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A10 Ely to Cambridge Transport Study

Local Model Validation Report

Cambridgeshire County Council

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Glossary

Item	Definition
A10E2C	A10 Ely to Cambridge Study
ATC	Automatic Traffic Count
CCC	Cambridgeshire County Council
CSRM2	Cambridge Sub-Regional Model, version 2
DfT	Department for Transport
GAP	Wardrop Equilibrium % Gap Function
GEH	Geoffrey E. Haver statistic. A statistic that measures the measures the difference between modelled traffic flow and observed traffic flow.
HGV	Heavy Goods Vehicle (also known as OGV) – Goods carrying vehicle over 3,500kg design gross weight
JTC	Junction Turning Count
LDF	Local Development Framework
LSOA	Lower Super Output Area
MCC	Manual Classified Count
ME	Matrix Estimation
MSOA	Middle Super Output Area
OD	Origin Destination
PCU	Passenger Carrying Unit – representing the amount of road space a vehicle occupies on the road network
PPK	Pence per Kilometre – used for representing the vehicle operating costs based on distances
PPM	Pence per Minute – used for representing the value of time
SATPIJA/SATME2	Process and control files used by SATURN during matrix estimation
SATURN	Simulation and Assignment of Traffic in Urban Road Networks - A suite of computer programmes designed to store traffic and road based information, route the traffic through the road network (assignment), and analyse the operational capabilities of the junctions (simulation)
SFC	Speed Flow Curve
WebTRIS	Highways England Trunk Road Information System – a database of traffic flow information for all trunk roads
VOC	Vehicle Operating Costs – measured in pence per kilometre
VoT	Value of Time – measured in pence per minute
WebTAG	Web based Traffic Appraisal Guidance – a series of Department for Transport advisory documents available online

Executive Summary

This Local Model Validation Report (LMVR) for the A10 Ely to Cambridge Study (A10E2C) Model details the methodology used in developing a 2018 base year model, derived from the parent Cambridge Sub-Regional Model (version 2) (CSRM2). Atkins were commissioned by Cambridgeshire County Council (CCC) on behalf of the Cambridgeshire And Peterborough Combined Authority (CPCA) to develop a highway model for use in the testing of potential highway improvement schemes on the A10 corridor between Ely and Cambridge, in order to provide additional network capacity required to support future planned development in the area.

Model Development

Following indicative testing using CSRM2, Atkins defined the core study area for the development of the A10E2C Model. Atkins undertook a full review of the network and zone structure within this area and identified necessary enhancement required to ensure the model was developed to a level of detail suitable for the detailed assessment of proposed highway improvements.

The wider CSRM2 highway model structure was maintained, providing a link to the parent model which should provide several advantages, particularly in terms of ensuring consistency with other schemes being tested in CSRM2 and providing access to the demand element of CSRM2.

The original CSRM2 highway trip matrices were used to provide the basis for the A10E2C highway matrices. For origin-destination movements which travel within or pass through the core study area, the original CSRM2 prior matrices were adopted (allowing for subsequent refinement) whilst movements outside of this area were taken from the final CSRM2 base year matrices (maintaining consistency with the parent model outside the core area). Zones within the core study area have then been disaggregated using census data statistics, with localised refinements made based on observed traffic volumes. The resulting prior matrices have been demonstrated to provide a suitable platform for matrix estimation (ME) within the study area. Close monitoring of the changes brought about by the ME process at a demand matrix and trip length distribution level has ensured that the scale of changes lie within prescribed ranges.

Model Performance

To assess the performance of the model, several sources of observed data in terms of traffic volumes (including a large number of link and turning count surveys for the specific purpose of this study) and journey times were collected and processed for the purpose of comparison.

Model calibration and validation was undertaken, comparing modelled flow and travel times against the available observed data for each of the modelled time periods. The model is shown to achieve a close match with observed traffic volumes, at both a screenline and individual link level (with over 87% of all link counts meeting WebTAG criteria across all 3 time periods). Critically, for the assessment of potential highway scheme improvements, high levels of accuracy were also demonstrated at a local level along the length of the A10, whilst the model also performs well at a turning level for key junctions along the A10 and the parallel B1049.

In terms of journey times, nine of ten routes in the AM peak, and all ten routes in the inter-peak and PM peak assignments were shown to match closely with observed Trafficmaster data along the route – in accordance with guidance criteria. This is again seen as critically important for future testing, with the model accurately reflecting the high levels of existing congestion seen on the A10 corridor during peak periods.

The base assignment model is stable for the three modelled time periods, and meets the convergence criteria.

Summary

The A10E2C Model has been through a rigorous development process, using up to date sources of observed data to ensure the model provides accurate representations of 2018 conditions in the core study area. Models for each time periods are shown to calibrate and validate well against these data sources, with a particular focus on the local area around the A10 corridor itself. The models therefore provide an accurate representation of current network conditions and are suitable for future forecasting in the study area.

1. Introduction

1.1. Purpose of this Report

Cambridgeshire County Council (CCC) have commissioned Atkins to undertake the development of a 2018 A10 Ely to Cambridge (A10E2C) base model, developed using the version 11.4.06D of the SATURN software suite. This is a bespoke traffic model, developed from the Cambridge Sub-Regional Model, version 2 C-series (CSRM2) which will be used to underpin the appraisal of potential highway scheme improvements to the A10 corridor between Ely and Cambridge.

This report sets out the methodology for the development of the model and the performance against key validation criteria, consistent with the Department for Transport (DfT) WebTAG guidance.

1.2. Base Model Requirements

The A10, to the north of Cambridge, is a key strategic link within Cambridgeshire, linking the city of Ely with Cambridge, the economic centre of the County. The link is currently a single carriageway along the length of the Ely to Cambridge section, with several known areas of congestion during peak periods. The A10E2C Model is intended to be used to test potential upgrades to the network.

An initial, preliminary test was carried out in CSRM2, to establish the potential impact of converting the A10E2C to dual carriageway. This is set out in the Preliminary Strategic Outline Business Case[1]. This suggested that the area affected by the scheme (in terms of significant movements) covered the area from the B1049 in the West, to the A142 in the East. For more detail on the core study area used in this model, see Section 4.3.

Given the significant impact that upgrades to the A10E2C Model may have, it was agreed with CCC that the model would be built using the Fixed-Cost Function (FCF) methodology. Rather than cordoning one section of a larger parent model, this methodology aims to maintain a close link to the parent model. Maintaining this link allows access to the demand model element of CSRM2 as well as easier integration with other schemes being tested in CSRM2.

1.3. Report Structure

Following this introduction, the report is structured as follows:

- Section 2 outlines the proposed uses of the model and key considerations;
- Section 3 defines the standards against which the model will be validated;
- Section 4 describes the key features of the model;
- Section 5 summarises the observed data used for model calibration and validation;
- Section 6 describes the network development;
- Section 7 describes the matrix development;
- Section 8 describes the procedures used to calibrate the model;
- Section 9 describes the matrix estimation procedure;
- Section 10 presents the calibration and validation results; and
- Section 11 summarises the model performance and fitness for purpose.

[1] Ely to Cambridge Transport Study, Mott MacDonald, January 2018, http://scambs.moderngov.co.uk/documents/s104001/Appendix%201%20Ely%20to%20Cambridge%20transport%20study.pdf

2. Proposed Uses of the Model and Key Model Design Considerations

The A10E2C Model will support the A10 Ely to Cambridge Transport Study being carried out by the Cambridgeshire and Peterborough Combined Authority (CPCA) which aims to study the transport schemes required to accommodate major developments along the A10 corridor, including the New Town north of Waterbeach, and developments at the Cambridge Science Park and Cambridge Northern Fringe East (CNFE).

A bespoke model, linked to the existing wider CSRM2, will enable further scheme development as part of the A10E2C Transport Study, and underpin the appraisal of any future proposed improvement scheme along the A10 corridor. The model described in this report will act as a base from which future-year models can be developed, to support scheme development along the corridor.

To ensure the model built is appropriate for the proposed uses of the model, the following design aspects have been considered:

- An integral element of this base model is that it accurately represents current traffic and network conditions in the A10 area. This ensures that the base model can be used as a reliable foundation from which future schemes can be modelled and appraised. In order to ensure the accuracy of the base model, Atkins have calibrated and validated the base model against WebTAG flow and journey time criteria, but with additional focus on the A10 corridor as well as turning movements at key junctions.
- To enable the testing of proposed CPCA schemes along the A10 corridor in the future, it was also necessary to ensure that this base model covered an appropriate study area and accounted for any elements of the highway design that CPCA may wish to test in the future. As such, a preliminary test was conducted using CSRM2, to examine the potential impact area of a significant development to the A10 corridor. The resulting area from this test was used to inform the core study area in this base model (as defined in Section 4) which is the focus of the model validation process.
- As agreed with CCC, it is intended that in future, as part of model forecasting, the wider CSRM2 network will be represented under the Fixed Cost Function (FCF) methodology, rather than cordoning out the core study area. In practice, this will allow for the core area identified to be the only fully simulated area, with fixed travel costs being retained over the wider network between scenarios. This allows for local validation and enhancements to be made to the core study area without losing links back to the parent model. Key advantages of this approach include:
    - Access to the demand model element of CSRM2 (the parent model);
    - Consistency with other schemes tested within CSRM2;
    - Easier integration with other schemes being tested within CSRM2;
    - Links back to previous work on the A10 corridor within CSRM2; and
    - Forecasting can take on board forecasts in place with CSRM2.

  As a result, the wider CSRM2 network structure is maintained for the purposes of the A10E2C base model development.
- As the A10E2C Model is being developed to support the appraisal of an A10 corridor improvement, the model will be required to provide outputs compatible with the Department for Transport (DfT) Transport User Benefit Appraisal (TUBA) software. Any application of this type needs to adhere to WebTAG guidance, including the values of time and operating costs adopted, as well as aspects such as assignment convergence.

3. Model Standards

The A10E2C Model consists of simulated junctions and links in the core study area, combined with the existing simulated network in the wider CSRM2 area, plus buffer network in the peripheral regions around Cambridgeshire.

The highway assignment model has been developed following the guidance in WebTAG M3.1, Highway Assignment Modelling[2].

3.1. Validation Criteria and Acceptability Guidelines

The below text quoted from WebTAG unit M3.1 summarises the validation criteria for a highway assignment model.

The validation of a highway assignment model should include comparisons of the following:

- "Assigned flows and counts totalled for each screenline or cordon, as a check on the quality of the trip matrices;
- Assigned flows and counts on individual links and turning movements at junctions as a check on the quality of the assignment; and
- Modelled and observed journey times along routes, as a check on the quality of the network and the assignment".

3.2. Trip Matrix Validation

The measure that should be used for trip matrix validation is the percentage difference between modelled flows and counts. Comparisons at screenline level provide information on the quality of the trip matrices. WebTAG Unit M3.1 describes the validation criterion and acceptability guideline as shown in Table 3-1.

Table 3-1 - Screenline Flow Validation and Acceptability Guidelines

Criteria	Acceptability Guidelines
Differences between modelled flows and counts should be less than 5% of the counts	All or nearly all screenlines

Regarding screenline validation, the following should be noted[3]:

- Screenlines should normally be made up of five links or more;
- The comparisons for screenlines containing high flow routes such as motorways should be presented both including and excluding such routes;
- The comparison should be presented separately for roadside interview screenlines where they exist, the other screenlines (made up of Automatic Traffic Counts (ATCs) for example) used as constraints in matrix estimation (excluding the roadside interview screenlines even though they have been used as constraints in matrix estimation) and screenlines used for independent validation;
- The comparisons should be presented by vehicle type (cars, light goods vehicles and other goods vehicles); and
- The comparisons should be presented separately for each modelled period.

[2] https://www.gov.uk/government/publications/webtag-tag-unit-m3-1-highway-assignment-modelling
[3] WebTAG Unit M3.1 Highway Assignment Modelling January 2014 (pg18)

3.3. Link Flow and Turning Movement Validation

Two measures are used for individual link validation: flow difference; and the Geoffrey E Haver (GEH) measure. The flow difference is based on the relative flow difference between modelled flows and observed counts, with three different criteria set depending on the scale of observed flows. The GEH measure uses the GEH statistic as defined below:

$$GEH = \sqrt{\frac{(M-C)^2}{½(M+C)}}$$

Where: GEH is the GEH statistic;
M is the modelled flow; and
C is the observed flow.

TAG Unit M3.1 describes the Link Flow and Turning Movements Validation Criteria and Acceptability Guidelines as shown in Table 3-2.

Table 3-2 - Link Flow and Turning Movement Validation Criteria and Acceptability Guidelines[4]

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

Regarding flow validation, the following should be noted[5]:

- The above criteria should be applied to both link flows and turning movements;
- The acceptability guideline should be applied to link flows but may be difficult to achieve for turning movements;
- The comparisons should be presented for cars and all vehicles but not for light and other goods vehicles (unless sufficiently accurate link counts have been obtained);
- The comparisons should be presented separately for each modelled period; and
- It is recommended that comparisons using both measures are reported in the model validation report.

3.4. Journey Time Validation

Journey time validation compares the percentage difference between modelled and observed journey time, subject to an absolute maximum difference. WebTAG Unit M3.1 describes the criteria and guidelines, as shown in Table 3-3. Comparisons of journey times should be presented separately for each modelled period.

Table 3-3 - Journey Time Validation and Acceptability Guidelines[6]

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

[4] Taken from Table 2 of the WebTAG Unit M3.1 guidance
[5] WebTAG Unit M3.1 Highway Assignment Modelling January 2014 (pg19)
[6] Taken from Table 3 of the WebTAG Unit M3.1 guidance

3.5. Convergence Criteria and Standards

The advice on model convergence is set out in WebTAG Unit M3.1 and is reproduced in Table 3-4.

Table 3-4 - Summary of Convergence Measures and Base Model Acceptable Values[7]

Measure of Convergence	Base Model Acceptable Values
Delta and %GAP	Less than 0.1%, or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P)<1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2)<1%	Four consecutive iterations greater than 98%
Percentage change in total user costs (V)	Four consecutive iterations less than 0.1% (Stochastic User Equilibrium only)

3.6. Intended Impact of Matrix Estimation

TAG Unit M3.1 states that the changes brought about by matrix estimation (ME) should be carefully monitored by the following means:

- Regression analysis of matrix zonal cell values, prior to and post ME (slopes, intercepts and R2 values);
- Regression analysis of zonal trip ends, prior to and post ME (slopes, intercepts and R2 values);
- Trip length distributions, prior to and post ME; and
- Sector to sector level matrices, prior to and post ME, with absolute and percentage changes.

The changes introduced by the application of ME should not be significant and are assessed using WebTAG Unit M3.1, as shown in Table 3-5.

Table 3-5 - Significance of ME Criteria

Measure	Significance Criteria
Matrix zonal cell levels	Slope within 0.98<Slope<1.02 Intercept near zero R2 in excess of 0.95
Matrix zonal trip ends	Slope within 0.99<Slope<1.01 Intercept near zero R2 in excess of 0.98
Trip length distributions	Means within 5% Standard deviations within 5%
Sector to sector level matrices	Differences within 5%

The unit states that it is important that the fidelity of the underlying trip matrices is not compromised in order to meet the validation standards. All exceptions to these criteria should be examined and assessed for their importance for the accuracy of the matrices.

The comparisons should be presented by vehicle type (preferably cars, light goods vehicles and other goods vehicles). The comparisons should also be presented separately for each modelled period or hour.

[7] Taken from Table 4 of the WebTAG Unit M3.1 guidance

4. Key Features of the Model

This chapter details the specification of the A10E2C Model in terms of temporal scope, spatial coverage and the level of network and zoning detail, demonstrating its suitability for its intended purposes. This section also sets out the details regarding some of the key characteristics of the model.

4.1. Model Base Year

The A10E2C Model has been developed to reflect 2018, neutral weekday (Tuesday-Thursday) traffic conditions. The model has been calibrated and validated using representative observed data (as summarised in Chapter 5). The existing CSRM2 base model matrix has been used as the foundation for the A10E2C matrices. These matrices have been disaggregated to encompass the new A10E2C zone structure in the core modelled area.

4.2. Modelling Software

The A10E2C Model has been developed using SATURN Version 11.4.06D. SATURN is regarded as the industry standard strategic highway assignment modelling software.

4.3. Core Study Area and Wider Area

The A10 is central in the model area, and the model includes the length of the A10 from the Ely southern bypass in the north, to the Milton Interchange (A14 Jct. 33) in the south. Following the preliminary testing it was identified that the core study area also needed to include the B1049 to the west, the A142 to the east, and the A14 along the south of the core study area as key links likely to be affected by potential improvements to the A10 corridor. Smaller routes that link into these roads were also included, such as the B1104 in the east of area. The core study area is displayed in Figure 4-1.

The rest of the modelled area outside this core study area is identical to the area modelled in CSRM2. This area covers the entire United Kingdom, with Cambridgeshire featuring detailed simulation network, and the rest of the UK featuring a simple skeletal buffer network. This area would be expected to feature negligible impacts from any proposed scheme on the A10. The wider A10E2C simulation network is shown in Figure 4-2.

4.4. Model Extent

The highway model network structure was developed from the existing CSRM2 base model network. The density of the adopted network structure differs between the simulation area and the external area as follows:

- Within the **simulation area**, all major A-roads and B-roads are represented, in addition to the main residential roads and access roads to major developments and car parks; whereas
- The **external area** includes major A-roads and B-roads with reduced detail further away from the simulation area.

The simulation area is coded in the SATURN simulation network (with explicit junction modelling) whilst the external area is coded in SATURN buffer network. The level of network detail decreases as progression is made from the core study area (A10 corridor) to the wider simulation area (Cambridgeshire), and again from this to the external area (Rest of UK). Further detail regarding the specific model network enhancements for the A10E2C model is provided in Chapter 6.

Figure 4-1 - A10E2C Model Core Study Area

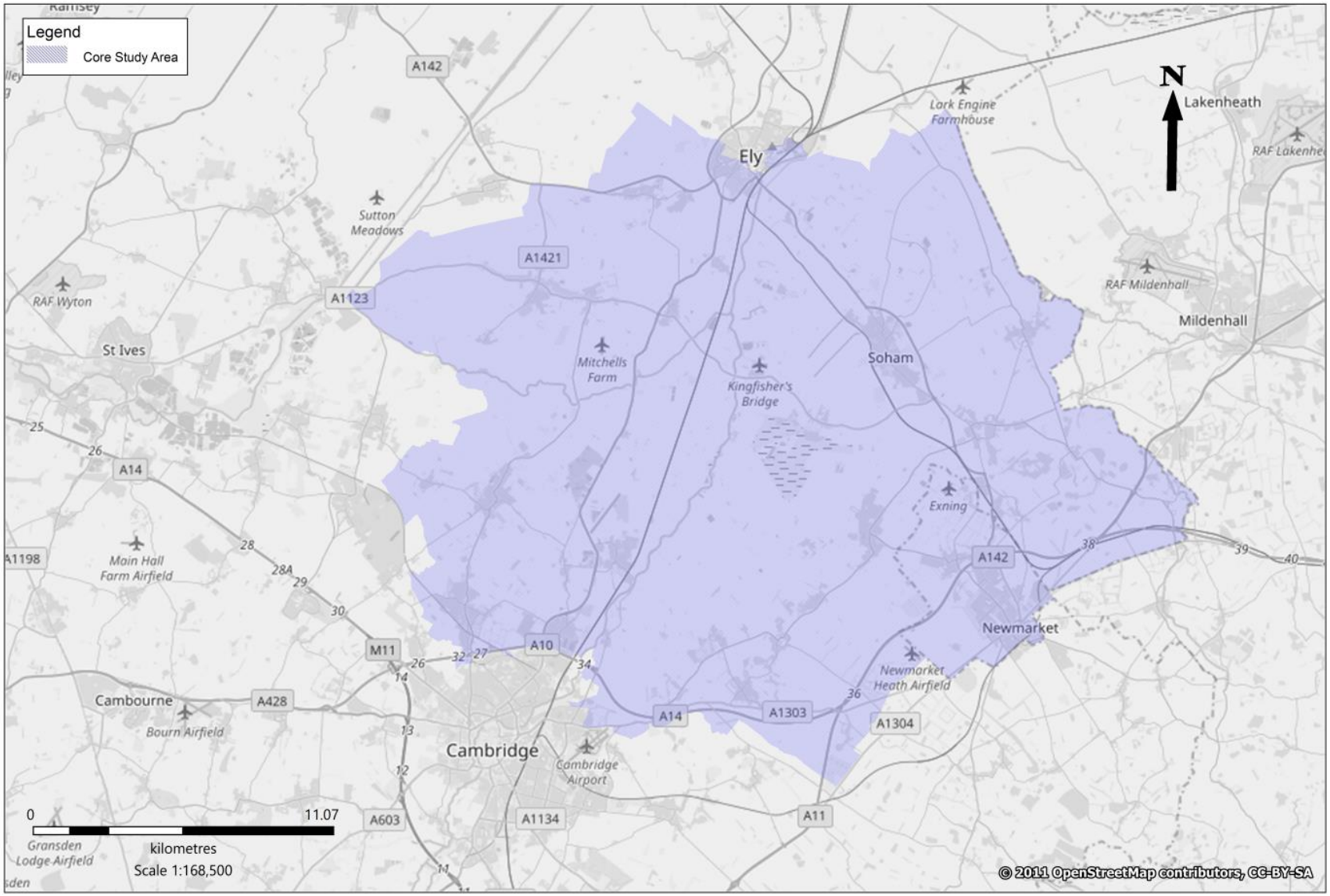
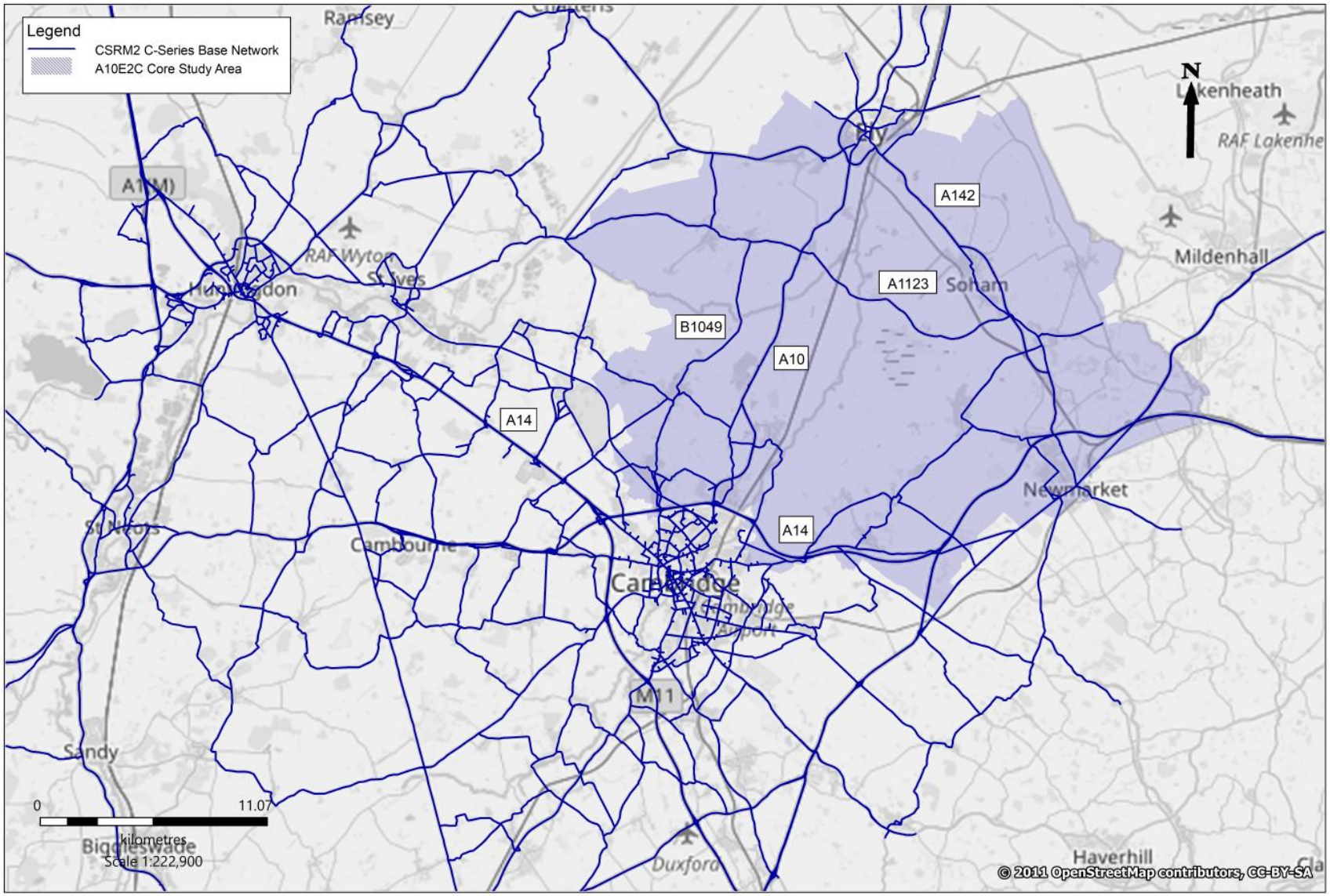


Figure 4-2 - A10E2C Wider Simulation Network



4.5. Zoning System

The CSRM2 zone system was used as a basis for the zoning featured in the A10E2C Model. Within the core study area, the 25 existing CSRM2 zones were generally too large and lacked the required detail to reflect local changes in trip distribution and so were disaggregated accordingly. 68 zones were created in the core study area, based upon aggregations of UK Census Output Areas, and considering the likely loading of trips onto key routes included in the model. Figure 4-3 shows the resulting zone system.

Beyond the core study area, existing CSRM2 zones were retained.

Zones in the A10E2C Study Area are classified by a four-digit number, which takes into account the following:

- The first digit is a '1', to signify the zone's inclusion in the A10E2C area;
- One digit relating to the district (South Cambridgeshire (2), East Cambridgeshire (4) or 'External' (7)) that the zone resides within, in CSRM2;
- One digit relating to the broad locality within which the zone resides (e.g. Newmarket, Ely, Soham); and
- One digit for an individual zone number.

Table 4-1 shows a breakdown of the 68 A10E2C Zones.

Table 4-1 - Zone Distribution

CSRM District/Area	Number of Zones
South Cambridgeshire	29
East Cambridgeshire	28
External (Newmarket)	10
Other (Park and Ride site)	1

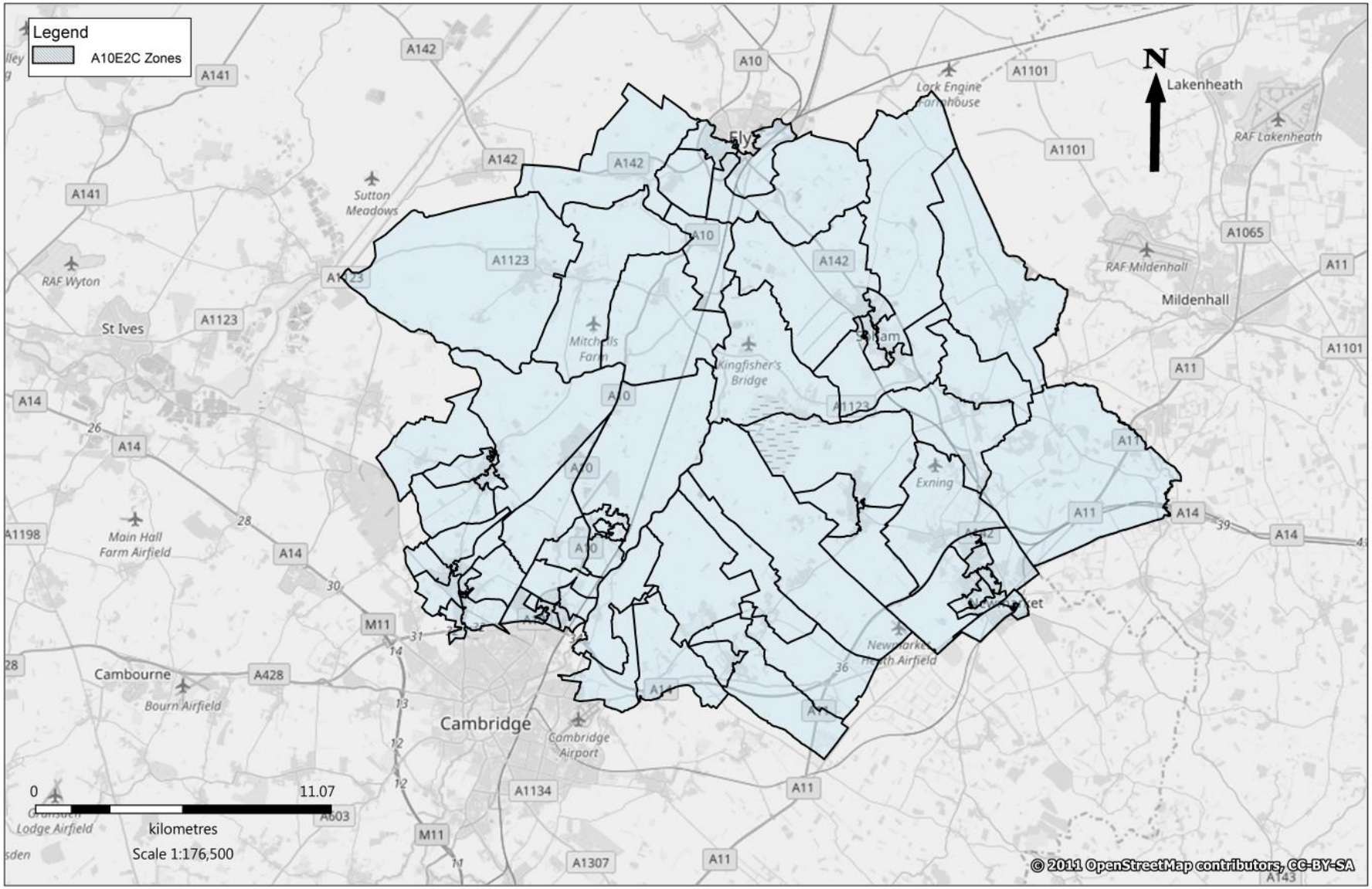
4.6. Centroid Connectors

Centroid connectors provide connectivity between zones and the highway link network. Centroid connectors for the CSRM2 parent model were coded with:

- Specific entry / exit junctions from local access roads onto the main road network from self-contained residential areas, business parks, retail areas and car parks for example; or
- Selected junctions representing multiple access points (i.e. removing the need to explicitly code every junction on each link).

For new zones contained with the A10E2C core study area, connectors are also coded for specific access points, with a limited number of connection points per zone (in most cases only one), restricting any potential route choice at the centroid connector level.

Figure 4-3 - Zones in Core Study Area



4.7. Screenlines

Four screenlines were chosen to help validate the A10E2C Model, the locations of which are shown in Figure 4-4. These are as follows:

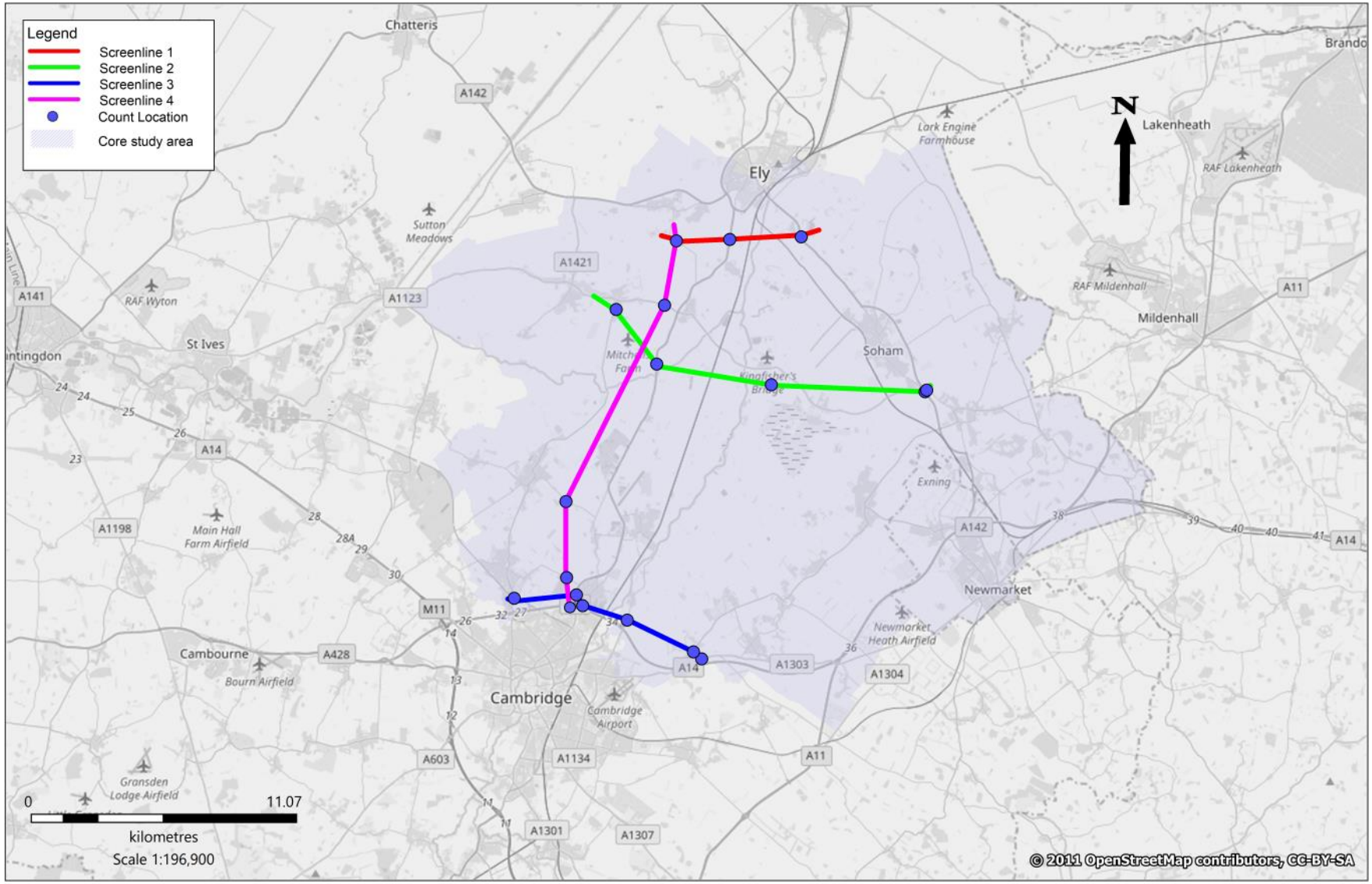
- **Screenline 1:** A northern north/south screenline capturing traffic using the A10 and A142 as well as traffic potentially routeing through Grunty Fen Road south of Witchford;
- **Screenline 2:** A central north/south screenline capturing traffic using the B1049, the A10, Upware Road, the A142 south of the Fordham Road/A1123 roundabout and Soham Road also south of this roundabout;
- **Screenline 3:** A southern north/south screenline which covers traffic using the A10 as well as traffic travelling on the key routes through the residential areas of Impington, Milton, Horningsea and Stow-cum-Quy; and
- **Screenline 4:** An east-west screenline to the west of the A10, capturing A14 traffic running along the southern edge of the core area together with local traffic travelling between the A10 and B1049, where initial scheme testing using CSRM2 has indicated that the majority of transfer would occur as a result of an A10 dualling scheme.

The number of links that intersect each screenline is shown in Table 4-2. As can be seen, Screenline 1 has less than the WebTAG-recommended five links, as outlined in Section 3.2. However, the sparsely populated nature of study area means that screenlines covering a large geographic area encompass a relatively small number of links, and as such, it is considered the screenlines chosen provide adequate coverage of the core study area.

Table 4-2 - Screenline Links

Screenline	Number of Links
1: Northern North/South	3
2: Central North/South	5
3: Southern North/South	6
4: East/West	5

Figure 4-4 - A10E2C Model Screenlines



4.8. Time Periods

The highway assignment model includes three single hour time periods as shown in Table 4-3. They represent the AM and PM peak hours, plus an hour period representing an average inter peak hour. These are the modelled hours in the CSRM2 base highway model, and were retained, after inspection of peak flows, as outlined in the A10E2C Data Collection Report[8].

Table 4-3 - Time Periods

Model Time Period	Temporal Coverage
AM Peak Hour	08:00 – 09:00
Average Inter Peak Hour	Average hour 10:00 – 16:00
PM Peak Hour	17:00 – 18:00

4.9. User Classes/Vehicle Types

The A10E2C model adopts the 12 user classes utilised in CSRM2 to ensure compatibility and comparison with the CSRM2 highway matrices. These user classes are set out in Table 4-4.

Table 4-4 - User Class Definitions

User Class	Vehicle Type	Purpose	Income	Identifier
1	MC, Car	Home-Based Work	Low	HBW Low Income
2	MC, Car	Home-Based Work	Medium	HBW Medium Income
3	MC, Car	Home-Based Work	High	HBW High Income
4	MC, Car	Education	N/A	Education
5	MC, Car	Employers Business	N/A	EB
6	MC, Car	Other	Low	Other Low Income
7	MC, Car	Other	Medium	Other Medium Income
8	MC, Car	Other	High	Other High Income
9	HGV	HGV	N/A	HGV
10	HGV	HGV (Huntingdon)	N/A	HGV (Huntingdon)
11	LGV	Home-Based Work, Education and Other	All	HBW + Ed+ Other (All income groups)
12	LGV	Employers Business	N/A	EB

4.9.1. Passenger Car Unit Factors

The vehicle to PCU conversion factors used for the various user classes are summarised in Table 4-5, taken originally from the DfT WebTAG Unit A5.4[9]. The factors have then been adjusted to ensure compatibility with the factors used in the CSRM2 highway assignment matrices.

[8] A10 Ely to Cambridge Transport Study Data Collection Report, Atkins, July 2018
[9] WebTAG Unit A5.4 : https://www.gov.uk/government/publications/webtag-tag-unit-a5-4-marginal-external-costs

Table 4-5 - PCU Factors

Vehicle Type	Description	PCU Factor
Motorcycle	Private motorcycle	1
Car	Private car	1
Light Goods Vehicle	Goods vehicle using car-based chassis	1
Heavy Goods Vehicle	OGV1 and OGV2 Rigid and Articulated	2.3
Bus	Scheduled coach and local bus services	2.5

4.10. Assignment Methodology

Route choice within a highway assignment model is generated using the generalised cost of travel time, vehicle operating cost and tolling / congestion charging in accordance with the WebTAG Unit A1.3. This is to make it compatible with the CSRM2 demand model which also uses generalised costs. The coefficients for the individual components of generalised costs were calculated using WebTAG Unit A1.3.

4.10.1. Values of Time and Vehicle Operating Costs

The Value of Time (VoT) and Vehicle Operating Costs (VOC) used for the A10E2C Model were calculated based upon the June 2018 WebTAG Databook (v1.10.1). Table 4-6 shows the VoT in Pence per Minute (PPM) and VOC in Pence per Kilometre (PPK) for the 12 user classes used in the 2018 base model.

The average speed used to inform these figures was taken directly from the underlying CSRM2 C-Series model.

Table 4-6 - Values of Time in Pence per Minute

User Class	Definition	AM Peak	Inter Peak	PM Peak
1	HBW Low Income	9.83	9.69	9.77
2	HBW Medium Income	16.59	16.35	16.49
3	HBW High Income	30.20	29.77	30.03
4	Education	15.92	15.67	16.24
5	EB	37.17	37.15	36.29
6	Other Low Income	7.88	7.75	8.03
7	Other Medium Income	13.32	13.11	13.59
8	Other High Income	22.09	21.74	22.53
9	HGV	50.47	50.47	50.47
10	HGV (Huntingdon)	50.47	50.47	50.47
11	HBW + Ed+ Other (All income groups)	21.64	23.55	22.43
12	EB	25.60	25.58	24.99

Table 4-7 - Values Operating Costs (Pence per Kilometre)

User Class	Definition	AM Peak	Inter-peak	PM Peak
1	HBW Low Income	7.01	6.83	7.06
2	HBW Medium Income	7.01	6.83	7.06
3	HBW High Income	7.01	6.83	7.06
4	Education	7.01	6.83	7.06
5	EB	15.10	14.65	15.24
6	Other Low Income	7.01	6.83	7.06
7	Other Medium Income	7.01	6.83	7.06
8	Other High Income	7.01	6.83	7.06
9	HGV	56.20	55.65	56.46
10	HGV (Huntingdon)	56.20	55.65	56.46
11	HBW + Ed+ Other (All income groups)	8.71	8.59	8.76
12	EB	16.73	16.53	16.80

4.11. Capacity Restraint Mechanisms: Junction Modelling and Speed/Flow Relationships

The simulation network of the model includes detailed coding of each junction within the area. This specifies the junction type, turn capacities, lane allocation and where appropriate signal timing data. Both longer links in urban areas and rural links tend to have most capacity restraint from the link itself, rather than the junctions at either end. Therefore, Speed Flow Curves (SFCs) are used to model the impact of the flow on the link on the delay exhibited.

Appendix Table A.1 outlines the SFCs applied in SATURN in the A10E2C Model core study area. The majority of these SFCs were taken from CSRM2. Four SFCs were created for use in the A10E2C Model, to recreate specific link properties where necessary.

5. Calibration and Validation Data

To help inform an understanding of trip rates and patterns in the A10 core study area, a range of data was collected and collated. This data was used to calibrate and validate the base year model. This section summarises the data used. More detailed analysis on the suitability and reliability of the data used can be found in the Data Collection Report[10].

The data sources presented in this chapter include:

- Traffic counts:
  - Automatic Traffic Count (ATC), Manual Classified Count (MCC) and Manual Classified Turning Count (MCTC) data collected in April and May 2018;
  - WebTRIS count data from March 2018; and
  - Historical count data from 2015
- 2016 TrafficMaster journey time data;
- Signal timing data; and
- Bus service and timetable data.

5.1. Data Collection Methods Employed

5.1.1. Count Data (2018 A10 Counts)

To provide an appropriately detailed range of traffic data covering the core study area, ATC, MCC and MCTC data was collected during April and May 2018. Table 5-1 provides a summary of the count data collected by Nationwide Data Collection on behalf of CCC:

Table 5-1 - 2018 Traffic Counts Conducted Specifically for the A10E2C Model

Count Type	Number of Counts	Collection Period
ATC	19	17th April – 23rd May 2018
ATC with accompanying MCC	17	18th April – 14th May 2018
MCTC	18	18th April – 19th April 2018

Figure 5-1 shows the locations of the 2018 count data collected specifically for the A10E2C Model. This data was checked for reliability/continuity of the data collected, with confidence interval calculations conducted (see Data Collection Report for details). The count data was processed to obtain average hourly traffic flows at each site for the three modelled time periods.

5.1.2. Count Data (Existing)

In addition to the counts collected as part of the 2018 A10 surveys, several existing counts were utilised in the calibration and validation process. This included:

- Six ATC sites collected in 2015 as part of the calibration and validation of the CSRM2 base model. Specifically:
  - Four sites around the northern perimeter of Cambridge; and
  - Two 'market town' sites, near to Ely;
- Four ATC sites collected in 2016 as part of the A14 Cambridge to Huntingdon Improvement Scheme; and
- Three MCCs collected in 2016 as part of the A14 Cambridge to Huntingdon Improvement Scheme.

The count data was again processed to obtain average hourly traffic flows for the individual modelled time periods. The locations for these sites are shown in Figure 5-2.

[10] A10 Ely to Cambridge Transport Study Data Collection Report, Atkins, July 2018

Figure 5-1 - 2018 Traffic Count Locations

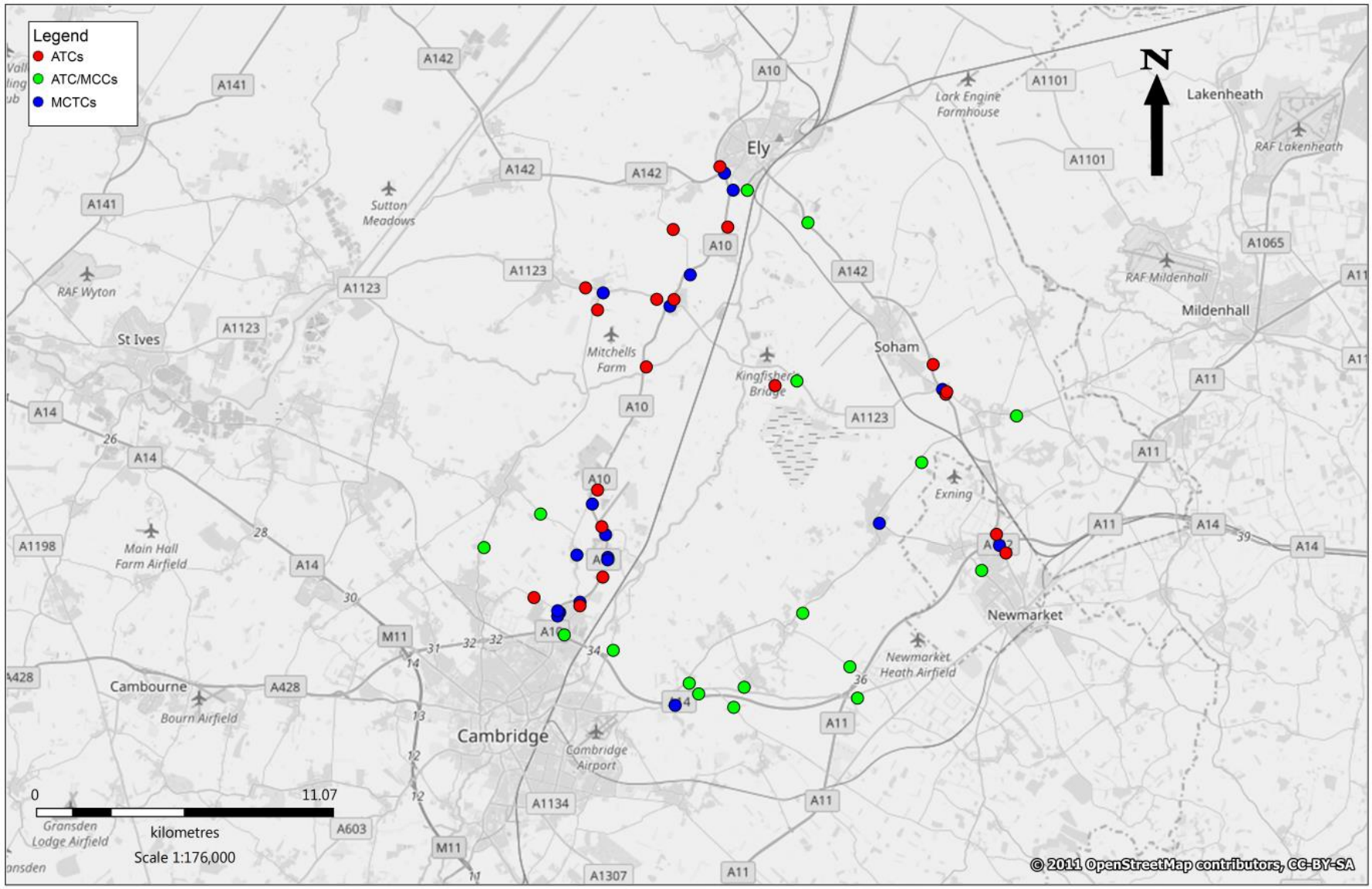
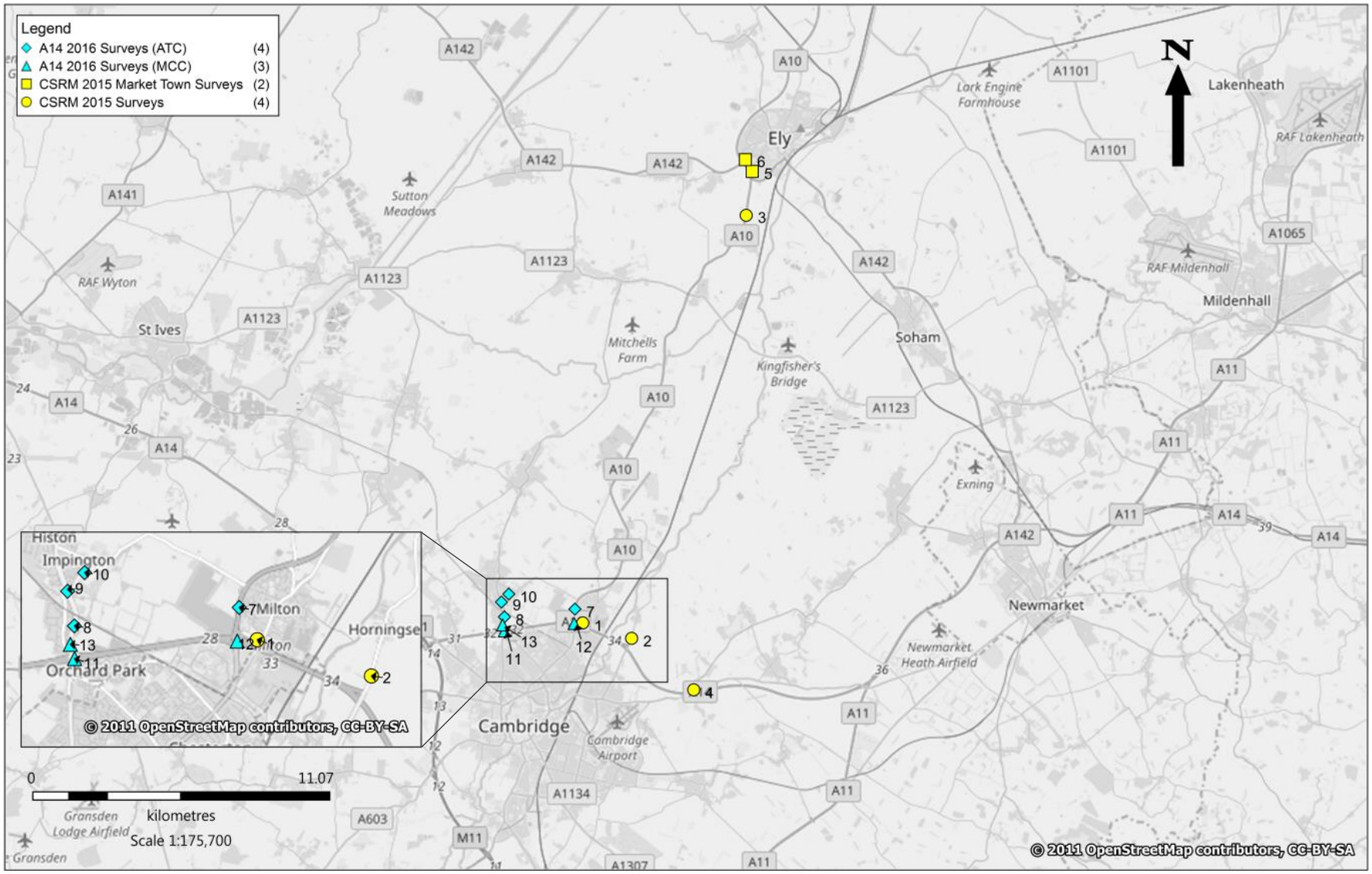


Figure 5-2 - Existing Count Data Locations



5.1.3. WebTRIS Data

Highways England WebTRIS data was collated from 12 sites along the A14, which runs along the southern edge of the core study area. Data from March 2018 was collated, as the most up-to-date available data. This data was compared with data from April 2017 to check consistency with the 2018 A10 counts, which were collected in April 2018. The data was averaged over neutral weekdays (Tuesday-Thursday), across the month, and used for calibration and validation. Figure 5-3 shows the locations of the WebTRIS sites collated.

5.1.4. Journey Time Data

TrafficMaster journey time data was collated across five routes for the purposes of journey time validation. This data provided average journey times and speeds along key routes in the model. Data for all routes was collected in 2016.

The five routes are shown in Figure 5-4.Route descriptions are as follows:

- Route 1 (Dark blue): A10 between Witchford Road Roundabout, Ely, and the Milton Interchange, A14 Jct.33;
- Route 2 (Red): A142 between Station Road Roundabout, Ely, and Jct. 37 of A14, Newmarket;
- Route 3 (Green): A1123 from Haddenham to A142 Roundabout, south of Soham;
- Route 4 (Light Blue): B1049 from Wilburton, via Twenty Pence Lane, to the Histon Interchange, A14 Jct. 32; and
- Route 5 (Purple): A14 between Jct. 32 (Histon) and Jct. 37 (Newmarket).

5.1.5. Traffic Signal Data

Traffic signal phasing, staging and timings for the traffic signal sites within the core study area were largely retained from the pre-existing CSRM2 network, based upon the reasonable assumption that traffic signal data would not have significantly changed in the period 2015-2018. However, signal data at five sites was obtained from CCC, to help review and update traffic signals along the A10 specifically. These sites are set out in Figure 5-5. One traffic signal in Histon utilised up-to-date signal data obtained from CCC for a separate project.

Further sites in Newmarket, on the periphery of the core study area and maintained by Suffolk County Council, were coded using estimated phasing staging and timings, based upon the level of flow on each approach arm. The level crossing near Fordham on the B1102 was estimated using similar timings as those featured on the existing level crossing at Wicken (A1123).

Figure 5-5 shows all signalised junctions and pedestrian crossings within the core study area. As can be seen, the data for these sites was either carried forward from the CSRM2 base model, updated using new data from CCC, or estimated.

5.1.6. Bus Route Data

The existing bus route coding from CSRM2 for all services within the core study area was reviewed as part of the A10E2C Model development. Services and routes were updated where necessary, and additional/surplus services were added/removed where appropriate. The bus route information to inform this review was collected from individual service websites and online timetables, utilising the CCC website (**https://www.cambridgeshire.gov.uk/residents/travel-roads-and-parking/buses/bus-timetables/**) as a guide to the services currently running through the core study area.

Figure 5-3 - WebTRIS Data Locations and Site References

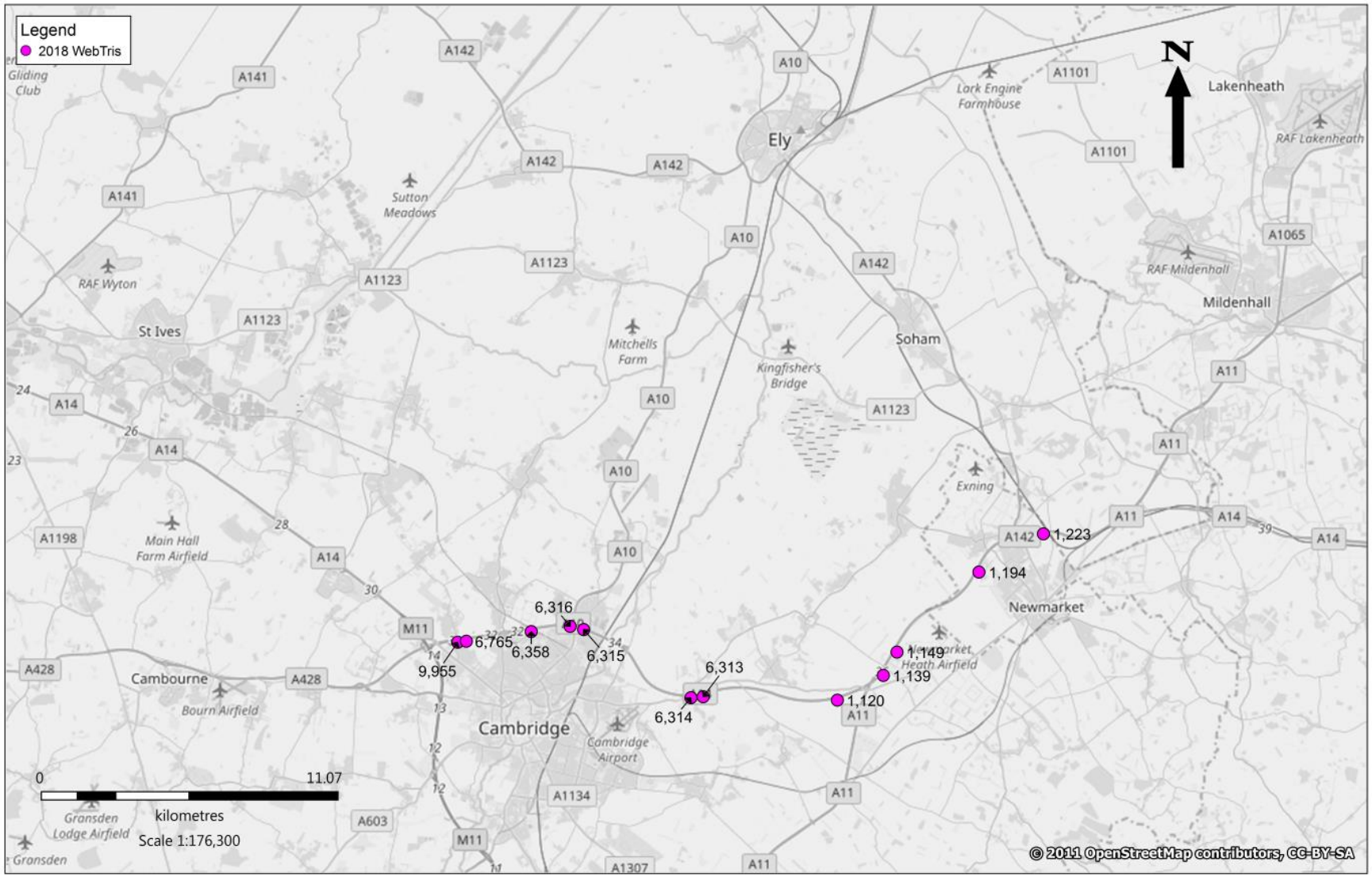


Figure 5-4 - Journey Time Routes and Timing Points

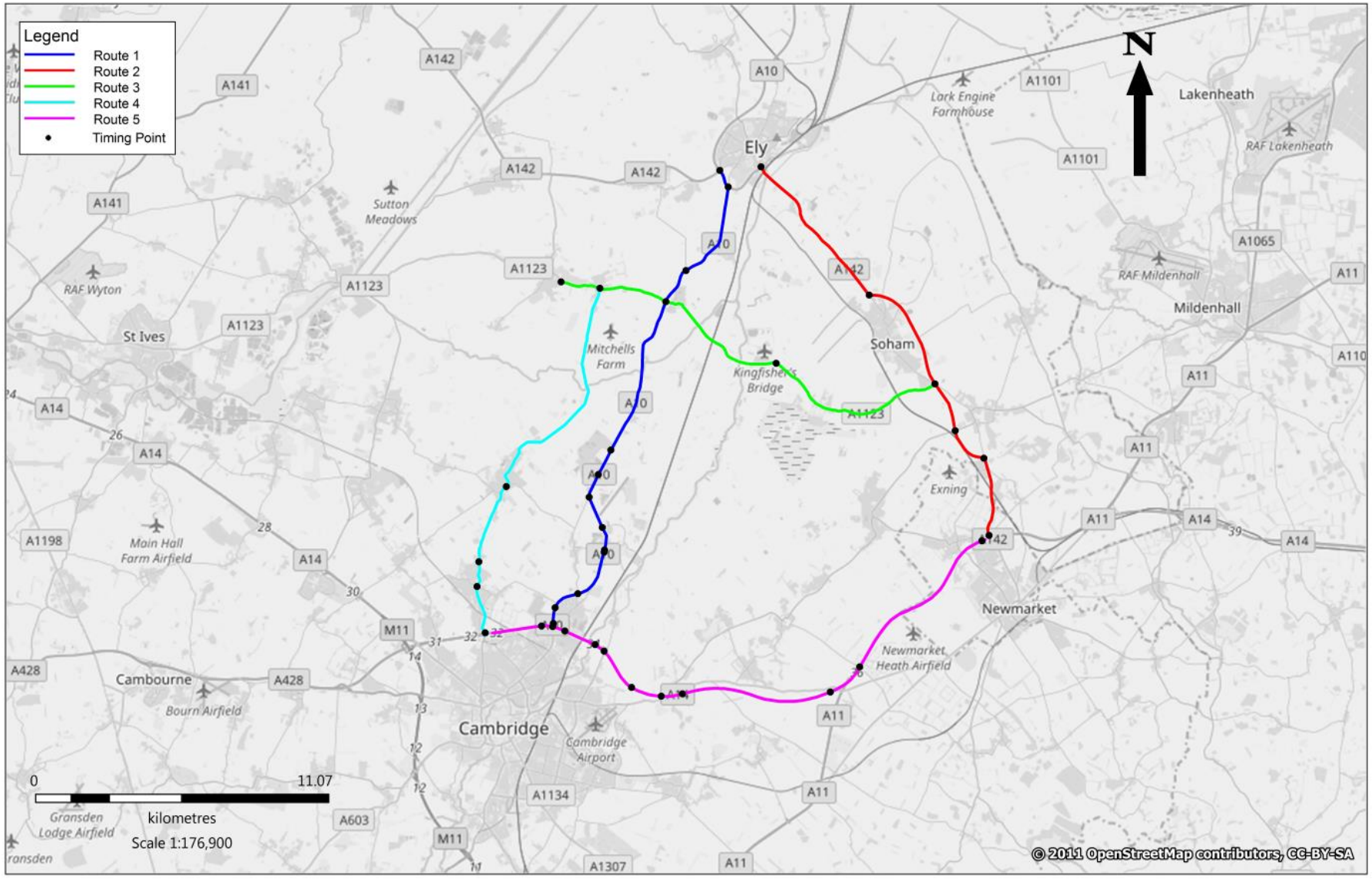
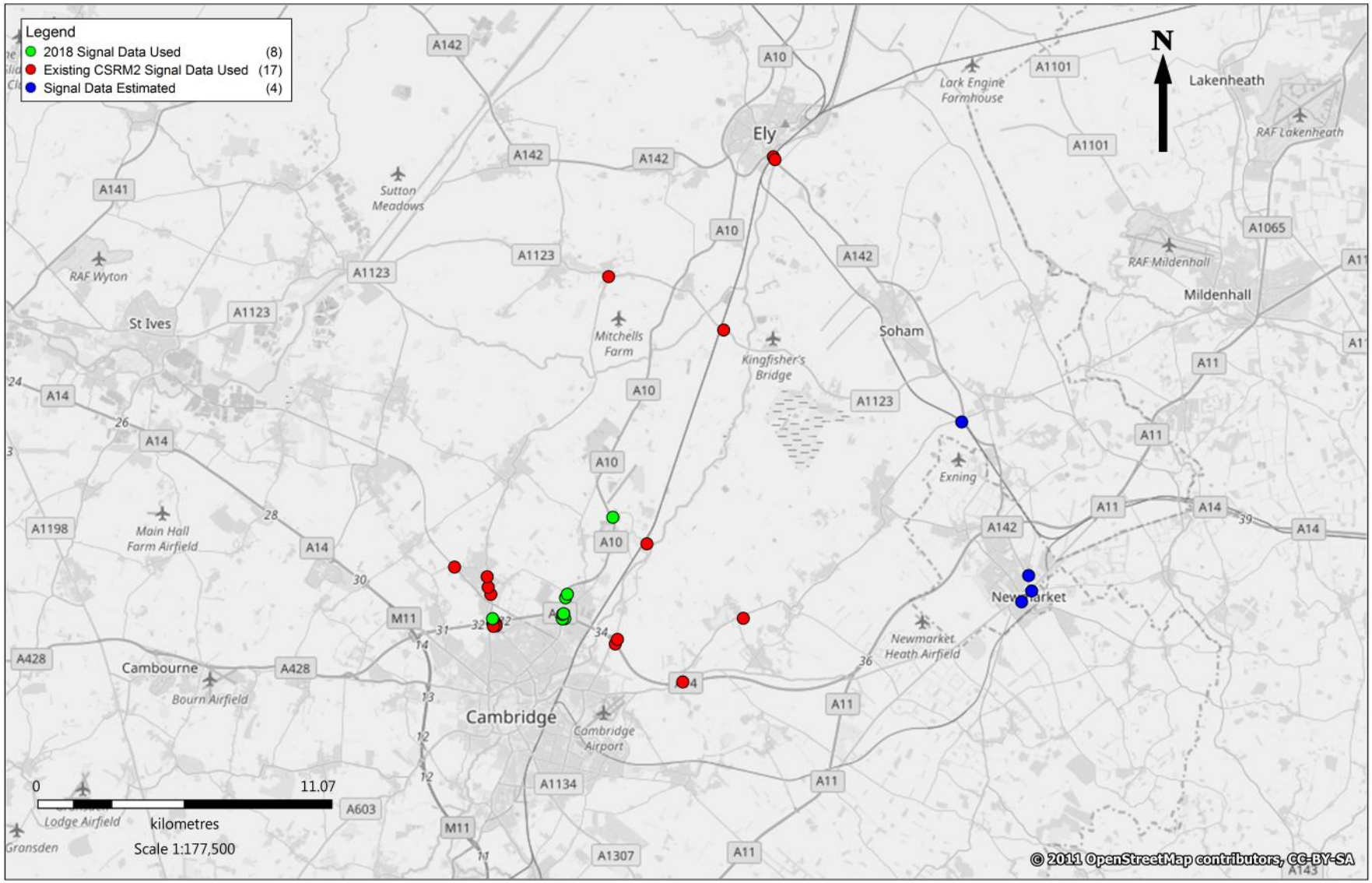


Figure 5-5 - Traffic Signals in A10E2C Model



6. Network Development

Having identified the core study area for the A10E2C Model and enhanced the zoning system within this area, it was also necessary to improve the level of detail of the highway network. This chapter sets out the additions and refinements made to the inherited CSRM2 network.

6.1. Overview of A10NCS Network Development

The development of the network of the A10E2C Model consisted of the following steps:

- Addition of significant detail within the core study area, incorporating significant B-Roads and access routes where necessary. Stub links were also added to allow access to the newly disaggregated zone system. In addition, the area south of Soham, along the A142 corridor to Newmarket, was converted from buffer network (as it was in CSRM2) to simulation network;
- Review of the existing network within the core study area, ensuring accuracy of link characteristics, as well as ensuring junction designs were as accurate as possible (for example, ensuring that staggered priority junctions along the A10 were represented accurately within SATURN);
- Review of the timings of signalised junctions along the A10; and
- Review of bus routes and services within the core study area.

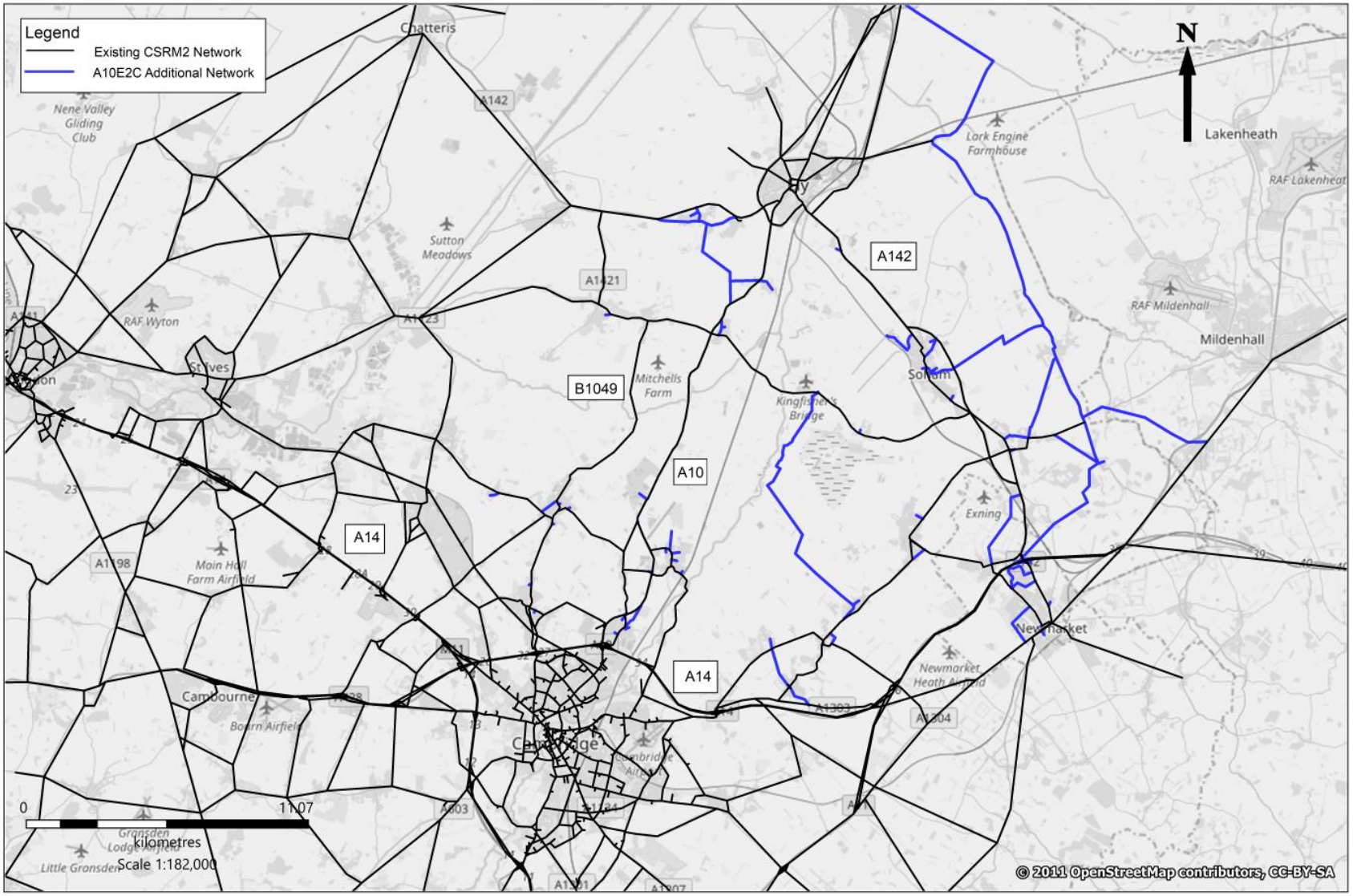
6.2. Network Coverage

Links were added to the existing network in several focused areas within the core study area, to ensure the road network was represented in suitable detail. These areas (shown in Figure 6-1) were:

- Ely Road, Milton (Connecting High Street with the A10);
- Lambs Lane, Cottenham;
- Stretham/Little Thetford/Witchford villages area (Stretham High Street, Red Fen Road and Grunty Fen Lane, plus Main Street, Witchford);
- Soham (Bushel Lane and Paddock Street);
- Fordham (B1102 through village);
- Exning and Chippenham area (Cotton End Road and Chippenham Road);
- Newmarket (Studlands Park Avenue and Brickfields Avenue);
- Lode Road/High Street, Bottisham;
- Heath Road, Swaffham Bulbeck;
- Isaacson Road, Burwell;
- Upware Road, connecting Swaffham Prior and the A1123, near Wicken;
- B1104, connecting Chippenham and Prickwillow; and
- Elms Road, Freckenham, as buffer network.

Additional, minor links were added throughout the core study area as short stub links, where centroid connectors could load onto the network. These were placed in locations as realistically as possible, generally linking into residential or industrial areas.

Figure 6-1 - A10E2C Model Network



6.3. Junctions

Enhanced detail was added to several priority junctions throughout the model. The most significant of these were:

- A10/Red Fen Road junction, Little Thetford;
- A10/Ely Road junction, Stretham;
- A10/Green End Road, Landbeach;
- A10/Denny End Road, Waterbeach;
- A10/Waterbeach Road/Car Dyke Road, Waterbeach;
- A10/Landbeach Road/Humphries Way, Milton; and
- A14 Junction 37, Newmarket.

Enhancements included giving consideration to the junction geometrics and revised characteristics to ensure the accuracy of junction operations, required to ensure robust validation of the model in terms of flow and journey time criteria.

Additional junctions were also added throughout the rest of the network, to cater for the additional links added. All other existing junctions (inherited from CSRM2) in the core study area were also checked for accuracy.

6.4. Signal Timings

Existing CSRM2 signalised junctions along the A10 were reviewed, and, where necessary, changed using up-to-date signal data obtained from CCC. Throughout the rest of the network, signals were sense-checked, but largely retained from CSRM2. In the south-east of the model, along the A142 and in Newmarket, which had previously been buffer coding in CSRM2, signalised junctions were added using estimated phasing, staging and timings. Green time was proportioned based on modelled traffic flows on each arm.

6.5. Bus Routes

Bus routes and services within the core study area were reviewed against current April 2018 timetables. Services and frequencies were updated where necessary, and routes updated to match the new detail added within the core study area.

7. Trip Matrix Development

7.1. Overview

This section summarises the approach taken to construct the base year trip matrices for the A10E2C Model which have been derived from the CSRM2 parent model.

7.2. A10E2C Prior Matrix Development Methodology

The overall approach to the development of the A10E2C prior matrices is as follows:

- Isolation of CSRM2 prior matrix movements for A10E2C core study area;
- Disaggregation of CSRM2 zones within the core study area to accord with the A10E2C zoning system; and
- Isolated refinement of the prior matrices (as part of the validation process).

Further detail regarding these steps is provided below.

7.2.1. CSRM2 Prior Matrix Isolation

A key focus of the A10E2C model development is to ensure that the link to the CSRM2 parent model is maintained as closely as possible, whilst allowing for the refinement of the trip matrices for movements travelling within the core study area. This refinement includes allowing for the matrix estimation process (detailed in Chapter 9) to make controlled adjustments to the matrix to match with observed calibration data. As matrix estimation was utilised in the development of CSRM2, it would not be appropriate to re-apply matrix estimation to the final CSRM2 trip matrices as it would not be possible to analyse the differences between the final model matrices and the original prior matrix movements derived primarily from observed data sources (including mobile phone data, Roadside Interview survey data and Park & Ride origin-destination surveys).

To allow for the controlled application of matrix estimation to the A10E2C prior matrices, trips which pass through the core study area (defined in Figure 4-1) were based on prior matrices whereas trips which do not pass through the study area were derived from the final CSRM2 matrices (and are therefore consistent with CSRM2 matrix totals). This was achieved by producing cordon matrices of the study area from the final CSRM2 assignment – identifying which zone-to-zone pairs include trips which travel through the study area, and which do not. Corresponding indicator matrices were produced which allowed for the extraction of relevant trips from the CSRM2 prior and final post-ME matrices.

Table 7-1 shows the total number of trips derived from the CSRM2 prior matrices and post-ME matrices as proportion of the original respective matrices, together with the total number of trips inherited for the initial A10E2C prior matrices for each modelled time period.

Table 7-1 – CSRM2 Prior and Post-ME Matrix Utilisation

Time Period	Matrix Element	CSRM2 Prior	CSRM2 Final	Initial A10E2C
AM Peak	Adopted	25,166	77,757	102,923
	Full	100,569	104,996	
	Proportion Used	25%	74%	100%
Inter-peak	Adopted	18,727	57,889	76,616
	Full	76,564	76,541	
	Proportion Used	24%	76%	100%
PM Peak	Adopted	25,884	84,703	110,587
	Full	108,234	111,012	
	Proportion Used	24%	76%	100%

Table 7-1 demonstrates that for all time periods, between 24 and 25% of the CSRM2 prior matrix trips are adopted for the initial A10E2C matrices, with between 74 and 76% of trips then adopted from the final CSRM2 matrices. This demonstrates that the majority of trip zone-to-zone totals used for the A10E2C model are consistent with the parent model (with these trips not being altered as part of matrix estimation). As would be expected, the initial A10E2C prior matrices are also close in total size to the CSRM2 parent matrices (both prior and post-ME).

7.2.2. Zone Disaggregation

Having derived the initial prior matrices from the CSRM2 prior and post-ME matrices, it was then necessary to disaggregate trips arriving or departing from zones within the core study area to accord with the detailed zoning system adopted for the A10E2C model (shown in Figure 4-3). As detailed in Section 4.4, the zone system for the A10E2C Model was built up from the pre-existing CSRM2 zone boundaries, divided into several smaller zones, based upon UK Census Output Areas.

In disaggregating the CSRM2 matrix numbers, it was necessary to ensure that the prior matrix reflected the differences in land use for A10E2C zones within each CSRM2 zone. To inform this process, UK Census statistics on the number of households, workers and jobs in each new zone was collected. Specifically, the UK Census statistics used were:

- car or van availability statistics to inform households;
- economic activity to inform the number of workers; and
- population (workplace population) to inform the number of jobs.

These statistics were used to calculate proportions for each new zone, whilst maintaining the overall number of trips. Different factors were applied for each user class, dependent on the most logical factor which would influence the number of trip departures (origins) or arrivals (destinations). For example, trip origins in the AM peak utilise the proportion of workers within each OA, whilst for destinations, proportions were based on the number of jobs (reflecting the typical nature of trip patterns for journeys to work). In the PM peak, origin factors were based on the number of jobs, with destinations based on the number of workers – reflecting return journeys. The relevant statistics used for each user class are shown in Table 7-2.

Table 7-2 – OA Census Statistics Used for Zone Disaggregation

Broad User Class	UK Census Source for Zone Disaggregation	
	Origin Trips	Destination Trips
1 – Car Business	Jobs	Jobs
2 – Car Commuting	AM Peak: Workers Inter-Peak: Workers PM Peak: Jobs	AM Peak: Jobs Inter-Peak: Jobs PM Peak: Workers
3 – Car Other	Households	Households
4 – LGV	Households	Households
5 – HGV	Jobs	Jobs

7.2.3. Validation Adjustments

Following the production of the initial prior matrices, early assignments of the model were undertaken to understand the suitability of the matrices prior to calibration. A number of checks were undertaken, comparing flows against screenlines and individual key links across the study area. This resulted in minor alterations to the initial matrices, accounting for detailed land use considerations which would not necessarily have been reflected accurately in the initial CSRM2 matrices or following the disaggregation of trips. For example, count data was used to ensure that the Tesco supermarket in Milton (located close to the A10 Milton Interchange) generated a sensible level of trips during each model time period, whilst initial screenline analysis helped to ensure the level of local trips travelling between the B1049 Twenty Pence Road and the A10 corridor better matched observed counts.

It was also recognised that the CSRM2 parent model was validated to a 2015 base year, whilst the A10E2C model was required to represent 2018 base year conditions. There was limited availability of 2015 count data available for comparison with newly commissioned sites. However, three suitable sites (conducted in neutral months) within the vicinity of the A10 corridor were identified. The comparisons are presented in Table 7-3.

Table 7-3 – A10E2C Core Study Area Count Comparisons

Location	Direction	2015 12-hr flow	2018 12-hr flow	Growth
Cambridge Road, Milton	NB	6,355	6,381	0.41%
	SB	6,434	6,393	-0.65%
	2-way	12,789	12,774	-0.12%
Horningsea Road, Horningsea	NB	2,525	2,608	3.29%
	SB	2,805	2,842	1.32%
	2-way	5,330	5,450	2.25%
A10 north of Little Thetford	NB	7,929	7,984	0.69%
	SB	7,382	7,521	1.88%
	2-way	15,311	15,505	1.27%
Total		**33,430**	**33,729**	**0.89%**

These sites revealed relatively little change in traffic levels between 2015 and 2018, with some counts demonstrating minor increases, and other sites showing decreases. Additionally, as presented in Section 9.1 of this report, the screenline results demonstrate the levels of traffic within the core area are generally sensible, with modelled flows typically slightly higher than observed. Consequently, no growth adjustments have been applied.

Final A10E2C prior matrix totals for each user class are presented in Table 7-4.

Table 7-4 – Final A10E2C Prior Matrix Totals by User Class (in PCUs)

CSRM2 User Class	AM Peak	Inter-peak	PM Peak
1 – Car: HBW Low Income	4,908	967	5,849
2 – Car: HBW Medium Income	12,551	2,522	14,958
3 – Car: HBW High Income	23,298	4,800	27,880
4 – Car: Education	21,414	4,294	4,072
5 – Car: EB	4,485	4,079	6,001
6 – Car: Other Low Income	8,435	15,008	14,613
7 – Car: Other Medium Income	6,007	13,623	13,082
8 – Car: Other High Income	4,492	13,882	12,266
9 – HGV 1	9,850	10,074	7,799
10 – HGV 2	761	433	216
11 – LGV: HBW + Ed + Other	8,386	7,892	5,491
12 – LGV: EB	463	592	358
Total	**105,050**	**78,166**	**112,585**

8. Calibrations and Validation Procedures

Model calibration refers to the process of refining and confirming the values of model parameters, and improving origin-destination movements in the demand matrices to improve the overall model performance. This performance is benchmarked against data collected as part of the study.

Model validation aims to demonstrate that the calibrated model reproduces observed base year traffic conditions. This is done by comparing model outputs with data independent of that used in model calibration.

8.1. Calibration/Validation Counts

For the A10E2C Model, the Central North-South Screenline (Screenline 2 in Section 4.6) was chosen for validation due to its position at the centre of the model study area. If the WebTAG criteria could be met along this screenline, this would provide independent verification to indicate that the correct volumes of traffic were travelling through the A10E2C Model network. All other screenlines were used as part of the calibration procedure.

Additionally, a further 111 individual link counts were selected for calibration, whilst a further 78 individual links were selected for validation. Hence overall, including screenlines and individual links, 139 link counts were monitored for calibration and 88 link counts were used for validation, and excluded from the matrix estimation process.

The A10E2C Model was also validated at a turn level, with 17 junctions throughout the study area (166 individual movements in total) considered. Key junction validation is discussed in Section 10.5.

8.2. Assignment Parameters

Model assignments were carried out using a Wardrop User Equilibrium procedure which aims to minimise the cost of travel for all vehicles within the network. The assignment is based on minimum generalised cost routes where the generalised cost is defined as a linear combination of time and distance:

$$Generalised\ cost = \beta\ x\ time + \alpha\ x\ distance$$

Full details of the parameters used in this procedure can be found in Section 4.11.1.

8.3. Calibration Procedure

The calibration procedure involved a series of steps designed to improve the performance of the model and ensure it was replicating observed 2018 traffic flows and journey times. Tasks included:

- Ensuring network characteristics, such as free-flow speeds and signal phases/timings represent observed conditions;
- Ensuring capacity controls, such as speed-flow curves, saturation flows and turn capacities were appropriate to replicate observed conditions;
- Checking the routing of vehicles in the model, by verifying routes from select link analysis in the P1X module of SATURN against online route planners; and
- Once calibration of the initial assignment had been carried out, matrix estimation (ME) was applied to ‘fit’ prior trip matrices to traffic flows in the study area.

8.4. Speed Flow Curves

Speed-flow curves (SFCs) can be used to represent delays on the network, replicating observed road conditions. Section 4.12 sets out the SFCs used in the A10E2C Model. During model calibration, SFCs were adjusted, with different SFCs selected to reflect the appropriate speeds and capacities on a specific link. These were adjusted until link travel times were better representing observed travel times.

9. Matrix Estimation

9.1. Case for Matrix Estimation

WebTAG unit M3.1 advises that the primary purpose of ME is to refine estimates of trips which have been synthesised (the 'prior' matrices). To check the need to use ME, prior matrix modelled flows along each screenline in each time period were compared against observed flows. Tables 9-1 to 9-3 display a comparison of modelled and observed flows along all screenlines for each time period. As modelled flows did not meet WebTAG criteria, ME was judged to be an appropriate step to take to improve the calibration of the matrices.

Table 9-1 - Summary of Flow Calibration Screenlines - AM Prior

Location	Direction	Observed	Modelled	Modelled - Observed	% diff	GEH	Meets WebTAG Criteria?
Northern North-South	NB	1,420	1,767	346	24.4%	8.7	×
	SB	1,685	1,804	119	7.1%	2.8	×
Central North-South	NB	1,567	1,737	170	10.8%	4.2	×
	SB	3,130	3,186	56	1.8%	1.0	✓
Southern North-South	NB	2,771	2,901	130	4.7%	2.4	✓
	SB	3,840	3,828	-12	-0.3%	0.2	✓
East-West	WB	3,622	3,881	259	7.1%	4.2	×
	EB	4,063	4,147	83	2.1%	1.3	✓

Table 9-2 - Summary of Flow Calibration Screenlines - IP Prior

Location	Direction	Observed	Modelled	Modelled - Observed	% diff	GEH	Meets WebTAG Criteria?
Northern North-South	NB	1,200	1,513	313	26.1%	8.5	×
	SB	1,185	1,476	291	24.5%	8.0	×
Central North-South	NB	1,706	1,471	-235	-13.8%	5.9	×
	SB	1,518	1,574	56	3.7%	1.4	✓
Southern North-South	NB	3,092	3,192	100	3.2%	1.8	✓
	SB	2,674	2,938	264	9.9%	5.0	×
East-West	WB	3,212	3,194	-18	-0.6%	0.3	✓
	EB	2,980	3,124	145	4.9%	2.6	✓

Table 9-3 - Summary of Calibration Flow Screenlines - PM Prior

Location	Direction	Observed	Modelled	Modelled - Observed	% diff	GEH	Meets WebTAG Criteria?
Northern North-South	NB	1,760	1,865	105	5.9%	2.5	×
	SB	1,507	1,893	386	25.6%	9.4	×
Central North-South	NB	3,017	2,835	-183	-6.1%	3.4	×
	SB	1,647	1,916	268	16.3%	6.4	×
Southern North-South	NB	4,922	4,929	7	0.1%	0.1	✓
	SB	2,956	3,388	432	14.6%	7.7	×
East-West	WB	4,796	4,678	-118	-2.5%	1.7	✓
	EB	3,800	4,227	427	11.2%	6.7	×

9.2. Matrix Estimation Procedure

ME is undertaken using the SATME2 module of SATURN, and aims to produce an estimated matrix that is consistent with observed traffic counts. The equation used may be written as:

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

where:

- Tij is the output matrix of OD pairs ij;
- tij is the prior matrix of OD pairs ij;
- ∏a product over all counted links a;
- Xa is the balancing factor associated with the counted link;
- Pija is the fraction of trips from i to j using link a.

The ME process is dependent on several factors including the quality of the prior matrix, traffic routeing, and the order and consistency of observed traffic counts. It is therefore essential that the process is monitored to ensure the following:

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

The matrix estimation provides a method by which an initial estimate of the trip matrix can be adjusted in order to reflect observed traffic count data. This process is accomplished within SATURN through use of the SATPIJA program, which creates a file in which each element represents the proportion (P) of the trips between a particular origin-destination pair (IJ) which uses the counted link (A). The SATME2 program then uses the PIJA file to adjust the prior matrix to create the most likely trip matrix consistent with the information contained in the count file. Finally, the output matrix is assigned back to the model network, and is compared to the observed count to gauge the degree to which these match. This process is looped for a limited number of iterations until satisfactory model calibration is achieved.

9.3. Impact of Matrix Estimation

This section describes the resulting impact of the matrix estimation process on the A10E2C prior matrices. The criteria for assessing the impact of ME is set out in Section 3.6.

9.3.1. Matrix Totals

A comparison of matrix trip totals for all user classes and just light vehicles, before and after ME, is shown in Table 9-4.

Table 9-4 - Comparison of Matrix Trip Totals - Prior vs Post-ME

Time Period	Lights			All		
	Prior	Post-ME	% Change	Prior	Post-ME	% Change
AM	94,437	94,253	-0.2%	105,048	104,240	-0.8%
IP	67,657	68,363	1.0%	78,164	78,359	0.2%
PM	104,570	106,181	1.5%	112,586	113,715	1.0%

Table 9-4 demonstrates that for all three time periods, the matrix estimation process makes relatively little change to the size of the overall trip matrices. Closer analysis of each iteration loop has also revealed the matrix estimation process converges to a stable solution rapidly, with minimal change after the second iteration for each time period.

9.3.2. Matrix Zonal Values

The impact of ME on individual zone to zone movements, between the prior and post-ME matrices is set out in Table 9-5.

Table 9-5 - Matrix Zonal Cell Value Changes - Prior vs Post-ME

Measure	Significance Criteria	AM	IP	PM
Matrix Zonal Cell Value	Slope within 0.98 and 1.02	1.00	1.00	1.00
	Intercept near zero	0.00	0.00	0.00
	R^2 in excess of 0.95	0.99	0.99	0.99

As displayed, the slope, intercept and R^2 across all time periods indicates that zonal cell values have not changed materially from the prior matrix.

9.3.3. Matrix Trip Ends

Table 9-6 presents the impact of ME on the trip end values.

Table 9-6 - Matrix Zonal Trip End Changes - Prior vs Post-ME

Measure	Significance Criteria	AM	IP	PM
Matrix Zonal Trip Ends – Origin (Rows)	Slope within 0.99 and 1.01	1.01	1.00	1.01
	Intercept near zero	-0.24	-0.01	-0.03
	R^2 in excess of 0.98	0.98	0.98	0.99
Matrix Zonal Trip Ends – Destination (Columns)	Slope within 0.99 and 1.01	**0.98**	1.00	**1.02**
	Intercept near zero	2.19	-0.09	-1.51
	R^2 in excess of 0.98	0.99	1.00	0.99

Table 9-6 shows that the significance criteria relating to origin trip ends were all met, indicating insignificant change in the origin trip ends. The slope of the destination trip ends was marginally outside the significance criteria, in the AM and PM, although both were close to meeting the criteria.

9.3.4. Matrix Trip Length Distribution

Figures 9-1 to 9-6 show the trip length distribution, broken down by time period and by light and heavy vehicles. These show that the trip length distribution did not change significantly for any user class, in any time period. The expected distribution of trip lengths was maintained, with the most significant change occurring between prior and post-ME in the 95km+ bin, which saw some changes in the Heavy user classes.

Figure 9-1 - Trip Length Distribution - Lights (AM)

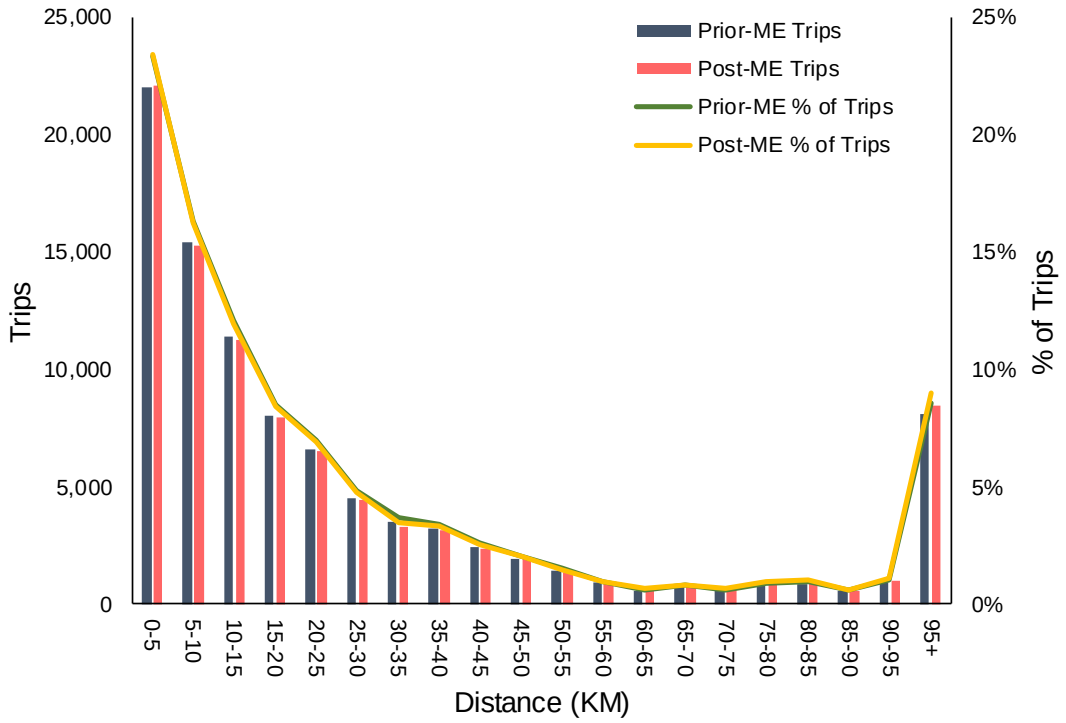


Figure 9-2 - Trip Length Distribution - Heavies (AM)

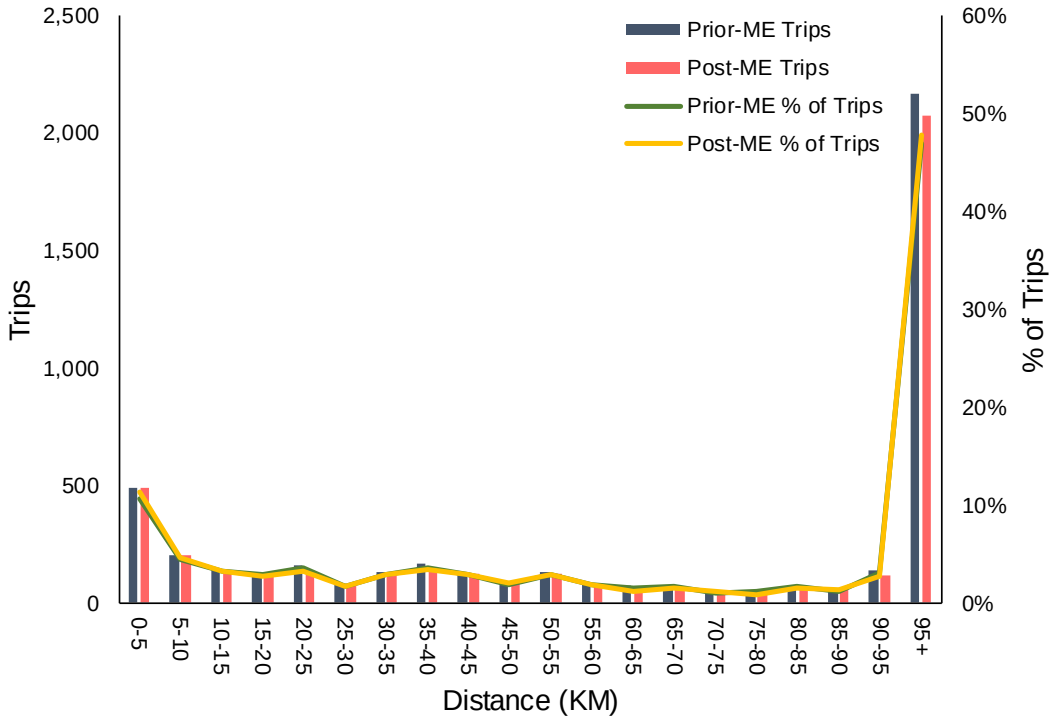


Figure 9-3 - Trip Length Distribution - Lights (IP)

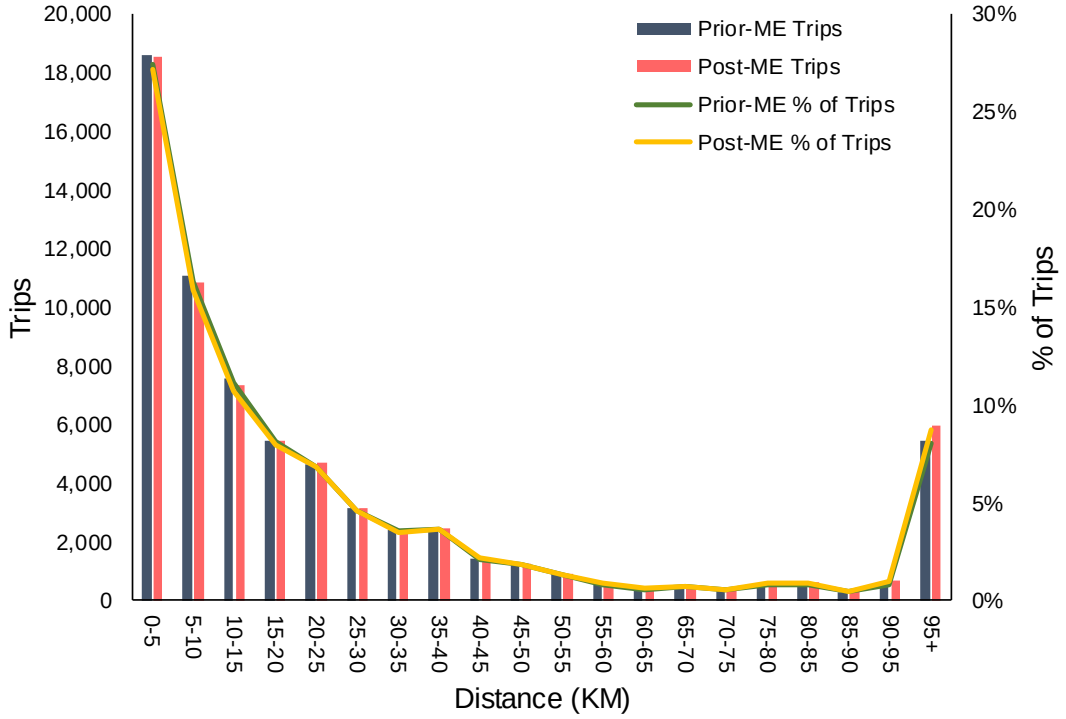


Figure 9-4 - Trip Length Distribution - Heavies (IP)

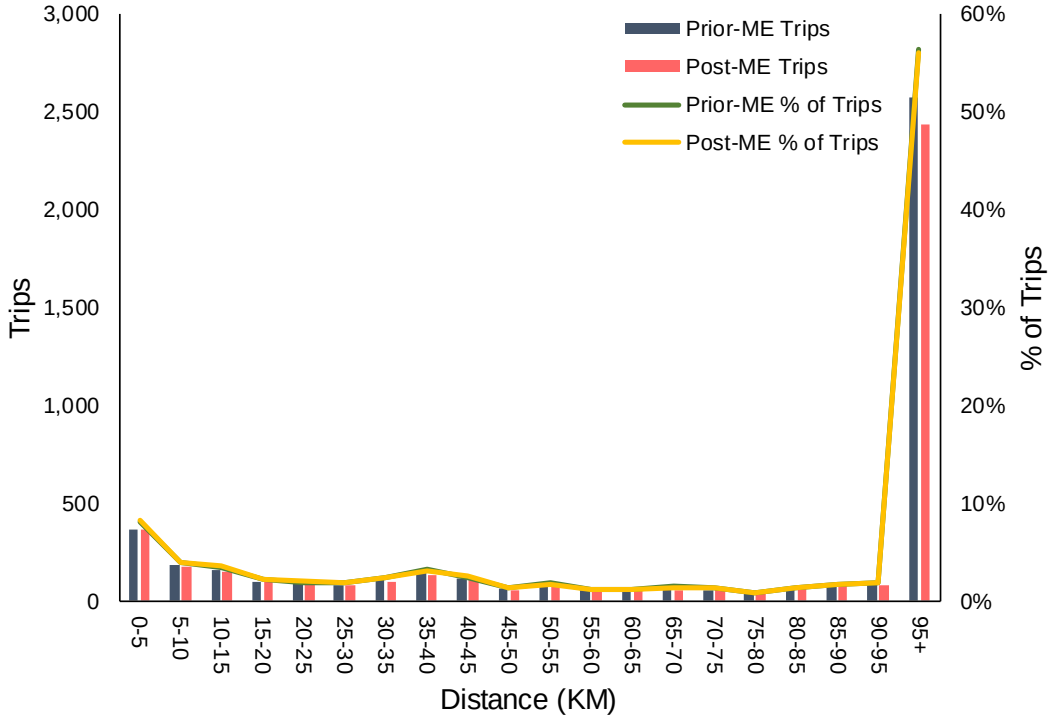


Figure 9-5 - Trip Length Distribution - Lights (PM)

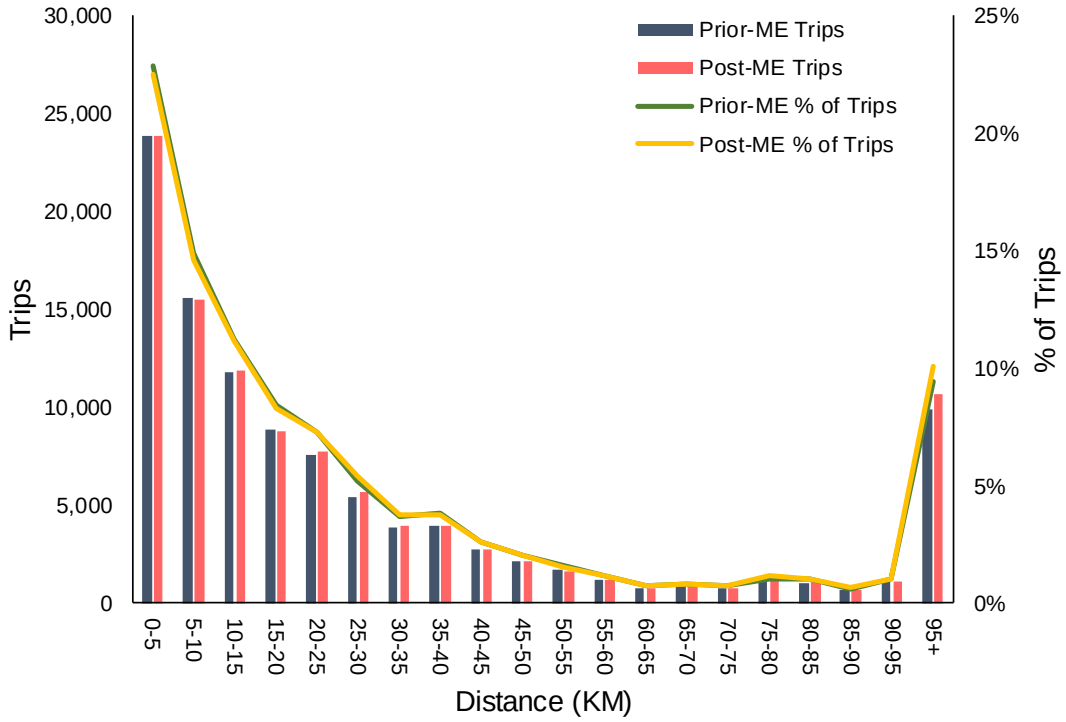
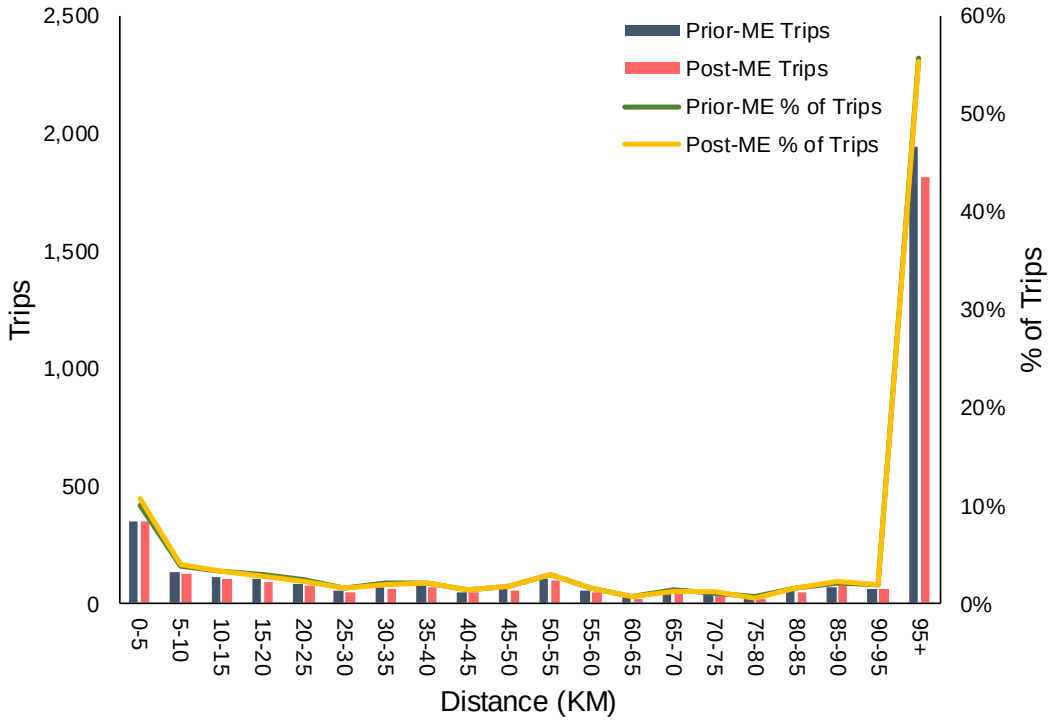


Figure 9-6 - Trip Length Distribution - Heavies (PM)



Average trip length comparisons are shown in Table 9-7.

Table 9-7 - Average Trip Length Comparison

Time Period	Matrix	Average Trip Length (Km)		
		All Vehicles	Lights	Heavies
AM Peak	Prior	39.7	32.2	106.2
	Post	40.2	33.0	107.9
	Change	1.1%	2.3%	1.6%
Inter-peak	Prior	44.0	31.5	124.4
	Post	44.8	33.2	124.3
	Change	1.9%	**5.5%**	-0.1%
PM Peak	Prior	41.3	35.1	122.9
	Post	42.0	36.3	123.0
	Change	1.6%	3.3%	0.1%

WebTAG M3.1 advises that changes in trip length distribution should not exceed +/- 5%. As displayed, overall vehicle changes are well within this criteria for the AM and PM peak. The inter-peak value falls slightly outside this range for light vehicles (5.5%) but all other values for lights and heavy goods vehicles are within the desired range.

9.3.5. Sector Analysis

For the purposes of sector analysis, the model zoning has been grouped as shown in Figure 9-7. The sector descriptions are as follows:

- Sector 1 – The northern section of the core study area, including southern Ely, Stretham, Little Thetford, Wilburton and Witchford;
- Sector 2 – The eastern section of the core study area, including Soham and Fordham as well as Newmarket to the south;
- Sector 3 – The southern section of the core study area, including Milton, Landbeach, Waterbeach, Cottenham and Histon; and
- Sector 4 – External zones which fall outside of the core study area.

The results of the analysis in terms of the percentage difference in vehicle totals across sector are displayed in Tables 9-8 to 9-10, with GEH statistic comparisons displayed in Tables 9-11 to 9-13.

Figure 9-7 - Sector System

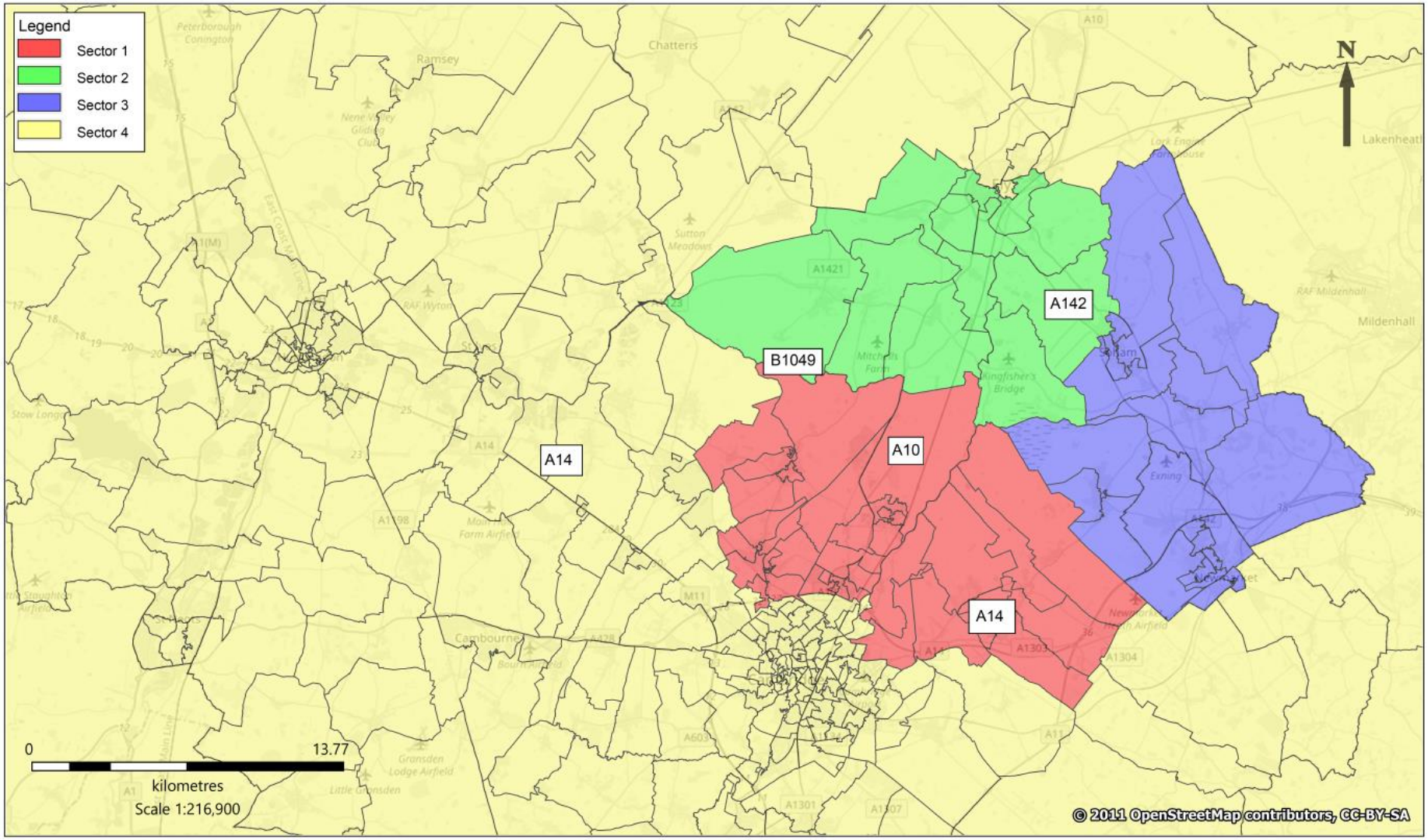


Table 9-8 - AM Peak Pre-ME vs Post-ME Sector Percentage Changes

Sector	1	2	3	4	Total
1	-0.3%	-0.1%	27.3%	-3.9%	**-1.7%**
2	1.5%	-4.4%	-2.1%	-6.1%	**-4.4%**
3	5.8%	-30.1%	2.2%	-15.5%	**-8.4%**
4	7.7%	0.3%	8.7%	-0.7%	**-0.2%**
Total	**5.5%**	**-6.0%**	**5.7%**	**-1.2%**	**-0.8%**

Table 9-9 – Inter-peak Pre-ME vs Post-ME Sector Percentage Changes

Sector	1	2	3	4	Total
1	-1.1%	-0.4%	29.2%	-3.1%	**-0.8%**
2	3.3%	-5.5%	-14.6%	-3.1%	**-4.9%**
3	9.5%	-25.0%	4.6%	-8.8%	**-3.6%**
4	-3.6%	0.6%	10.2%	0.6%	**0.6%**
Total	**-2.2%**	**-4.4%**	**6.9%**	**0.2%**	**0.2%**

Table 9-10 – PM Peak Pre-ME vs Post-ME Sector Percentage Changes

Sector	1	2	3	4	Total
1	-1.2%	2.3%	2.4%	4.7%	**3.2%**
2	10.7%	-1.2%	-20.1%	7.1%	**1.3%**
3	3.0%	-8.6%	9.6%	2.3%	**4.6%**
4	2.1%	-6.8%	23.8%	0.1%	**0.7%**
Total	**1.7%**	**-5.0%**	**13.3%**	**0.5%**	**1.0%**

Table 9-11 - AM Peak Pre-ME vs Post-ME Sector GEH Changes

Sector	1	2	3	4	Total
1	0.1	0.0	3.7	2.3	**1.1**
2	0.2	1.0	0.4	2.3	**2.3**
3	1.1	7.5	1.0	7.6	**6.2**
4	4.1	0.1	3.7	1.9	**0.6**
Total	**3.6**	**3.3**	**3.8**	**3.7**	**2.5**

Table 9-12 – Inter-Peak Pre-ME vs Post-ME Sector GEH Changes

Sector	1	2	3	4	Total
1	0.3	0.0	4.0	1.6	**0.5**
2	0.4	1.1	2.7	1.1	**2.3**
3	1.2	4.6	1.6	3.3	**2.1**
4	1.9	0.2	3.9	1.5	**1.7**
Total	**1.4**	**2.0**	**3.9**	**0.5**	**0.7**

Table 9-13 - PM Peak Pre-ME vs Post-ME Sector GEH Changes

Sector	1	2	3	4	Total
1	0.4	0.4	0.5	2.7	**2.3**
2	1.3	0.3	4.7	3.0	**0.7**
3	0.5	1.7	4.1	1.0	**3.1**
4	1.3	2.8	11.6	0.4	**2.3**
Total	**1.2**	**2.7**	**9.5**	**1.4**	**3.4**

Analysing the sector changes in terms of percentage differences demonstrates that the total change in origins is low (either lower than or close to 5% difference) whilst the vast majority of individual sector-to-sector movements have a GEH value of less than 5. Sector movements outside of this value are where base year flows are relatively low compared to other movements (for example movement 3 to 2 in the AM features only 366 vehicles post-ME).

Crucially, the external-to-external (sector 4 to sector 4) changes are very low as would be expected – given that matrix estimation has only been allowed to make adjustments to trips which travel to/from or pass through the core study area.

10. Calibration and Validation Results

10.1. Overview

The calibration and validation procedure was conducted as set out in Sections 8 and 9, in conjunction with the ME process. An iterative process was undertaken whereby the validation of the model was assessed using comparisons of the modelled and observed data as discussed below. Adjustments were made to the model to reduce the differences between the modelled and observed data.

The model was validated by means of the following comparisons:

- Modelled and observed traffic flows across the identified calibration and validation screenlines by time period;
- Modelled and observed traffic flows on individual links compared by cars and all vehicles and by time period;
- Modelled and observed journey times along routes, as a check on the quality of the network and the assignment; and
- Route choice validation.

Each of these validations is presented in separate sections below. The final section presents the levels of model convergence achieved.

10.2. Flow Calibration Results

Tables 10-1 to Table 10-3 show the level of validation achieved across the three screenlines chosen for model calibration, across the three modelled time periods. Appendix C shows full results for each count within the calibration screenlines.

Table 10-1 - Summary of Flow Calibration Screenlines - AM (Vehicles)

Location	Direction	Observed	Modelled	Modelled - Observed	% diff	GEH	WebTAG Criteria?
Northern North-South	NB	1,420	1,447	27	1.9%	0.7	✓
	SB	1,685	1,627	-59	-3.5%	1.4	✓
Southern North-South	NB	2,771	2,656	-115	-4.2%	2.2	✓
	SB	3,840	3,807	-32	-0.8%	0.5	✓
East-West	WB	3,622	3,664	42	1.2%	0.7	✓
	EB	4,063	3,999	-65	-1.6%	1.0	✓

Table 10-2 - Summary of Flow Calibration Screenlines – Inter-peak (Vehicles)

Location	Direction	Observed	Modelled	Modelled - Observed	% diff	GEH	WebTAG Criteria?
Northern North-South	NB	1,200	1,317	117	9.8%	3.3	×
	SB	1,185	1,184	-2	-0.2%	0.1	✓
Southern North-South	NB	3,092	2,947	-145	-4.7%	2.6	✓
	SB	2,674	2,726	52	1.9%	1.0	✓
East-West	WB	3,212	3,207	-4	-0.1%	0.1	✓
	EB	2,980	3,025	45	1.5%	0.8	✓

Table 10-3 - Summary of Flow Calibration Screenlines – PM (Vehicles)

Location	Direction	Observed	Modelled	Modelled - Observed	% diff	GEH	WebTAG Criteria?
Northern North-South	NB	1,760	1,808	48	2.7%	1.1	✓
	SB	1,507	1,543	36	2.4%	0.9	✓
Southern North-South	NB	4,922	4,824	-98	-2.0%	1.4	✓
	SB	2,956	3,075	119	4.0%	2.2	✓
East-West	WB	4,796	4,770	-26	-0.5%	0.4	✓
	EB	3,800	3,993	194	5.1%	3.1	×

Tables Table 10-1 to Table 10-3 demonstrate that the calibration screenlines achieve a high level of accuracy across all three time periods, including:

- All AM peak calibration screenlines had modelled flows within 5% of observed flows, demonstrating a high level of accuracy;
- In the inter-peak period, five out of six screenlines met the required criteria in terms percentage flow difference. Regarding the Northern North-South screenline which does not meet the criteria in the northbound direction;
  - Modelled flows through the screenline were 9.8% greater than those observed, although as can be seen, the overall volumes through this screenline were relatively small (1,200 vehicles observed), and as such a relatively minor absolute difference (117 vehicles) resulted in a percentage flow greater than 5%. A low GEH statistic of 3.3 for the screenline total gives increased confidence over the flows in this area of the model;
  - Appendix Table C.2 shows that much of the additional volume travelling through this screenline occurred at the A142, near Stuntney. There were however, only 108 extra vehicles, over and above the observed flows, to the extent that the count featured a GEH of 4.2 (and therefore meeting individual link criteria); and
- In the PM peak, again five out of six screenlines met the required standard. Regarding the East-West screenline which does not meet the criteria in the eastbound direction;
  - The screenline result fell just outside the criteria with modelled flows 5.1% above observed (194 vehicles). Again, this was a relatively minor discrepancy, with modelled flows 5.1% over observed, and a screenline GEH statistic of 3.1.
  - Appendix Table B.9 shows that all individual counts used in this screenline featured either flows within 5% or a GEH value of under 5 compared to observed flows, giving confidence in the robustness of this area in the model.

Table 10-4 shows the overall share of links used in the calibration which meet the link criteria for each time period.

Table 10-4 - Link Calibration Summary

Time Period	Percentage of Links Passing WebTAG Criteria
AM Peak	87%
Inter-peak	94%
PM Peak	91%

Table 10-4 demonstrates that the majority of links used in calibration satisfy WebTAG criteria for individual links across all of the modelled time periods, exceeding the WebTAG requirement of 85% of links meeting the link criteria. Appendix E presents the results for all individual links used in calibration.

10.3. Flow Validation Results

Tables 10-5 to 10-7 show the overall level of screenline validation, in each direction and across all time periods for the Central North-South screenline selected as an independent validation screenline. Appendix B shows full results for each count within the validation screenlines.

Table 10-5 - Summary of Flow Validation Screenline - AM (Vehicles)

Location	Direction	Observed	Modelled	Modelled - Observed	% diff	GEH	WebTAG Criteria?
Central North-South	NB	1,567	1,732	164	10.5%	4.0	×
	SB	3,130	2,881	-249	-8.0%	4.5	×

Table 10-6 - Summary of Flow Validation Screenline – Inter-peak (Vehicles)

Location	Direction	Observed	Modelled	Modelled - Observed	% diff	GEH	WebTAG Criteria?
Central North-South	NB	1,706	1,612	-94	-5.5%	2.3	×
	SB	1,518	1,471	-47	-3.1%	1.2	✓

Table 10-7 - Summary of Flow Validation Screenline - PM (Vehicles)

Location	Direction	Observed	Modelled	Modelled - Observed	% diff	GEH	WebTAG Criteria?
Central North-South	NB	3,017	3,035	18	0.6%	0.3	✓
	SB	1,647	1,746	99	6.0%	2.4	×

The results show that across all time periods and in both directions, the validation screenline flows either fall within WebTAG criteria for flows or come close to the threshold. Where flows are not within the ±5% criteria, the GEH statistic has a value of lower than 5 for all time periods, providing confidence that the overall level of flow is a good fit with the observed volume of traffic.

Table 10-8 shows the percentage of links used as independent counts that pass the validation criteria for each time period.

Table 10-8 - Link Validation Summary

Time Period	Percentage of Links Passing WebTAG Criteria
AM Peak	84%
Inter-peak	88%
PM Peak	84%

Table 10-8 shows that, overall, a very high share of links met the validation criteria, 88% of links meeting the criteria in the Inter-peak period, and 84% in both the AM and PM peak. Appendix C presents the results for all links used for model validation.

Considering both links used for calibration or validation of the model, the overall percentages of links meeting the WebTAG criteria are calculated as 87%, 92% and 90% for the AM, inter-peak and PM periods respectively, demonstrating a strong accuracy across the core study area as a whole.

10.4. A10 Flow Calibration

As an extra check on the accuracy of the model, flows along the length of the A10 were monitored throughout the calibration and validation process. Figure 10-1 shows the locations of these counts, along with an ID that corresponds with Tables 10-9 to 10-14. These tables show the resulting modelled flows along the A10, broken down by time period and direction.

Figure 10-1 - A10 Calibration Count IDs

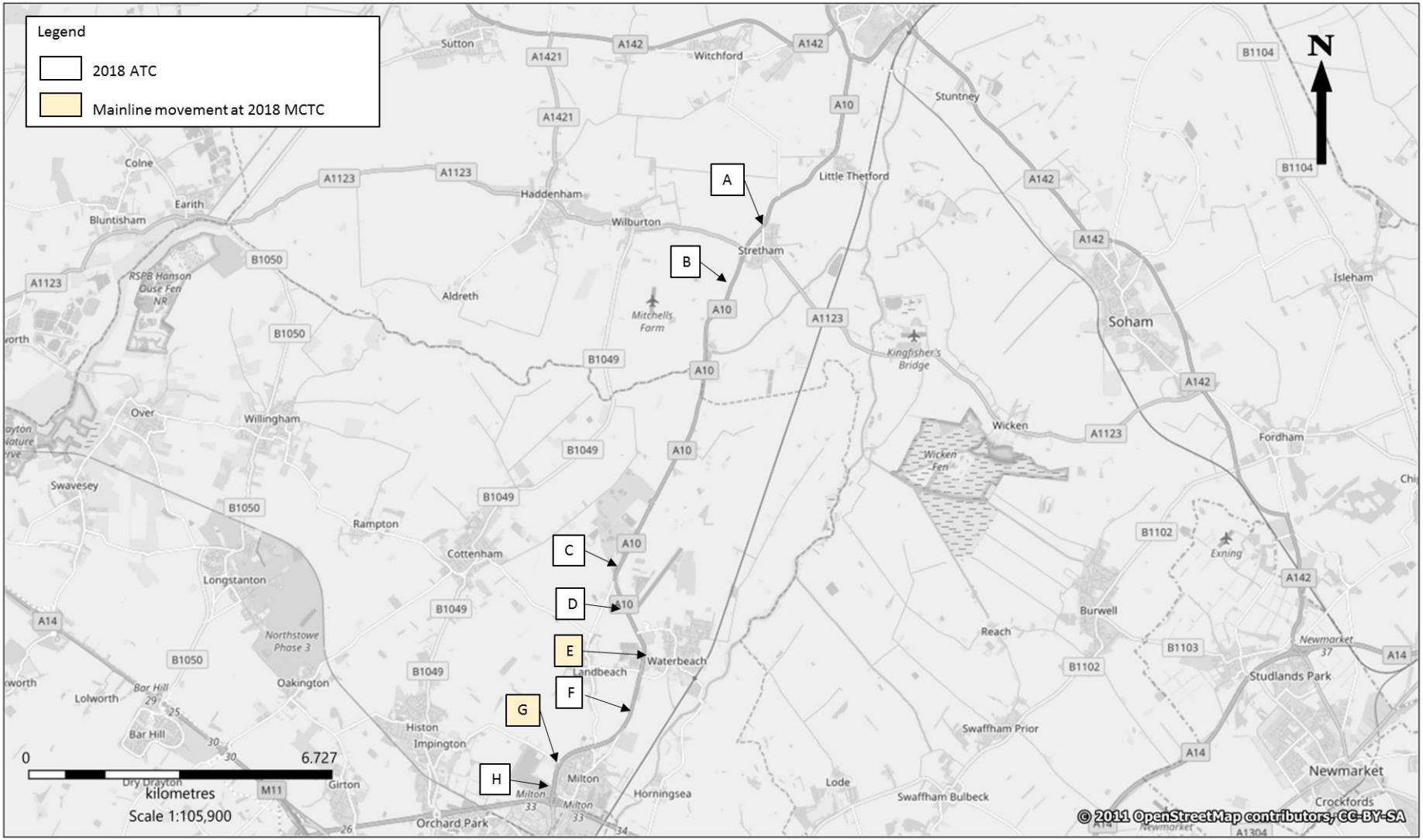


Table 10-9 - A10SB flows, AM (Vehicles)

ID	Location	Count Type	Observed	Modelled	Diff.	% Diff	GEH
A	North of Stretham Roundabout	ATC	873	832	-42	-5%	1.4
B	South of Stretham Roundabout	ATC	1,044	969	-75	-7%	2.4
C	North of Green End Road	ATC	1,029	968	-60	-6%	1.9
D	North of Denny End Road	ATC	1,025	1,015	-10	-1%	0.3
E	Waterbeach Road	MCTC	803	818	15	2%	0.5
F	North of Ely Road, Milton	ATC	1,015	1,119	104	10%	3.2
G	Butt Lane	MCTC	1,070	933	-137	-13%	4.3
H	North of Milton Interchange	ATC	1,205	1,183	-22	-2%	0.6

Table 10-10 - A10NB flows, AM (Vehicles)

ID	Location	Count Type	Observed	Modelled	Diff.	% Diff	GEH
H	North of Milton Interchange	ATC	700	781	81	12%	3.0
G	Butt Lane	MCTC	767	719	-48	-6%	1.7
F	North of Ely Road, Milton	ATC	758	738	-20	-3%	0.7
E	Waterbeach Road	MCTC	731	688	-43	-6%	1.6
D	North of Denny End Road	ATC	659	655	-3	-1%	0.1
C	North of Green End Road	ATC	776	725	-51	-7%	1.8
B	South of Stretham Roundabout	ATC	449	565	116	26%	5.2
A	North of Stretham Roundabout	ATC	653	709	57	9%	2.2

Table 10-11 - A10SB flows, IP (Vehicles)

ID	Location	Count Type	Observed	Modelled	Diff.	% Diff	GEH
A	North of Stretham Roundabout	ATC	565	613	48	9%	2.0
B	South of Stretham Roundabout	ATC	552	661	110	20%	4.5
C	North of Green End Road	ATC	720	722	2	0%	0.1
D	North of Denny End Road	ATC	708	713	5	1%	0.2
E	Waterbeach Road	MCTC	685	661	-24	-3%	0.9
F	North of Ely Road, Milton	ATC	819	751	-69	-8%	2.4
G	Butt Lane	MCTC	756	718	-38	-5%	1.4
H	North of Milton Interchange	ATC	767	790	23	3%	0.8

Table 10-12 - A10NB flows, IP (Vehicles)

ID	Location	Count Type	Observed	Modelled	Diff.	% Diff	GEH
H	North of Milton Interchange	ATC	873	857	-16	-2%	0.5
G	Butt Lane	MCTC	798	798	0	0%	0.0
F	North of Ely Road, Milton	ATC	840	794	-46	-5%	1.6
E	Waterbeach Road	MCTC	708	694	-14	-2%	0.5
D	North of Denny End Road	ATC	700	709	8	1%	0.3
C	North of Green End Road	ATC	760	716	-44	-6%	1.6
B	South of Stretham Roundabout	ATC	625	681	55	9%	2.2
A	North of Stretham Roundabout	ATC	707	729	22	3%	0.8

Table 10-13 - A10SB flows, PM (Vehicles)

ID	Location	Count Type	Observed	Modelled	Diff.	% Diff	GEH
A	North of Stretham Roundabout	ATC	570	648	79	14%	3.2
B	South of Stretham Roundabout	ATC	505	623	117	23%	4.9
C	North of Green End Road	ATC	794	765	-29	-4%	1.0
D	North of Denny End Road	ATC	732	739	6	1%	0.2
E	Waterbeach Road	MCTC	795	744	-51	-6%	1.8
F	North of Ely Road, Milton	ATC	916	894	-22	-2%	0.7
G	Butt Lane	MCTC	836	824	-12	-1%	0.4
H	North of Milton Interchange	ATC	762	877	116	15%	4.0

Table 10-14 - A10NB flows, PM (Vehicles)

ID	Location	Count Type	Observed	Modelled	Diff.	% Diff	GEH
H	North of Milton Interchange	ATC	1,300	1,341	41	3%	1.1
G	Butt Lane	MCTC	1,150	1,255	105	9%	3.0
F	North of Ely Road, Milton	ATC	986	972	-13	-1%	0.4
E	Waterbeach Road	MCTC	736	807	71	10%	2.6
D	North of Denny End Road	ATC	803	963	160	20%	5.4
C	North of Green End Road	ATC	895	928	33	4%	1.1
B	South of Stretham Roundabout	ATC	968	971	3	0%	0.1
A	North of Stretham Roundabout	ATC	973	1,002	29	3%	0.9

Analysis of modelled flows throughout the A10 corridor demonstrates:

- In the AM peak, for the southbound direction (Table 10-9), all link counts are within the WebTAG validation criteria which represents the most congested direction during this time period. In the northbound direction (Table 10-10), all but one of the counts meet the

WebTAG criteria. Site B (south of Stretham Roundabout) does not meet the criteria although the GEH value of 5.2 is close to the threshold;

- In the inter-peak, across both directions, all counts meet the WebTAG criteria along the length of the A10; and
- In the PM peak, in the more congested northbound direction, only one count does not meet the criteria (Site D, North of Denny End Road). All counts in the southbound direction meet the criteria.

Overall, the results presented above provide evidence that the A10, as a key focus of this model, is well validated in all time periods in terms of link validation.

10.5. Turn Validation

In addition to monitoring link flows along the A10, turn flows were monitored throughout the model, and in particular along the A10 and B1049 to ensure routing along these key routes was as expected. Table 10-15 shows the overall number of turning movements, for key junctions identified in Figure 10-2, that pass the WebTAG criteria. Appendix F displays the full results for each turn along these routes, in each time period.

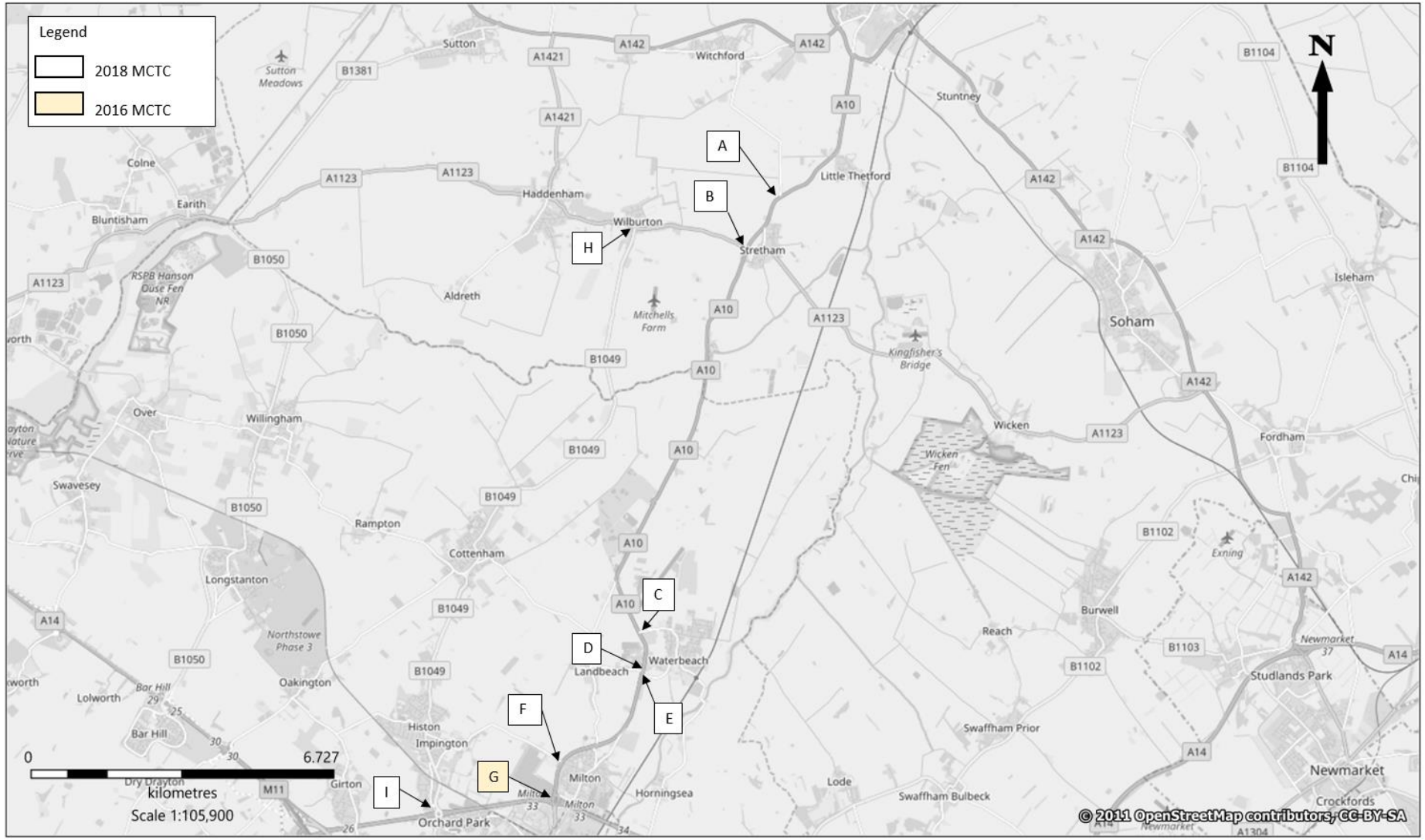
Note that for the larger Milton and Histon Interchanges, the turns on approach arms of to the junctions are included in Table 10-15 statistics (i.e. considering vehicles which either make the first available exit or navigate the circulatory carriageway), and movements *within* the junction are excluded.

Table 10-15 - A10 and B1049 Turn Count Validation Summary

Time Period	Model Area	Total Number of Turns	% of turns passing flow criteria	% of turns with GEH statistic < 5	Overall % passing
AM	A10	49	94%	84%	96%
	B1049	14	86%	86%	86%
IP	A10	49	100%	90%	100%
	B1049	14	100%	100%	100%
PM	A10	49	96%	82%	98%
	B1049	14	100%	86%	100%

Table 10-15 shows a generally strong level of turn count validation throughout the selected turns along the A10 and B1049. This gives a good level of confidence regarding the accuracy of flows through junctions around the A10; this will be important if the A10E2C Model is utilised for forecasting the effectiveness of junction improvement schemes.

Figure 10-2 - A10 and B1049 Turn Count IDs



10.6. Journey Time Validation

As set out in Section 5.1.4, all journey time routes were validated against 2016 TrafficMaster data. The journey time routes are shown in Figure 5-4.

Modelled journey times are compared against observed data in each of the modelled periods. Summaries of the observed modelled and observed journey time comparisons for each route are provided for the AM peak, Inter-peak and PM peak in Tables 10-16 to 10-18. Time-distance plots for all routes, directions and time periods are displayed in Appendix G.

Table 10-16 - AM Peak Journey Time Validation Summary

Route Number	Route Description	Route Journey Time		Difference	Difference (%)	Within 15% (or 60 seconds if higher)
		Modelled (hh:mm:ss)	Observed (Mean)			
1S	A10 South	00:25:39	00:29:31	00:03:52	-13%	✓
1N	A10 North	00:20:44	00:18:43	00:02:01	11%	✓
2S	A142 South	00:17:16	00:24:12	00:06:56	-29%	×
2N	A142 North	00:17:47	00:19:21	00:01:34	-8%	✓
3E	A1123 East	00:17:05	00:16:57	00:00:08	1%	✓
3W	A1123 West	00:16:03	00:15:55	00:00:08	1%	✓
4S	B1049 South	00:22:42	00:25:50	00:03:08	-12%	✓
4N	B1049 North	00:20:33	00:18:23	00:02:10	12%	✓
5E	A14 East	00:13:34	00:13:39	00:00:05	-1%	✓
5W	A14 West	00:18:55	00:19:38	00:00:43	-4%	✓

Table 10-17 - Inter-peak Journey Time Validation Summary

Route Number	Route Description	Route Journey Time		Difference	Difference (%)	Within 15% (or 60 seconds if higher)
		Modelled (hh:mm:ss)	Observed (Mean)			
1S	A10 South	00:20:26	00:18:57	00:01:29	8%	✓
1N	A10 North	00:20:39	00:18:55	00:01:44	9%	✓
2S	A142 South	00:16:33	00:16:20	00:00:13	1%	✓
2N	A142 North	00:17:13	00:17:29	00:00:16	-2%	✓
3E	A1123 East	00:15:58	00:15:29	00:00:29	3%	✓
3W	A1123 West	00:15:53	00:15:32	00:00:21	2%	✓
4S	B1049 South	00:19:23	00:17:40	00:01:43	10%	✓
4N	B1049 North	00:19:27	00:18:00	00:01:27	8%	✓
5E	A14 East	00:13:47	00:13:01	00:00:46	6%	✓
5W	A14 West	00:14:32	00:12:51	00:01:41	13%	✓

Table 10-18 - PM Peak Journey Time Validation Summary

Route Number	Route Description	Route Journey Time		Difference	Difference (%)	Within 15% (or 60 seconds if higher)
		Modelled (hh:mm:ss)	Observed (Mean)			
1S	A10 South	00:20:51	00:20:53	00:00:02	0%	✓
1N	A10 North	00:30:03	00:34:14	00:04:11	-12%	✓
2S	A142 South	00:17:27	00:16:21	00:01:06	7%	✓
2N	A142 North	00:19:03	00:21:00	00:01:57	-9%	✓
3E	A1123 East	00:16:25	00:15:23	00:01:02	7%	✓
3W	A1123 West	00:16:49	00:15:38	00:01:11	8%	✓
4S	B1049 South	00:19:48	00:18:01	00:01:47	10%	✓
4N	B1049 North	00:29:35	00:27:19	00:02:16	8%	✓
5E	A14 East	00:15:26	00:13:44	00:01:42	12%	✓
5W	A14 West	00:15:07	00:15:14	00:00:07	-1%	✓

As shown above, modelled journey times perform very well against the criteria set out in Section 3.4 of this report. Key observations are as follows:

- During the AM peak, 9 out of 10 routes analysed satisfy the WebTAG criteria. For these routes, detailed analysis as presented in Appendix G demonstrates the accuracy of modelled journey times along each section of the route, providing confidence that delays are observed in the correct locations, particularly for southbound traffic where congestion is most prevalent. The only route which does not satisfy the criteria is Route 2 southbound on the A142. Journey times on this route are closely matched with observed data until the final section of the route where modelled journey times are faster than observed. The reasons for this are explored further below;
- For the inter-peak time period, all routes are validated successfully in both directions. This provides confidence that in attempting to replicate congestion issues experienced during peak periods, the model network does not underestimate network capacity on the key routes identified and consequently replicates journey times well during the less congested period of the day; and
- During the PM peak, all routes satisfy the WebTAG criteria, with detailed analysis again demonstrating the accuracy of the model along individual sections of the routes rather than just for the route as a whole. For this time period, this is particularly important for northbound routes given the high levels of delay seen on these links.

Overall therefore, the A10E2C model achieves a very high level of accuracy in terms of journey validation, particularly on the A10 corridor and the B1049 which runs parallel to this route – which would be likely to experience the greatest impact in terms of traffic diversion as a result of improvements along the A10 corridor.

Regarding Route 2 southbound in the AM peak, closer analysis has identified the reasons why modelled journey times are faster than the observed data from Trafficmaster at the final section of the route. At A14 Junction 37, where A142 southbound traffic seeks to join the A14 westbound, right turning traffic is required to give way to traffic travelling in the northbound direction on the A142. The model demonstrates that these vehicles experience significant delays in making this turn (over 6 minutes in the AM peak hour). In comparison, modelled vehicles continuing southbound on the A142 towards Newmarket (as extracted for the modelled joy ride presented) do not experience delay at this location as this movement is unopposed. The observed Trafficmaster data for this link is based on aggregated data both for vehicles making the right turn and the straight on movement (and is likely to be biased towards right turning traffic onto the strategic network given the

Trafficmaster is primarily fleet based). Consequently, it is considered that the model is reflecting delays for individual movements realistically despite the disparity with the Trafficmaster dataset. The levels of flow at this location compare well against observed data and so overall, it is considered that the model is replicating observed conditions well in this area.

10.7. Route Choice Validation

The validity of route choice has also been checked in the model by examining modelled routes between selected origins and destinations. The movements considered, in both directions and at each time period, were between:

- Ely town centre and Cambridge town centre (Peterhouse);
- Ely town centre and Newmarket town centre (Guineas Shopping Centre);
- Sutton and Cambridge (Histon Road);
- Soham and Cambridge (Histon Road); and
- Fordham and Impington.

Model diagrams for these routes are displayed in Appendix H. Routes were examined for User Class 1 (HBW Low Income) and User Class 9 (HGV), although route plots are shown for User Class 1 only, with no significant differences noted between the two User Classes. Key observations are that:

- As shown in Appendix Figure H.1, routing on the A10 southbound in the AM Peak follows the expected route choices, with most traffic travelling along the A10, with some minor routing via Milton. In terms of wider routing, the B1049 is shown as a potential alternative route, although with a very small proportion of traffic taking this route. In the PM Peak, the reverse journey (shown in Appendix Figure H.22) shows similar route choices, with the A10 northbound proving the most attractive option, followed by using the B1049;
- Figure H.3 shows the routing along the A142 in the AM Peak. The route choice elements shown here are as would be expected, with potential re-routing occurring along Landwade Road and Windmill Hill, to avoid the significant delays at J37 of the A14 (See Figure G.1.3). Northbound in the PM Peak (Figure H.24), this journey shows route choice both leaving Newmarket (via Exning) and through Fordham. The vast majority however takes the expected route, along the A142;
- The routing associated with the journey from Sutton to Cambridge is as expected in both peak periods. In the AM (Figure H.5), drivers route down the B1049 all the way to Histon Road, whilst in PM (Figure H.26), this routing is mirrored northbound, albeit with the potential use of the B1050 to avoid the significant delays at Wilburton;
- From Soham to Cambridge in the AM Peak (Figure H.7), there are several routes available to the drivers, namely the A1123/A10, B1102 and A142/A14. The majority of drivers however will take the A142/A14, reflecting the significant delays southbound on the A10, and minor nature of the B1102. In the PM Peak (Figure H.28), the return journey shows four clear potential routes, along the B1049, A10, B1102 or A14. The A10 northbound (and A1123) is the preferred route for this journey, likely due to delays on other routes, such as at Wilburton along the B1049, and J37 of the A14;
- From Fordham to Impington, in the AM Peak (Figure H.9), drivers will choose to route along the B1049, avoiding delays southbound along the A10. In the PM Peak (Figure H.30), drivers taking the return journey from Impington to Fordham have a choice similar to those travelling from Cambridge to Soham, but choose to route along the A14, potentially reflecting differences in delays getting onto the A14 in Cambridge; and
- The Inter-peak route choice plots (Figure H.11 to Figure H.20) confirm the expected routing, when the network is relatively free-flowing.

Overall, it is considered that confidence can be had in the ability of the A10E2C model to replicate the route choices of drivers in the model study area. More routes are taken for a specific journey when travelling through more congested areas of the network, or at more congested times of the day, whilst more direct routes are taken on less busy parts of the network or, for example, during the Inter-peak period.

10.8. Assignment Convergence

The convergence for each model period is summarised in Table 10-19. This shows that in each time period, the model converged in fewer than 30 iterations.

The statistics and their descriptions are as follows:

- Flow Change (%) – Percentage of Link Flows differing by < 1% between assignment-simulation loops;
- Delay Change (%) – Turn delays differing by < 1% between assignment and simulation;
- Gap (%) – Wardrop Equilibrium Gap Function post simulation;
- Assignment Convergence – Delta Function (%)/Number of iterations;
- Simulation Convergence – Final average absolute change in CFP (PCU/hr)/Number of iterations; and
- VI (%) – Variational inequality (should be > 0).

Table 10-19 - Summary of Model Convergence

Time Period	Iteration	Flow Change (%)	Delay Change (%)	Gap	Assignment Convergence	Simulation Convergence	VI (%)
AM	22	98.4	98.8	0.0140	0.0161	0.0190	0.0000
	23	97.7	98.6	0.0100	0.0125	0.0120	0.0001
	24	97.9	98.7	0.0130	0.0082	0.0240	0.0000
	25	98.0	98.9	0.0130	0.0092	0.0190	0.0001
IP	16	98.7	99.7	0.0010	0.0009	0.0050	0.0001
	17	98.1	99.7	0.0020	0.0007	0.0040	0.0000
	18	98.2	99.8	0.0010	0.0009	0.0060	0.0001
	19	99.4	99.8	0.0000	0.0011	0.0070	0.0001
PM	25	98.3	98.7	0.0180	0.0066	0.0180	0.0004
	26	97.5	98.6	0.0080	0.0067	0.0280	0.0001
	27	99.1	99	0.0080	0.0052	0.0130	0.0004
	28	98.9	98.9	0.0100	0.0048	0.0130	0.0002

11. Summary of Model Development

11.1. Summary of Model

The A10E2C model will support the A10 Ely to Cambridge Transport Study, which seeks to identify appropriate transport schemes required to accommodate major developments along the A10 corridor. A bespoke model, the A10E2C model has been developed from the wider CSRM2, focusing on improving the level of detail and accuracy within the core study area as defined from initial testing using CSRM2. Outside of the core study area, the wider CSRM2 network, zone structure and travel demand has been maintained, with the intention that future scheme testing will deploy the use of the Fixed-Cost Function methodology outside of the core study area.

The model represents a neutral weekday (Tuesday-Thursday) in May 2018. It covers three time periods; the AM Peak (08:00-09:00), an average Inter-peak hour (10:00-16:00) and the PM peak (17:00-18:00). The model has utilised data from a range of local and national sources, alongside bespoke data collected specifically for the A10E2C Model.

This LMVR has described the development of the modelled network and demand matrix, along with the matrix estimation procedures undertaken. The calibration and validation of the model, and standards achieved, have also been set out.

11.2. Summary of Standards Achieved

The A10E2C Model has been tested against the WebTAG calibration and validation criteria for:

- Model convergence;
- Link flows across selected screenlines, individual flows; and
- Journey time comparison.

The base assignment model is stable for the three modelled time periods, and meets the convergence criteria.

In terms of screenline and individual flow accuracy, the model performs strongly. Across all time periods, the majority of screenlines used are within the ±5% threshold defined in WebTAG guidance with the remaining results close to the threshold and with low GEH values (less than 5). In terms of individual links used either for calibration or validation, over 87% of all links considered in all time periods meet the defined criteria. This demonstrates the model achieves a good level of fit against observed flows across the core study area.

Additionally, recognising the primary focus of the model, further analysis has demonstrated that the model achieves a high level of accuracy for individual sections along the length of the A10 corridor, as well as for turning movements at key junctions on the A10 and the B1049 which runs parallel (and is highly likely to be impacted by A10 corridor improvements).

Modelled journey times across the model, and across all time periods, are very strong, with 29 out of 30 modelled journey times within 15% of the observed journey time. This is important for the successful application of the model for scheme testing, given the congested nature of the roads in the A10E2C study area. The one route that did not meet the WebTAG criteria was southbound on the A142 in the AM peak, which is attributed to considerable differences in delays for turning movements at A14 Junction 37 rather than the model not reflecting network conditions.

Overall, having demonstrated that the model performs strongly against the relevant WebTAG criteria, it is concluded that the model is applicable for future scheme testing.

Appendices

Appendix A. Speed Flow Curves

A.1. Speed Flow Curve Definitions

SFC ID	Free Flow Speed (kph)	Speed at Capacity (kph)	Capacity (PCU/Hr)	N Factor	Description
3	86	40	6780	3.7	B/S Rural D3AP
6	67	36	1660	2.1	B/S Rural S10 (Typical)
7	70	36	1640	2.2	B/S Rural S7.3 (Good)
8	62	36	1380	2.1	B/S Rural S7.0 (Typical)
9	54	36	1010	1.8	B/S Rural S7.0 (Typical)
12	54	36	1010	1.8	Buf Suburban D2 – Poor A – 40mph
14	49	20	1285	3.8	Buf Suburban S2 - Avg. A / Good B - 40mph
15	46	20	1030	2.3	Buf Suburban S2 – Poor. A/Avg. B – 30mph
17	38	20	780	1.6	B/S Urban - Non Central S2 - Good A - 30mph, Typical Development
19	30	12	740	1.8	Buf Urban - Central S2 - Avg A /Good B - 30mph, Low Development
20	27	12	630	1.7	Buf Urban - Central S2 - Avg A/Avg B/Good C – 30mph, Typical Dev
23	46	24	1000	3.4	B/S Rural Village S2 - Village - 40mph, High Development
24	38	24	880	2.5	Buf Urban - Central S2 - Avg A /Good B - 30mph, Low Development
38	84	40	4360	3.7	CHARM3a SFC - 105kph
41	38	20	1560	1.6	Taken from CSRM2
65	76	56	2000	5.3	Taken from CSRM2
67	61	44	1230	1.2	Taken from CSRM2
75	50	32	1400	2	Taken from CSRM2
82	80	36	1640	2.2	*New for A10E2C Model* (SFC 7 with free-flow speed increased)
83	105	40	4360	3.7	*New for A10E2C Model* (SFC 38, but with free-flow speed increased)
84	105	40	6780	3.7	*New for A10E2C Model* (SFC 3, but with free-flow speed increased)
85	55	20	1285	2.0	*New for A10E2C Model* (SFC 14 but with free-flow speed increased, and N decreased)

Appendix B. Validation Screenline Flows

B.1. Central North-South - AM

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
2_1	Twenty Pence Road	NB	23008-41105	130	200	71	55%	5.5	✓	×	✓
2_2	Twenty Pence Road	SB	41105-23008	538	452	-86	-16%	3.8	✓	✓	✓
2_3	A10 south of Stretham Roundabout	NB	20704-42001	449	565	116	26%	5.2	×	×	×
2_4	A10 south of Stretham Roundabout	SB	42001-20704	1,044	969	-75	-7%	2.4	✓	✓	✓
2_5	Upware Road	NB	14611-14311	29	1	-28	-96%	7.1	✓	×	✓
2_6	Upware Road	SB	14311-14611	27	4	-24	-87%	6.1	✓	×	✓
2_7	A142 south of A142/A1123 Roundabout	NB	41201-41402	689	697	8	1%	0.3	✓	✓	✓
2_8	A142 south of A142/A1123 Roundabout	SB	41402-41201	1,231	977	-254	-21%	7.6	×	×	×
2_9	Fordham Road, south of A142/A1123 Roundabout	NB	14431-41402	270	267	-3	-1%	0.2	✓	✓	✓
2_10	Fordham Road, south of A142/A1123 Roundabout	SB	41402-14431	289	478	189	65%	9.7	×	×	×

B.2. Central North-South - IP

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
2_1	Twenty Pence Road	NB	23008-41105	172	186	14	8%	1.1	✓	✓	✓
2_2	Twenty Pence Road	SB	41105-23008	133	168	35	26%	2.8	✓	✓	✓
2_3	A10 south of Stretham Roundabout	NB	20704-42001	625	681	55	9%	2.2	✓	✓	✓
2_4	A10 south of Stretham Roundabout	SB	42001-20704	552	661	110	20%	4.5	×	✓	✓
2_5	Upware Road	NB	14611-14311	26	1	-25	-95%	6.7	✓	×	✓
2_6	Upware Road	SB	14311-14611	25	1	-25	-96%	6.7	✓	×	✓
2_7	A142 south of A142/A1123 Roundabout	NB	41201-41402	675	589	-86	-13%	3.4	✓	✓	✓
2_8	A142 south of A142/A1123 Roundabout	SB	41402-41201	606	413	-193	-32%	8.5	×	×	×
2_9	Fordham Road, south of A142/A1123 Roundabout	NB	14431-41402	207	154	-53	-25%	3.9	✓	✓	✓
2_10	Fordham Road, south of A142/A1123 Roundabout	SB	41402-14431	201	227	26	13%	1.8	✓	✓	✓

B.3. Central North-South - PM

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
2_1	Twenty Pence Road	NB	23008-41105	267	319	52	19%	3.0	✓	✓	✓
2_2	Twenty Pence Road	SB	41105-23008	114	207	92	81%	7.3	✓	×	✓
2_3	A10 south of Stretham Roundabout	NB	20704-42001	968	971	3	0%	0.1	✓	✓	✓
2_4	A10 south of Stretham Roundabout	SB	42001-20704	505	623	117	23%	4.9	×	✓	✓
2_5	Upware Road	NB	14611-14311	38	17	-21	-55%	4.0	✓	✓	✓
2_6	Upware Road	SB	14311-14611	60	2	-58	-97%	10.5	✓	×	✓
2_7	A142 south of A142/A1123 Roundabout	NB	41201-41402	1,276	1,270	-5	0%	0.2	✓	✓	✓
2_8	A142 south of A142/A1123 Roundabout	SB	41402-41201	643	695	53	8%	2.0	✓	✓	✓
2_9	Fordham Road, south of A142/A1123 Roundabout	NB	14431-41402	469	459	-10	-2%	0.5	✓	✓	✓
2_10	Fordham Road, south of A142/A1123 Roundabout	SB	41402-14431	325	220	-105	-32%	6.4	×	×	×

Appendix C. Validation Link Flows

C.1. AM Peak

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
2_1	Twenty Pence Road	NB	23008-41105	130	200	71	55%	5.5	✓	×	✓
2_2	Twenty Pence Road	SB	41105-23008	538	452	-86	-16%	3.8	✓	✓	✓
2_3	A10 south of Stretham Roundabout	NB	20704-42001	449	565	116	26%	5.2	×	×	×
2_4	A10 south of Stretham Roundabout	SB	42001-20704	1044	969	-75	-7%	2.4	✓	✓	✓
2_5	Upware Road	NB	14611-14311	29	1	-28	-96%	7.1	✓	×	✓
2_6	Upware Road	SB	14311-14611	27	4	-24	-87%	6.1	✓	×	✓
2_7	A142 south of A142/A1123 Roundabout	NB	41201-41402	689	697	8	1%	0.3	✓	✓	✓
2_8	A142 south of A142/A1123 Roundabout	SB	41402-41201	1231	977	-254	-21%	7.6	×	×	×
2_9	Fordham Road, south of A142/A1123 Roundabout	NB	14431-41402	270	267	-3	-1%	0.2	✓	✓	✓
2_10	Fordham Road, south of A142/A1123 Roundabout	SB	41402-14431	289	478	189	65%	9.7	×	×	×
5_5	Cottenham Road, north of Histon	NB	12031-12631	257	306	49	19%	2.9	✓	✓	✓
5_6	Cottenham Road, north of Histon	SB	12631-12031	684	666	-18	-3%	0.7	✓	✓	✓
10_3	Witchford Road, Ely	NB	40203-40702	349	288	-61	-18%	3.4	✓	✓	✓
10_4	Witchford Road, Ely	SB	40702-40203	253	205	-48	-19%	3.2	✓	✓	✓
14_3	A142 north of J with A14	NB	73902-14432	679	939	260	38%	9.1	×	×	×
14_4	A142 north of J with A14	SB	14432-73902	695	771	76	11%	2.8	✓	✓	✓
15_1	B1102, east of Burwell	NB	14511-14433	244	308	64	26%	3.9	✓	✓	✓
15_2	B1102, east of Burwell	SB	14433-14511	427	483	56	13%	2.6	✓	✓	✓
15_5	Swaffham Heath Road	EB	14622-41704	199	138	-61	-31%	4.7	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
15_6	Swaffham Heath Road	WB	41704-14622	43	64	21	49%	2.9	✓	✓	✓
17_1	A14 EB between J31 and J32	EB	92061-92064	3157	2939	-218	-7%	3.9	✓	✓	✓
17_2	A14 WB between J32 and J31	WB	92062-92059	2676	2783	107	4%	2.1	✓	✓	✓
18_5	A142/A10 Roundabout, Ely	To A	40204-40702	280	274	-6	-2%	0.4	✓	✓	✓
18_6	A142/A10 Roundabout, Ely	To B	40204-14221	700	721	21	3%	0.8	✓	✓	✓
18_7	A142/A10 Roundabout, Ely	To C	40204-14125	1083	1064	-19	-2%	0.6	✓	✓	✓
18_8	A142/A10 Roundabout, Ely	To D	40204-40203	589	527	-62	-11%	2.6	✓	✓	✓
18_22	Witchford Road Roundabout, Ely	To A	40203-40701	693	606	-87	-13%	3.4	✓	✓	✓
18_24	Witchford Road Roundabout, Ely	To C	40203-40204	930	844	-86	-9%	2.9	✓	✓	✓
18_25	Witchford Road Roundabout, Ely	To D	40203-40201	1070	1111	41	4%	1.3	✓	✓	✓
18_36	A10-Broad Baulk	To A	14111-14021	65	78	13	21%	1.6	✓	✓	✓
18_37	A10-Broad Baulk	To B	14111-14123	640	641	1	0%	0.0	✓	✓	✓
18_38	A10-Broad Baulk	To C	14111-42002	931	903	-28	-3%	0.9	✓	✓	✓
18_43	A10 Stretham Roundabout	To A	42001-14113	673	709	36	5%	1.4	✓	✓	✓
18_44	A10 Stretham Roundabout	To B	42001-14112	349	311	-38	-11%	2.1	✓	✓	✓
18_46	A10 Stretham Roundabout	To D	42001-41105	448	465	17	4%	0.8	✓	✓	✓
18_58	A10-Waterbeach Road	To A	12812-28108	772	690	-82	-11%	3.0	✓	✓	✓
18_59	A10-Waterbeach Road	To B	12812-12813	896	932	36	4%	1.2	✓	✓	✓
18_60	A10-Waterbeach Road	To C	12812-20701	47	25	-22	-46%	3.6	✓	✓	✓
18_64	A10-Car Dyke Road	To A	12813-12812	782	711	-71	-9%	2.6	✓	✓	✓
18_65	A10-Car Dyke Road	To B	12813-28102	200	111	-89	-45%	7.1	✓	×	✓
18_66	A10-Car Dyke Road	To C	12813-25708	970	1119	149	15%	4.6	×	✓	✓
18_70	A10-Denny End Road	To A	28108-12711	737	655	-82	-11%	3.1	✓	✓	✓
18_71	A10-Denny End Road	To B	28108-12831	392	433	41	10%	2.0	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_72	A10-Denny End Road	To C	28108-12812	807	820	13	2%	0.4	✓	✓	✓
18_76	A10-Butt Lane	To A	25704-12232	880	854	-26	-3%	0.9	✓	✓	✓
18_77	A10-Butt Lane	To B	25704-97403	1070	933	-137	-13%	4.3	✓	✓	✓
18_78	A10-Butt Lane	To C	25704-25798	198	198	0	0%	0.0	✓	✓	✓
18_82	A10-Milton P&R	To A	97403-25704	831	762	-69	-8%	2.4	✓	✓	✓
18_83	A10-Milton P&R	To B	97403-25602	1289	1192	-97	-8%	2.8	✓	✓	✓
18_84	A10-Milton P&R	To C	97403-97402	10	20	10	95%	2.5	✓	✓	✓
18_99	Milton Interchange	To B	25601-20404	709	757	48	7%	1.8	✓	✓	✓
18_100	Milton Interchange	To C	25604-25602	287	369	82	29%	4.5	✓	✓	✓
18_101	Milton Interchange	To D	25604-25601	830	562	-268	-32%	10.2	×	×	×
18_102	Milton Interchange	To E	25701-25604	1074	918	-156	-14%	4.9	✓	✓	✓
18_103	Milton Interchange	To F	25605-25701	2304	2101	-203	-9%	4.3	✓	✓	✓
18_104	Milton Interchange	To G	25605-25703	165	226	61	37%	4.4	✓	✓	✓
18_108	Milton Interchange	To K	20404-20405	2486	2095	-391	-16%	8.2	×	×	×
18_109	Milton Interchange	To L	20404-20407	1906	1761	-145	-8%	3.4	✓	✓	✓
18_114	Histon Interchange	To B	24611-24613	490	475	-15	-3%	0.7	✓	✓	✓
18_115	Histon Interchange	To C	24614-24611	819	798	-21	-3%	0.7	✓	✓	✓
18_116	Histon Interchange	To D	24614-24609	900	893	-7	-1%	0.2	✓	✓	✓
18_117	Histon Interchange	To E	20302-24614	983	770	-213	-22%	7.2	×	×	×
18_119	Histon Interchange	To G	24613-20302	1575	1402	-173	-11%	4.5	✓	✓	✓
18_120	Histon Interchange	To H	24613-20301	1751	1559	-192	-11%	4.7	✓	✓	✓
18_89	A14 Jct.37 WB Off-Slip	To B	17063-17067	789	454	-335	-42%	13.4	×	×	×
18_90	A14 Jct.37 WB Off-Slip	To C	17063-17061	1051	970	-81	-8%	2.5	✓	✓	✓
18_94	A14 Jct.37 WB On-Slip	To A	17061-17164	808	753	-55	-7%	2.0	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_95	A14 Jct.37 WB On-Slip	To B	17061-17063	292	419	127	43%	6.7	×	×	×
18_96	A14 Jct.37 WB On-Slip	To C	17061-17041	710	599	-111	-16%	4.4	×	✓	✓
18_100	A14 Jct.37 EB On-Slip	To A	17164-17163	592	753	161	27%	6.2	×	×	×
18_101	A14 Jct.37 EB On-Slip	To B	17164-17165	507	272	-235	-46%	11.9	×	×	×
18_102	A14 Jct.37 EB On-Slip	To C	17164-17061	759	759	0	0%	0.0	✓	✓	✓
18_106	A14 Jct.37 EB Off-Slip	To A	17163-17162	900	1084	184	20%	5.9	×	×	×
18_107	A14 Jct.37 EB Off-Slip	To B	17163-17164	1051	1031	-20	-2%	0.6	✓	✓	✓
18_114	A142-A1123 Roundabout, Fordham	To A	41402-14331	571	659	88	15%	3.5	✓	✓	✓
18_117	A142-A1123 Roundabout, Fordham	To D	41402-14312	222	352	130	58%	7.7	×	×	×
18_118	A142-A1123 Roundabout, Fordham	To E	41402-14361	271	227	-44	-16%	2.8	✓	✓	✓
18_137	Twenty Pence Road Junction, Wilburton	To A	41105-41104	279	332	53	19%	3.0	✓	✓	✓
18_138	Twenty Pence Road Junction, Wilburton	To B	41105-42001	589	668	79	13%	3.2	✓	✓	✓
18_143	Crossroads, Landbeach Village	To A	20701-20702	113	111	-2	-2%	0.2	✓	✓	✓
18_144	Crossroads, Landbeach Village	To B	20701-12812	123	115	-8	-7%	0.7	✓	✓	✓
18_145	Crossroads, Landbeach Village	To C	20701-12811	257	73	-184	-71%	14.3	×	×	×
18_155	B1102-B1103, Burwell	To A	42201-14521	344	329	-15	-4%	0.8	✓	✓	✓
18_156	B1102-B1103, Burwell	To B	42201-14532	223	207	-16	-7%	1.1	✓	✓	✓
18_157	B1102-B1103, Burwell	To C	42201-14531	617	567	-50	-8%	2.1	✓	✓	✓
18_161	Butt Lane-Milton P&R	To A	25702-24616	162	150	-12	-7%	0.9	✓	✓	✓
18_162	Butt Lane-Milton P&R	To B	25798-25704	115	135	20	17%	1.8	✓	✓	✓
18_163	Butt Lane-Milton P&R	To C	25702-25797	250	279	29	11%	1.8	✓	✓	✓

C.2. Inter-peak

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
2_1	Twenty Pence Road	NB	23008-41105	172	186	14	8%	1.1	✓	✓	✓
2_2	Twenty Pence Road	SB	41105-23008	133	168	35	26%	2.8	✓	✓	✓
2_3	A10 south of Stretham Roundabout	NB	20704-42001	625	681	55	9%	2.2	✓	✓	✓
2_4	A10 south of Stretham Roundabout	SB	42001-20704	552	661	110	20%	4.5	×	✓	✓
2_5	Upware Road	NB	14611-14311	26	1	-25	-95%	6.7	✓	×	✓
2_6	Upware Road	SB	14311-14611	25	1	-25	-96%	6.7	✓	×	✓
2_7	A142 south of A142/A1123 Roundabout	NB	41201-41402	675	589	-86	-13%	3.4	✓	✓	✓
2_8	A142 south of A142/A1123 Roundabout	SB	41402-41201	606	413	-193	-32%	8.5	×	×	×
2_9	Fordham Road, south of A142/A1123 Roundabout	NB	14431-41402	207	154	-53	-25%	3.9	✓	✓	✓
2_10	Fordham Road, south of A142/A1123 Roundabout	SB	41402-14431	201	227	26	13%	1.8	✓	✓	✓
5_5	Cottenham Road, north of Histon	NB	12031-12631	325	342	17	5%	0.9	✓	✓	✓
5_6	Cottenham Road, north of Histon	SB	12631-12031	304	343	39	13%	2.2	✓	✓	✓
10_3	Witchford Road, Ely	NB	40203-40702	251	117	-134	-53%	9.9	×	×	×
10_4	Witchford Road, Ely	SB	40702-40203	205	178	-26	-13%	1.9	✓	✓	✓
14_3	A142 north of J with A14	NB	73902-14432	713	729	16	2%	0.6	✓	✓	✓
14_4	A142 north of J with A14	SB	14432-73902	689	389	-300	-44%	12.9	×	×	×
15_1	B1102, east of Burwell	NB	14511-14433	244	179	-64	-26%	4.4	✓	✓	✓
15_2	B1102, east of Burwell	SB	14433-14511	200	192	-8	-4%	0.6	✓	✓	✓
15_5	Swaffham Heath Road	EB	14622-41704	47	24	-24	-50%	3.9	✓	✓	✓
15_6	Swaffham Heath Road	WB	41704-14622	53	32	-21	-39%	3.2	✓	✓	✓
17_1	A14 EB between J31 and J32	EB	92061-92064	2388	2352	-37	-2%	0.8	✓	✓	✓
17_2	A14 WB between J32 and J31	WB	92062-92059	2523	2533	11	0%	0.2	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_5	A142/A10 Roundabout, Ely	To A	40204-40702	273	232	-41	-15%	2.6	✓	✓	✓
18_6	A142/A10 Roundabout, Ely	To B	40204-14221	652	531	-120	-18%	4.9	×	✓	✓
18_7	A142/A10 Roundabout, Ely	To C	40204-14125	913	794	-120	-13%	4.1	✓	✓	✓
18_8	A142/A10 Roundabout, Ely	To D	40204-40203	728	658	-69	-10%	2.6	✓	✓	✓
18_22	Witchford Road Roundabout, Ely	To A	40203-40701	714	639	-75	-11%	2.9	✓	✓	✓
18_24	Witchford Road Roundabout, Ely	To C	40203-40204	690	685	-4	-1%	0.2	✓	✓	✓
18_25	Witchford Road Roundabout, Ely	To D	40203-40201	819	888	70	9%	2.4	✓	✓	✓
18_36	A10-Broad Baulk	To A	14111-14021	58	54	-3	-6%	0.4	✓	✓	✓
18_37	A10-Broad Baulk	To B	14111-14123	669	647	-21	-3%	0.8	✓	✓	✓
18_38	A10-Broad Baulk	To C	14111-42002	642	617	-24	-4%	1.0	✓	✓	✓
18_43	A10 Stretham Roundabout	To A	42001-14113	702	729	27	4%	1.0	✓	✓	✓
18_44	A10 Stretham Roundabout	To B	42001-14112	244	183	-61	-25%	4.2	✓	✓	✓
18_46	A10 Stretham Roundabout	To D	42001-41105	382	380	-2	-1%	0.1	✓	✓	✓
18_58	A10-Waterbeach Road	To A	12812-28108	722	695	-26	-4%	1.0	✓	✓	✓
18_59	A10-Waterbeach Road	To B	12812-12813	724	672	-52	-7%	2.0	✓	✓	✓
18_60	A10-Waterbeach Road	To C	12812-20701	48	16	-32	-67%	5.7	✓	×	✓
18_64	A10-Car Dyke Road	To A	12813-12812	745	709	-36	-5%	1.4	✓	✓	✓
18_65	A10-Car Dyke Road	To B	12813-28102	179	124	-55	-31%	4.5	✓	✓	✓
18_66	A10-Car Dyke Road	To C	12813-25708	807	751	-56	-7%	2.0	✓	✓	✓
18_70	A10-Denny End Road	To A	28108-12711	781	709	-72	-9%	2.7	✓	✓	✓
18_71	A10-Denny End Road	To B	28108-12831	201	298	96	48%	6.1	✓	×	✓
18_72	A10-Denny End Road	To C	28108-12812	695	662	-33	-5%	1.3	✓	✓	✓
18_76	A10-Butt Lane	To A	25704-12232	912	895	-16	-2%	0.5	✓	✓	✓
18_77	A10-Butt Lane	To B	25704-97403	757	718	-39	-5%	1.4	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_78	A10-Butt Lane	To C	25704-25798	200	123	-78	-39%	6.1	✓	×	✓
18_82	A10-Milton P&R	To A	97403-25704	899	831	-68	-8%	2.3	✓	✓	✓
18_83	A10-Milton P&R	To B	97403-25602	881	791	-90	-10%	3.1	✓	✓	✓
18_84	A10-Milton P&R	To C	97403-97402	10	27	17	170%	4.0	✓	✓	✓
18_99	Milton Interchange	To B	25601-20404	767	752	-15	-2%	0.5	✓	✓	✓
18_100	Milton Interchange	To C	25604-25602	315	339	24	8%	1.3	✓	✓	✓
18_101	Milton Interchange	To D	25604-25601	1149	933	-216	-19%	6.7	×	×	×
18_102	Milton Interchange	To E	25701-25604	866	739	-127	-15%	4.5	✓	✓	✓
18_103	Milton Interchange	To F	25605-25701	1634	1529	-105	-6%	2.6	✓	✓	✓
18_104	Milton Interchange	To G	25605-25703	224	442	217	97%	11.9	×	×	×
18_108	Milton Interchange	To K	20404-20405	940	900	-40	-4%	1.3	✓	✓	✓
18_109	Milton Interchange	To L	20404-20407	1125	1093	-32	-3%	1.0	✓	✓	✓
18_114	Histon Interchange	To B	24611-24613	379	373	-6	-2%	0.3	✓	✓	✓
18_115	Histon Interchange	To C	24614-24611	777	763	-14	-2%	0.5	✓	✓	✓
18_116	Histon Interchange	To D	24614-24609	712	694	-18	-3%	0.7	✓	✓	✓
18_117	Histon Interchange	To E	20302-24614	524	510	-14	-3%	0.6	✓	✓	✓
18_119	Histon Interchange	To G	24613-20302	777	770	-8	-1%	0.3	✓	✓	✓
18_120	Histon Interchange	To H	24613-20301	783	782	-2	0%	0.1	✓	✓	✓
18_89	A14 Jct.37 WB Off-Slip	To B	17063-17067	651	335	-317	-49%	14.3	×	×	×
18_90	A14 Jct.37 WB Off-Slip	To C	17063-17061	923	845	-78	-8%	2.6	✓	✓	✓
18_94	A14 Jct.37 WB On-Slip	To A	17061-17164	785	627	-157	-20%	5.9	×	×	×
18_95	A14 Jct.37 WB On-Slip	To B	17061-17063	415	329	-86	-21%	4.4	✓	✓	✓
18_96	A14 Jct.37 WB On-Slip	To C	17061-17041	392	624	233	59%	10.3	×	×	×
18_100	A14 Jct.37 EB On-Slip	To A	17164-17163	559	627	68	12%	2.8	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_101	A14 Jct.37 EB On-Slip	To B	17164-17165	466	108	-358	-77%	21.1	×	×	×
18_102	A14 Jct.37 EB On-Slip	To C	17164-17061	670	756	85	13%	3.2	✓	✓	✓
18_106	A14 Jct.37 EB Off-Slip	To A	17163-17162	834	1022	188	23%	6.2	×	×	×
18_107	A14 Jct.37 EB Off-Slip	To B	17163-17164	911	863	-48	-5%	1.6	✓	✓	✓
18_114	A142-A1123 Roundabout, Fordham	To A	41402-14331	576	562	-14	-2%	0.6	✓	✓	✓
18_117	A142-A1123 Roundabout, Fordham	To D	41402-14312	209	246	37	18%	2.5	✓	✓	✓
18_118	A142-A1123 Roundabout, Fordham	To E	41402-14361	287	125	-163	-57%	11.3	×	×	×
18_137	Twenty Pence Road Junction, Wilburton	To A	41105-41104	393	406	13	3%	0.6	✓	✓	✓
18_138	Twenty Pence Road Junction, Wilburton	To B	41105-42001	390	383	-7	-2%	0.4	✓	✓	✓
18_143	Crossroads, Landbeach Village	To A	20701-20702	143	144	1	1%	0.1	✓	✓	✓
18_144	Crossroads, Landbeach Village	To B	20701-12812	51	13	-38	-75%	6.8	✓	×	✓
18_145	Crossroads, Landbeach Village	To C	20701-12811	90	89	0	-1%	0.0	✓	✓	✓
18_155	B1102-B1103, Burwell	To A	42201-14521	430	399	-30	-7%	1.5	✓	✓	✓
18_156	B1102-B1103, Burwell	To B	42201-14532	141	154	14	10%	1.1	✓	✓	✓
18_157	B1102-B1103, Burwell	To C	42201-14531	280	190	-90	-32%	5.8	✓	×	✓
18_161	Butt Lane-Milton P&R	To A	25702-24616	187	102	-85	-45%	7.1	✓	×	✓
18_162	Butt Lane-Milton P&R	To B	25798-25704	113	97	-17	-15%	1.6	✓	✓	✓
18_163	Butt Lane-Milton P&R	To C	25702-25797	135	71	-64	-47%	6.3	✓	×	✓

C.3. PM Peak

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
2_1	Twenty Pence Road	NB	23008-41105	267	319	52	19%	3.0	✓	✓	✓
2_2	Twenty Pence Road	SB	41105-23008	114	207	92	81%	7.3	✓	×	✓
2_3	A10 south of Stretham Roundabout	NB	20704-42001	968	971	3	0%	0.1	✓	✓	✓
2_4	A10 south of Stretham Roundabout	SB	42001-20704	505	623	117	23%	4.9	×	✓	✓
2_5	Upware Road	NB	14611-14311	38	17	-21	-55%	4.0	✓	✓	✓
2_6	Upware Road	SB	14311-14611	60	2	-58	-97%	10.5	✓	×	✓
2_7	A142 south of A142/A1123 Roundabout	NB	41201-41402	1276	1270	-5	0%	0.2	✓	✓	✓
2_8	A142 south of A142/A1123 Roundabout	SB	41402-41201	643	695	53	8%	2.0	✓	✓	✓
2_9	Fordham Road, south of A142/A1123 Roundabout	NB	14431-41402	469	459	-10	-2%	0.5	✓	✓	✓
2_10	Fordham Road, south of A142/A1123 Roundabout	SB	41402-14431	325	220	-105	-32%	6.4	×	×	×
5_5	Cottenham Road, north of Histon	NB	12031-12631	566	590	24	4%	1.0	✓	✓	✓
5_6	Cottenham Road, north of Histon	SB	12631-12031	319	422	103	32%	5.4	×	×	×
10_3	Witchford Road, Ely	NB	40203-40702	283	147	-136	-48%	9.2	×	×	×
10_4	Witchford Road, Ely	SB	40702-40203	459	318	-141	-31%	7.2	×	×	×
14_3	A142 north of J with A14	NB	73902-14432	802	1155	353	44%	11.3	×	×	×
14_4	A142 north of J with A14	SB	14432-73902	699	868	169	24%	6.0	×	×	×
15_1	B1102, east of Burwell	NB	14511-14433	530	441	-89	-17%	4.1	✓	✓	✓
15_2	B1102, east of Burwell	SB	14433-14511	279	354	75	27%	4.2	✓	✓	✓
15_5	Swaffham Heath Road	EB	14622-41704	57	65	8	14%	1.0	✓	✓	✓
15_6	Swaffham Heath Road	WB	41704-14622	153	144	-10	-6%	0.8	✓	✓	✓
17_1	A14 EB between J31 and J32	EB	92061-92064	3115	3076	-40	-1%	0.7	✓	✓	✓
17_2	A14 WB between J32 and J31	WB	92062-92059	3319	3274	-45	-1%	0.8	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_5	A142/A10 Roundabout, Ely	To A	40204-40702	596	525	-71	-12%	3.0	✓	✓	✓
18_6	A142/A10 Roundabout, Ely	To B	40204-14221	636	540	-96	-15%	4.0	✓	✓	✓
18_7	A142/A10 Roundabout, Ely	To C	40204-14125	919	780	-139	-15%	4.8	×	✓	✓
18_8	A142/A10 Roundabout, Ely	To D	40204-40203	846	830	-16	-2%	0.6	✓	✓	✓
18_22	Witchford Road Roundabout, Ely	To A	40203-40701	1031	1045	14	1%	0.4	✓	✓	✓
18_24	Witchford Road Roundabout, Ely	To C	40203-40204	696	721	25	4%	1.0	✓	✓	✓
18_25	Witchford Road Roundabout, Ely	To D	40203-40201	1029	1124	95	9%	2.9	✓	✓	✓
18_36	A10-Broad Baulk	To A	14111-14021	136	151	15	11%	1.3	✓	✓	✓
18_37	A10-Broad Baulk	To B	14111-14123	832	868	36	4%	1.2	✓	✓	✓
18_38	A10-Broad Baulk	To C	14111-42002	714	727	13	2%	0.5	✓	✓	✓
18_43	A10 Stretham Roundabout	To A	42001-14113	943	1097	154	16%	4.8	×	✓	✓
18_44	A10 Stretham Roundabout	To B	42001-14112	334	239	-95	-29%	5.6	✓	×	✓
18_46	A10 Stretham Roundabout	To D	42001-41105	640	667	27	4%	1.0	✓	✓	✓
18_58	A10-Waterbeach Road	To A	12812-28108	743	808	65	9%	2.3	✓	✓	✓
18_59	A10-Waterbeach Road	To B	12812-12813	850	754	-96	-11%	3.4	✓	✓	✓
18_60	A10-Waterbeach Road	To C	12812-20701	117	43	-74	-63%	8.2	✓	×	✓
18_64	A10-Car Dyke Road	To A	12813-12812	818	849	31	4%	1.1	✓	✓	✓
18_65	A10-Car Dyke Road	To B	12813-28102	304	195	-109	-36%	6.9	×	×	×
18_66	A10-Car Dyke Road	To C	12813-25708	924	894	-30	-3%	1.0	✓	✓	✓
18_70	A10-Denny End Road	To A	28108-12711	918	963	45	5%	1.5	✓	✓	✓
18_71	A10-Denny End Road	To B	28108-12831	187	281	94	50%	6.2	✓	×	✓
18_72	A10-Denny End Road	To C	28108-12812	828	745	-83	-10%	2.9	✓	✓	✓
18_76	A10-Butt Lane	To A	25704-12232	1264	1367	103	8%	2.8	✓	✓	✓
18_77	A10-Butt Lane	To B	25704-97403	836	824	-12	-1%	0.4	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_78	A10-Butt Lane	To C	25704-25798	265	267	2	1%	0.1	✓	✓	✓
18_82	A10-Milton P&R	To A	97403-25704	1302	1357	55	4%	1.5	✓	✓	✓
18_83	A10-Milton P&R	To B	97403-25602	906	877	-29	-3%	1.0	✓	✓	✓
18_84	A10-Milton P&R	To C	97403-97402	6	18	12	207%	3.6	✓	✓	✓
18_99	Milton Interchange	To B	25601-20404	999	1130	131	13%	4.0	✓	✓	✓
18_100	Milton Interchange	To C	25604-25602	351	366	15	4%	0.8	✓	✓	✓
18_101	Milton Interchange	To D	25604-25601	2073	1876	-197	-9%	4.4	✓	✓	✓
18_102	Milton Interchange	To E	25701-25604	1330	1203	-127	-10%	3.6	✓	✓	✓
18_103	Milton Interchange	To F	25605-25701	2202	2081	-121	-6%	2.6	✓	✓	✓
18_104	Milton Interchange	To G	25605-25703	259	493	234	90%	12.0	×	×	×
18_108	Milton Interchange	To K	20404-20405	791	667	-124	-16%	4.6	×	✓	✓
18_109	Milton Interchange	To L	20404-20407	1034	1070	36	4%	1.1	✓	✓	✓
18_114	Histon Interchange	To B	24611-24613	552	559	7	1%	0.3	✓	✓	✓
18_115	Histon Interchange	To C	24614-24611	1339	1356	17	1%	0.4	✓	✓	✓
18_116	Histon Interchange	To D	24614-24609	1176	1198	22	2%	0.6	✓	✓	✓
18_117	Histon Interchange	To E	20302-24614	890	847	-43	-5%	1.5	✓	✓	✓
18_119	Histon Interchange	To G	24613-20302	1080	1067	-13	-1%	0.4	✓	✓	✓
18_120	Histon Interchange	To H	24613-20301	1012	1063	51	5%	1.6	✓	✓	✓
18_89	A14 Jct.37 WB Off-Slip	To B	17063-17067	778	520	-258	-33%	10.1	×	×	×
18_90	A14 Jct.37 WB Off-Slip	To C	17063-17061	1313	1233	-80	-6%	2.2	✓	✓	✓
18_94	A14 Jct.37 WB On-Slip	To A	17061-17164	1110	985	-125	-11%	3.9	✓	✓	✓
18_95	A14 Jct.37 WB On-Slip	To B	17061-17063	492	491	-1	0%	0.1	✓	✓	✓
18_96	A14 Jct.37 WB On-Slip	To C	17061-17041	521	541	20	4%	0.9	✓	✓	✓
18_100	A14 Jct.37 EB On-Slip	To A	17164-17163	672	984	312	46%	10.8	×	×	×

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_101	A14 Jct.37 EB On-Slip	To B	17164-17165	790	299	-491	-62%	21.0	×	×	×
18_102	A14 Jct.37 EB On-Slip	To C	17164-17061	812	788	-24	-3%	0.8	✓	✓	✓
18_106	A14 Jct.37 EB Off-Slip	To A	17163-17162	1165	1361	196	17%	5.5	×	×	×
18_107	A14 Jct.37 EB Off-Slip	To B	17163-17164	1164	1105	-59	-5%	1.8	✓	✓	✓
18_114	A142-A1123 Roundabout, Fordham	To A	41402-14331	1081	1048	-33	-3%	1.0	✓	✓	✓
18_117	A142-A1123 Roundabout, Fordham	To D	41402-14312	379	413	34	9%	1.7	✓	✓	✓
18_118	A142-A1123 Roundabout, Fordham	To E	41402-14361	510	533	23	5%	1.0	✓	✓	✓
18_137	Twenty Pence Road Junction, Wilburton	To A	41105-41104	695	724	29	4%	1.1	✓	✓	✓
18_138	Twenty Pence Road Junction, Wilburton	To B	41105-42001	526	523	-3	-1%	0.1	✓	✓	✓
18_143	Crossroads, Landbeach Village	To A	20701-20702	463	447	-16	-3%	0.8	✓	✓	✓
18_144	Crossroads, Landbeach Village	To B	20701-12812	70	11	-59	-84%	9.2	✓	×	✓
18_145	Crossroads, Landbeach Village	To C	20701-12811	92	116	24	26%	2.4	✓	✓	✓
18_155	B1102-B1103, Burwell	To A	42201-14521	985	879	-106	-11%	3.5	✓	✓	✓
18_156	B1102-B1103, Burwell	To B	42201-14532	159	250	91	58%	6.4	✓	×	✓
18_157	B1102-B1103, Burwell	To C	42201-14531	340	192	-148	-43%	9.1	×	×	×
18_161	Butt Lane-Milton P&R	To A	25702-24616	267	261	-6	-2%	0.4	✓	✓	✓
18_162	Butt Lane-Milton P&R	To B	25798-25704	115	112	-3	-3%	0.3	✓	✓	✓
18_163	Butt Lane-Milton P&R	To C	25702-25797	81	40	-41	-51%	5.3	✓	×	✓

Appendix D. Calibration Screenline Flows

D.1. Northern North-South - AM

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
1_1	Grunty Fen Rd	NB	14021-14253	79	87	8	10%	0.8	✓	✓	✓
1_2	Grunty Fen Rd	SB	14253-14021	102	102	1	1%	0.1	✓	✓	✓
1_3	A10 north of Little Thetford	NB	14125-40204	671	687	16	2%	0.6	✓	✓	✓
1_4	A10 north of Little Thetford	SB	40204-14125	846	787	-60	-7%	2.1	✓	✓	✓
1_5	A142 near Stuntney	NB	14321-14241	670	673	3	0%	0.1	✓	✓	✓
1_6	A142 near Stuntney	SB	14241-14321	738	738	0	0%	0.0	✓	✓	✓

D.2. Northern North-South - IP

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
1_1	Grunty Fen Rd	NB	14021-14253	57	59	3	5%	0.3	✓	✓	✓
1_2	Grunty Fen Rd	SB	14253-14021	38	43	5	13%	0.8	✓	✓	✓
1_3	A10 north of Little Thetford	NB	14125-40204	656	662	6	1%	0.2	✓	✓	✓
1_4	A10 north of Little Thetford	SB	40204-14125	614	604	-10	-2%	0.4	✓	✓	✓
1_5	A142 near Stuntney	NB	14321-14241	487	596	108	22%	4.7	×	✓	✓
1_6	A142 near Stuntney	SB	14241-14321	534	536	3	1%	0.1	✓	✓	✓

D.3. Northern North-South - PM

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
1_1	Grunty Fen Rd	NB	14021-14253	145	164	19	13%	1.5	✓	✓	✓
1_2	Grunty Fen Rd	SB	14253-14021	53	69	16	30%	2.0	✓	✓	✓
1_3	A10 north of Little Thetford	NB	14125-40204	836	869	33	4%	1.1	✓	✓	✓
1_4	A10 north of Little Thetford	SB	40204-14125	675	692	17	3%	0.6	✓	✓	✓
1_5	A142 near Stuntney	NB	14321-14241	779	775	-4	-1%	0.2	✓	✓	✓
1_6	A142 near Stuntney	SB	14241-14321	779	782	3	0%	0.1	✓	✓	✓

D.4. Southern North-South - AM

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
3_1	Bridge Rd, Histon (Bridge over Busway)	NB	24609-24608	758	786	28	4%	1.0	✓	✓	✓
3_2	Bridge Rd, Histon (Bridge over Busway)	SB	24608-24609	778	779	1	0%	0.0	✓	✓	✓
3_3	A10 (north of A14 Jct 33)	NB	25602-97403	700	781	81	12%	3.0	✓	✓	✓
3_4	A10 (north of A14 Jct 33)	SB	25603-25602	1,205	1,183	-22	-2%	0.6	✓	✓	✓
3_5	Cambridge Road, Milton (between Tesco and A14)	SB	25705-25703	372	412	40	11%	2.0	✓	✓	✓
3_6	Cambridge Road, Milton (between Tesco and A14)	NB	25703-25705	429	226	-203	-47%	11.2	×	×	×
3_7	Horningsea Road (just north of A14), Horningsea	NB	27702-27703	161	167	6	4%	0.5	✓	✓	✓
3_8	Horningsea Road (just north of A14), Horningsea	SB	27703-27702	431	391	-39	-9%	1.9	✓	✓	✓
3_9	Stow Road, Quy	NB	27809-12512	169	175	6	3%	0.4	✓	✓	✓
3_10	Stow Road, Quy	SB	12512-27809	453	452	-1	0%	0.0	✓	✓	✓
3_11	A1303 south of Quy	NB	27807-27810	553	521	-32	-6%	1.4	✓	✓	✓
3_12	A1303 south of Quy	SB	27810-27807	603	590	-13	-2%	0.5	✓	✓	✓

D.5. Southern North-South - IP

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
3_1	Bridge Rd, Histon (Bridge over Busway)	NB	24609-24608	618	626	8	1%	0.3	✓	✓	✓
3_2	Bridge Rd, Histon (Bridge over Busway)	SB	24608-24609	608	614	6	1%	0.3	✓	✓	✓
3_3	A10 (north of A14 Jct 33)	NB	25602-97403	873	857	-16	-2%	0.5	✓	✓	✓
3_4	A10 (north of A14 Jct 33)	SB	25603-25602	767	790	23	3%	0.8	✓	✓	✓
3_5	Cambridge Road, Milton (between Tesco and A14)	SB	25705-25703	555	571	16	3%	0.7	✓	✓	✓
3_6	Cambridge Road, Milton (between Tesco and A14)	NB	25703-25705	554	442	-112	-20%	5.0	×	×	×
3_7	Horningsea Road (just north of A14), Horningsea	NB	27702-27703	223	203	-20	-9%	1.4	✓	✓	✓
3_8	Horningsea Road (just north of A14), Horningsea	SB	27703-27702	211	199	-13	-6%	0.9	✓	✓	✓
3_9	Stow Road, Quy	NB	27809-12512	327	332	4	1%	0.2	✓	✓	✓
3_10	Stow Road, Quy	SB	12512-27809	257	260	3	1%	0.2	✓	✓	✓
3_11	A1303 south of Quy	NB	27807-27810	497	488	-9	-2%	0.4	✓	✓	✓
3_12	A1303 south of Quy	SB	27810-27807	276	292	17	6%	1.0	✓	✓	✓

D.6. Southern North-South - PM

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
3_1	Bridge Rd, Histon (Bridge over Busway)	NB	24609-24608	992	956	-36	-4%	1.2	✓	✓	✓
3_2	Bridge Rd, Histon (Bridge over Busway)	SB	24608-24609	768	795	27	4%	1.0	✓	✓	✓
3_3	A10 (north of A14 Jct 33)	NB	25602-97403	1,300	1,341	41	3%	1.1	✓	✓	✓
3_4	A10 (north of A14 Jct 33)	SB	25603-25602	762	877	116	15%	4.0	×	✓	✓
3_5	Cambridge Road, Milton (between Tesco and A14)	SB	25705-25703	655	616	-38	-6%	1.5	✓	✓	✓
3_6	Cambridge Road, Milton (between Tesco and A14)	NB	25703-25705	570	493	-78	-14%	3.4	✓	✓	✓
3_7	Horningsea Road (just north of A14), Horningsea	NB	27702-27703	323	326	3	1%	0.2	✓	✓	✓
3_8	Horningsea Road (just north of A14), Horningsea	SB	27703-27702	185	185	0	0%	0.0	✓	✓	✓
3_9	Stow Road, Quy	NB	27809-12512	782	771	-12	-1%	0.4	✓	✓	✓
3_10	Stow Road, Quy	SB	12512-27809	204	207	3	1%	0.2	✓	✓	✓
3_11	A1303 south of Quy	NB	27807-27810	954	937	-16	-2%	0.5	✓	✓	✓
3_12	A1303 south of Quy	SB	27810-27807	383	394	11	3%	0.6	✓	✓	✓

D.7. East-West - AM

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
4_1	Grunty Fen Rd	WB	14021-14253	79	87	8	10%	0.8	✓	✓	✓
4_2	Grunty Fen Rd	EB	14253-14021	102	102	1	1%	0.1	✓	✓	✓
4_3	A1123 East of Wilburton	EB	41105-42001	672	668	-4	-1%	0.2	✓	✓	✓
4_4	A1123 East of Wilburton	WB	42001-41105	460	465	5	1%	0.2	✓	✓	✓
4_5	Beach Road, east of Cottenham	EB	12651-20702	509	341	-169	-33%	8.2	×	×	×
4_6	Beach Road, east of Cottenham	WB	20702-12651	161	160	-1	0%	0.1	✓	✓	✓
4_7	Butt Lane	WB	25702-24616	136	150	15	11%	1.2	✓	✓	✓
4_8	Butt Lane	EB	24616-25702	349	358	9	3%	0.5	✓	✓	✓
4_9	A14 WB between J33 and J32	WB	92070-92067	2,786	2,802	16	1%	0.3	✓	✓	✓
4_10	A14 EB between J32 and J33	EB	92069-92072	2,431	2,530	99	4%	2.0	✓	✓	✓

D.8. East-West - IP

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
4_1	Grunty Fen Rd	WB	14021-14253	57	59	3	5%	0.3	✓	✓	✓
4_2	Grunty Fen Rd	EB	14253-14021	38	43	5	13%	0.8	✓	✓	✓
4_3	A1123 East of Wilburton	EB	41105-42001	367	383	16	4%	0.8	✓	✓	✓
4_4	A1123 East of Wilburton	WB	42001-41105	374	380	6	2%	0.3	✓	✓	✓
4_5	Beach Road, east of Cottenham	EB	12651-20702	138	139	1	1%	0.1	✓	✓	✓
4_6	Beach Road, east of Cottenham	WB	20702-12651	188	190	3	1%	0.2	✓	✓	✓
4_7	Butt Lane	WB	25702-24616	118	102	-16	-14%	1.5	✓	✓	✓
4_8	Butt Lane	EB	24616-25702	138	124	-15	-10%	1.3	✓	✓	✓
4_9	A14 WB between J33 and J32	WB	92070-92067	2,475	2,476	1	0%	0.0	✓	✓	✓
4_10	A14 EB between J32 and J33	EB	92069-92072	2,299	2,337	38	2%	0.8	✓	✓	✓

D.9. East-West - PM

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
4_1	Grunty Fen Rd	WB	14021-14253	145	164	19	13%	1.5	✓	✓	✓
4_2	Grunty Fen Rd	EB	14253-14021	53	69	16	30%	2.0	✓	✓	✓
4_3	A1123 East of Wilburton	EB	41105-42001	453	502	50	11%	2.3	✓	✓	✓
4_4	A1123 East of Wilburton	WB	42001-41105	652	648	-4	-1%	0.2	✓	✓	✓
4_5	Beach Road, east of Cottenham	EB	12651-20702	137	172	36	26%	2.9	✓	✓	✓
4_6	Beach Road, east of Cottenham	WB	20702-12651	622	564	-58	-9%	2.4	✓	✓	✓
4_7	Butt Lane	WB	25702-24616	254	261	7	3%	0.4	✓	✓	✓
4_8	Butt Lane	EB	24616-25702	127	137	11	8%	0.9	✓	✓	✓
4_9	A14 WB between J33 and J32	WB	92070-92067	3,123	3,133	10	0%	0.2	✓	✓	✓
4_10	A14 EB between J32 and J33	EB	92069-92072	3,031	3,112	82	3%	1.5	✓	✓	✓

Appendix E. Calibration Link Flows

E.1. AM Peak

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
1_1	Grunty Fen Rd	NB	14021-14253	79	87	8	10%	0.8	✓	✓	✓
1_2	Grunty Fen Rd	SB	14253-14021	102	102	1	1%	0.1	✓	✓	✓
1_3	A10 north of Little Thetford	NB	14125-40204	671	687	16	2%	0.6	✓	✓	✓
1_4	A10 north of Little Thetford	SB	40204-14125	846	787	-60	-7%	2.1	✓	✓	✓
1_5	A142 near Stuntney	NB	14321-14241	670	673	3	0%	0.1	✓	✓	✓
1_6	A142 near Stuntney	SB	14241-14321	738	738	0	0%	0.0	✓	✓	✓
3_1	Bridge Rd, Histon (Bridge over Busway)	NB	24609-24608	758	786	28	4%	1.0	✓	✓	✓
3_2	Bridge Rd, Histon (Bridge over Busway)	SB	24608-24609	778	779	1	0%	0.0	✓	✓	✓
3_3	A10 (north of A14 Jct 33)	NB	25602-97403	700	781	81	12%	3.0	✓	✓	✓
3_4	A10 (north of A14 Jct 33)	SB	25603-25602	1205	1183	-22	-2%	0.6	✓	✓	✓
3_5	Cambridge Road, Milton (between Tesco and A14)	SB	25705-25703	372	412	40	11%	2.0	✓	✓	✓
3_6	Cambridge Road, Milton (between Tesco and A14)	NB	25703-25705	429	226	-203	-47%	11.2	×	×	×
3_7	Horningsea Road (just north of A14), Horningsea	NB	27702-27703	161	167	6	4%	0.5	✓	✓	✓
3_8	Horningsea Road (just north of A14), Horningsea	SB	27703-27702	431	391	-39	-9%	1.9	✓	✓	✓
3_9	Stow Road, Quy	NB	27809-12512	169	175	6	3%	0.4	✓	✓	✓
3_10	Stow Road, Quy	SB	12512-27809	453	452	-1	0%	0.0	✓	✓	✓
3_11	A1303 south of Quy	NB	27807-27810	553	521	-32	-6%	1.4	✓	✓	✓
3_12	A1303 south of Quy	SB	27810-27807	603	590	-13	-2%	0.5	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
4_1	Grunty Fen Rd	WB	14021-14253	79	87	8	10%	0.8	✓	✓	✓
4_2	Grunty Fen Rd	EB	14253-14021	102	102	1	1%	0.1	✓	✓	✓
4_3	A1123 East of Wilburton	EB	41105-42001	672	668	-4	-1%	0.2	✓	✓	✓
4_4	A1123 East of Wilburton	WB	42001-41105	460	465	5	1%	0.2	✓	✓	✓
4_5	Beach Road, east of Cottenham	EB	12651-20702	509	341	-169	-33%	8.2	×	×	×
4_6	Beach Road, east of Cottenham	WB	20702-12651	161	160	-1	0%	0.1	✓	✓	✓
4_7	Butt Lane	WB	25702-24616	136	150	15	11%	1.2	✓	✓	✓
4_8	Butt Lane	EB	24616-25702	349	358	9	3%	0.5	✓	✓	✓
4_9	A14 WB between J33 and J32	WB	92070-92067	2786	2802	16	1%	0.3	✓	✓	✓
4_10	A14 EB between J32 and J33	EB	92069-92072	2431	2530	99	4%	2.0	✓	✓	✓
5_1	Bridge Rd, Histon	NB	24607-24603	642	618	-24	-4%	0.9	✓	✓	✓
5_2	Bridge Rd, Histon	SB	24603-24607	631	625	-6	-1%	0.2	✓	✓	✓
5_3	New Rd, Impington	NB	24607-24615	187	136	-51	-27%	4.0	✓	✓	✓
5_4	New Rd, Impington	SB	24615-24607	197	166	-30	-15%	2.2	✓	✓	✓
6_1	A1123 West of Wilburton	EB	14011-41104	613	659	45	7%	1.8	✓	✓	✓
6_2	A1123 West of Wilburton	WB	41104-14011	271	273	2	1%	0.1	✓	✓	✓
7_1	Landbeach Rd, Milton	NB	12225-12223	309	66	-243	-79%	17.7	×	×	×
7_2	Landbeach Rd, Milton	SB	12223-12225	146	184	38	26%	3.0	✓	✓	✓
7_3	A10 north of J with Ely Rd, Milton	NB	25708-12813	758	738	-20	-3%	0.7	✓	✓	✓
7_4	A10 north of J with Ely Rd, Milton	SB	12813-25708	1015	1119	104	10%	3.2	✓	✓	✓
8_1	A10 north of Green End Rd	NB	20703-20705	776	725	-51	-7%	1.8	✓	✓	✓
8_2	A10 north of Green End Rd	SB	20705-20703	1029	968	-60	-6%	1.9	✓	✓	✓
8_3	A10 north of J with Denny end Rd	NB	28108-12711	659	655	-3	-1%	0.1	✓	✓	✓
8_4	A10 north of J with Denny end Rd	SB	12711-28108	1025	1015	-10	-1%	0.3	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
9_1	A10 north of Stretham Roundabout	NB	42001-14113	653	709	57	9%	2.2	✓	✓	✓
9_2	A10 north of Stretham Roundabout	SB	14113-42001	873	832	-42	-5%	1.4	✓	✓	✓
10_1	Cambridge Road, Ely	NB	40204-40702	274	274	0	0%	0.0	✓	✓	✓
10_2	Cambridge Road, Ely	SB	40702-40204	229	268	39	17%	2.5	✓	✓	✓
10_5	A10 west of Ely	NB	40203-40701	602	609	7	1%	0.3	✓	✓	✓
10_6	A10 west of Ely	SB	40701-40203	1003	1024	21	2%	0.7	✓	✓	✓
10_7	Ely Southern Bypass, east of A10	NB	40204-14221	715	721	6	1%	0.2	✓	✓	✓
10_8	Ely Southern Bypass, east of A10	SB	14221-40204	505	510	5	1%	0.2	✓	✓	✓
11_1	A1123, Wicken	NB	14312-14311	300	278	-22	-7%	1.3	✓	✓	✓
11_2	A1123, Wicken	SB	14311-14312	336	337	1	0%	0.1	✓	✓	✓
12_1	A142 south of J with East Fen Drove, Soham	NB	41402-14331	543	659	116	21%	4.7	×	✓	✓
12_2	A142 south of J with East Fen Drove, Soham	SB	14331-41402	811	806	-4	-1%	0.1	✓	✓	✓
13_1	B1102, Fordham	EB	14422-14423	305	306	1	0%	0.1	✓	✓	✓
13_2	B1102, Fordham	WB	14423-14422	345	346	1	0%	0.0	✓	✓	✓
14_1	A142 south of J with A14	NB	17067-17063	781	672	-109	-14%	4.1	✓	✓	✓
14_2	A142 south of J with A14	SB	17063-17067	798	454	-344	-43%	13.7	×	×	×
14_5	B1103, Exning Rd, Newmarket	NB	17042-73901	300	301	0	0%	0.0	✓	✓	✓
14_6	B1103, Exning Rd, Newmarket	SB	73901-17042	684	337	-347	-51%	15.4	×	×	×
15_3	B1102, east of Swaffham Bulbeck	NB	14621-41702	204	241	37	18%	2.5	✓	✓	✓
15_4	B1102, east of Swaffham Bulbeck	SB	41702-14621	836	837	1	0%	0.0	✓	✓	✓
16_1	A1303 Newmarket Road (Roundabout approach)	NB	27803-12511	653	677	24	4%	0.9	✓	✓	✓
16_2	A1303 Newmarket Road (Roundabout approach)	SB	27807-27806	755	1023	268	35%	9.0	×	×	×
16_3	A1303 south of A14 Jct 36	NB	41703-41704	223	231	8	4%	0.6	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
16_4	A1303 south of A14 Jct 36	SB	41704-41703	575	476	-99	-17%	4.3	✓	✓	✓
16_5	Little Wilbraham Road	NB	28001-27810	334	337	3	1%	0.1	✓	✓	✓
16_6	Little Wilbraham Road	SB	27810-28001	282	314	32	11%	1.9	✓	✓	✓
16_7	Bell Road, Bottisham	NB	41802-41805	141	164	23	16%	1.8	✓	✓	✓
16_8	Bell Road, Bottisham	SB	41805-41802	248	272	24	10%	1.5	✓	✓	✓
17_3	A14 WB between J33 and J32	WB	92070-92067	2786	2802	16	1%	0.3	✓	✓	✓
17_4	A14 EB at J33	EB	92072-92074	1377	1392	15	1%	0.4	✓	✓	✓
17_5	A14 WB at J33	WB	92075-92073	2138	2129	-8	0%	0.2	✓	✓	✓
17_6	A14 EB at J35	EB	92087-92089	995	895	-100	-10%	3.3	✓	✓	✓
17_7	A14 WB at J35	WB	92088-92086	1818	1885	67	4%	1.6	✓	✓	✓
17_10	A14 EB between J35 and J36	EB	92090-92091	1025	1032	7	1%	0.2	✓	✓	✓
17_13	A14 EB at J36	EB	92091-92095	1023	1032	9	1%	0.3	✓	✓	✓
17_16	A14 WB between J36 and J37	WB	17041-92093	3829	3671	-159	-4%	2.6	✓	✓	✓
17_22	A14 EB between J36 and J37	EB	92096-17166	2063	1507	-556	-27%	13.2	×	×	×
17_26	A14 WB between J38 and J37	WB	92099-17062	3802	3372	-430	-11%	7.2	×	×	×
18_4	A142/A10 Roundabout, Ely	From D	40203-40204	921	844	-77	-8%	2.6	✓	✓	✓
18_20	Witchford Road Roundabout, Ely	From C	40204-40203	591	527	-64	-11%	2.7	✓	✓	✓
18_21	Witchford Road Roundabout, Ely	From D	40201-40203	1149	1095	-54	-5%	1.6	✓	✓	✓
18_33	A10-Broad Baulk	From A	14021-14111	93	91	-2	-3%	0.3	✓	✓	✓
18_34	A10-Broad Baulk	From B	14123-14111	848	813	-35	-4%	1.2	✓	✓	✓
18_35	A10-Broad Baulk	From C	42002-14111	695	719	24	3%	0.9	✓	✓	✓
18_40	A10 Stretham Roundabout	From B	14112-42001	479	389	-90	-19%	4.3	✓	✓	✓
18_55	A10-Waterbeach Road	From A	28108-12812	807	820	13	2%	0.4	✓	✓	✓
18_56	A10-Waterbeach Road	From B	12813-12812	774	712	-62	-8%	2.3	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_57	A10-Waterbeach Road	From C	20701-12812	134	115	-19	-14%	1.7	✓	✓	✓
18_61	A10-Car Dyke Road	From A	12812-12813	897	932	35	4%	1.1	✓	✓	✓
18_62	A10-Car Dyke Road	From B	28102-12813	227	272	45	20%	2.9	✓	✓	✓
18_68	A10-Denny End Road	From B	12831-28108	193	203	10	5%	0.7	✓	✓	✓
18_69	A10-Denny End Road	From C	12812-28108	773	690	-83	-11%	3.1	✓	✓	✓
18_73	A10-Butt Lane	From A	12232-25704	1206	1088	-118	-10%	3.5	✓	✓	✓
18_74	A10-Butt Lane	From B	97403-25704	829	762	-67	-8%	2.4	✓	✓	✓
18_75	A10-Butt Lane	From C	25798-25704	113	135	22	20%	2.0	✓	✓	✓
18_79	A10-Milton P&R	From A	25704-97403	1075	956	-119	-11%	3.7	✓	✓	✓
18_81	A10-Milton P&R	From C	97402-97403	217	236	19	9%	1.3	✓	✓	✓
18_85	Milton Interchange	From A	92072-25601	1054	1138	84	8%	2.5	✓	✓	✓
18_86	Milton Interchange	From B	20404-25601	492	562	70	14%	3.1	✓	✓	✓
18_87	Milton Interchange	From C	25602-25604	1230	1183	-47	-4%	1.4	✓	✓	✓
18_88	Milton Interchange	From D	25601-25604	1074	919	-155	-14%	4.9	✓	✓	✓
18_89	Milton Interchange	From E	25604-25701	2200	2101	-99	-4%	2.1	✓	✓	✓
18_90	Milton Interchange	From F	25701-25605	2035	1875	-160	-8%	3.6	✓	✓	✓
18_91	Milton Interchange	From G	25703-25605	394	412	18	5%	0.9	✓	✓	✓
18_92	Milton Interchange	From H	25605-20407	1906	1761	-145	-8%	3.4	✓	✓	✓
18_93	Milton Interchange	From I	92075-20407	1289	1090	-199	-15%	5.8	×	×	×
18_94	Milton Interchange	From J	20406-20405	170	202	32	19%	2.3	✓	✓	✓
18_95	Milton Interchange	From K	20405-20404	492	275	-217	-44%	11.1	×	×	×
18_96	Milton Interchange	From L	20407-20404	709	757	48	7%	1.8	✓	✓	✓
18_105	Histon Interchange	From A	92064-24611	1064	865	-199	-19%	6.4	×	×	×
18_106	Histon Interchange	From B	24613-24611	819	798	-21	-3%	0.7	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_107	Histon Interchange	From C	24611-24614	983	825	-158	-16%	5.3	×	×	×
18_108	Histon Interchange	From D	24609-24614	933	1016	83	9%	2.7	✓	✓	✓
18_109	Histon Interchange	From E	24614-20302	1575	1370	-205	-13%	5.3	✓	×	✓
18_110	Histon Interchange	From F	92067-20302	666	664	-2	0%	0.1	✓	✓	✓
18_111	Histon Interchange	From G	20302-24613	490	475	-15	-3%	0.7	✓	✓	✓
18_112	Histon Interchange	From H	20301-24613	969	968	-1	0%	0.0	✓	✓	✓
18_85	A14 Jct.37 WB Off-Slip	From A	17062-17063	765	334	-431	-56%	18.4	×	×	×
18_86	A14 Jct.37 WB Off-Slip	From B	17067-17063	784	672	-112	-14%	4.2	✓	✓	✓
18_87	A14 Jct.37 WB Off-Slip	From C	17061-17063	291	419	128	44%	6.8	×	×	×
18_91	A14 Jct.37 WB On-Slip	From A	17164-17061	763	805	42	5%	1.5	✓	✓	✓
18_92	A14 Jct.37 WB On-Slip	From B	17063-17061	1047	965	-82	-8%	2.6	✓	✓	✓
18_97	A14 Jct.37 EB On-Slip	From A	17163-17164	1051	1031	-20	-2%	0.6	✓	✓	✓
18_99	A14 Jct.37 EB On-Slip	From C	17061-17164	807	753	-54	-7%	1.9	✓	✓	✓
18_103	A14 Jct.37 EB Off-Slip	From A	17162-17163	912	861	-51	-6%	1.7	✓	✓	✓
18_104	A14 Jct.37 EB Off-Slip	From B	17164-17163	592	753	161	27%	6.2	×	×	×
18_105	A14 Jct.37 EB Off-Slip	From C	17166-17163	447	502	55	12%	2.5	✓	✓	✓
18_112	A142-A1123 Roundabout, Fordham	From D	14312-41402	391	376	-15	-4%	0.8	✓	✓	✓
18_134	Twenty Pence Road Junction, Wilburton	From A	41104-41105	714	787	73	10%	2.7	✓	✓	✓
18_140	Crossroads, Landbeach Village	From A	20702-20701	359	175	-184	-51%	11.2	×	×	×
18_141	Crossroads, Landbeach Village	From B	12812-20701	63	25	-38	-60%	5.7	✓	×	✓
18_142	Crossroads, Landbeach Village	From C	12811-20701	71	99	28	39%	3.0	✓	✓	✓
18_152	B1102-B1103, Burwell	From A	14521-42201	780	769	-11	-1%	0.4	✓	✓	✓
18_153	B1102-B1103, Burwell	From B	14532-42201	110	144	34	31%	3.0	✓	✓	✓
18_154	B1102-B1103, Burwell	From C	14531-42201	294	189	-105	-36%	6.7	×	×	×

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_159	Butt Lane-Milton P&R	From B	25704-25798	197	198	1	0%	0.1	✓	✓	✓
18_160	Butt Lane-Milton P&R	From C	25797-25702	4	8	4	111%	1.8	✓	✓	✓

E.2. Inter-peak

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
1_1	Grunty Fen Rd	NB	14021-14253	57	59	3	5%	0.3	✓	✓	✓
1_2	Grunty Fen Rd	SB	14253-14021	38	43	5	13%	0.8	✓	✓	✓
1_3	A10 north of Little Thetford	NB	14125-40204	656	662	6	1%	0.2	✓	✓	✓
1_4	A10 north of Little Thetford	SB	40204-14125	614	604	-10	-2%	0.4	✓	✓	✓
1_5	A142 near Stuntney	NB	14321-14241	487	596	108	22%	4.7	×	✓	✓
1_6	A142 near Stuntney	SB	14241-14321	534	536	3	1%	0.1	✓	✓	✓
3_1	Bridge Rd, Histon (Bridge over Busway)	NB	24609-24608	618	626	8	1%	0.3	✓	✓	✓
3_2	Bridge Rd, Histon (Bridge over Busway)	SB	24608-24609	608	614	6	1%	0.3	✓	✓	✓
3_3	A10 (north of A14 Jct 33)	NB	25602-97403	873	857	-16	-2%	0.5	✓	✓	✓
3_4	A10 (north of A14 Jct 33)	SB	25603-25602	767	790	23	3%	0.8	✓	✓	✓
3_5	Cambridge Road, Milton (between Tesco and A14)	SB	25705-25703	555	571	16	3%	0.7	✓	✓	✓
3_6	Cambridge Road, Milton (between Tesco and A14)	NB	25703-25705	554	442	-112	-20%	5.0	×	×	×
3_7	Horningsea Road (just north of A14), Horningsea	NB	27702-27703	223	203	-20	-9%	1.4	✓	✓	✓
3_8	Horningsea Road (just north of A14), Horningsea	SB	27703-27702	211	199	-13	-6%	0.9	✓	✓	✓
3_9	Stow Road, Quy	NB	27809-12512	327	332	4	1%	0.2	✓	✓	✓
3_10	Stow Road, Quy	SB	12512-27809	257	260	3	1%	0.2	✓	✓	✓
3_11	A1303 south of Quy	NB	27807-27810	497	488	-9	-2%	0.4	✓	✓	✓
3_12	A1303 south of Quy	SB	27810-27807	276	292	17	6%	1.0	✓	✓	✓
4_1	Grunty Fen Rd	WB	14021-14253	57	59	3	5%	0.3	✓	✓	✓
4_2	Grunty Fen Rd	EB	14253-14021	38	43	5	13%	0.8	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
4_3	A1123 East of Wilburton	EB	41105-42001	367	383	16	4%	0.8	✓	✓	✓
4_4	A1123 East of Wilburton	WB	42001-41105	374	380	6	2%	0.3	✓	✓	✓
4_5	Beach Road, east of Cottenham	EB	12651-20702	138	139	1	1%	0.1	✓	✓	✓
4_6	Beach Road, east of Cottenham	WB	20702-12651	188	190	3	1%	0.2	✓	✓	✓
4_7	Butt Lane	WB	25702-24616	118	102	-16	-14%	1.5	✓	✓	✓
4_8	Butt Lane	EB	24616-25702	138	124	-15	-10%	1.3	✓	✓	✓
4_9	A14 WB between J33 and J32	WB	92070-92067	2475	2476	1	0%	0.0	✓	✓	✓
4_10	A14 EB between J32 and J33	EB	92069-92072	2299	2337	38	2%	0.8	✓	✓	✓
5_1	Bridge Rd, Histon	NB	24607-24603	538	527	-11	-2%	0.5	✓	✓	✓
5_2	Bridge Rd, Histon	SB	24603-24607	514	504	-9	-2%	0.4	✓	✓	✓
5_3	New Rd, Impington	NB	24607-24615	103	96	-7	-7%	0.7	✓	✓	✓
5_4	New Rd, Impington	SB	24615-24607	103	108	5	5%	0.5	✓	✓	✓
6_1	A1123 West of Wilburton	EB	14011-41104	325	335	10	3%	0.5	✓	✓	✓
6_2	A1123 West of Wilburton	WB	41104-14011	361	364	3	1%	0.1	✓	✓	✓
7_1	Landbeach Rd, Milton	NB	12225-12223	127	88	-39	-30%	3.7	✓	✓	✓
7_2	Landbeach Rd, Milton	SB	12223-12225	94	90	-4	-4%	0.4	✓	✓	✓
7_3	A10 north of J with Ely Rd, Milton	NB	25708-12813	840	794	-46	-5%	1.6	✓	✓	✓
7_4	A10 north of J with Ely Rd, Milton	SB	12813-25708	819	751	-69	-8%	2.4	✓	✓	✓
8_1	A10 north of Green End Rd	NB	20703-20705	760	716	-44	-6%	1.6	✓	✓	✓
8_2	A10 north of Green End Rd	SB	20705-20703	720	722	2	0%	0.1	✓	✓	✓
8_3	A10 north of J with Denny end Rd	NB	28108-12711	700	709	8	1%	0.3	✓	✓	✓
8_4	A10 north of J with Denny end Rd	SB	12711-28108	708	713	5	1%	0.2	✓	✓	✓
9_1	A10 north of Stretham Roundabout	NB	42001-14113	707	729	22	3%	0.8	✓	✓	✓
9_2	A10 north of Stretham Roundabout	SB	14113-42001	565	613	48	9%	2.0	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
10_1	Cambridge Road, Ely	NB	40204-40702	232	232	0	0%	0.0	✓	✓	✓
10_2	Cambridge Road, Ely	SB	40702-40204	160	162	2	1%	0.1	✓	✓	✓
10_5	A10 west of Ely	NB	40203-40701	674	641	-33	-5%	1.3	✓	✓	✓
10_6	A10 west of Ely	SB	40701-40203	659	659	0	0%	0.0	✓	✓	✓
10_7	Ely Southern Bypass, east of A10	NB	40204-14221	524	531	7	1%	0.3	✓	✓	✓
10_8	Ely Southern Bypass, east of A10	SB	14221-40204	601	516	-85	-14%	3.6	✓	✓	✓
11_1	A1123, Wicken	NB	14312-14311	224	258	34	15%	2.2	✓	✓	✓
11_2	A1123, Wicken	SB	14311-14312	211	215	4	2%	0.2	✓	✓	✓
12_1	A142 south of J with East Fen Drove, Soham	NB	41402-14331	556	561	6	1%	0.2	✓	✓	✓
12_2	A142 south of J with East Fen Drove, Soham	SB	14331-41402	519	510	-9	-2%	0.4	✓	✓	✓
13_1	B1102, Fordham	EB	14422-14423	224	182	-42	-19%	2.9	✓	✓	✓
13_2	B1102, Fordham	WB	14423-14422	237	165	-71	-30%	5.0	✓	×	✓
14_1	A142 south of J with A14	NB	17067-17063	748	483	-265	-35%	10.7	×	×	×
14_2	A142 south of J with A14	SB	17063-17067	622	335	-287	-46%	13.1	×	×	×
14_5	B1103, Exning Rd, Newmarket	NB	17042-73901	288	258	-31	-11%	1.8	✓	✓	✓
14_6	B1103, Exning Rd, Newmarket	SB	73901-17042	355	223	-133	-37%	7.8	×	×	×
15_3	B1102, east of Swaffham Bulbeck	NB	14621-41702	344	350	6	2%	0.3	✓	✓	✓
15_4	B1102, east of Swaffham Bulbeck	SB	41702-14621	274	282	8	3%	0.5	✓	✓	✓
16_1	A1303 Newmarket Road (Roundabout approach)	NB	27803-12511	753	798	46	6%	1.6	✓	✓	✓
16_2	A1303 Newmarket Road (Roundabout approach)	SB	27807-27806	524	531	8	2%	0.3	✓	✓	✓
16_3	A1303 south of A14 Jct 36	NB	41703-41704	284	294	11	4%	0.6	✓	✓	✓
16_4	A1303 south of A14 Jct 36	SB	41704-41703	226	292	66	29%	4.1	✓	✓	✓
16_5	Little Wilbraham Road	NB	28001-27810	142	142	0	0%	0.0	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
16_6	Little Wilbraham Road	SB	27810-28001	156	157	1	1%	0.1	✓	✓	✓
16_7	Bell Road, Bottisham	NB	41802-41805	102	120	17	17%	1.7	✓	✓	✓
16_8	Bell Road, Bottisham	SB	41805-41802	104	182	77	74%	6.5	✓	×	✓
17_3	A14 WB between J33 and J32	WB	92070-92067	2475	2476	1	0%	0.0	✓	✓	✓
17_4	A14 EB at J33	EB	92072-92074	1633	1673	40	2%	1.0	✓	✓	✓
17_5	A14 WB at J33	WB	92075-92073	1659	1703	44	3%	1.1	✓	✓	✓
17_6	A14 EB at J35	EB	92087-92089	1436	1260	-176	-12%	4.8	✓	✓	✓
17_7	A14 WB at J35	WB	92088-92086	1220	1275	55	4%	1.5	✓	✓	✓
17_10	A14 EB between J35 and J36	EB	92090-92091	1443	1428	-16	-1%	0.4	✓	✓	✓
17_13	A14 EB at J36	EB	92091-92095	1443	1428	-15	-1%	0.4	✓	✓	✓
17_16	A14 WB between J36 and J37	WB	17041-92093	2402	2267	-135	-6%	2.8	✓	✓	✓
17_22	A14 EB between J36 and J37	EB	92096-17166	2544	2030	-514	-20%	10.8	×	×	×
17_26	A14 WB between J38 and J37	WB	92099-17062	2354	2012	-342	-15%	7.3	✓	×	✓
18_4	A142/A10 Roundabout, Ely	From D	40203-40204	921	685	-236	-26%	8.3	×	×	×
18_20	Witchford Road Roundabout, Ely	From C	40204-40203	726	659	-67	-9%	2.5	✓	✓	✓
18_21	Witchford Road Roundabout, Ely	From D	40201-40203	879	833	-46	-5%	1.6	✓	✓	✓
18_33	A10-Broad Baulk	From A	14021-14111	38	40	1	4%	0.2	✓	✓	✓
18_34	A10-Broad Baulk	From B	14123-14111	612	578	-34	-6%	1.4	✓	✓	✓
18_35	A10-Broad Baulk	From C	42002-14111	717	702	-16	-2%	0.6	✓	✓	✓
18_40	A10 Stretham Roundabout	From B	14112-42001	313	277	-36	-11%	2.1	✓	✓	✓
18_55	A10-Waterbeach Road	From A	28108-12812	696	662	-34	-5%	1.3	✓	✓	✓
18_56	A10-Waterbeach Road	From B	12813-12812	745	709	-36	-5%	1.3	✓	✓	✓
18_57	A10-Waterbeach Road	From C	20701-12812	53	13	-40	-76%	7.0	✓	×	✓
18_61	A10-Car Dyke Road	From A	12812-12813	724	672	-52	-7%	2.0	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_62	A10-Car Dyke Road	From B	28102-12813	161	117	-44	-27%	3.7	✓	✓	✓
18_68	A10-Denny End Road	From B	12831-28108	267	260	-8	-3%	0.5	✓	✓	✓
18_69	A10-Denny End Road	From C	12812-28108	720	695	-25	-3%	0.9	✓	✓	✓
18_73	A10-Butt Lane	From A	12232-25704	855	808	-46	-5%	1.6	✓	✓	✓
18_74	A10-Butt Lane	From B	97403-25704	900	831	-69	-8%	2.4	✓	✓	✓
18_75	A10-Butt Lane	From C	25798-25704	114	97	-17	-15%	1.7	✓	✓	✓
18_79	A10-Milton P&R	From A	25704-97403	756	718	-38	-5%	1.4	✓	✓	✓
18_81	A10-Milton P&R	From C	97402-97403	127	73	-54	-43%	5.5	✓	×	✓
18_85	Milton Interchange	From A	92072-25601	666	664	-2	0%	0.1	✓	✓	✓
18_86	Milton Interchange	From B	20404-25601	797	933	136	17%	4.6	×	✓	✓
18_87	Milton Interchange	From C	25602-25604	768	790	22	3%	0.8	✓	✓	✓
18_88	Milton Interchange	From D	25601-25604	866	739	-127	-15%	4.5	✓	✓	✓
18_89	Milton Interchange	From E	25604-25701	1369	1529	159	12%	4.2	✓	✓	✓
18_90	Milton Interchange	From F	25701-25605	1145	1087	-58	-5%	1.7	✓	✓	✓
18_91	Milton Interchange	From G	25703-25605	557	571	14	3%	0.6	✓	✓	✓
18_92	Milton Interchange	From H	25605-20407	1125	1094	-32	-3%	0.9	✓	✓	✓
18_93	Milton Interchange	From I	92075-20407	582	558	-24	-4%	1.0	✓	✓	✓
18_94	Milton Interchange	From J	20406-20405	284	272	-12	-4%	0.7	✓	✓	✓
18_95	Milton Interchange	From K	20405-20404	797	682	-115	-14%	4.2	✓	✓	✓
18_96	Milton Interchange	From L	20407-20404	767	752	-15	-2%	0.5	✓	✓	✓
18_105	Histon Interchange	From A	92064-24611	459	441	-19	-4%	0.9	✓	✓	✓
18_106	Histon Interchange	From B	24613-24611	777	763	-14	-2%	0.5	✓	✓	✓
18_107	Histon Interchange	From C	24611-24614	524	510	-15	-3%	0.6	✓	✓	✓
18_108	Histon Interchange	From D	24609-24614	694	686	-7	-1%	0.3	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_109	Histon Interchange	From E	24614-20302	777	770	-7	-1%	0.3	✓	✓	✓
18_110	Histon Interchange	From F	92067-20302	385	384	0	0%	0.0	✓	✓	✓
18_111	Histon Interchange	From G	20302-24613	379	373	-6	-2%	0.3	✓	✓	✓
18_112	Histon Interchange	From H	20301-24613	846	832	-14	-2%	0.5	✓	✓	✓
18_85	A14 Jct.37 WB Off-Slip	From A	17062-17063	412	367	-45	-11%	2.3	✓	✓	✓
18_86	A14 Jct.37 WB Off-Slip	From B	17067-17063	748	483	-265	-35%	10.7	×	×	×
18_87	A14 Jct.37 WB Off-Slip	From C	17061-17063	414	329	-85	-20%	4.4	✓	✓	✓
18_91	A14 Jct.37 WB On-Slip	From A	17164-17061	668	756	87	13%	3.3	✓	✓	✓
18_92	A14 Jct.37 WB On-Slip	From B	17063-17061	923	825	-98	-11%	3.3	✓	✓	✓
18_97	A14 Jct.37 EB On-Slip	From A	17163-17164	911	863	-48	-5%	1.6	✓	✓	✓
18_99	A14 Jct.37 EB On-Slip	From C	17061-17164	784	627	-157	-20%	5.9	×	×	×
18_103	A14 Jct.37 EB Off-Slip	From A	17162-17163	789	701	-88	-11%	3.2	✓	✓	✓
18_104	A14 Jct.37 EB Off-Slip	From B	17164-17163	559	627	68	12%	2.8	✓	✓	✓
18_105	A14 Jct.37 EB Off-Slip	From C	17166-17163	397	557	160	40%	7.3	×	×	×
18_112	A142-A1123 Roundabout, Fordham	From D	14312-41402	249	231	-18	-7%	1.2	✓	✓	✓
18_134	Twenty Pence Road Junction, Wilburton	From A	41104-41105	357	390	33	9%	1.7	✓	✓	✓
18_140	Crossroads, Landbeach Village	From A	20702-20701	124	94	-30	-24%	2.9	✓	✓	✓
18_141	Crossroads, Landbeach Village	From B	12812-20701	45	16	-29	-64%	5.2	✓	×	✓
18_142	Crossroads, Landbeach Village	From C	12811-20701	115	136	21	19%	1.9	✓	✓	✓
18_152	B1102-B1103, Burwell	From A	14521-42201	350	339	-10	-3%	0.5	✓	✓	✓
18_153	B1102-B1103, Burwell	From B	14532-42201	143	141	-1	-1%	0.1	✓	✓	✓
18_154	B1102-B1103, Burwell	From C	14531-42201	358	263	-95	-26%	5.4	✓	×	✓
18_159	Butt Lane-Milton P&R	From B	25704-25798	201	123	-78	-39%	6.1	✓	×	✓
18_160	Butt Lane-Milton P&R	From C	25797-25702	17	23	6	36%	1.4	✓	✓	✓

E.3. PM Peak

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
1_1	Grunty Fen Rd	NB	14021-14253	145	164	19	13%	1.5	✓	✓	✓
1_2	Grunty Fen Rd	SB	14253-14021	53	69	16	30%	2.0	✓	✓	✓
1_3	A10 north of Little Thetford	NB	14125-40204	836	869	33	4%	1.1	✓	✓	✓
1_4	A10 north of Little Thetford	SB	40204-14125	675	692	17	3%	0.6	✓	✓	✓
1_5	A142 near Stuntney	NB	14321-14241	779	775	-4	-1%	0.2	✓	✓	✓
1_6	A142 near Stuntney	SB	14241-14321	779	782	3	0%	0.1	✓	✓	✓
3_1	Bridge Rd, Histon (Bridge over Busway)	NB	24609-24608	992	956	-36	-4%	1.2	✓	✓	✓
3_2	Bridge Rd, Histon (Bridge over Busway)	SB	24608-24609	768	795	27	4%	1.0	✓	✓	✓
3_3	A10 (north of A14 Jct 33)	NB	25602-97403	1300	1341	41	3%	1.1	✓	✓	✓
3_4	A10 (north of A14 Jct 33)	SB	25603-25602	762	877	116	15%	4.0	×	✓	✓
3_5	Cambridge Road, Milton (between Tesco and A14)	SB	25705-25703	655	616	-38	-6%	1.5	✓	✓	✓
3_6	Cambridge Road, Milton (between Tesco and A14)	NB	25703-25705	570	493	-78	-14%	3.4	✓	✓	✓
3_7	Horningsea Road (just north of A14), Horningsea	NB	27702-27703	323	326	3	1%	0.2	✓	✓	✓
3_8	Horningsea Road (just north of A14), Horningsea	SB	27703-27702	185	185	0	0%	0.0	✓	✓	✓
3_9	Stow Road, Quy	NB	27809-12512	782	771	-12	-1%	0.4	✓	✓	✓
3_10	Stow Road, Quy	SB	12512-27809	204	207	3	1%	0.2	✓	✓	✓
3_11	A1303 south of Quy	NB	27807-27810	954	937	-16	-2%	0.5	✓	✓	✓
3_12	A1303 south of Quy	SB	27810-27807	383	394	11	3%	0.6	✓	✓	✓
4_1	Grunty Fen Rd	WB	14021-14253	145	164	19	13%	1.5	✓	✓	✓
4_2	Grunty Fen Rd	EB	14253-14021	53	69	16	30%	2.0	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
4_3	A1123 East of Wilburton	EB	41105-42001	453	502	50	11%	2.3	✓	✓	✓
4_4	A1123 East of Wilburton	WB	42001-41105	652	648	-4	-1%	0.2	✓	✓	✓
4_5	Beach Road, east of Cottenham	EB	12651-20702	137	172	36	26%	2.9	✓	✓	✓
4_6	Beach Road, east of Cottenham	WB	20702-12651	622	564	-58	-9%	2.4	✓	✓	✓
4_7	Butt Lane	WB	25702-24616	254	261	7	3%	0.4	✓	✓	✓
4_8	Butt Lane	EB	24616-25702	127	137	11	8%	0.9	✓	✓	✓
4_9	A14 WB between J33 and J32	WB	92070-92067	3123	3133	10	0%	0.2	✓	✓	✓
4_10	A14 EB between J32 and J33	EB	92069-92072	3031	3112	82	3%	1.5	✓	✓	✓
5_1	Bridge Rd, Histon	NB	24607-24603	934	758	-176	-19%	6.0	×	×	×
5_2	Bridge Rd, Histon	SB	24603-24607	663	631	-33	-5%	1.3	✓	✓	✓
5_3	New Rd, Impington	NB	24607-24615	220	196	-24	-11%	1.7	✓	✓	✓
5_4	New Rd, Impington	SB	24615-24607	204	132	-72	-36%	5.6	✓	×	✓
6_1	A1123 West of Wilburton	EB	14011-41104	342	380	38	11%	2.0	✓	✓	✓
6_2	A1123 West of Wilburton	WB	41104-14011	648	662	14	2%	0.6	✓	✓	✓
7_1	Landbeach Rd, Milton	NB	12225-12223	207	213	5	2%	0.4	✓	✓	✓
7_2	Landbeach Rd, Milton	SB	12223-12225	106	97	-9	-8%	0.9	✓	✓	✓
7_3	A10 north of J with Ely Rd, Milton	NB	25708-12813	986	972	-13	-1%	0.4	✓	✓	✓
7_4	A10 north of J with Ely Rd, Milton	SB	12813-25708	916	894	-22	-2%	0.7	✓	✓	✓
8_1	A10 north of Green End Rd	NB	20703-20705	895	928	33	4%	1.1	✓	✓	✓
8_2	A10 north of Green End Rd	SB	20705-20703	794	765	-29	-4%	1.0	✓	✓	✓
8_3	A10 north of J with Denny end Rd	NB	28108-12711	803	963	160	20%	5.4	×	×	×
8_4	A10 north of J with Denny end Rd	SB	12711-28108	732	739	6	1%	0.2	✓	✓	✓
9_1	A10 north of Stretham Roundabout	NB	42001-14113	973	1002	29	3%	0.9	✓	✓	✓
9_2	A10 north of Stretham Roundabout	SB	14113-42001	570	648	79	14%	3.2	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
10_1	Cambridge Road, Ely	NB	40204-40702	607	525	-82	-14%	3.5	✓	✓	✓
10_2	Cambridge Road, Ely	SB	40702-40204	144	153	9	6%	0.7	✓	✓	✓
10_5	A10 west of Ely	NB	40203-40701	1006	1050	44	4%	1.4	✓	✓	✓
10_6	A10 west of Ely	SB	40701-40203	729	735	5	1%	0.2	✓	✓	✓
10_7	Ely Southern Bypass, east of A10	NB	40204-14221	528	540	12	2%	0.5	✓	✓	✓
10_8	Ely Southern Bypass, east of A10	SB	14221-40204	932	842	-90	-10%	3.0	✓	✓	✓
11_1	A1123, Wicken	NB	14312-14311	373	370	-2	-1%	0.1	✓	✓	✓
11_2	A1123, Wicken	SB	14311-14312	316	287	-29	-9%	1.7	✓	✓	✓
12_1	A142 south of J with East Fen Drove, Soham	NB	41402-14331	1037	1048	11	1%	0.3	✓	✓	✓
12_2	A142 south of J with East Fen Drove, Soham	SB	14331-41402	657	652	-5	-1%	0.2	✓	✓	✓
13_1	B1102, Fordham	EB	14422-14423	339	292	-46	-14%	2.6	✓	✓	✓
13_2	B1102, Fordham	WB	14423-14422	409	289	-120	-29%	6.4	×	×	×
14_1	A142 south of J with A14	NB	17067-17063	1128	1002	-126	-11%	3.9	✓	✓	✓
14_2	A142 south of J with A14	SB	17063-17067	686	520	-166	-24%	6.8	×	×	×
14_5	B1103, Exning Rd, Newmarket	NB	17042-73901	594	622	27	5%	1.1	✓	✓	✓
14_6	B1103, Exning Rd, Newmarket	SB	73901-17042	402	411	9	2%	0.4	✓	✓	✓
15_3	B1102, east of Swaffham Bulbeck	NB	14621-41702	994	960	-34	-3%	1.1	✓	✓	✓
15_4	B1102, east of Swaffham Bulbeck	SB	41702-14621	249	257	8	3%	0.5	✓	✓	✓
16_1	A1303 Newmarket Road (Roundabout approach)	NB	27803-12511	1544	1676	132	9%	3.3	✓	✓	✓
16_2	A1303 Newmarket Road (Roundabout approach)	SB	27807-27806	535	570	34	6%	1.5	✓	✓	✓
16_3	A1303 south of A14 Jct 36	NB	41703-41704	538	542	4	1%	0.2	✓	✓	✓
16_4	A1303 south of A14 Jct 36	SB	41704-41703	234	244	10	4%	0.6	✓	✓	✓
16_5	Little Wilbraham Road	NB	28001-27810	236	279	44	19%	2.7	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
16_6	Little Wilbraham Road	SB	27810-28001	329	338	10	3%	0.5	✓	✓	✓
16_7	Bell Road, Bottisham	NB	41802-41805	191	217	26	14%	1.8	✓	✓	✓
16_8	Bell Road, Bottisham	SB	41805-41802	127	216	89	71%	6.8	✓	×	✓
17_3	A14 WB between J33 and J32	WB	92070-92067	3123	3133	10	0%	0.2	✓	✓	✓
17_4	A14 EB at J33	EB	92072-92074	2368	2443	75	3%	1.5	✓	✓	✓
17_5	A14 WB at J33	WB	92075-92073	1809	1918	110	6%	2.5	✓	✓	✓
17_6	A14 EB at J35	EB	92087-92089	2353	1980	-373	-16%	8.0	×	×	×
17_7	A14 WB at J35	WB	92088-92086	1199	1213	14	1%	0.4	✓	✓	✓
17_10	A14 EB between J35 and J36	EB	92090-92091	2275	2323	49	2%	1.0	✓	✓	✓
17_13	A14 EB at J36	EB	92091-92095	2267	2323	56	2%	1.2	✓	✓	✓
17_16	A14 WB between J36 and J37	WB	17041-92093	2428	2362	-66	-3%	1.3	✓	✓	✓
17_22	A14 EB between J36 and J37	EB	92096-17166	4061	3906	-154	-4%	2.4	✓	✓	✓
17_26	A14 WB between J38 and J37	WB	92099-17062	2362	2050	-311	-13%	6.6	✓	×	✓
18_4	A142/A10 Roundabout, Ely	From D	40203-40204	921	722	-199	-22%	7.0	×	×	×
18_20	Witchford Road Roundabout, Ely	From C	40204-40203	832	830	-2	0%	0.1	✓	✓	✓
18_21	Witchford Road Roundabout, Ely	From D	40201-40203	1154	1159	5	0%	0.1	✓	✓	✓
18_33	A10-Broad Baulk	From A	14021-14111	60	64	4	7%	0.5	✓	✓	✓
18_34	A10-Broad Baulk	From B	14123-14111	664	663	-1	0%	0.0	✓	✓	✓
18_35	A10-Broad Baulk	From C	42002-14111	958	1019	61	6%	1.9	✓	✓	✓
18_40	A10 Stretham Roundabout	From B	14112-42001	480	462	-18	-4%	0.8	✓	✓	✓
18_55	A10-Waterbeach Road	From A	28108-12812	832	745	-87	-10%	3.1	✓	✓	✓
18_56	A10-Waterbeach Road	From B	12813-12812	816	849	33	4%	1.2	✓	✓	✓
18_57	A10-Waterbeach Road	From C	20701-12812	62	11	-51	-82%	8.4	✓	×	✓
18_61	A10-Car Dyke Road	From A	12812-12813	847	754	-93	-11%	3.3	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_62	A10-Car Dyke Road	From B	28102-12813	208	212	4	2%	0.3	✓	✓	✓
18_68	A10-Denny End Road	From B	12831-28108	462	440	-22	-5%	1.0	✓	✓	✓
18_69	A10-Denny End Road	From C	12812-28108	740	811	71	10%	2.6	✓	✓	✓
18_73	A10-Butt Lane	From A	12232-25704	951	989	38	4%	1.2	✓	✓	✓
18_74	A10-Butt Lane	From B	97403-25704	1300	1357	57	4%	1.6	✓	✓	✓
18_75	A10-Butt Lane	From C	25798-25704	114	112	-2	-2%	0.2	✓	✓	✓
18_79	A10-Milton P&R	From A	25704-97403	835	824	-11	-1%	0.4	✓	✓	✓
18_81	A10-Milton P&R	From C	97402-97403	74	87	13	18%	1.5	✓	✓	✓
18_85	Milton Interchange	From A	92072-25601	663	669	6	1%	0.2	✓	✓	✓
18_86	Milton Interchange	From B	20404-25601	1516	1876	360	24%	8.7	×	×	×
18_87	Milton Interchange	From C	25602-25604	872	877	5	1%	0.2	✓	✓	✓
18_88	Milton Interchange	From D	25601-25604	1330	1203	-127	-10%	3.6	✓	✓	✓
18_89	Milton Interchange	From E	25604-25701	1871	2081	210	11%	4.7	✓	✓	✓
18_90	Milton Interchange	From F	25701-25605	1612	1588	-24	-1%	0.6	✓	✓	✓
18_91	Milton Interchange	From G	25703-25605	623	630	7	1%	0.3	✓	✓	✓
18_92	Milton Interchange	From H	25605-20407	1034	1029	-5	0%	0.1	✓	✓	✓
18_93	Milton Interchange	From I	92075-20407	756	768	12	2%	0.4	✓	✓	✓
18_94	Milton Interchange	From J	20406-20405	734	586	-148	-20%	5.8	×	×	×
18_95	Milton Interchange	From K	20405-20404	1516	1375	-141	-9%	3.7	✓	✓	✓
18_96	Milton Interchange	From L	20407-20404	999	1130	131	13%	4.0	✓	✓	✓
18_105	Histon Interchange	From A	92064-24611	727	690	-37	-5%	1.4	✓	✓	✓
18_106	Histon Interchange	From B	24613-24611	1339	1356	17	1%	0.5	✓	✓	✓
18_107	Histon Interchange	From C	24611-24614	890	824	-66	-7%	2.2	✓	✓	✓
18_108	Histon Interchange	From D	24609-24614	935	952	17	2%	0.5	✓	✓	✓

Link ID	Link Name	Dir.	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
18_109	Histon Interchange	From E	24614-20302	1080	1067	-13	-1%	0.4	✓	✓	✓
18_110	Histon Interchange	From F	92067-20302	484	555	71	15%	3.1	✓	✓	✓
18_111	Histon Interchange	From G	20302-24613	552	559	7	1%	0.3	✓	✓	✓
18_112	Histon Interchange	From H	20301-24613	1488	1492	4	0%	0.1	✓	✓	✓
18_85	A14 Jct.37 WB Off-Slip	From A	17062-17063	442	260	-182	-41%	9.7	×	×	×
18_86	A14 Jct.37 WB Off-Slip	From B	17067-17063	1158	1002	-156	-13%	4.8	✓	✓	✓
18_87	A14 Jct.37 WB Off-Slip	From C	17061-17063	491	491	0	0%	0.0	✓	✓	✓
18_91	A14 Jct.37 WB On-Slip	From A	17164-17061	813	807	-6	-1%	0.2	✓	✓	✓
18_92	A14 Jct.37 WB On-Slip	From B	17063-17061	1310	1210	-100	-8%	2.8	✓	✓	✓
18_97	A14 Jct.37 EB On-Slip	From A	17163-17164	1164	1086	-78	-7%	2.3	✓	✓	✓
18_99	A14 Jct.37 EB On-Slip	From C	17061-17164	1110	985	-125	-11%	3.9	✓	✓	✓
18_103	A14 Jct.37 EB Off-Slip	From A	17162-17163	980	948	-32	-3%	1.0	✓	✓	✓
18_104	A14 Jct.37 EB Off-Slip	From B	17164-17163	672	984	312	46%	10.8	×	×	×
18_105	A14 Jct.37 EB Off-Slip	From C	17166-17163	677	534	-143	-21%	5.8	×	×	×
18_112	A142-A1123 Roundabout, Fordham	From D	14312-41402	301	308	7	2%	0.4	✓	✓	✓
18_134	Twenty Pence Road Junction, Wilburton	From A	41104-41105	362	463	101	28%	5.0	×	✓	✓
18_140	Crossroads, Landbeach Village	From A	20702-20701	143	116	-27	-19%	2.4	✓	✓	✓
18_141	Crossroads, Landbeach Village	From B	12812-20701	113	43	-70	-62%	7.9	✓	×	✓
18_142	Crossroads, Landbeach Village	From C	12811-20701	369	415	46	12%	2.3	✓	✓	✓
18_152	B1102-B1103, Burwell	From A	14521-42201	435	438	3	1%	0.1	✓	✓	✓
18_153	B1102-B1103, Burwell	From B	14532-42201	222	139	-83	-37%	6.1	✓	×	✓
18_154	B1102-B1103, Burwell	From C	14531-42201	827	744	-83	-10%	2.9	✓	✓	✓
18_159	Butt Lane-Milton P&R	From B	25704-25798	269	267	-2	-1%	0.1	✓	✓	✓
18_160	Butt Lane-Milton P&R	From C	25797-25702	42	8	-34	-80%	6.7	✓	×	✓

Appendix F. Turn Count Validation

F.1. AM Peak Selected Turn Count Validation

Junction ID	Movement	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
A	Broad Baulk-A10NB	14021-14111-14123	7	0	-7	-100%	3.7	✓	✓	✓
A	Broad Baulk-A10SB	14021-14111-42002	86	91	5	5%	0.5	✓	✓	✓
A	A10SB-A10SB	14123-14111-42002	845	813	-32	-4%	1.1	✓	✓	✓
A	A10SB-Broad Baulk	14123-14111-14021	3	0	-3	-100%	2.4	✓	✓	✓
A	A10NB-Broad Baulk	42002-14111-14021	62	78	16	26%	2.0	✓	✓	✓
A	A10NB-A10NB	42002-14111-14123	633	641	8	1%	0.3	✓	✓	✓
B	A10SB-A1123EB	14113-42001-14112	26	21	-5	-18%	0.9	✓	✓	✓
B	A10SB-A10SB	14113-42001-20704	687	619	-68	-10%	2.7	✓	✓	✓
B	A10SB-A1123WB	14113-42001-41105	138	191	53	39%	4.2	✓	✓	✓
B	A1123WB-A10SB	14112-42001-20704	125	174	49	40%	4.0	✓	✓	✓
B	A1123WB-A1123WB	14112-42001-41105	235	202	-33	-14%	2.2	✓	✓	✓
B	A1123WB-A10NB	14112-42001-14113	119	13	-106	-89%	13.1	×	×	×
B	A10NB-A1123WB	20704-42001-41105	75	71	-4	-5%	0.4	✓	✓	✓
B	A10NB-A10NB	20704-42001-14113	361	417	56	15%	2.8	✓	✓	✓
B	A10NB-A1123EB	20704-42001-14112	27	77	50	186%	7.0	✓	×	✓
B	A1123EB-A10NB	41105-42001-14113	193	280	87	45%	5.6	✓	×	✓
B	A1123EB-A1123EB	41105-42001-14112	296	212	-84	-28%	5.2	✓	×	✓
B	A1123EB-A10SB	41105-42001-20704	220	176	-44	-20%	3.1	✓	✓	✓
C	A10SB-Denny End Road EB	12711-28108-12831	233	276	43	19%	2.7	✓	✓	✓
C	A10SB-A10SB	12711-28108-12812	737	739	2	0%	0.1	✓	✓	✓

Junction ID	Movement	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
C	Denny End Road WB-A10SB	12831-28108-12812	70	81	11	16%	1.3	✓	✓	✓
C	Denny End Road WB-A10NB	12831-28108-12711	123	122	-1	-1%	0.1	✓	✓	✓
C	A10NB-A10NB	12812-28108-12711	614	533	-81	-13%	3.4	✓	✓	✓
C	A10NB-Denny End Road EB	12812-28108-12831	159	157	-2	-1%	0.2	✓	✓	✓
D	A10SB-A10SB	28108-12812-12813	803	818	15	2%	0.5	✓	✓	✓
D	A10SB-Waterbeach Road WB	28108-12812-20701	4	1	-3	-67%	1.6	✓	✓	✓
D	A10NB-Waterbeach Road WB	12813-12812-20701	43	24	-19	-44%	3.3	✓	✓	✓
D	A10NB-A10NB	12813-12812-28108	731	688	-43	-6%	1.6	✓	✓	✓
D	Waterbeach Road EB-A10NB	20701-12812-28108	41	2	-39	-95%	8.4	✓	×	✓
D	Waterbeach Road EB-A10SB	20701-12812-12813	93	113	20	22%	2.0	✓	✓	✓
E	A10SB-Car Dyke Road EB	12812-12813-28102	103	39	-64	-62%	7.5	✓	×	✓
E	A10SB-A10SB	12812-12813-25708	794	892	98	12%	3.4	✓	✓	✓
E	Car Dyke Road WB-A10SB	28102-12813-25708	176	227	51	29%	3.6	✓	✓	✓
E	Car Dyke Road WB-A10NB	28102-12813-12812	51	45	-6	-11%	0.8	✓	✓	✓
E	A10NB-A10NB	25708-12813-12812	731	666	-65	-9%	2.5	✓	✓	✓
E	A10NB-Car Dyke Road EB	25708-12813-28102	97	72	-25	-26%	2.8	✓	✓	✓
F	A10SB-A10SB	12232-25704-97403	1070	933	-137	-13%	4.3	✓	✓	✓
F	A10SB-Butt Lane WB	12232-25704-25798	136	155	19	14%	1.6	✓	✓	✓
F	A10NB-Butt Lane WB	97403-25704-25798	62	43	-19	-31%	2.6	✓	✓	✓
F	A10NB-A10NB	97403-25704-12232	767	719	-48	-6%	1.7	✓	✓	✓
F	Butt Lane EB-A10NB	25798-25704-12232	113	135	22	20%	2.0	✓	✓	✓
G	A14EB Offslip-A10NB	92072-25601-25602	287	369	82	29%	4.5	✓	✓	✓
G	A14EB Offslip-Interchange	92072-25601-25604	767	768	1	0%	0.0	✓	✓	✓
G	A10SB-Interchange	25602-25604-25701	1230	1183	-47	-4%	1.4	✓	✓	✓

Junction ID	Movement	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
G	Cambridge Road SB-A14EB	25703-25605-92076	106	194	88	83%	7.2	✓	×	✓
G	Cambridge Road SB-Interchange	25703-25605-20407	288	218	-70	-24%	4.4	✓	✓	✓
G	A14WB Offslip-Milton Road SB	92075-20407-20405	954	807	-147	-15%	5.0	×	✓	✓
G	A14WB Offslip-Interchange	92075-20407-20404	335	283	-52	-15%	2.9	✓	✓	✓
G	Milton Road NB-Interchange	20405-20404-25601	492	275	-217	-44%	11.1	×	×	×
H	A1123EB-A1123EB	41104-41105-42001	493	529	36	7%	1.6	✓	✓	✓
H	A1123EB-B1049 SB	41104-41105-23008	221	258	37	17%	2.4	✓	✓	✓
H	A1123WB-B1049 SB	42001-41105-23008	333	194	-139	-42%	8.5	×	×	×
H	A1123WB-A1123WB	42001-41105-41104	224	271	47	21%	3.0	✓	✓	✓
H	B1049 NB-A1123WB	23008-41105-41104	55	61	6	11%	0.8	✓	✓	✓
H	B1049 NB-A1123EB	23008-41105-42001	96	139	43	45%	4.0	✓	✓	✓
I	A14EB Offslip-B1049 NB	92064-24611-24609	272	354	82	30%	4.6	✓	✓	✓
I	A14EB Offslip-Interchange	92064-24611-24614	792	511	-281	-35%	11.0	×	×	×
I	B1049 SB-Interchange	24609-24614-20302	783	840	57	7%	2.0	✓	✓	✓
I	B1049 SB-A14 EB	24609-24614-92068	150	176	26	18%	2.1	✓	✓	✓
I	A14WB Offslip-Histon Road SB	92067-20302-20301	402	463	61	15%	2.9	✓	✓	✓
I	A14WB Offslip-Interchange	92067-20302-24613	264	201	-63	-24%	4.1	✓	✓	✓
I	Histon Road NB-A14WB Onslip	20301-24613-92063	414	372	-42	-10%	2.1	✓	✓	✓
I	Histon Road NB-Interchange	20301-24613-24611	555	595	40	7%	1.7	✓	✓	✓

F.2. Inter-peak Selected Turn Count Validation

Junction ID	Movement	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
A	Broad Baulk-A10NB	14021-14111-14123	5	0	-5	-100%	3.2	✓	✓	✓
A	Broad Baulk-A10SB	14021-14111-42002	33	40	7	20%	1.1	✓	✓	✓
A	A10SB-A10SB	14123-14111-42002	608	578	-31	-5%	1.3	✓	✓	✓
A	A10SB-Broad Baulk	14123-14111-14021	4	0	-4	-100%	2.6	✓	✓	✓
A	A10NB-Broad Baulk	42002-14111-14021	54	54	0	0%	0.0	✓	✓	✓
A	A10NB-A10NB	42002-14111-14123	663	647	-16	-2%	0.6	✓	✓	✓
B	A10SB-A1123EB	14113-42001-14112	47	20	-27	-58%	4.7	✓	✓	✓
B	A10SB-A10SB	14113-42001-20704	453	458	5	1%	0.3	✓	✓	✓
B	A10SB-A1123WB	14113-42001-41105	73	135	62	85%	6.1	✓	×	✓
B	A1123WB-A10SB	14112-42001-20704	54	95	41	76%	4.8	✓	✓	✓
B	A1123WB-A1123WB	14112-42001-41105	176	143	-33	-18%	2.6	✓	✓	✓
B	A1123WB-A10NB	14112-42001-14113	83	39	-44	-53%	5.7	✓	×	✓
B	A10NB-A1123WB	20704-42001-41105	133	101	-31	-24%	2.9	✓	✓	✓
B	A10NB-A10NB	20704-42001-14113	479	519	41	9%	1.8	✓	✓	✓
B	A10NB-A1123EB	20704-42001-14112	49	60	11	22%	1.5	✓	✓	✓
B	A1123EB-A10NB	41105-42001-14113	140	171	31	22%	2.5	✓	✓	✓
B	A1123EB-A1123EB	41105-42001-14112	148	104	-44	-30%	3.9	✓	✓	✓
B	A1123EB-A10SB	41105-42001-20704	97	108	11	11%	1.0	✓	✓	✓
C	A10SB-Denny End Road EB	12711-28108-12831	110	156	46	42%	4.0	✓	✓	✓
C	A10SB-A10SB	12711-28108-12812	580	558	-22	-4%	0.9	✓	✓	✓
C	Denny End Road WB-A10SB	12831-28108-12812	115	104	-11	-10%	1.0	✓	✓	✓
C	Denny End Road WB-A10NB	12831-28108-12711	152	155	3	2%	0.3	✓	✓	✓
C	A10NB-A10NB	12812-28108-12711	629	553	-76	-12%	3.1	✓	✓	✓

Junction ID	Movement	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
C	A10NB-Denny End Road EB	12812-28108-12831	91	142	51	56%	4.7	✓	✓	✓
D	A10SB-A10SB	28108-12812-12813	685	661	-24	-3%	0.9	✓	✓	✓
D	A10SB-Waterbeach Road WB	28108-12812-20701	11	1	-10	-90%	4.1	✓	✓	✓
D	A10NB-Waterbeach Road WB	12813-12812-20701	37	15	-22	-60%	4.3	✓	✓	✓
D	A10NB-A10NB	12813-12812-28108	708	694	-14	-2%	0.5	✓	✓	✓
D	Waterbeach Road EB-A10NB	20701-12812-28108	14	1	-12	-91%	4.5	✓	✓	✓
D	Waterbeach Road EB-A10SB	20701-12812-12813	39	12	-28	-71%	5.5	✓	×	✓
E	A10SB-Car Dyke Road EB	12812-12813-28102	42	12	-30	-72%	5.8	✓	×	✓
E	A10SB-A10SB	12812-12813-25708	682	661	-22	-3%	0.8	✓	✓	✓
E	Car Dyke Road WB-A10SB	28102-12813-25708	125	90	-35	-28%	3.3	✓	✓	✓
E	Car Dyke Road WB-A10NB	28102-12813-12812	36	27	-9	-26%	1.7	✓	✓	✓
E	A10NB-A10NB	25708-12813-12812	709	682	-27	-4%	1.0	✓	✓	✓
E	A10NB-Car Dyke Road EB	25708-12813-28102	137	112	-25	-18%	2.2	✓	✓	✓
F	A10SB-A10SB	12232-25704-97403	756	718	-38	-5%	1.4	✓	✓	✓
F	A10SB-Butt Lane WB	12232-25704-25798	98	90	-8	-8%	0.8	✓	✓	✓
F	A10NB-Butt Lane WB	97403-25704-25798	102	33	-70	-68%	8.5	✓	×	✓
F	A10NB-A10NB	97403-25704-12232	798	798	0	0%	0.0	✓	✓	✓
F	Butt Lane EB-A10NB	25798-25704-12232	114	97	-17	-15%	1.6	✓	✓	✓
G	A14EB Offslip-A10NB	92072-25601-25602	315	339	24	8%	1.3	✓	✓	✓
G	A14EB Offslip-Interchange	92072-25601-25604	351	325	-26	-7%	1.4	✓	✓	✓
G	A10SB-Interchange	25602-25604-25701	768	790	22	3%	0.8	✓	✓	✓
G	Cambridge Road SB-A14EB	25703-25605-92076	141	143	2	2%	0.2	✓	✓	✓
G	Cambridge Road SB-Interchange	25703-25605-20407	416	428	12	3%	0.6	✓	✓	✓
G	A14WB Offslip-Milton Road SB	92075-20407-20405	259	311	52	20%	3.1	✓	✓	✓

Junction ID	Movement	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
G	A14WB Offslip-Interchange	92075-20407-20404	323	247	-76	-24%	4.5	✓	✓	✓
G	Milton Road NB-Interchange	20405-20404-25601	797	682	-115	-14%	4.2	✓	✓	✓
H	A1123EB-A1123EB	41104-41105-42001	280	296	16	6%	0.9	✓	✓	✓
H	A1123EB-B1049 SB	41104-41105-23008	77	94	17	22%	1.9	✓	✓	✓
H	A1123WB-B1049 SB	42001-41105-23008	89	74	-15	-16%	1.6	✓	✓	✓
H	A1123WB-A1123WB	42001-41105-41104	293	306	13	5%	0.8	✓	✓	✓
H	B1049 NB-A1123WB	23008-41105-41104	100	100	0	0%	0.0	✓	✓	✓
H	B1049 NB-A1123EB	23008-41105-42001	110	87	-23	-21%	2.3	✓	✓	✓
I	A14EB Offslip-B1049 NB	92064-24611-24609	178	194	16	9%	1.2	✓	✓	✓
I	A14EB Offslip-Interchange	92064-24611-24614	281	247	-34	-12%	2.1	✓	✓	✓
I	B1049 SB-Interchange	24609-24614-20302	496	523	27	5%	1.2	✓	✓	✓
I	B1049 SB-A14 EB	24609-24614-92068	198	163	-34	-17%	2.5	✓	✓	✓
I	A14WB Offslip-Histon Road SB	92067-20302-20301	189	229	40	21%	2.8	✓	✓	✓
I	A14WB Offslip-Interchange	92067-20302-24613	196	155	-41	-21%	3.1	✓	✓	✓
I	Histon Road NB-A14WB Onslip	20301-24613-92063	265	224	-41	-15%	2.6	✓	✓	✓
I	Histon Road NB-Interchange	20301-24613-24611	581	608	27	5%	1.1	✓	✓	✓

F.3. PM Peak Selected Turn Count Validation

Junction ID	Movement	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
A	Broad Baulk-A10NB	14021-14111-14123	4	0	-4	-100%	2.8	✓	✓	✓
A	Broad Baulk-A10SB	14021-14111-42002	56	64	8	15%	1.1	✓	✓	✓
A	A10SB-A10SB	14123-14111-42002	658	663	5	1%	0.2	✓	✓	✓
A	A10SB-Broad Baulk	14123-14111-14021	6	0	-6	-100%	3.5	✓	✓	✓
A	A10NB-Broad Baulk	42002-14111-14021	130	151	21	16%	1.8	✓	✓	✓
A	A10NB-A10NB	42002-14111-14123	828	868	40	5%	1.4	✓	✓	✓
B	A10SB-A1123EB	14113-42001-14112	50	27	-23	-45%	3.6	✓	✓	✓
B	A10SB-A10SB	14113-42001-20704	444	412	-32	-7%	1.5	✓	✓	✓
B	A10SB-A1123WB	14113-42001-41105	102	209	107	105%	8.6	×	×	×
B	A1123WB-A10SB	14112-42001-20704	38	122	84	221%	9.4	✓	×	✓
B	A1123WB-A1123WB	14112-42001-41105	341	303	-38	-11%	2.1	✓	✓	✓
B	A1123WB-A10NB	14112-42001-14113	101	37	-64	-64%	7.8	✓	×	✓
B	A10NB-A1123WB	20704-42001-41105	197	155	-42	-21%	3.2	✓	✓	✓
B	A10NB-A10NB	20704-42001-14113	644	773	129	20%	4.9	×	✓	✓
B	A10NB-A1123EB	20704-42001-14112	65	84	19	29%	2.2	✓	✓	✓
B	A1123EB-A10NB	41105-42001-14113	195	287	92	47%	5.9	✓	×	✓
B	A1123EB-A1123EB	41105-42001-14112	219	127	-92	-42%	7.0	✓	×	✓
B	A1123EB-A10SB	41105-42001-20704	64	88	24	38%	2.8	✓	✓	✓
C	A10SB-Denny End Road EB	12711-28108-12831	114	146	32	28%	2.8	✓	✓	✓
C	A10SB-A10SB	12711-28108-12812	617	593	-24	-4%	1.0	✓	✓	✓
C	Denny End Road WB-A10SB	12831-28108-12812	211	153	-58	-28%	4.3	✓	✓	✓
C	Denny End Road WB-A10NB	12831-28108-12711	251	287	36	14%	2.2	✓	✓	✓
C	A10NB-A10NB	12812-28108-12711	667	676	9	1%	0.3	✓	✓	✓

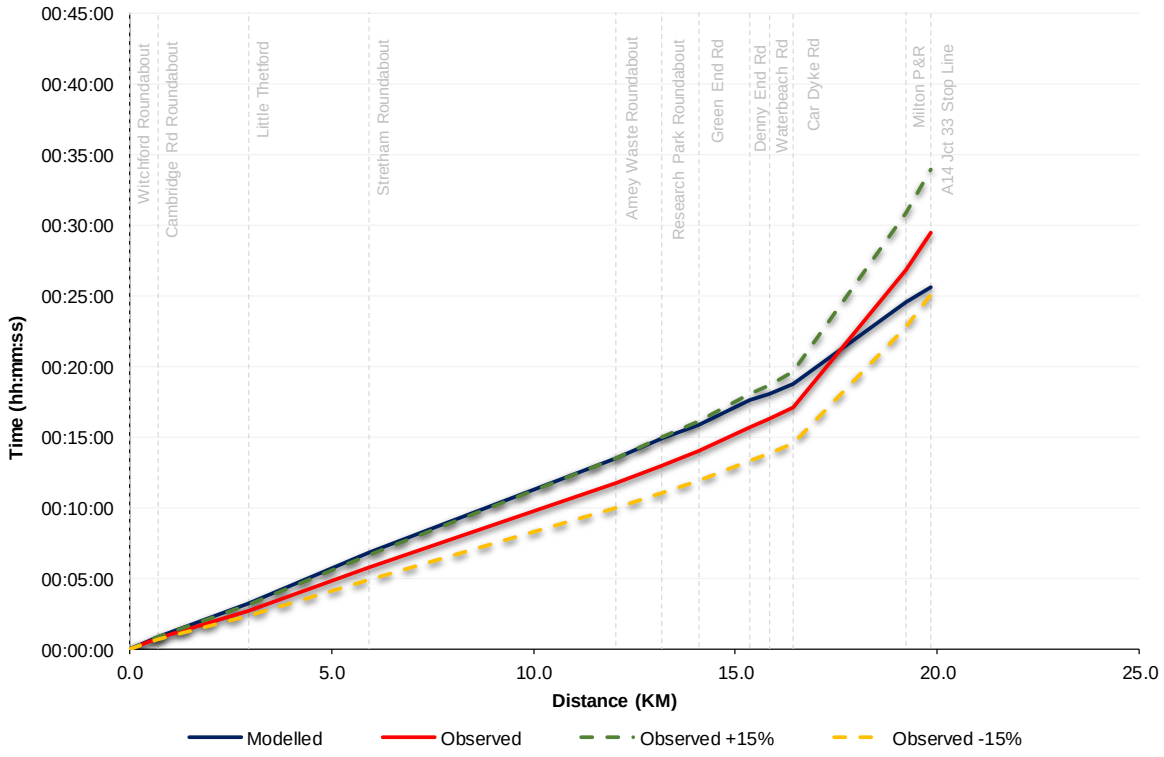
Junction ID	Movement	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
C	A10NB-Denny End Road EB	12812-28108-12831	73	135	62	85%	6.1	✓	×	✓
D	A10SB-A10SB	28108-12812-12813	795	744	-51	-6%	1.8	✓	✓	✓
D	A10SB-Waterbeach Road WB	28108-12812-20701	37	2	-35	-96%	8.1	✓	×	✓
D	A10NB-Waterbeach Road WB	12813-12812-20701	80	42	-38	-48%	4.9	✓	✓	✓
D	A10NB-A10NB	12813-12812-28108	736	807	71	10%	2.6	✓	✓	✓
D	Waterbeach Road EB-A10NB	20701-12812-28108	7	1	-6	-87%	3.1	✓	✓	✓
D	Waterbeach Road EB-A10SB	20701-12812-12813	55	10	-45	-81%	7.8	✓	×	✓
E	A10SB-Car Dyke Road EB	12812-12813-28102	59	10	-49	-82%	8.2	✓	×	✓
E	A10SB-A10SB	12812-12813-25708	788	744	-44	-6%	1.6	✓	✓	✓
E	Car Dyke Road WB-A10SB	28102-12813-25708	136	150	14	11%	1.2	✓	✓	✓
E	Car Dyke Road WB-A10NB	28102-12813-12812	72	61	-11	-15%	1.3	✓	✓	✓
E	A10NB-A10NB	25708-12813-12812	746	788	42	6%	1.5	✓	✓	✓
E	A10NB-Car Dyke Road EB	25708-12813-28102	245	185	-60	-25%	4.1	✓	✓	✓
F	A10SB-A10SB	12232-25704-97403	836	824	-12	-1%	0.4	✓	✓	✓
F	A10SB-Butt Lane WB	12232-25704-25798	115	165	50	43%	4.2	✓	✓	✓
F	A10NB-Butt Lane WB	97403-25704-25798	150	102	-48	-32%	4.3	✓	✓	✓
F	A10NB-A10NB	97403-25704-12232	1150	1255	105	9%	3.0	✓	✓	✓
F	Butt Lane EB-A10NB	25798-25704-12232	114	112	-2	-2%	0.2	✓	✓	✓
G	A14EB Offslip-A10NB	92072-25601-25602	351	366	15	4%	0.8	✓	✓	✓
G	A14EB Offslip-Interchange	92072-25601-25604	312	303	-9	-3%	0.5	✓	✓	✓
G	A10SB-Interchange	25602-25604-25701	872	877	5	1%	0.2	✓	✓	✓
G	Cambridge Road SB-A14EB	25703-25605-92076	206	230	24	12%	1.6	✓	✓	✓
G	Cambridge Road SB-Interchange	25703-25605-20407	417	400	-17	-4%	0.8	✓	✓	✓
G	A14WB Offslip-Milton Road SB	92075-20407-20405	250	260	10	4%	0.6	✓	✓	✓

Junction ID	Movement	SATURN Link	Obs.	Mod.	Diff.	% Diff.	GEH	Flow	GEH	Overall
G	A14WB Offslip-Interchange	92075-20407-20404	506	508	2	0%	0.1	✓	✓	✓
G	Milton Road NB-Interchange	20405-20404-25601	1516	1375	-141	-9%	3.7	✓	✓	✓
H	A1123EB-A1123EB	41104-41105-42001	301	370	69	23%	3.8	✓	✓	✓
H	A1123EB-B1049 SB	41104-41105-23008	61	93	32	53%	3.7	✓	✓	✓
H	A1123WB-B1049 SB	42001-41105-23008	90	113	23	26%	2.3	✓	✓	✓
H	A1123WB-A1123WB	42001-41105-41104	508	535	27	5%	1.2	✓	✓	✓
H	B1049 NB-A1123WB	23008-41105-41104	187	189	2	1%	0.2	✓	✓	✓
H	B1049 NB-A1123EB	23008-41105-42001	225	153	-72	-32%	5.3	✓	×	✓
I	A14EB Offslip-B1049 NB	92064-24611-24609	286	284	-2	-1%	0.1	✓	✓	✓
I	A14EB Offslip-Interchange	92064-24611-24614	441	405	-36	-8%	1.7	✓	✓	✓
I	B1049 SB-Interchange	24609-24614-20302	639	676	37	6%	1.4	✓	✓	✓
I	B1049 SB-A14 EB	24609-24614-92068	296	276	-20	-7%	1.2	✓	✓	✓
I	A14WB Offslip-Histon Road SB	92067-20302-20301	207	302	95	46%	6.0	✓	×	✓
I	A14WB Offslip-Interchange	92067-20302-24613	277	253	-24	-9%	1.5	✓	✓	✓
I	Histon Road NB-A14WB Onslip	20301-24613-92063	426	389	-37	-9%	1.8	✓	✓	✓
I	Histon Road NB-Interchange	20301-24613-24611	1062	1103	41	4%	1.2	✓	✓	✓

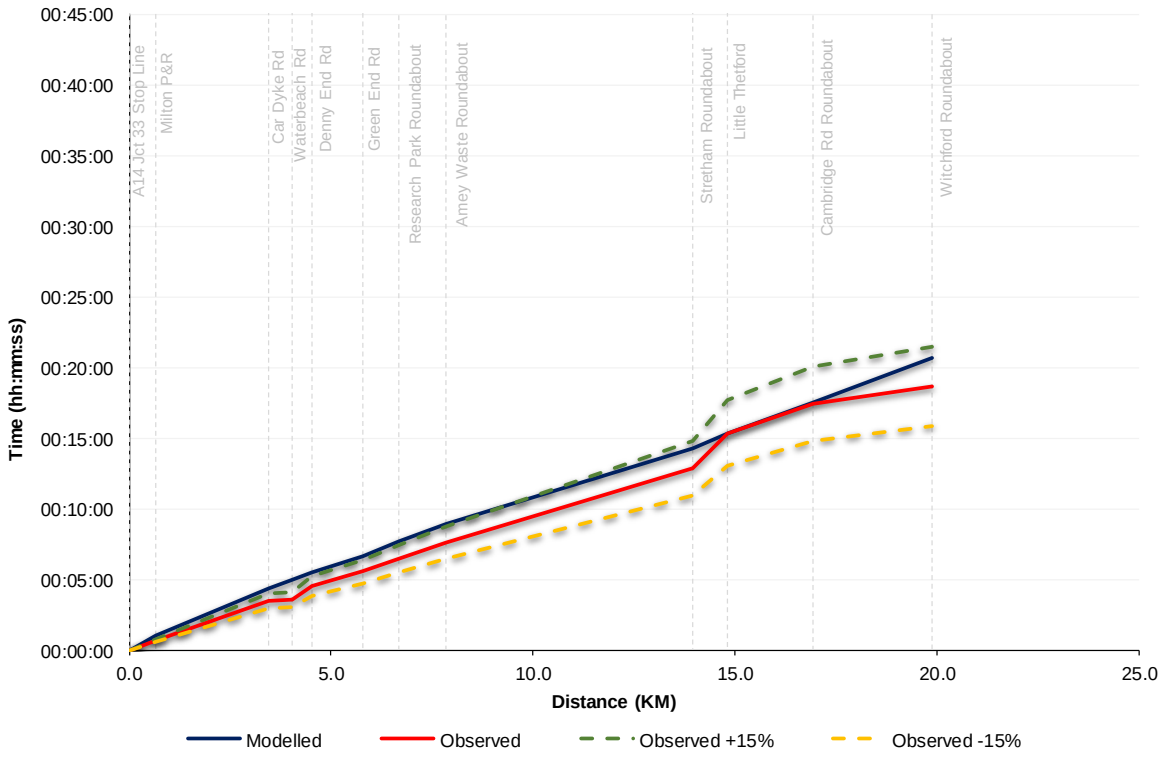
Appendix G. Journey Time Validation

G.1. Journey Time Route Graphs

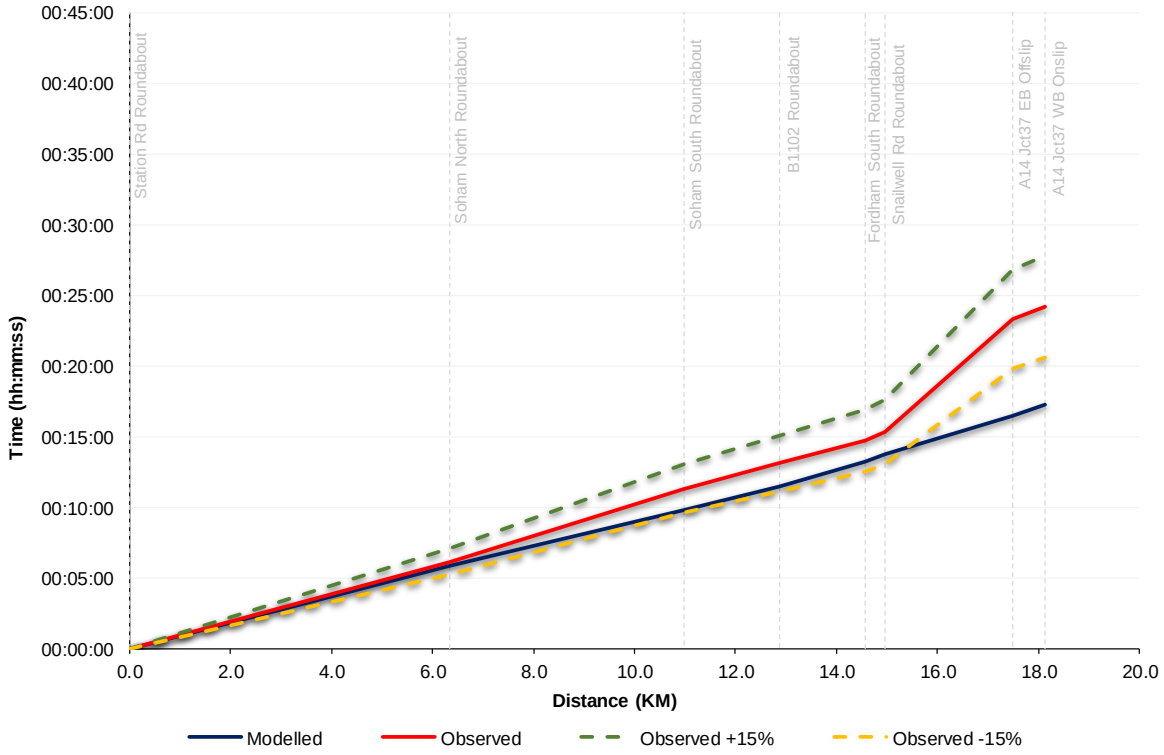
G.1.1. 1S: A10; Witchford Rd Roundabout, Ely, to Milton Interchange – AM



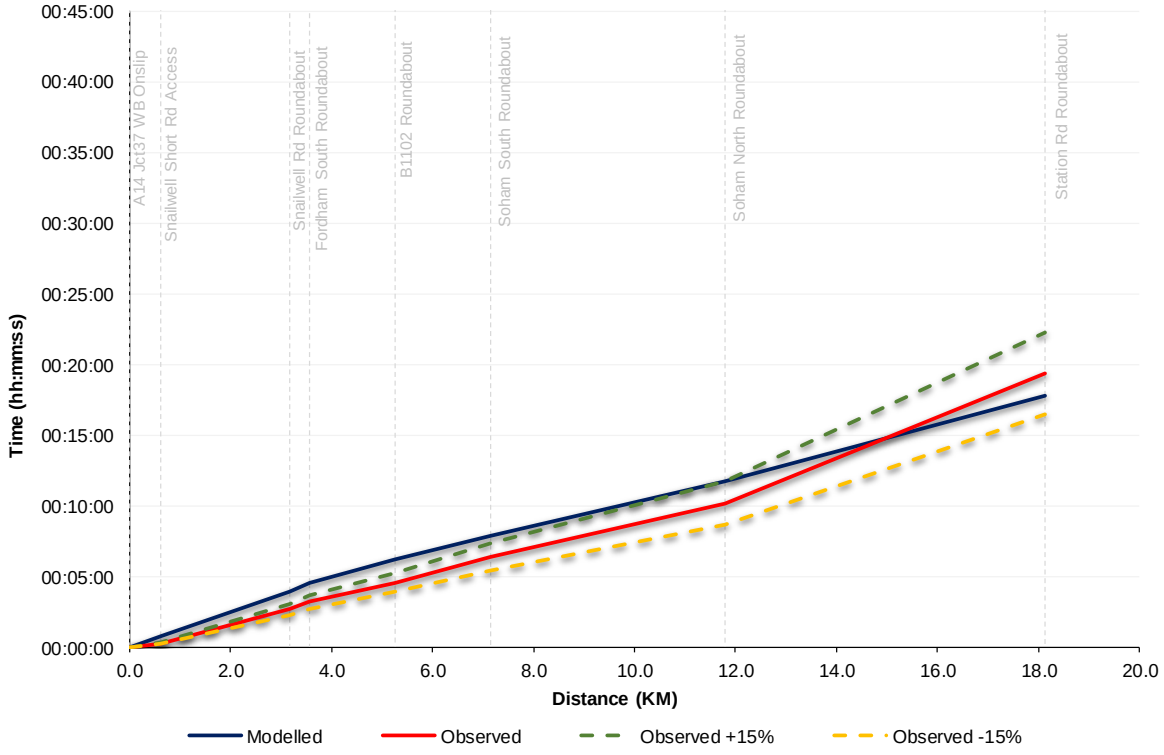
G.1.2. 1N: A10; Milton Interchange to Witchford Rd Roundabout, Ely – AM



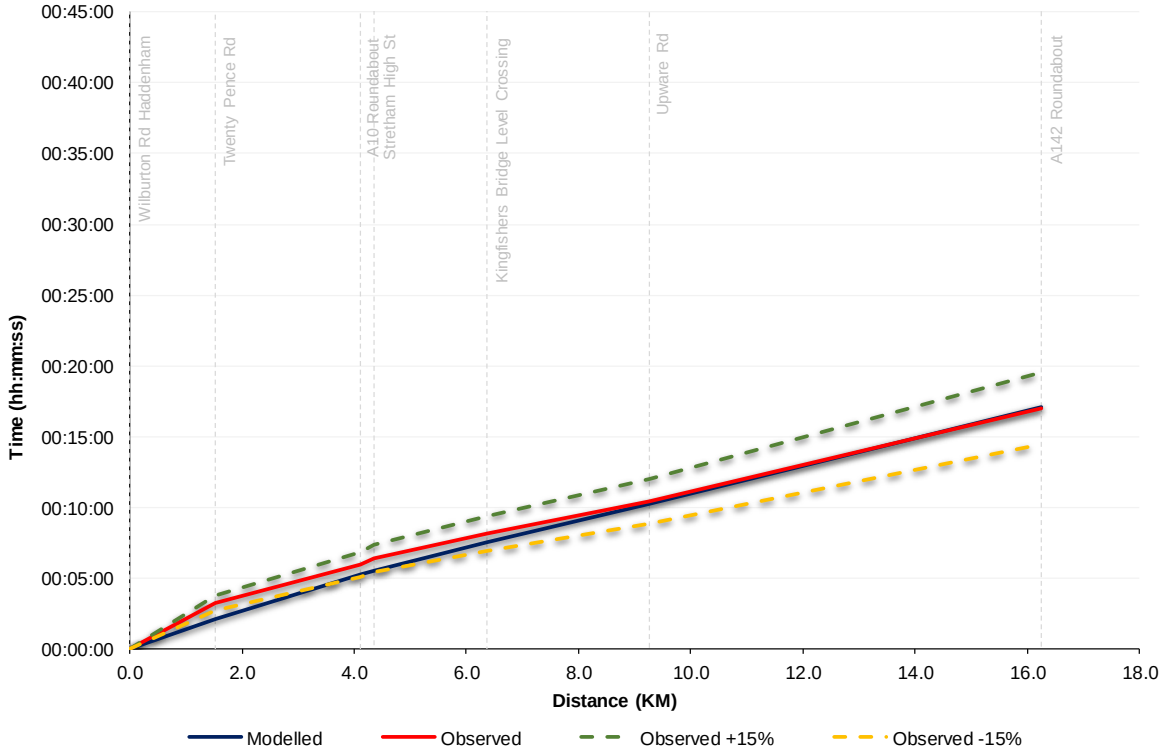
G.1.3. 2S: A142; Station Rd Roundabout, Ely, to A14 J37 – AM



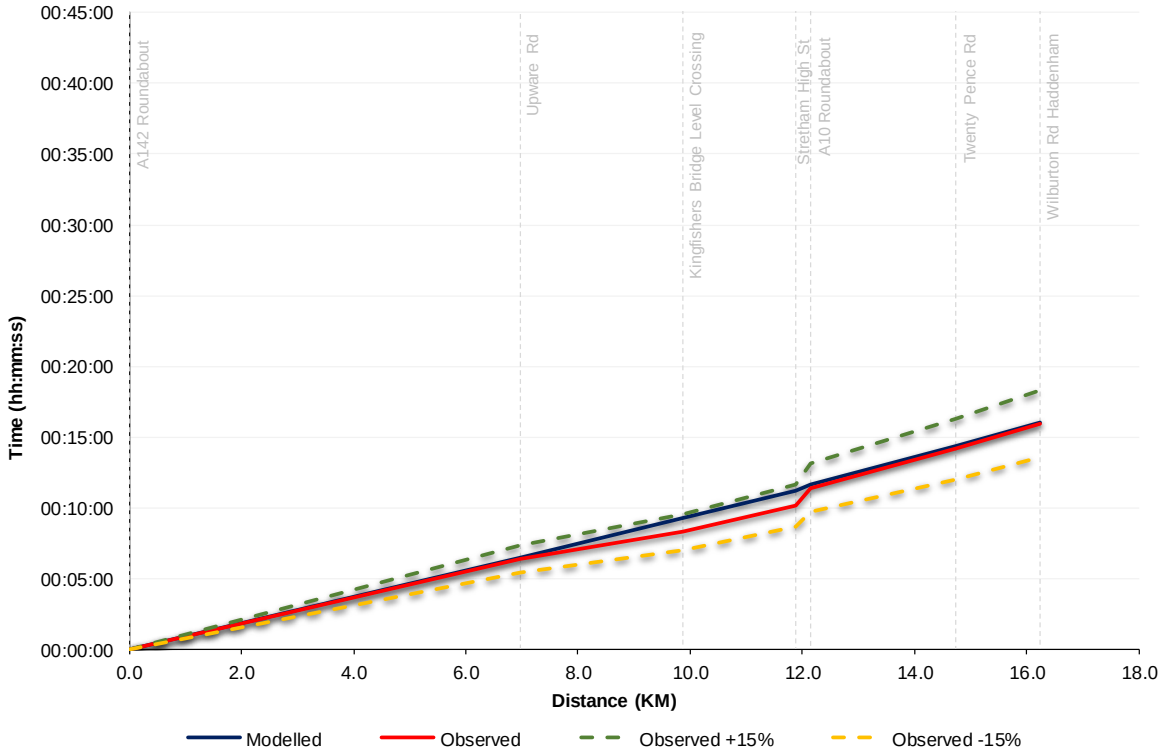
G.1.4. 2N: A142; A14 J37 to Station Rd Roundabout, Ely – AM



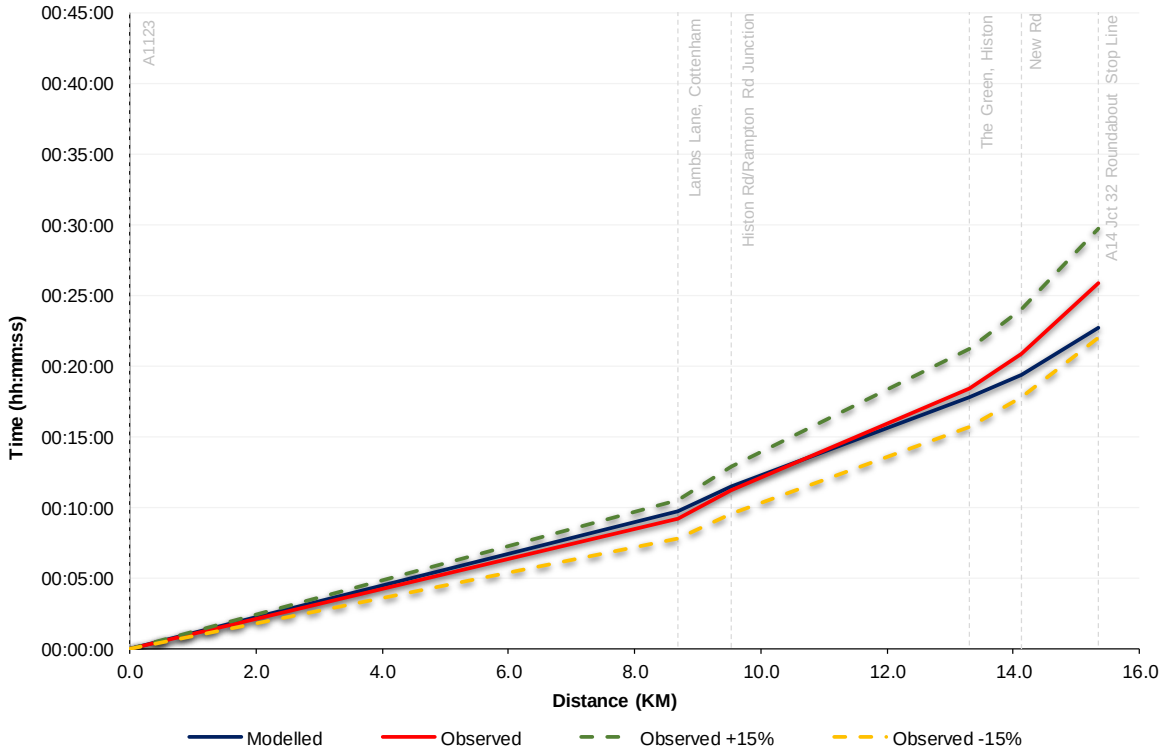
G.1.5. 3E: A1123; Haddenham to A142 Roundabout, Soham – AM



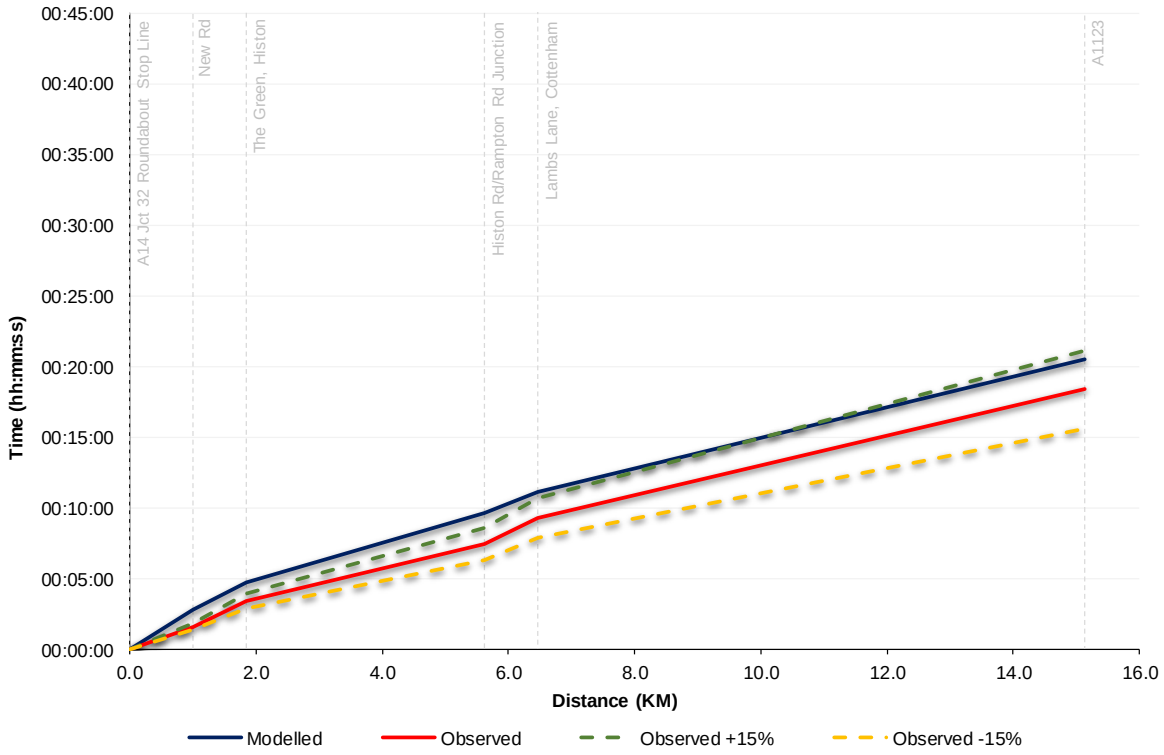
G.1.6. 3W: A1123; A142 Roundabout, Soham to Haddenham – AM



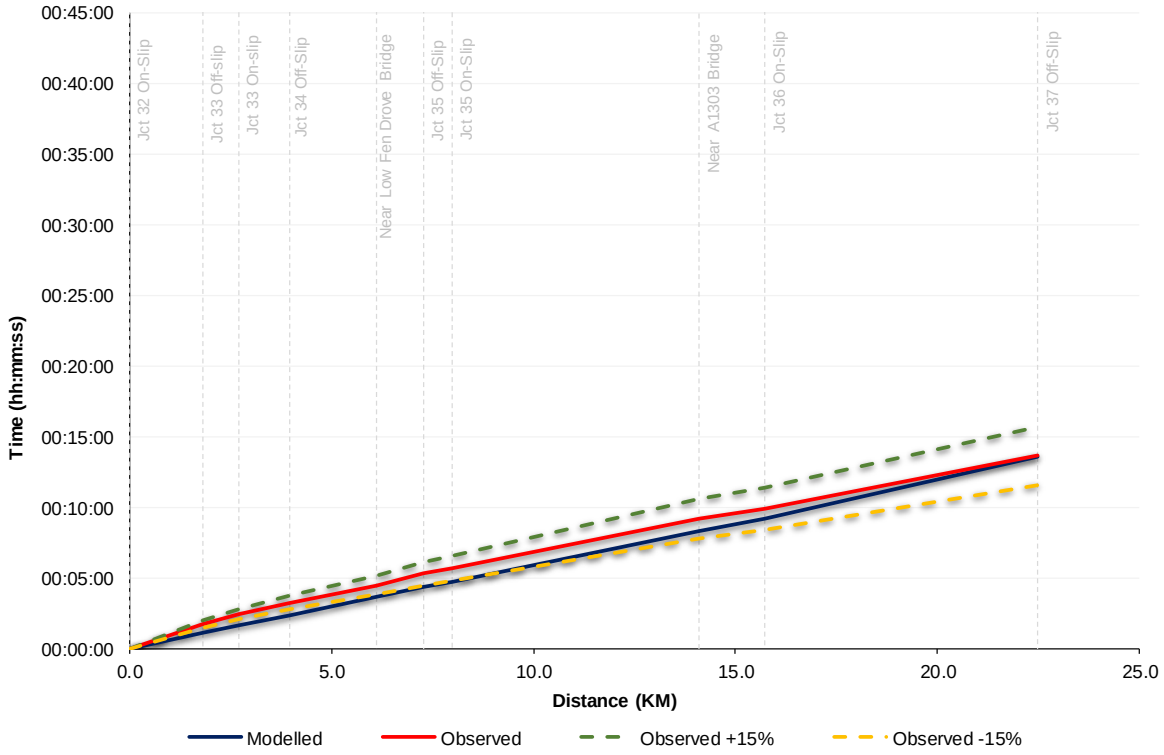
G.1.7. 4S: B1049; Wilburton to Histon Interchange – AM



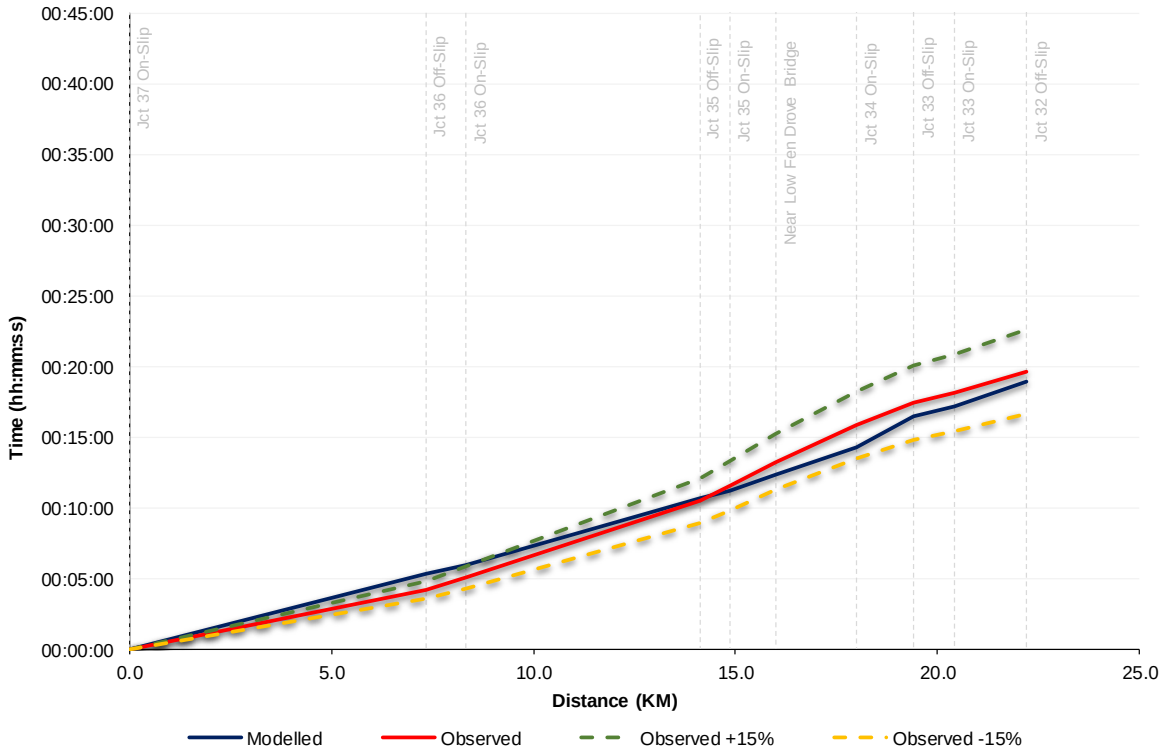
G.1.8. 4N: B1049; Histon Interchange to Wilburton – AM



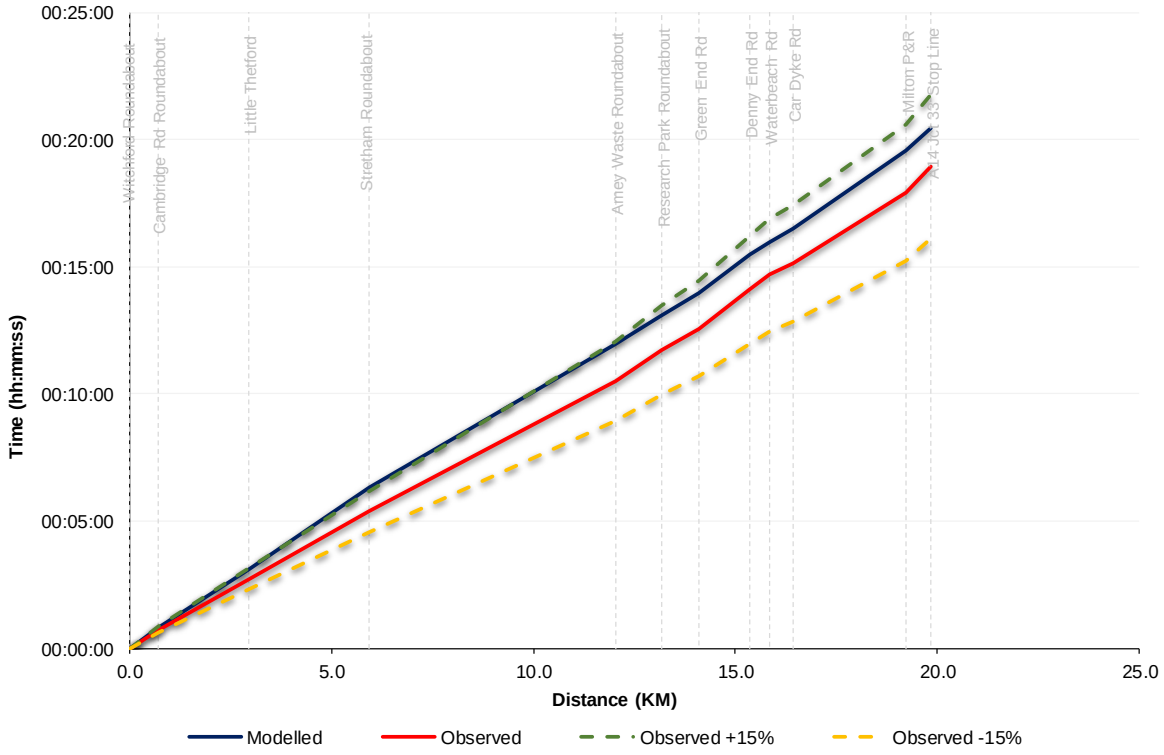
G.1.9. 5E: A14; J32 (Histon) to J37 (Newmarket) – AM



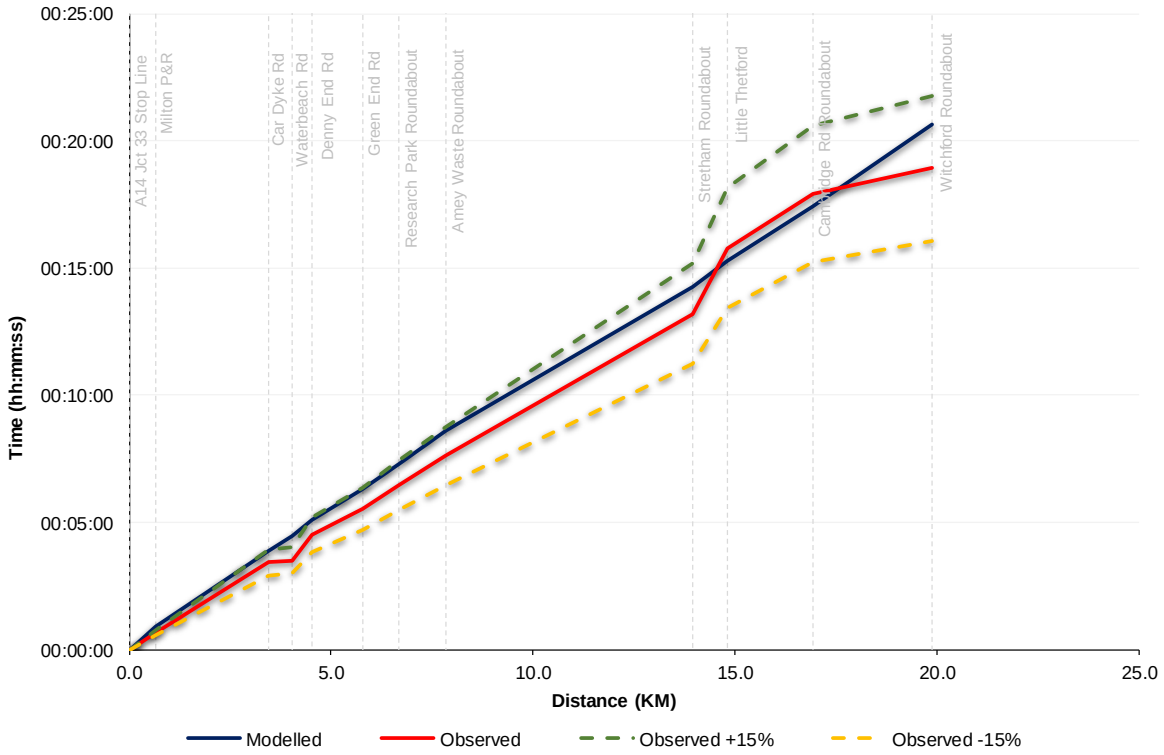
G.1.10. 5W: A14; J37 (Newmarket) to J32 (Histon) – AM



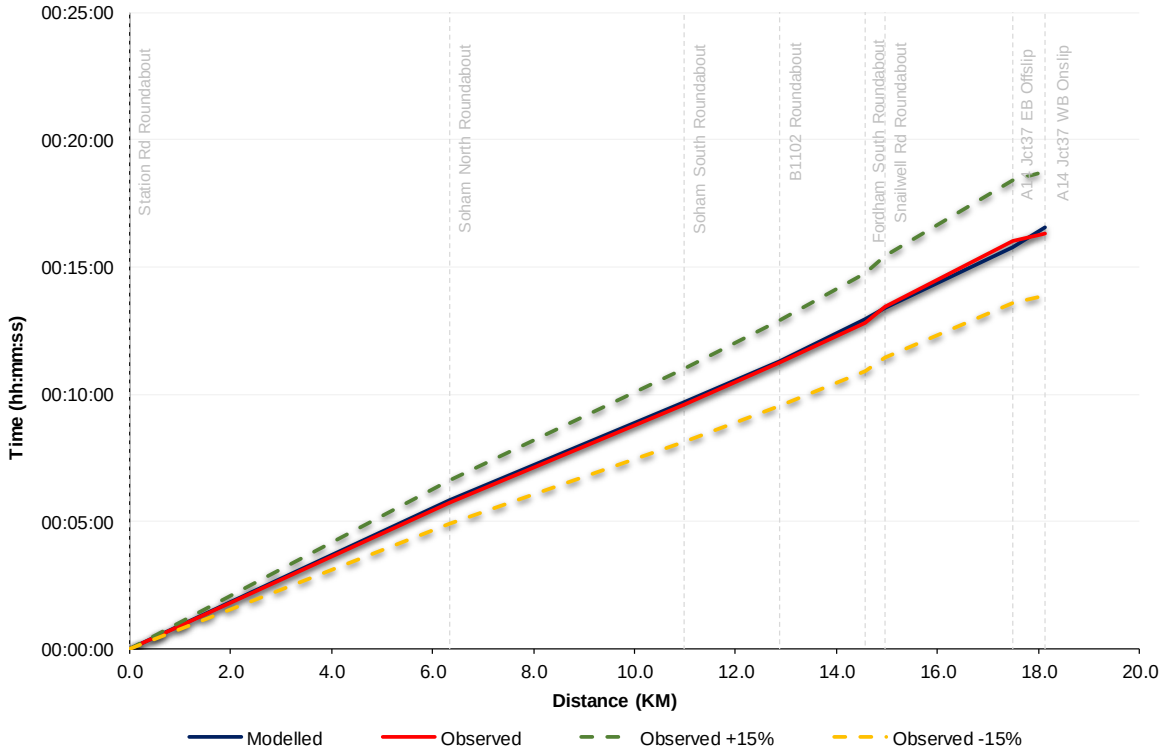
G.1.11. 1S: A10; Witchford Rd Roundabout, Ely, to Milton Interchange – IP



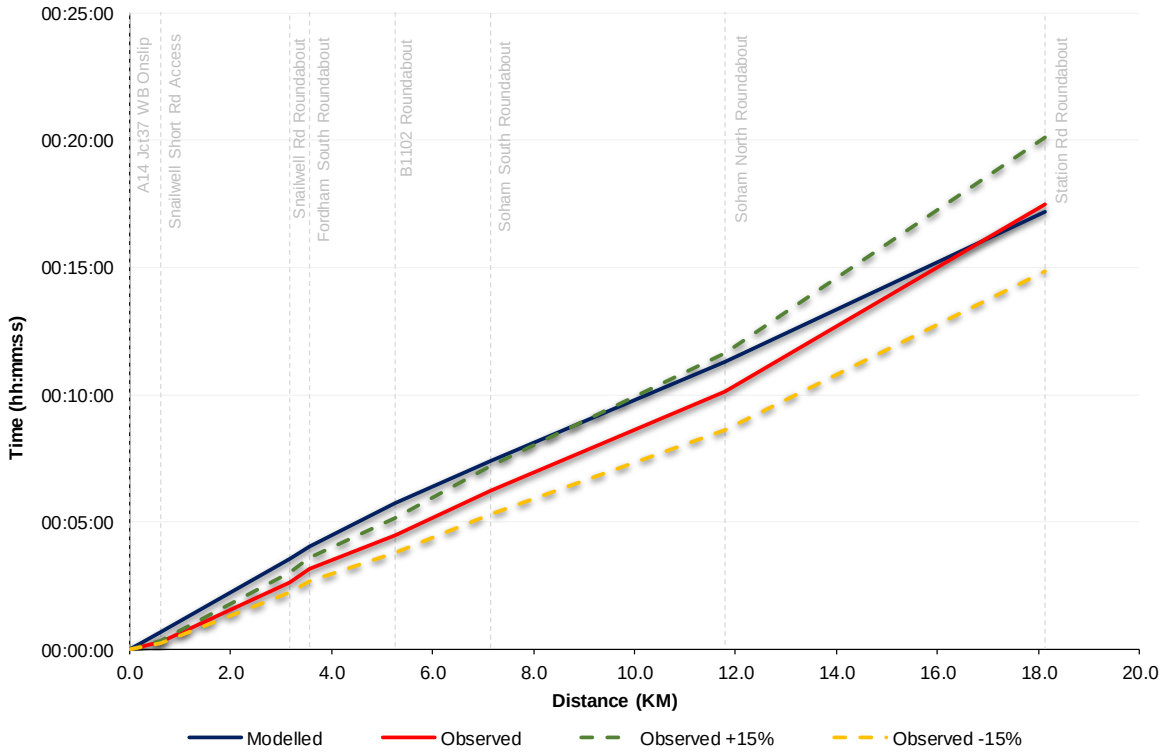
G.1.12. 1N: A10; Milton Interchange to Witchford Rd Roundabout, Ely – IP



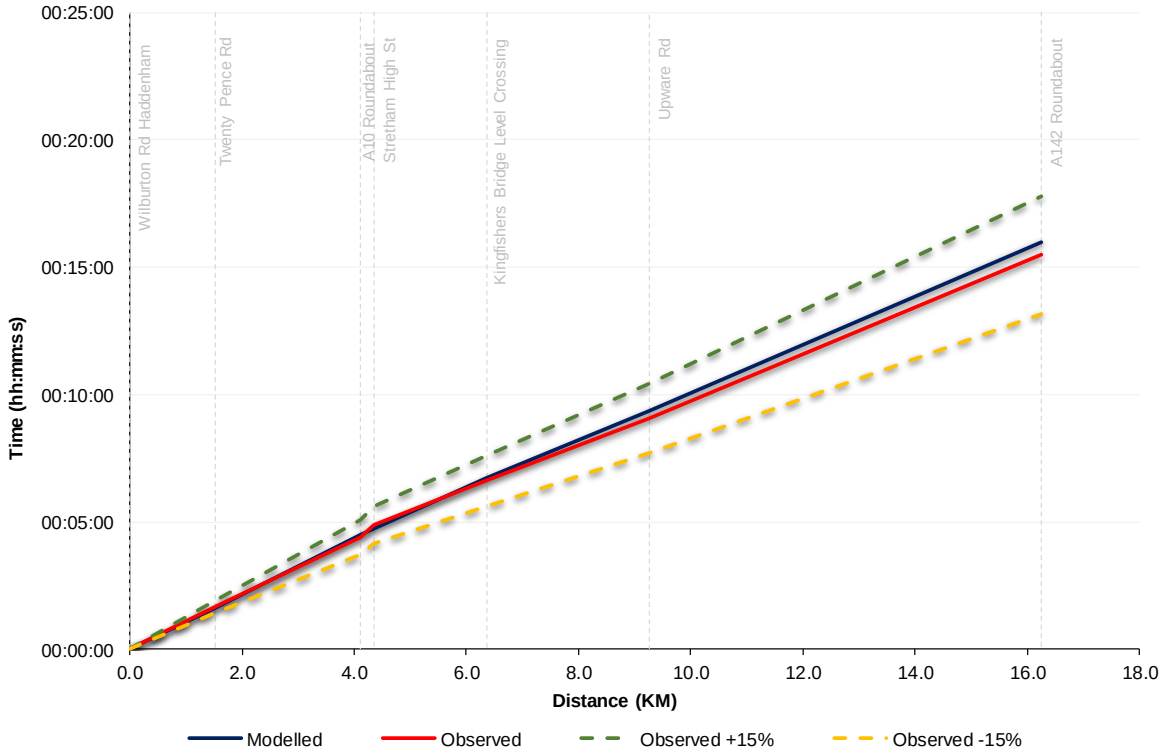
G.1.13. 2S: A142; Station Rd Roundabout, Ely, to A14 J37 – IP



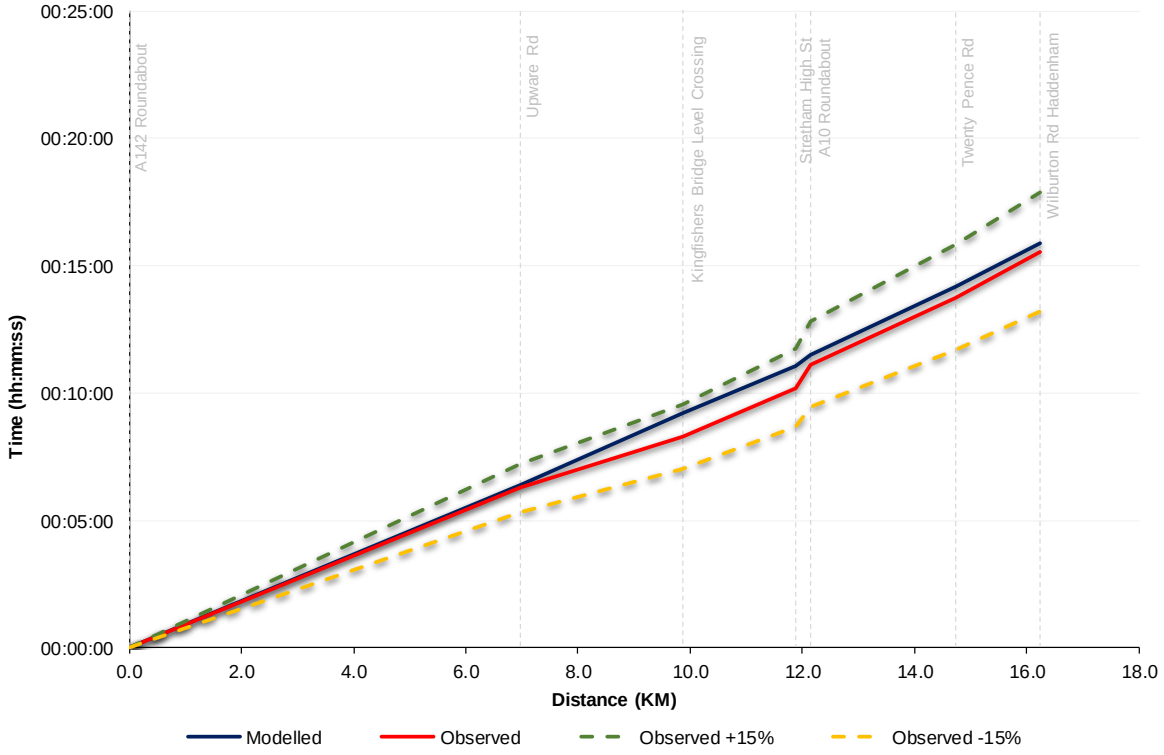
G.1.14. 2N: A142; A14 J37 to Station Rd Roundabout, Ely – IP



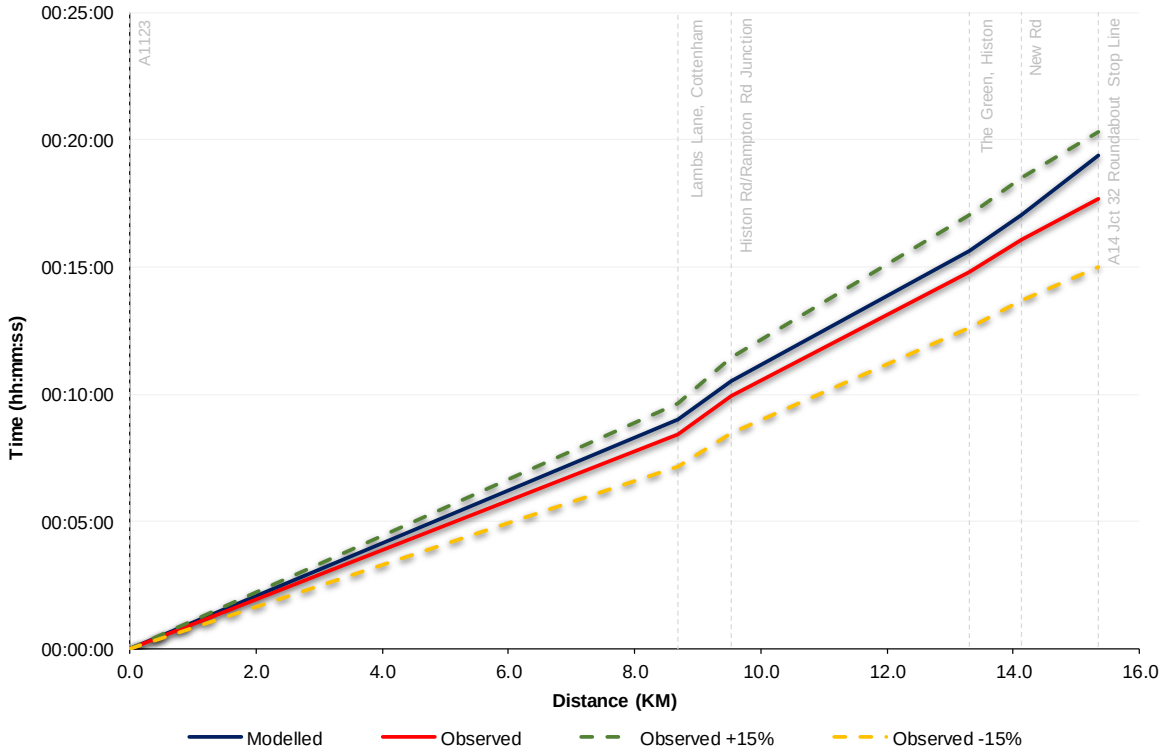
G.1.15. 3E: A1123; Haddenham to A142 Roundabout, Soham – IP



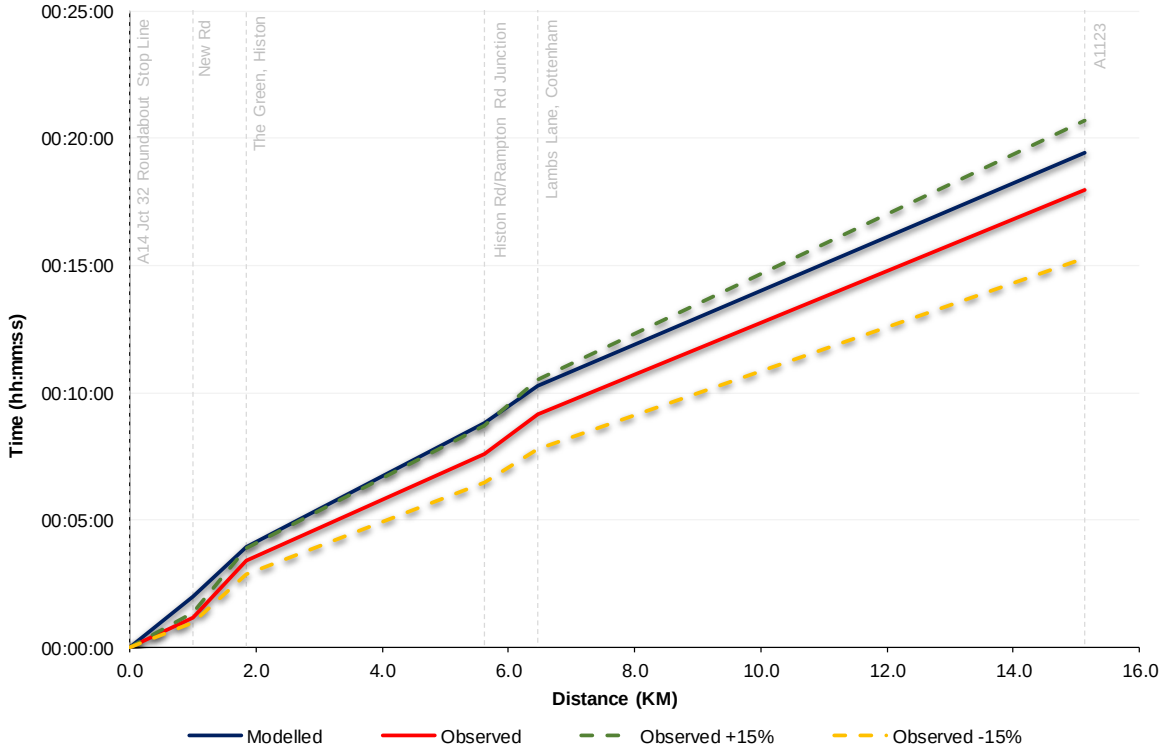
G.1.16. 3W: A1123; A142 Roundabout, Soham to Haddenham – IP



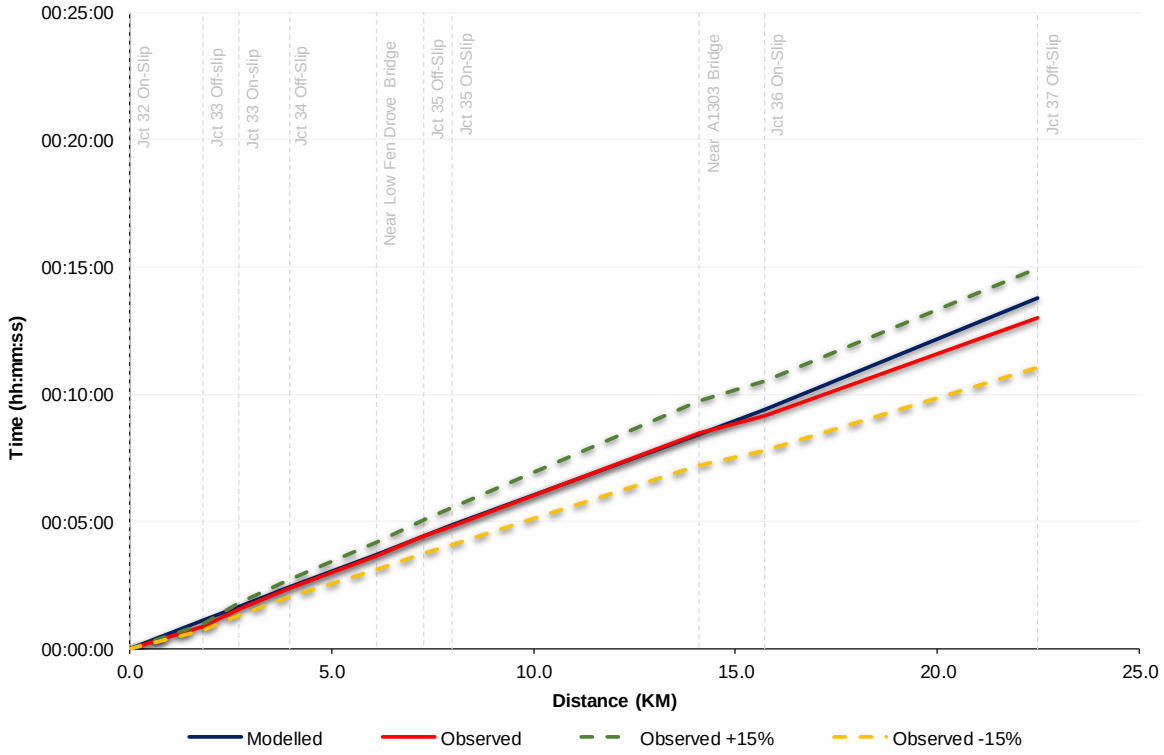
G.1.17. 4S: B1049; Wilburton to Histon Interchange – IP



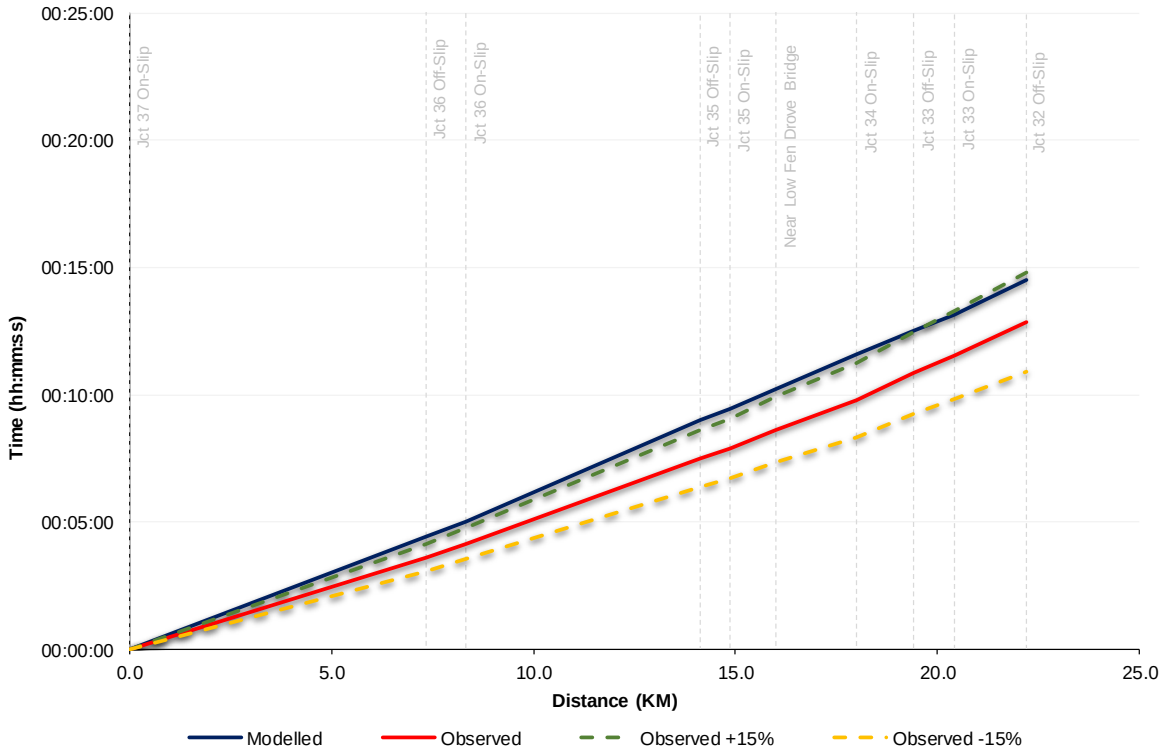
G.1.18. 4N: B1049; Histon Interchange to Wilburton – IP



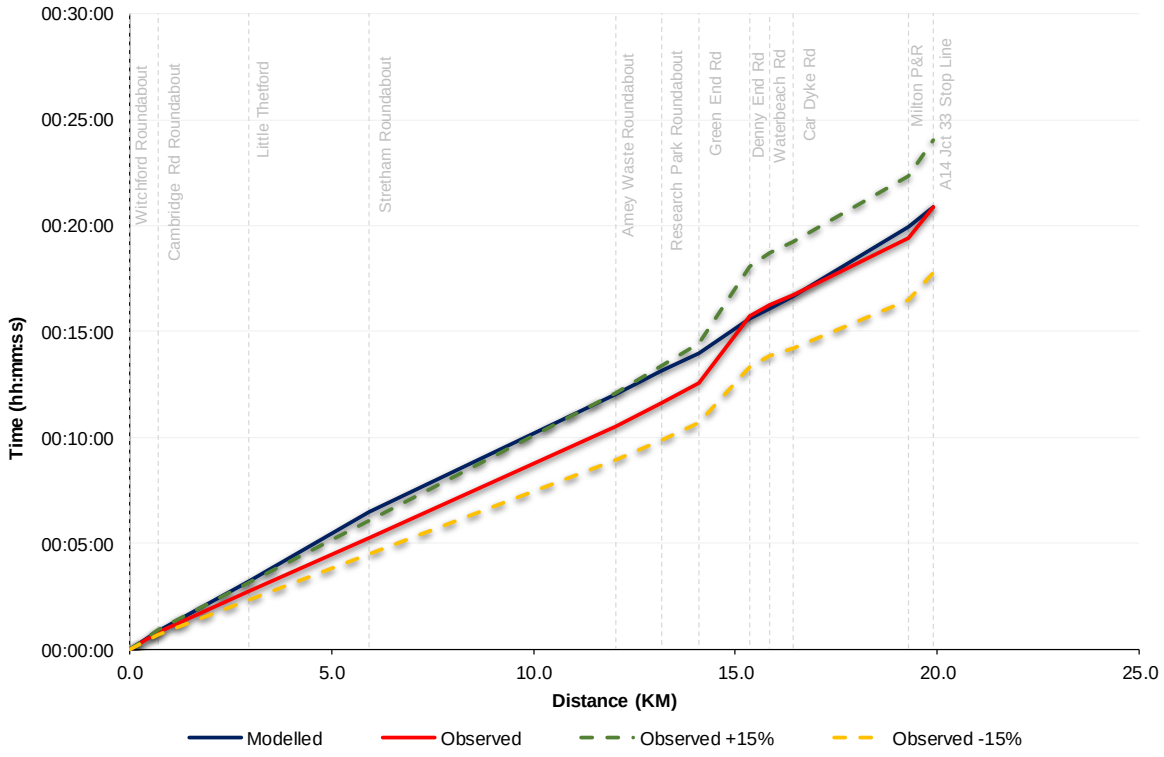
G.1.19. 5E: A14; J32 (Histon) to J37 (Newmarket) – IP



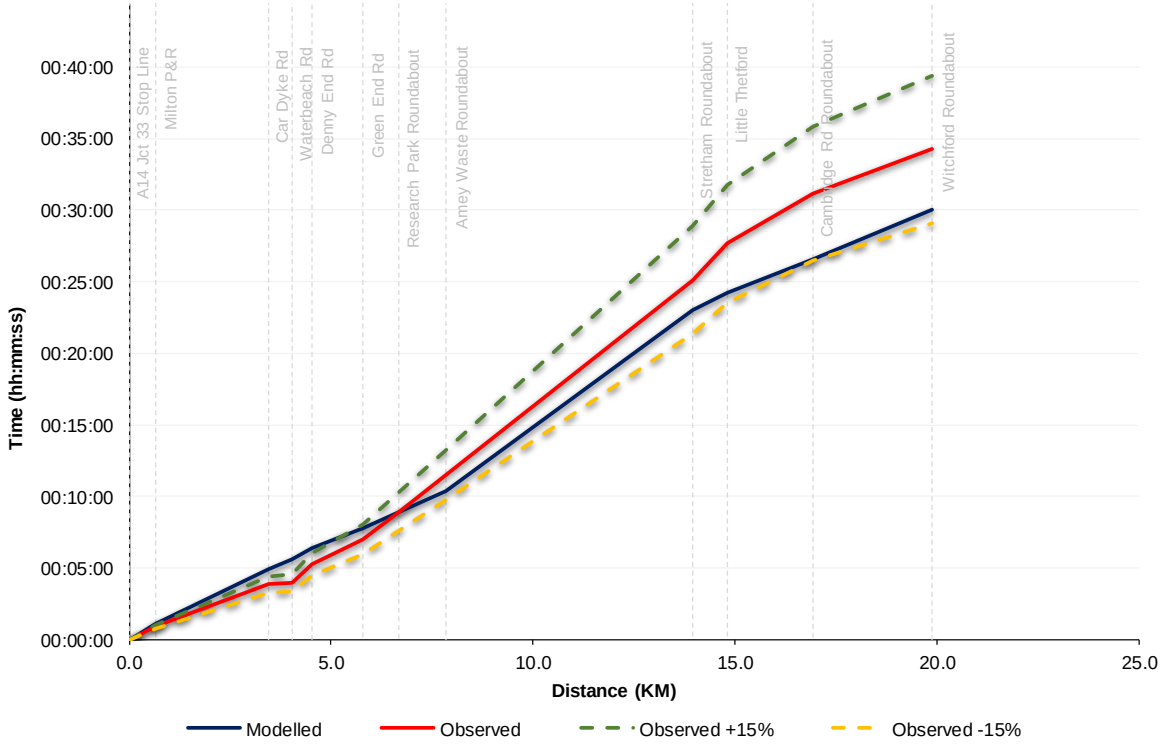
G.1.20. 5W: A14; J37 (Newmarket) to J32 (Histon) – IP



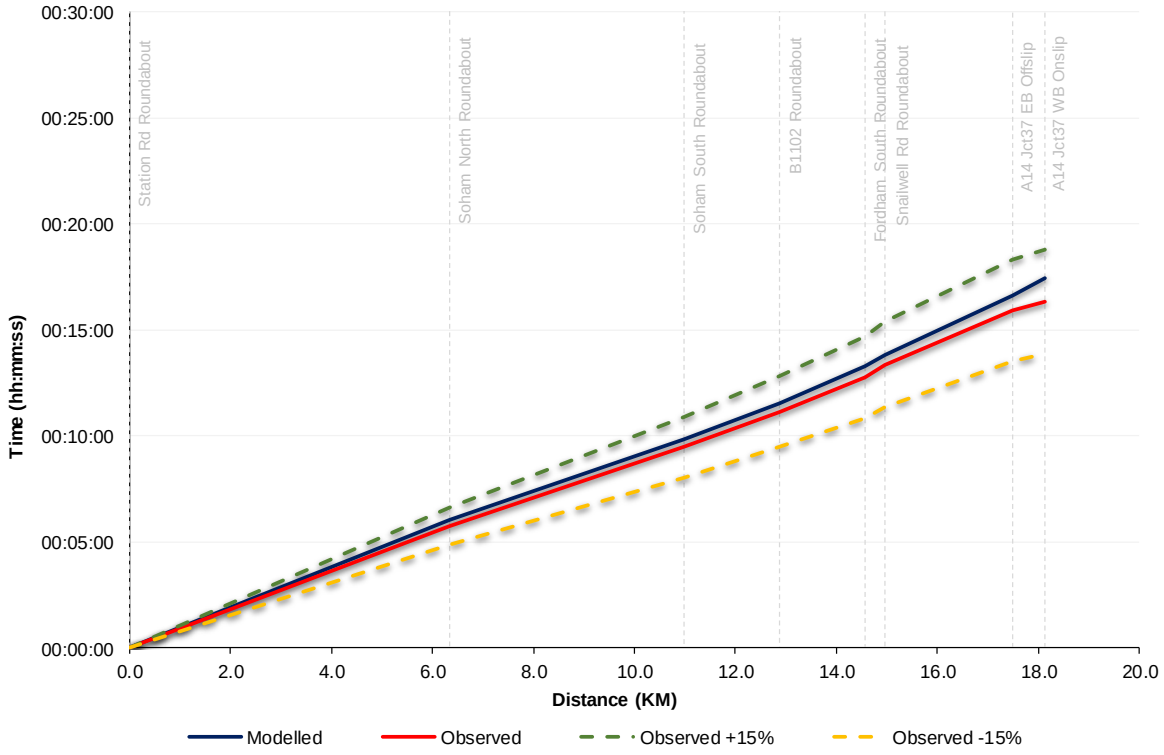
G.1.21. 1S: A10; Witchford Rd Roundabout, Ely, to Milton Interchange – PM



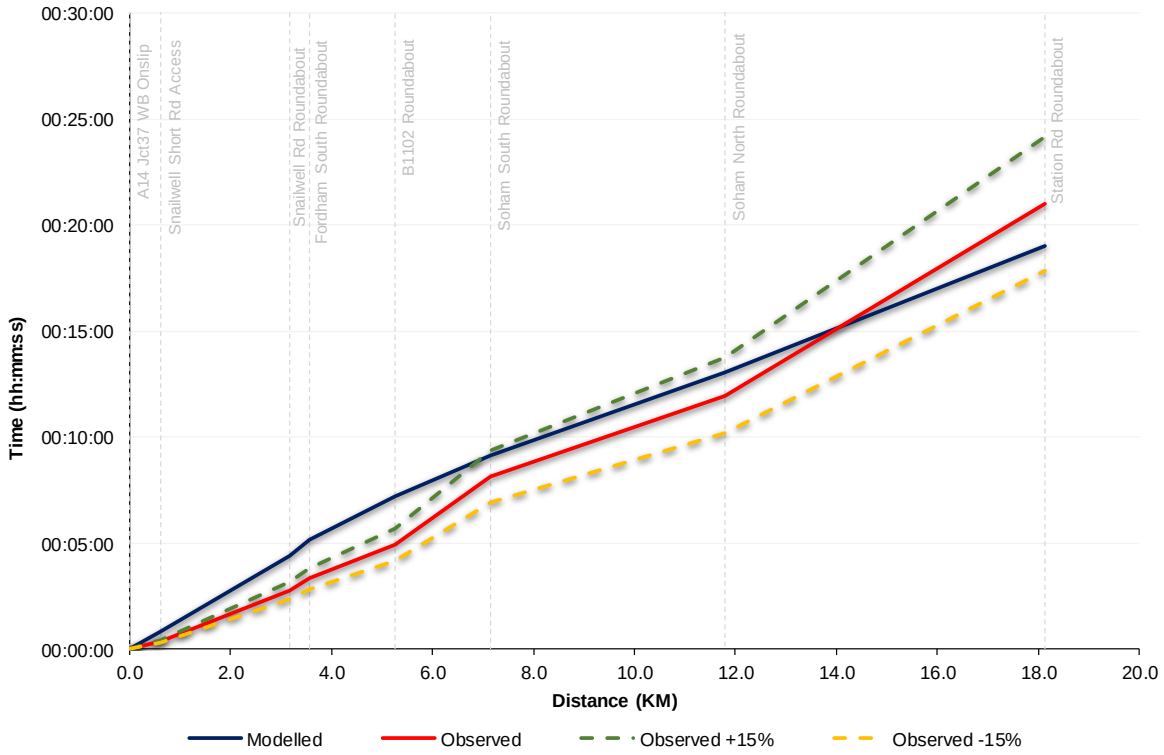
G.1.22. 1N: A10; Milton Interchange to Witchford Rd Roundabout, Ely – PM



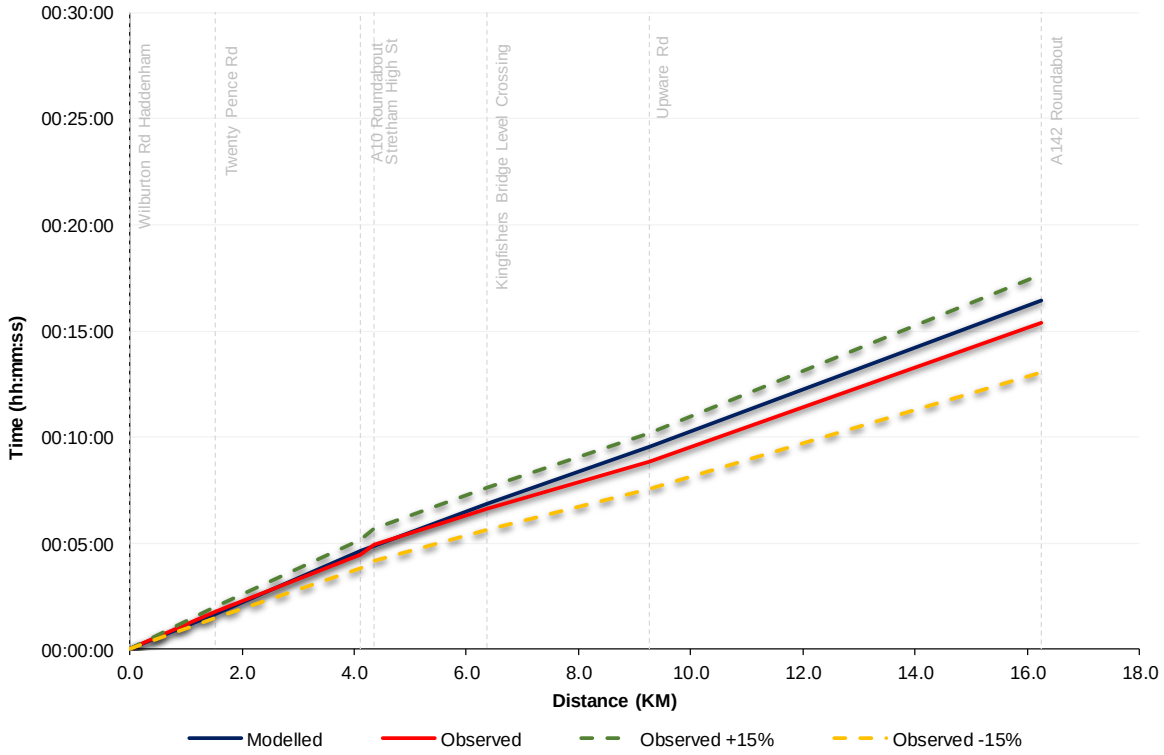
G.1.23. 2S: A142; Station Rd Roundabout, Ely, to A14 J37 – PM



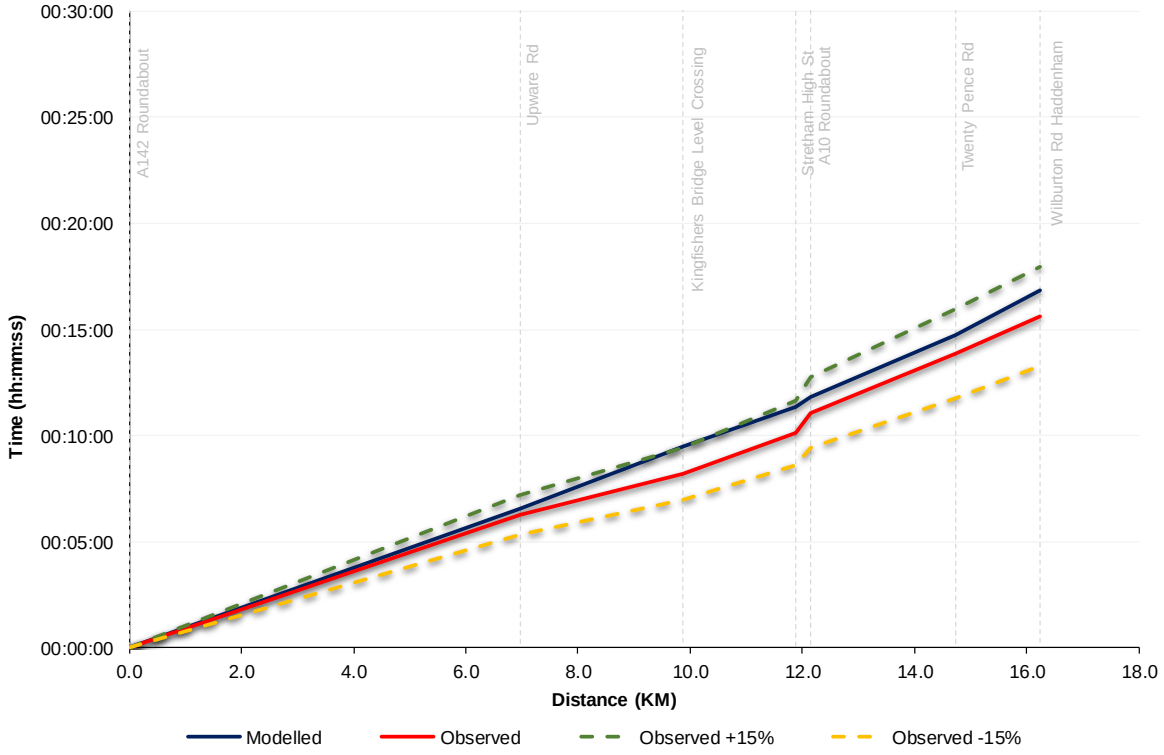
G.1.24. 2N: A142; A14 J37 to Station Rd Roundabout, Ely – PM



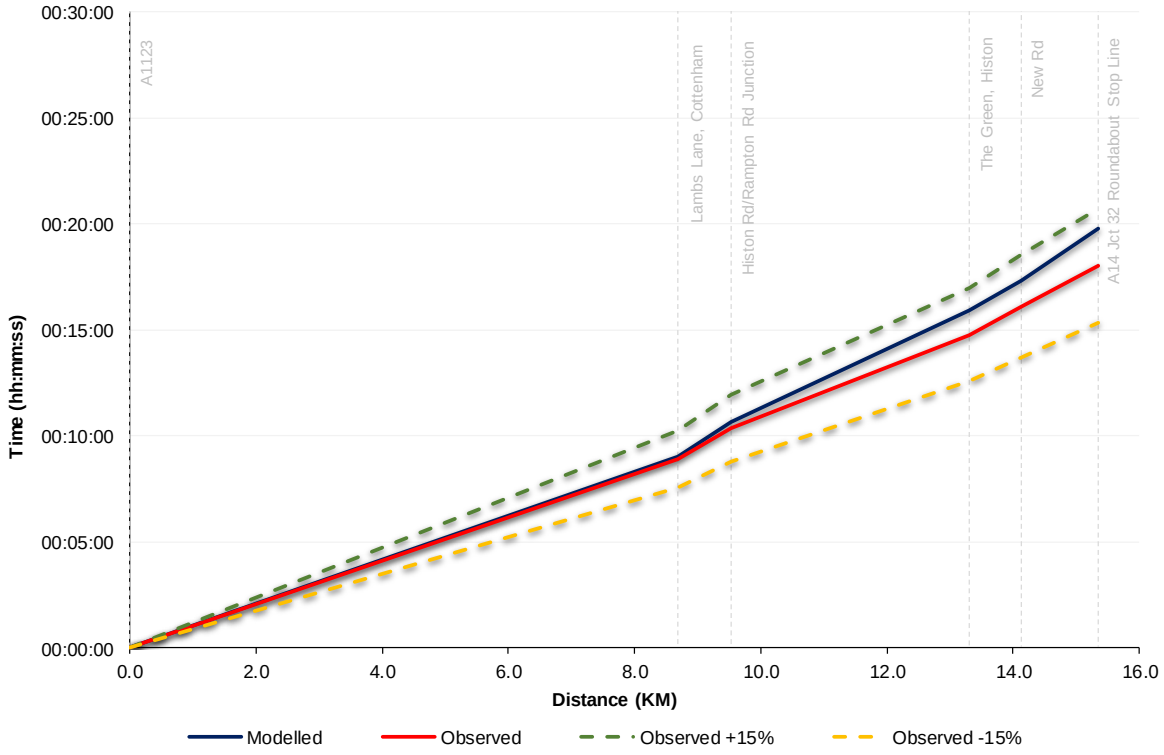
G.1.25. 3E: A1123; Haddenham to A142 Roundabout, Soham – PM



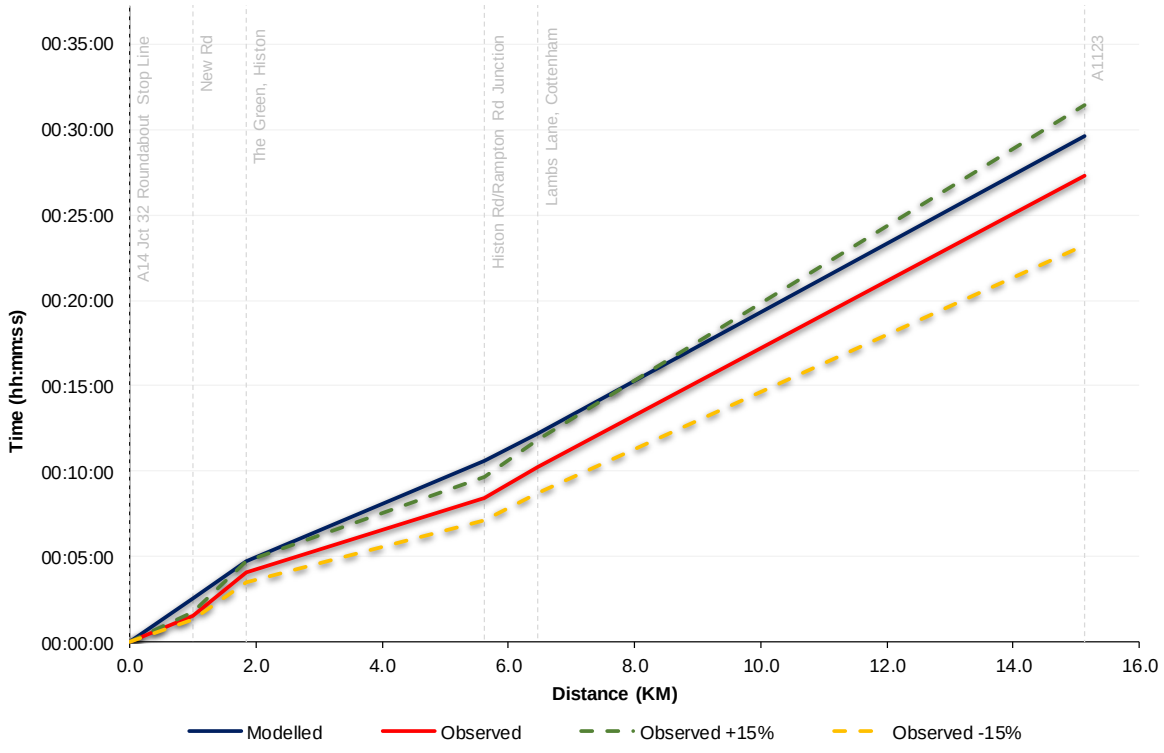
G.1.26. 3W: A1123; A142 Roundabout, Soham to Haddenham – PM



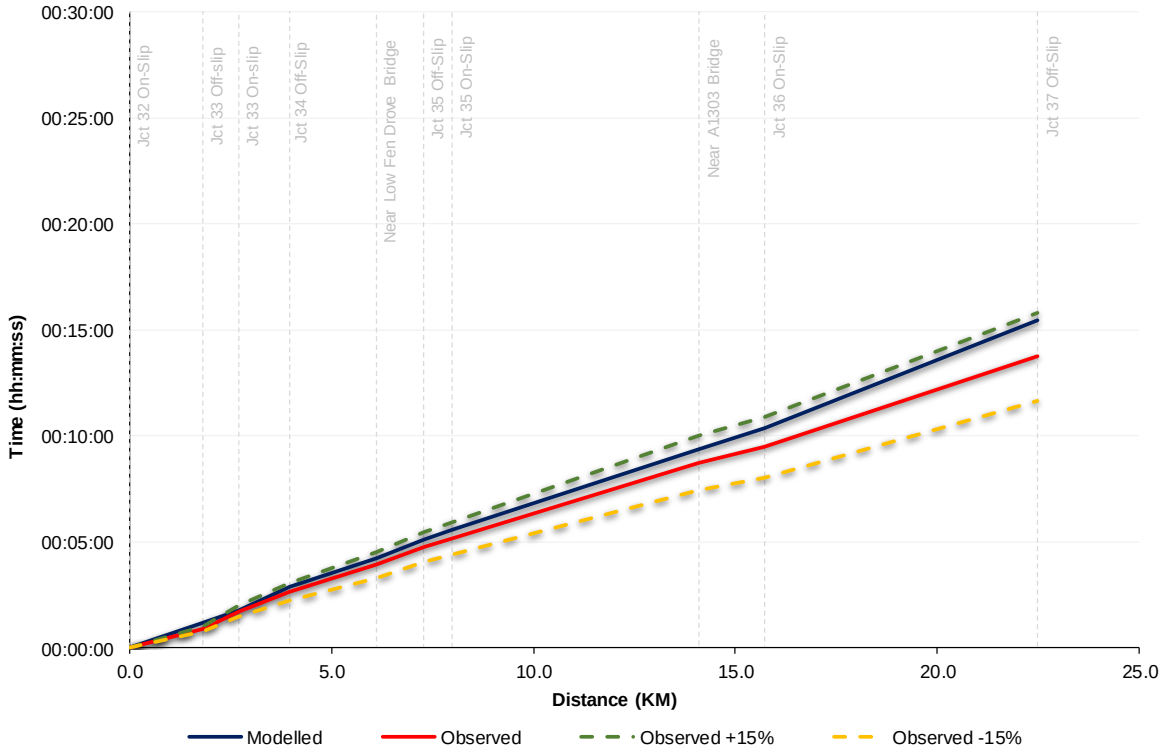
G.1.27. 4S: B1049; Wilburton to Histon Interchange – PM



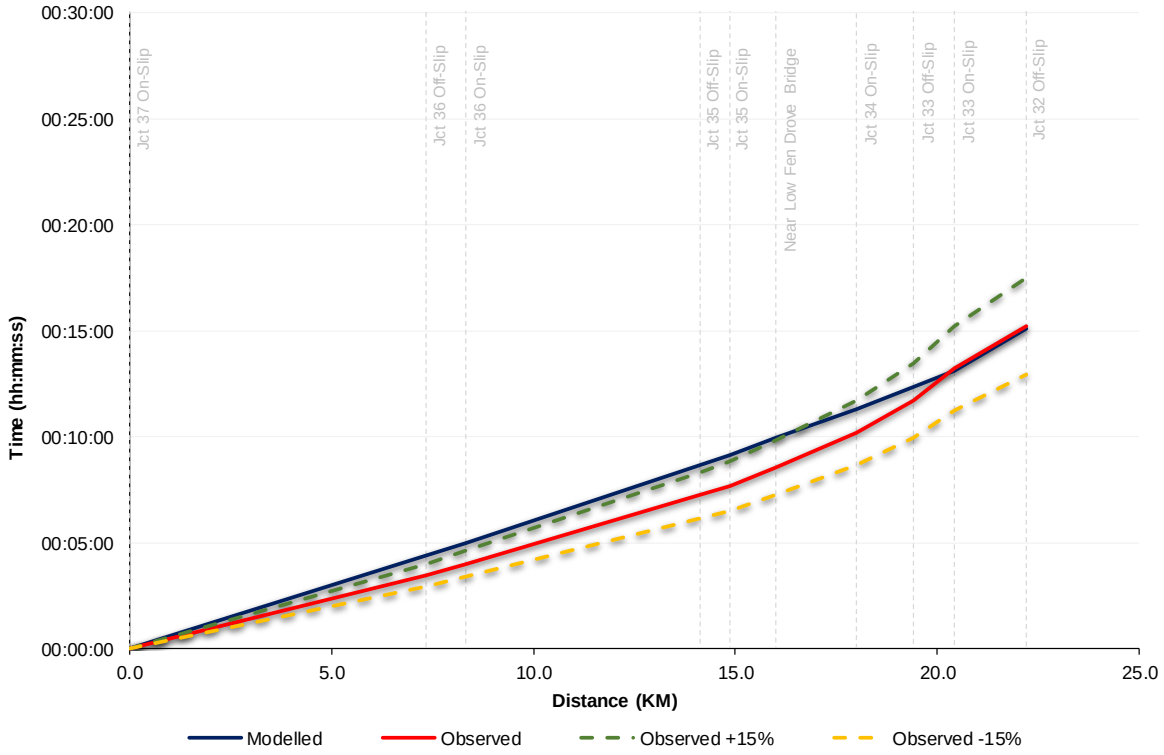
G.1.28. 4N: B1049; Histon Interchange to Wilburton – PM



G.1.29. 5E: A14; J32 (Histon) to J37 (Newmarket) – PM

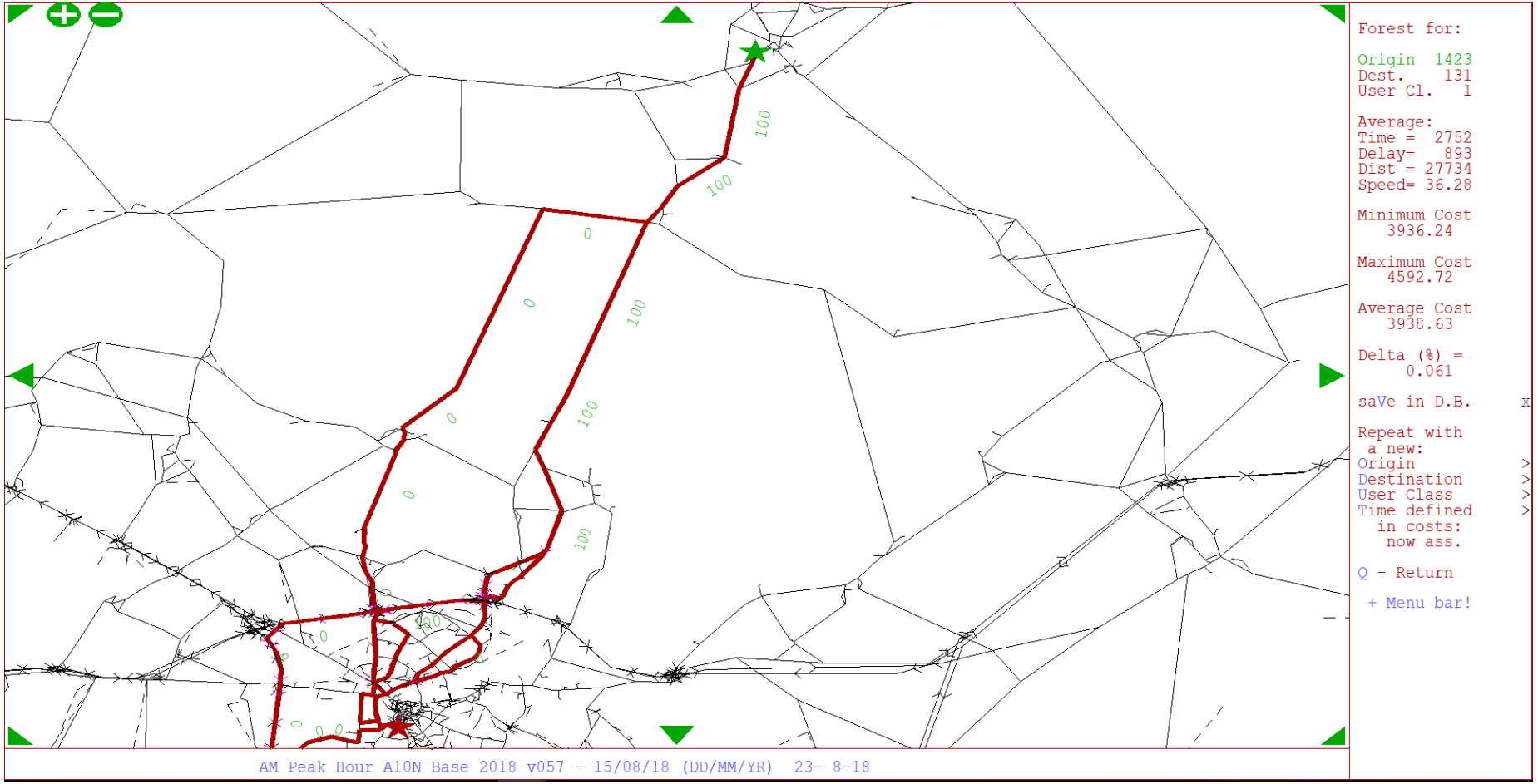


G.1.30. 5W: A14; J37 (Newmarket) to J32 (Histon) – PM

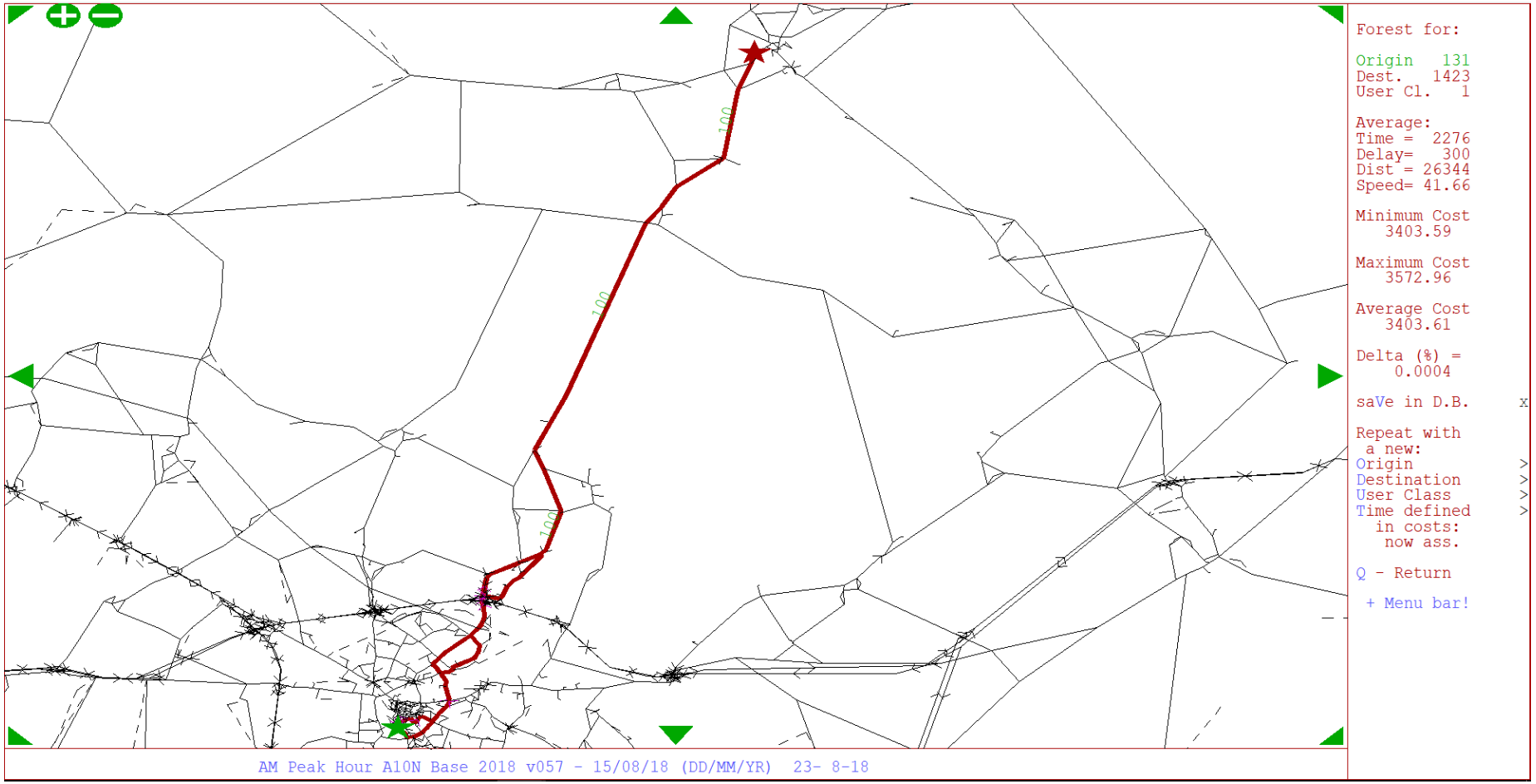


Appendix H. Route Choice Plots

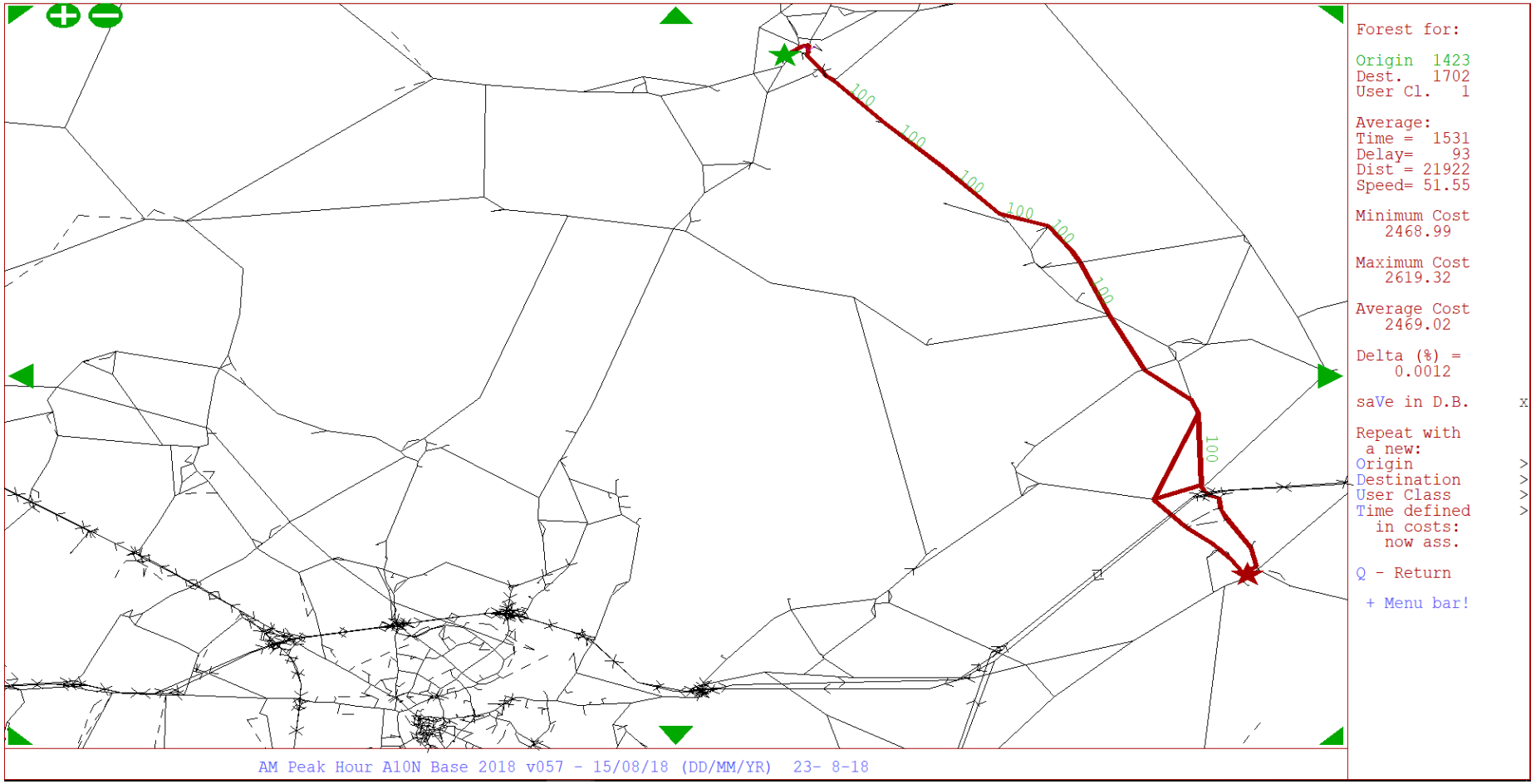
H.1. Ely to Cambridge, AM Peak



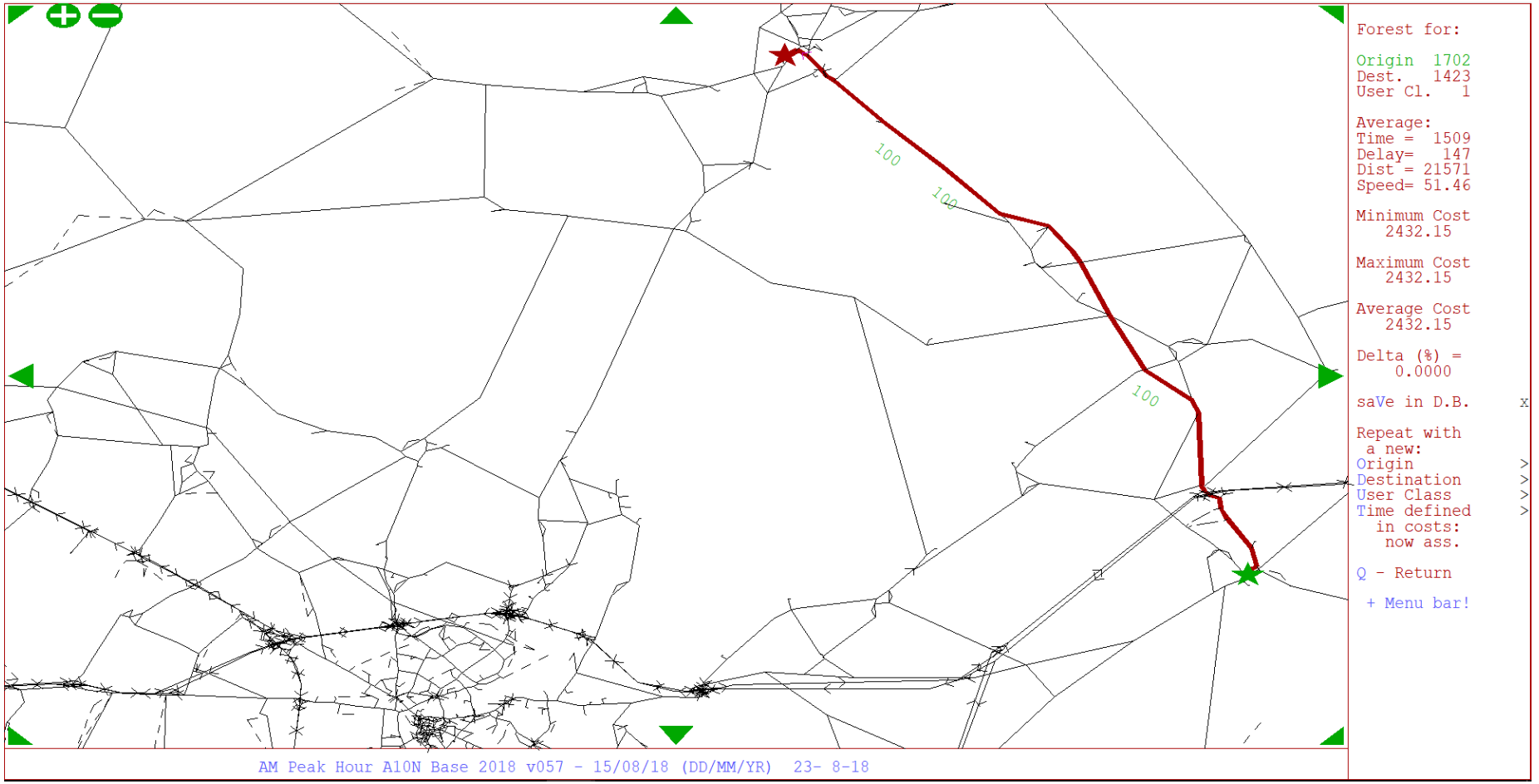
H.2. Cambridge to Ely, AM Peak



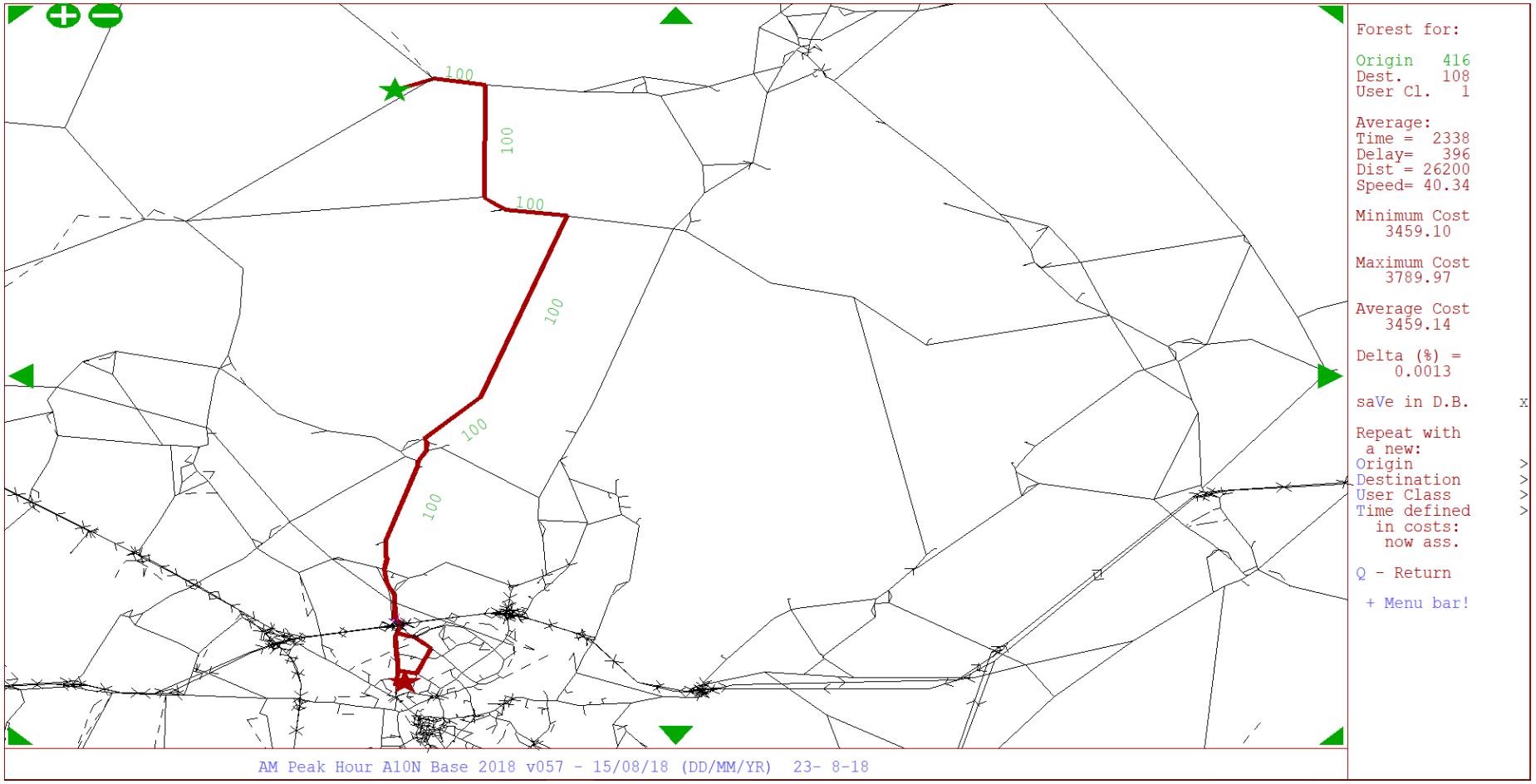
H.3. Ely to Newmarket, AM Peak



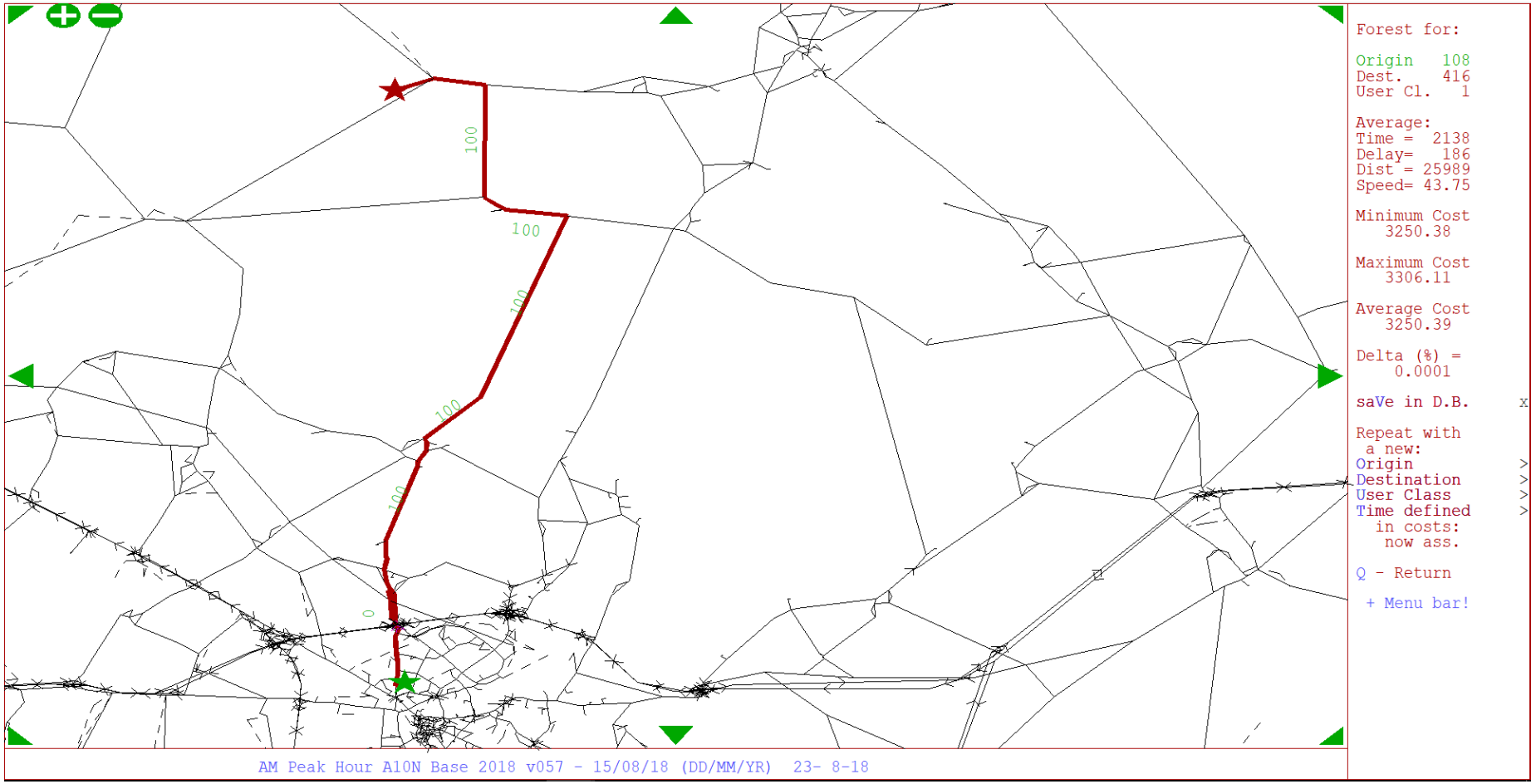
H.4. Newmarket to Ely, AM Peak



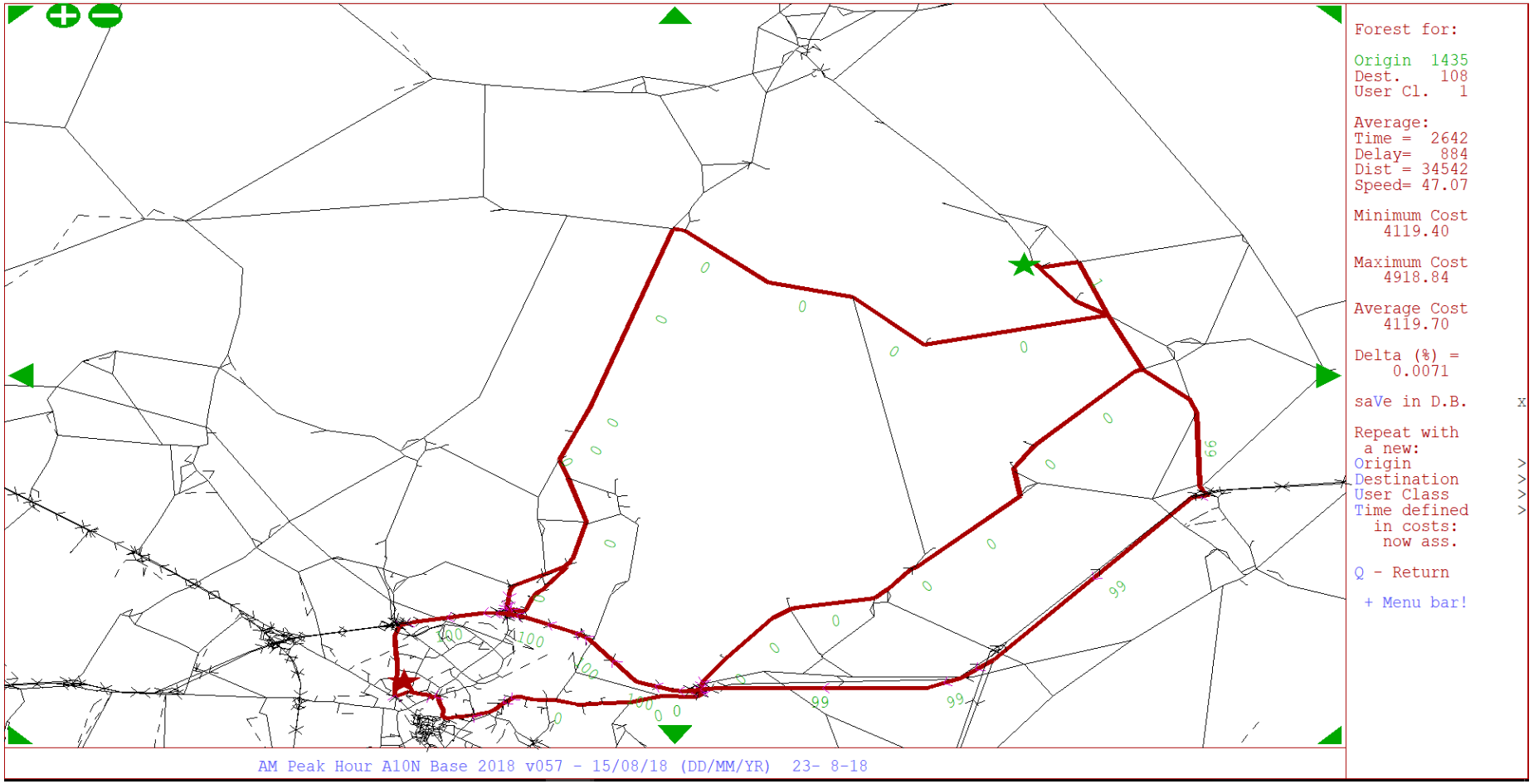
H.5. Sutton to Cambridge, AM Peak



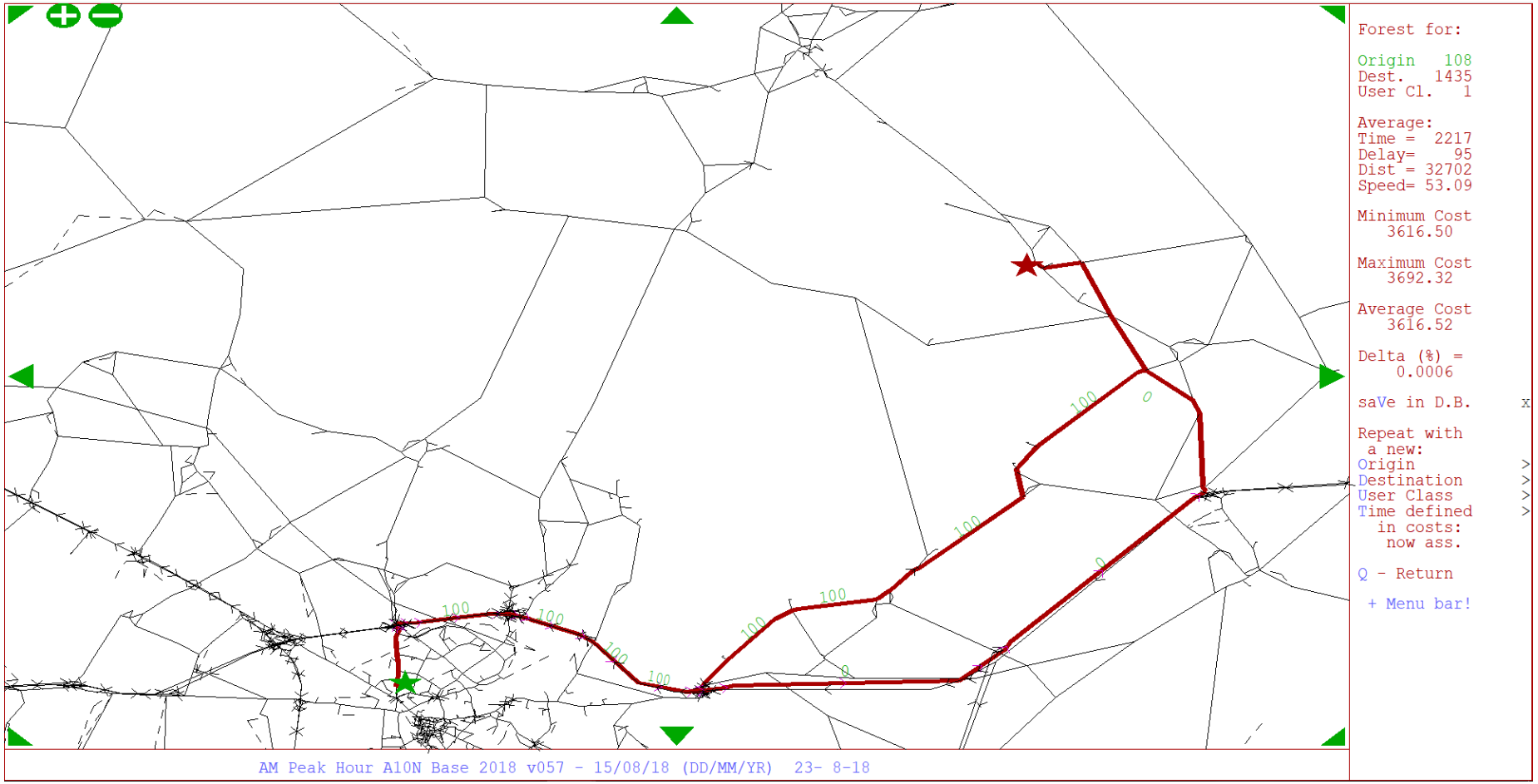
H.6. Cambridge to Sutton, AM Peak



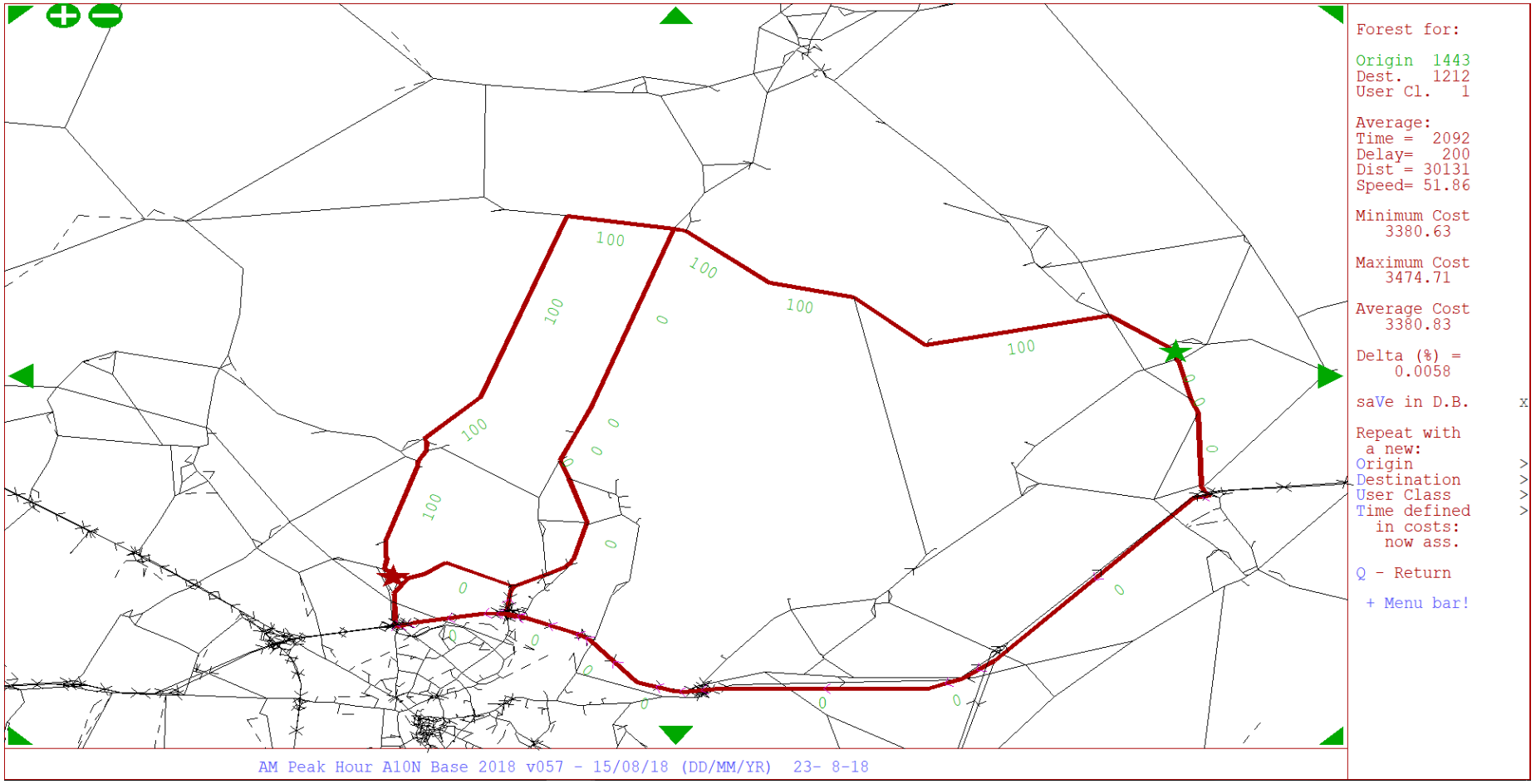
H.7. Soham to Cambridge, AM Peak



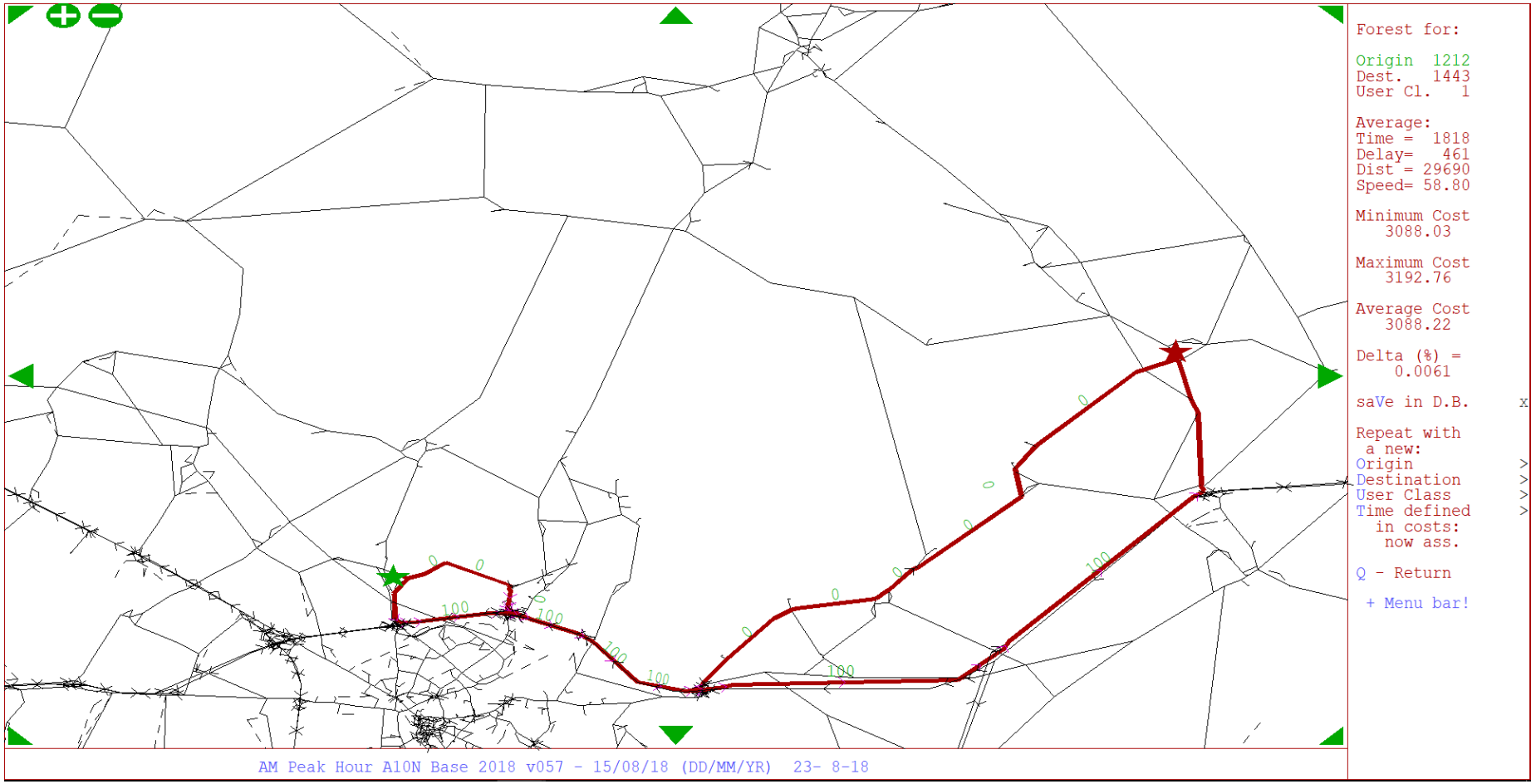
H.8. Cambridge to Soham, AM Peak



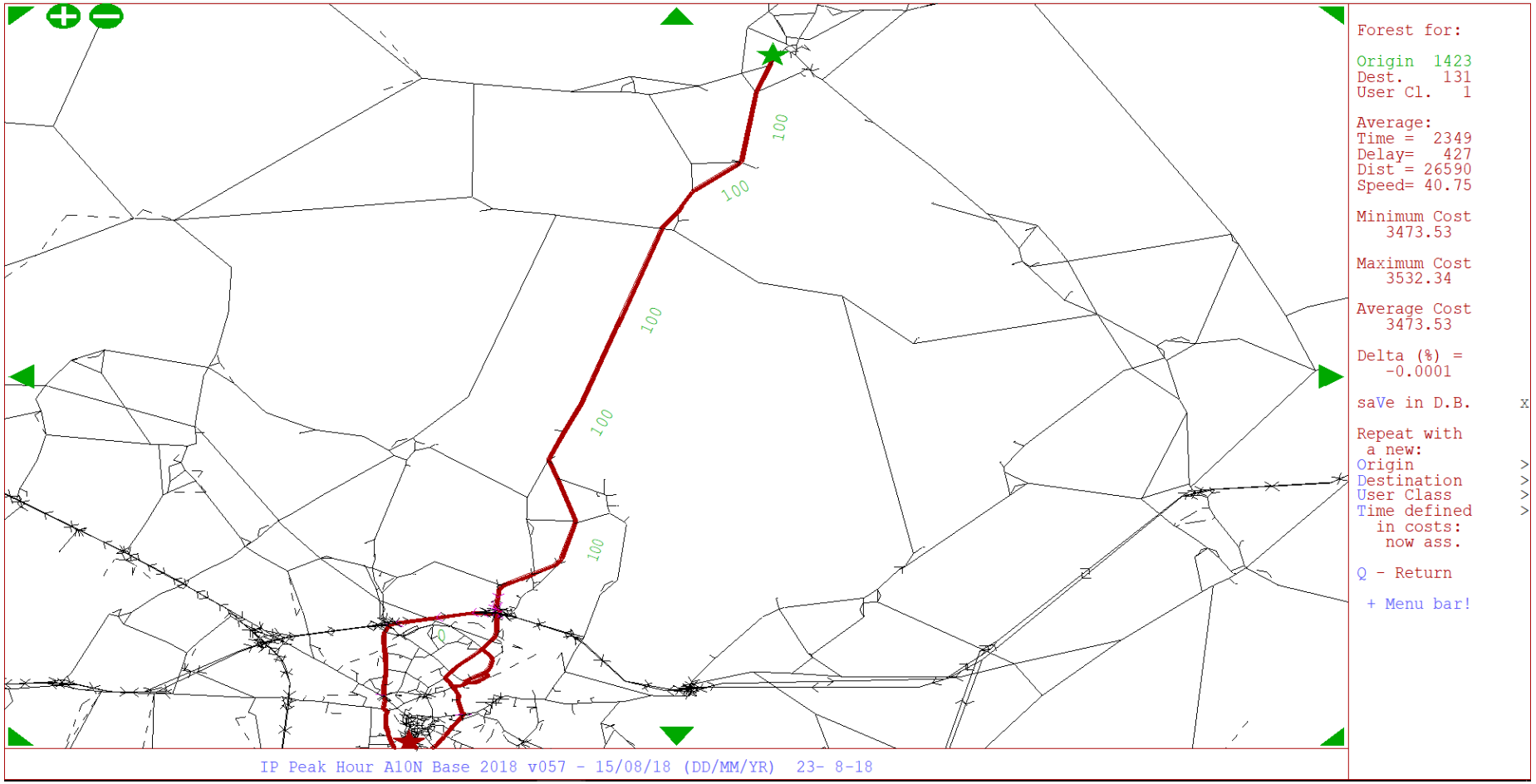
H.9. Fordham to Impington, AM Peak



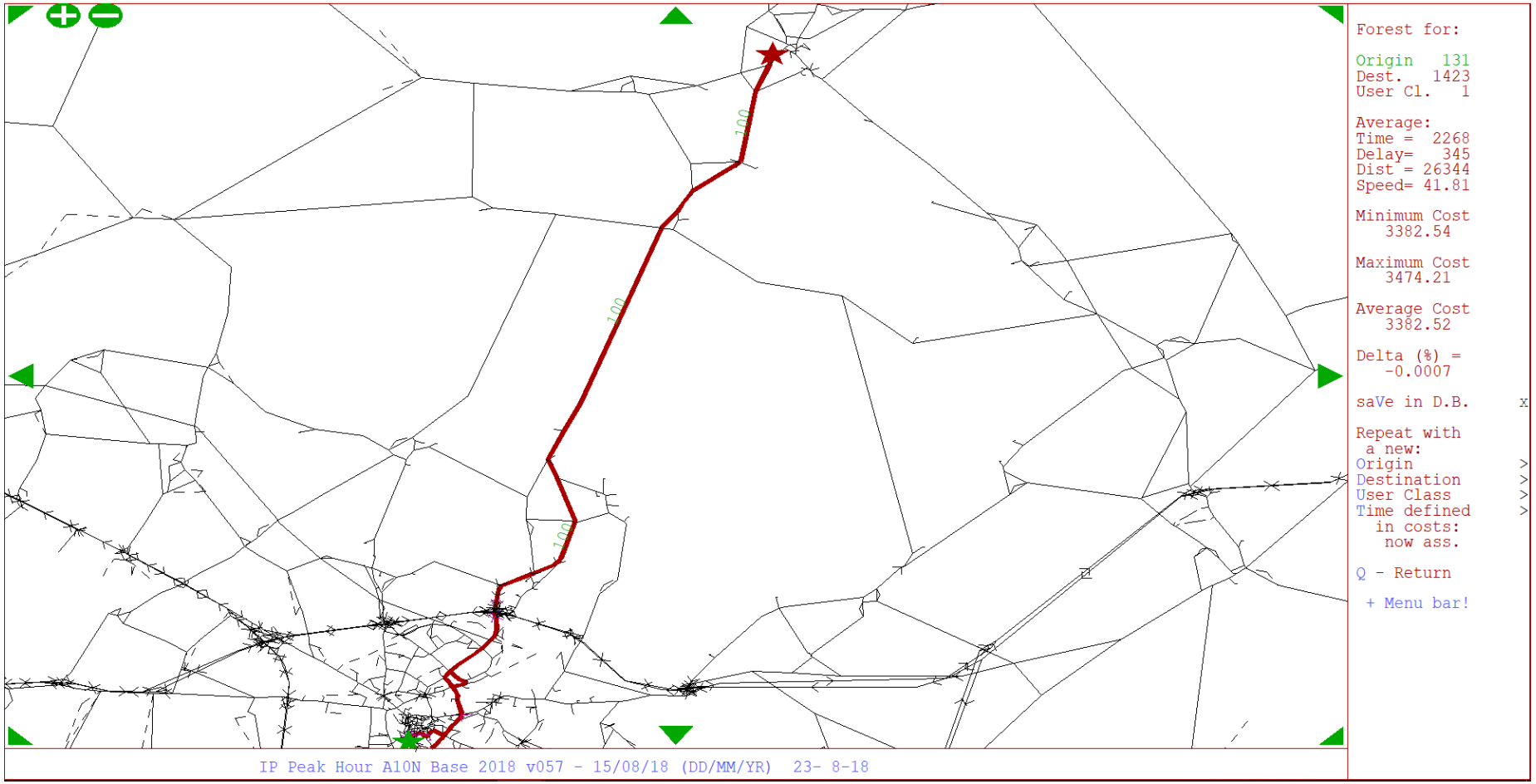
H.10. Impington to Fordham, AM Peak



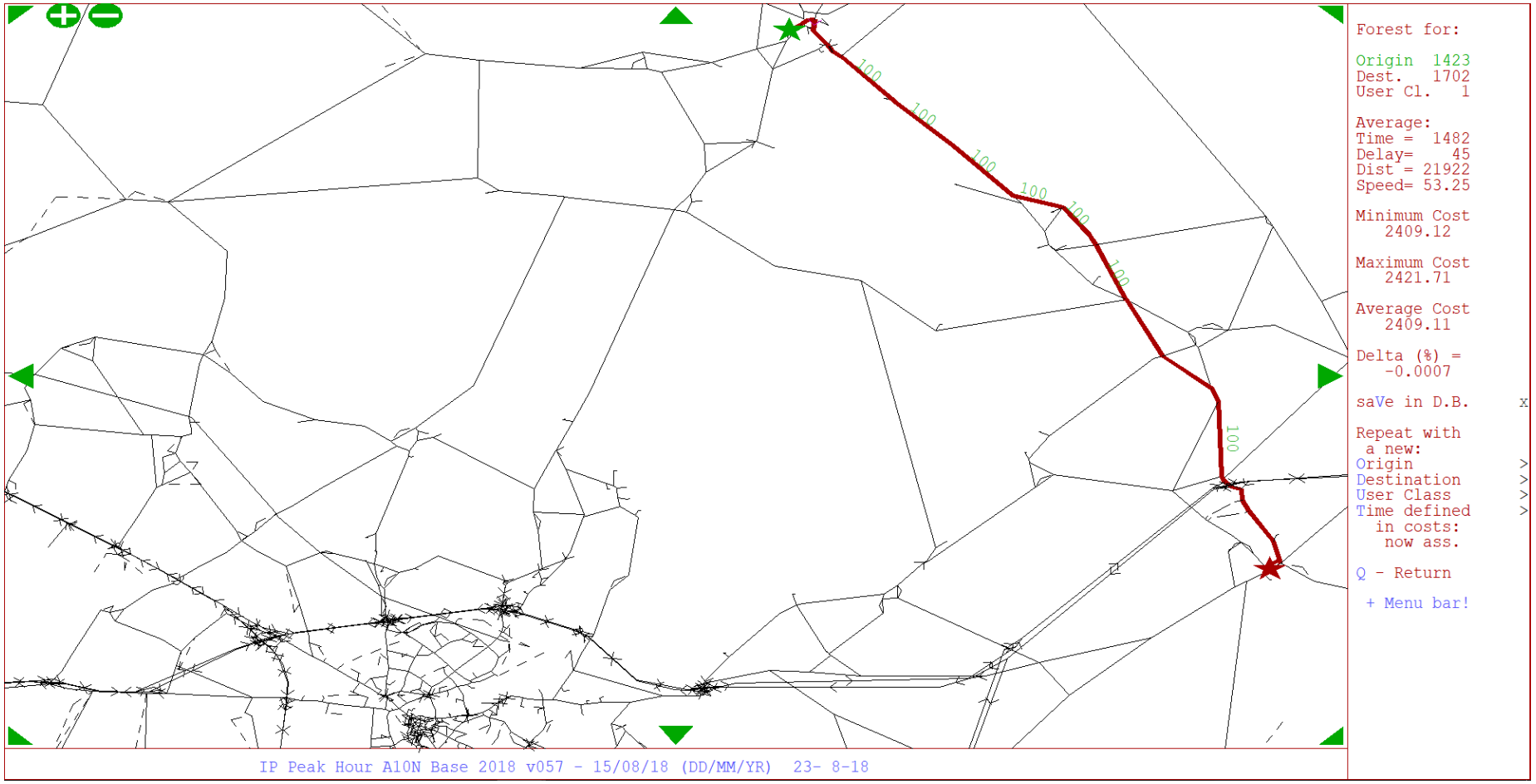
H.11. Ely to Cambridge, Inter-peak



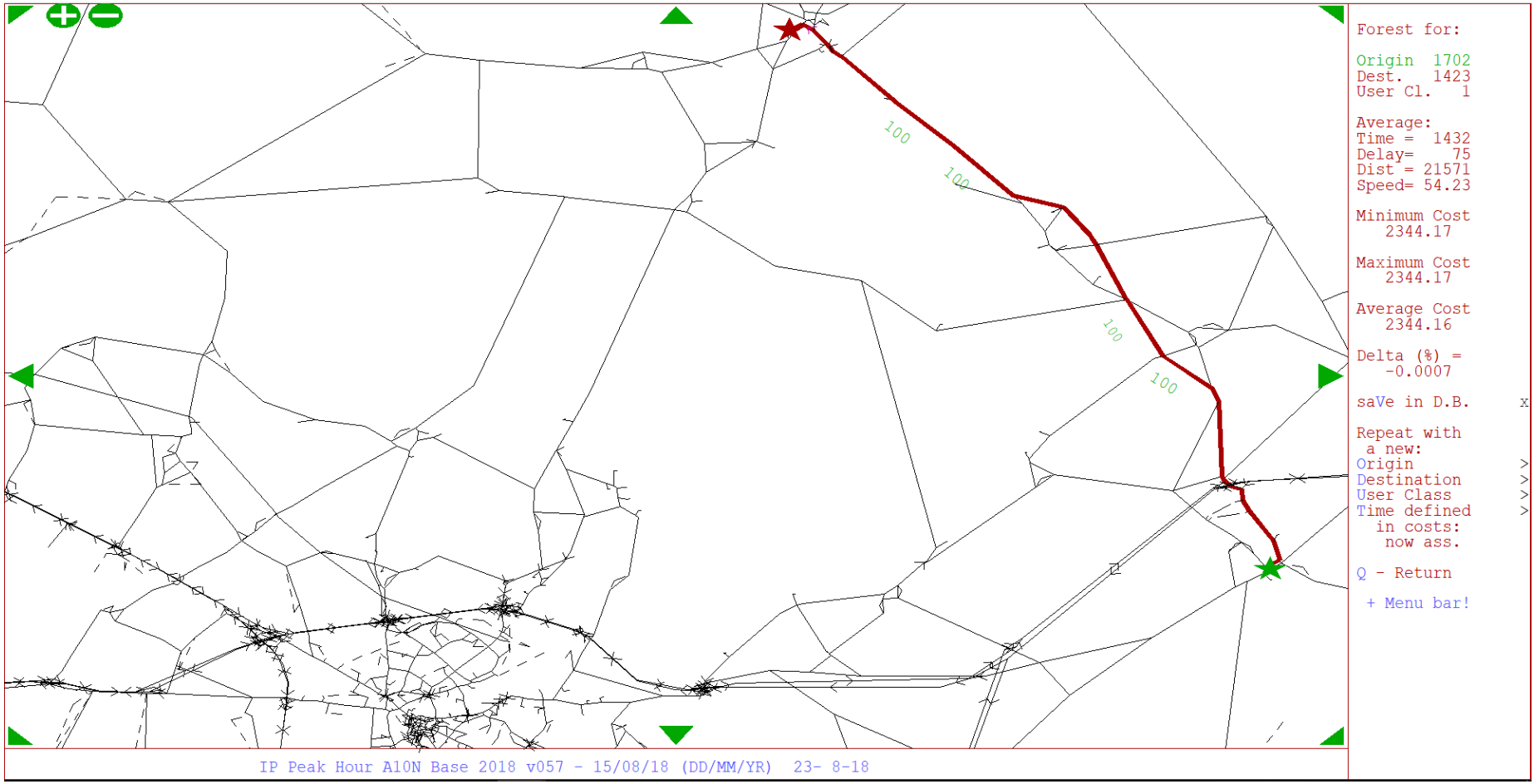
H.12. Cambridge to Ely, Inter-peak



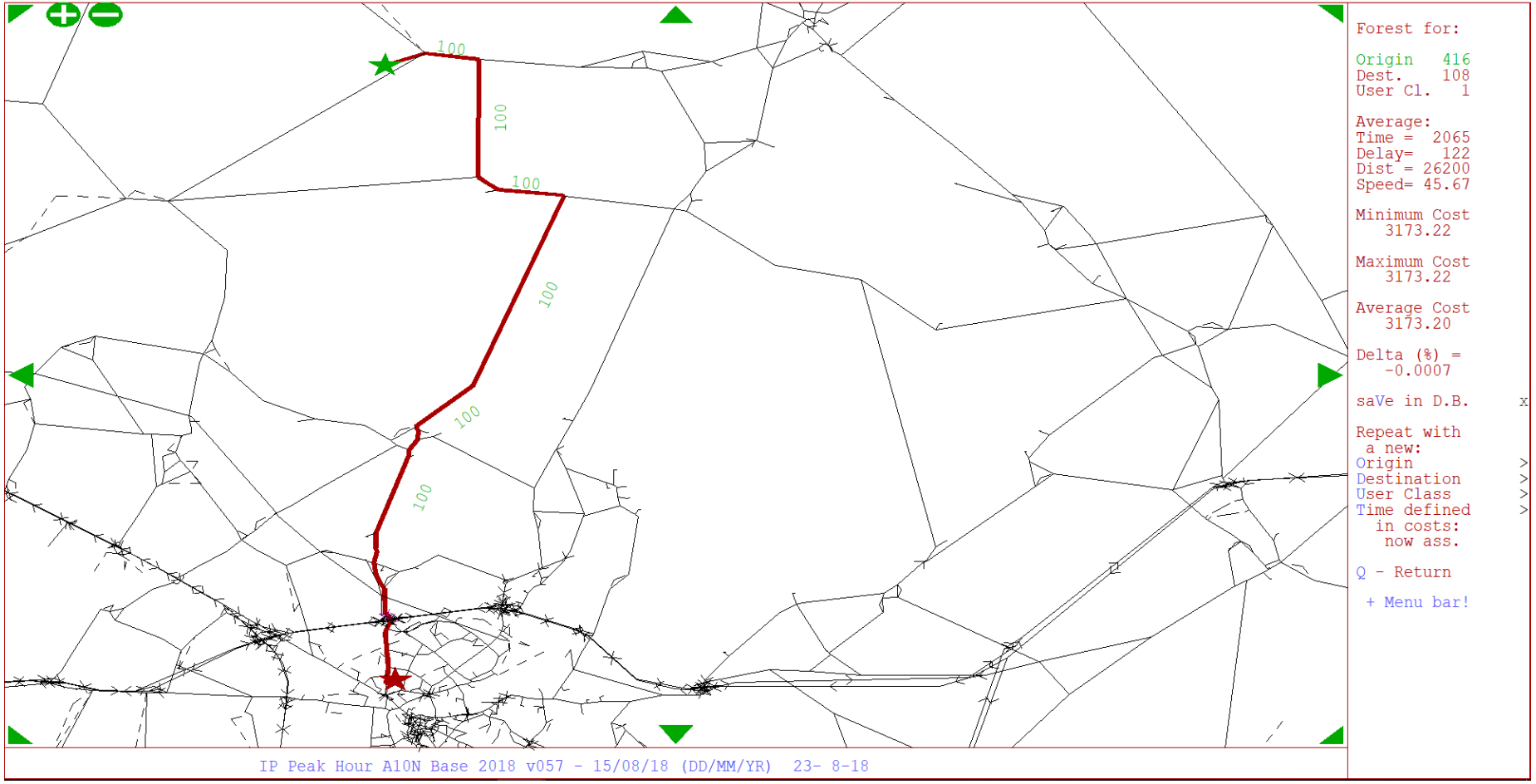
H.13. Ely to Newmarket, Inter-peak



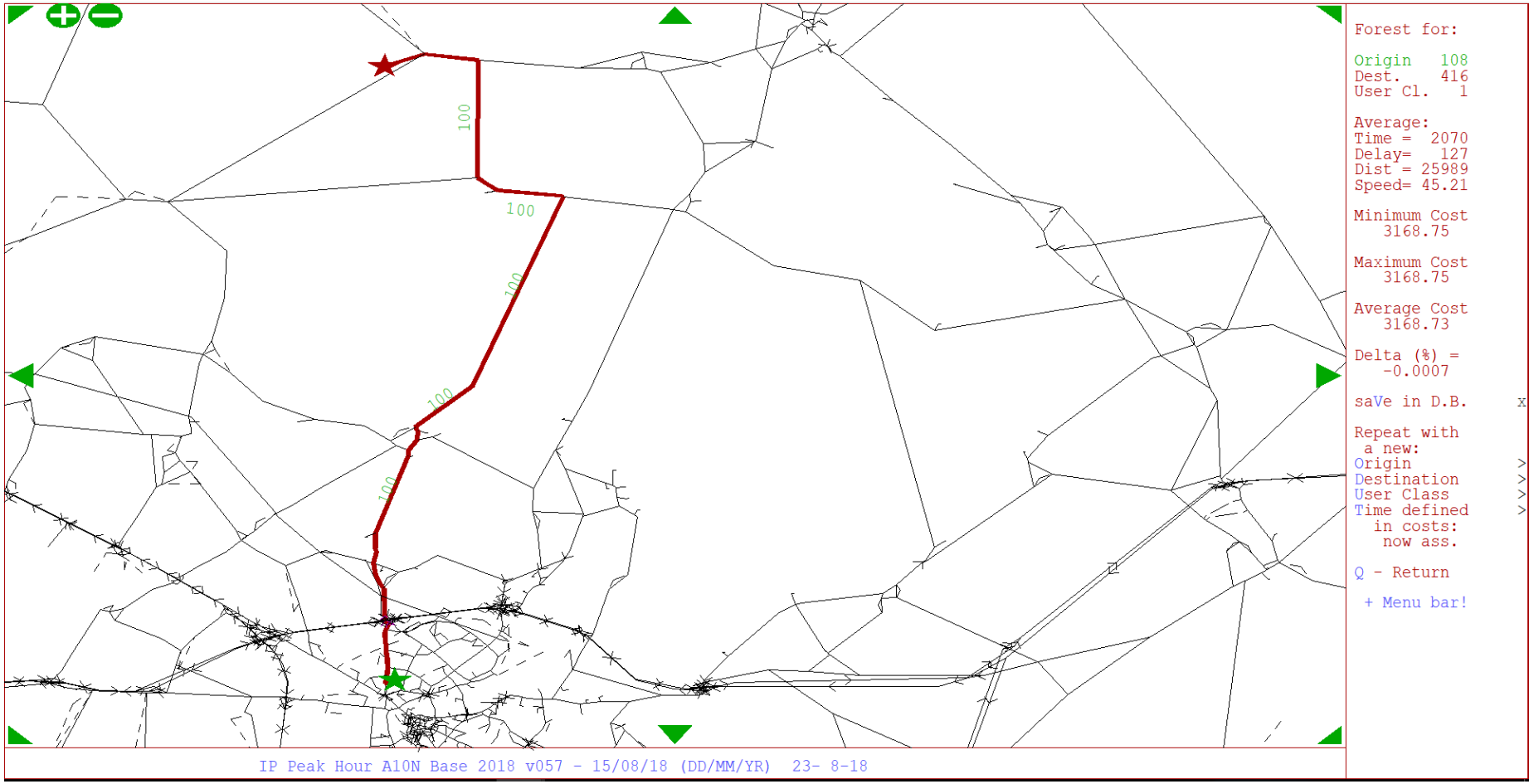
H.14. Newmarket to Ely, Inter-peak



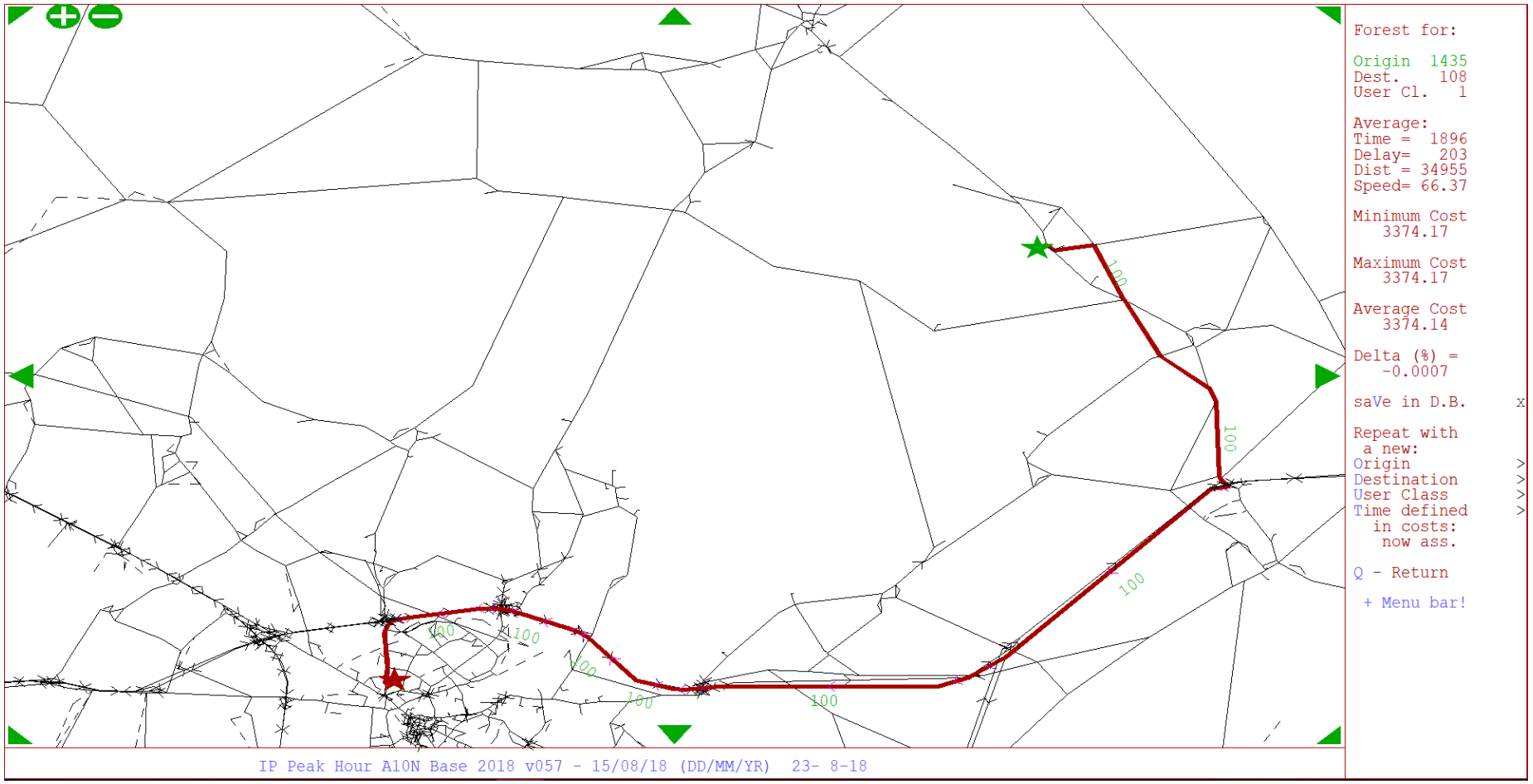
H.15. Sutton to Cambridge, Inter-peak



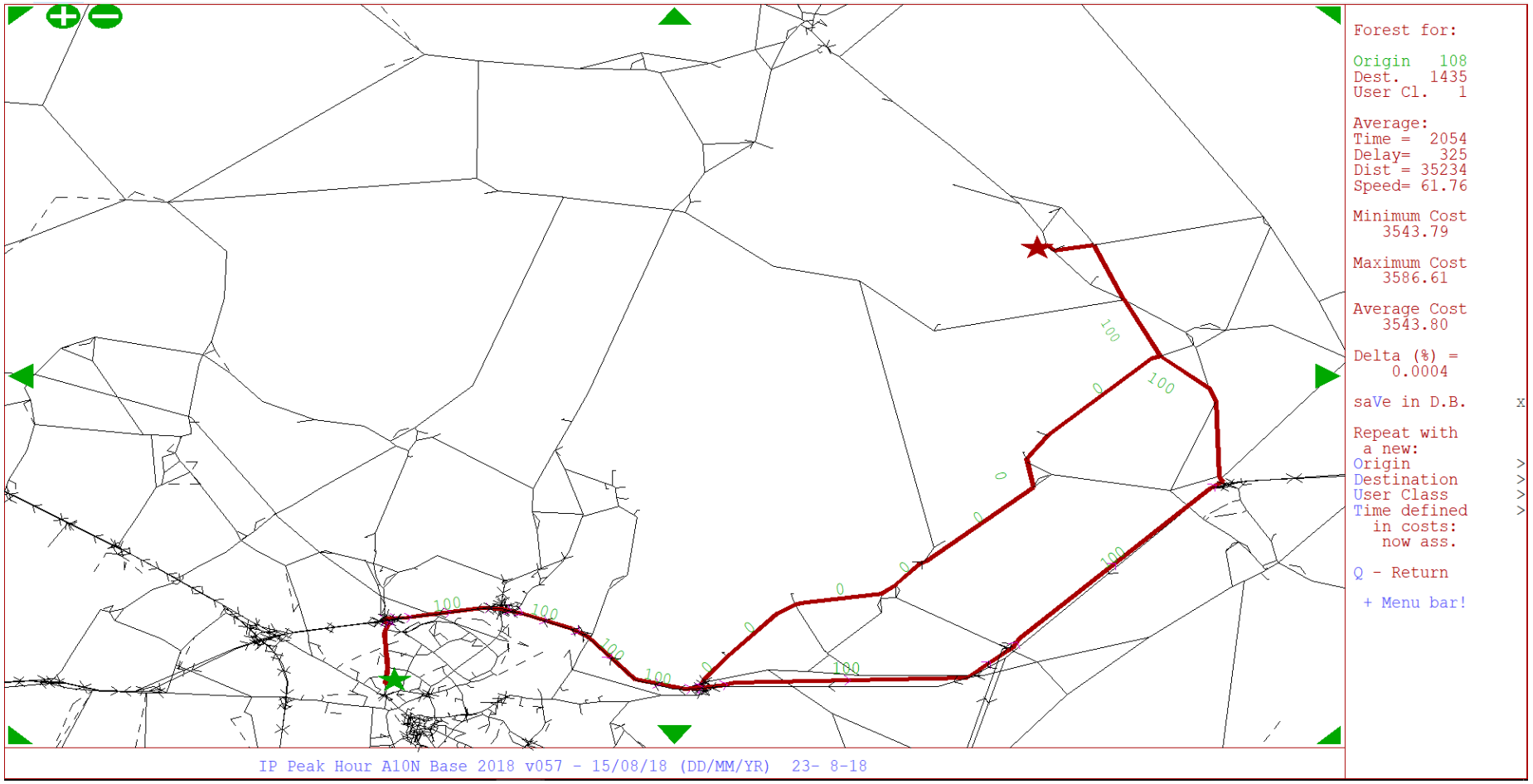
H.16. Cambridge to Sutton, Inter-peak



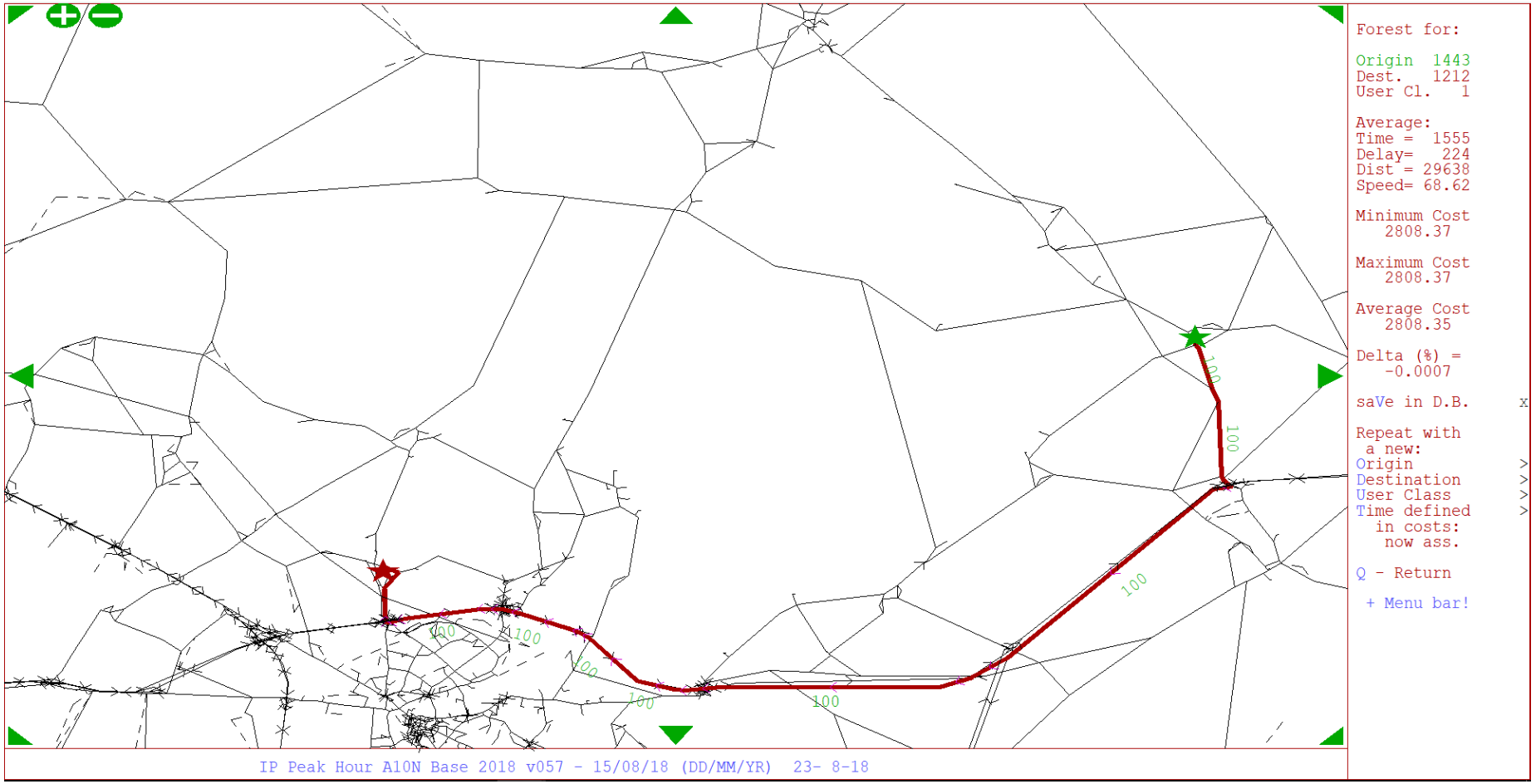
H.17. Soham to Cambridge, Inter-peak



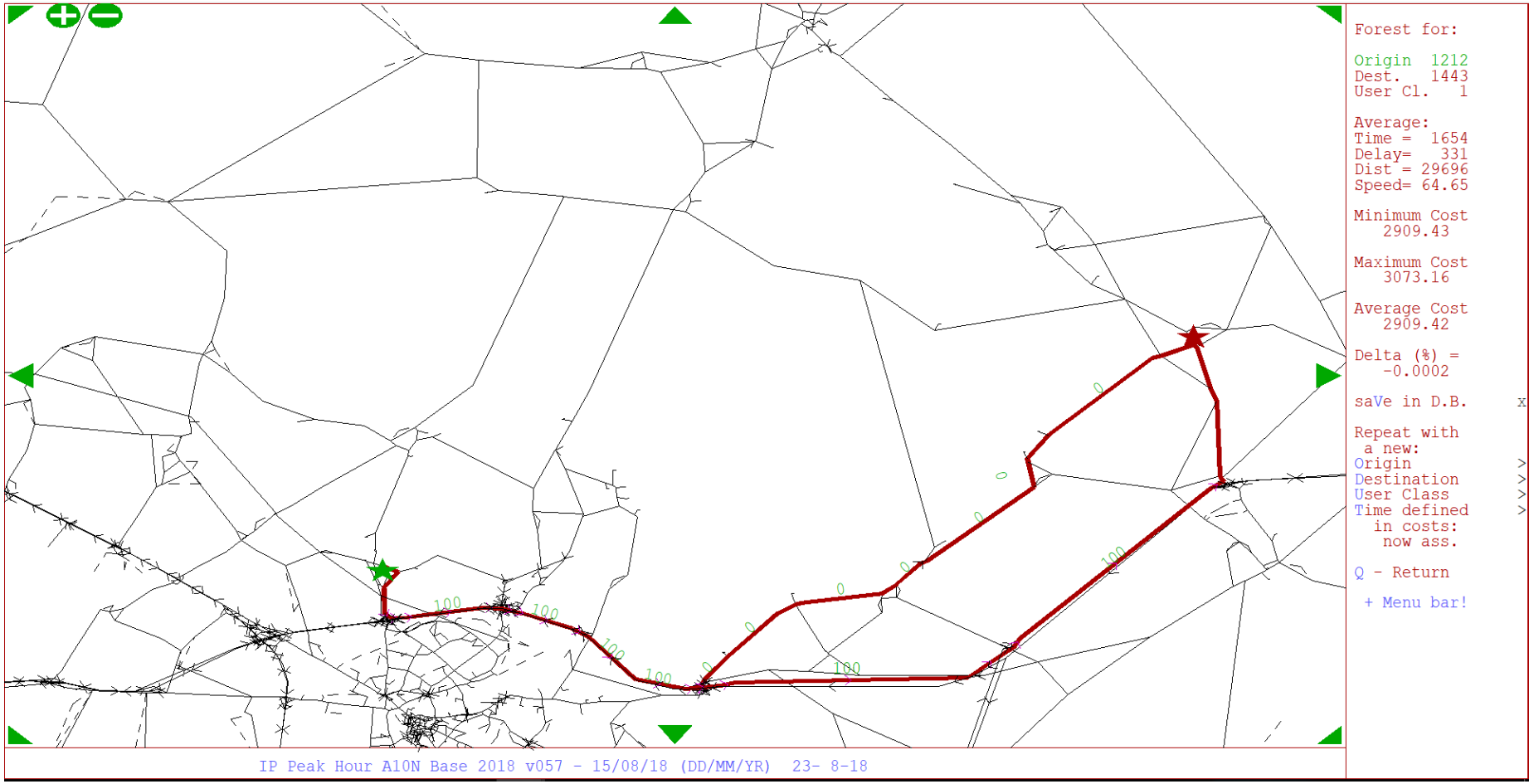
H.18. Cambridge to Soham, Inter-peak



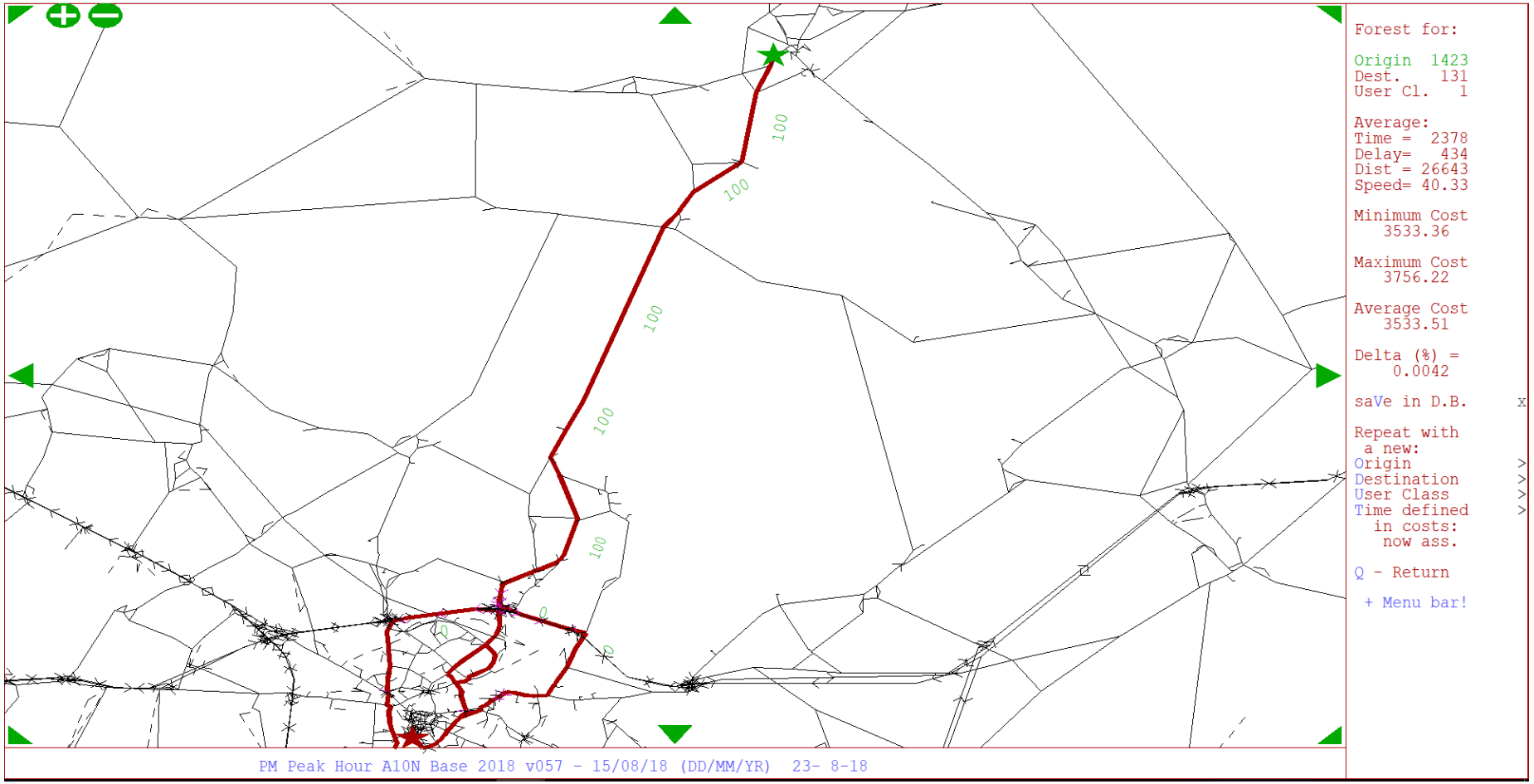
H.19. Fordham to Impington, Inter-peak



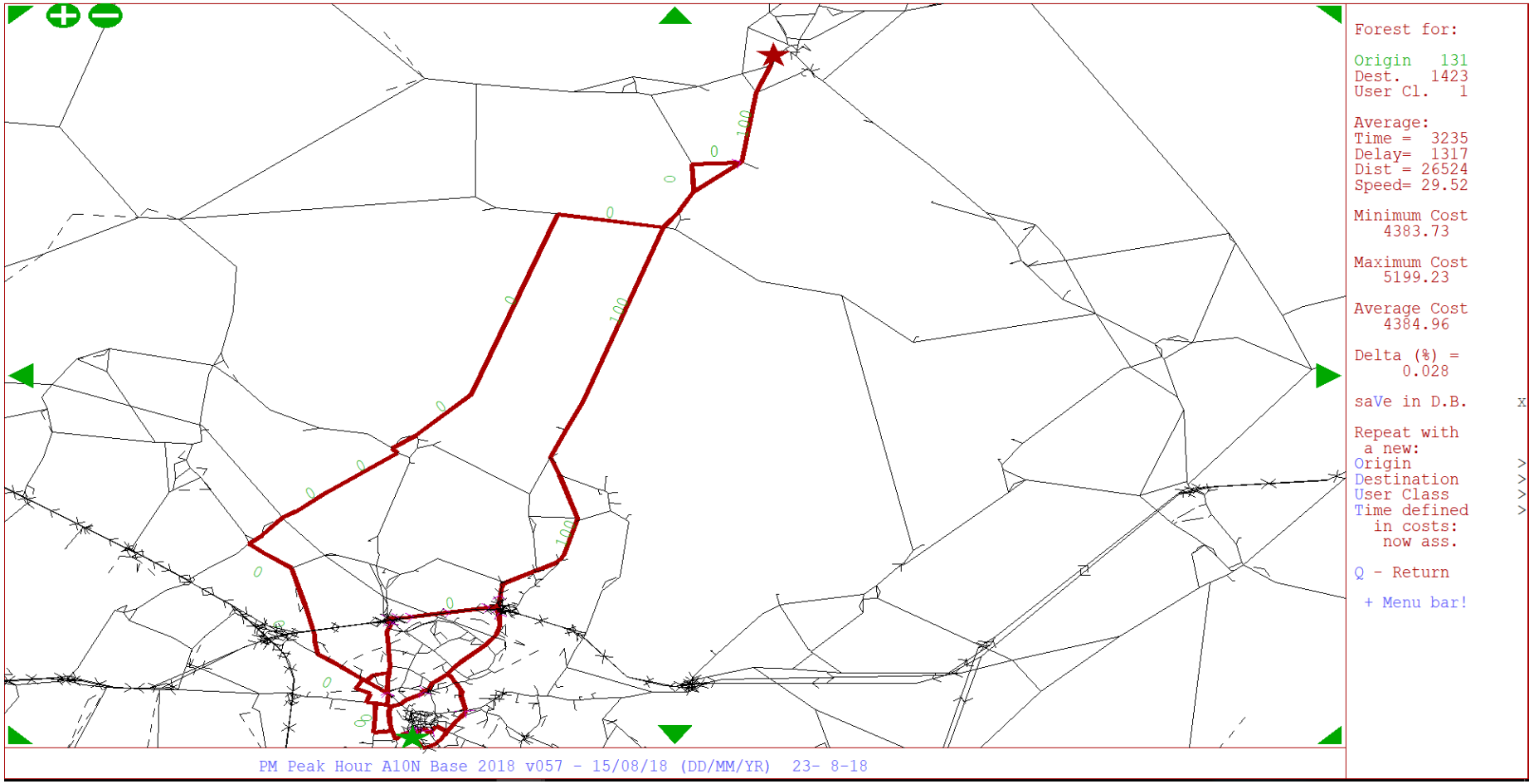
H.20. Impington to Fordham, Inter-peak



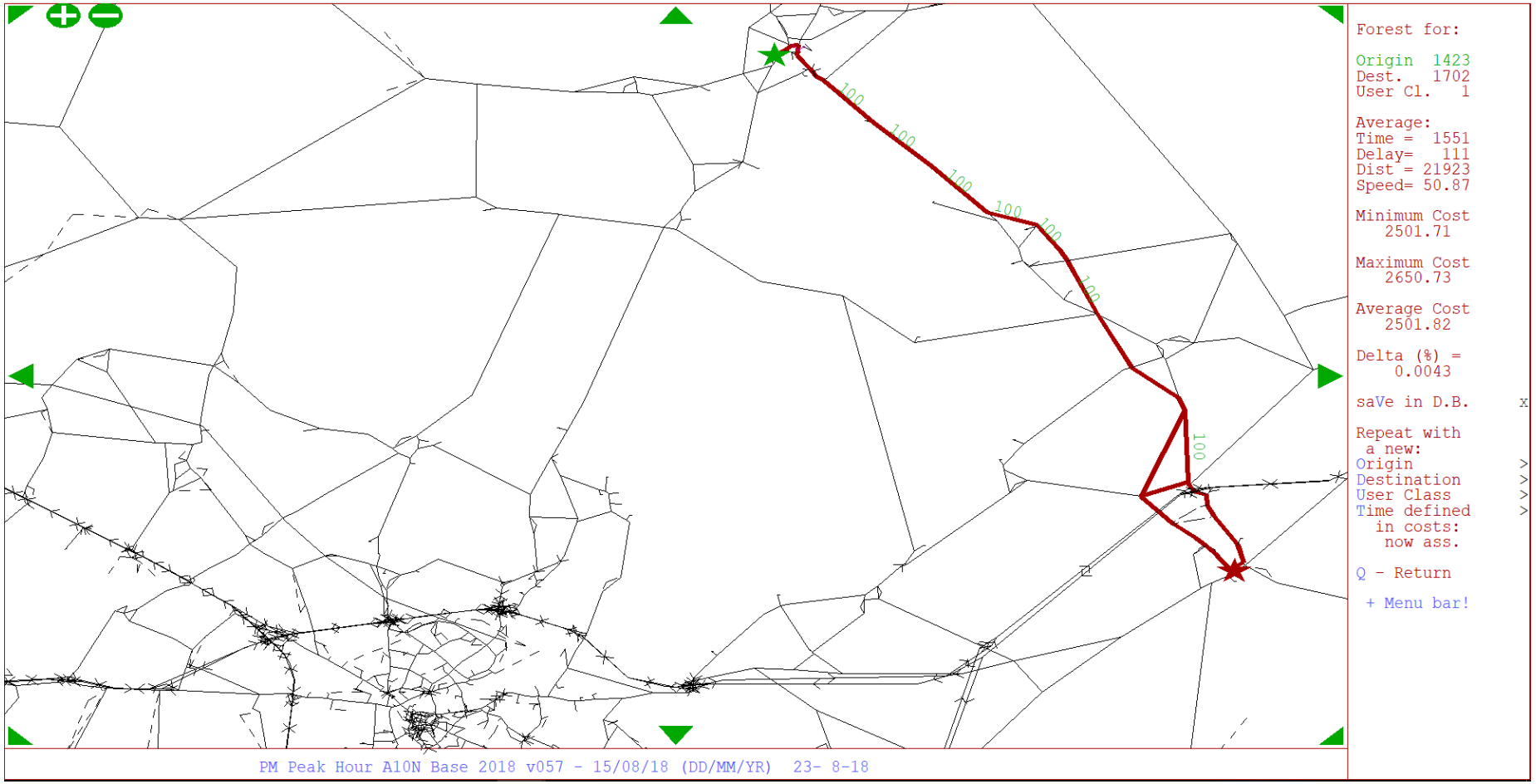
H.21. Ely to Cambridge, PM Peak



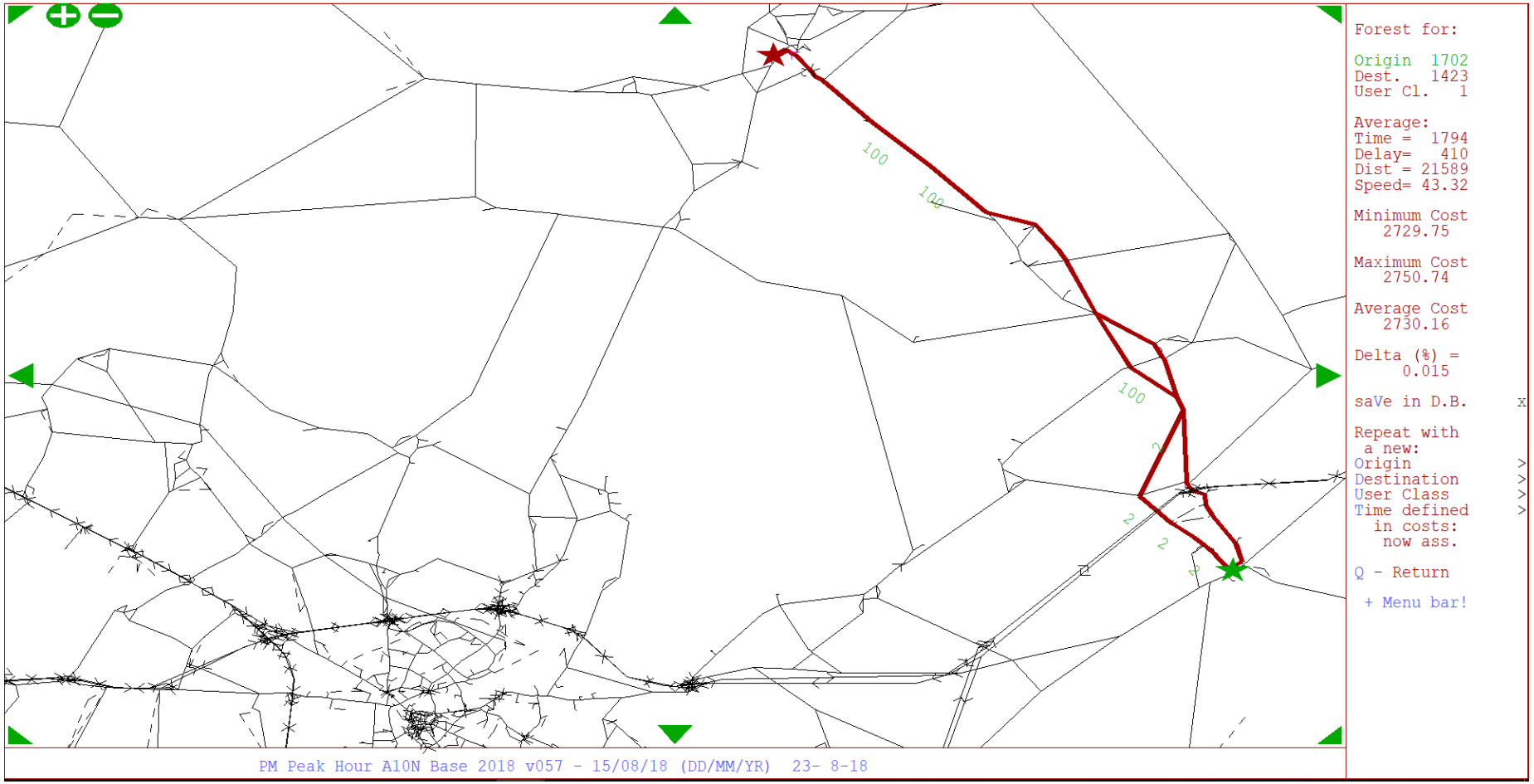
H.22. Cambridge to Ely, PM Peak



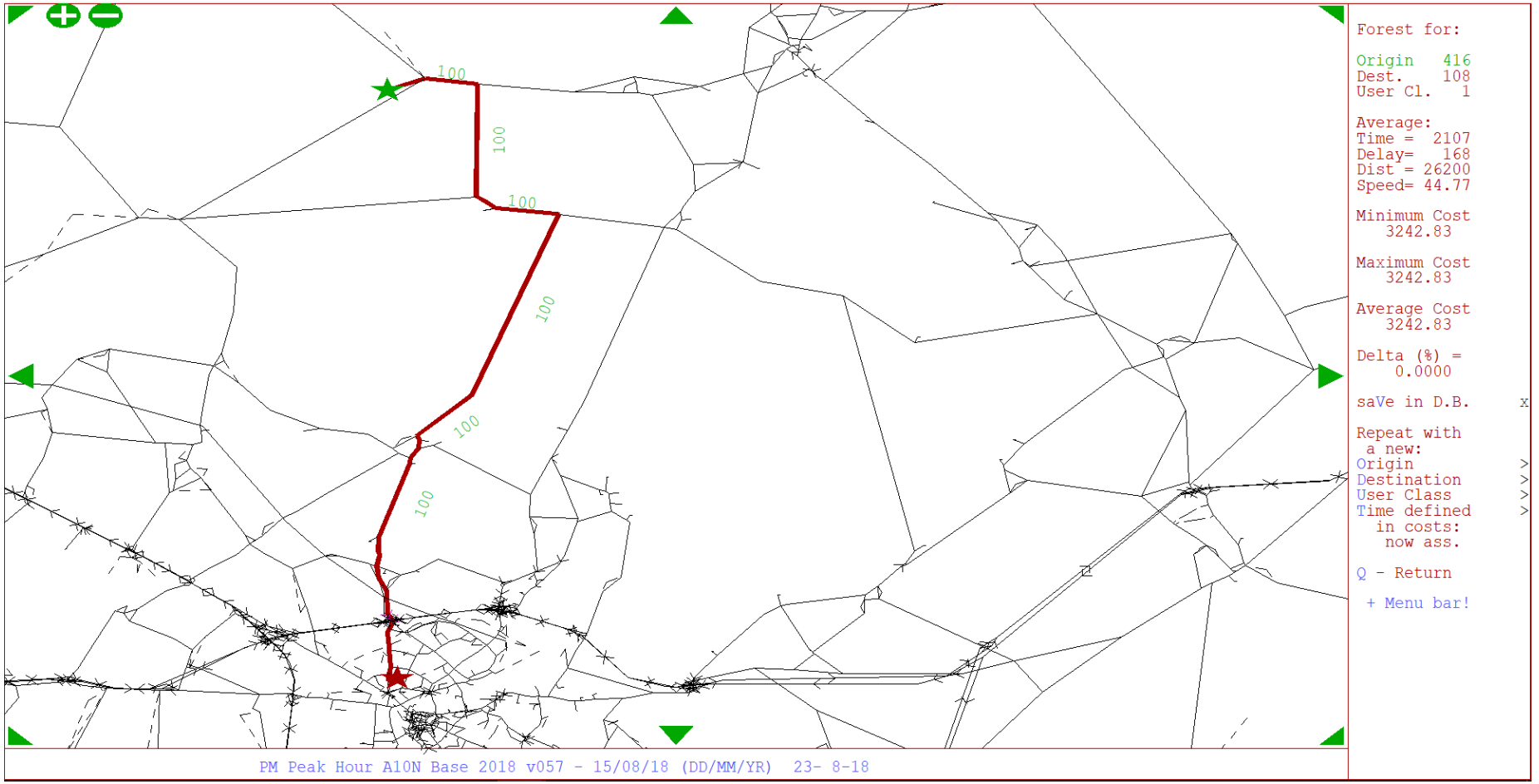
H.23. Ely to Newmarket, PM Peak



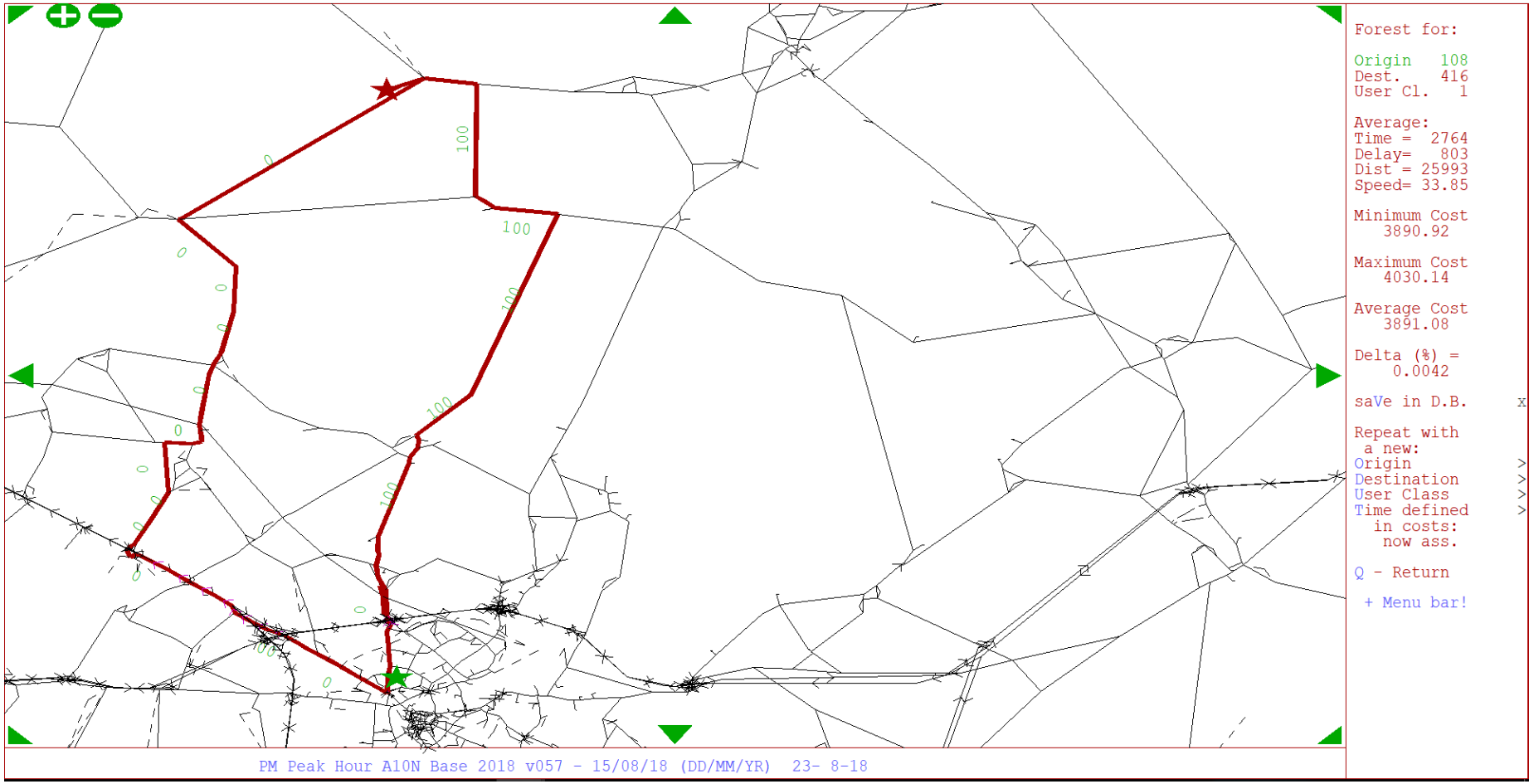
H.24. Newmarket to Ely, PM Peak



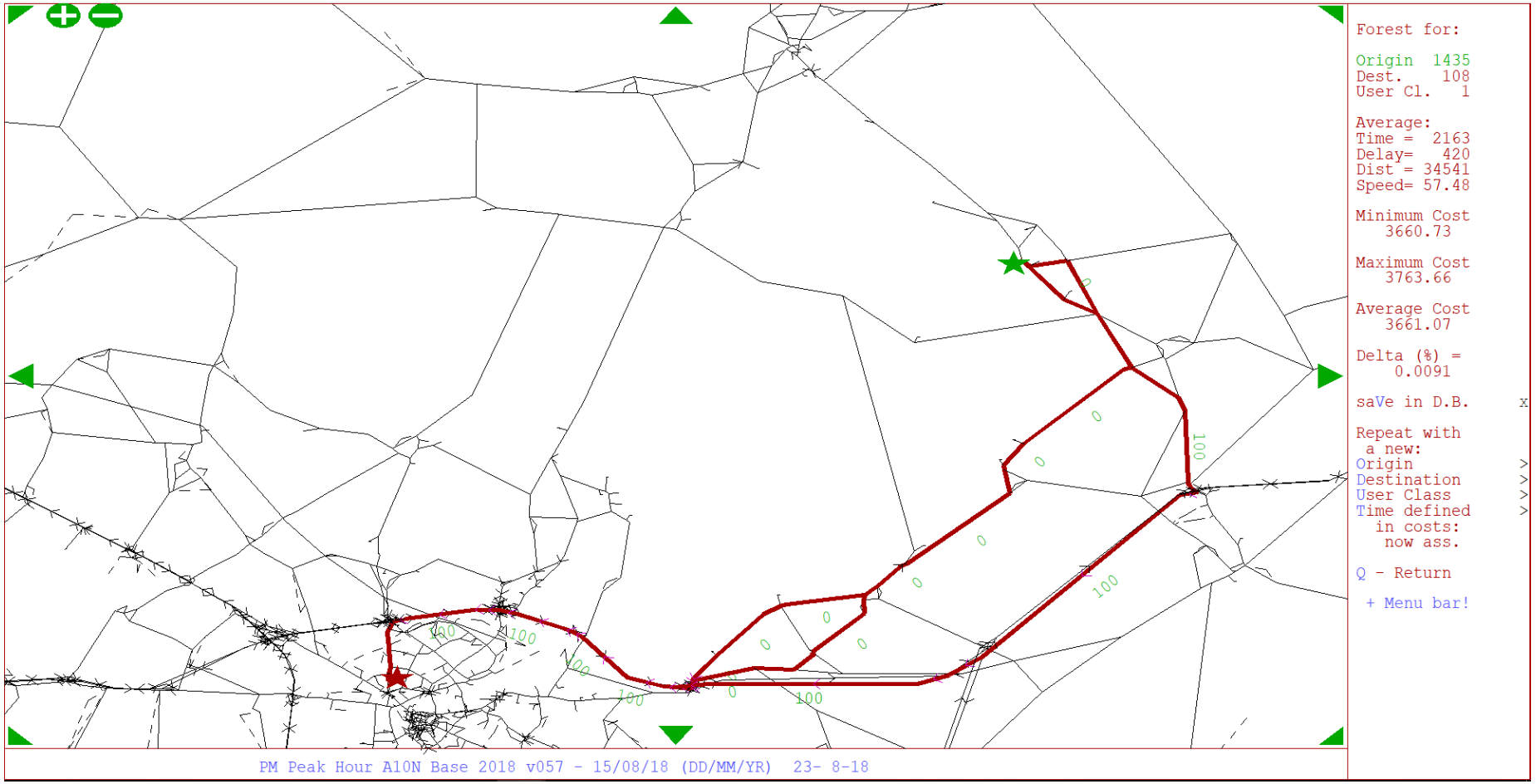
H.25. Sutton to Cambridge, PM Peak



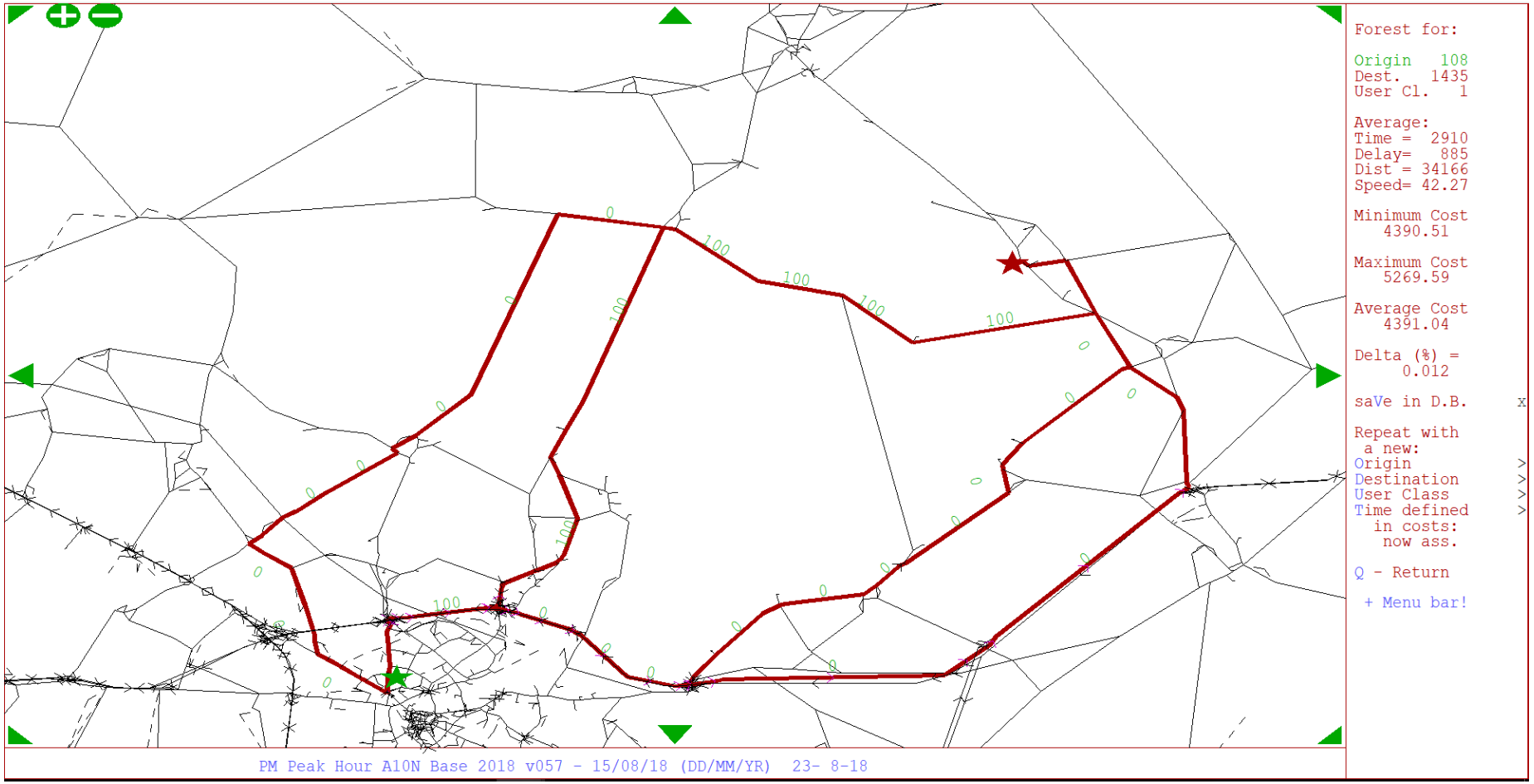
H.26. Cambridge to Sutton, PM Peak



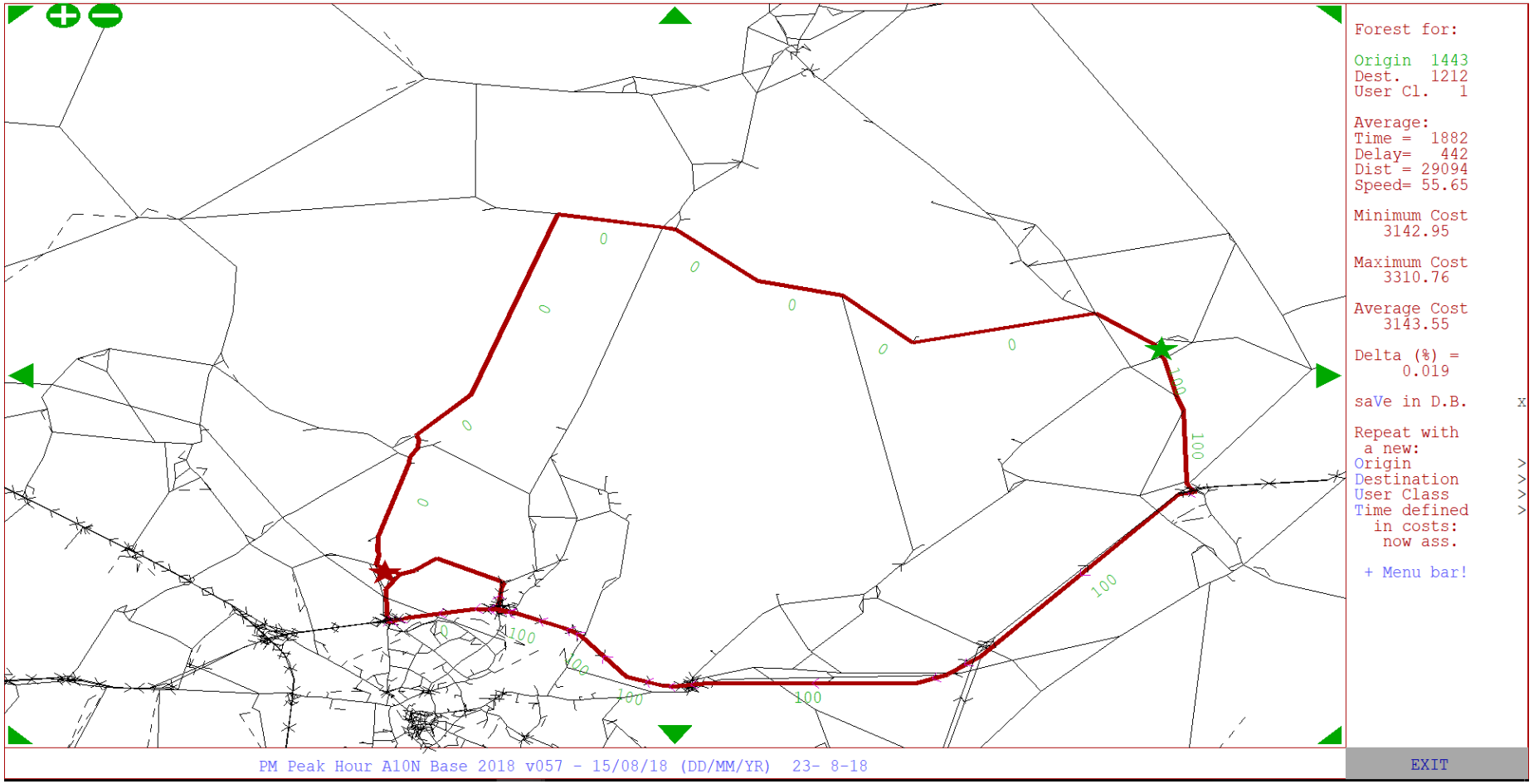
H.27. Soham to Cambridge, PM Peak



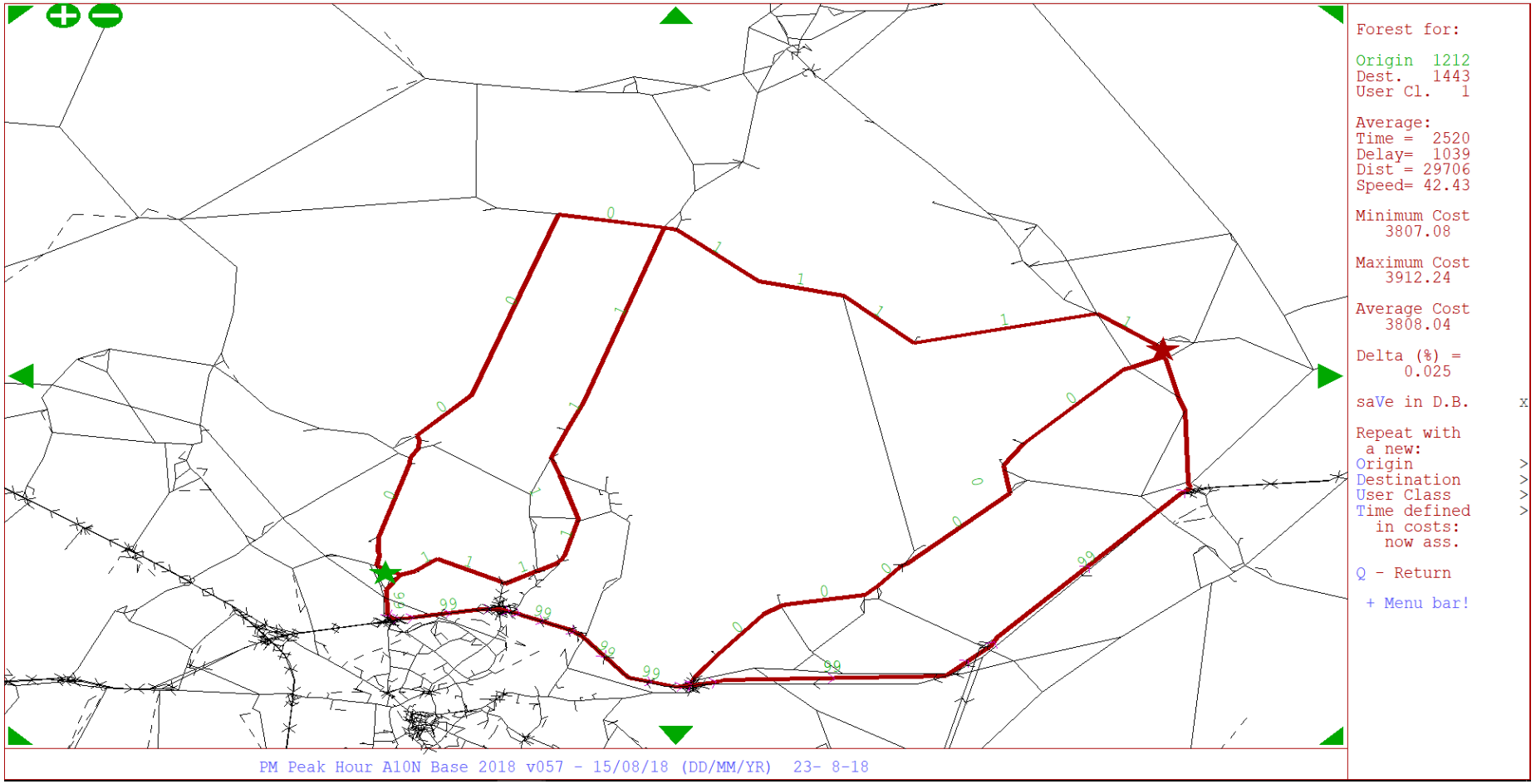
H.28. Cambridge to Soham, PM Peak



H.29. Fordham to Impington, PM Peak



H.30. Impington to Fordham, PM Peak



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