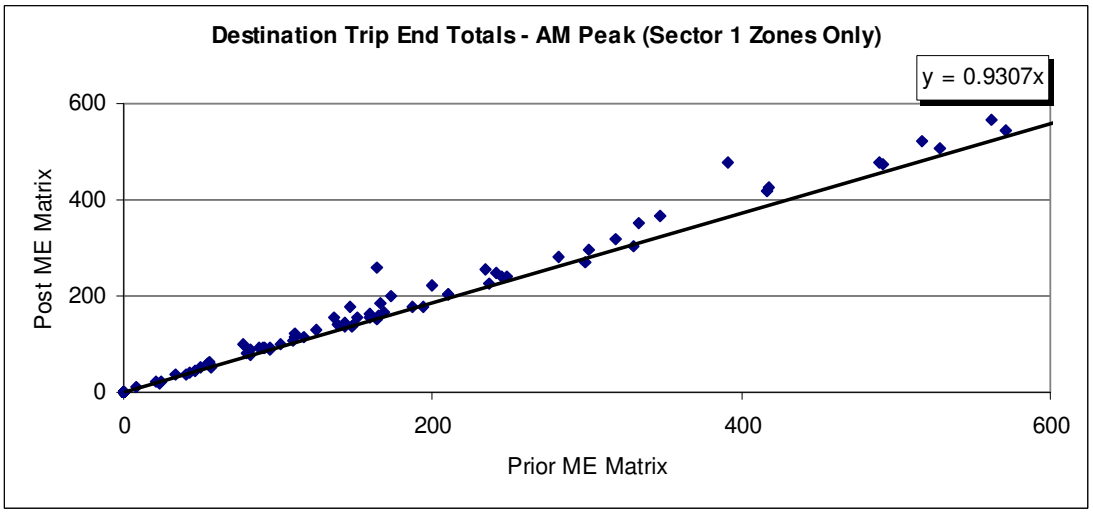


Figure 6-5 – Effects of ME on Origin Trip Ends - AM Peak (Zones In Sectors 2 to 10)

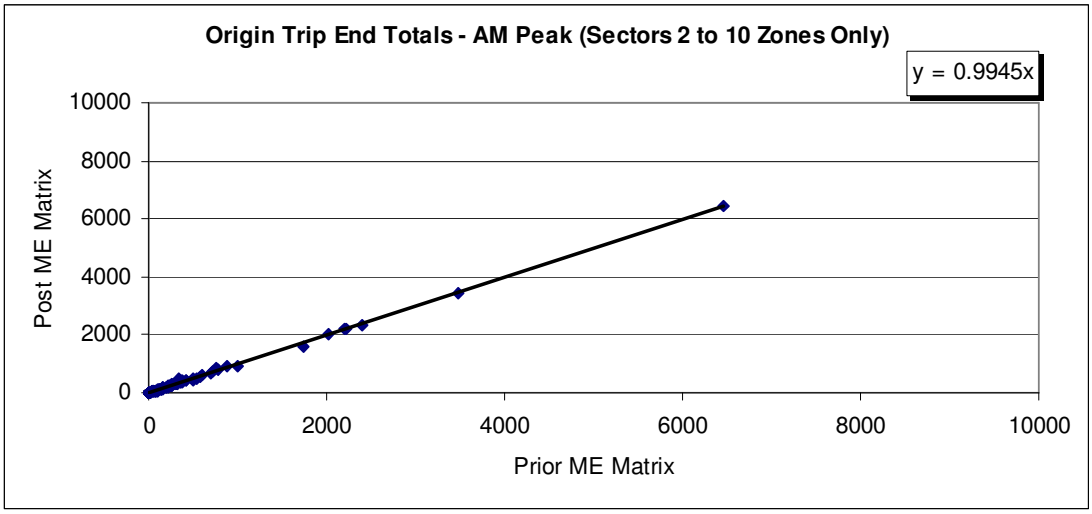


Figure 6-6 – Effects of ME on Destination Trip Ends - AM Peak (Zones In Sectors 2 to 10)

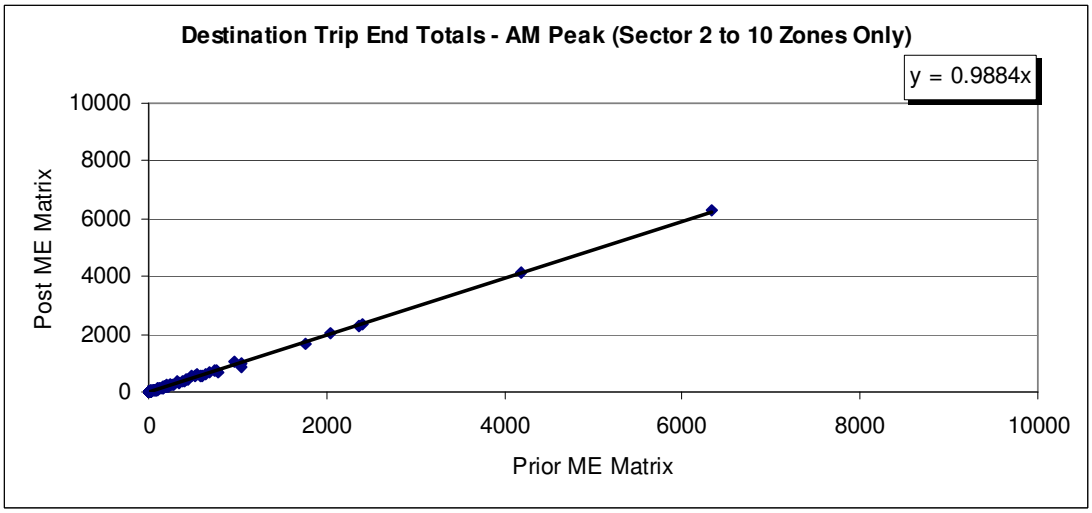


Figure 6-7 – Effects of ME on Origin Trip Ends - Interpeak (Zones In Sector 1)

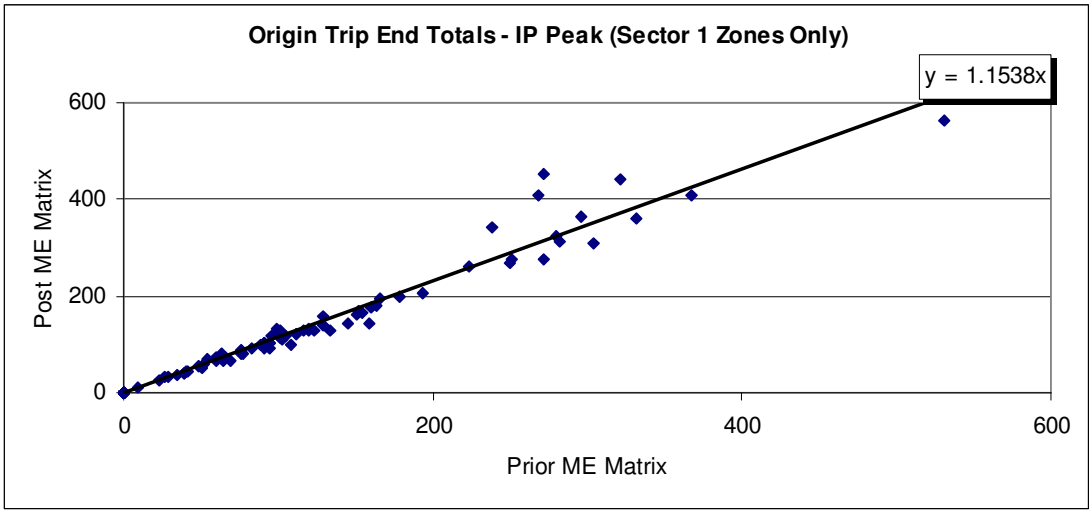


Figure 6-8 – Effects of ME on Destination Trip Ends - Interpeak (Zones In Sector 1)

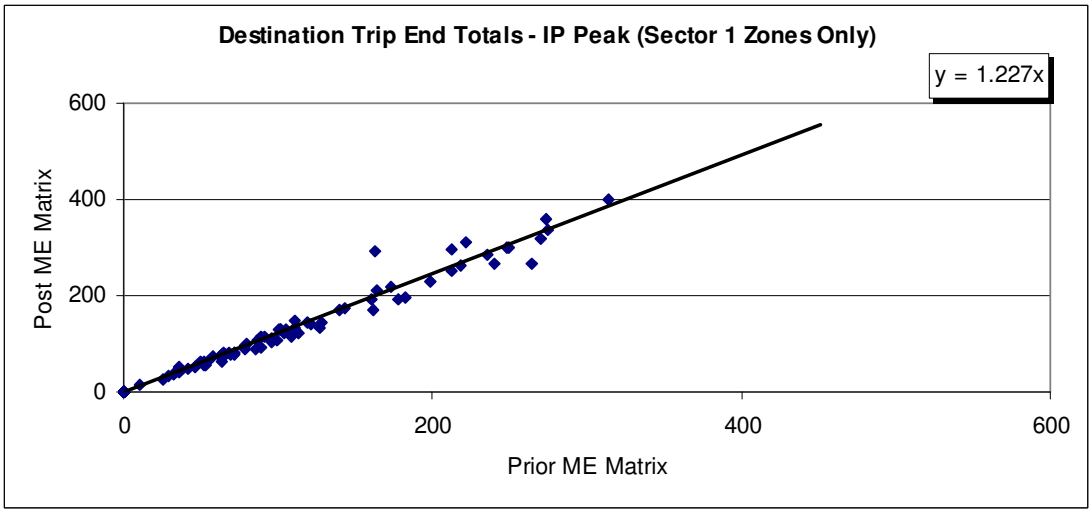


Figure 6-9 – Effects of ME on Origin Trip Ends - Interpeak (Zones In Sectors 2 to 10)

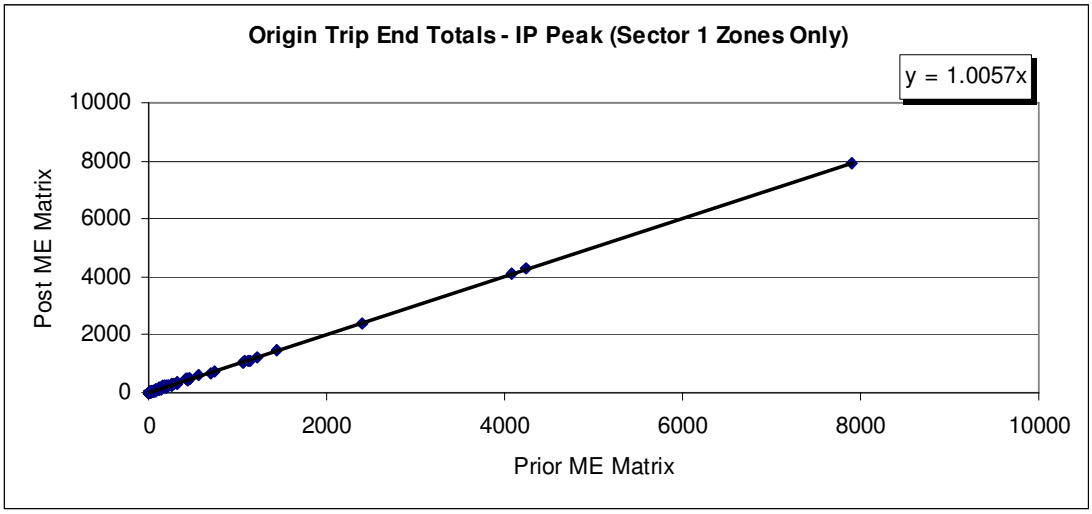


Figure 6-10 – Effects of ME on Destination Trip Ends - Interpeak (Zones In Sectors 2 to 10)

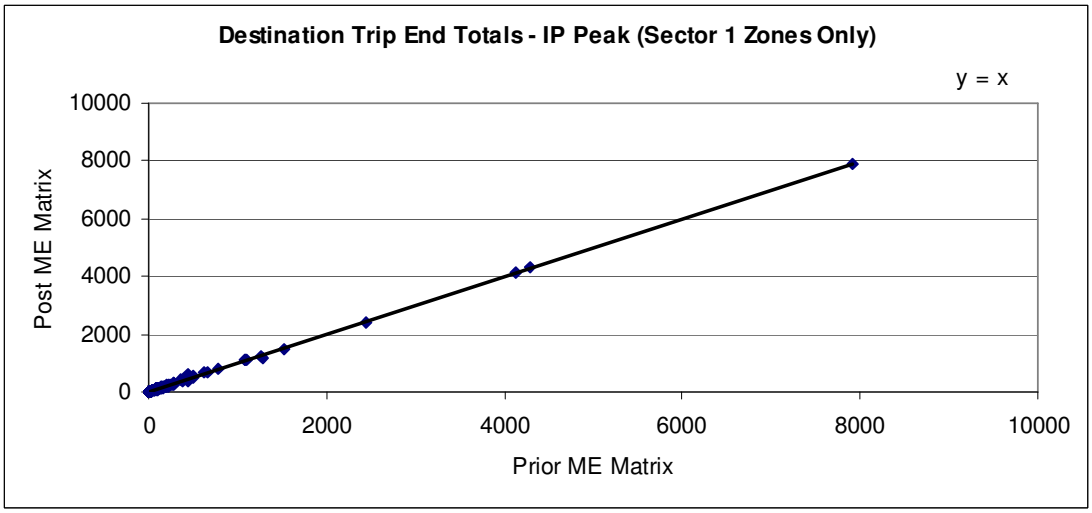


Figure 6-11 – Effects of ME on Origin Trip Ends - PM (Zones In Sector 1)

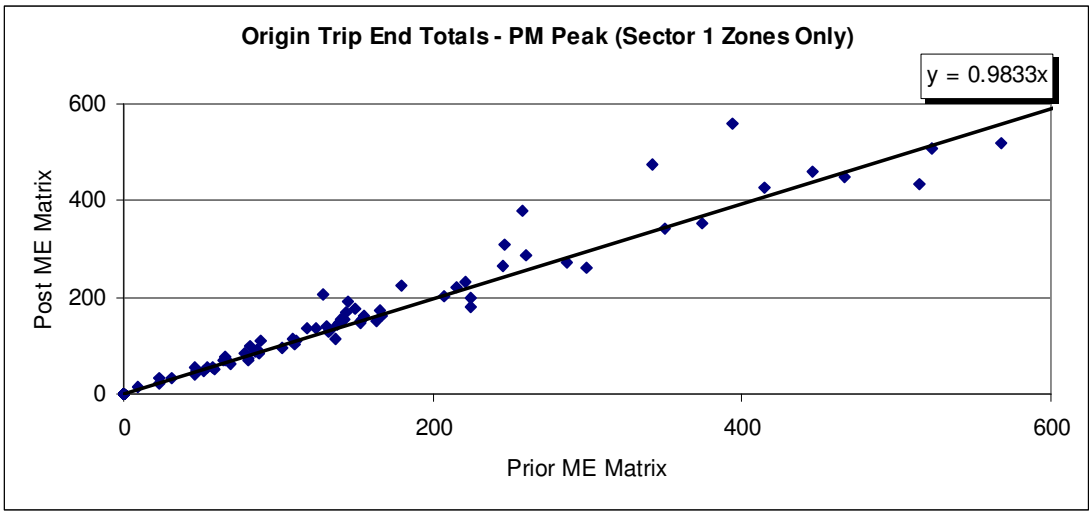


Figure 6-12 – Effects of ME on Destination Trip Ends - PM (Zones In Sector 1)

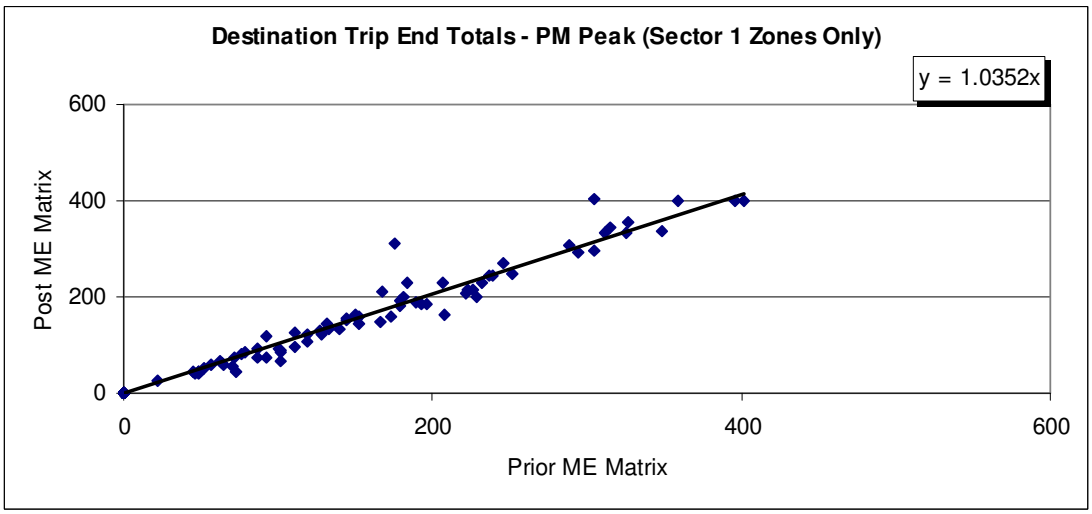


Figure 6-13 – Effects of ME on Origin Trip Ends - PM (Zones In Sectors 2 to 10)

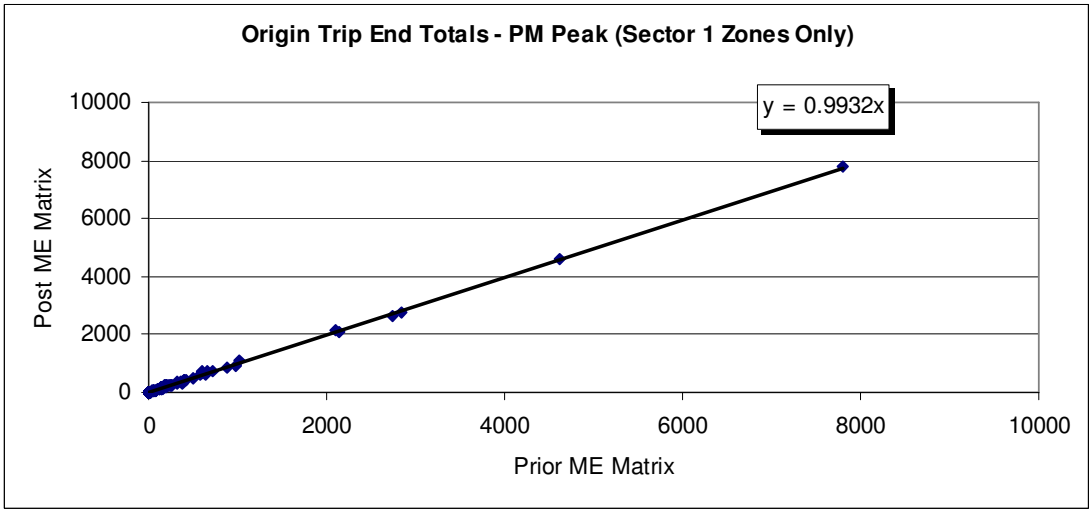
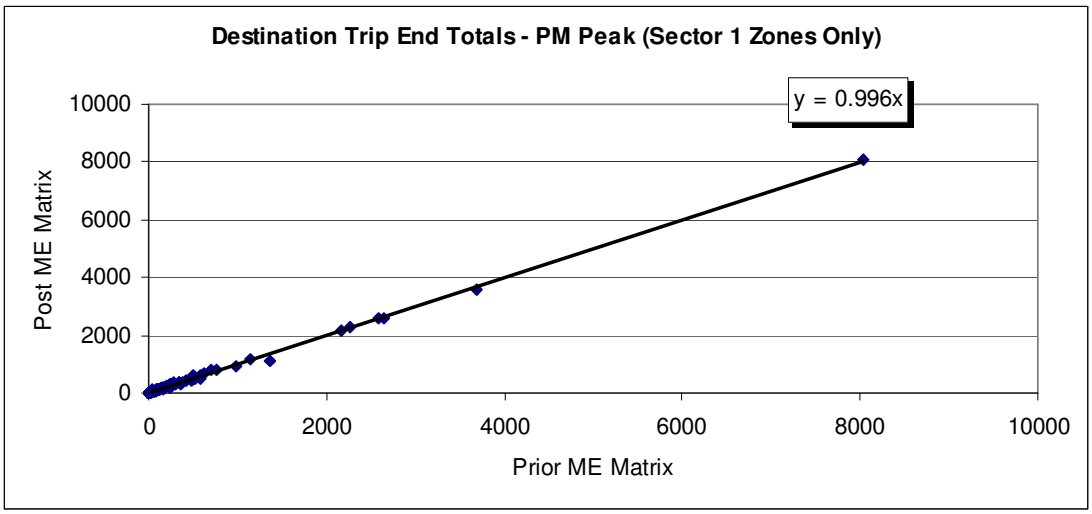


Figure 6-14 – Effects of ME on Destination Trip Ends - PM (Zones In Sectors 2 to 10)



6.9 Trip Length Distribution

Comparisons of the prior and post matrix trip length distributions have been undertaken for the AM, PM and Inter Peak models.

Figures 6-15 to 6-17 present the trip length distributions for the prior and post matrix estimation trip matrices as altered by the matrix estimation process. It can be seen that matrix estimation has the biggest effect on short distance trips, whilst longer distance trips remained relatively unchanged.

Figure 6-15 – Trip Length Distribution – AM Peak

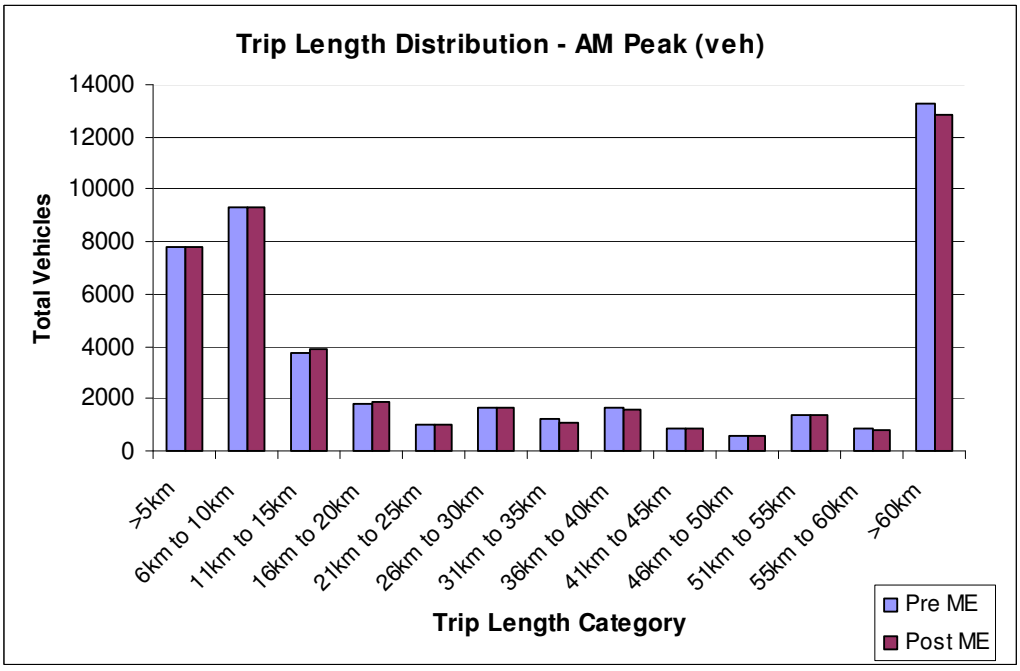


Figure 6-16 – Trip Length Distribution – Inter Peak

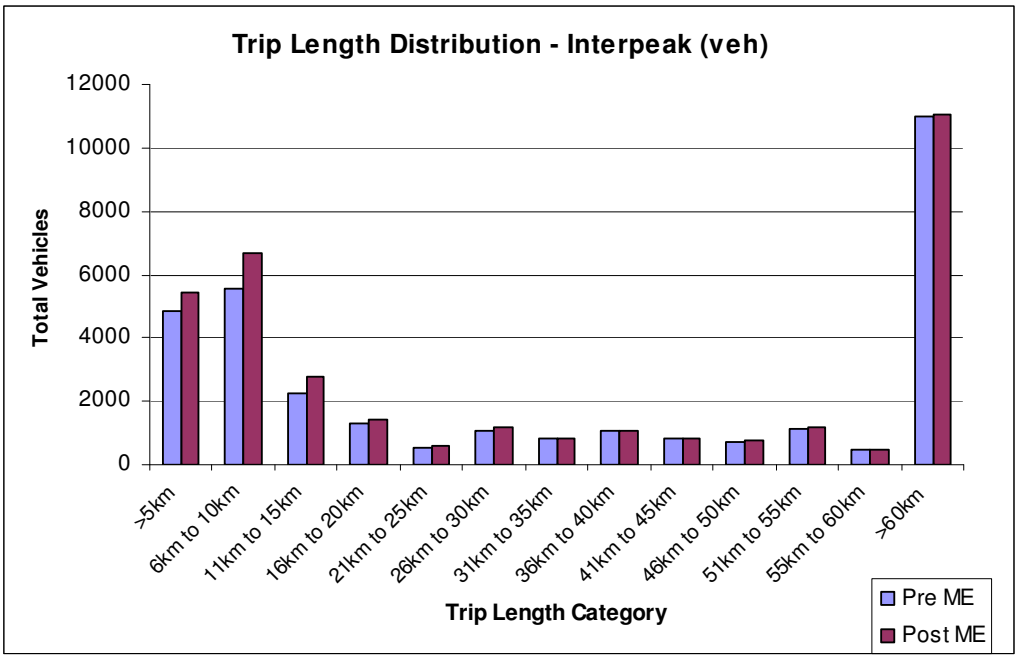
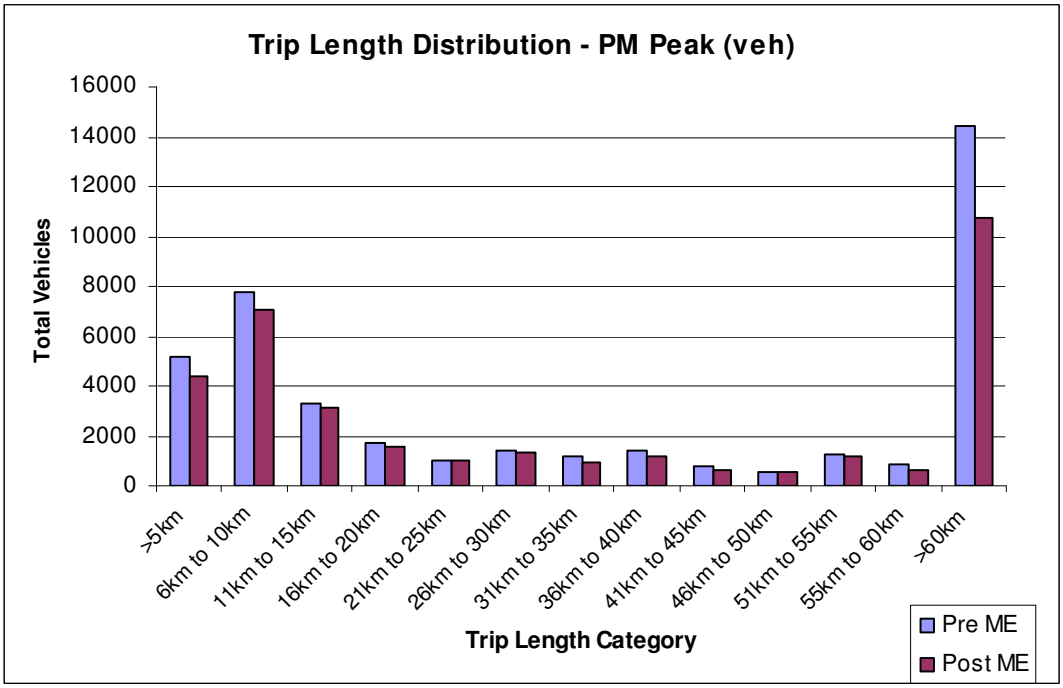


Figure 6-17 – Trip Length Distribution – PM Peak



6.10 Model Convergence

Convergence is the measure used to determine model stability during the assignment process (see Section 5.2). A suitably converged model can be expected to produce consistent outputs with minimal model noise. A total of 50 iterations were run to gain a statistically significant sample of convergence data.

The following convergence criteria are recommended in TAG Unit 3.19:

- Duality Gap less than 1% - this expresses the difference between the current estimates of the costs associated with trips through the modelled network against the theoretical costs if all traffic were to use the minimum cost route associated with their journey. It measures how far modelled flows differ from the desired equilibrium.
- Average absolute difference less than 1 – this is the number of routes that deviate from each other based on the impedances of the assignment.
- Relative average absolute difference less than 5% - this is the percentage of routes that deviate from each other based on the impedances of the assignment.

Figure 6-18 to Figure 6-20 below show the graphs of Duality Gap against the number of iterations in each time-period. Where no join between points can be observed, it indicates that the duality gap fell to a figure close enough to 0 to be rounded down to 0, and therefore does not register on a logarithmic chart.

Figure 6-18 – Model Convergence – AM Peak

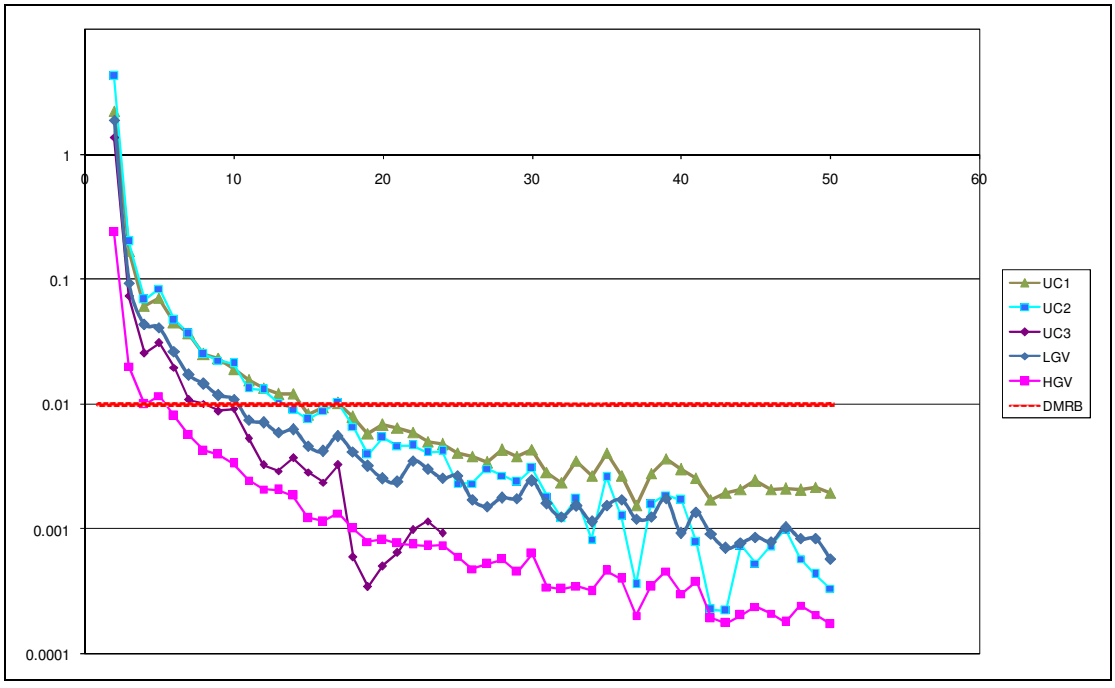


Figure 6-19 – Model Convergence – Inter Peak

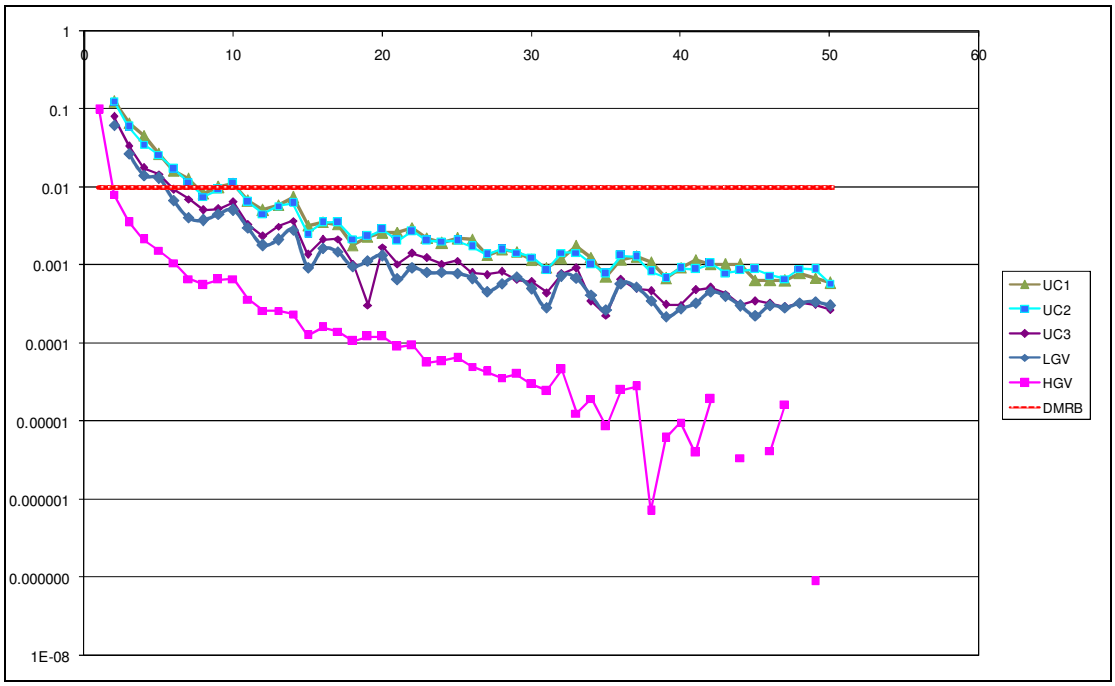
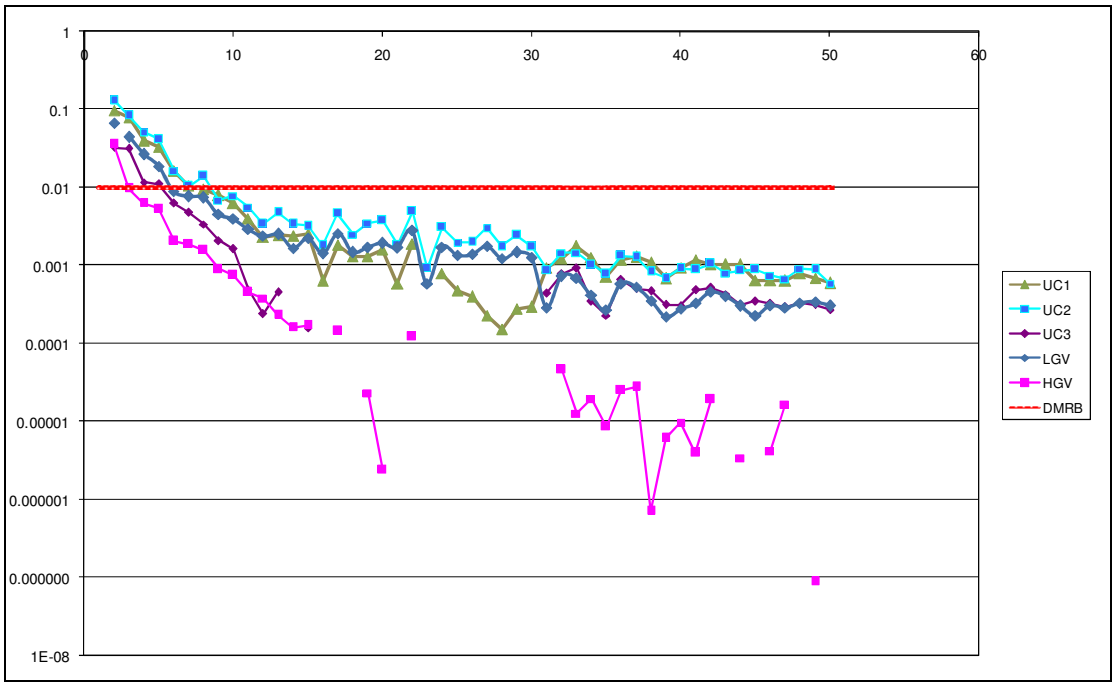


Figure 6-20 – Model Convergence – PM Peak



It can be seen from the figures above that all three models for each time period reached convergence within 50 assignment iterations. Along with satisfactory results from modelled link flow against observed counts, a high degree of confidence was established with the calibrated models.

Where no join between points can be observed, it indicates that the duality gap fell to a figure close enough to 0 to be rounded down to 0, and therefore does not register on a logarithmic chart.

6.11 Calibration Results

The calibration at the postcard sites are summarized in Tables 6-6, 6-7 and 6-8 below. These results indicate a fair correlation between observed and modelled flows with many postcard screenlines meeting DfT (validation) criteria in respect of percentage flow differences.

Table 6-9 - Calibration at Postcard sites AM Peak

Site Number	Road section	Observed counts (pcu)	Modelled counts (pcu)	Abs Diff	% Diff	GEH	Validated (Flow)	Validated (GEH)
Inbound Movements								
01	B1398 Middle St	642	580	62	-64%	2.5	✓	✓
02	A15 North of Lincs	774	797	23	3%	0.8	✓	✓
03	A57 West of Linc	1042	1019	22	-2%	0.7	✓	✓
04	A46 North of Lincs	652	809	157	24%	5.8	×	×
05	B1190 Lincoln Rd	329	434	105	32%	5.4	×	×
06	A46 SW of Lincs	1322	1171	151	-11%	4.3	✓	✓
07	B1308 Greetwell Rd	563	437	126	-22%	5.6	×	×
08	B1190 Washingb. Rd	443	504	61	14%	2.8	✓	✓
09	B1188 Canwick Rd	1122	1157	36	3%	1.1	✓	✓
10	A15 Cross O Cliff	458	409	49	-11%	2.4	✓	✓
11	Brant Rd	418	511	93	22%	4.3	✓	✓
11a	Station Rd	329	285	44	-13%	2.5	✓	✓
12	A158 Ragby Rd East	612	789	177	29%	6.7	×	×
	Total	**8,705**	**8,902**	**197**	**2%**	**2.1**	2.5	✓
						Total Passed Guidance	**69%**	**69%**
Outbound Movements								
01	B1398 Middle St	166	98	69	-41%	6.0	✓	×
02	A15 North of Lincs	447	447	0	0%	0.0	✓	✓
03	A57 West of Linc	661	450	211	-32%	8.9	×	×
04	A46 North of Lincs	346	356	10	3%	0.5	✓	✓
05	B1190 Lincoln Rd	230	185	45	-20%	3.1	✓	✓
06	A46 SW of Lincs	1267	1021	246	-19%	7.3	×	×
07	B1308 Greetwell Rd	123	112	11	-9%	1.0	✓	✓
08	B1190 Washingb. Rd	124	119	5	-4%	0.4	✓	✓
09	B1188 Canwick Rd	577	640	63	11%	2.6	✓	✓
10	A15 Cross O Cliff	314	352	37	12%	2.0	✓	✓
11	Brant Rd	271	348	77	28%	4.3	✓	✓
11a	Station Rd	376	408	32	8%	1.6	✓	✓
12	A158 Ragby Rd East	481	475	6	-1%	0.3	✓	✓
	Total	**5,384**	**5,010**	**374**	**-7%**	**5.2**	✓	✓
						Total Passed Guidance	**85%**	**77%**

Table 6-10 - Calibration at Postcard sites Interpeak

Site Number	Road section	Observed counts (pcu)	Modelled counts (pcu)	Abs Diff	% Diff	GEH	Validated (Flow)	Validated (GEH)
Inbound Movements								
01	B1398 Middle St	196	130	66	-0.34	5.2	✓	×
02	A15 North of Lincs	413	534	121	0.29	5.6	×	×
03	A57 West of Linc	578	582	4	0.01	0.2	✓	✓
04	A46 North of Lincs	513	545	32	6%	1.4	✓	✓
05	B1190 Lincoln Rd	202	219	17	8%	1.2	✓	✓
06*	A46 SW of Lincs	822	822	0	0%	0.0	✓	✓
07	B1308 Greetwell Rd	199	169	30	-15%	2.2	✓	✓
08*	B1190 Washingb. Rd	223	223	0	0%	0.0	✓	✓
09	B1188 Canwick Rd	641	678	38	6%	1.5	✓	✓
10	A15 Cross O Cliff	455	415	41	-9%	1.9	✓	✓
11	Brant Rd	322	320	2	-1%	0.1	✓	✓
11a	Station Rd	217	209	8	-4%	0.6	✓	✓
12	A158 Ragby Rd East	540	577	37	7%	1.5	✓	✓
	Total	5,322	5,423	100	0.02	1.4	✓	✓
						Total Passed Guidance	**92%**	**85%**
Outbound Movements								
01	B1398 Middle St	190	164	26	-14%	2.0	✓	✓
02	A15 North of Lincs	434	537	103	24%	4.7	×	✓
03	A57 West of Linc	553	452	101	-18%	4.5	×	✓
04	A46 North of Lincs	526	567	42	8%	1.8	✓	✓
05	B1190 Lincoln Rd	221	235	14	6%	0.9	✓	✓
06	A46 SW of Lincs	894	864	30	-3%	1.0	✓	✓
07	B1308 Greetwell Rd	211	169	42	-20%	3.1	✓	✓
08*	B1190 Washingb. Rd	163	163	0	0%	0.0	✓	✓
09	B1188 Canwick Rd	758	767	9	1%	0.3	✓	✓
10	A15 Cross O Cliff	426	461	35	8%	1.7	✓	✓
11	Brant Rd	319	408	88	28%	4.6	✓	✓
11a	Station Rd	225	241	15	7%	1.0	✓	✓
12	A158 Ragby Rd East	558	615	57	10%	2.3	✓	✓
	Total	5,478	5,643	164	0.03	2.2	✓	✓
						Total Passed Guidance	**88%**	**92%**

Note - * Denotes that count data was unavailable at these sites and so the observed count is set to equal the modelled count.

Table 6-11 - Calibration at Postcard sites PM peak

Site Number	Road section	Observed counts (pcu)	Modelled counts (pcu)	Abs Diff	% Diff	GEH	Validated (Flow)	Validated (GEH)
Inbound Movements								
01	B1398 Middle St	293	228	65	-0.22	4.0	✓	✓
02	A15 North of Lincs	533	620	87	0.16	3.6	✓	✓
03	A57 West of Linc	597	644	46	0.08	1.9	✓	✓
04	A46 North of Lincs	590	685	95	0.16	3.8	✓	✓
05	B1190 Lincoln Rd	277	379	102	0.37	5.6	×	×
06*	A46 SW of Lincs	1261	1261	0	0.00	0.0	✓	✓
07	B1308 Greetwell Rd	127	97	30	-0.24	2.8	✓	✓
08*	B1190 Washingb. Rd	272	272	0	0.00	0.0	✓	✓
09	B1188 Canwick Rd	614	632	17	0.03	0.7	✓	✓
10	A15 Cross O Cliff	473	491	18	0.04	0.8	✓	✓
11	Brant Rd	424	351	74	-0.17	3.7	✓	✓
11a	Station Rd	402	327	75	-0.19	3.9	✓	✓
12	A158 Ragby Rd East	542	575	33	0.06	1.4	✓	✓
	Total	6,407	6,562	155	2%	1.9	✓	✓
						Total Passed Guidance	**92%**	**92%**
Outbound Movements								
01	B1398 Middle St	608	566	42	-0.07	1.7	✓	✓
02	A15 North of Lincs	688	660	28	-0.04	1.1	✓	✓
03	A57 West of Linc	1025	750	275	-0.27	9.2	×	×
04	A46 North of Lincs	749	541	208	-0.28	8.2	×	×
05	B1190 Lincoln Rd	292	230	62	-0.21	3.8	✓	✓
06	A46 SW of Lincs	1165	945	220	-0.19	6.8	×	×
07	B1308 Greetwell Rd	506	372	134	-0.27	6.4	×	×
08*	B1190 Washingb. Rd	295	295	0	0.00	0.0	✓	✓
09	B1188 Canwick Rd	1354	1080	274	-0.20	7.9	×	×
10	A15 Cross O Cliff	740	828	89	0.12	3.2	✓	✓
11	Brant Rd	538	649	111	0.21	4.6	×	✓
11a	Station Rd	236	259	23	0.10	1.5	✓	✓
12	A158 Ragby Rd East	776	683	93	-0.12	3.4	✓	✓
	Total	8,971	7,858	111	-12%	12.	×	×
						Total Passed Guidance	**73%**	**77%**

Note - * Denotes that count data was unavailable at these sites and so the observed count is set to equal the modelled count.

7 Model Validation

7.1 Introduction

Model Validation is undertaken to check that a transport model accurately represents the transport network that it has been based upon. The main aims of this process, as stated in TAG Unit 3.19 - Highway Assignment Modelling, are:

- To demonstrate that the model accurately reproduces an existing and independently observed situation
- To summarise the accuracy of the base from which future forecasts are to be prepared.

7.2 Screenline Flow Validation

Seven screenlines (as shown in Figure 7-1) controlling major movements in the study area have been devised from observed data. Due to an overall lack of count data, some counts have been included in more than one screenline. This has resulted in screenlines containing a combination of both calibration and validation counts. Comparisons of modelled and observed flows were undertaken for these screenlines (by direction) as shown below in Tables 7-1 to 7-4.

Note - Guidelines for model calibration/validation stated in TAG Unit 3.19 do not suggest using the GEH criteria along screenline totals, which is a departure from the superseded DMRB (Design Manual for Roads & Bridges) guidance. GEH statistics along screenlines have been included in this report and have been used as an additional check during the model calibration/validation.

Table 7-1 – Screenlines Summary

Pass/Fail	AM		Inter Peak		PM	
	Flow	GEH	Flow	GEH	Flow	GEH
Screenline 1 - NB	✓	✓	✓	✓	✓	×
Screenline 1 - SB	✓	✓	✓	✓	✓	✓
Screenline 2 - EB	✓	×	✓	✓	✓	×
Screenline 2 - WB	✓	×	✓	✓	✓	✓
Screenline 3 - NB	✓	✓	✓	✓	✓	✓
Screenline 3 - SB	✓	✓	✓	✓	✓	✓
Screenline 4 - EB	×	×	✓	✓	✓	✓
Screenline 4 - WB	✓	×	✓	✓	×	×
Screenline 5 - NB	✓	✓	×	×	✓	✓
Screenline 5 - SB	✓	×	×	×	✓	✓
Screenline 6 - EB	✓	✓	✓	×	×	×
Screenline 6 - WB	✓	✓	✓	✓	✓	✓
Screenline 7 - EB	✓	✓	✓	✓	×	×

Pass/Fail	AM		Inter Peak		PM	
	Flow	GEH	Flow	GEH	Flow	GEH
Screenline 7 - WB	✓	✓	✓	✓	×	×
Total Passing Criteria	**13 / 14**	**9 / 14**	**12 / 14**	**11 / 14**	**10 / 14**	**8 / 14**
% Passing Criteria	**93%**	**64%**	**86%**	**79%**	**71%**	**57%**

Figure 7-1 - Calibration & Validation Screenlines

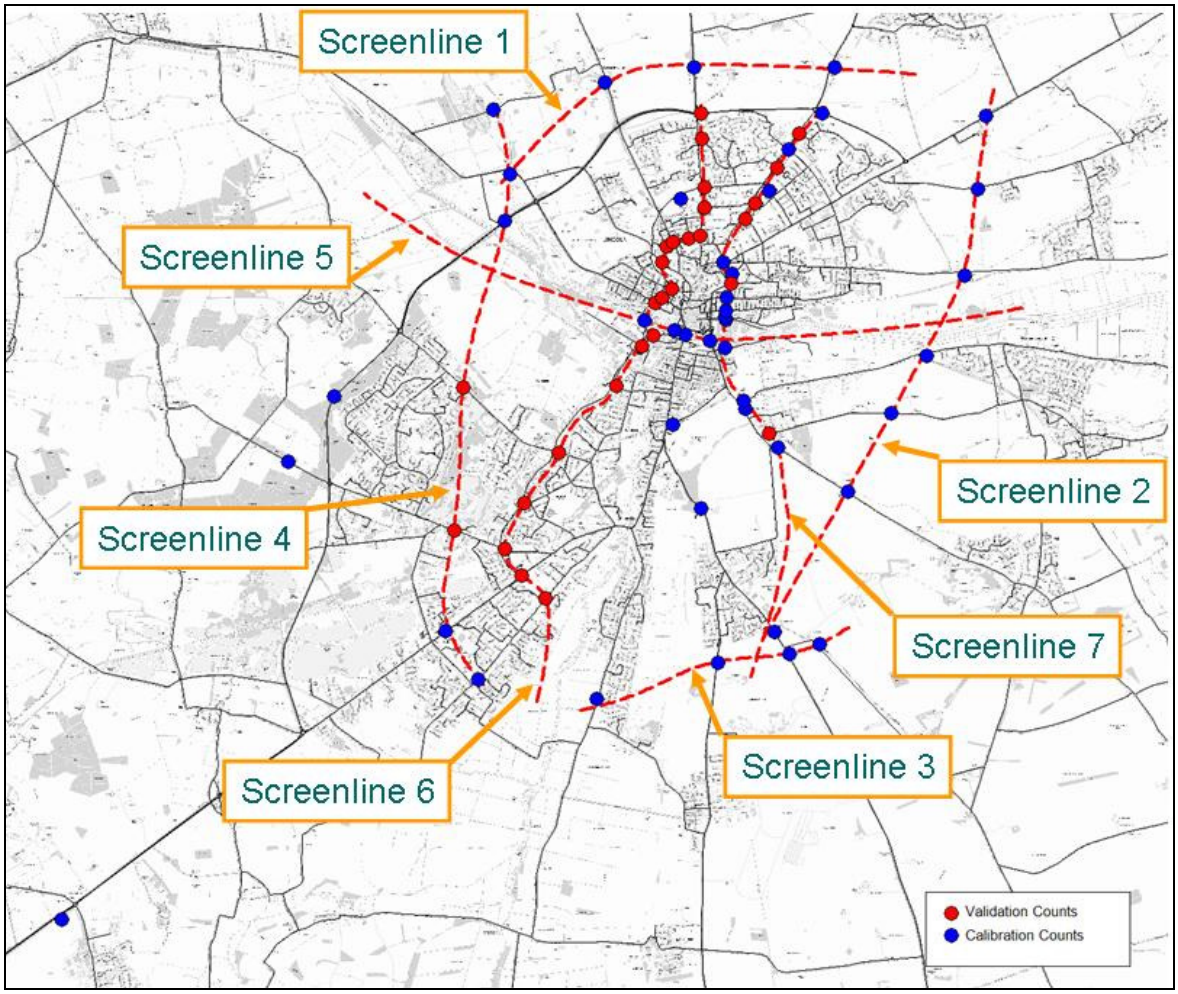


Table 7-2 –Screenline Summary – AM Peak

Screenline	Direction	Observed (pcu)	Modelled (pcu)	Abs Diff (pcu)	% Diff	Average GEH	Pass TAG Flow	Pass DMRB GEH
Screenline1	NB	1,767	1,638	129	-0.07	3.1	✓	✓
	SB	3,356	3,321	35	-0.01	0.6	✓	✓
Screenline2	EB	1,895	1,714	181	-0.10	4.2	✓	×
	WB	3,723	3,451	272	-0.07	4.5	✓	×
Screenline3	NB	1,371	1,362	9	-0.01	0.2	✓	✓
	SB	1,538	1,470	68	-0.04	1.8	✓	✓
Screenline4	EB	4,837	4,098	739	-0.15	11.1	×	×
	WB	3,237	2,869	368	-0.11	6.7	✓	×
Screenline5	NB	5,272	5,522	251	0.05	3.4	✓	✓
	SB	4,212	4,588	376	0.09	5.7	✓	×
Screenline6	EB	7,205	7,257	52	0.01	0.6	✓	✓
	WB	6,053	6,255	202	0.03	2.6	✓	✓
Screenline7	EB	5,555	5,464	91	-0.02	1.2	✓	✓
	WB	6,127	6,329	202	0.03	2.6	✓	✓
Number of Screenlines passing Criteria							**13/14**	**9/14**
Percentage of Screenlines passing Criteria							**93%**	**64%**

Table 7-3 –Screenline Summary – Inter Peak

Screenline	Direction	Observed (pcu)	Modelled (pcu)	Abs Diff (pcu)	% Diff	Average GEH	Pass TAG Flow	Pass DMRB GEH
Screenline 1	NB	1,814	1,849	35	0.02	0.8	✓	✓
	SB	1,840	1,818	21	-0.01	0.5	✓	✓
Screenline 2	EB	1,929	1,965	36	0.02	0.8	✓	✓
	WB	1,843	1,895	52	0.03	1.2	✓	✓
Screenline 3	NB	855	881	25	0.03	0.9	✓	✓
	SB	1,021	1,048	27	0.03	0.8	✓	✓
Screenline 4	EB	3,512	3,545	33	0.01	0.6	✓	✓
	WB	3,617	3,617	0	0.00	0.0	✓	✓
Screenline 5	NB	3,510	4,015	505	0.14	8.2	×	×
	SB	3,904	4,520	615	0.16	9.5	×	×
Screenline 6	EB	5,594	5,272	322	-0.06	4.4	✓	×
	WB	5,472	5,371	101	-0.02	1.4	✓	✓
Screenline 7	EB	4,803	4,721	82	-0.02	1.2	✓	✓
	WB	5,318	5,123	196	-0.04	2.7	✓	✓
Number of Screenlines passing Criteria							**12/14**	**11/14**
Percentage of Screenlines passing Criteria							**86%**	**79%**

Table 7-4 –Screenline Summary – PM Peak

Screenline	Direction	Observed (pcu)	Modelled (pcu)	Abs Diff (pcu)	% Diff	Average GEH	Pass TAG Flow	Pass DMRB GEH
Screenline 1	NB	3,264	2,878	386	-0.12	7.0	✓	×
	SB	2,302	2,219	83	-0.04	1.7	✓	✓
Screenline 2	EB	3,385	3,029	356	-0.11	6.3	✓	×
	WB	1,875	1,938	63	0.03	1.4	✓	✓
Screenline 3	NB	1,396	1,376	20	-0.01	0.5	✓	✓
	SB	1,492	1,383	109	-0.07	2.9	✓	✓
Screenline 4	EB	4,687	4,524	163	-0.03	2.4	✓	✓
	WB	4,963	4,250	713	-0.14	10.5	×	×
Screenline 5	NB	4,358	4,238	120	-0.03	1.8	✓	✓
	SB	5,269	5,387	119	0.02	1.6	✓	✓
Screenline 6	EB	6,843	6,098	745	-0.11	9.3	×	×
	WB	6,474	6,319	155	-0.02	1.9	✓	✓
Screenline 7	EB	6,275	5,531	743	-0.12	9.7	×	×
	WB	6,299	5,687	612	-0.10	7.9	×	×
Number of Screenlines passing Criteria							**10/14**	**8/14**
Percentage of Screenlines passing Criteria							**71%**	**57%**

7.3 Journey Time Validation

It is important that journey times are properly validated to ensure that speeds on links and delays at junctions are accurately represented by the model. This will give confidence in the model's ability to correctly forecast the likely impacts of changing traffic demand and network improvements.

The journey time validation is based on comparisons of observed and modelled journey times along 10 (bi-directional) routes (shown below).

Figure 7-2 – Journey Time Routes

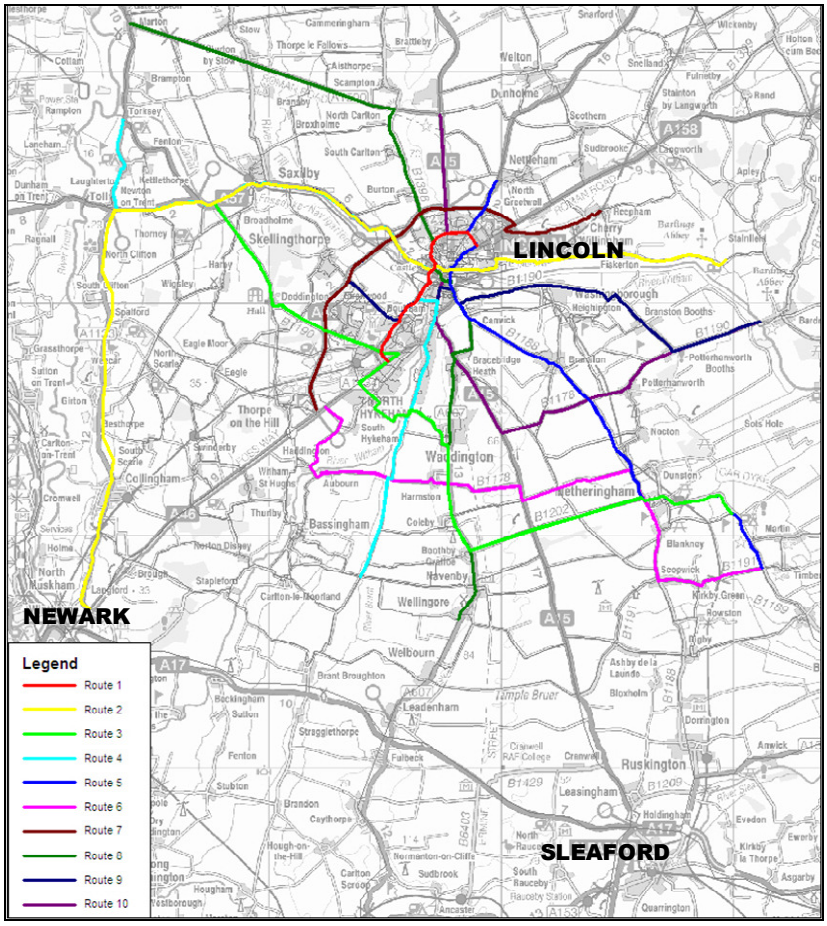


Table 7-5 provides a summary of the journey time validation results for the three modelled time periods. It shows that, for all three time periods, the difference between modelled and observed journey times is within 15% or 1 minute for 18 out of 20 routes (90%) for AM Peak, 18 out of 20 routes (90%) for the Inter-Peak and 18 out of 20 routes (90%) for the PM Peak. All periods therefore meet the TAG Unit 3.19 journey time validation criteria (as described in Table 6-1).

Detailed journey time validation results for all routes are presented in Appendix I, which includes tables and figures showing comparisons of observed and modelled journey times over the length of each route.

Table 7-5 – Journey Time Validation Summary – All Periods

Route	Description	Pass Criteria		
		AM	IP	PM
Route 1	B1182 Ruskin Ave/A15 Wragby Rd and A1434 Newark Rd/B1003 Tritton Rd	✓	✓	✓
		✓	✓	✓
Route 2	Ferry Rd/Short Ferry Rd and A1133/A46	✓	✓	✓
		✓	✓	✓
Route 3	B1189 Moor Ln and A57 Gainsborough Rd/B1190 Tom Otters Ln	×	✓	×
		✓	✓	✓
Route 4	Hopyard Ln/Navenby Ln and A1133 Newark Rd/A156	✓	✓	✓
		✓	✓	✓
Route 5	B1189/B1191 Main St/Station Rd and A46 Lincoln Rd/Washdyke Ln	✓	✓	✓
		✓	✓	✓
Route 6	B1191 Main St/B1189/Station Rd and A1434 Newark Rd/Boundary Ln	✓	✓	✓
		✓	✓	✓
Route 7	A46/A1434 Newark Rd and Moor Ln/Fiskerton Rd	✓	×	✓
		×	×	×
Route 8	A607 Cliff Rd/Skinnand Ln and A1500 Stow Park Rd/High St	✓	✓	✓
		✓	✓	✓
Route 9	B1190 Branston Causway at river and B1378 Skellingthorpe Rd/Lincoln Rd	✓	✓	✓
		✓	✓	✓
Route 10	B1190 Branston Causeway at river and A1500 Horncastle Ln/A15	✓	✓	✓
		✓	✓	✓
Number of routes passing criteria		**18 / 20**	**18 / 20**	**18 / 20**
Percentage of routes passing criteria		**90%**	**90%**	**90%**

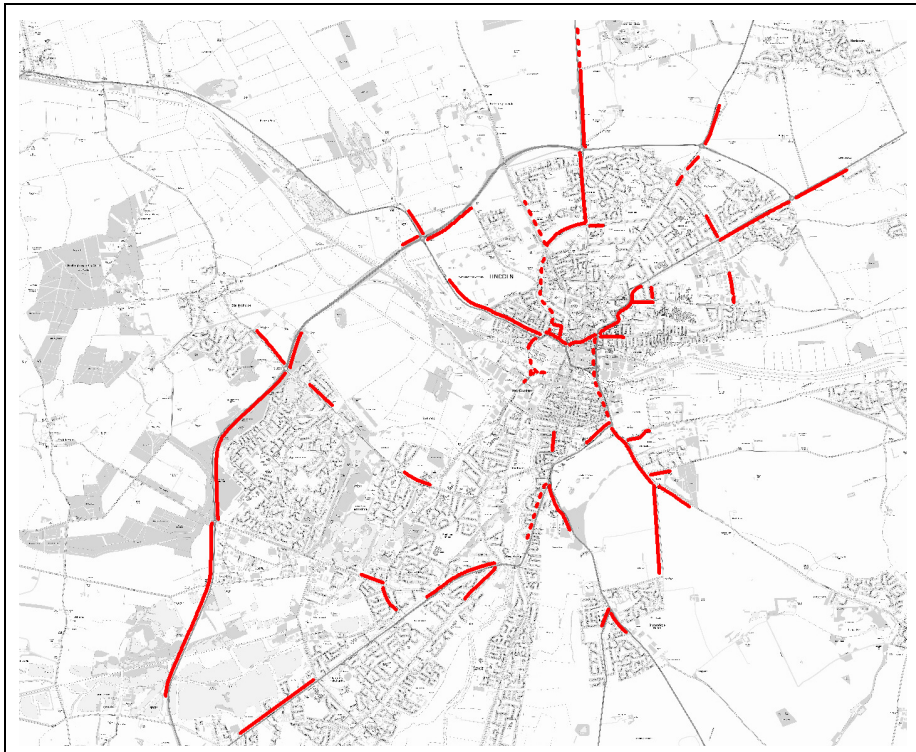
7.4 Checking of Routing & Congestion

Further checks were undertaken on all major routes in the network to ensure that the routes used between origin and destination pairs were realistic. Example of these checks can be seen in Appendix J.

To ensure that the congestion patterns in the models resembled the observed queuing patterns across Lincoln, several employees from Lincolnshire County Council were interviewed and asked to contribute to a congestion map of Lincoln. Figures 7.3 and 7.4 show the observed congestion maps for the AM and PM peaks that were derived from discussions with Lincolnshire County Council employees.

The observed queuing patterns are based on peoples' perceptions of queues, rather than precise measurements, therefore the observed diagram includes areas with slow moving traffic as well as standing traffic. With this in mind, the diagrams show that the modelled queuing pattern is similar to the observed queue patterns with both diagrams showing queues on the main strategic routes through Lincoln.

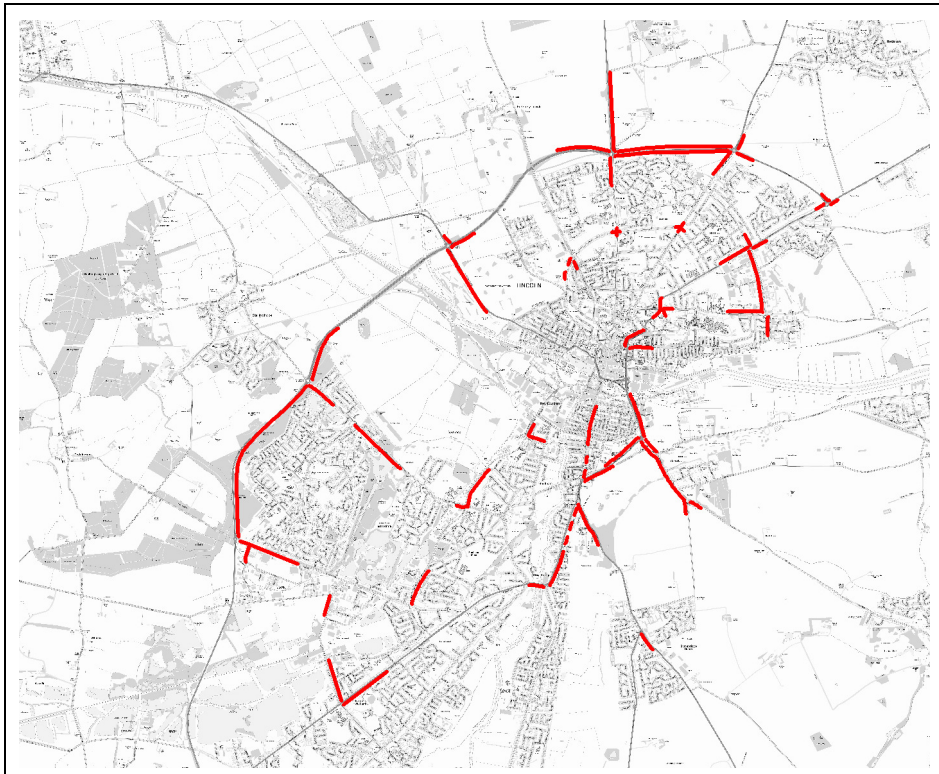
Figure 7-3 – Queue Patterns – AM Peak



Local Knowledge

Modelled Relative Queues

Figure 7-4 – Queue Patterns – PM Peak



Local Knowledge

Modelled Relative Queues

7.5 Network Flow Summaries

Summary plots of network flows for the validated Base Year traffic model are shown, for each time period, in Figures 7-6 to 7-7 below.

Figure 7-5 - Flow Diagram AM Peak (Hourly PCUs)

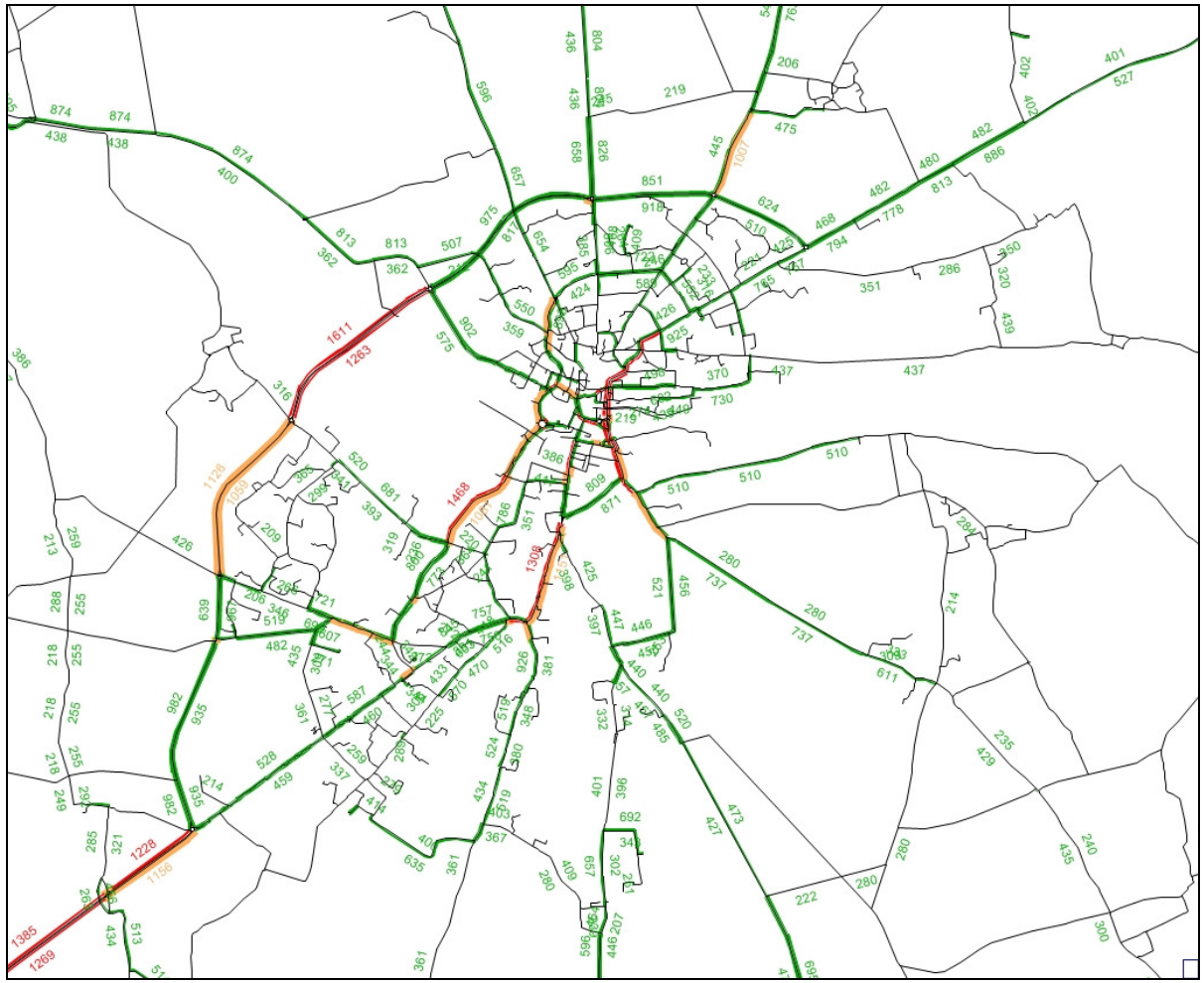


Figure 7-6 - Flow Diagram AM Peak (Hourly PCUs)

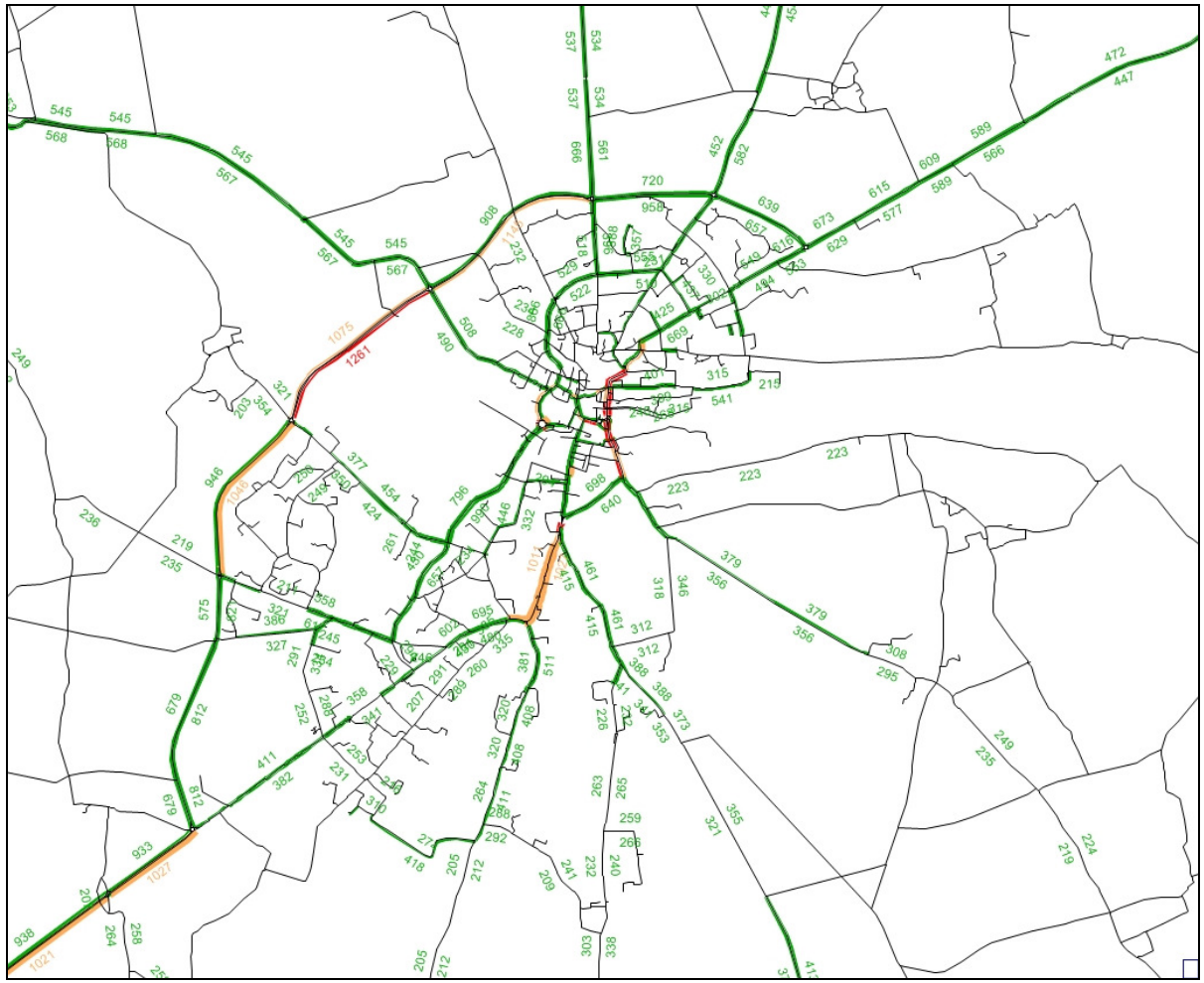
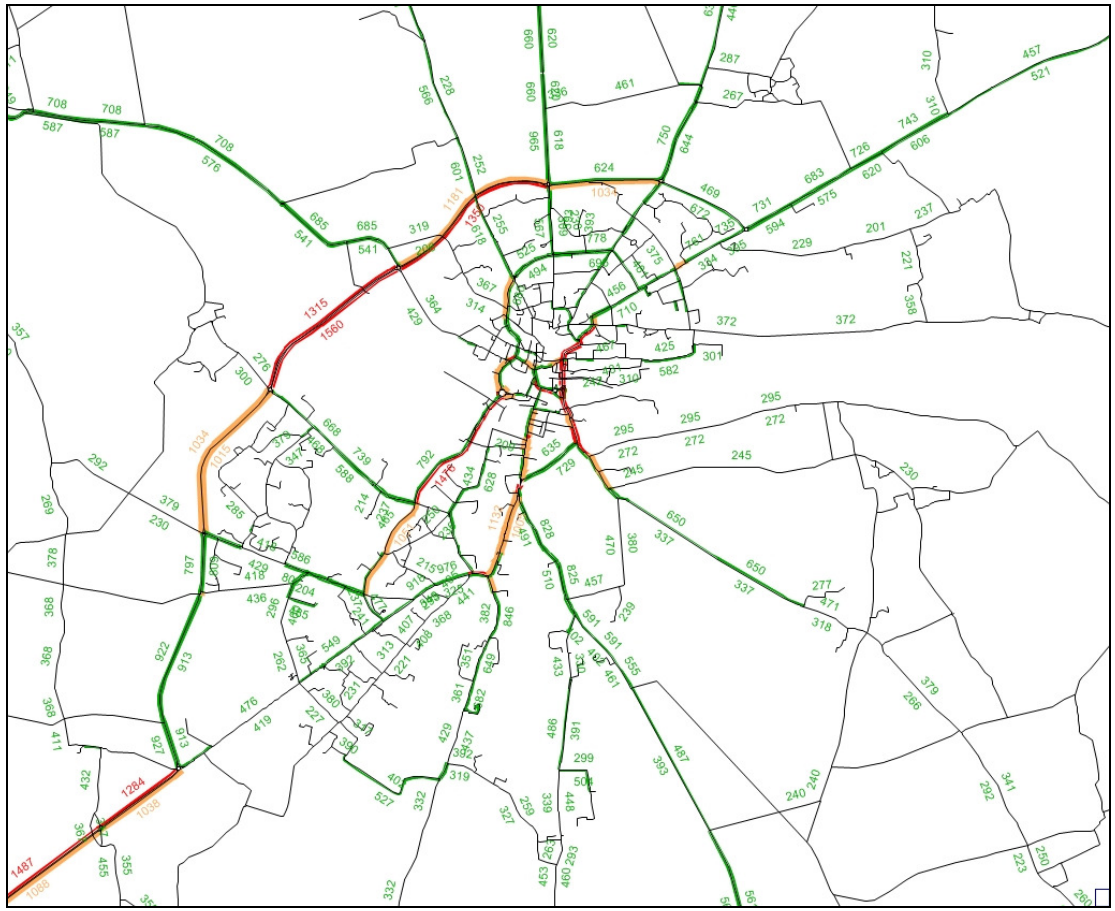


Figure 7-7 - Flow diagram PM



8 Summary and Conclusions

8.1 Summary and Conclusions

The “Greater Lincoln Transport Model" (GLTM) was developed to support, amongst other things, the Major Scheme Business Case (MSBC) funding bid for the Lincoln Eastern Bypass. The original model was used in 2011 to provide an updated funding application for this scheme.

This Local Model Validation Report (LMVR) describes the subsequent updating of the modelled networks and trip matrices and the revalidation of the Base Year model in 2012.

8.2 Model overview

The model reconstruction retained the original structure, in particular the approach to demand forecasting, but involved a thorough review and reworking of the available traffic data. Hence the principle stages reported here include network validation, matrix development (combining observed and synthetic elements), model calibration and model validation.

The model itself represents typical weekday (Tuesday-Thursday) conditions in October and November 2006. Separate models were developed for the AM Peak hour (08:00-09:00), PM peak hour (17:00-18:00) and an average inter-peak hour (10:00-16:00). The model has used data primarily from a comprehensive set of highway traffic surveys undertaken during the last quarter of 2006.

The model covers the urban area of Lincoln City and surrounding countryside, and broadly aligns with the Lincoln Planning Area (LPA). The highway network model was capacity restrained, incorporating junction delay simulation within the Lincoln urban area.

The travel demands were derived from trips observed at a cordon around Lincoln combined with synthetic estimates of internal and wholly external trips. Checks included the assignment of the observed matrix cells and comparison with traffic flow data at the study area cordon. Subsequently, the observed and synthetic matrices were merged prior to the calibration of the overall demand matrices using matrix estimation techniques.

8.3 Traffic Data

The available traffic data used in the model was thoroughly checking, including the postcard returns from roadside surveys at the study area cordon.

The database of traffic counts was also reviewed and conflicting or inconsistent counts removed. The count data was also allocated to either the model calibration or validation stages.

Whilst the original 2006 journey time data was largely retained, the relatively low sample size was enhanced using observations from the Trafficmaster database.

8.4 Network Development

A comprehensive review of the highway network model was undertaken as part of the updating process and corrections or adjustments made for application of the model to the Lincoln Eastern Bypass assessment.

External 'buffer' network links were either extended or added to the model and the detailed coding of simulation nodes revised within the detailed study area. The latter included the derivation of signal timings to represent the SCOOT control system in Lincoln city centre. Bus services were also updated and coded into the highway model.

Network validation checks included link attributes, junction type coding, link distances and assignment routing checks.

8.5 Matrix Development

The matrix development process retained the original study methodology in combining observed and synthetic matrix elements, although all steps in this process were updated and data sources revisited.

The observed matrix elements were derived from the roadside surveys undertaken at the study area cordon. Where (the less busy) roads crossing the cordon were not included in the original survey, estimated movement patterns were derived from analyses using the existing model.

Possible bias in the self-completion interview survey, in particular journey purpose descriptions, was tested against comparable databases from other studies. This did not reveal any significant bias judged to have affected the quality of the data.

The synthetic matrix process included the derivation of internal and external trips, for all vehicle purposes including freight transport. In merging the observed and synthetic matrices, smoothing was undertaken to reduce the effects of variable sample sizes within the model data.

8.6 Model Calibration

Model calibration involved the iterative adjustment of the network models, including junction and speed/ flow coding, and matrix estimation to derive model outputs which were measured against count and journey time data, adopting TAG 3.19 validation guidelines. Assignment parameters were derived from guidance in the Transport Economics Note (TEN 2007) and WebTAG 3.5.6.

The effects of matrix estimation were monitored at sector level to gauge the extent of adjustment within the model. This was judged to be acceptable within the various sectors, including those where observed data was incorporated within the model.

Other aspects of the performance of the model were also monitored and reported here; including origin/ destination trip ends, trip length distribution and model convergence.

Observed and modelled flow comparisons were also carried out over a number of sites, including the study area cordon and other ATC sites, as summarised below in Table 8-1.

8.7 Model Validation

The process of model validation again followed the guidance given in TAG Unit 3.19 in terms of comparisons between observed and modelled traffic flows and journey times.

Data was formed for a series of 7 two-way screenlines at which observed and modelled traffic flows were compared. In most cases, these comparisons met or exceeded the TAG Unit 3.19 guidelines for flow statistics, as shown in Table 8-1.

Table 8-1 - Summary of Screenlines

Pass/Fail	AM		Inter Peak		PM	
	Flow	GEH	Flow	GEH	Flow	GEH
Screenline 1 - NB	✓	✓	✓	✓	✓	×
Screenline 1 - SB	✓	✓	✓	✓	✓	✓
Screenline 2 - EB	✓	×	✓	✓	✓	×
Screenline 2 - WB	✓	×	✓	✓	✓	✓
Screenline 3 - NB	✓	✓	✓	✓	✓	✓
Screenline 3 - SB	✓	✓	✓	✓	✓	✓
Screenline 4 - EB	×	×	✓	✓	✓	✓
Screenline 4 - WB	✓	×	✓	✓	×	×
Screenline 5 - NB	✓	✓	×	×	✓	✓
Screenline 5 - SB	✓	×	×	×	✓	✓
Screenline 6 - EB	✓	✓	✓	×	×	×
Screenline 6 - WB	✓	✓	✓	✓	✓	✓
Screenline 7 - EB	✓	✓	✓	✓	×	×
Screenline 7 - WB	✓	✓	✓	✓	×	×
Total Passing Criteria	**13 / 14**	**9 / 14**	**12 / 14**	**11 / 14**	**10 / 14**	**8 / 14**
% Passing Criteria	**93%**	**64%**	**86%**	**79%**	**71%**	**57%**

Journey time validation showed that, for each of the three time periods, the difference between modelled and observed journey times was within 15% or 1 minute, if higher, for all routes, and therefore 90% or more of routes pass the journey time validation criteria defined in TAG Unit 3.19 Table 3. A summary of the journey time validation is provided in Table 8.2 below.

Table 8-2 - Summary of Journey Time Validation

Time Period	% of Routes Passing TAG Validation Criteria
AM Peak	90%
Inter Peak	90%
PM Peak	90%

In all cases, the model compares very well with the observed situation, and largely meets TAG validation criteria. On this basis, it has been demonstrated that the base year traffic model, for each of the three modelled time periods, provides an accurate representation of the current traffic demands in the wider Lincoln area.

Given that the model update reported here is intended as an interim improvement, prior to further traffic surveys in 2013, the model is judged to be sufficiently robust for the current planning and design studies of the Lincoln Eastern Bypass.

We have used our reasonable endeavours to provide information that is correct and accurate and have discussed above the reasonable conclusions that can be reached on the basis of the information available. Having issued the range of conclusions it is for the client to decide how to proceed with this project

9 Appendices

Lincoln Eastern Bypass

Local Model Validation Report

Appendices

November 2012
V0.1

Document Control Sheet

Project Title	Lincoln Eastern Bypass
Report Title	Local Model Validation Report - Appendices
Version	01
Status	Final
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Record of Issue

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Lincolnshire County Council	Lee Rowley	1

Appendices

Appendix A: Inconsistent Counts

Appendix B: Calibration / Validation counts

Appendix C: Speed – Flow Curves

Appendix D: Zoning System

Appendix E: Bus Routes

Appendix F: Calibration at Postcard Sites

Appendix G: Screenline Calibration / Validation

Appendix H: Observed / Modelled Journey Time Distance

Appendix I: Journey Time Validation

Appendix J: Routing Plots

Appendix A – Inconsistent Counts

ID	Inconsistent Site Names	Action Taken
1	ATC@IS1, MCLC@IS1	ATC Total split into classification proportions from MCLC
2	ATC@IS10, MCLC@IS10	ATC Total split into classification proportions from MCLC
3	ATC@IS11, MCLC@IS11	ATC Total split into classification proportions from MCLC
4	ATC@IS11a, MCLC@IS11a, ATC75	ATC75 flows exactly the same as ATC@RSI11a Flows. Split ATC@RSI11a Total into classification proportions from MCLC
5	ATC@IS12, MCLC@IS12	ATC Total split into classification proportions from MCLC
6	ATC@IS13N, MCLC@IS13N, TC65, MCLC@IS13S, ATC@IS13S	Discovered that the directional split on the MCLC at 13N appears reversed when compared to the other data; this has been reversed. ATC Total split into average classification proportions shown in MCLC@13N, MCLC@13S and the MCJC. MCJC Turning movements factored to match ATC flows
7	ATC@IS14N, MCLC@IS14N, Site 10 (2010), Site 10 (2009), Traf 07, Traf 07a, TC60, ATC94, LS4, TC61	Average classification proportions across the MCLC and MCJC surveys have then been calculated and applied to ATC totals to derive Cars, LGVs and HGVs. Turning movements at TC60 and TC61 have then been factored to match the calculated link flows
8	ATC@IS14S, MCLC@IS14S	ATC Total split into classification proportions from MCLC
9	ATC@IS16, MCLC@IS16, TC33, TC40	ATC Total split into average classification proportions shown in MCLC@RSI16, TC33 and TC40. MCJC Turning movements factored to match ATC flows
10	ATC@IS2, MCLC@IS2	ATC Total split into classification proportions from MCLC
11	ATC@IS3, MCLC@IS3, TC23	ATC Total split into average classification proportions shown in MCLC@RSI3 and the MCJC. MCJC Turning movements factored to match ATC flows
12	ATC@IS4, MCLC@IS4, ATC63	ATC Total split into classification proportions from MCLC
13	ATC@IS5, MCLC@IS5, TC43	ATC Total split into average classification proportions shown in MCLC@RSI5 and the MCJC

ID	Inconsistent Site Names	Action Taken
14	MCLC@IS6, TC15	Average of MCLC and MCJC flows taken
15	ATC@IS7, MCLC@IS7, TC30, ATC88	ATC Total split into average classification proportions shown in MCLC@RSI7 and the MCJC. ATC88 same as RSI ATC so excluded from database
16	ATC@IS8, MCLC@IS8, ATC87, TC36	ATC Total split into average classification proportions shown in MCLC@RSI8 and the MCJC. ATC87 same as RSI ATC so excluded from database. MCJC Turning movements factored to match ATC flows
17	ATC@IS9, TC36, MCLC@IS9	ATC Total split in classification proportions from MCLC. MCJC movements towards ID16 fixed and so remaining MCJC movements have been factored to match ATC Total
18	ATC02, TC01	ATC Total split into classification proportions from MCJC. MCJC Turning Movements Factored to match total ATC
19	ATC03, TC02	ATC Total split into classification proportions from MCJC
20	ATC04, TC02	ATC Total split into classification proportions from MCJC
21	ATC05, TC03	ATC Total split into classification proportions from MCJC
22	ATC06, TC04	ATC Total split into classification proportions from MCJC
23	ATC17, TC07	ATC Total split into classification proportions from MCJC. MCJC Turning Movements Factored to match total ATC
24	ATC25, TC13	ATC Total split into classification proportions from MCJC. MCJC Turning Movements Factored to match total ATC
25	ATC30, TC11	ATC Total split into classification proportions from MCJC
26	ATC65, TC32, LS5, L081	ATC Data retained, Adjust TC32 (note that no calculation is required for this as same AnodeBnode as ATC65) and L081 MCJC to match, Delete LS5 as less reliable than ATC65
27	ATC68, TC34	ATC Total split into classification proportions from MCJC. MCJC Turning Movements Factored to match total ATC

ID	Inconsistent Site Names	Action Taken
28	ATC69, TC40	ATC Total split into classification proportions from MCJC
29	ATC70, TC47	ATC Total split into classification proportions from MCJC
30	ATC77, TC50	ATC Total split into classification proportions from MCJC. MCJC Turning Movements Factored to match total ATC
31	ATC77, TC51	ATC Classifications calculated in ID33 split in proportion with turning movements at MCJC
32	ATC78, TC50	ATC Classifications calculated from TC50, inconsistent movements that have already been calculated in ID32 held fixed
33	ATC79, TC39	ATC Total split into classification proportions from MCJC
34	ATC80, TC39	ATC Total split into classification proportions from MCJC
35	ATC91, TC65	ATC Total split into classification proportions from MCJC. MCJC Turning Movements Factored to match total ATC
36	L082, ATC95	ATC Total split into classification proportions from MCJC. MCJC Turning Movements Factored to match total ATC
37	ATC93, LS2	ATC Total split into classification proportions from LS2
38	L082, L084	Totals of inconsistent flows averaged, with average flows distributed over turning movements, taking those movements calculated in ID38 as fixed
39	L083, TC32	Use TC32 totals as from 2006, L082 is 2008, totals distributed at L082 in accordance with turning proportions
40	Site 1 (2010), Site 1 (2009)	Counts averaged
41	Site 11 (2010), Site 11 (2009), TC62, Traf 08	Delete Site 1110, Site 1109 and Traf 08 counts as uncertain of their exact locations and also outside 2006, retain 2006 TC62 count
42	Site 12 (2010), Site 12 (2009)	Link counts look ok, average taken

ID	Inconsistent Site Names	Action Taken
43	Site 13 (2010), Site 13 (2009), Traf 10	Retain Traf 10, Delete Sites 1309 and 1310 as distant from 2006
44	Site 14 (2010), Site 14 (2009), Traf 11	Retain Traf 11, Delete Sites 1409 and 1410 as distant from 2006
45	Site 15 (2010), Site 15 (2009), Traf 12, TC55	Remove Sites 1509, 1510 and Traf 08, use TC55 (Note: could have averaged sites Traf 08 and TC55 as both 2006 but did not do this due to time pressures)
46	Site 16 (2010), Site 16 (2009)	Counts averaged
47	Site 17 (2010), Site 17 (2009)	Counts averaged
48	Site 18 (2010), Site 18 (2009)	Counts averaged
49	Site 19 (2010), Site 19 (2009)	Counts averaged
50	Site 20 (2010), Site 20 (2009)	Not in VISUM network so removed
51	Site 2 (2010), Site 2 (2009)	Counts averaged
52	Site 3 (2010), Site 3 (2009)	Counts averaged
53	Site 4 (2010), Site 4 (2009)	Counts averaged
54	Site 5 (2010), Site 5 (2009), TC31	Retain TC 31, Sites 509 and 510 deleted as distant from 2006
55	Site 6 (2010), Site 6 (2009), Traf 03	Remove Sites 609 and 610, retain Traf 03 as 2006 count
56	Site 7 (2010), Site 7 (2009), Traf 04	Remove Sites 709 and 710, retain Traf 04 as 2006 count
57	Site 8 (2010), Site 8 (2009), Traf 05	Remove Sites 809 and 810, retain Traf 05 as 2006 count

ID	Inconsistent Site Names	Action Taken
58	Site 9 (2010), Site 9 (2009), ATC66a, Traf 06	ATC Total split in proportion with classifications from Traf06 MCLC
59	TC01, TC06	Totals of inconsistent flows averaged, with average flows distributed over turning movements, taking those movements calculated in ID19 as fixed
60	TC03, TC04	Counts averaged
61	TC17, TC51	Totals of inconsistent flows averaged, with average flows distributed over turning movements, taking those movements calculated in ID33 as fixed (these movements are linked to ATC data and so are considered more reliable)
62	TC16, TC17	Totals of inconsistent flows averaged, with average flows then distributed over turning movements, taking those movements calculated in ID64 as fixed
63	TC14, TC16	Totals of inconsistent flows averaged, with average flows then distributed over turning movements, taking those movements calculated in ID65 as fixed
64	TC18, TC18a	Totals of inconsistent flows averaged, with average flows distributed over turning movements
65	TC22, TC23	Totals of inconsistent flows averaged, comparisons look ok
66	TC23, TC24	Totals of inconsistent flows averaged, comparisons look ok
67	TC27, TC26	Totals of inconsistent flows averaged, with average flows distributed over turning movements
68	TC33, L111	TC33 flows fixed and L111 flows factored to match
69	TC44, TC45	Totals of inconsistent flows averaged, comparisons look ok
70	TC45, TC46	Totals of inconsistent flows averaged, comparisons look ok
71	TC51, TC50	Amendments from ClashIDs32 and 33 have addressed clashes between these junctions
72	TC66, TC67	Totals of inconsistent flows averaged, with average flows distributed over turning movements
73	TC73, TC25	TC73 flows held fixed and TC25 flows factored to match, comparisons show that TC26 and TC73

ID	Inconsistent Site Names	Action Taken
		are not too disimilar but that TC25 is much more different
74	TC73, TC26	Totals of inconsistent flows averaged, with average flows distributed over turning movements
75	Traf 02, TC31, TC58	Excluded Traf02 as flows differ significantly to TC31 and TC58. TC31 and TC58 flows averaged and distributed across turning movements
76	Traf 09, TC32, Traf 09a	Average Flows used
77	TC41, TC22	Totals of inconsistent flows averaged
78	TC42, TC43	Totals of inconsistent flows averaged
79	LS3, TC64, LS3, TC63	ATC Classifications considered unreliable, for simplicity and speed average flows across MCJCs taken, then distributed over turning movements
80	TC70, TC69	Totals of inconsistent flows averaged
81	TC41, TC42, LS1	inconsistent flows average
82	TC35, TC36	TC36 flows were calculated under ClashIDs 16 & 17 where comparisons were drawn with ATC data, where there are conflicts TC36 flows have therefore been held fixed and TC35 flows have been adjusted to match
83	L113, L112	inconsistent flows average

Appendix B – Calibration & Validation Counts

Calibration Count Sites

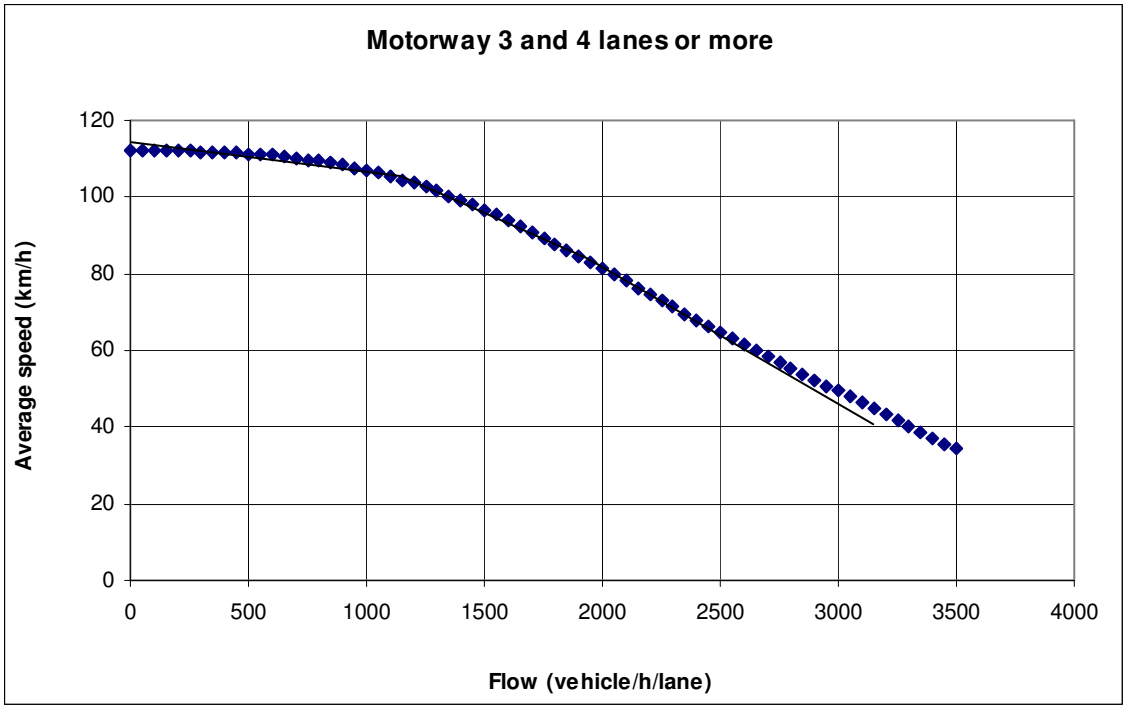
Site No.	Site	Dir,	Anode	Bnode	AM (pcu)	IP (pcu)	PM (veh)
Calibration Count Sites							
RSI01	B1398 Middle St	SB	5631	4135	642	196	293
RSI01	B1398 Middle St	SB	4135	5631	166	190	608
RSI02	A15 North of Lincs	NB	119527799	119512936	447	434	688
RSI02	A15 North of Lincs	SB	119512936	119527799	774	413	533
RSI03	A57 West of Linc	NB	119537502	119529293	1042	578	597
RSI03	A57 West of Linc	SB	119529293	119537502	661	553	1025
RSI04	A46 North of Lincs	NB	119520663	119530689	652	513	590
RSI04	A46 North of Lincs	SB	119530689	119520663	346	526	749
RSI05	B1190 Lincoln Rd	EB	119523255	119539035	329	202	277
RSI05	B1190 Lincoln Rd	WB	119539035	119523255	230	221	292
RSI06	A46 SW of Lincs	NB	119519586	119512782	1322	-	-
RSI06	A46 SW of Lincs	SB	119512781	119539003	1267	894	1165
RSI07	B1308 Greetwell Rd	EB	119516693	119545527	123	211	506
RSI07	B1308 Greetwell Rd	WB	119545527	119516693	563	199	127
RSI08	B1190 Washingb. Rd	EB	119525748	119545520	124	-	-
RSI08	B1190 Washingb. Rd	WB	119545520	119525748	443	-	-
RSI09	B1188 Canwick Rd	NB	119534819	119534820	1122	641	614
RSI09	B1188 Canwick Rd	SB	119534820	119534819	577	758	1354
RSI10	A15 Cross O Cliff	NB	119525785	119540776	458	455	473
RSI10	A15 Cross O Cliff	SB	119540776	119525785	314	426	740
RSI11	Brant Rd	NB	31	119536355	418	322	424
RSI11	Brant Rd	SB	119536355	31	271	319	538
RSI11a	Station Rd	EB	119516945	119513147	376	225	236
RSI11a	Station Rd	WB	119513147	119516945	329	217	402
RSI12	A158 Ragby Rd East	EB	119512694	119532410	612	540	542
RSI12	A158 Ragby Rd East	WB	119532410	119512694	481	558	776
ATC62	Fen Ln	SB	119523323	119538005	110	43	117
ATC62	Fen Ln	EB	119523323	119538005	110	43	117
ATC66a	Waterside South	WB	119541695	119537117	178	56	64
ATC76	A607 Grantham Rd	NB	119535799	119544516	428	322	545
ATC76	A607 Grantham Rd	SB	119544516	119535799	575	301	500
ATC77	A15 Sleaford Rd	NB	119529229	119545504	479	258	312
ATC77	A15 Sleaford Rd	SB	119545504	119529229	419	265	447
ATC78	Bloxholm Ln	NB	119525811	119545622	101	37	76
ATC80	B1188 Lincoln Rd	EB	119542251	119545512	296	387	681
ATC80	B1188 Lincoln Rd	WB	119545512	119542251	712	371	349
ATC81	Heighington Rd	WB	119521125	119524079	307	94	88
ATC89	Hawthorn Rd	EB	119545621	119531885	259	-	-

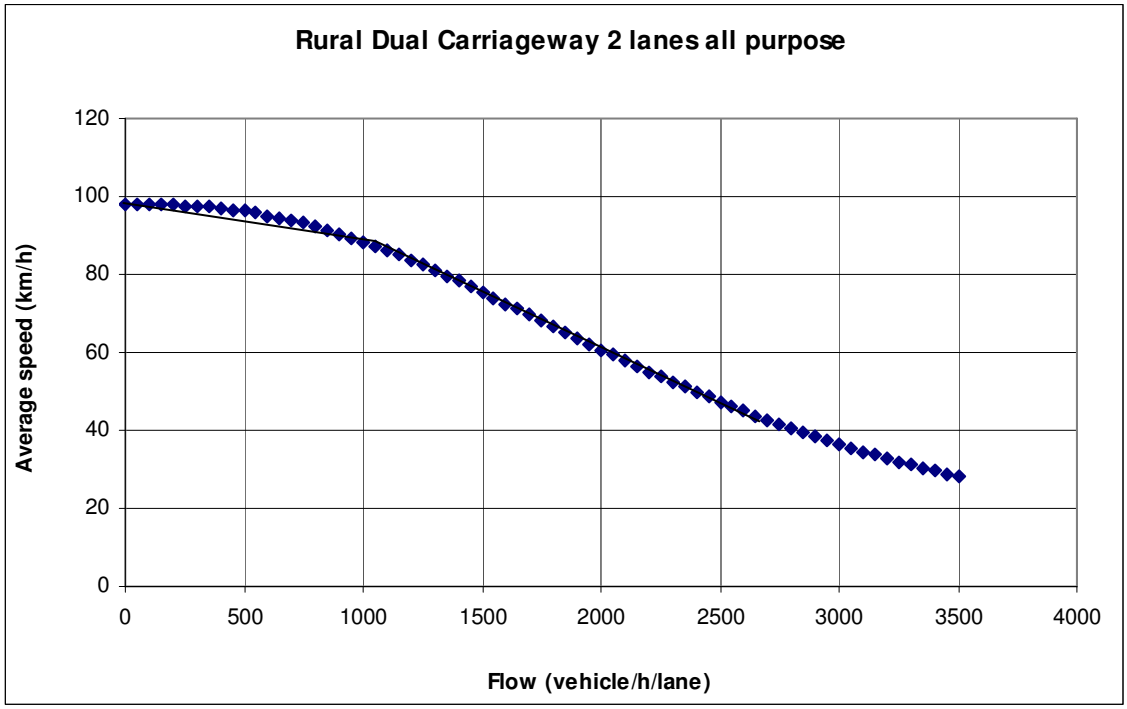
Site No.	Site	Dir,	Anode	Bnode	AM (pcu)	IP (pcu)	PM (veh)
ATC89	Hawthorn Rd	WB	119531885	119545621	506	-	-
L081	Brayford Way	NB	119526713	119527712	862	845	1027
L081	Brayford Way	SB	119527712	119526713	1046	899	1077
L082	BrayFord Wharf East	SB	119518823	119517044	206	259	262
L113	Northern Terrace	EB	119521029	119531615	319	231	100
L113	Gt Northern Terrace	WB	119531615	119521029	122	214	212
RSI14N	A15 Canwick Rd	NB	119532688	119522918	1994	1202	1146
RSI14N	A15 Canwick Rd	SB	119522918	119532688	1216	1341	1774
Site 3	East Gate	WB	119526595	119524011	224	-	-
Site 4	A15 Wragby Rd	WB	119523371	119529580	625	-	-
TC22	A15	NB	119531101	4560	520	506	801
TC22	A15	SB	4560	119531101	910	509	705
TC23	A158	WB	119515142	119516326	675	700	895
TC24	A158	EB	119516326	119515142	820	644	745
TC25	B1182 Ruskin Ave	EB	119513411	119515357	565	511	823
TC25	B1182 Ruskin Ave	WB	119515357	119513411	808	526	574
TC36	Washingb' Rd	EB	119534820	3533	125	175	312
TC36	Washingb' Rd	WB	3533	119534820	448	236	308
TC41	A46	WB	119531738	119529131	1428	1100	1873
TC41	A46	SB	119531738	119529131	1428	1100	1873
TC42	A46	EB	119514146	119536562	1962	1080	1786
TC42	A46	NB	119514146	119536562	1962	1080	1786
TC50	A15 London Rd	EB	119542296	119545503	514	308	555
TC50	A15 London Rd	WB	119545503	119542296	580	294	388
TC52	Lincoln Rd	EB	119513975	119524365	392	283	351
TC52	Lincoln Rd	WB	119524365	119513975	308	274	359
TC53	A1434 Newark Rd	EB	119531204	165	636	650	776
TC53	A1434 Newark Rd	WB	165	119531204	597	622	665
TC63	B1262 High St	NB	119516576	119514127	368	279	295
TC63	B1262 High St	SB	119514127	119516576	315	306	282
TC68	Brant Rd	NB	119518650	119526790	363	238	463
TC68	Brant Rd	SB	119526790	119518650	444	-	-
TC74	Outer Circle Dr	EB	119519672	119529037	301	262	339
TC74	Outer Circle Dr	WB	119529037	119519672	182	351	377
Traf 03	B1308 Monks Rd	EB	119524816	119517474	467	417	392
Traf 03	B1308 Monks Rd	WB	119517474	119524816	349	480	461
Traf 04	Croft St	EB	119516165	119522506	155	182	181
Traf 04	Croft St	WB	119522506	119516165	351	224	296
Traf 05	Waterside North	WB	119527059	119535794	147	141	119

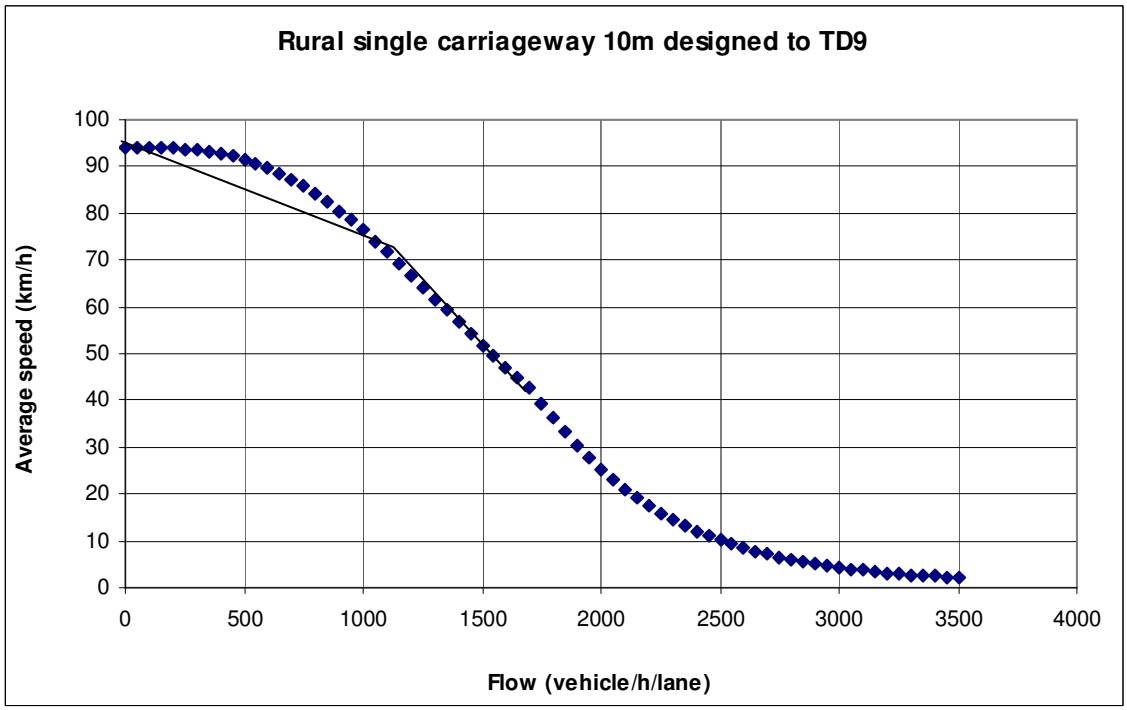
Validation Count Sites

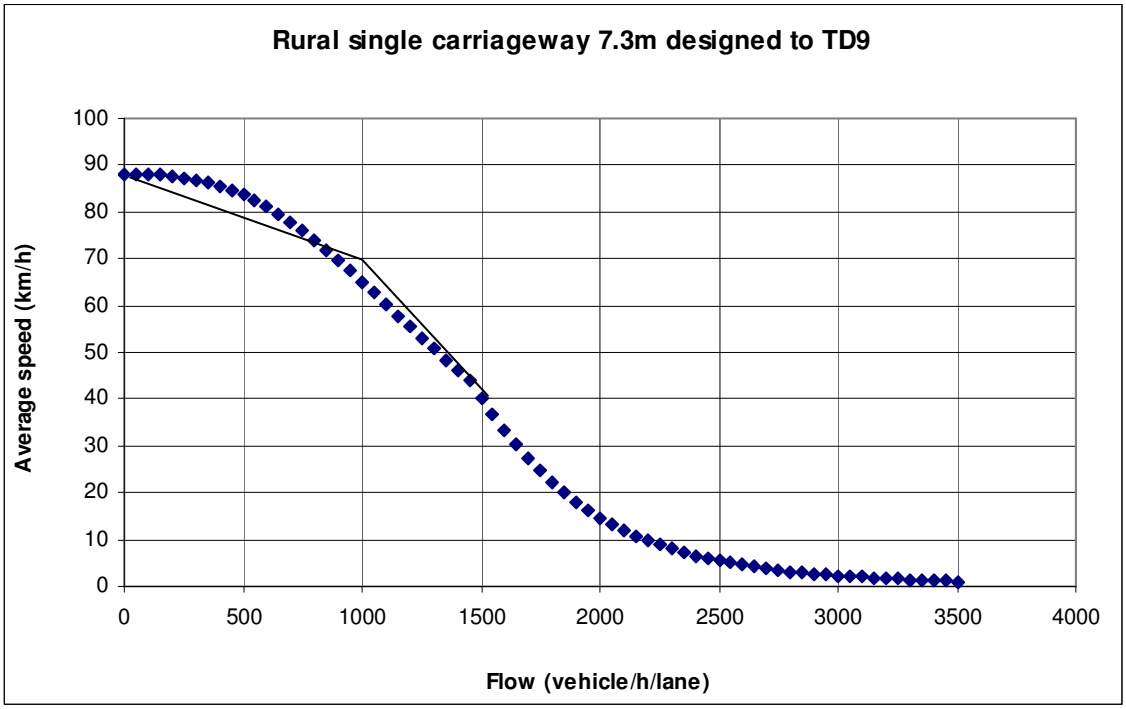
Site No.	Site	Dir.	Anode	Bnode	AM (pcu)	IP (pcu)	PM (veh)
Validation Count Sites							
ATC66a	Waterside South	EB	119537117	119541695	53	51	102
ATC71	B1190 Doddington Rd	EB	119545645	119530811	507	553	670
ATC71	B1190 Doddington Rd	WB	119530811	119545645	728	573	649
ATC78	Bloxholm Ln	SB	119545622	119525811	100	43	108
ATC81	Heighington Rd	EB	119524079	119521125	97	159	343
L082	BrayFord Wharf East	NB	119517044	119518823	86	104	104
LTC1	Beevor St	EB	119512888	119535466	165	68	29
LTC1	Beevor St	WB	119535466	119512888	78	78	85
Site 1	Newport	EB	119525571	119529003	352	-	-
Site 16	Carline Rd	EB	119528366	119539263	87	-	-
Site 17	Upper Long Leys Rd	EB	119519544	119529869	19	-	-
Site 18	Burton Rd	EB	119518285	119515671	501	-	-
Site 19	Mildmay St	EB	119533604	119536871	31	-	-
TC22	A46	WB	119528632	119529186	805	885	870
TC23	A46	EB	119529186	119528632	981	821	1120
TC26	B1273 Longdales Rd	EB	119527203	119545636	583	576	837
TC26	B1273 Longdales Rd	WB	119545636	119527203	763	545	593
TC31	Lindum Terrace	WB	119533260	119537871	106	67	193
TC32	B1003 Ropewalk	WB	119528600	119524325	294	602	701
TC32	B1003 Ropewalk	EB	119541066	119528600	698	525	365
TC33	B1360 Valentine Rd	EB	119518113	119519166	429	601	777
TC33	B1360 Valentine Rd	WB	119519166	119518113	676	579	624
TC40	Skellingthorpe Rd	EB	119525974	5198	282	307	435
TC40	Skellingthorpe Rd	WB	5198	119525974	278	271	270
TC44	B1190 Doddington Rd	EB	119532776	119534353	181	255	385
TC44	B1190 Doddington Rd	WB	119534353	119532776	428	272	318
TC45	A1434 Newark Rd	EB	119526471	171	462	402	558
TC45	A1434 Newark Rd	WB	171	119526471	300	399	428
TC56	B1308 West Parade	EB	119524201	119524200	424	298	332
TC56	B1308 West Parade	WB	119524200	119524201	393	390	419
TC66	A57 Newland	EB	119532301	119525809	879	704	719
TC66	A57 Newland	WB	119525809	119532301	490	427	684
TC67	Brayford Wharf North	EB	119534515	119514190	51	6	3
TC67	Brayford Wharf North	WB	119514190	119534515	11	7	62
TC71	B1378 Skellingth' Rd	EB	119536558	119516921	1085	389	398
TC71	B1378 Skellingth' Rd	WB	119516921	119536558	485	483	587
TC72	Scopwick Pl	EB	119524096	119536786	250	179	233
TC72	Scopwick Pl	WB	119536786	119524096	213	177	196
Traf 05	Waterside North	EB	119535794	119527059	26	12	5

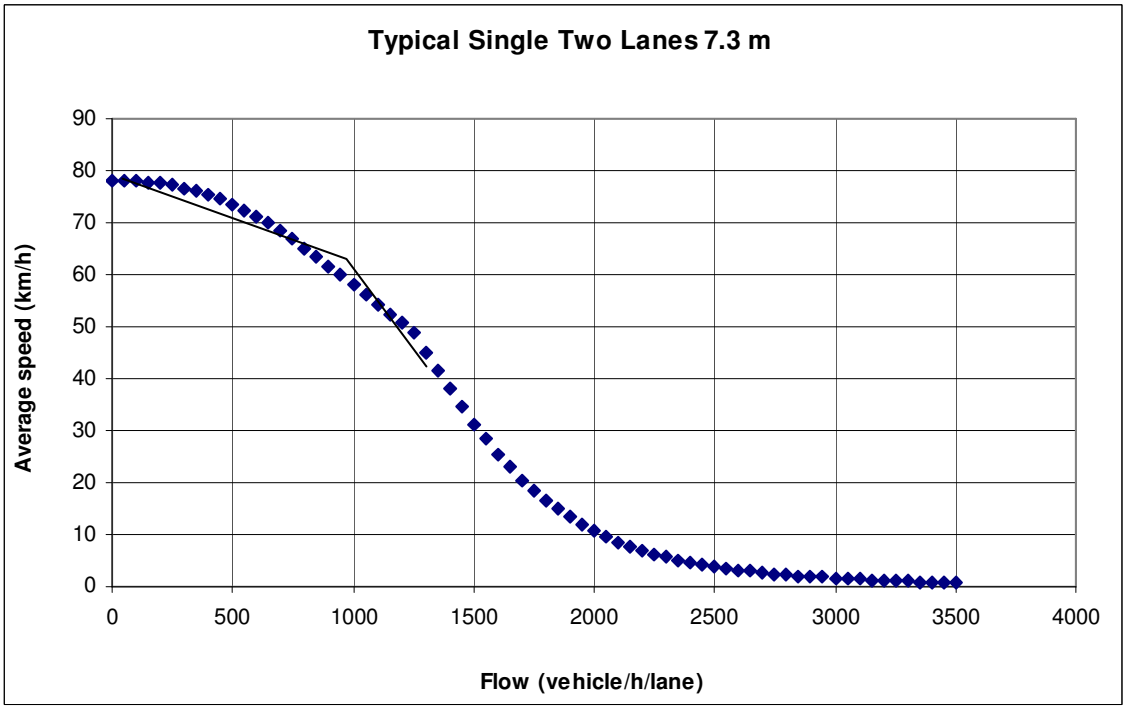
Appendix C – Speed – Flow Curves

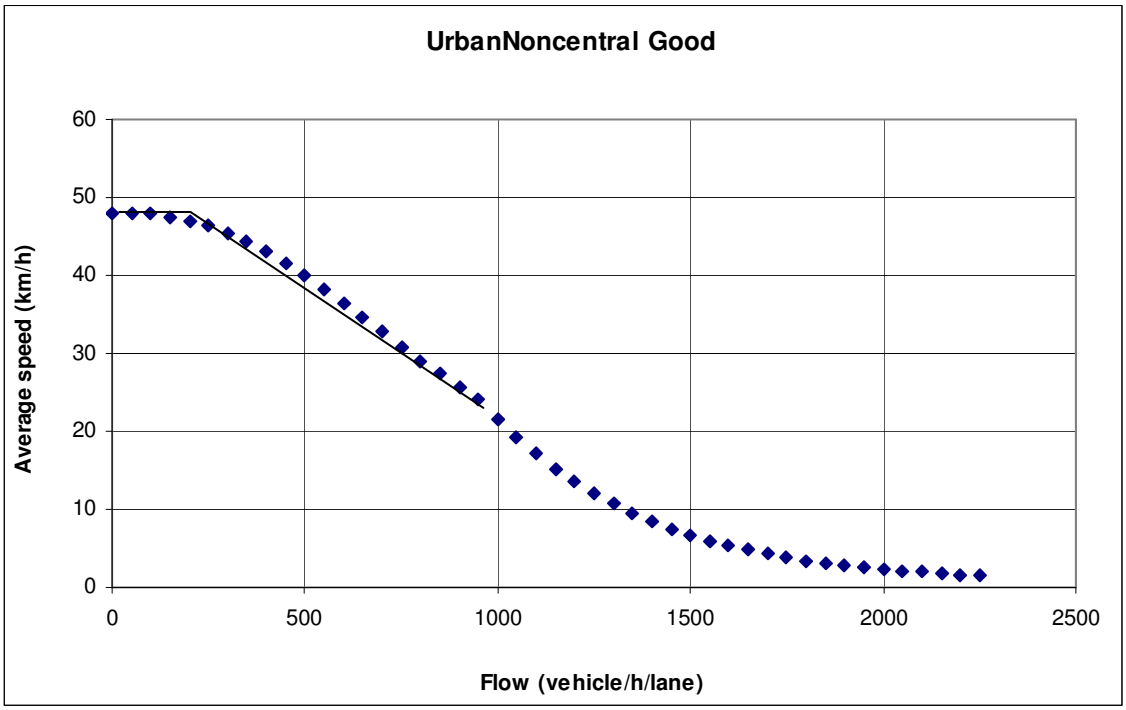


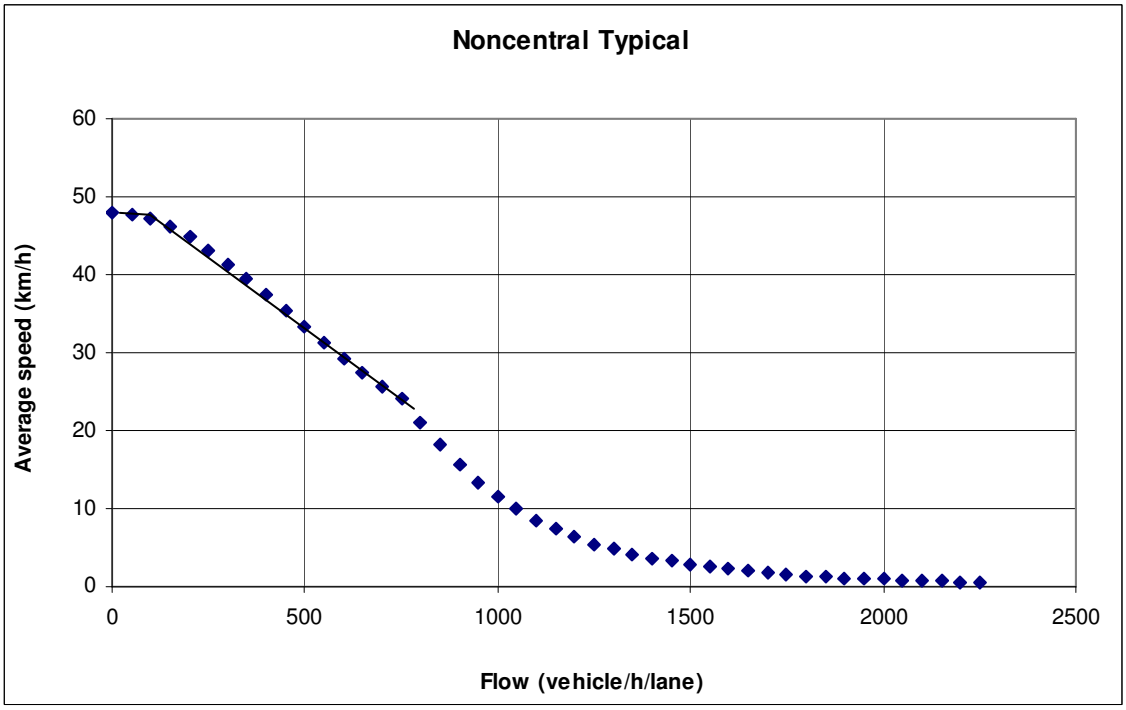

Rural Dual Carriageway 2 lanes all purpose
Average speed (km/h)
120
100
80
60
40
20
0
0
500
1000
1500
2000
2500
3000
3500
4000
Flow (vehicle/h/lane)

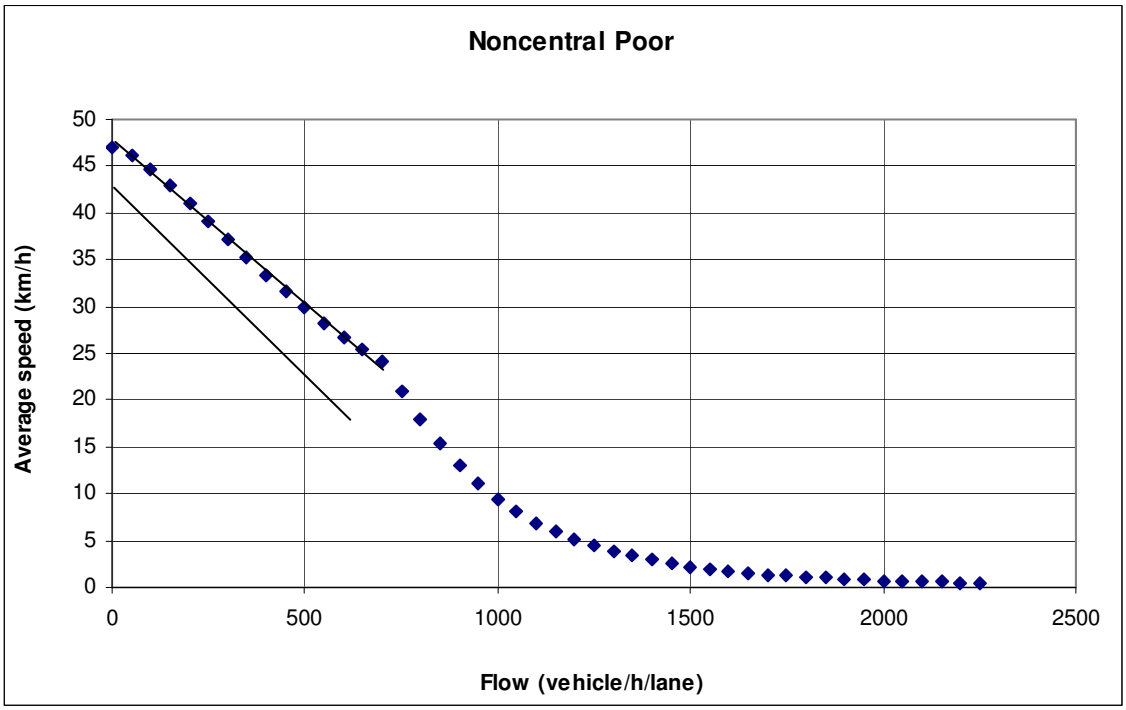

Rural single carriageway 10m designed to TD9
Average speed (km/h)
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
Flow (vehicle/h/lane)

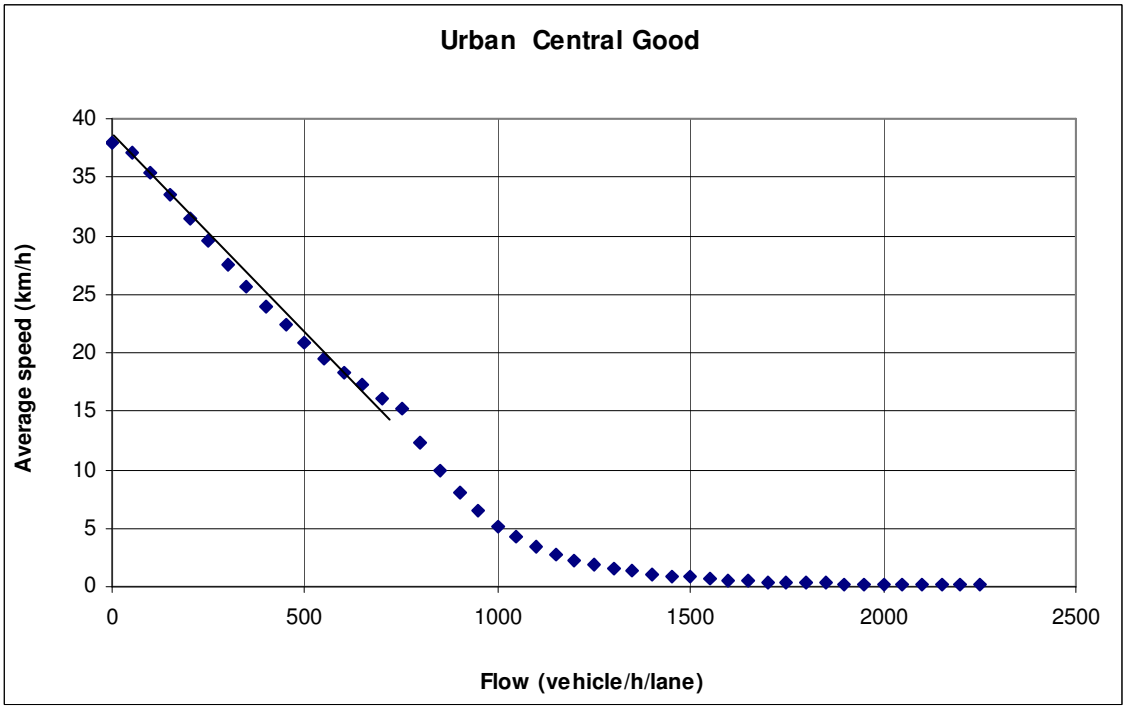

Rural single carriageway 7.3m designed to TD9
Average speed (km/h)
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
Flow (vehicle/h/lane)

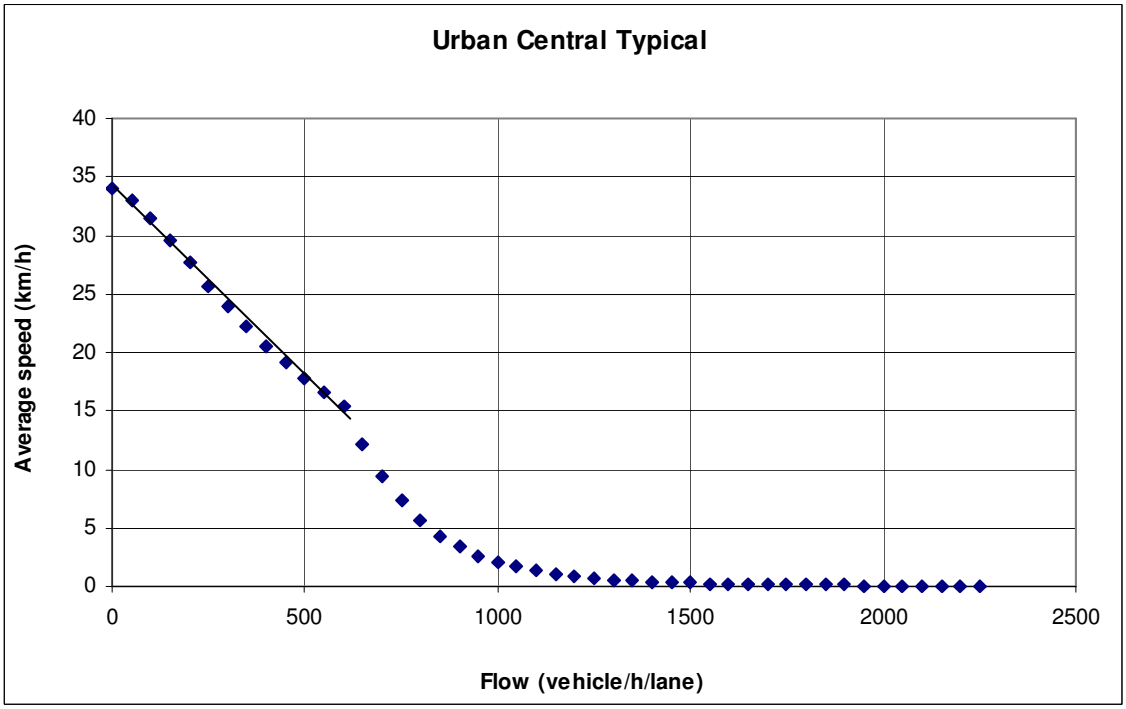

Typical Single Two Lanes 7.3 m
Average speed (km/h)
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
Flow (vehicle/h/lane)

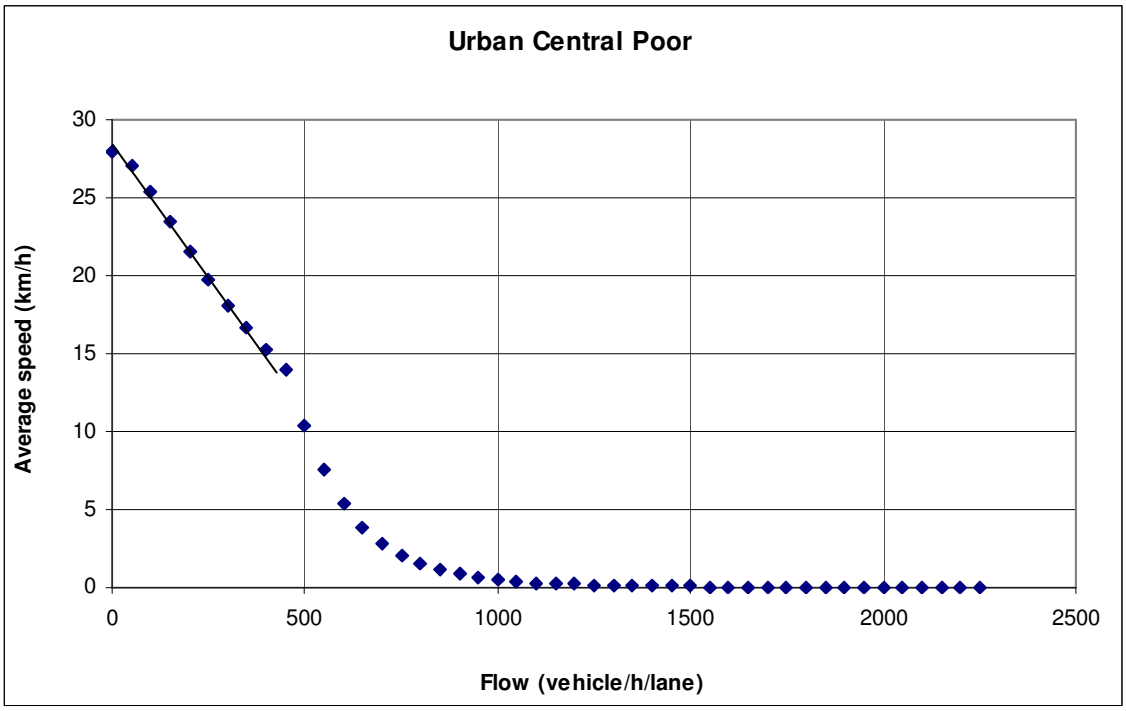

UrbanNoncentral Good
Average speed (km/h)
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)

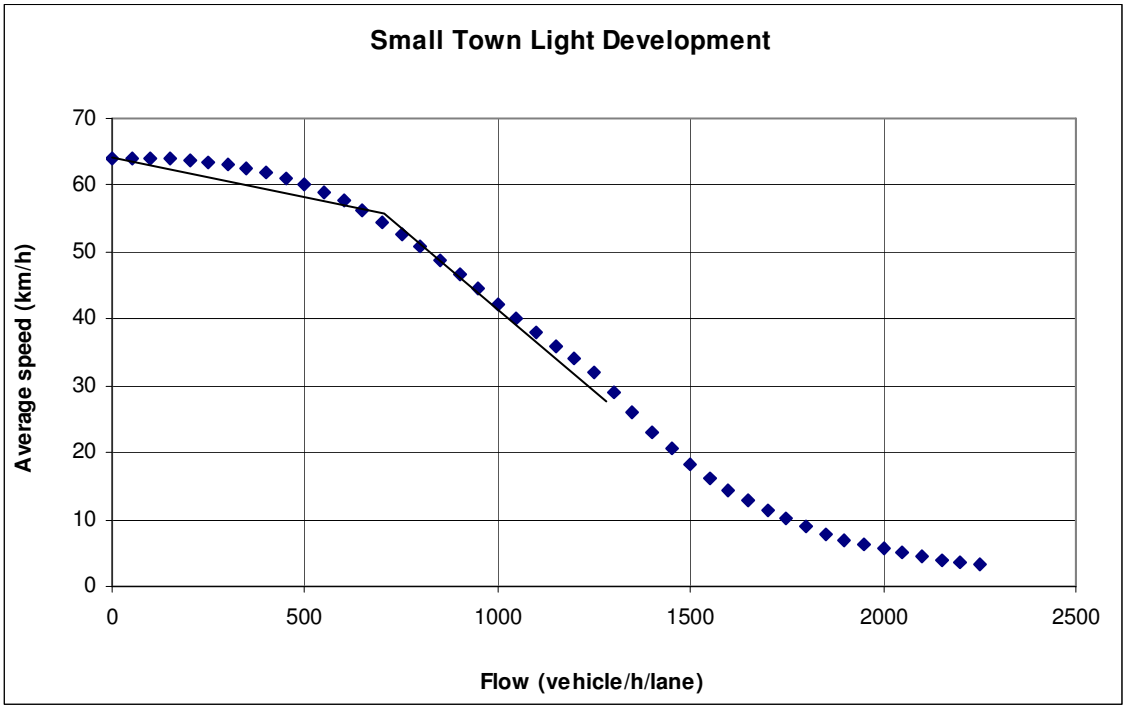

Noncentral Typical
Average speed (km/h)
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)

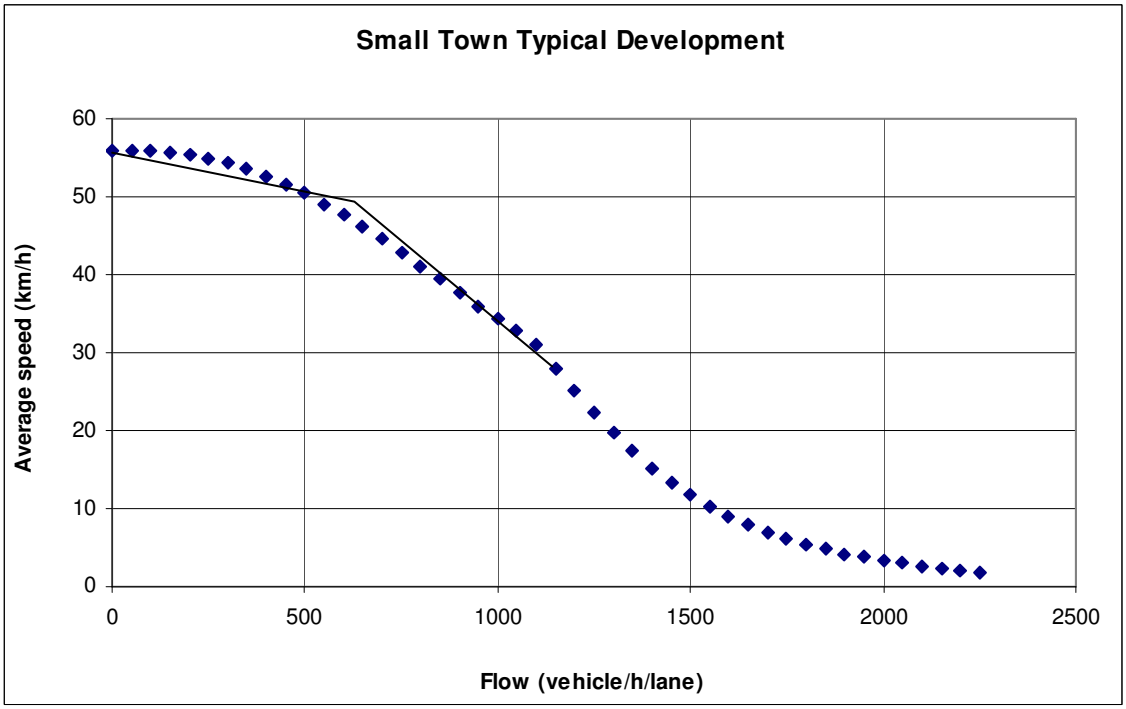

Noncentral Poor
Average speed (km/h)
50
45
40
35
30
25
20
15
10
5
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)

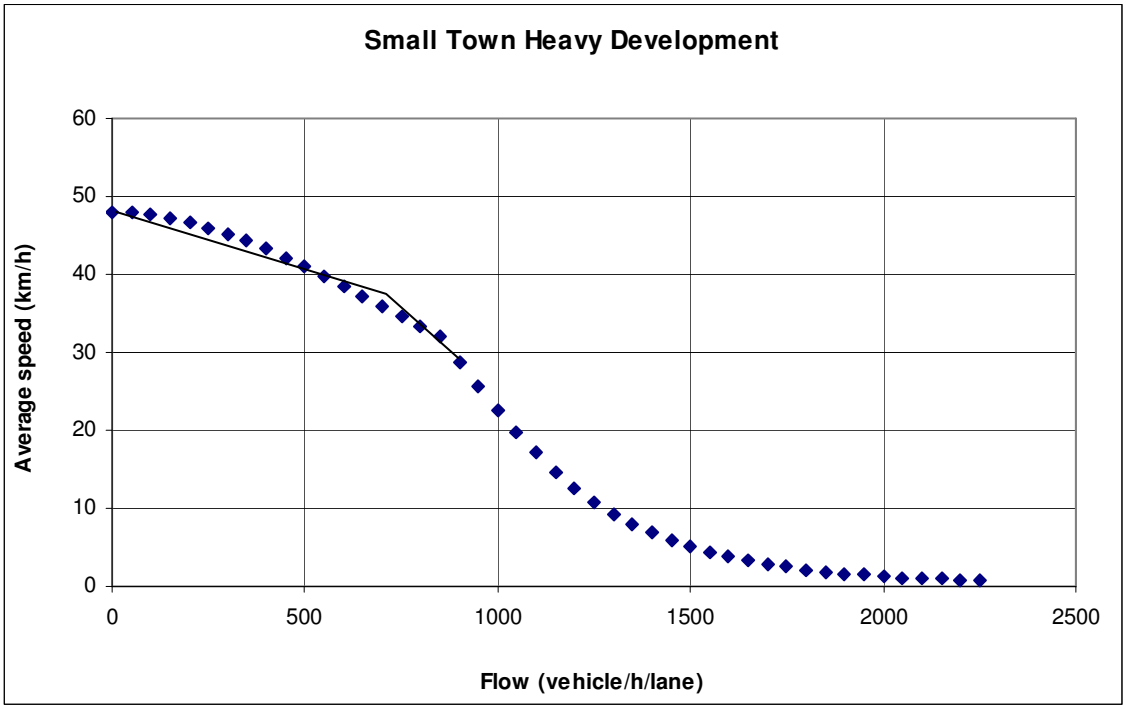

Urban Central Good
Average speed (km/h)
40
35
30
25
20
15
10
5
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)

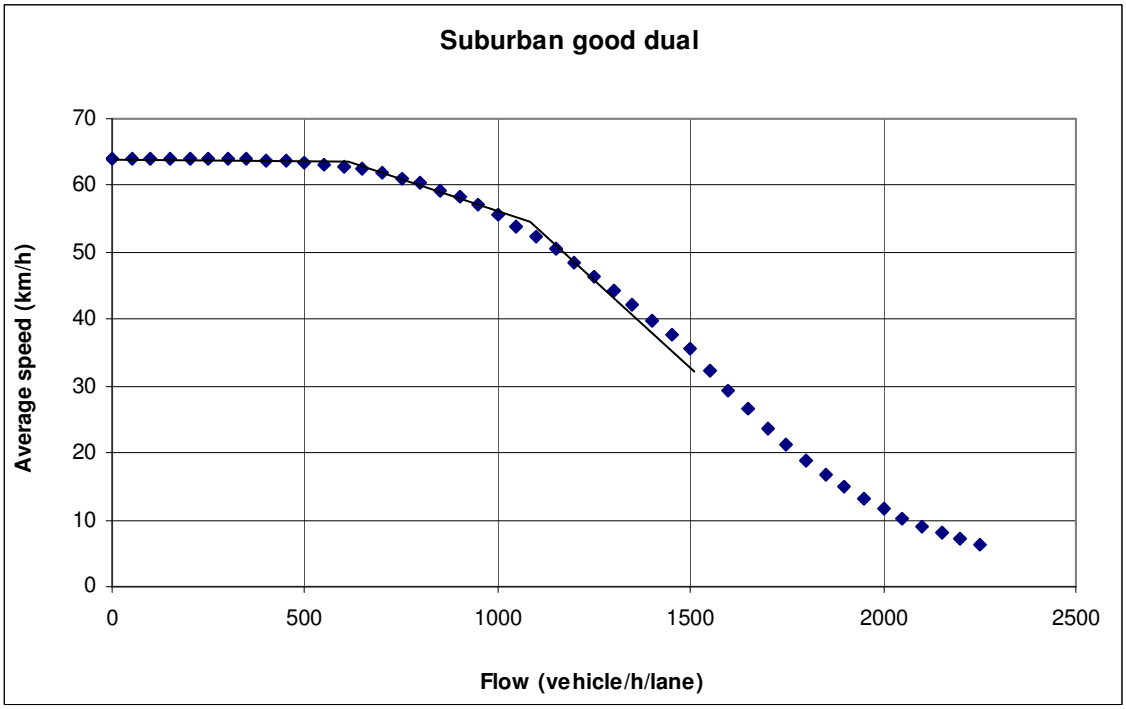

Urban Central Typical
Average speed (km/h)
40
35
30
25
20
15
10
5
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)

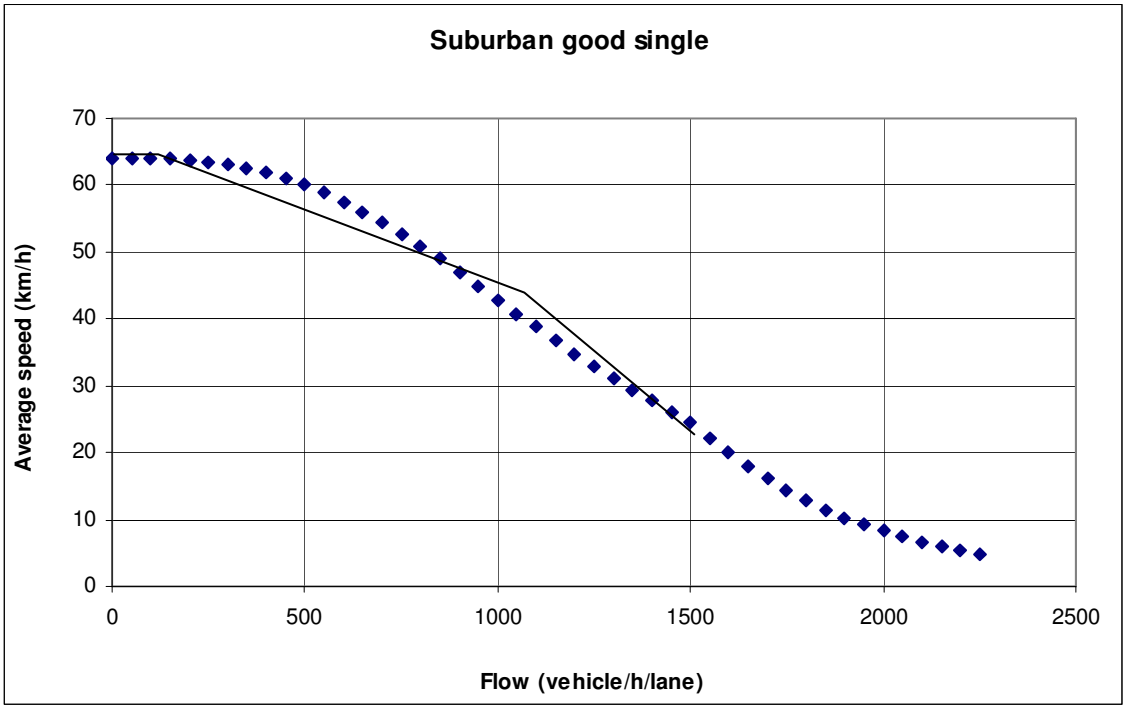

Urban Central Poor
Average speed (km/h)
30
25
20
15
10
5
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)

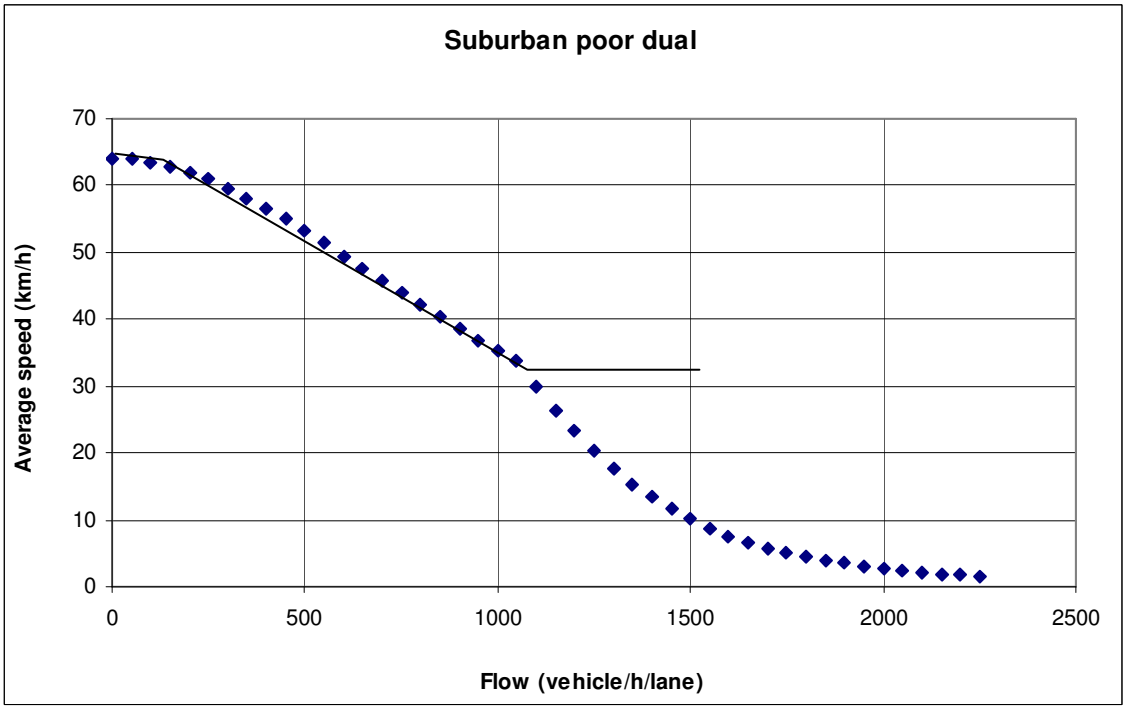

Small Town Light Development
Average speed (km/h)
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)

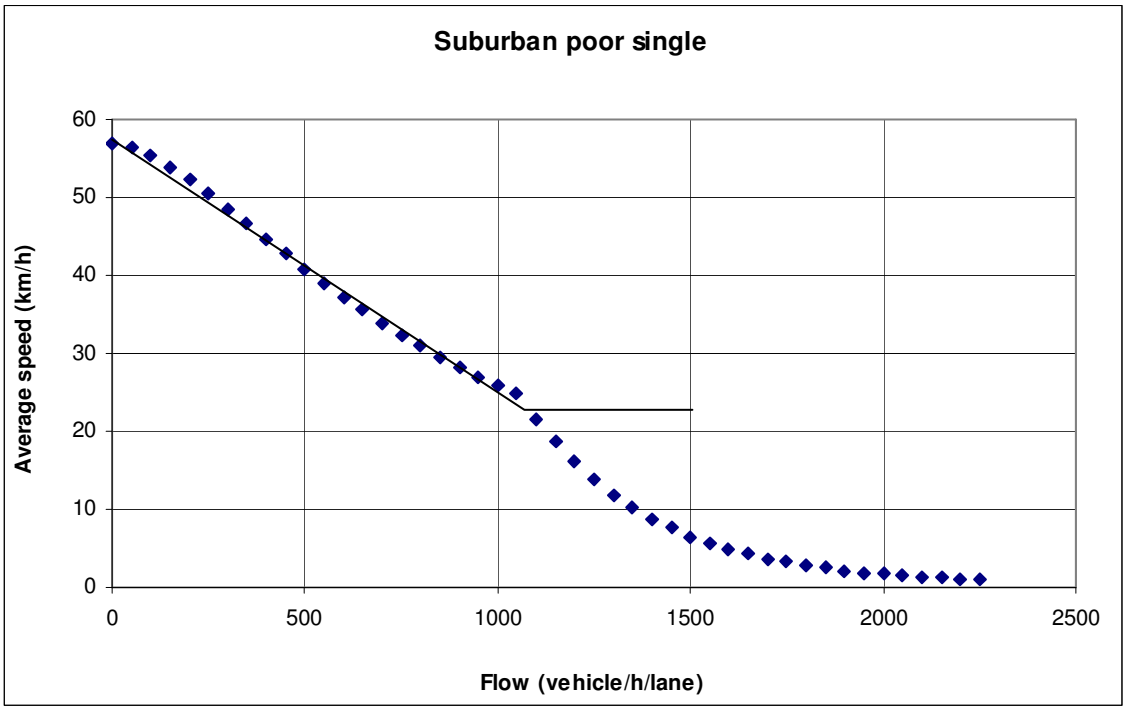

Small Town Typical Development
Average speed (km/h)
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)


Small Town Heavy Development
Average speed (km/h)
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)

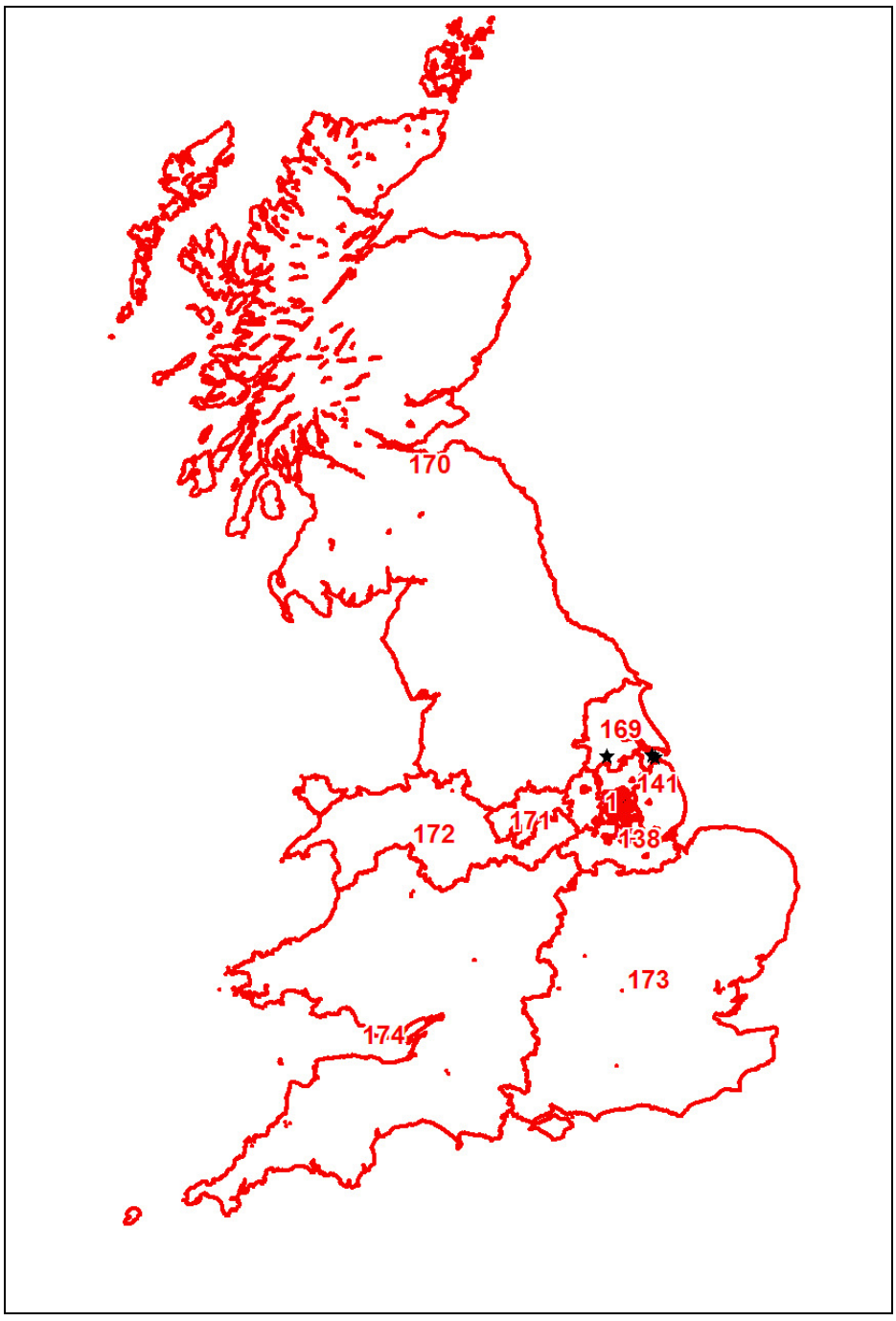

Suburban good dual
Average speed (km/h)
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)

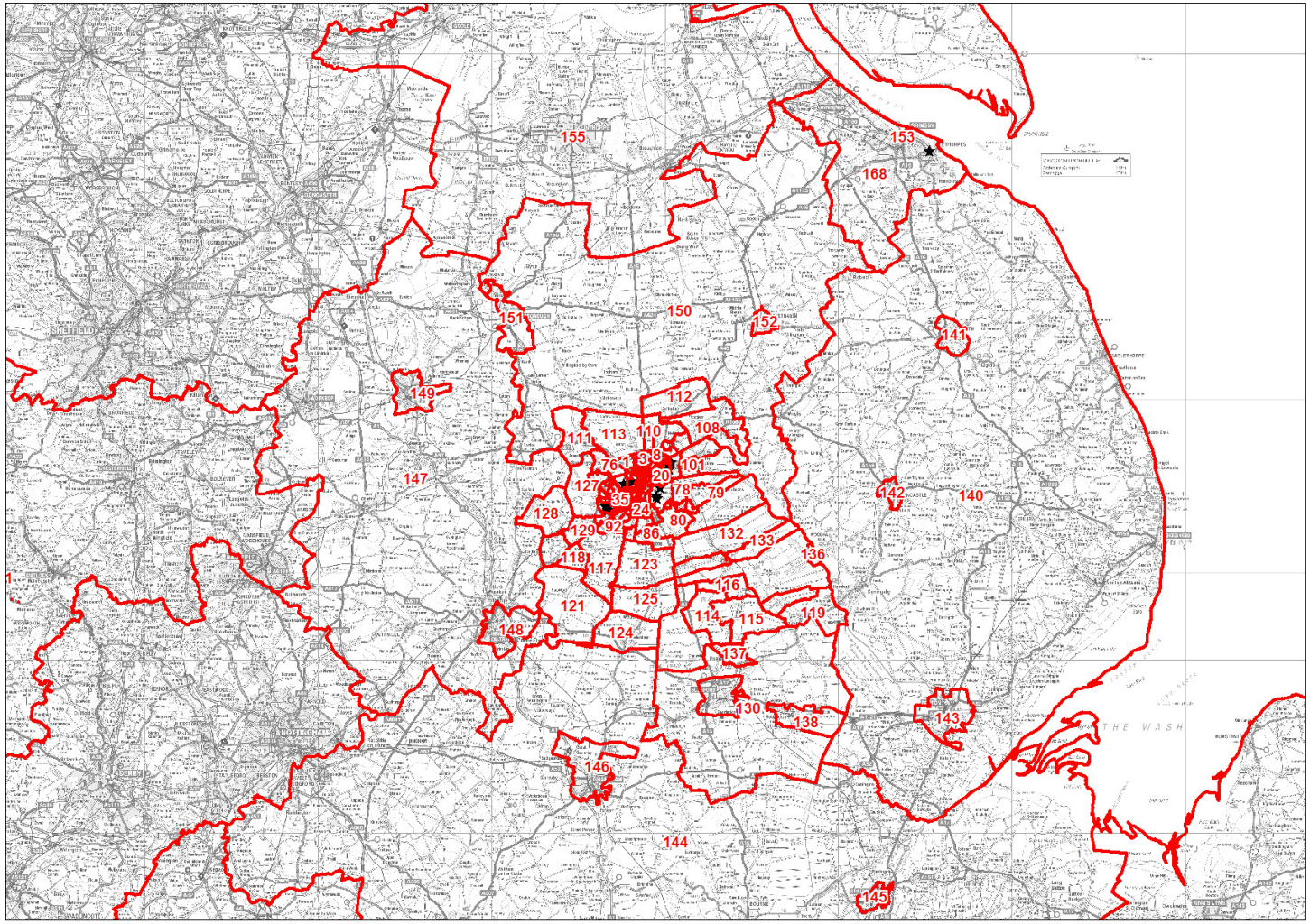

Suburban good single
Average speed (km/h)
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)

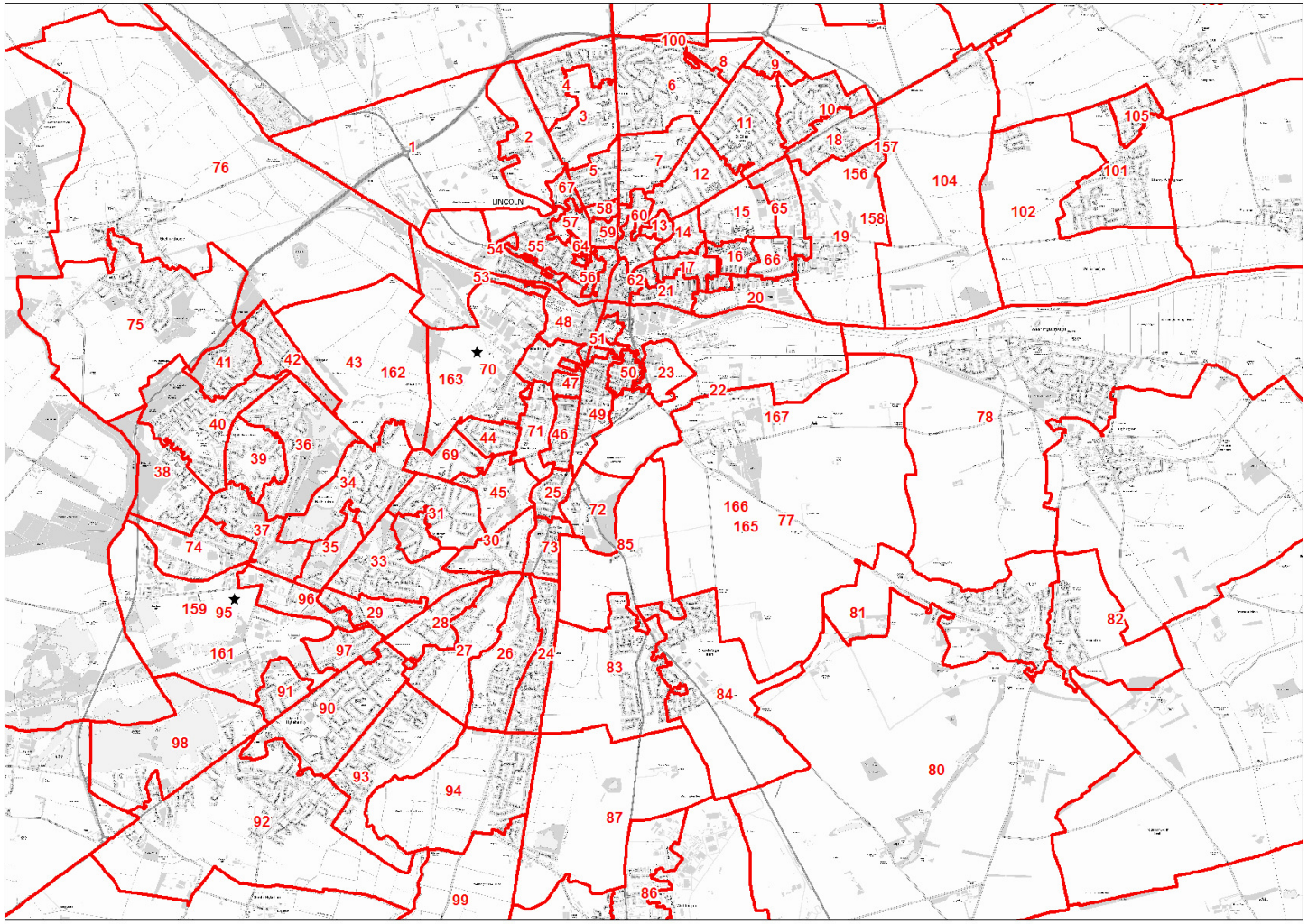

Suburban poor dual
Average speed (km/h)
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)


Suburban poor single
Average speed (km/h)
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
Flow (vehicle/h/lane)

Appendix D – Zoning System




155
153
168
151
150
152
141
149
112
111
113
110
108
76
3
8
101
20
147
127
35
78
79
142
140
128
24
80
129
92
86
132
133
136
118
117
123
116
125
121
114
115
119
148
124
137
130
138
143
146
144
145
THE WASH


LINCOLN
1
2
3
4
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9
10
11
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13
14
15
16
17
18
19
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83
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85
86
87
90
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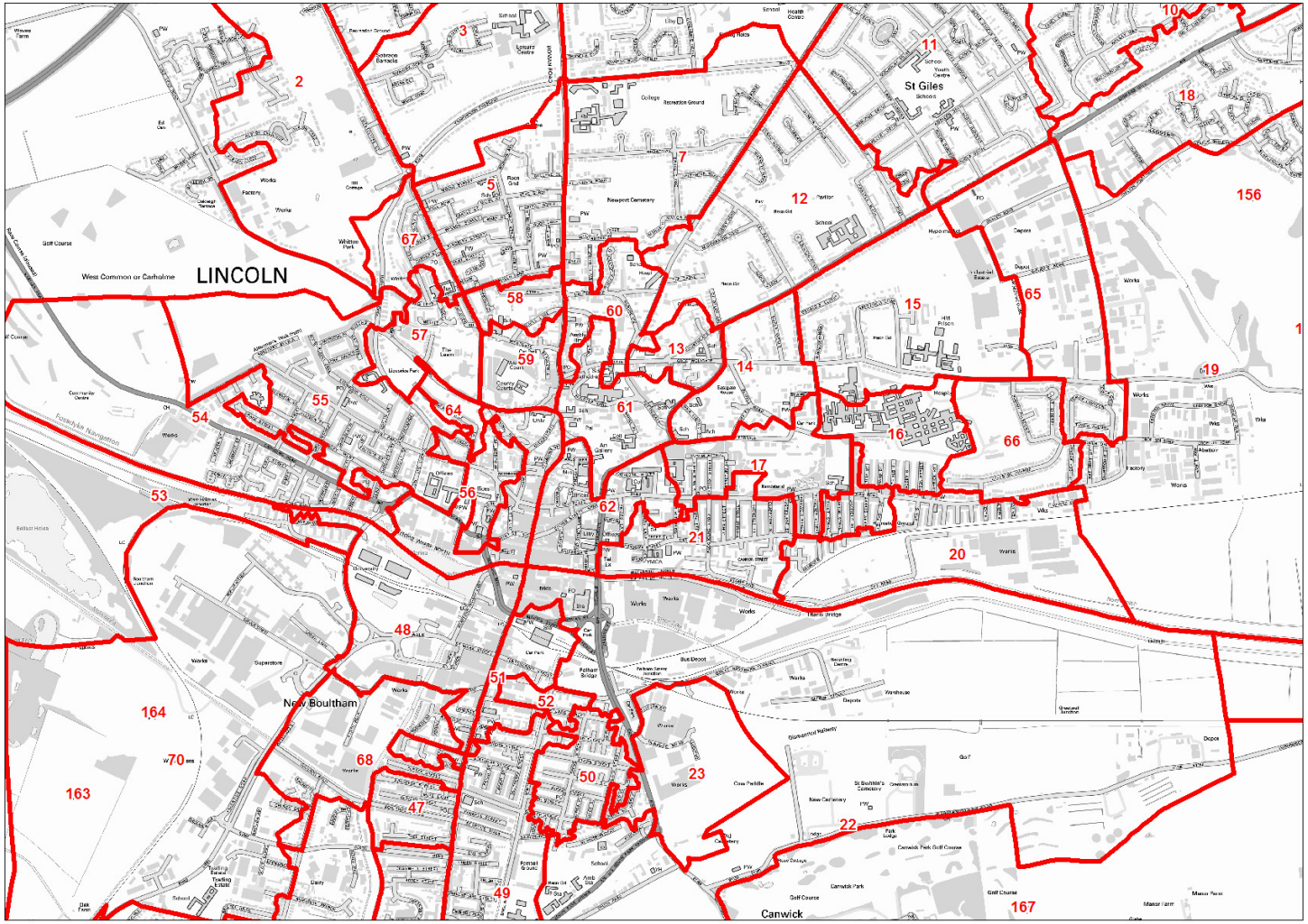
98
99
100
101
102
104
105
156
157
158
159
161
162
163
165
166
167


LINCOLN
St Giles
West Common or Carholme
New Boultham
Canwick
2
3
5
7
10
11
12
15
16
17
18
19
20
21
22
23
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
64
65
66
67
68
70
156
163
164
167

Zone Number	Zone Description	Level
1	Lincoln (main)	LPA
2	Lincoln (main)	LPA
3	Lincoln (main)	LPA
4	Lincoln (main)	LPA
5	Lincoln (main)	LPA
6	Lincoln (main)	LPA
7	Lincoln (main)	LPA
8	Lincoln (main)	LPA
9	Lincoln (main)	LPA
10	Lincoln (main)	LPA
11	Lincoln (main)	LPA
12	Lincoln (main)	LPA
13	Lincoln (main)	LPA
14	Lincoln (main)	LPA
15	Lincoln (main)	LPA
16	Lincoln (main)	LPA
17	Lincoln (main)	LPA
18	Lincoln (main)	LPA
19	Lincoln (main)	LPA
20	Lincoln (main)	LPA
21	Lincoln (main)	LPA
22	Lincoln (main)	LPA
23	Lincoln (main)	LPA
24	Lincoln (main)	LPA
25	Lincoln (main)	LPA
26	Lincoln (main)	LPA
27	Lincoln (main)	LPA
28	Lincoln (main)	LPA
29	Lincoln (main)	LPA
30	Lincoln (main)	LPA
31	Lincoln (main)	LPA
32	Lincoln (main)	LPA
33	Lincoln (main)	LPA
34	Lincoln (main)	LPA
35	Lincoln (main)	LPA
36	Birchwood	LPA
37	Birchwood	LPA
38	Birchwood	LPA
39	Birchwood	LPA
40	Birchwood	LPA
41	Birchwood	LPA
42	Birchwood	LPA
43	Lincoln (main)	LPA
44	Lincoln (main)	LPA
45	Lincoln (main)	LPA
		LPA
46	Lincoln (main)	

Zone Number	Zone Description	Level
47	Lincoln (main)	LPA
48	Lincoln (main)	LPA
49	Lincoln (main)	LPA
50	Lincoln (main)	LPA
51	Lincoln (main)	LPA
52	Lincoln (main)	LPA
53	Lincoln (main)	LPA
54	Lincoln (main)	LPA
55	Lincoln (main)	LPA
56	Lincoln (main)	LPA
57	Lincoln (main)	LPA
58	Lincoln (main)	LPA
59	Lincoln (main)	LPA
60	Lincoln (main)	LPA
61	Lincoln (main)	LPA
62	Lincoln (main)	LPA
63	Lincoln (main)	LPA
64	Lincoln (main)	LPA
65	Lincoln (main)	LPA
66	Lincoln (main)	LPA
67	Lincoln (main)	LPA
68	Lincoln (main)	LPA
69	Lincoln (main)	LPA
70	Lincoln (main)	LPA
71	Lincoln (main)	LPA
72	Lincoln (main)	LPA
73	Lincoln (main)	LPA
74	Birchwood	LPA
75	Skellingthorpe	LPA
76	Skellingthorpe	LPA
77	Lincoln (part of)	LPA
78	Heighington / Washingborough	LPA
79	Heighington / Washingborough	LPA
80	Branston	LPA
81	Branston	LPA
82	Branston	LPA
83	Bracebridge Heath	LPA
84	Bracebridge Heath	LPA
85	Bracebridge Heath	LPA
86	Waddington	LPA
87	Waddington	LPA
88	Waddington	LPA
89	Waddington	LPA
90	Lincoln (part of)	LPA
91	Lincoln (part of)	LPA
		LPA
92	Lincoln (part of)	

Zone Number	Zone Description	Level
93	Lincoln (part of)	LPA
94	Lincoln (part of)	LPA
95	Lincoln (part of)	LPA
96	Lincoln (part of)	LPA
97	Lincoln (part of)	LPA
98	Lincoln (part of)	LPA
99	Waddington	LPA
100	Lincoln (part of)	LPA
101	Cherry Willingham / Reepham	LPA
102	Rural	LPA
103	Cherry Willingham / Reepham	LPA
104	Rural	LPA
105	Cherry Willingham / Reepham	LPA
106	Nettleham	LPA
107	Nettleham	LPA
108	Rural	LPA
109	Rural	LPA
110	Rural	LPA
111	Saxilby	LPA
112	Welton / Dunholme	LPA
113	Rural	LPA
114	Rural	LPA
115	Rural	LPA
116	Rural	LPA
117	Rural	LPA
118	Rural	LPA
119	Rural	LPA
120	Rural	LPA
121	Rural	LPA
122	Rural	LPA
123	Rural	LPA
124	Rural	LPA
125	Rural	LPA
126	Rural	LPA
127	Rural	LPA
128	Rural	LPA
129	Rural	LPA
130	Rural	LPA
131	Rural	LPA
132	Rural	LPA
133	Metheringham	LPA
134	Rural	LPA
135	Metheringham	LPA
136	Woodhall Spa (part of)	LPA
137	Ruskinton	LPA
		LPA
138	Heckington	

Zone Number	Zone Description	Level
139	Sleaford	LPA
140	East Lindsey	External
141	Louth	External
142	Horncastle	External
143	Boston	External
144	South Kesteven	External
145	Spalding	External
146	Grantham	External
147	West Lindsey	External
148	Newark-On-Trent	External
149	Retford	External
150	West Lindsey	External
151	Gainsborough	External
152	Market Rasen	External
153	Grimsby - Point Zone	External
154	Cleethorpes - Point Zone	External
155	Scunthorpe - Point Zone	External
156	NEQ1 - Point Zone	LPA
157	NEQ2 - Point Zone	LPA
158	NEQ3 - Point Zone	LPA
159	SWQ1 - Point Zone	LPA
160	SWQ2 - Point Zone	LPA
161	SWQ3 - Point Zone	LPA
162	WGC1 - Point Zone	LPA
163	WGC2 - Point Zone	LPA
164	WGC3 - Point Zone	LPA
165	SEQ1 - Point Zone	LPA
166	SEQ2 - Point Zone	LPA
167	SEQ3 - Point Zone	LPA
168	Grimsby	External
169	Hull and A15	External
170	A1 North	External
171	Chesterfield, Mansfield and the Peak District	External
172	Nottingham, Derby and A50	External
173	A1 South	External
174	M42 and M69	External

Appendix E – Bus Routes

Bus Service	Route	Direction	Frequency		
			AM	IP	PM
1	Lincoln-Grantham	IB	2	6	1
		OB	2	12	2
2	Lincoln-Branston	IB	3	16	3
		OB	1	16	3
3	Lincoln-Grimsby	IB	2	10	2
		OB	2	12	2
4(1)	Lincoln-County Hospital	IB	2	16	3
		OB	3	16	3
4(2)	Lincoln-Nettleham	IB	1	4	0
		OB	1	6	0
5(1)	Lincoln-Boston	IB	1	7	1
		OB	1	10	1
5(2)	Lincoln-Er Estate	-	1	6	1
6	Lincoln-Skegness	IB	2	6	1
		OB	2	7	1
10(1)	Lincoln-Horncastle	IB	1	2	1
		OB	1	4	1
10(2)	Lincoln-Louth	IB	1	3	1
		OB	1	3	1
11	Lincoln-Welton	IB	2	12	2
		OB	2	12	2
13	Lincoln-Waddington	IB	2	12	2
		OB	2	12	2
15	Lincoln-Short Ferry	IB	1	13	2
		OB	3	13	2
27	Lincoln-North Hykeham	IB	5	35	5
		OB	5	35	5
29	Lincoln-Doddington	IB	1	6	1
		OB	1	6	2
31	Sleaford-Lincoln	IB	1	3	1
		OB	1	3	1
44	Lincoln-Birchwood	IB	4	24	4
		OB	4	24	4
46	Lincoln-Newark	IB	1	2	1
		OB	1	3	1
46A	Lincoln-Carlton Le Moorland	IB	0	1	1
		OB	0	2	1
66	Lincoln-Birchwood	IB	6	35	6
		OB	6	30	6
87	Lincoln-Newark	IB	1	2	1
		OB	0	2	1
100	Scunthorpe-Lincoln	IB	1	5	1
		OB	1	5	1
103	Lincoln-Scunthorpe	IB	1	3	1
		OB	1	3	1
106/107	Lincoln-Gainsborough	IB	1	3	1
		OB	1	3	2
777	Lincoln-Carltons	-	1	6	1

Appendix F – Calibration at Postcard Sites

AM Calibration

Site	Dir.	A Node	B Node	Obs. (pcu)	Mod. (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Inbound										
01	SB	5631	4135	642	580	62	-64%	2.5	✓	✓
02	SB	119512936	119527799	774	797	23	3%	0.8	✓	✓
03	NB	119537502	119529293	1042	1019	22	-2%	0.7	✓	✓
04	NB	119520663	119530689	652	809	157	24%	5.8	×	×
05	EB	119523255	119539035	329	434	105	32%	5.4	×	×
06	NB	119519586	119512782	1322	1171	151	-11%	4.3	✓	✓
07	WB	119545527	119516693	563	437	126	-22%	5.6	×	×
08	WB	119545520	119525748	443	504	61	14%	2.8	✓	✓
09	NB	119534819	119534820	1122	1157	36	3%	1.1	✓	✓
10	NB	119525785	119540776	458	409	49	-11%	2.4	✓	✓
11	NB	31	119536355	418	511	93	22%	4.3	✓	✓
11a	WB	119513147	119516945	329	285	44	-13%	2.5	✓	✓
12	EB	119512694	119532410	612	789	177	29%	6.7	×	×
			Total	**8,705**	**8,902**	**197**	**2%**	**2.1**	✓	✓
								Postcard Sites Passed	**9/13**	**9/13**
								% Passed	**69%**	**69%**
Outbound										
01	NB	5631	4135	642	580	62	-64%	2.5	✓	×
02	SB	119512936	119527799	774	797	23	3%	0.8	✓	✓
03	NB	119537502	119529293	1042	1019	22	-2%	0.7	✓	×
04	NB	119520663	119530689	652	809	157	24%	5.8	×	✓
05	EB	119523255	119539035	329	434	105	32%	5.4	×	✓
06	NB	119519586	119512782	1322	1171	151	-11%	4.3	✓	×
07	WB	119545527	119516693	563	437	126	-22%	5.6	×	✓
08	WB	119545520	119525748	443	504	61	14%	2.8	✓	✓
09	NB	119534819	119534820	1122	1157	36	3%	1.1	✓	✓
10	NB	119525785	119540776	458	409	49	-11%	2.4	✓	✓
11	NB	31	119536355	418	511	93	22%	4.3	✓	✓
11a	WB	119513147	119516945	329	285	44	-13%	2.5	✓	✓
12	EB	119512694	119532410	481	475	6	-1%	0.3	✓	✓
			Total	**5,384**	**5,010**	**374**	**-7%**	**5.2**	✓	×
								Postcard Sites Passed	**11/13**	**10/13**
								% Passed	**85%**	**77%**

IP Calibration

Site	Dir.	A Node	B Node	Obs. (pcu)	Mod. (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Inbound										
01	SB	5631	4135	196	130	66	-0.34	5.2	✓	×
02	SB	119512936	119527799	413	534	121	0.29	5.6	×	×
03	NB	119537502	119529293	578	582	4	0.01	0.2	✓	✓
04	NB	119520663	119530689	513	545	32	6%	1.4	✓	✓
05	EB	119523255	119539035	202	219	17	8%	1.2	✓	✓
06*	NB	119519586	119512782	822	822	0	0%	0.0	✓	✓
07	WB	119545527	119516693	199	169	30	-15%	2.2	✓	✓
08*	WB	119545520	119525748	223	223	0	0%	0.0	✓	✓
09	NB	119534819	119534820	641	678	38	6%	1.5	✓	✓
10	NB	119525785	119540776	455	415	41	-9%	1.9	✓	✓
11	NB	31	119536355	322	320	2	-1%	0.1	✓	✓
11a	WB	119513147	119516945	217	209	8	-4%	0.6	✓	✓
12	EB	119512694	119532410	540	577	37	7%	1.5	✓	✓
			Total	5,322	5,423	100	0.02	1.4	✓	✓
								Postcard Sites Passed	**12/13**	**11/13**
								% Passed	**92%**	**85%**
Outbound										
01	NB	5631	4135	190	164	26	-14%	2.0	✓	✓
02	SB	119512936	119527799	434	537	103	24%	4.7	×	✓
03	NB	119537502	119529293	553	452	101	-18%	4.5	×	✓
04	NB	119520663	119530689	526	567	42	8%	1.8	✓	✓
05	EB	119523255	119539035	221	235	14	6%	0.9	✓	✓
06	NB	119519586	119512782	894	864	30	-3%	1.0	✓	✓
07	WB	119545527	119516693	211	169	42	-20%	3.1	✓	✓
08*	WB	119545520	119525748	163	163	0	0%	0.0	✓	✓
09	NB	119534819	119534820	758	767	9	1%	0.3	✓	✓
10	NB	119525785	119540776	426	461	35	8%	1.7	✓	✓
11	NB	31	119536355	319	408	88	28%	4.6	✓	✓
11a	WB	119513147	119516945	225	241	15	7%	1.0	✓	✓
12	EB	119512694	119532410	558	615	57	10%	2.3	✓	✓
			Total	5,478	5,643	164	0.03	2.2	✓	✓
								Postcard Sites Passed	**11/13**	**13/13**
								% Passed	**85%**	**100%**

Note - * Denotes that count data was unavailable at these sites and so the observed count is set to equal the modelled count.

PM Calibration

Site	Dir.	A Node	B Node	Obs. (pcu)	Mod. (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Inbound										
01	SB	5631	4135	293	228	65	-0.22	4.0	✓	✓
02	SB	119512936	119527799	533	620	87	0.16	3.6	✓	✓
03	NB	119537502	119529293	597	644	46	0.08	1.9	✓	✓
04	NB	119520663	119530689	590	685	95	0.16	3.8	✓	✓
05	EB	119523255	119539035	277	379	102	0.37	5.6	×	×
06*	NB	119519586	119512782	1261	1261	0	0.00	0.0	✓	✓
07	WB	119545527	119516693	127	97	30	-0.24	2.8	✓	✓
08*	WB	119545520	119525748	272	272	0	0.00	0.0	✓	✓
09	NB	119534819	119534820	614	632	17	0.03	0.7	✓	✓
10	NB	119525785	119540776	473	491	18	0.04	0.8	✓	✓
11	NB	31	119536355	424	351	74	-0.17	3.7	✓	✓
11a	WB	119513147	119516945	402	327	75	-0.19	3.9	✓	✓
12	EB	119512694	119532410	542	575	33	0.06	1.4	✓	✓
			Total	6,407	6,562	155	2%	1.9	✓	✓
								Postcard Sites Passed	**12/13**	**12/13**
								% Passed	**92%**	**92%**
Outbound										
01	NB	5631	4135	608	566	42	-0.07	1.7	✓	✓
02	SB	119512936	119527799	688	660	28	-0.04	1.1	✓	✓
03	NB	119537502	119529293	1025	750	275	-0.27	9.2	×	×
04	NB	119520663	119530689	749	541	208	-0.28	8.2	×	×
05	EB	119523255	119539035	292	230	62	-0.21	3.8	✓	✓
06	NB	119519586	119512782	1165	945	220	-0.19	6.8	×	×
07	WB	119545527	119516693	506	372	134	-0.27	6.4	×	×
08*	WB	119545520	119525748	295	295	0	0.00	0.0	✓	✓
09	NB	119534819	119534820	1354	1080	274	-0.20	7.9	×	×
10	NB	119525785	119540776	740	828	89	0.12	3.2	✓	✓
11	NB	31	119536355	538	649	111	0.21	4.6	×	✓
11a	WB	119513147	119516945	236	259	23	0.10	1.5	✓	✓
12	EB	119512694	119532410	776	683	93	-0.12	3.4	✓	✓
			Total	8,971	7,858	1113	-12%	12.1	×	×
								Postcard Sites Passed	**7/13**	**8/13**
								% Passed	**54%**	**62%**

Appendix G – Screenline Calibration / Validation

AM Screenline Summary

Screenline	Dir.	Obs (pcu)	Mod (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
1	NB	1,767	1,638	129	-0.07	3.1	✓	✓
	SB	3,356	3,321	35	-0.01	0.6	✓	✓
2	EB	1,895	1,714	181	-0.10	4.2	✓	×
	WB	3,723	3,451	272	-0.07	4.5	✓	×
3	NB	1,371	1,362	9	-0.01	0.2	✓	✓
	SB	1,538	1,470	68	-0.04	1.8	✓	✓
4	EB	4,837	4,098	739	-0.15	11.1	×	×
	WB	3,237	2,869	368	-0.11	6.7	✓	×
5	NB	5,272	5,522	251	0.05	3.4	✓	✓
	SB	4,212	4,588	376	0.09	5.7	✓	×
6	EB	7,205	7,257	52	0.01	0.6	✓	✓
	WB	6,053	6,255	202	0.03	2.6	✓	✓
7	EB	5,555	5,464	91	-0.02	1.2	✓	✓
	WB	6,127	6,329	202	0.03	2.6	✓	✓
Screenlines Passed							**13/14**	**9/14**
Screenlines Pass Rate							**93%**	**64%**

AM Screenlines Calibration & Validation – Screenline 1

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 1 - Northbound										
A57 Saxilby Rd	119530689	119520663	Calibration	346	356	10	0.03	0.5	✓	✓
Fen Ln	119538005	119523323	Validation	73	65	8	-0.11	1.0	✓	✓
B1398 Middle St	4135	5631	Calibration	166	98	69	-0.41	6.0	✓	×
A15	119531101	4560	Calibration	520	669	149	0.29	6.1	×	×
A46 Lincoln Rd	119529293	119537502	Calibration	661	450	211	-0.32	8.9	×	×
			Screenline Total	**1,767**	**1,638**	**129**	**-0.07**	**3.1**	✓	✓
Screenline 1 - Southbound										
A57 Saxilby Rd	119520663	119530689	Calibration	652	809	157	0.24	5.8	×	×
Fen Ln	119523323	119538005	Calibration	110	99	11	-0.10	1.1	✓	✓
B1398 Middle St	5631	4135	Calibration	642	580	62	-0.10	2.5	✓	✓
A15	4560	119531101	Calibration	910	814	96	-0.11	3.3	✓	✓
A46 Lincoln Rd	119537502	119529293	Calibration	1,042	1019	22	-0.02	0.7	✓	✓
			Screenline Total	**3,356**	**3,321**	**35**	**-0.01**	**0.6**	✓	✓

AM Screenlines Calibration & Validation – Screenline 2

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 2 - Eastbound										
A158 Wragby Rd	119532410	119512694	Calibration	481	475	6	-0.01	0.3	✓	✓
Hawthorn Rd	119545621	119531885	Calibration	259	152	108	-0.41	7.5	×	×
Greetwell Rd	119516693	119545527	Calibration	123	112	11	-0.09	1.0	✓	✓
B1190 Washingborough Rd	119525748	119545520	Calibration	124	119	5	-0.04	0.4	✓	✓
Heighington Rd	119524079	119521125	Validation	97	64	33	-0.34	3.7	✓	✓
B1188 Lincoln Rd	119542251	119545512	Calibration	296	276	20	-0.07	1.2	✓	✓
A15 Sleaford Rd	119542296	119545503	Calibration	514	517	2	0.00	0.1	✓	✓
			Screenline Total	**1,895**	**1,714**	181	-0.10	4.2	✓	×
Screenline 2 - Westbound										
A158 Wragby Rd	119512694	119532410	Calibration	612	789	177	0.29	6.7	×	×
Hawthorn Rd	119531885	119545621	Calibration	506	344	162	-0.32	7.9	×	×
Greetwell Rd	119545527	119516693	Calibration	563	437	126	-0.22	5.6	×	×
B1190 Washingborough Rd	119545520	119525748	Calibration	443	504	61	0.14	2.8	✓	✓
Heighington Rd	119521125	119524079	Calibration	307	110	197	-0.64	13.6	×	×
B1188 Lincoln Rd	119545512	119542251	Calibration	712	725	14	0.02	0.5	✓	✓
A15 Sleaford Rd	119545503	119542296	Calibration	580	542	38	-0.07	1.6	✓	✓
			Screenline Total	**3,723**	**3,451**	272	-0.07	4.5	✓	×

AM Screenlines Calibration & Validation – Screenline 3

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 3 - Northbound										
Bloxholm Ln	119525811	119545622	Calibration	101	100	2	-0.02	0.2	✓	✓
A15 Sleaford Rd	119529229	119545504	Calibration	479	442	36	-0.08	1.7	✓	✓
A607 Grantham Rd	119535799	119544516	Calibration	428	395	33	-0.08	1.6	✓	✓
Brant Rd	119518650	119526790	Calibration	363	426	63	0.17	3.2	✓	✓
			Screenline Total	**1,371**	**1,362**	9	-0.01	0.2	✓	✓
Screenline 3 - Southbound										
Bloxholm Ln	119545622	119525811	Validation	100	47	52	-0.53	6.1	✓	×
A15 Sleaford Rd	119545504	119529229	Calibration	419	469	50	0.12	2.4	✓	✓
A607 Grantham Rd	119544516	119535799	Calibration	575	434	140	-0.24	6.2	×	×
Brant Rd	119526790	119518650	Calibration	444	519	75	0.17	3.4	✓	✓
			Screenline Total	**1,538**	**1,470**	68	-0.04	1.8	✓	✓

AM Screenlines Calibration & Validation – Screenline 4

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 4 - Eastbound										
Lincoln Rd	119513975	119524365	Calibration	392	433	41	0.10	2.0	✓	✓
A1434 Newark Rd	119531204	165	Calibration	636	593	44	-0.07	1.8	✓	✓
B1190 Doddington Rd	119545645	119530811	Validation	507	855	349	0.69	13.4	×	×
B1378 Skellingthorpe Rd	119536558	119516921	Validation	1,085	528	557	-0.51	19.6	×	×
A46	119514146	119536562	Calibration	1,962	1637	325	-0.17	7.7	×	×
A57 Saxilby Rd	119520663	119530689	Calibration	652	809	157	0.24	5.8	×	×
Fen Ln	119523323	119538005	Calibration	110	99	11	-0.10	1.1	✓	✓
			Screenline Total	**4,837**	**4,098**	**739**	**-0.15**	**11.1**	×	×
Screenline 4 - Westbound										
Lincoln Rd	119524365	119513975	Calibration	308	273	35	-0.11	2.1	✓	✓
A1434 Newark Rd	165	119531204	Calibration	597	562	35	-0.06	1.5	✓	✓
B1190 Doddington Rd	119530811	119545645	Validation	728	1053	325	0.45	10.9	×	×
B1378 Skellingthorpe Rd	119516921	119536558	Validation	485	342	143	-0.30	7.0	×	×
A46	119531738	119529131	Calibration	1,428	1272	156	-0.11	4.3	✓	✓
A57 Saxilby Rd	119530689	119520663	Calibration	346	356	10	0.03	0.5	✓	✓
Fen Ln	119538005	119523323	Validation	73	65	8	-0.11	1.0	✓	✓
			Screenline Total	**3,237**	**2,869**	**368**	**-0.11**	**6.7**	✓	×

AM Screenlines Calibration & Validation – Screenline 5

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 5 - Northbound										
A15 Canwick Rd	119532688	119522918	Calibration	1,994	2282	289	0.14	6.2	✓	×
B1262 High St	119516576	119514127	Calibration	368	404	36	0.10	1.8	✓	✓
B1003 Brayford Wharf East	119517044	119518823	Validation	86	29	57	-0.66	7.5	✓	×
Brayford Way	119526713	119527712	Calibration	862	1170	308	0.36	9.7	×	×
A46	119514146	119536562	Calibration	1,962	1637	325	-0.17	7.7	×	×
			Screenline Total	**5,272**	**5,522**	251	0.05	3.4	✓	✓
Screenline 5 - Southbound										
A15 Canwick Rd	119522918	119532688	Calibration	1,216	1281	65	0.05	1.9	✓	✓
B1262 High St	119514127	119516576	Calibration	315	566	251	0.80	11.9	×	×
B1003 Brayord Wharf East	119518823	119517044	Calibration	206	562	356	1.72	18.1	×	×
Brayford Way	119527712	119526713	Calibration	1,046	907	140	-0.13	4.5	✓	✓
A46	119531738	119529131	Calibration	1,428	1272	156	-0.11	4.3	✓	✓
			Screenline Total	**4,212**	**4,588**	376	0.09	5.7	✓	×

AM Screenlines Calibration & Validation – Screenline 6

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 6 - Eastbound										
A46	119529186	119528632	Validation	981	857	124	-0.13	4.1	✓	✓
Scopwick Pl	119524096	119536786	Validation	250	255	5	0.02	0.3	✓	✓
B1273 Longdales Rd	119527203	119545636	Validation	583	715	132	0.23	5.2	×	×
Broadway	119525820	119528801	Validation	139	139	0	0.00	0.0	✓	✓
Newport	119525571	119529003	Validation	352	218	134	-0.38	7.9	×	×
Mildmay St	119533604	119536871	Validation	31	74	43	1.36	5.9	✓	×
Burton Rd	119518285	119515671	Validation	501	409	93	-0.18	4.3	✓	✓
Upper Long Leys Rd	119519544	119529869	Validation	19	0	19	-0.99	6.1	✓	×
Carline Rd	119528366	119539263	Validation	87	32	55	-0.63	7.2	✓	×
B1308 West Parade	119524201	119524200	Validation	424	339	85	-0.20	4.3	✓	✓
A57 Newland	119532301	119525809	Validation	879	1165	286	0.32	8.9	×	×
Brayford Wharf North	119534515	119514190	Validation	51	0	51	-1.00	10.1	✓	×
B1003 Ropewalk	119541066	119528600	Validation	698	567	131	-0.19	5.2	×	×
Beevor St	119512888	119535466	Validation	165	143	21	-0.13	1.7	✓	✓
B1360 Valentine Rd	119518113	119519166	Validation	429	412	17	-0.04	0.8	✓	✓
Skellingthorpe Rd	119525974	5198	Validation	282	334	52	0.18	2.9	✓	✓
Moorland Ave	119526358	119536569	Validation	263	263	0	0.00	0.0	✓	✓
B1190 Doddington Rd	119532776	119534353	Validation	181	75	106	-0.59	9.4	×	×
A1434 Newark Rd	119526471	171	Validation	462	832	371	0.80	14.6	×	×
Hykeham Rd	119538384	119521800	Validation	429	429	0	0.00	0.0	✓	✓
A46	119514146	119536562	Calibration	1,962	1637	325	-0.17	7.7	×	×
			Screenline Total	**7205**	**7257**	52	0.01	0.6	✓	✓

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 6 - Westbound										
A46	119528632	119529186	Validation	805	916	111	0.14	3.8	✓	✓
Scopwick Pl	119536786	119524096	Validation	213	166	48	-0.22	3.5	✓	✓
B1273 Longdales Rd	119545636	119527203	Validation	763	665	98	-0.13	3.7	✓	✓
Broadway	119528801	119525820	Validation	28	28	0	0.00	0.0	✓	✓
Newport	119529003	119525571	Validation	127	127	0	0.00	0.0	✓	✓
Mildmay St	119536871	119533604	Validation	72	72	0	0.00	0.0	✓	✓
Burton Rd	119515671	119518285	Validation	37	37	0	0.00	0.0	✓	✓
Upper Long Leys Rd	119529869	119519544	Validation	105	105	0	0.00	0.0	✓	✓
Carline Rd	119539263	119528366	Validation	33	33	0	0.00	0.0	✓	✓
B1308 West Parade	119524200	119524201	Validation	393	736	343	0.87	14.4	×	×
A57 Newland	119525809	119532301	Validation	490	288	202	-0.41	10.2	×	×
Brayford Wharf North	119514190	119534515	Validation	11	0	11	-1.00	4.7	✓	✓
B1003 Ropewalk	119528600	119524325	Validation	294	740	446	1.52	19.6	×	×
Beevor St	119535466	119512888	Validation	78	70	9	-0.11	1.0	✓	✓
B1360 Valentine Rd	119519166	119518113	Validation	676	315	361	-0.53	16.2	×	×
Skellingthorpe Rd	5198	119525974	Validation	278	328	50	0.18	2.9	✓	✓
Moorland Ave	119536569	119526358	Validation	365	365	0	0.00	0.0	✓	✓
B1190 Doddington Rd	119534353	119532776	Validation	428	445	18	0.04	0.8	✓	✓
A1434 Newark Rd	171	119526471	Validation	300	263	37	-0.12	2.2	✓	✓
Hykeham Rd	119521800	119538384	Validation	555	555	0	0.00	0.0	✓	✓
			Screenline Total	**6053**	**6255**	202	0.03	2.6	✓	✓

AM Screenlines Calibration & Validation – Screenline 7

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 7 - Eastbound										
A158	119516326	119515142	Calibration	820	607	212	-0.26	7.9	×	×
Wolsey Way	119519162	5124	Validation	133	133	0	0.00	0.0	✓	✓
Outer Circle Dr	119519672	119529037	Calibration	301	269	32	-0.11	1.9	✓	✓
Oval Approach	119535701	119514617	Validation	56	56	0	0.00	0.0	✓	✓
B1182 Ruskin Ave	119513411	119515357	Calibration	565	580	14	0.03	0.6	✓	✓
Byron Ave	119524094	119524093	Validation	99	99	0	0.00	0.0	✓	✓
Lee Rd	119534350	119536525	Validation	512	512	0	0.00	0.0	✓	✓
East Gate	119524011	119526595	Validation	77	77	0	0.00	0.0	✓	✓
A15 Wragby Rd	119529580	119523371	Validation	972	972	0	0.00	0.0	✓	✓
B1308 Monks Rd	119524816	119517474	Calibration	467	550	83	0.18	3.7	✓	✓
Croft St	119516165	119522506	Calibration	155	0	155	-1.00	17.6	×	×
Waterside North	119535794	119527059	Validation	26	58	32	1.21	4.9	✓	✓
Waterside South	119537117	119541695	Validation	53	138	85	1.60	8.7	✓	×
Great Northern Terrace	119521029	119531615	Calibration	319	438	118	0.37	6.1	×	×
Washingborough Rd	119534820	3533	Calibration	125	119	6	-0.05	0.5	✓	✓
Heightington Rd	119518310	2821	Validation	64	64	0	0.00	0.0	✓	✓
B1188 Lincoln Rd	119542251	119545512	Calibration	296	276	20	-0.07	1.2	✓	✓
A15 London Rd	119542296	119545503	Calibration	514	517	2	0.00	0.1	✓	✓
			Screenline Total	**5555**	**5464**	91	-0.02	1.2	✓	✓

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 7 - Westbound										
A158	119515142	119516326	Calibration	675	483	191	-0.28	7.9	×	×
Wolsey Way	5124	119519162	Validation	194	194	0	0.00	0.0	✓	✓
Outer Circle Dr	119529037	119519672	Calibration	182	151	31	-0.17	2.4	✓	✓
Oval Approach	119514617	119535701	Validation	63	63	0	0.00	0.0	✓	✓
B1182 Ruskin Ave	119515357	119513411	Calibration	808	453	355	-0.44	14.1	×	×
Byron Ave	119524093	119524094	Validation	35	35	0	0.00	0.0	✓	✓
Lee Rd	119536525	119534350	Validation	219	219	0	0.00	0.0	✓	✓
East Gate	119526595	119524011	Calibration	224	108	117	-0.52	9.1	×	×
A15 Wragby Rd	119523371	119529580	Calibration	625	1421	796	1.27	24.9	×	×
Lindum Terrace	119533260	119537871	Validation	106	0	105	-1.00	14.4	×	×
B1308 Monks Rd	119517474	119524816	Calibration	349	610	261	0.75	11.9	×	×
Croft St	119522506	119516165	Calibration	351	281	70	-0.20	3.9	✓	✓
Waterside North	119527059	119535794	Calibration	147	218	71	0.49	5.3	✓	×
Waterside South	119541695	119537117	Calibration	178	62	116	-0.65	10.5	×	×
Great Northern Terrace	119531615	119521029	Calibration	122	150	28	0.23	2.4	✓	✓
Washingborough Rd	3533	119534820	Calibration	448	504	56	0.12	2.6	✓	✓
Heightington Rd	2821	119518310	Validation	110	110	0	0.00	0.0	✓	✓
B1188 Lincoln Rd	119545512	119542251	Calibration	712	725	14	0.02	0.5	✓	✓
A15 London Rd	119545503	119542296	Calibration	580	542	38	-0.07	1.6	✓	✓
			Screenline Total	**6127**	**6329**	202	0.03	2.6	✓	✓

IP Screenline Summary

Screenline	Dir.	Obs (pcu)	Mod (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
1	NB	1,814	1,849	35	0.02	0.8	✓	✓
	SB	1,840	1,818	21	-0.01	0.5	✓	✓
2	EB	1,929	1,965	36	0.02	0.8	✓	✓
	WB	1,843	1,895	52	0.03	1.2	✓	✓
3	NB	855	881	25	0.03	0.9	✓	✓
	SB	1,021	1,048	27	0.03	0.8	✓	✓
4	EB	3,512	3,545	33	0.01	0.6	✓	✓
	WB	3,617	3,617	0	0.00	0.0	✓	✓
5	NB	3,510	4,015	505	0.14	8.2	×	×
	SB	3,904	4,520	615	0.16	9.5	×	×
6	EB	5,594	5,272	322	-0.06	4.4	✓	×
	WB	5,472	5,371	101	-0.02	1.4	✓	✓
7	EB	4,803	4,721	82	-0.02	1.2	✓	✓
	WB	5,318	5,123	196	-0.04	2.7	✓	✓
Screenlines Passed							**12/14**	**12/14**
Screenlines Pass Rate							**86%**	**86%**

IP Screenlines Calibration & Validation – Screenline 1

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 1 - Northbound										
A57 Saxilby Rd	119530689	119520663	Calibration	526	567	42	0.1	1.8	✓	✓
Fen Ln	119538005	119523323	Validation	40	0	40	-1.0	8.9	✓	×
B1398 Middle St	4135	5631	Calibration	190	164	26	-0.1	2.0	✓	✓
A15	119531101	4560	Calibration	506	666	160	0.3	6.6	×	×
A46 Lincoln Rd	119529293	119537502	Calibration	553	452	101	-0.2	4.5	×	✓
			Screenline Total	**1,814**	**1,849**	35	0.02	0.8	✓	✓
Screenline 1 - Southbound										
A57 Saxilby Rd	119520663	119530689	Calibration	513	545	32	0.1	1.4	✓	✓
Fen Ln	119523323	119538005	Calibration	43	0	43	-1.0	9.3	✓	×
B1398 Middle St	5631	4135	Calibration	196	130	66	-0.3	5.2	✓	×
A15	4560	119531101	Calibration	509	561	52	0.1	2.3	✓	✓
A46 Lincoln Rd	119537502	119529293	Calibration	578	582	4	0.0	0.2	✓	✓
			Screenline Total	**1,840**	**1,818**	21	-0.01	0.5	✓	✓

IP Screenlines Calibration & Validation – Screenline 2

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 2 - Eastbound										
A158 Wragby Rd	119532410	119512694	Calibration	558	615	57	0.1	2.3	✓	✓
Hawthorn Rd	119545621	119531885	Calibration	143	143	0	0.0	0.0	✓	✓
Greetwell Rd	119516693	119545527	Calibration	211	169	42	-0.2	3.1	✓	✓
B1190 Washingborough Rd	119525748	119545520	Calibration	163	163	0	0.0	0.0	✓	✓
Heighington Rd	119524079	119521125	Validation	159	124	35	-0.2	3.0	✓	✓
B1188 Lincoln Rd	119542251	119545512	Calibration	387	379	8	0.0	0.4	✓	✓
A15 Sleaford Rd	119542296	119545503	Calibration	308	373	65	0.2	3.5	✓	✓
			Screenline Total	**1,929**	**1,965**	36	0.02	0.8	✓	✓
Screenline 2 - Westbound										
A158 Wragby Rd	119512694	119532410	Calibration	540	577	37	0.1	1.5	✓	✓
Hawthorn Rd	119531885	119545621	Calibration	122	122	0	0.0	0.0	✓	✓
Greetwell Rd	119545527	119516693	Calibration	199	169	30	-0.2	2.2	✓	✓
B1190 Washingborough Rd	119545520	119525748	Calibration	223	223	0	0.0	0.0	✓	✓
Heighington Rd	119521125	119524079	Calibration	94	95	1	0.0	0.1	✓	✓
B1188 Lincoln Rd	119545512	119542251	Calibration	371	356	15	0.0	0.8	✓	✓
A15 Sleaford Rd	119545503	119542296	Calibration	294	353	59	0.2	3.3	✓	✓
			Screenline Total	**1,843**	**1,895**	52	0.03	1.2	✓	✓

IP Screenlines Calibration & Validation – Screenline 3

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 3 - Northbound										
Bloxholm Ln	119525811	119545622	Calibration	37	32	5	-0.1	0.8	✓	✓
A15 Sleaford Rd	119529229	119545504	Calibration	258	321	63	0.2	3.7	✓	✓
A607 Grantham Rd	119535799	119544516	Calibration	322	263	59	-0.2	3.4	✓	✓
Brant Rd	119518650	119526790	Calibration	238	264	26	0.1	1.6	✓	✓
			Screenline Total	**855**	**881**	25	0.03	0.9	✓	✓
Screenline 3 - Southbound										
Bloxholm Ln	119545622	119525811	Validation	43	18	25	-0.6	4.6	✓	✓
A15 Sleaford Rd	119545504	119529229	Calibration	265	355	89	0.3	5.1	✓	×
A607 Grantham Rd	119544516	119535799	Calibration	301	265	37	-0.1	2.2	✓	✓
Brant Rd	119526790	119518650	Calibration	411	411	0	0.0	0.0	✓	✓
			Screenline Total	**1,021**	**1,048**	27	0.03	0.8	✓	✓

IP Screenlines Calibration & Validation – Screenline 4

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 4 - Eastbound										
Lincoln Rd	119513975	119524365	Calibration	283	309	25	0.1	1.5	✓	✓
A1434 Newark Rd	119531204	165	Calibration	650	543	107	-0.2	4.4	×	✓
B1190 Doddington Rd	119545645	119530811	Validation	553	695	142	0.3	5.7	×	×
B1378 Skellingthorpe Rd	119536558	119516921	Validation	389	377	12	0.0	0.6	✓	✓
A46	119514146	119536562	Calibration	1080	1075	4	0.0	0.1	✓	✓
A57 Saxilby Rd	119520663	119530689	Calibration	513	545	32	0.1	1.4	✓	✓
Fen Ln	119523323	119538005	Calibration	43	0	43	-1.0	9.3	✓	×
			Screenline Total	**3,512**	**3,545**	33	0.01	0.6	✓	✓
Screenline 4 - Westbound										
Lincoln Rd	119524365	119513975	Calibration	274	228	46	-0.2	2.9	✓	✓
A1434 Newark Rd	165	119531204	Calibration	622	463	159	-0.3	6.8	×	×
B1190 Doddington Rd	119530811	119545645	Validation	573	747	174	0.3	6.8	×	×
B1378 Skellingthorpe Rd	119516921	119536558	Validation	483	350	132	-0.3	6.5	×	×
A46	119531738	119529131	Calibration	1100	1261	161	0.1	4.7	✓	✓
A57 Saxilby Rd	119530689	119520663	Calibration	526	567	42	0.1	1.8	✓	✓
Fen Ln	119538005	119523323	Validation	40	0	40	-1.0	8.9	✓	×
			Screenline Total	**3,617**	**3,617**	0	0.00	0.0	✓	✓

IP Screenlines Calibration & Validation – Screenline 5

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 5 - Northbound										
A15 Canwick Rd	119532688	119522918	Calibration	1202	1443	241	0.2	6.6	×	×
B1262 High St	119516576	119514127	Calibration	279	352	72	0.3	4.1	✓	✓
B1003 Brayford Wharf East	119517044	119518823	Validation	104	0	104	-1.0	14.4	×	×
Brayford Way	119526713	119527712	Calibration	845	1145	300	0.4	9.5	×	×
A46	119514146	119536562	Calibration	1080	1075	4	0.0	0.1	✓	✓
			Screenline Total	**3,510**	**4,015**	505	0.14	8.2	×	×
Screenline 5 - Southbound										
A15 Canwick Rd	119522918	119532688	Calibration	1341	1335	7	0.0	0.2	✓	✓
B1262 High St	119514127	119516576	Calibration	306	609	303	1.0	14.2	×	×
B1003 Brayord Wharf East	119518823	119517044	Calibration	259	433	174	0.7	9.3	×	×
Brayford Way	119527712	119526713	Calibration	899	883	16	0.0	0.5	✓	✓
A46	119531738	119529131	Calibration	1100	1261	161	0.1	4.7	✓	✓
			Screenline Total	**3,904**	**4,520**	615	0.16	9.5	×	×

IP Screenlines Calibration & Validation – Screenline 6

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 6 - Eastbound										
A46	119529186	119528632	Validation	821	720	100	-0.1	3.6	✓	✓
Scopwick Pl	119524096	119536786	Validation	179	173	6	0.0	0.4	✓	✓
B1273 Longdales Rd	119527203	119545636	Validation	576	528	49	-0.1	2.1	✓	✓
Broadway	119525820	119528801	Validation	1	1	0	0.0	0.0	✓	✓
Newport	119525571	119529003	Validation	104	104	0	0.0	0.0	✓	✓
Mildmay St	119533604	119536871	Validation	45	45	0	0.0	0.0	✓	✓
Burton Rd	119518285	119515671	Validation	160	160	0	0.0	0.0	✓	✓
Upper Long Leys Rd	119519544	119529869	Validation	0	0	0	0.0	0.0	✓	✓
Carline Rd	119528366	119539263	Validation	11	11	0	0.0	0.0	✓	✓
B1308 West Parade	119524201	119524200	Validation	298	368	69	0.2	3.8	✓	✓
A57 Newland	119532301	119525809	Validation	704	817	113	0.2	4.1	×	✓
Brayford Wharf North	119534515	119514190	Validation	6	0	6	-1.0	3.6	✓	✓
B1003 Ropewalk	119541066	119528600	Validation	525	377	147	-0.3	6.9	×	×
Beevor St	119512888	119535466	Validation	68	169	100	1.5	9.2	×	×
B1360 Valentine Rd	119518113	119519166	Validation	601	323	277	-0.5	12.9	×	×
Skellingthorpe Rd	119525974	5198	Validation	307	290	16	-0.1	0.9	✓	✓
Moorland Ave	119526358	119536569	Validation	239	239	0	0.0	0.0	✓	✓
B1190 Doddington Rd	119532776	119534353	Validation	255	218	37	-0.1	2.4	✓	✓
A1434 Newark Rd	119526471	171	Validation	402	437	35	0.1	1.7	✓	✓
Hykeham Rd	119538384	119521800	Validation	291	291	0	0.0	0.0	✓	✓
A46	119514146	119536562	Calibration	821	720	100	-0.1	3.6	✓	✓
			Screenline Total	**5594**	**5272**	322	-0.06	4.4	✓	×

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 6 - Westbound										
A46	119528632	119529186	Validation	885	958	73	0.1	2.4	✓	✓
Scopwick Pl	119536786	119524096	Validation	177	138	39	-0.2	3.1	✓	✓
B1273 Longdales Rd	119545636	119527203	Validation	545	591	46	0.1	1.9	✓	✓
Broadway	119528801	119525820	Validation	12	12	0	0.0	0.0	✓	✓
Newport	119529003	119525571	Validation	179	179	0	0.0	0.0	✓	✓
Mildmay St	119536871	119533604	Validation	50	50	0	0.0	0.0	✓	✓
Burton Rd	119515671	119518285	Validation	72	72	0	0.0	0.0	✓	✓
Upper Long Leys Rd	119529869	119519544	Validation	72	72	0	0.0	0.0	✓	✓
Carline Rd	119539263	119528366	Validation	20	20	0	0.0	0.0	✓	✓
B1308 West Parade	119524200	119524201	Validation	390	676	286	0.7	12.4	×	×
A57 Newland	119525809	119532301	Validation	427	258	169	-0.4	9.1	×	×
Brayford Wharf North	119514190	119534515	Validation	7	0	7	-1.0	3.8	✓	✓
B1003 Ropewalk	119528600	119524325	Validation	602	682	80	0.1	3.2	✓	✓
Beevor St	119535466	119512888	Validation	78	170	92	1.2	8.3	✓	×
B1360 Valentine Rd	119519166	119518113	Validation	579	305	275	-0.5	13.1	×	×
Skellingthorpe Rd	5198	119525974	Validation	271	280	10	0.0	0.6	✓	✓
Moorland Ave	119536569	119526358	Validation	146	146	0	0.0	0.0	✓	✓
B1190 Doddington Rd	119534353	119532776	Validation	272	268	4	0.0	0.2	✓	✓
A1434 Newark Rd	171	119526471	Validation	399	205	194	-0.5	11.2	×	×
Hykeham Rd	119521800	119538384	Validation	289	289	0	0.0	0.0	✓	✓
			Screenline Total	**5472**	**5371**	101	-0.02	1.4	✓	✓

IP Screenlines Calibration & Validation – Screenline 7

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 7 - Eastbound										
A158	119516326	119515142	Calibration	644	639	5	0.0	0.2	✓	✓
Wolsey Way	119519162	5124	Validation	130	130	0	0.0	0.0	✓	✓
Outer Circle Dr	119519672	119529037	Calibration	262	136	126	-0.5	8.9	×	×
Oval Approach	119535701	119514617	Validation	18	18	0	0.0	0.0	✓	✓
B1182 Ruskin Ave	119513411	119515357	Calibration	511	451	60	-0.1	2.7	✓	✓
Byron Ave	119524094	119524093	Validation	23	23	0	0.0	0.0	✓	✓
Lee Rd	119534350	119536525	Validation	344	344	0	0.0	0.0	✓	✓
East Gate	119524011	119526595	Validation	96	96	0	0.0	0.0	✓	✓
A15 Wragby Rd	119529580	119523371	Validation	890	890	0	0.0	0.0	✓	✓
B1308 Monks Rd	119524816	119517474	Calibration	417	460	43	0.1	2.1	✓	✓
Croft St	119516165	119522506	Calibration	182	55	127	-0.7	11.7	×	×
Waterside North	119535794	119527059	Validation	12	88	76	6.6	10.8	✓	×
Waterside South	119537117	119541695	Validation	51	85	34	0.7	4.2	✓	✓
Great Northern Terrace	119521029	119531615	Calibration	231	268	37	0.2	2.3	✓	✓
Washingborough Rd	119534820	3533	Calibration	175	163	12	-0.1	0.9	✓	✓
Heightington Rd	119518310	2821	Validation	124	124	0	0.0	0.0	✓	✓
B1188 Lincoln Rd	119542251	119545512	Calibration	387	379	8	0.0	0.4	✓	✓
A15 London Rd	119542296	119545503	Calibration	308	373	65	0.2	3.5	✓	✓
			Screenline Total	**4803**	**4721**	82	-0.02	1.2	✓	✓

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 7 - Westbound										
A158	119515142	119516326	Calibration	700	657	43	-0.1	1.6	✓	✓
Wolsey Way	5124	119519162	Validation	140	140	0	0.0	0.0	✓	✓
Outer Circle Dr	119529037	119519672	Calibration	351	246	105	-0.3	6.1	×	×
Oval Approach	119514617	119535701	Validation	25	25	0	0.0	0.0	✓	✓
B1182 Ruskin Ave	119515357	119513411	Calibration	526	371	155	-0.3	7.3	×	×
Byron Ave	119524093	119524094	Validation	23	23	0	0.0	0.0	✓	✓
Lee Rd	119536525	119534350	Validation	157	157	0	0.0	0.0	✓	✓
East Gate	119526595	119524011	Calibration	114	114	0	0.0	0.0	✓	✓
A15 Wragby Rd	119523371	119529580	Calibration	1104	1104	0	0.0	0.0	✓	✓
Lindum Terrace	119533260	119537871	Validation	67	121	53	0.8	5.5	✓	×
B1308 Monks Rd	119517474	119524816	Calibration	480	477	4	0.0	0.2	✓	✓
Croft St	119522506	119516165	Calibration	224	240	15	0.1	1.0	✓	✓
Waterside North	119527059	119535794	Calibration	141	199	58	0.4	4.4	✓	✓
Waterside South	119541695	119537117	Calibration	56	82	27	0.5	3.2	✓	✓
Great Northern Terrace	119531615	119521029	Calibration	214	140	74	-0.3	5.6	✓	×
Washingborough Rd	3533	119534820	Calibration	236	223	13	-0.1	0.8	✓	✓
Heightington Rd	2821	119518310	Validation	95	95	0	0.0	0.0	✓	✓
B1188 Lincoln Rd	119545512	119542251	Calibration	371	356	15	0.0	0.8	✓	✓
A15 London Rd	119545503	119542296	Calibration	294	353	59	0.2	3.3	✓	✓
			Screenline Total	**5318**	**5123**	196	-0.04	2.7	✓	✓

PM Screenline Summary

Screenline	Dir.	Obs (pcu)	Mod (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
1	NB	3,264	2,878	386	-0.12	7.0	✓	×
	SB	2,302	2,219	83	-0.04	1.7	✓	✓
2	EB	3,385	3,029	356	-0.11	6.3	✓	×
	WB	1,875	1,938	63	0.03	1.4	✓	✓
3	NB	1,396	1,376	20	-0.01	0.5	✓	✓
	SB	1,492	1,383	109	-0.07	2.9	✓	✓
4	EB	4,687	4,524	163	-0.03	2.4	✓	✓
	WB	4,963	4,250	713	-0.14	10.5	×	×
5	NB	4,358	4,238	120	-0.03	1.8	✓	✓
	SB	5,269	5,387	119	0.02	1.6	✓	✓
6	EB	6,843	6,098	745	-0.11	9.3	×	×
	WB	6,474	6,319	155	-0.02	1.9	✓	✓
7	EB	6,275	5,531	743	-0.12	9.7	×	×
	WB	6,299	5,687	612	-0.10	7.9	×	×
Screenlines Passed							**10/14**	**8/14**
Screenlines Pass Rate							**71%**	**57%**

PM Screenlines Calibration & Validation – Screenline 1

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 1 – Northbound										
A57 Saxilby Rd	119530689	119520663	Calibration	749	541	208	-0.3	8.2	×	×
Fen Ln	119538005	119523323	Validation	81	56	25	-0.3	3.0	✓	✓
B1398 Middle St	4135	5631	Calibration	608	566	42	-0.1	1.7	✓	✓
A15	119531101	4560	Calibration	801	965	164	0.2	5.5	×	×
A46 Lincoln Rd	119529293	119537502	Calibration	1025	750	275	-0.3	9.2	×	×
			Screenline Total	**3,264**	**2,878**	386	-0.12	7.0	✓	×
Screenline 1 – Southbound										
A57 Saxilby Rd	119520663	119530689	Calibration	590	685	95	0.2	3.8	✓	✓
Fen Ln	119523323	119538005	Calibration	117	44	73	-0.6	8.1	✓	×
B1398 Middle St	5631	4135	Calibration	293	228	65	-0.2	4.0	✓	✓
A15	4560	119531101	Calibration	705	618	86	-0.1	3.4	✓	✓
A46 Lincoln Rd	119537502	119529293	Calibration	597	644	46	0.1	1.9	✓	✓
			Screenline Total	**2,302**	**2,219**	83	-0.04	1.7	✓	✓

PM Screenlines Calibration & Validation – Screenline 2

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 2 - Eastbound										
A158 Wragby Rd	119532410	119512694	Calibration	776	683	93	-0.1	3.4	✓	✓
Hawthorn Rd	119545621	119531885	Calibration	229	229	0	0.0	0.0	✓	✓
Greetwell Rd	119516693	119545527	Calibration	506	372	134	-0.3	6.4	×	×
B1190 Washingborough Rd	119525748	119545520	Calibration	295	295	0	0.0	0.0	✓	✓
Heighington Rd	119524079	119521125	Validation	343	245	98	-0.3	5.7	✓	×
B1188 Lincoln Rd	119542251	119545512	Calibration	681	650	32	0.0	1.2	✓	✓
A15 Sleaford Rd	119542296	119545503	Calibration	555	555	0	0.0	0.0	✓	✓
			Screenline Total	**3,385**	**3,029**	356	-0.11	6.3	✓	×
Screenline 2 - Westbound										
A158 Wragby Rd	119512694	119532410	Calibration	542	575	33	0.1	1.4	✓	✓
Hawthorn Rd	119531885	119545621	Calibration	108	108	0	0.0	0.0	✓	✓
Greetwell Rd	119545527	119516693	Calibration	127	97	30	-0.2	2.8	✓	✓
B1190 Washingborough Rd	119545520	119525748	Calibration	272	272	0	0.0	0.0	✓	✓
Heighington Rd	119521125	119524079	Calibration	88	88	0	0.0	0.0	✓	✓
B1188 Lincoln Rd	119545512	119542251	Calibration	349	337	12	0.0	0.6	✓	✓
A15 Sleaford Rd	119545503	119542296	Calibration	388	461	72	0.2	3.5	✓	✓
			Screenline Total	**1,875**	**1,938**	63	0.03	1.4	✓	✓

PM Screenlines Calibration & Validation – Screenline 3

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 3 - Northbound										
Bloxholm Ln	119525811	119545622	Calibration	76	68	8	-0.1	1.0	✓	✓
A15 Sleaford Rd	119529229	119545504	Calibration	312	393	81	0.3	4.3	✓	✓
A607 Grantham Rd	119535799	119544516	Calibration	545	486	59	-0.1	2.6	✓	✓
Brant Rd	119518650	119526790	Calibration	463	429	34	-0.1	1.6	✓	✓
			Screenline Total	**1,396**	**1,376**	20	-0.01	0.5	✓	✓
Screenline 3 - Southbound										
Bloxholm Ln	119545622	119525811	Validation	108	69	40	-0.4	4.2	✓	✓
A15 Sleaford Rd	119545504	119529229	Calibration	447	487	40	0.1	1.9	✓	✓
A607 Grantham Rd	119544516	119535799	Calibration	500	391	109	-0.2	5.2	×	×
Brant Rd	119526790	119518650	Calibration	437	437	0	0.0	0.0	✓	✓
			Screenline Total	**1,492**	**1,383**	109	-0.07	2.9	✓	✓

PM Screenlines Calibration & Validation – Screenline 4

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 4 - Eastbound										
Lincoln Rd	119513975	119524365	Calibration	351	400	49	0.1	2.5	✓	✓
A1434 Newark Rd	119531204	165	Calibration	776	587	189	-0.2	7.2	×	×
B1190 Doddington Rd	119545645	119530811	Validation	670	825	156	0.2	5.7	×	×
B1378 Skellingthorpe Rd	119536558	119516921	Validation	398	668	270	0.7	11.7	×	×
A46	119514146	119536562	Calibration	1786	1315	471	-0.3	12.0	×	×
A57 Saxilby Rd	119520663	119530689	Calibration	590	685	95	0.2	3.8	✓	✓
Fen Ln	119523323	119538005	Calibration	117	44	73	-0.6	8.1	✓	×
			Screenline Total	**4,687**	**4,524**	163	-0.03	2.4	✓	✓
Screenline 4 - Westbound										
Lincoln Rd	119524365	119513975	Calibration	359	264	95	-0.3	5.4	✓	×
A1434 Newark Rd	165	119531204	Calibration	665	457	208	-0.3	8.8	×	×
B1190 Doddington Rd	119530811	119545645	Validation	649	904	254	0.4	9.1	×	×
B1378 Skellingthorpe Rd	119516921	119536558	Validation	587	468	119	-0.2	5.2	×	×
A46	119531738	119529131	Calibration	1873	1560	313	-0.2	7.5	×	×
A57 Saxilby Rd	119530689	119520663	Calibration	749	541	208	-0.3	8.2	×	×
Fen Ln	119538005	119523323	Validation	81	56	25	-0.3	3.0	✓	✓
			Screenline Total	**4,963**	**4,250**	713	-0.14	10.5	×	×

PM Screenlines Calibration & Validation – Screenline 5

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 5 - Northbound										
A15 Canwick Rd	119532688	119522918	Calibration	1146	1367	221	0.2	6.2	×	×
B1262 High St	119516576	119514127	Calibration	295	362	67	0.2	3.7	✓	✓
B1003 Brayford Wharf East	119517044	119518823	Validation	104	0	104	-1.0	14.4	×	×
Brayford Way	119526713	119527712	Calibration	1027	1194	167	0.2	5.0	×	×
A46	119514146	119536562	Calibration	1786	1315	471	-0.3	12.0	×	×
			Screenline Total	**4,358**	**4,238**	120	-0.03	1.8	✓	✓
Screenline 5 - Southbound										
A15 Canwick Rd	119522918	119532688	Calibration	1774	1655	119	-0.1	2.9	✓	✓
B1262 High St	119514127	119516576	Calibration	282	664	382	1.4	17.6	×	×
B1003 Brayord Wharf East	119518823	119517044	Calibration	262	562	300	1.1	14.8	×	×
Brayford Way	119527712	119526713	Calibration	1077	945	132	-0.1	4.1	✓	✓
A46	119531738	119529131	Calibration	1873	1560	313	-0.2	7.5	×	×
			Screenline Total	**5,269**	**5,387**	119	0.02	1.6	✓	✓

PM Screenlines Calibration & Validation – Screenline 6

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 6 - Eastbound										
A46	119529186	119528632	Validation	1120	624	496	-0.4	16.8	×	×
Scopwick Pl	119524096	119536786	Validation	233	230	3	0.0	0.2	✓	✓
B1273 Longdales Rd	119527203	119545636	Validation	837	704	133	-0.2	4.8	×	✓
Broadway	119525820	119528801	Validation	121	121	0	0.0	0.0	✓	✓
Newport	119525571	119529003	Validation	59	59	0	0.0	0.0	✓	✓
Mildmay St	119533604	119536871	Validation	55	55	0	0.0	0.0	✓	✓
Burton Rd	119518285	119515671	Validation	154	154	0	0.0	0.0	✓	✓
Upper Long Leys Rd	119519544	119529869	Validation	0	0	0	0.0	0.0	✓	✓
Carline Rd	119528366	119539263	Validation	12	12	0	0.0	0.0	✓	✓
B1308 West Parade	119524201	119524200	Validation	332	335	3	0.0	0.1	✓	✓
A57 Newland	119532301	119525809	Validation	719	910	191	0.3	6.7	×	×
Brayford Wharf North	119534515	119514190	Validation	3	0	3	-1.0	2.5	✓	✓
B1003 Ropewalk	119541066	119528600	Validation	365	277	88	-0.2	4.9	✓	✓
Beevor St	119512888	119535466	Validation	29	86	58	2.0	7.6	✓	×
B1360 Valentine Rd	119518113	119519166	Validation	777	417	360	-0.5	14.7	×	×
Skellingthorpe Rd	119525974	5198	Validation	435	456	21	0.0	1.0	✓	✓
Moorland Ave	119526358	119536569	Validation	241	241	0	0.0	0.0	✓	✓
B1190 Doddington Rd	119532776	119534353	Validation	385	230	155	-0.4	8.8	×	×
A1434 Newark Rd	119526471	171	Validation	558	779	221	0.4	8.6	×	×
Hykeham Rd	119538384	119521800	Validation	407	407	0	0.0	0.0	✓	✓
A46	119514146	119536562	Calibration	1120	624	496	-0.4	16.8	×	×
			Screenline Total	**6843**	**6098**	745	-0.11	9.3	×	×

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 6 - Westbound										
A46	119528632	119529186	Validation	870	1034	164	0.2	5.3	×	×
Scopwick Pl	119536786	119524096	Validation	196	185	12	-0.1	0.8	✓	✓
B1273 Longdales Rd	119545636	119527203	Validation	593	763	170	0.3	6.5	×	×
Broadway	119528801	119525820	Validation	28	28	0	0.0	0.0	✓	✓
Newport	119529003	119525571	Validation	273	273	0	0.0	0.0	✓	✓
Mildmay St	119536871	119533604	Validation	49	49	0	0.0	0.0	✓	✓
Burton Rd	119515671	119518285	Validation	129	129	0	0.0	0.0	✓	✓
Upper Long Leys Rd	119529869	119519544	Validation	110	110	0	0.0	0.0	✓	✓
Carline Rd	119539263	119528366	Validation	40	40	0	0.0	0.0	✓	✓
B1308 West Parade	119524200	119524201	Validation	419	792	373	0.9	15.2	×	×
A57 Newland	119525809	119532301	Validation	684	288	396	-0.6	18.0	×	×
Brayford Wharf North	119514190	119534515	Validation	62	0	62	-1.0	11.1	✓	×
B1003 Ropewalk	119528600	119524325	Validation	701	1012	311	0.4	10.6	×	×
Beevor St	119535466	119512888	Validation	85	173	88	1.0	7.7	✓	×
B1360 Valentine Rd	119519166	119518113	Validation	624	214	410	-0.7	20.1	×	×
Skellingthorpe Rd	5198	119525974	Validation	270	279	10	0.0	0.6	✓	✓
Moorland Ave	119536569	119526358	Validation	186	186	0	0.0	0.0	✓	✓
B1190 Doddington Rd	119534353	119532776	Validation	318	207	111	-0.3	6.9	×	×
A1434 Newark Rd	171	119526471	Validation	428	148	279	-0.7	16.5	×	×
Hykeham Rd	119521800	119538384	Validation	408	408	0	0.0	0.0	✓	✓
			Screenline Total	**6474**	**6319**	155	-0.02	1.9	✓	✓

PM Screenlines Calibration & Validation – Screenline 7

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 7 - Eastbound										
A158	119516326	119515142	Calibration	745	469	276	-0.4	11.2	×	×
Wolsey Way	119519162	5124	Validation	183	183	0	0.0	0.0	✓	✓
Outer Circle Dr	119519672	119529037	Calibration	339	125	214	-0.6	14.0	×	×
Oval Approach	119535701	119514617	Validation	51	51	0	0.0	0.0	✓	✓
B1182 Ruskin Ave	119513411	119515357	Calibration	823	571	252	-0.3	9.6	×	×
Byron Ave	119524094	119524093	Validation	176	176	0	0.0	0.0	✓	✓
Lee Rd	119534350	119536525	Validation	399	399	0	0.0	0.0	✓	✓
East Gate	119524011	119526595	Validation	58	58	0	0.0	0.0	✓	✓
A15 Wragby Rd	119529580	119523371	Validation	929	929	0	0.0	0.0	✓	✓
B1308 Monks Rd	119524816	119517474	Calibration	392	449	58	0.1	2.8	✓	✓
Croft St	119516165	119522506	Calibration	181	56	126	-0.7	11.6	×	×
Waterside North	119535794	119527059	Validation	5	92	87	16.4	12.4	✓	×
Waterside South	119537117	119541695	Validation	102	54	47	-0.5	5.4	✓	×
Great Northern Terrace	119521029	119531615	Calibration	100	175	76	0.8	6.5	✓	×
Washingborough Rd	119534820	3533	Calibration	312	295	17	-0.1	1.0	✓	✓
Heightington Rd	119518310	2821	Validation	245	245	0	0.0	0.0	✓	✓
B1188 Lincoln Rd	119542251	119545512	Calibration	681	650	32	0.0	1.2	✓	✓
A15 London Rd	119542296	119545503	Calibration	555	555	0	0.0	0.0	✓	✓
			Screenline Total	**6275**	**5531**	743	-0.12	9.7	×	×

Road Name	A Node	B Node	Calibration/ Validation	Observed (pcu)	Modelled (pcu)	Abs Diff	% Diff	GEH	Pass on Flows	Pass on GEH
Screenline 7 - Westbound										
A158	119515142	119516326	Calibration	895	672	223	-0.2	8.0	×	×
Wolsey Way	5124	119519162	Validation	210	210	0	0.0	0.0	✓	✓
Outer Circle Dr	119529037	119519672	Calibration	377	265	112	-0.3	6.2	×	×
Oval Approach	119514617	119535701	Validation	21	21	0	0.0	0.0	✓	✓
B1182 Ruskin Ave	119515357	119513411	Calibration	574	458	116	-0.2	5.1	×	×
Byron Ave	119524093	119524094	Validation	0	0	0	0.0	0.0	✓	✓
Lee Rd	119536525	119534350	Validation	282	282	0	0.0	0.0	✓	✓
East Gate	119526595	119524011	Calibration	186	186	0	0.0	0.0	✓	✓
A15 Wragby Rd	119523371	119529580	Calibration	1277	1277	0	0.0	0.0	✓	✓
Lindum Terrace	119533260	119537871	Validation	193	0	193	-1.0	19.6	×	×
B1308 Monks Rd	119517474	119524816	Calibration	461	491	31	0.1	1.4	✓	✓
Croft St	119522506	119516165	Calibration	296	242	54	-0.2	3.3	✓	✓
Waterside North	119527059	119535794	Calibration	119	181	62	0.5	5.1	✓	×
Waterside South	119541695	119537117	Calibration	64	61	3	0.0	0.4	✓	✓
Great Northern Terrace	119531615	119521029	Calibration	212	183	29	-0.1	2.1	✓	✓
Washingborough Rd	3533	119534820	Calibration	308	272	35	-0.1	2.1	✓	✓
Heightington Rd	2821	119518310	Validation	88	88	0	0.0	0.0	✓	✓
B1188 Lincoln Rd	119545512	119542251	Calibration	349	337	12	0.0	0.6	✓	✓
A15 London Rd	119545503	119542296	Calibration	388	461	72	0.2	3.5	✓	✓
			Screenline Total	**6299**	**5687**	612	-0.10	7.9	×	×

Appendix H – Observed / Modelled JT Distance

Route	Description	Direction	Observed Distance (km)	Modelled Distance (km)	Diff. %
1	B1182 Ruskin Ave/A15 Wragby Rd to A1434 Newark Rd/B1003 Tritton Rd	SB	8.63	8.48	-1.75%
		NB	8.57	8.43	-1.63%
2	Greetwell Rd/Fishkerton Rd to A113/A46	WB	47.22	46.82	-0.86%
		EB	46.98	46.90	-0.16%
3	B1189 Moor Ln to A57 Gainsborough Rd/B1190 Tom Otters Ln	NB	36.53	36.38	-0.40%
		SB	36.60	36.42	-0.49%
4	Hopyard Ln/Navenby Ln to A1133 Newark Rd/A156	NB	34.53	34.32	-0.61%
		SB	34.66	34.42	-0.67%
5	B1189/B1191 Main St/Station Rd to A46 Lincoln Rd/Washdyke Ln	NB	26.04	25.88	-0.60%
		SB	25.99	26.14	0.59%
6	B1191 Main St/B1189/Station Rd to A1434 Newark Rd/Boundary Ln	WB	28.78	28.74	-0.11%
		EB	28.84	28.74	-0.33%
7	A46/A1434 Newark Rd to Moor Ln/Fiskerton Rd	EB	19.55	19.52	-0.15%
		WB	19.53	19.50	-0.16%
8	A607 Cliff Rd/Skinnand Ln to A1500 Stow Park Rd/railway	NB	36.34	36.52	0.50%
		SB	37.38	36.66	-1.93%
9	B1190 Branston Causway at river to B1378 Skellingthorpe Rd/Lincoln Rd	WB	21.39	21.34	-0.28%
		EB	21.58	21.48	-0.44%
10	B1190 Branston Causeway at river to A1500 Horncastle Ln/A15	NB	23.80	23.72	-0.34%
		EB	23.85	23.70	-0.60%

Appendix I – Journey Time Validation

Journey Time Validation Summary – AM

Route	Description	Direction	Modelled Distance (km)	Journey Times (mm:ss)				
				Observed	Modelled	Difference	% Diff	Pass DMRB
Route 1	B1182 Ruskin Ave/A15 Wragby Rd and A1434 Newark Rd/B1003 Tritton Rd	SB	8.6292	1,231	1,345	114	9%	✓
		NB	8.5735	1,115	1,198	83	7%	✓
Route 2	Ferry Rd/Short Ferry Rd and A1133/A46	WB	47.224	3,052	3,344	292	10%	✓
		EB	46.975	3,381	3,662	281	8%	✓
Route 3	B1189 Moor Ln and A57 Gainsborough Rd/B1190 Tom Otters Ln	NB	36.529	2,727	3,320	593	22%	×
		SB	36.599	2,947	2,962	15	1%	✓
Route 4	Hopyard Ln/Navenby Ln and A1133 Newark Rd/A156	NB	34.53	2,511	2,761	250	10%	✓
		SB	34.657	2,978	2,864	114	-4%	✓
Route 5	B1189/B1191 Main St/Station Rd and A46 Lincoln Rd/Washdyke Ln	NB	26.038	2,044	2,281	237	12%	✓
		SB	25.989	1,957	2,202	245	13%	✓
Route 6	B1191 Main St/B1189/Station Rd and A1434 Newark Rd/Boundary Ln	WB	28.778	1,678	1,726	48	3%	✓
		EB	28.839	1,724	1,644	80	-5%	✓
Route 7	A46/A1434 Newark Rd and Moor Ln/Fiskerton Rd	EB	19.551	1,263	1,122	141	-11%	✓
		WB	19.531	1,369	1,593	224	16%	×
Route 8	A607 Cliff Rd/Skinnand Ln and A1500 Stow Park Rd/High St	NB	36.337	2,688	2,724	36	1%	✓
		SB	37.376	2,824	3,162	338	12%	✓
Route 9	B1190 Branston Causway at river and B1378 Skellingthorpe Rd/Lincoln Rd	WB	21.394	1,793	1,860	67	4%	✓
		EB	21.577	2,049	2,065	16	1%	✓
Route 10	B1190 Branston Causeway at river and A1500 Horncastle Ln/A15	NB	23.8	2,218	2,487	269	12%	✓
		EB	23.846	2,181	2,030	151	-7%	✓
Number of routes passing DMRB criteria								**18 / 20**
Percentage of routes passing DMRB criteria								**90%**

Journey Time Validation Summary – IP

Route	Description	Direction	Modelled Distance (km)	Journey Times (mm:ss)				
				Observed	Modelled	Difference	% Diff	Pass DMRB
Route 1	B1182 Ruskin Ave/A15 Wragby Rd and A1434 Newark Rd/B1003 Tritton Rd	SB	8.650	1,151	1,040	111	-10%	✓
		NB	8.580	1,073	963	110	-10%	✓
Route 2	Ferry Rd/Short Ferry Rd and A1133/A46	WB	47.070	3,030	2,913	117	-4%	✓
		EB	47.100	3,002	2,847	155	-5%	✓
Route 3	B1189 Moor Ln and A57 Gainsborough Rd/B1190 Tom Otters Ln	NB	36.430	2,514	2,477	37	-1%	✓
		SB	36.460	2,736	2,530	206	-8%	✓
Route 4	Hopyard Ln/Navenby Ln and A1133 Newark Rd/A156	NB	34.520	2,444	2,558	114	5%	✓
		SB	34.610	2,654	2,387	267	-10%	✓
Route 5	B1189/B1191 Main St/Station Rd and A46 Lincoln Rd/Washdyke Ln	NB	26.050	1,866	1,921	55	3%	✓
		SB	24.670	1,825	1,950	125	7%	✓
Route 6	B1191 Main St/B1189/Station Rd and A1434 Newark Rd/Boundary Ln	WB	28.760	1,640	1,493	147	-9%	✓
		EB	28.830	1,664	1,479	185	-11%	✓
Route 7	A46/A1434 Newark Rd and Moor Ln/Fiskerton Rd	EB	19.770	1,118	916	202	-18%	×
		WB	19.690	1,169	958	211	-18%	×
Route 8	A607 Cliff Rd/Skinnand Ln and A1500 Stow Park Rd/High St	NB	36.630	2,488	2,510	22	1%	✓
		SB	36.930	2,608	2,670	62	2%	✓
Route 9	B1190 Branston Causway at river and B1378 Skellingthorpe Rd/Lincoln Rd	WB	21.300	1,777	1,730	47	-3%	✓
		EB	29.770	1,872	1,792	80	-4%	✓
Route 10	B1190 Branston Causeway at river and A1500 Horncastle Ln/A15	NB	27.940	2,221	1,890	331	-15%	✓
		EB	27.940	2,036	1,856	180	-9%	✓
Number of routes passing DMRB criteria								**18 / 20**
Percentage of routes passing DMRB criteria								**90%**

Journey Time Validation Summary – PM Peak

Route	Description	Direction	Modelled Distance (km)	Journey Times (mm:ss)				
				Observed	Modelled	Difference	% Diff	Pass DMRB
Route 1	B1182 Ruskin Ave/A15 Wragby Rd and A1434 Newark Rd/B1003 Tritton Rd	SB	8.650	1,320	1,329	9	1%	✓
		NB	8.580	1,174	1,175	1	0%	✓
Route 2	Ferry Rd/Short Ferry Rd and A1133/A46	WB	47.070	3,315	3,463	148	4%	✓
		EB	47.100	2,904	3,220	316	11%	✓
Route 3	B1189 Moor Ln and A57 Gainsborough Rd/B1190 Tom Otters Ln	NB	36.430	2,863	3,209	346	12%	✓
		SB	36.460	2,912	3,102	190	7%	✓
Route 4	Hopyard Ln/Navenby Ln and A1133 Newark Rd/A156	NB	34.520	2,651	2,975	324	12%	✓
		SB	34.610	2,746	3,006	260	9%	✓
Route 5	B1189/B1191 Main St/Station Rd and A46 Lincoln Rd/Washdyke Ln	NB	26.050	2,064	2,447	383	19%	×
		SB	24.670	2,025	2,252	227	11%	✓
Route 6	B1191 Main St/B1189/Station Rd and A1434 Newark Rd/Boundary Ln	WB	28.760	1,656	1,742	86	5%	✓
		EB	28.830	1,668	1,725	57	3%	✓
Route 7	A46/A1434 Newark Rd and Moor Ln/Fiskerton Rd	EB	19.770	1,274	1,096	178	-14%	✓
		WB	19.690	1,338	996	342	-26%	×
Route 8	A607 Cliff Rd/Skinnand Ln and A1500 Stow Park Rd/High St	NB	36.630	2,782	2,864	82	3%	✓
		SB	36.930	2,836	2,963	127	4%	✓
Route 9	B1190 Branston Causway at river and B1378 Skellingthorpe Rd/Lincoln Rd	WB	21.300	2,158	2,089	69	-3%	✓
		EB	29.770	1,968	1,717	251	-13%	✓
Route 10	B1190 Branston Causeway at river and A1500 Horncastle Ln/A15	NB	27.940	2,374	2,227	147	-6%	✓
		EB	27.940	2,247	2,171	76	-3%	✓
Number of routes passing DMRB criteria								**18 / 20**
Percentage of routes passing DMRB criteria								**90%**