Bandon Transportation and Public Realm Enhancement Plan
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BANDON TRAFFIC MODEL DEVELOPMENT REPORT- DRAFT

Cork County Council
Comhairle Contae Chorcaí

BARRY & PARTNERS
consulting engineers

SYSTRA

BANDON TRANSPORTATION AND PUBLIC REALM ENHANCEMENT PLAN

BANDON TRAFFIC MODEL DEVELOPMENT REPORT- DRAFT

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1. INTRODUCTION

1.1 Overview

1.1.1 SYSTRA and J.B. Barry & Partners were appointed by Cork County Council to undertake the Bandon Transportation and Public Realm Enhancement Plan (Bandon T-PREP). The overall aim of the Bandon T-PREP is to ensure that there is an integrated approach to public realm enhancement and transportation engineering for the future development of the town.

1.1.2 The study will determine what transport infrastructure improvements and policy measures are needed to accommodate the anticipated expansion of the town that will result in a growth in vehicular, pedestrian and cyclist traffic volumes. The study shall also address the potential to enhance the public realm in specific locations to increase the vibrancy and attractiveness of the town and to encourage active travel.

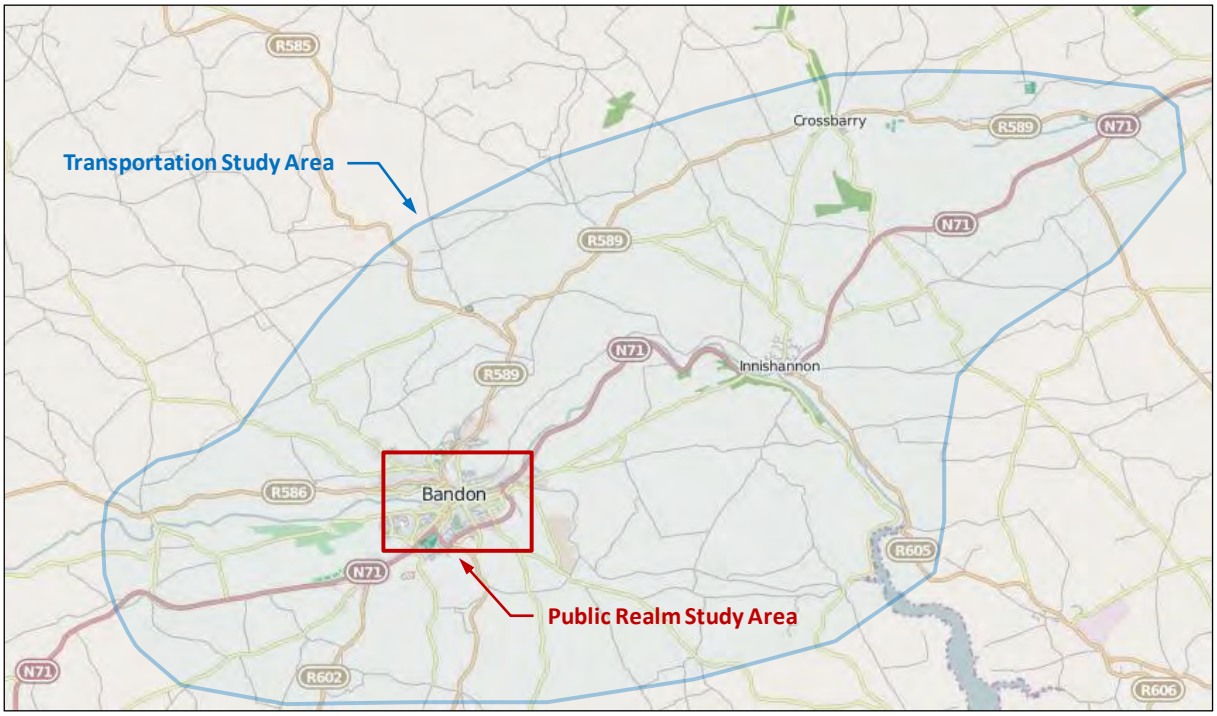

Figure 1.1 Bandon TPREP Study Area

1.1.3 The overall methodology for the Bandon TPREP is outlined in Figure 1.2 overleaf, and can be broken down into the following key steps:

- **Evaluation of Existing Situation:** SYSTRA and JB Barry will carry out a baseline study of Bandon to gain an appreciation of current conditions within the town, including the identification of potential transportation and public realm issues. A public consultation event will be held to present the study to the general public in Bandon, and allow them to voice their opinions and concerns regarding the future of the town.
- **Visioning, Evaluation Framework & Strategy Development:** The vision for the Bandon TREP will be defined based on feedback from the public consultation and

a review of national and local policy. Objectives and Key Performance Indicators (KPI's) will be defined to achieve the defined vision. A package of strategy measures will be developed for testing based on current transportation and public realm issues identified within the Bandon Local Area.

- **Strategy Assessment & Future Plan:** The various strategies will be tested utilising a strategic traffic model developed for the Bandon Local Area. The results of the model runs will be analysed using the defined KPI's to identify which strategy best achieves our study objectives.

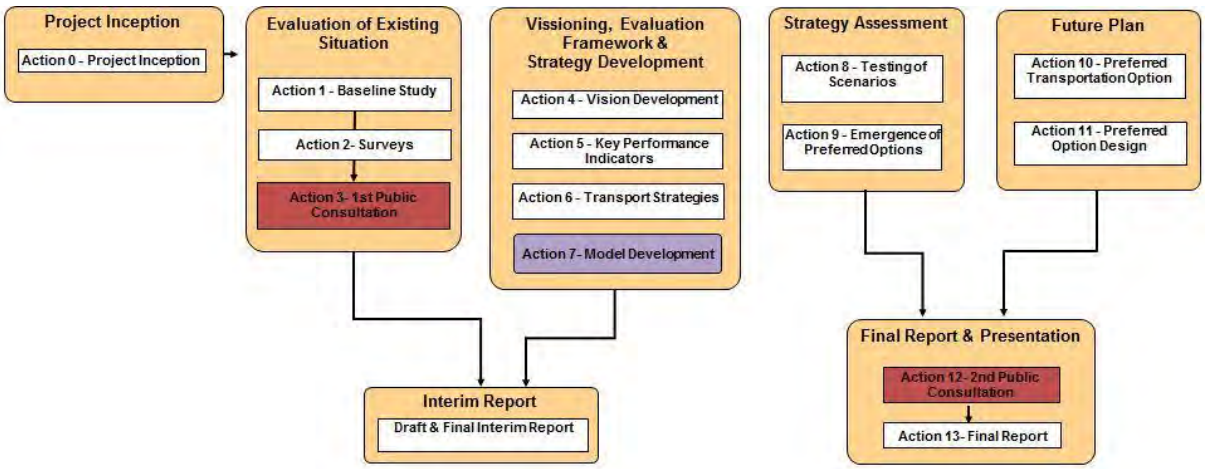

Figure 1.2 Bandon TPREP Study Methodology

1.2 Purpose of this Report

1.2.1 To adequately assess the various transport strategies developed for the Bandon TPREP, a strategic traffic model has been developed for the Bandon Local Area. In this report, we describe the model development process used for the base year Bandon Traffic model (BTM), including a detailed description of the calibration process and validation statistics.

1.2.2 SYSTRA are currently developing the Southwest Regional Model (SWRM) for the National Transport Authority (NTA) which covers Cork City, Cork County and neighbouring counties. The SWRM was utilised as a base for developing the strategic traffic model for the Bandon TPREP.

1.2.3 The base SWRM was updated with additional network and zonal detail to provide an enhanced representation of the road network, and route choice, in the study area (see Figure 1.1 above).

1.2.4 Traffic survey data collated for Bandon from March to April 2015 was then utilised to calibrate and validate the base BTM to ensure that it provides a robust and accurate representation of traffic flow in our study area.

1.3 Report Structure

Chapter 2 – Highway Network Development

Chapter Two provides a high level overview of the modelling software used and model dimensions such as the study area, time periods and vehicle types modelled within the BTM. Also included is an overview of the road network detail included in the study area.

Chapter 3 – Prior Trip Matrix Development

Chapter Three describes the development of the base prior trip matrix utilised in the BTM including detail on additional zone disaggregation required.

Chapter 4 - Model Calibration Process and Results

Chapter Four outlines the calibration process adopted and the accuracy achieved. The calibration methods employed to ensure the BTM is 'fit for purpose' are presented.

Chapter 5 - Validation

Chapter Five presents the validation statistics which demonstrate that the model is a suitable and robust tool to be used for the Bandon TPREP assessment. The validation uses independent count and journey time data sets.

Chapter 6 – Summary and Conclusions

Finally, Chapter Six provides a summary of the key points of this modelling report.

2. HIGHWAY NETWORK DEVELOPMENT

2.1 Introduction

2.1.1 This chapter describes the development of the base BTM highway network with reference to the following aspects:

- Modelling software used;
- Model time periods; and
- Network development.

2.2 Model Software Platform: SATURN

2.2.1 The model software used is the SATURN (Simulation Assignment of Traffic to Urban Road Networks) suite of transportation modelling programs.

2.2.2 SATURN has 6 basic functions:

1) As a combined traffic simulation and assignment model for the analysis of road-investment schemes ranging from traffic management schemes over relatively localised networks (typically of the order of 100 to 200 nodes) through to major infrastructure improvements where models with over 1000 junctions are not infrequent;
2) As a "conventional" traffic assignment model for the analysis of much larger networks (e.g., up to 6000 links in the standard PC version, 37500 in the largest);
3) As a simulation model of individual junctions;
4) As a network editor, data base and analysis system;
5) As a matrix manipulation package for the production of, for example, trip matrices; and
6) As a trip matrix demand model covering the basic elements of trip distribution, modal split, etc.

2.3 Model Time Periods

2.3.1 The standard model time period for traffic simulation and assignment models is one hour. At the outset of this project it was proposed that the BTM would also be a one hour model and initial model development and data collection was carried out based on this assumption.

2.3.2 Following a review of traffic movements, patterns and journey times, it became apparent that a one hour model would not be suitable for the BTM for the following reasons:

Observed Journey Times: SYSTRA carried out a journey time assessment on three specified routes through Bandon Town (described in detail in Chapter 5). These

independent tests indicated a significant increase in journey times between the half hour period of 08:30 – 09:00 when compared against the preceding half hour.

Traffic Counts: Automatic Traffic Counts (ATC) and Junction Turning Counts (JTC) were carried out in Bandon to gain an understanding of current traffic flows in the area (see Chapter 4 for further details). Analysis of baseline count information indicated that traffic within Bandon is not evenly spread over the peak hour but concentrated within a half hour period (see Figure 2.1 below).

School Trips: The majority of schools in the Bandon Area start at 09:00. The result of this is that the majority of school trips, which are a significant contribution factor to congestion in Bandon, take place between 08:30 and 09:00.

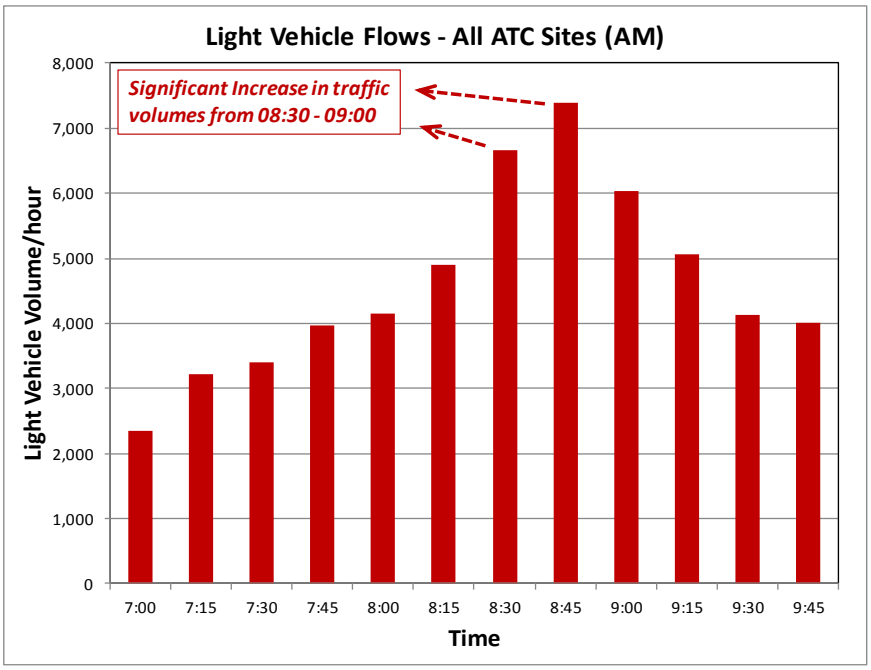

Figure 2.1 Bandon TPREP Observed Traffic Flows

2.3.3 In order to realistically represent the delay that occurs in Bandon, the decision was made, based on the above findings, to develop a half hour traffic model for the area. This would enable the capture of all key movements (home to work and home to school) during the morning and evening peak period and would replicate the areas impacted most by congestion in Bandon.

2.3.4 Therefore, the BTM was developed, calibrated and validated to represent the following time periods:

AM Morning peak period:	**08:30 to 09:00**
PM Evening peak period:	**17:30 to 18:00**

2.3.5 The trip demand matrices for these time periods, representing a base year of 2015, were developed for the BTM using survey data collected in March 2015 (described in Section 4.2 of this report). The demand matrices are segregated into two vehicle types (or user classes), as follows:

User Class One - Cars and light Goods Vehicles (LV's). All cars and two axle trucks or other type commercial vehicles are considered LV's; and

User Class Two - Heavy Goods Vehicles (HV's). This user class is comprised of goods vehicles with 3 or more axles.

2.4 Network Development

2.4.1 The goal in developing the BTM was to develop a traffic model that accurately reflects current traffic conditions in the study area (illustrated in Figure 1.1 previously) for the 2015 base year, and to a sufficient level of detail to allow assessments to be made on both local and strategic interventions. To achieve this goal, the model must be defined in terms of road network and trip demand representation.

2.4.2 The SWRM developed for the NTA was utilised as a base for generating the highway network for the BTM. However, as the SWRM is primarily focused on Cork City, areas outside the city are represented in lesser detail within the model.

2.4.3 The Bandon road network, represented in the SWRM, is outlined in Figure 2.2 below. Within the SWRM, the Bandon road network is coded in 'Buffer' and therefore the junctions, and hence delay, are not represented accurately. This is common practice in large scale models such as the SWRM. To reduce computing time, only the key area of interest, i.e. Cork City, is represented in detail. For all other areas of the model, the road network is only coded in sufficient detail to ensure that the correct routes are utilised by traffic.

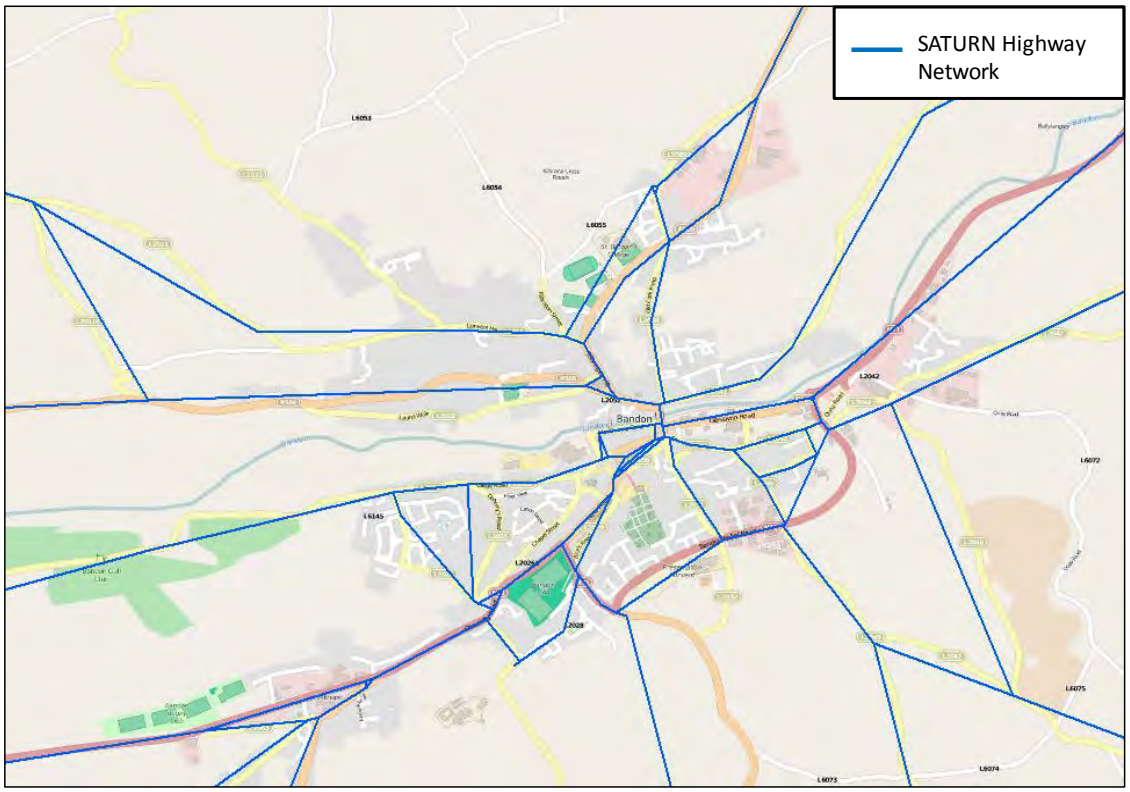

Figure 2.2 SWRM Bandon Road Network

2.4.4 In developing the BTM, additional network detail was added to the SWRM to enhance the traffic network, in particular, around Bandon Town. All junctions within the network were also represented in detail.

2.4.5 As part of the regional model development process for the NTA, SYSTRA have carried out a review of traffic modelling processes and generated a best practice approach for coding road networks, including:

- Standardised turning saturation flows at junctions;
- Standardised speeds used on different types of road;
- The use of flares for turns at junctions with sufficient space etc.

This best practice approach was utilised to generate the detailed traffic network for the BTM. Digital mapping systems such as Google Earth were used to get a high level view of the network including junction layout details, such as permitted or banned turns, junction priority etc., to ensure it represented, as accurately as possible, the existing road network. Figure 2.3 illustrates the finalised road network developed for the BTM.

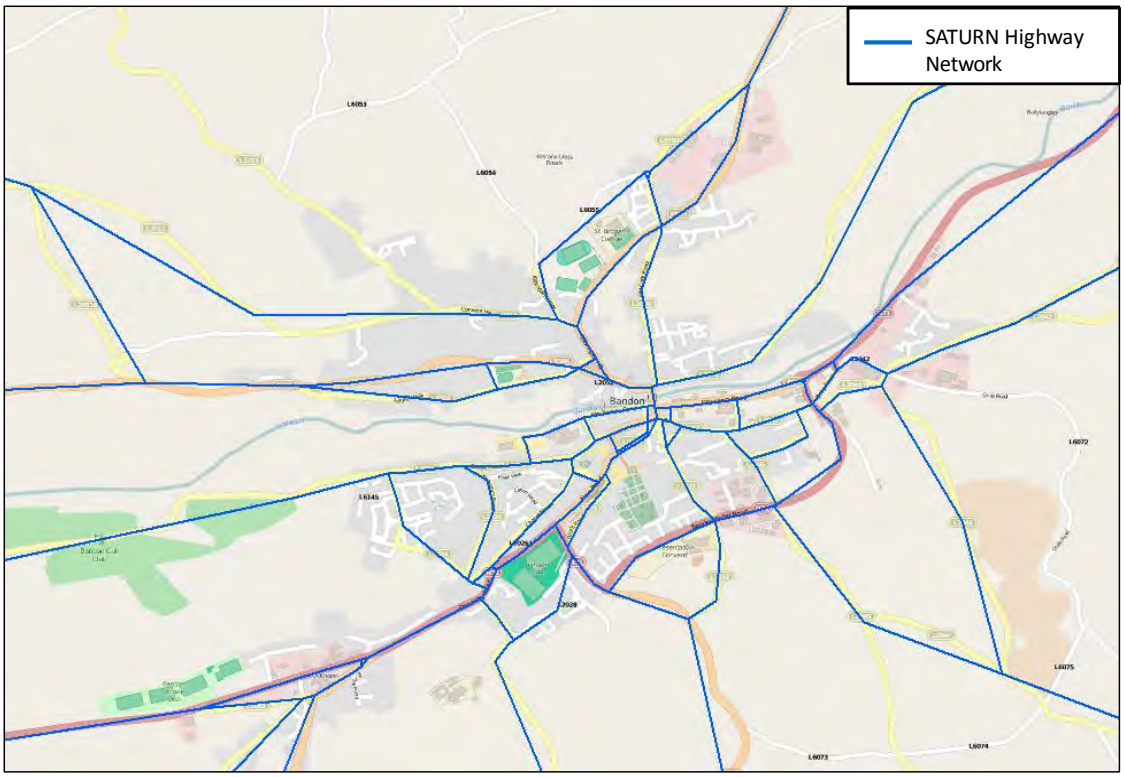

Figure 2.3 Bandon Traffic Model Road Network

2.4.6 As can be seen above in Figure 2.3, a very detailed highway network has been developed for Bandon Town. To ensure full network coverage and route choice, all roads have been taken into account from the national primary routes to minor residential streets.

2.4.7 The model network has been developed to incorporate the entire transportation study area outlined in Figure 1.1 previously. The overall BTM modelled area extends from the

Civic Amenity Road and Baxter's Bridge in the west, to Halfway in the east and is illustrated in Figure 2.4 below.

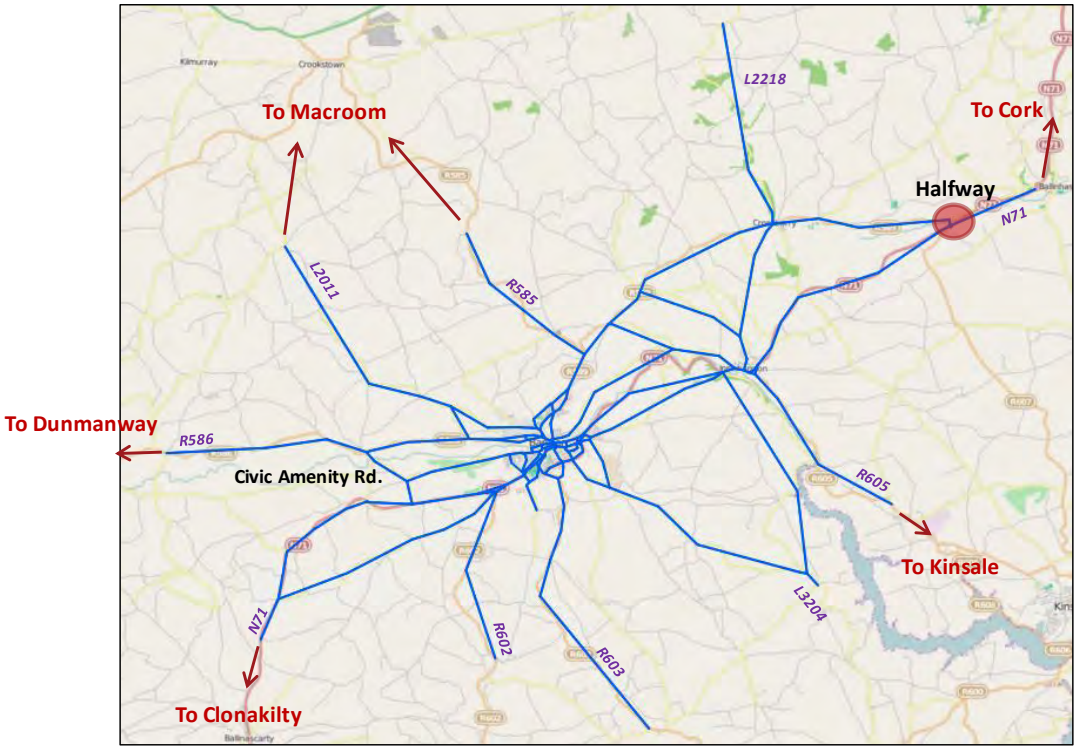

Figure 2.4 Bandon Traffic Model Area

2.4.8 The road network is represented in lesser detail towards the edge of the modelled area, outside Bandon Town, with key strategic access roads joining to defined external zones (model zoning will be discussed in further detail in Chapter 3 of this report).

2.4.9 A detailed zoning system has been put in place to connect to the network. Major trip production / attraction zones such as housing estates, shopping centres, schools, car parks and employment locations have all been designated individual zones to provide detail in trip distribution between zones and destination choice.

Speed-Flow Curves

2.4.10 Speed-flow curves are useful for modelling delays on links which tend to be dictated by conditions on the link itself (e.g. on-street parking, bus stops etc.) as opposed to junction properties. This would be considered the case for some key routes in Bandon Town. For example, a lot of the delay associated with South Main Street is due to the availability of parking on each side of the road causing issues in terms of lane width restrictions, and people entering/exiting parking spaces (see Figure 2.5, overleaf). The use of speed-flow curves is the only method in SATURN to adequately represent this behaviour.

2.4.11 Speed-flow curves essentially define a relationship between the speed at which vehicles can travel and the amount of traffic currently on a link. As the number of vehicles approaches the defined road capacity, the vehicle speed is reduced.

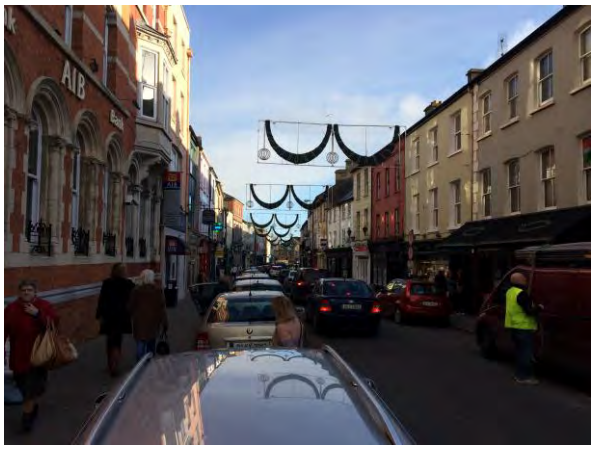

Figure 2.5 South Main Street

2.4.12 Speed-flow curves were assigned to external links (outside Bandon Town) based on the link type, and the defined speed-flow relationship developed through a best practice review carried out by SYSTRA as part of the Greater Dublin Area (GDA) Regional Model development. A full list of speed-flow curves developed for the GDA model are presented in Appendix A of this report.

2.4.13 For certain key routes within Bandon Town centre, traffic survey data (see Chapter 3 & 4 for further details) provided information on vehicular flows and approximate speeds on the network. These values were utilised to generate site specific speed-flow curves to represent issues such as lane width restrictions, gradient, availability of parking etc. The speed-flow curves generated are illustrated in Figure 2.6 below. Figure 2.7, overleaf, outlines the key routes for which these speed-flow curves have been applied.

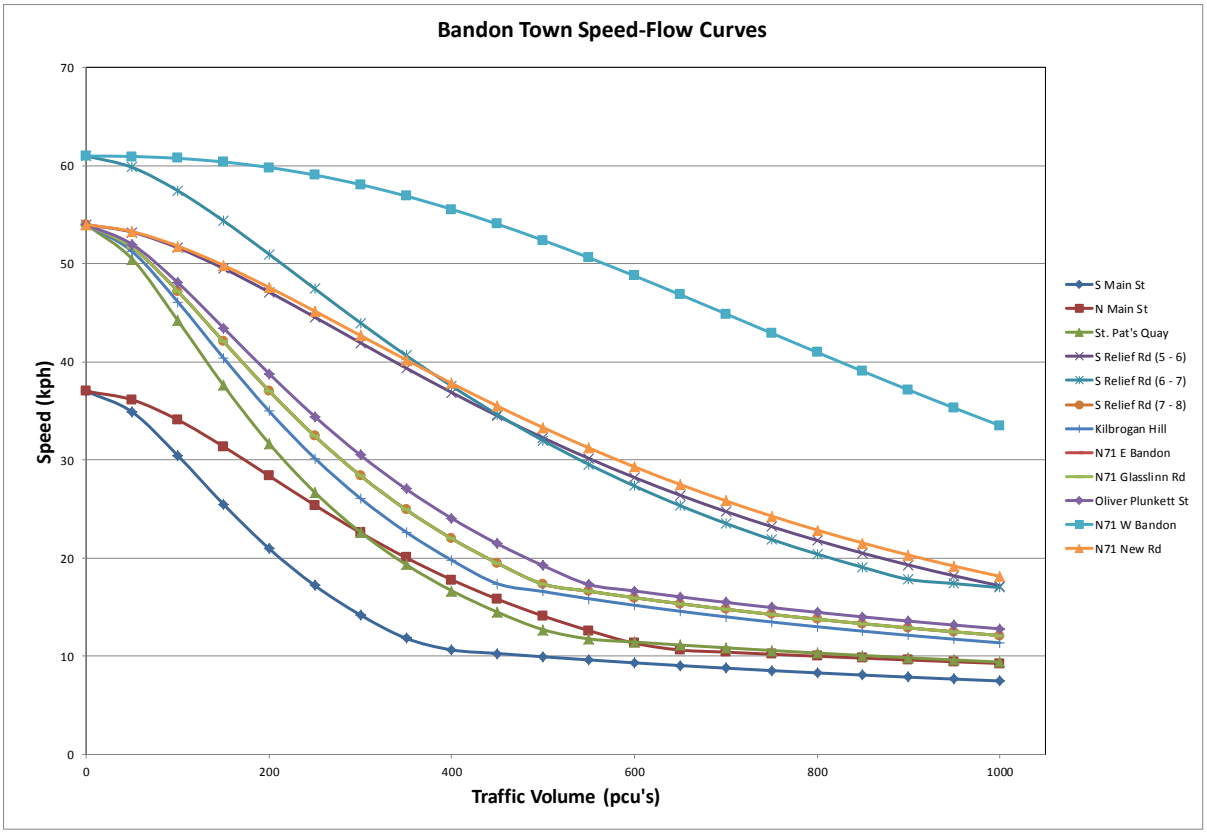

Figure 2.6 Bandon Speed-Flow Curves

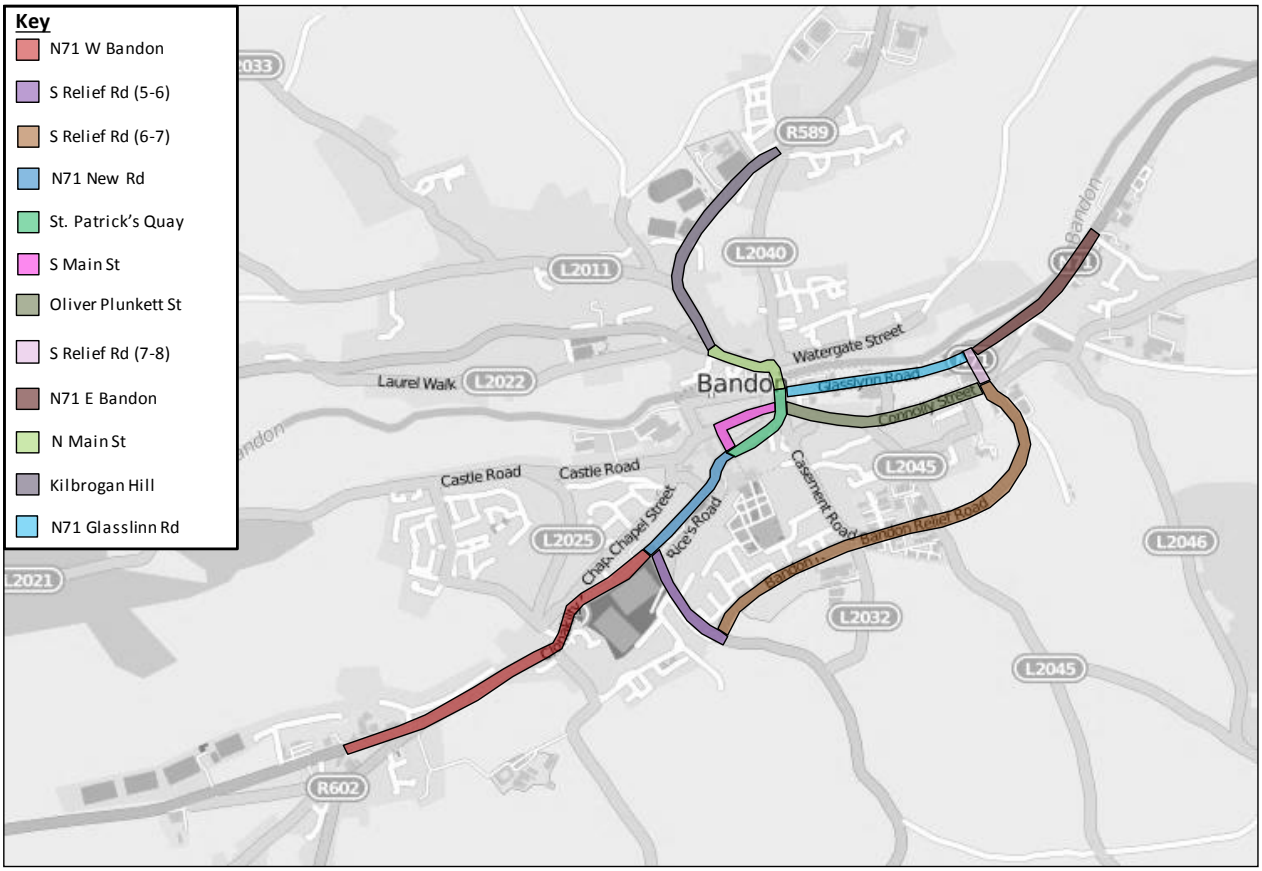

Figure 2.7 Bandon Speed-Flow Curve Routes

3. PRIOR TRIP MATRIX DEVELOPMENT

3.1 Introduction

3.1.1 This chapter provides information on the development of the Bandon zone system and the base prior trip matrices utilised in the BTM.

3.2 Zone System Development

3.2.1 As outlined in Section 2.4 previously, the SWRM was utilised as a basis for development of the BTM road network. However, as Bandon is located outside the main model area, the SWRM zone structure is at too aggregate a level to accurately reflect loading of traffic in Bandon Town.

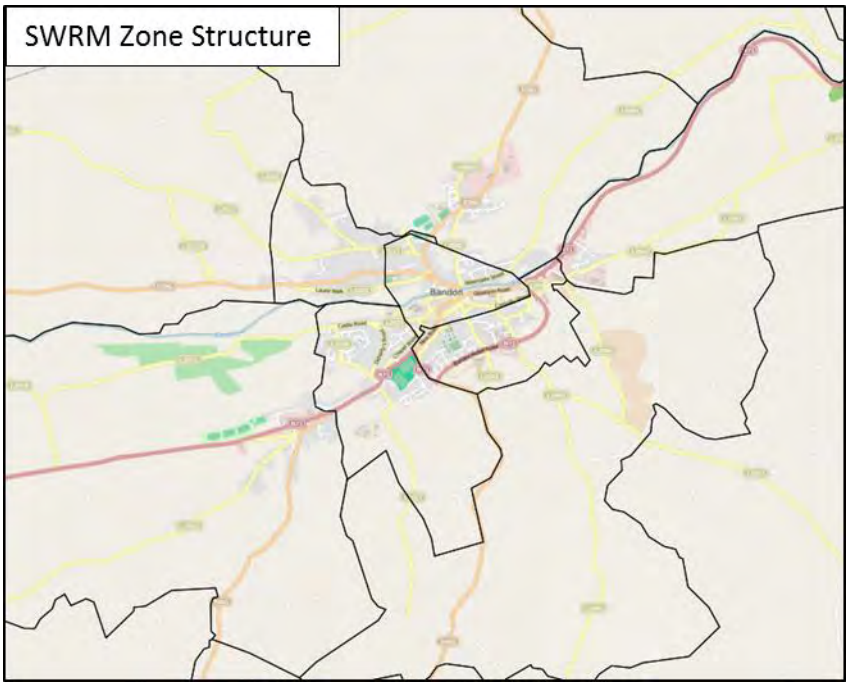

Figure 3.1 SWRM Bandon Zone Structure

3.2.2 To provide an accurate representation of traffic loading in Bandon, a detailed zonal structure was developed for the BTM using Census Small Areas. Census travel data such as the Place of Work, School or College - Census of Anonymised Records (POWSCAR) and Small Area Population Statistics (SAPS) are available at a Small Area level which can be linked to the BTM zone system.

3.2.3 Within Bandon Town, some Small Areas have been disaggregated further to reflect key generators and attractors of trips such as:

- Schools;
- Key employers e.g. Riverview Shopping Centre, Bandon Co-Op etc.
- Housing Estates etc.

3.2.4 Figure 3.2 illustrates the zonal system developed for Bandon Town in the BTM. In total, 110 zones have been created for the entire model area, along with eight identified external zones representing traffic loading onto the model network.

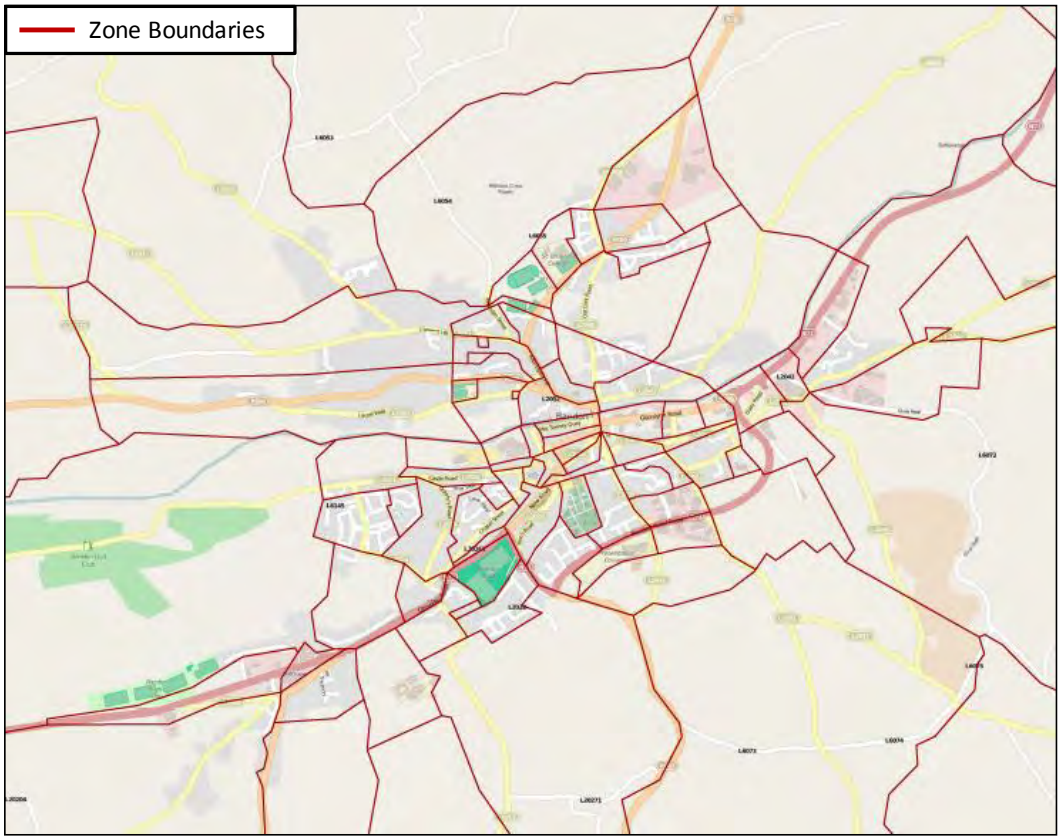

Figure 3.2 BTM Zone Structure

3.2.5 The new BTM zone structure will provide sufficient detail to ensure that traffic loads accurately onto the Bandon road network. At distances further from Bandon Town, the zone system is at a more aggregate level and consists of combinations of Census Small Areas.

3.2.6 Eight large external zones, illustrated in Figure 3.3 overleaf, have been developed to represent traffic outside the model area e.g. traffic entering Bandon from Cork City. To generate these external zones, Census Small Areas have been grouped together based on the key routes they are likely to utilise when accessing Bandon. For example, all traffic accessing Bandon from the southwest of Cork, e.g. Clonakilty, are most likely to use the N71.

3.2.7 The connection of the road network to the defined external zones is illustrated in Figure 3.4, overleaf. External to external zone movements have only been included in the model if they are likely to pass through the model area. This is to ensure that non-relevant trips, e.g. Dublin - Galway, are not being represented in the model as passing through Bandon Town.

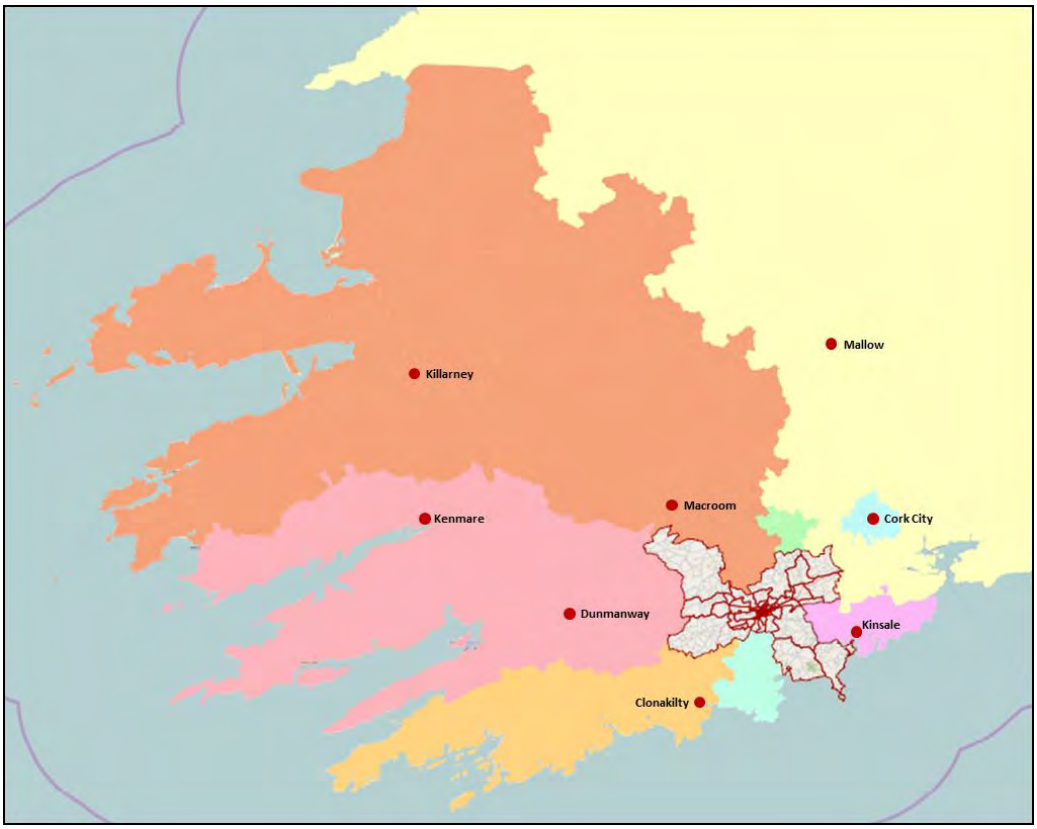

Figure 3.3 BTM External Zone Structure

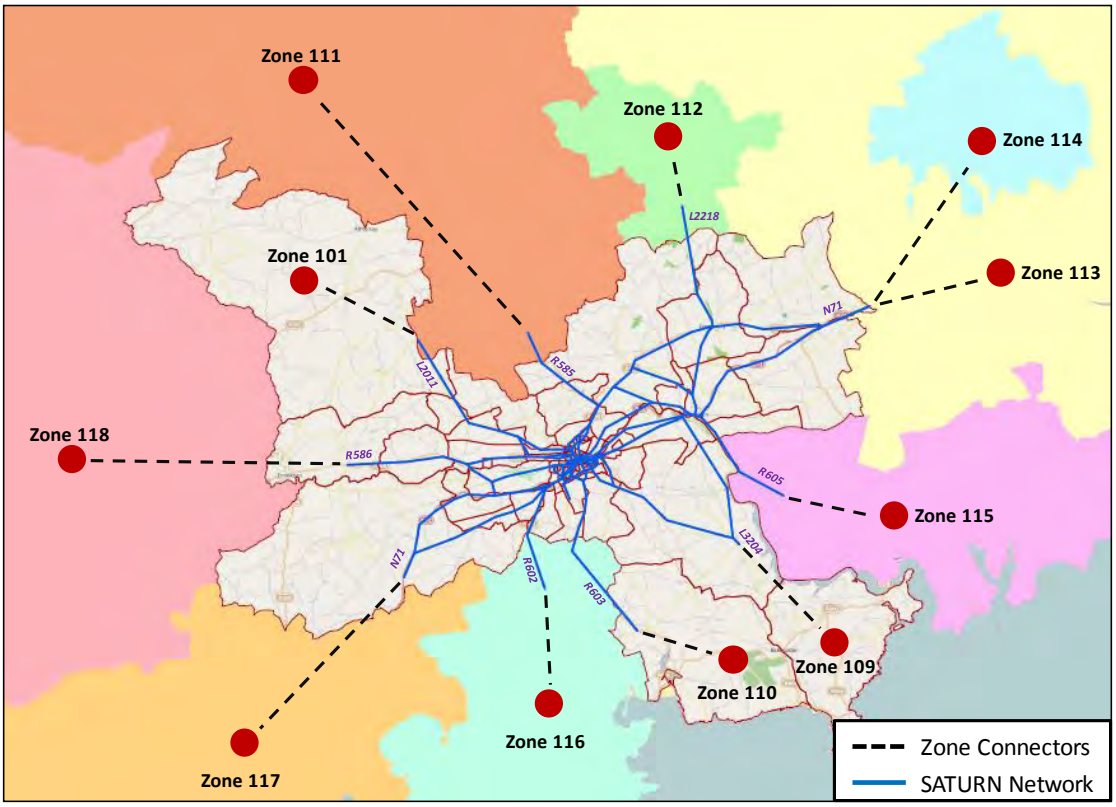

Figure 3.4 BTM External Zone Connectors

3.3 Base AM Light Vehicles Matrix

3.3.1 The SWRM is currently under development by the NTA and, at the time of commencement of the model development for the Bandon TPREP study, the SWRM base model matrix had not been calibrated or validated, and therefore, could not be used as a base for the BTM.

3.3.2 However, as part of the regional model development, SYSTRA developed a process which utilises information from the Census POWSCAR database to create a base matrix of traffic movements. Permission was granted by the NTA to utilises this process to develop a base POWSCAR matrix for the Bandon model area for the period of 08:30 - 09:00. As described in the previous section of this report, POWSCAR data is available at a Small Area level, and therefore, can easily be assigned to the newly developed BTM zone structure.

3.3.3 POWSCAR has some limitations as it only represents trips to work or school/college, and therefore, omits other journey purposes such as recreation, shopping etc. However, it was decided that for an area such as Bandon, work and school trips would represent the majority of journeys undertaken for the AM peak half hour. Therefore, the 08:30 - 09:00 POWSCAR matrix was utilised as the prior LV matrix for the BTM.

3.4 Base AM Heavy Vehicle Matrix

3.4.1 Throughout the baseline study review and 1st phase public consultation, a key recurring issue identified in Bandon Town was the significant number of Heavy Vehicles (HV's) which travel through the town centre and across Bandon Bridge. Concerns were raised regarding the impact of HV's on safety and accessibility for all road users, as well as their impact on the overall attractiveness of the town.

3.4.2 As part of the Bandon TPREP, strategies will be developed to manage HV flows through the town. Therefore, it is important that an accurate HV matrix can be developed for the BTM. The methodology utilised to develop a base HV prior matrix for the BTM is illustrated in Figure 3.5 below, and is described in the following sections.

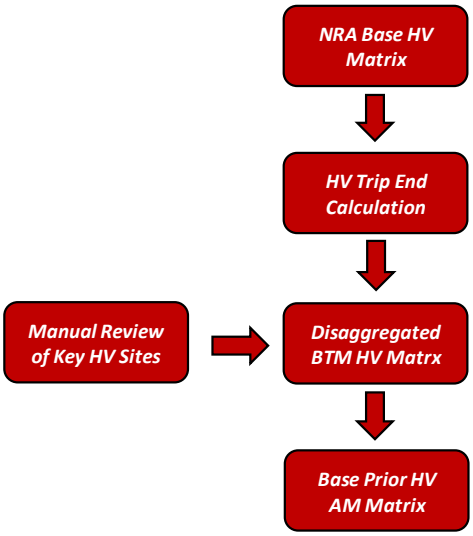

Figure 3.5 HV Prior Matrix Development Process

3.4.3 POWSCAR does not provide information on HV flows, and therefore, cannot be used to create a base matrix. A review was carried out on all available sources of HV flow data. The National Roads Authority (NRA) have developed a HV trip-end process as part of their National Model which has been found to correlate well with traffic counts on national roads throughout the network.

3.4.4 The NRA model uses Census HV travel information at a county to county level and then disaggregates this data using an algorithm based on the number of employees in various industry types.

3.4.5 The NRA provided a base HV matrix from their National Model which was cordoned for the Bandon Area. The NRA zone structure, illustrated in Figure 3.6 below, was modified to match the newly developed BTM zone system.

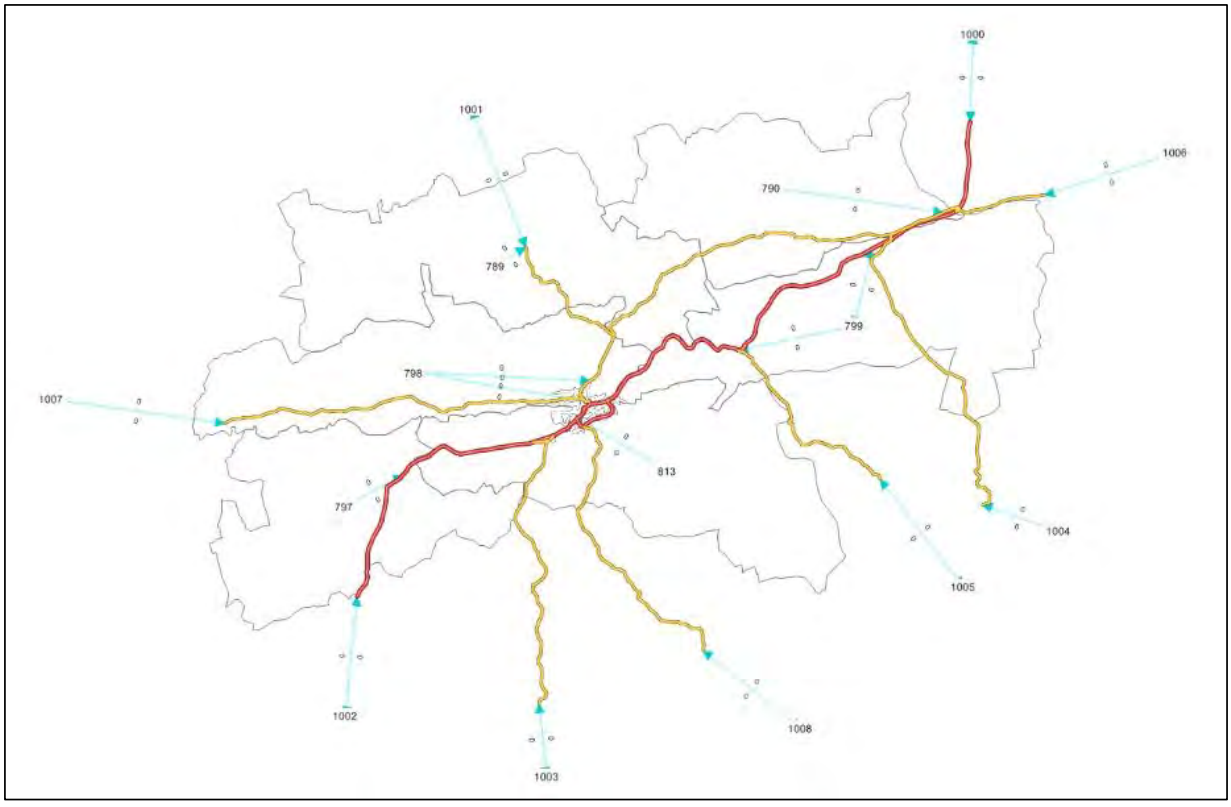

Figure 3.6 NRA Model Zone System for Bandon

3.4.6 A number of the NRA zones needed to be disaggregated to match the additional zonal detail of the BTM. This disaggregation was carried out using the HV trip-end calculation developed by the NRA. This calculation was reviewed during the regional modelling scoping process undertaken by SYSTRA and refined to provide the following equation:

$$HV\ Trip\ Ends\ (000s) = (0.0858 \times POWSCAR\ 1) + (0.0234 \times POWSCAR\ 4)$$

Where:

- ***POWSCAR 1*** = No. of employees in Agriculture, forestry and fishing; and
- ***POWSCAR 4*** = No. of employees in Wholesale, Retail Trade, Transportation and Storage, Accommodation and Food Service Activities

3.4.7 As part of the Regional Demand Model development for the NTA, SYSTRA have extracted employment numbers by POWSCAR industry type at a Small Area level. This information was then assigned to the defined BTM Zone System. The HV trip-end calculation was then utilised to identify the proportion of NRA HV zonal trips which should be assigned to the BTM zones.

3.4.8 It was noted that, due to the nature of the HV trip-end equation, some areas which would have been assigned HV trips in the town centre may not be realistic. For example, small shops, which would be defined as retail in POWSCAR, are unlikely to be serviced by large HV's. To avoid this issue, a manual review of zones was carried out in Bandon Town to identify key HV attractors/generators which are illustrated in Figure 3.7. Weightings were applied to these key HV zones to ensure that the disaggregated NRA HV volumes were distributed to appropriate areas.

3.4.9 The NRA HV matrix, disaggregated to the developed Bandon Zone System was utilised as the prior HV matrix for the BTM.

Figure 3.7 Defined HV Zones in Bandon Town

3.5 PM Trip Matrix Development

3.5.1 As the majority of trips in the PM peak are usually the reverse of AM peak trips (i.e. work to home as opposed to home to work), the PM peak demand matrix was derived by transposing the AM demand matrix. This is a standard modelling technique for developing PM matrices and converts all I-J trips in the AM matrix to J-I trips in the PM matrix and vice versa.

3.5.2 To reflect the fact that schools are closed during the PM peak period, all trips to/from designated school zones were removed from the transposed AM matrix.

3.5.3 The PM prior matrix was then further refined using PM peak count information in a matrix estimation process. Further details on the matrix estimation process are explained in the following chapter of this report.

4. MODEL CALIBRATION PROCESS AND RESULTS

4.1 Overview

4.1.1 Once the base prior matrix is created, calibration is used to improve agreement in the model between observed and modelled traffic characteristics.

4.1.2 Generally, the components of the model that may be adjusted on the demand side are trip distribution and trip production and generation rates. This adjustment usually involves trip matrix estimation.

4.1.3 On the supply side (network), modelled junction and link characteristics may be altered if sufficient new information is available to justify changes to the existing network.

4.1.4 The following sources on traffic model calibration/validation guidance have been used to inform the model development process:

- Highway Capacity Manual 2000 (US);
- DMRB Volume 12 Section 2 Part 1 (UK);
- National Roads Authority Project Appraisal Guidelines, Appendix 3, Traffic Modelling;
- National Transport Authority validation criteria; and
- SATURN manual validation guidelines.

4.1.5 The following sections of this chapter detail the calibration process undertaken to ensure that the BTM accurately reflects baseline conditions, including information on:

- Traffic Count Data;
- Calibration Steps;
- Matrix Estimation; and
- Calibration Statistics i.e. GEH and Linear Regression Analysis

4.2 Traffic Count Data

4.2.1 To ensure the robustness of the developed strategic model, a series of traffic counts were commissioned for Bandon Town to assist in the calibration and validation of base model flows.

4.2.2 A dedicated traffic survey company, Abacus Transportation Surveys Ltd., were commissioned to undertake the following surveys in Bandon Town:

- Junction Turning Counts (JTC) at 28 locations;
- Automatic Traffic Counts (ATC) at 12 location;
- Bluetooth Origin Destination Surveys at 4 locations;
- Bluetooth Journey Time Surveys on three key routes; and
- Pedestrian counts at 15 locations.

4.2.3 The JTC and ATC survey locations are illustrated in Figure 4.1 and 4.2, overleaf. The Journey Time Surveys are discussed in further detail in Chapter 5 describing the model validation process.

4.2.4 Turning counts were taken at key locations and provide an exact knowledge of movements within a specified junction. The locations of ATC surveys provide a record of traffic on the key routes entering/exiting Bandon Town over an extended period of time (14 days). Incorporating this information enables an accurate representation of traffic flows within the model.

4.2.5 For further information on analysis of the traffic count data, the reader is referred to the *Traffic Survey Data Collection Note* produced by SYSTRA and JB Barry & Partners. The ATC and JTC data is presented in Appendix B of this report.

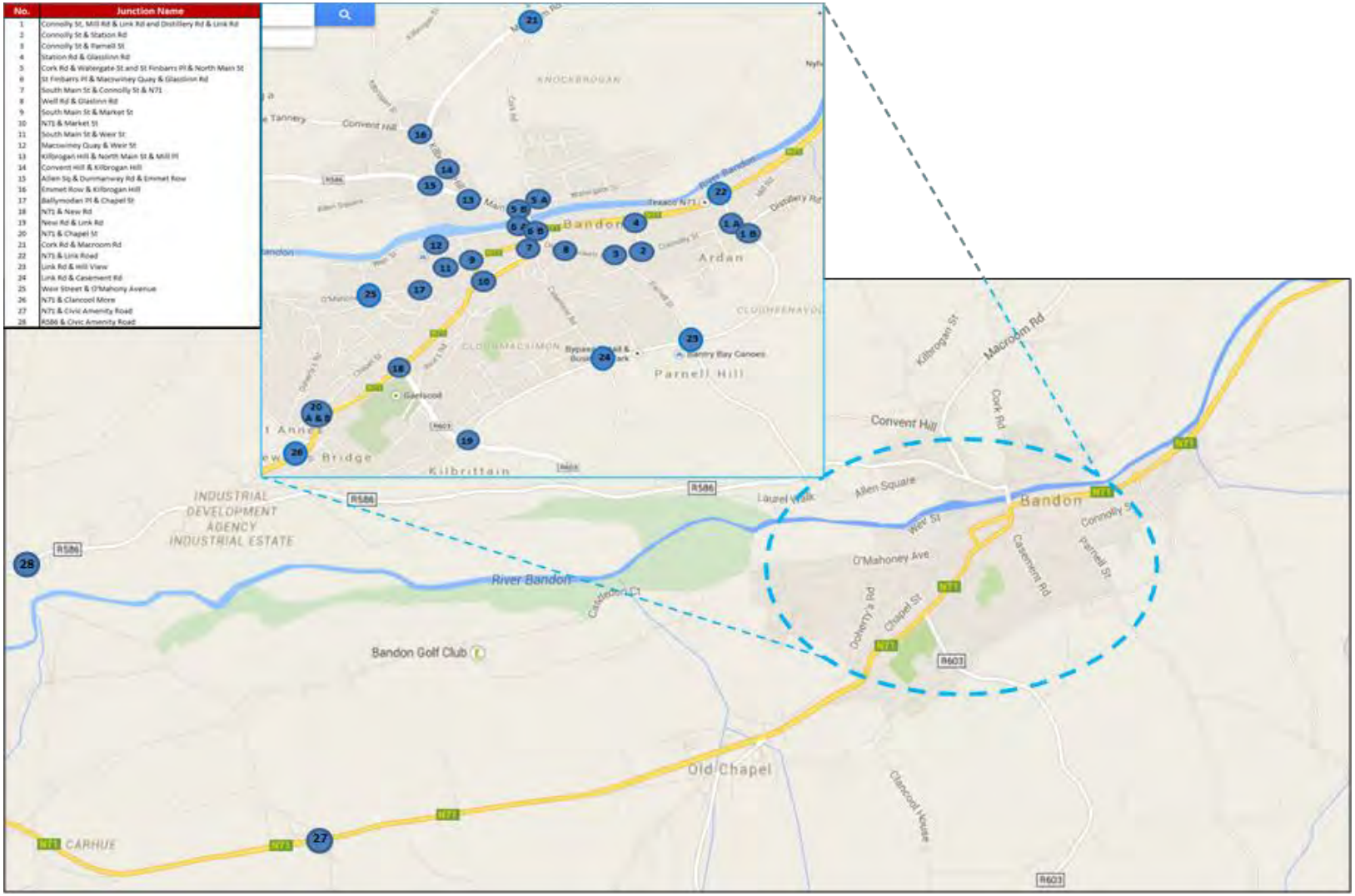

Figure 4.1 Bandon JTC Survey Locations

No.	Road Name
1	R589 Macroom Road
2	Local Road @ Coolfadda
3	R586 Dunmanway Road @ Coolfadda
4	N71 Clonakilty Road
5	R603 New Road, South of Link Road
6	Hill View, South of Link Road
7	Distillery Road, South of Rosewood Meadows
8	N71 Cork Road
9	R586, East of Baxter's Bridge
10	Civic Amenity Road
11	N71 @ Knocknagarrane
12	Local Road @ Killountain

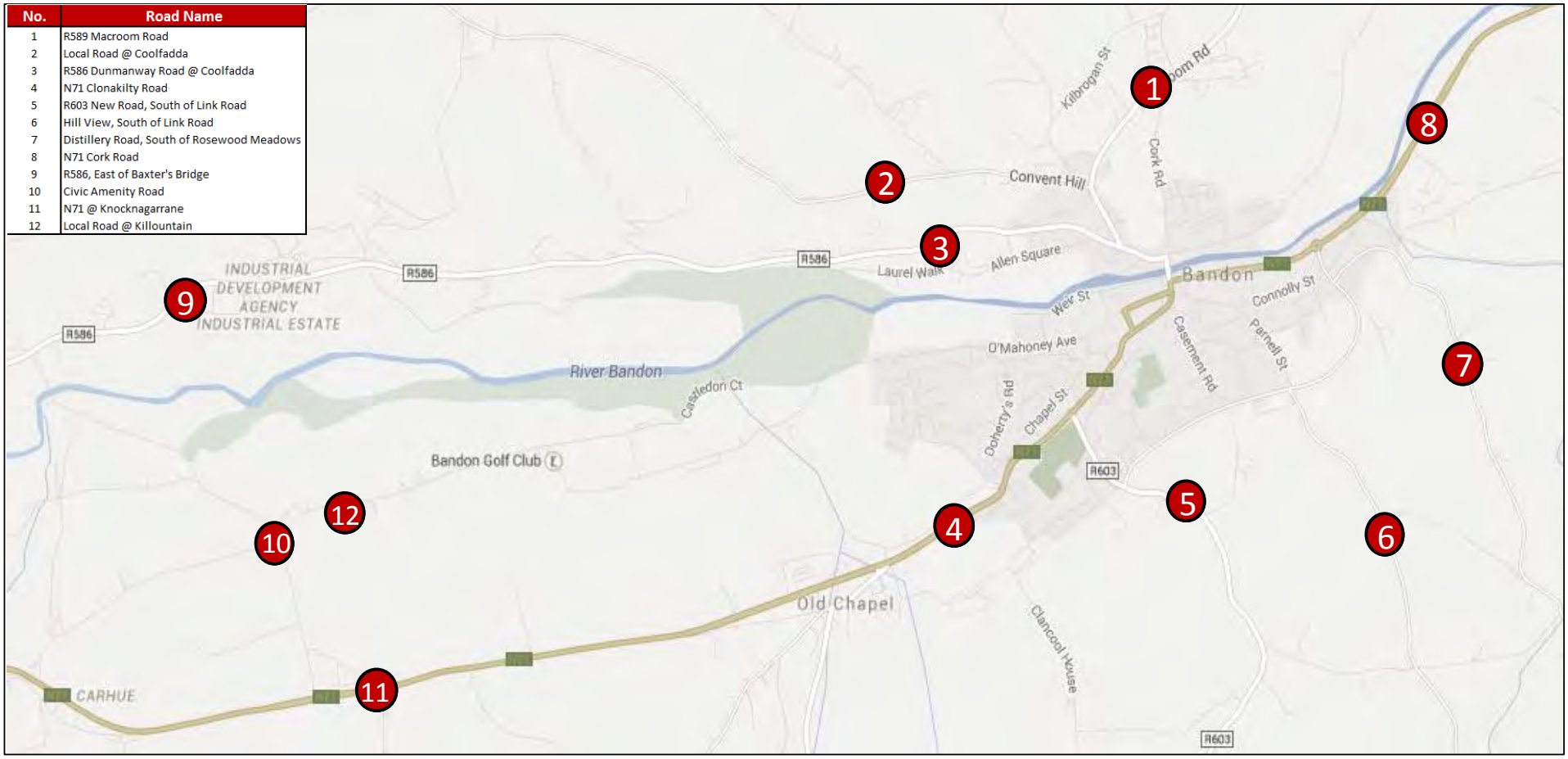

Figure 4.2 Bandon ATC Survey Locations

4.3 Network Calibration Steps

4.3.1 As an initial calibration step, all modelled movements with corresponding junction turning counts were examined to determine if the count exceeded modelled capacity. Remedial steps were then taken to permit realistic flows in the model.

4.3.2 Similarly, the capacity and speeds of modelled links were also checked to ensure they were broadly in line with survey information.

4.3.3 As the BTM was coded based on best practice approaches developed during the NTA Regional Model Scoping Process, the network coded was an accurate and up-to date representation of the existing road network. If required however, the following network model parameters were adjusted if there was clear reason for doing so:

Network Adjustment Possibilities

- Junction type (Priority, Signalised, Roundabout);
- Road lengths;
- Signal timings;
- Link free flow travel speed;
- The number of approach lanes at each junction arm;
- Traffic lane width per junction approach, and the lane discipline adopted (including prohibited turns);
- Saturation flow through junctions;
- Assumed road capacities;
- Link based flow-delay relationships; and
- Any other traffic management measures that may impact on capacity, such as bus lanes, traffic calming, parking controls and cycle-lanes.

Network Adjustment Possibilities – Traffic Zones

- Zone co-ordinates; and
- Zone loading points (connections to the network).

4.4 Trip Demand Adjustment (Matrix Estimation)

4.4.1 Following calibration of the network, trip demand is adjusted according to count data, so that there is an improved agreement between counts and modelled flows. The base prior matrix (described in Chapter 3) is fed into a SATURN programme called ME2. ME2 then adjusts origin-destination patterns to produce a trip demand matrix that better replicates counts when assigned to the network. When this replication is satisfactory the matrix is said to be calibrated.

4.4.2 The prior matrix is adjusted only after all options for improving the network are exhausted. Any matrix adjustment must significantly improve the match between observed and modelled flows, and not introduce more trips into a zone than could realistically be expected. Controls are placed on zones to ensure that the trip demand generated is sensible and in line with census population and employment statistics.

Matrix Adjustment Constraints

4.4.3 The algorithm driving the ME2 estimation process tends to reduce long trips in place of chains of short trips, especially when counts are spread over the entire area, which may not fully reflect reality.

4.4.4 Constraints are therefore placed on the adjustment process to protect the number of movements and distribution of the through trips contained within the original car trip matrix. By restricting such long through trips, the matrix adjustment algorithm is forced to create or re-distribute short trips.

4.4.5 Detailed constraints were developed for all zones within the study area to ensure that the ME2 process did not unrealistically alter trips entering/exiting the main areas of assessment. Census 2011 and land-use data were utilised to determine a range of the likely amount of trips that would originate, or end, in each zone and these were used as constraints in the matrix estimation process. In Summary:

Residential Zones: As POWSCAR is known to under represent trips (as it only includes work or education trips), the trip generation values from the prior matrix were utilised as minimum constraints for residential zones. Land use information identified through the creation of the BTM zone system gave a breakdown on the approximate number of housing units in each residential zone. By applying standard trip rates derived from previous studies carried out in Cork, such as the Douglas Land Use and Transportation Strategy (DLUTS), it was possible to identify maximum values for car trips produced/attracted during the AM and PM peak half hour.

Employment Zones: Minimum constraints based on POWSCAR data from the prior trip matrix were utilised to encourage employment zones as destinations. Maximum constraints were applied to areas within the town centre to reflect the amount of on-street parking available.

Schools: Minimum constraints were applied to school zones based on POWSCAR data in the prior matrix. Standard trip rates were applied to the total number of pupils and staff in each school to identify the absolute maximum number of trips that could be attracted in the AM peak half hour (08:30 - 09:00). For the PM peak (17:30 - 18:00), constraints were applied to ensure that no trips were attracted to school zones to reflect the fact that all schools would be closed at this time.

Heavy Vehicles: Constraints were applied on all residential and unsuitable zones to ensure that HV traffic was not assigned to inappropriate zones in the BTM. For key HV generators/attractors in Bandon (see Figure 3.7), a possible range of values were defined based on localised surveys carried out in the area.

4.5 Traffic Flow Accuracy Measure: GEH

4.5.1 The GEH statistic is a measure that considers both absolute and proportional differences in flows. Thus for high levels of flow a low GEH may only be achieved if the percentage difference in flow is small. For lower flows, a low GEH may be achieved even if the percentage difference is relatively large. GEH is formulated as:

$$GEH = \sqrt{\frac{(observed - modelled)^2}{0.5 \times (observed + modelled)}}$$

The reason for introducing such a statistic is the inability of either the absolute difference or the relative difference to cope over a wide range of flows. For example an absolute difference of 100 pcu/h may be considered a big difference if the flows are of the order of 100 pcu/h, but would be unimportant for flows in the order of several thousand pcu/h. Equally a 10% error in 100 pcu/h would not be important, whereas a 10% error in, say, 3000 pcu/h might mean the difference between building an extra road lane or not.

4.5.2 In general the GEH parameter is less sensitive to the above statistical biases since a modeller would probably feel that an error of 20 in 100 would be roughly as bad as an error of 90 in 2,000, and both would have a GEH statistic of roughly 2.

4.5.3 As a rule of thumb in comparing assigned volumes with observed flows, a GEH parameter of 5 or less would be an acceptable fit, while GEH parameters greater than 10 would require closer attention.

4.5.4 Two primary guideline documents, the British Design Manual for Roads and Bridges (DMRB) Volume 12a and the NRA Project Appraisal Guidelines Appendix 3, were used as a basis for assessing the appropriateness of the highway model for traffic appraisal. The DMRB Volume 12a guidelines are a widely accepted standard in Ireland (with the NRA basing their guidelines on this document) that provides extremely robust validation criteria to which certain types of highway models should adhere.

DMRB Guidance on GEH Distribution

4.5.5 DMRB sets a guideline that 85% of links should have a GEH less than 5 (when measured in vehicles per hour). In addition it is commonplace to establish that 90% of assessment links have a GEH of less than 10 and that 100% of validation links have a GEH less than 20.

4.6 Model Fit to Counts (Prior to Calibration)

4.6.1 An initial test was performed to determine how well the existing prior demand matrices assigned to the base BTM replicated observed traffic volumes. Table 4.1 below details the model fit prior to undertaking the calibration process for each of the time periods modelled.

Table 4.1 Count Validation Statistics (Pre-Calibration)

GEH	AM	PM
GEH < 5	79%	82%
GEH < 10	98%	98%
GEH < 20	100%	100%

Overall Average GEH	3.3	3.1

4.6.2 The percentage of total traffic at all count locations with a GEH less than 5 is relatively high in the AM at 79%. This reflects the fact that the POWSCAR database provides quite a good representation of traffic movements in Bandon Town for the AM half hour peak. However, the GEH statistics fall short of the DMRB and NRA guidelines discussed previously, and therefore, further calibration adjustments must be carried out on the AM and PM prior matrices.

4.6.3 The remaining course of action to improve the fit between model flows and assigned volumes was therefore to perform controlled adjustments to the prior matrix using matrix estimation techniques (described previously in Section 4.4).

4.7 GEH Statistics for Calibrated Model

4.7.1 Table 4.2 below summarises the GEH calibration results for the model after the matrix estimation process, for each of the two modelled time periods. The full list of GEH results for each traffic count location are presented in Appendix C of this report.

Table 4.2 Count Validation Statistics (Post-Calibration)

GEH	AM	PM
GEH < 5	93%	99%
GEH < 10	99%	1%
GEH < 20	100%	100%
Overall Average GEH	1.82	1.32

4.7.2 The figures demonstrate that an excellent calibration has been achieved in the model for the morning and evening peak periods, with an overall GEH of over ninety percent which falls well within DMRB Standards.

4.8 Linear Regression of Counts and Modelled Flows

4.8.1 DMRB recommends a further check on flow validation: to fit a linear regression line through the origin with observed flow as the independent variable and modelled flow as the dependent variable. The slope, and R^2 measure of goodness of fit, for the pre-calibration and post-calibration are presented in Table 4.3 and Table 4.4.

4.8.2 DMRB guidance recommends that the slope of the regression line should be in the range 0.9 to 1.1 and that R^2 should be greater than 0.85.

Table 4.3 Pre-Calibration Count Regression Analysis

MEASURE OF FIT	AM	PM
Slope	0.89	0.81
R^2	0.83	0.86

Table 4.4 Post-Calibration Count Regression Analysis

MEASURE OF FIT	AM	PM
Slope	0.98	1.05
R^2	0.94	0.97

4.8.3 Both the slope and R^2 criteria are met in the post-calibration regression analysis.

4.8.4 The following charts show the correspondence between count and modelled flow data sets, with the best fit linear match plotted on each graph. The two graphs shown are for the prior and post calibration data sets, and illustrate how the relationship between observed and modelled flows is improved by calibration.

4.8.5 Figures 4.3 to 4.6 below illustrate the fit achieved between the modelled and measured link flow for the pre-calibration and post-calibration trip matrices for each of the time periods modelled. The data points are distributed closely to the y = x straight line without any significant outliers. This uniformity is reflected in the R^2 values detailed in Table 4.4 above.

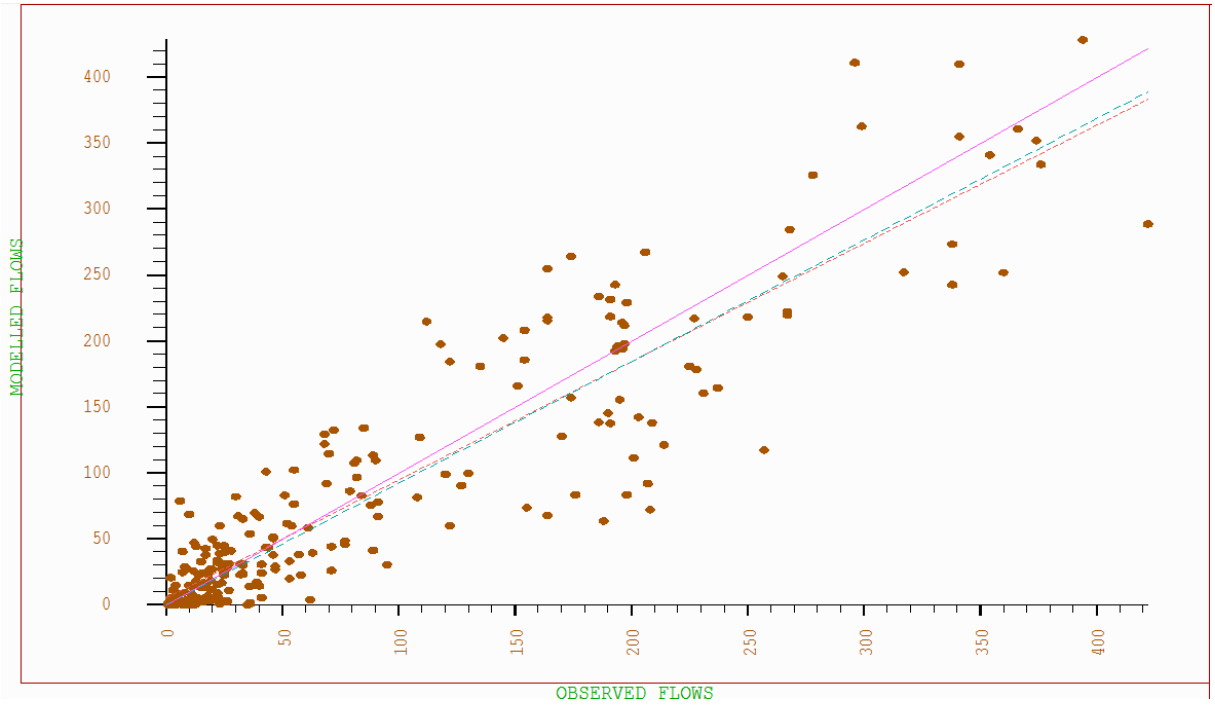

Figure 4.3 Pre-Calibration Fit of Observed Vs Modelled AM-Peak Flows

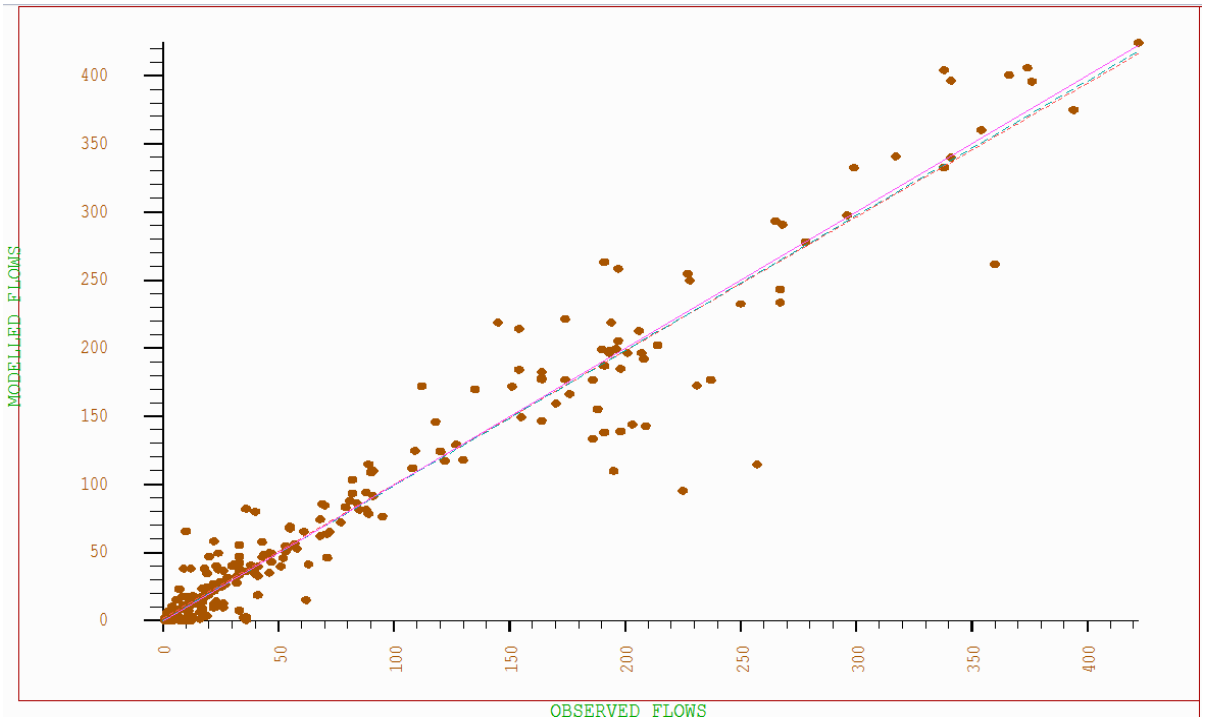

Figure 4.4 Post-Calibration Fit of Observed Vs Modelled AM-Peak Flows

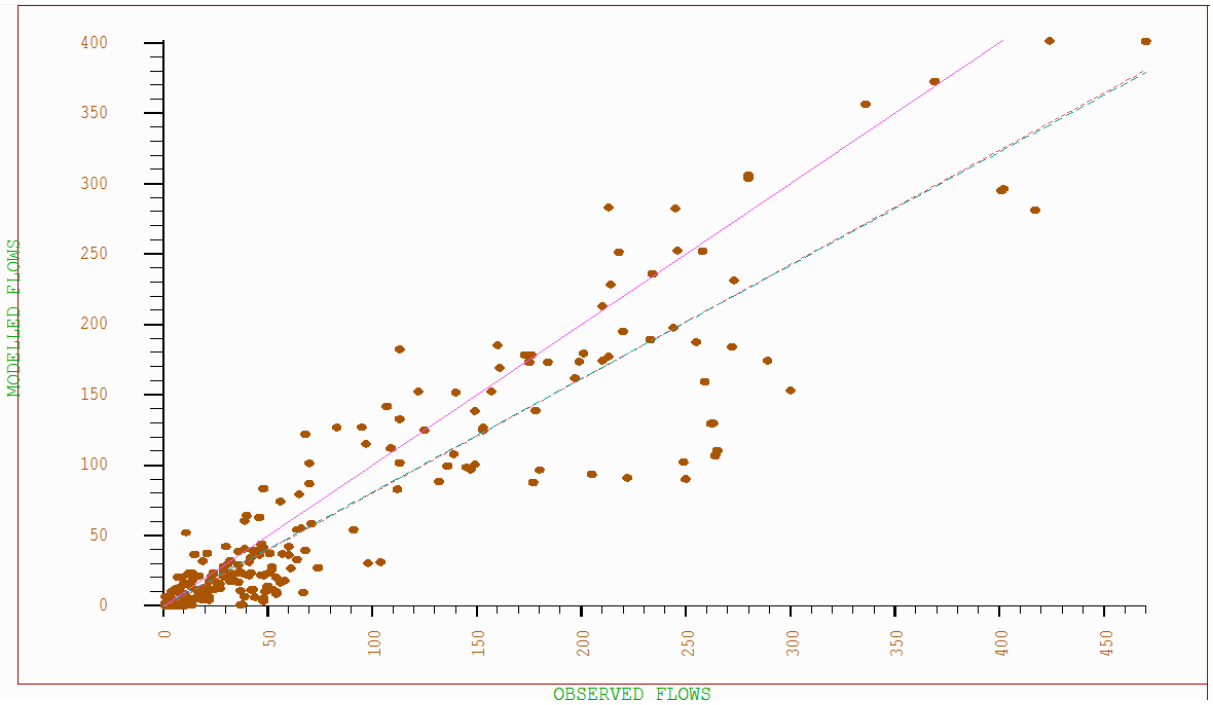

Figure 4.5 Pre-Calibration Fit of Observed Vs Modelled PM-Peak Flows

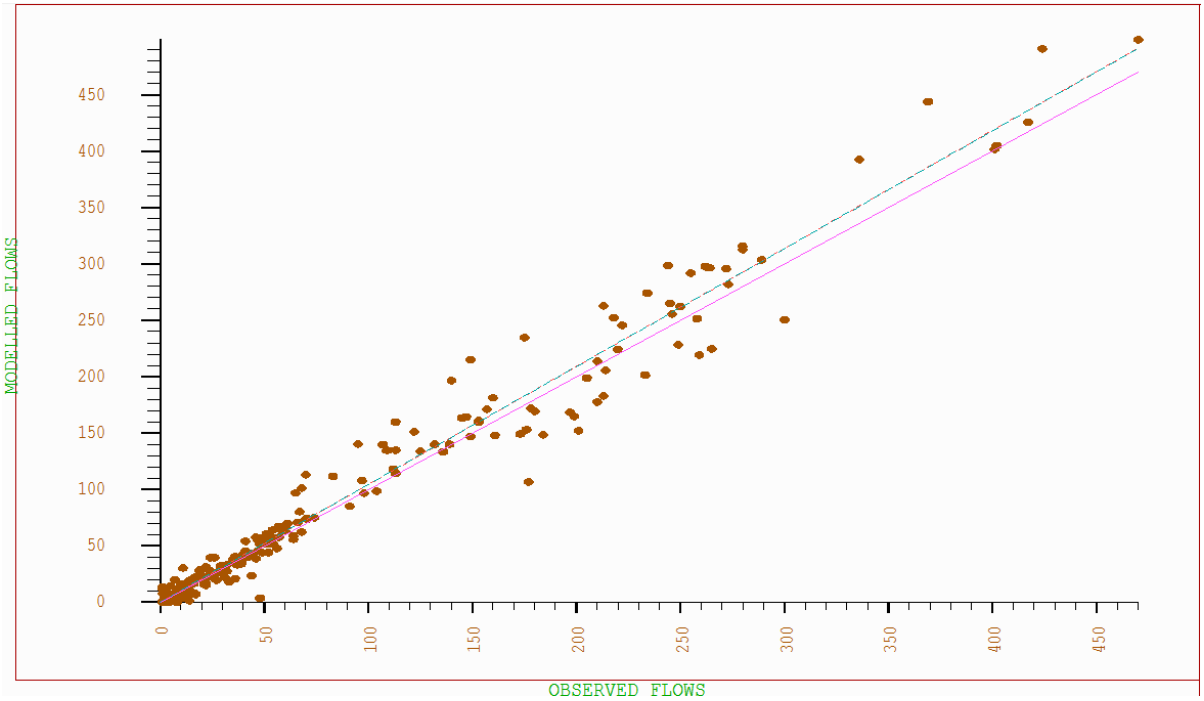

Figure 4.6 Post-Calibration Fit of Observed Vs Modelled PM-Peak Flows

4.9 Trip Length Distribution

4.9.1 A further calibration step is to compare trip length distributions for the prior and post calibrated matrices to ensure they have not been distorted in any way by the ME2 process.

4.9.2 The trip length distribution of the prior (blue line) and post-calibration (red line) matrices for both the AM and PM peak period are shown in Figure 4.7 and 4.8, overleaf. The data shows that the ME2 process has added some short distance trips to the matrix. These trips represent other non-work and school related trips which would have been absent from the initial prior matrix. The data also indicates that there is little difference evident in terms of how trip distribution was altered by the overall matrix adjustment process. Therefore, it is considered that the Matrix estimation has worked correctly in this instance and 'in-filled' missing trips that were absent from the original prior matrix without distorting the overall trip distribution from POWSCAR.

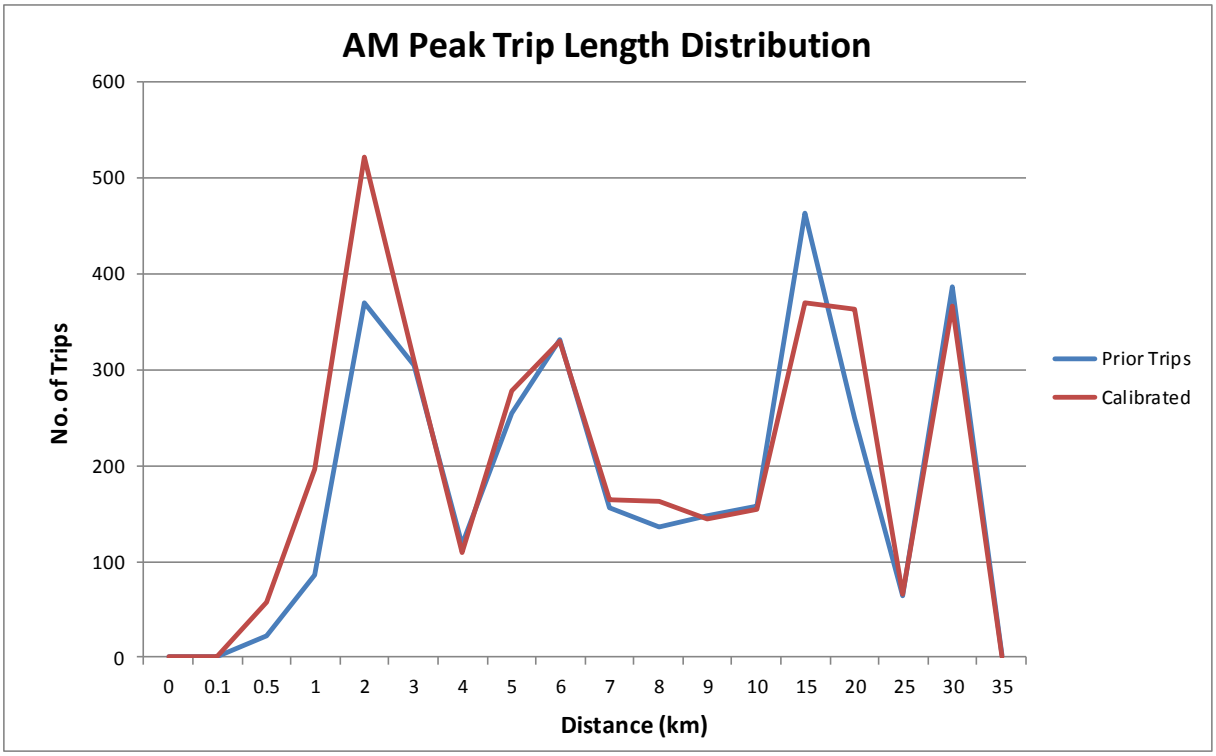

Figure 4.7 LV trip length distribution AM Peak (08:30 - 09:00)

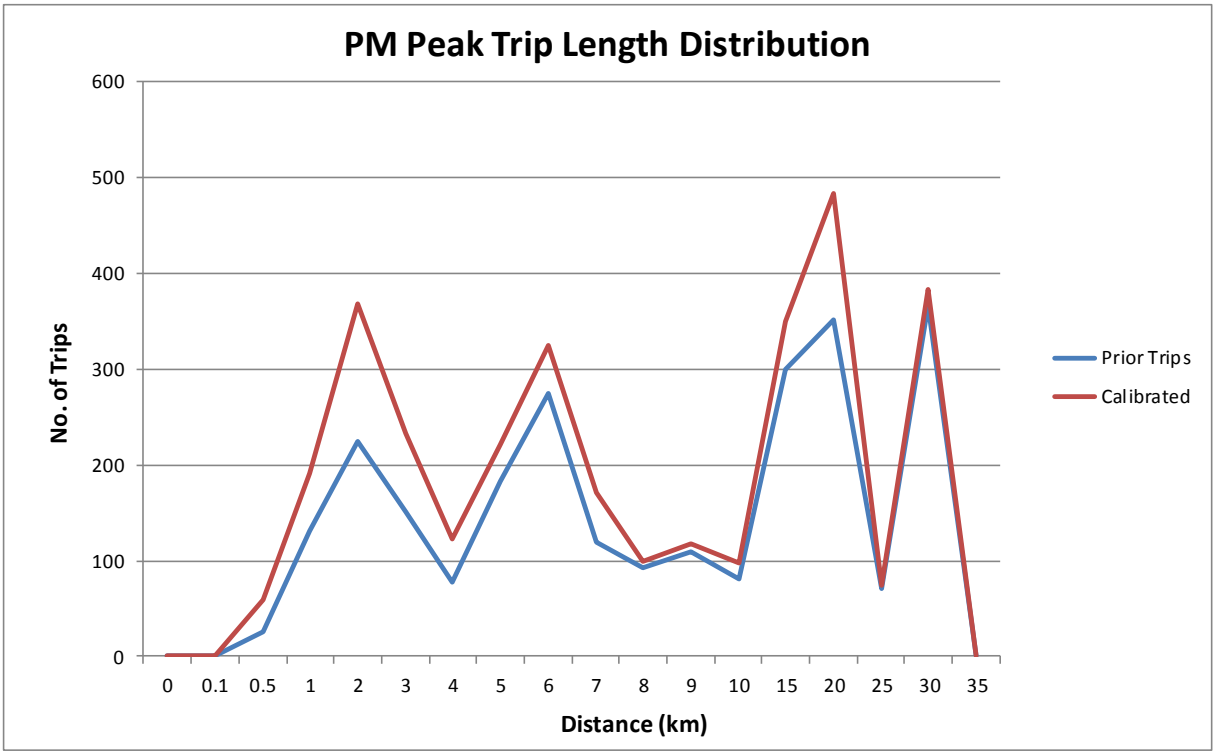

Figure 4.8 LV trip length distribution PM Peak (17:30 - 18:00)

4.10 Summary of Calibration Actions

4.10.1 To improve the agreement between the observed and modelled traffic characteristics, a number of calibration steps were taken for the BTM.

The first and most significant of these was to carry out a matrix estimation to ensure origin-destination patterns in the model were consistent with those observed during traffic count surveys.

Following on from the matrix estimation process, a link count calibration was carried out. During this stage, modelled flows were compared with actual flows. The results of these comparisons (outlined in Table 4.2) show an excellent calibration between modelled and observed flows with all falling well within DMRB and NRA Project Appraisal guidelines.

Further calibration checks carried out on the BTM include linear regression analysis and trip length distribution analysis. All of which demonstrated that the model is stable and meets all DMRB criteria for model calibration.

5. VALIDATION

5.1 Introduction

5.1.1 This section sets out additional comparative measures by which the robustness of the calibrated model may be judged. The following model performance characteristics are detailed:

- Comparison of modelled traffic flows to each individual survey location; and
- Comparison of modelled and observed journey times.

5.2 Individual Survey Location Validation

5.2.1 Modelled flows are compared with link flows at count locations. The junctions are chosen to provide a wide geographical spread of validation locations around the modelled area of interest.

5.2.2 DMRB presents additional guidelines for traffic flow validation, these are that 85% of links should satisfy the following criteria:

- flows within 100 for links with flow less than 700 vehicles per hour;
- flows within 15% for links with flow between 700 and 2,700 vehicles per hour; and
- flows within 400 for links with flow over 2,700 vehicles per hour.

5.2.3 The results in Table 5.1 below were obtained when testing all individual link counts throughout the model under the three criteria set out above.

Table 5.1 Turning Count Validation - % Links Satisfying Alternative DMRB Criteria

DMRB CONDITION	AM	PM
Flow < 700; modelled within 100	100%	100%
700 < Flow < 2750; modelled within 15%	N/A[1]	N/A
2750 < Flow; modelled within 400	N/A	N/A

5.2.4 All of the alternative DMRB criteria are met for the post-calibration trip matrix.

5.3 Journey Time Validation

5.3.1 As outlined previously in Chapter 4, Journey Time Surveys were carried out along three routes through Bandon Town illustrated in Figure 5.1, overleaf. Along each route, recordings were taken at a series of different survey points in order to properly observe the journey time along stages of the route. The journey time observations recorded for each route are presented in Appendix D of this report.

[1] No flows recorded on any link in the model area exceeding 700 vehicles per half hour

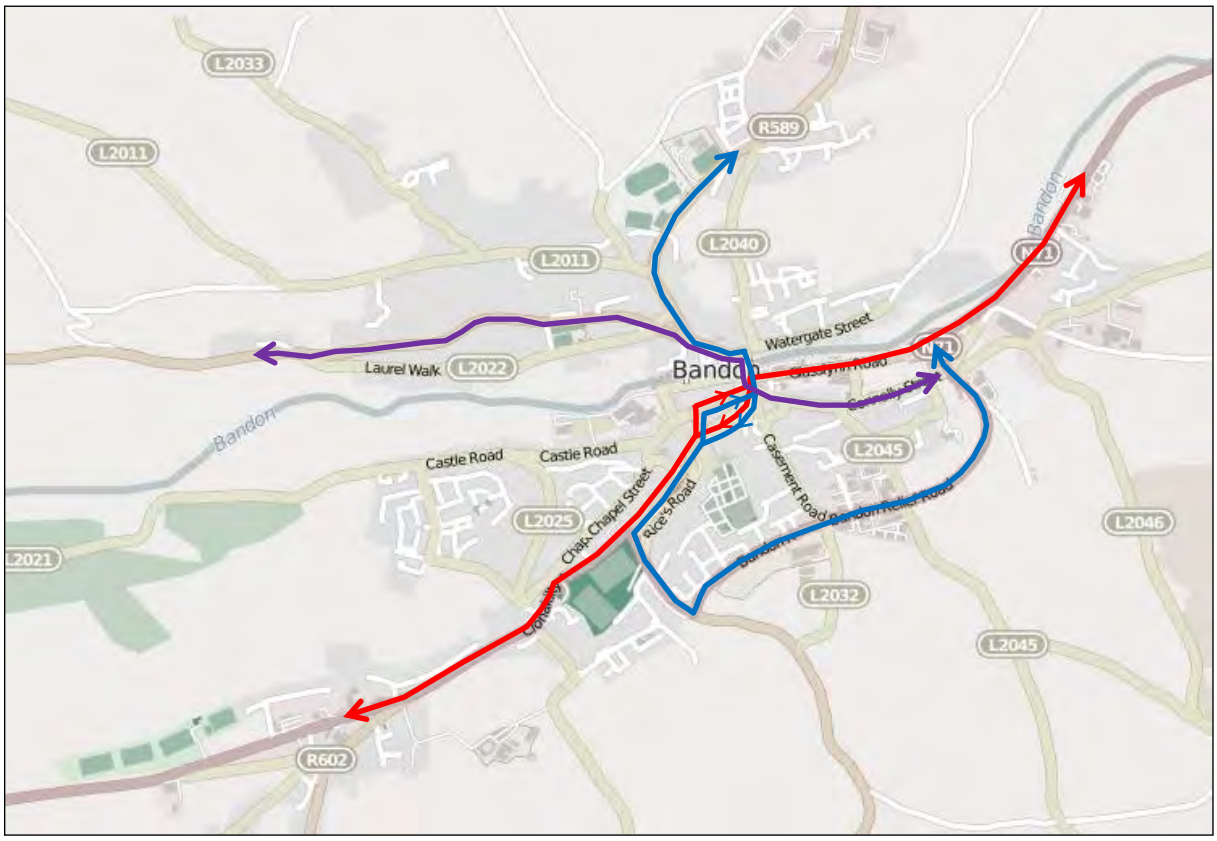

Figure 5.1 Journey Time Survey Routes

AM Journey Times

5.3.2 The DMRB and NRA guidelines advise that modelled journey times should be within 15% of the observed time, or 1 minute if higher, in more than 85% of cases. Table 5.2 below summarises the observed journey times against the model times for each of the journey time routes outlined in Figure 5.1 above.

Table 5.2 Observed Vs Modelled Journey Times during the AM Peak

ROUTE	OBSERVED TIME (SECONDS)	MODELLED TIME (SECONDS)	% DIFFERENCE
Blue Route (N-S)	328	319	-3%
Blue Route (N-S) - Bypass	186	178	-4%
Blue Route (S-N)	358	379	6%
Blue Route (S-N) - Bypass	214	199	-7%
Red Route (W-E)	457	466	2%
Red Route (E-W)	395	403	2%
Purple Route (W-E)	308	292	-5%

Purple Route (E-W)	263	292	11%
Routes Combined	2509	2528	1%

5.3.3 The results outlined in Table 5.2 indicate that all of the routes surveyed in the AM peak satisfy the DMRB and NRA guidelines.

5.3.4 The average observed and modelled journey times for the AM peak are all plotted graphically in Appendix E, along with detailed maps of each journey time route.

PM Journey Times

5.3.5 As mentioned previously, DMRB and NRA guidelines advise that modelled journey times should be within 15% of the observed time, or 1 minute if higher, in more than 85% of cases. Table 5.3 below summarises the observed and model journey times for each of the journey time routes outlined in Figure 5.1 above for the PM peak period.

Table 5.3 Observed Vs Modelled Journey Times during the PM Peak

ROUTE	OBSERVED TIME (SECONDS)	MODELLED TIME (SECONDS)	% DIFFERENCE
Blue Route (N-S)	278	284	2%
Blue Route (N-S) - Bypass	169	174	3%
Blue Route (S-N)	291	300	3%
Blue Route (S-N) - Bypass	204	206	1%
Red Route (W-E)	411	405	-2%
Red Route (E-W)	385	412	7%
Purple Route (W-E)	266	269	1%
Purple Route (E-W)	236	272	15%
Routes Combined	2240	2322	4%

5.3.6 The results outlined in Table 5.4 indicate that all of the routes surveyed in the PM peak satisfy the DMRB and NRA guidelines.

5.3.7 The observed and modelled journey times for the PM peak are all plotted graphically in Appendix E, along with detailed maps of each journey time route.

5.4 Validation Summary

5.4.1 A number of additional comparative measures have been carried out to assess the robustness of the calibrated base AM and PM BTM, and the results are as follows:

The traffic flow validation of individual link flows is acceptable using additional criteria guidelines outlined by DMRB ;

Journey time validations are within DMRB and NRA guidelines for all routes surveyed in the AM and PM peak periods;

Based on the results of the validation measures, it was concluded that the base AM and PM BTM are appropriately robust and validated in accordance with DMRB and NRA guidelines.

6. SUMMARY AND CONCLUSIONS

6.1 Overview

6.1.1 This report documents the development, calibration, and validation of the BTM for a base year of 2015.

6.1.2 Two half-hour, full area, models were calibrated and validated. These represent the AM peak period from 08:30 to 09:00, and the PM peak period from 17:30 to 18:00.

6.1.3 Traffic flow calibration and validation indicates that the correlation between modelled and observed flows is excellent for the Bandon area for all periods modelled.

6.1.4 The traffic flow validation of individual link flows is acceptable using both the standard guidelines and the alternative criteria outlined by the DMRB. The regression analysis also indicates that there is no strong bias in the modelled flows.

6.1.5 The highway assignment model is fit for purpose. It represents AM and PM peak period base year traffic conditions well, as demonstrated statistically in Chapters 4 and 5. It provides a robust basis for assessing the impacts on the road network of any future infrastructure improvements/developments as:

The model realistically represents journey times;

The study area is covered by a large number of counts for both calibration and validation; and

Regression analysis indicates a high correlation between modelled and observed flows and no strong biases.

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SYSTRA

Appendix A – Greater Dublin Area Model Speed-Flow Curves

1. GDA SPEED-FLOW CURVES

FREE FLOW SPEED (KPH)	SPEED AT CAPACITY	MAX CAPACITY (PCU/HR PER LINK)	N	INDEX	DESCRIPTION
37	15	740	1.83	1	Urban Central
54	25	980	1.67	2	Urban Non-central
61	25	1270	2.32	3	Suburban Narrow Collector
78	35	1730	3.29	4	Suburban Distributor
68	25	1730	3.74	5	Suburban Narrow Distributor
78	45	1380	2.07	6	Rural Narrow Country Road
112	45	4860	3.85	7	Dual Carriageway
105	45	4360	3.68	8	Dual Motorway
91	45	1860	2.20	9	Wide National
84	45	1660	2.20	10	National / Regional
87	45	1640	2.20	11	Regional

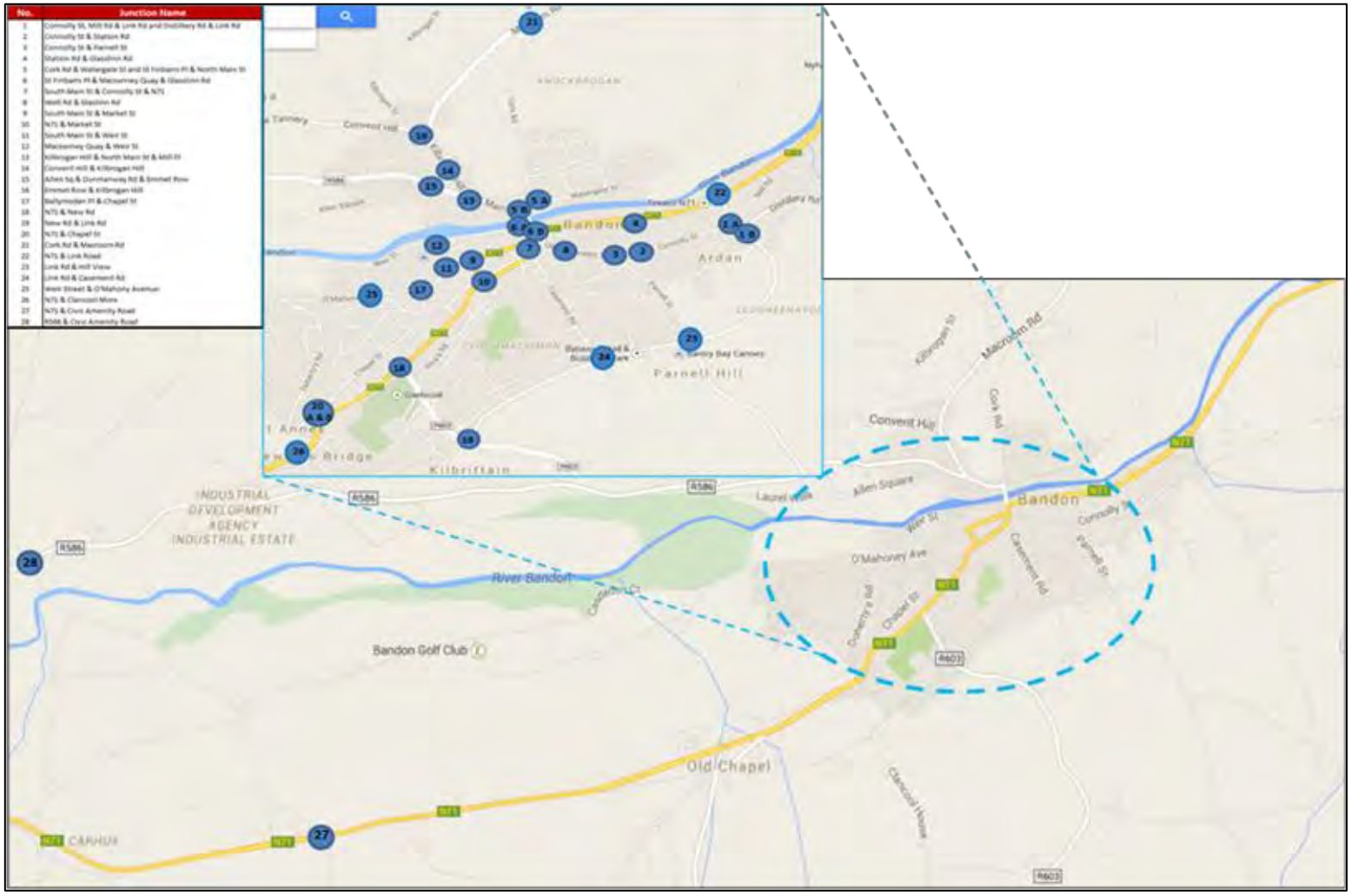
FREE FLOW SPEED (KPH)	SPEED AT CAPACITY	MAX CAPACITY (PCU/HR PER LINK)	N	INDEX	DESCRIPTION
37	15	740	1.83	11	Urban Central 1 Lane
37	15	1480	1.83	12	Urban Central 2 Lanes
37	15	2220	1.83	13	Urban Central 3 Lanes
37	15	2960	1.83	14	Urban Central 4+ Lanes
54	25	980	1.67	21	Urban Non-Central 1 Lane
54	25	1960	1.67	22	Urban Non-Central 2 Lanes
54	25	2940	1.67	23	Urban Non-Central 3 Lanes
54	25	3920	1.67	24	Urban Non-Central 4+ Lanes
61	25	1270	2.32	31	Suburban Narrow Collector 1 Lane
61	25	2540	2.32	32	Suburban Narrow Collector 2 Lanes
61	25	3810	2.32	33	Suburban Narrow Collector 3 Lanes
78	35	1730	3.29	41	Suburban Distributor 1 Lane
78	35	3460	3.29	42	Suburban Distributor 2 Lanes

FREE FLOW SPEED (KPH)	SPEED AT CAPACITY	MAX CAPACITY (PCU/HR PER LINK)	N	INDEX	DESCRIPTION
78	35	5190	3.29	43	Suburban Distributor 3 Lanes
68	25	1730	3.74	51	Suburban Narrow Distributor 1 Lane
68	25	3460	3.74	52	Suburban Narrow Distributor 2 Lanes
68	25	5190	3.74	53	Suburban Narrow Distributor 3 Lanes
78	45	1380	2.07	61	Rural Narrow Country Road 1 Lane
78	45	2760	2.07	62	Rural Narrow Country Road 2 Lanes
78	45	4140	2.07	63	Rural Narrow Country Road 3 Lanes
112	45	4860	3.85	71	Dual C'way – Motorway Standard 2 Lanes
112	45	7290	3.85	72	Dual C'way – Motorway Standard 3 Lanes
112	45	9720	3.85	73	Dual C'way – Motorway Standard 4+ Lanes
105	45	4360	3.68	81	Dual C'way – Near Motorway Standard 2 Lanes
105	45	6540	3.68	82	Dual C'way – Near Motorway Standard 3 Lanes
105	45	8720	3.68	83	Dual C'way – Near Motorway Standard 4+ Lanes

FREE FLOW SPEED (KPH)	SPEED AT CAPACITY	MAX CAPACITY (PCU/HR PER LINK)	N	INDEX	DESCRIPTION
91	45	1860	2.20	91	Wide National 1 Lane
91	45	3720	2.20	92	Wide National 2 Lanes
91	45	5580	2.20	93	Wide National 3 Lanes
91	45	7440	2.20	94	Wide National 4+ Lanes
84	45	1660	2.20	101	National / Regional 1 Lane
84	45	3320	2.20	102	National / Regional 2 Lanes
84	45	4980	2.20	103	National / Regional 3 Lanes
84	45	6640	2.20	104	National / Regional 4+ Lanes
87	45	1640	2.20	111	Regional 1 Lane
87	45	3280	2.20	112	Regional 2 Lanes
87	45	4920	2.20	113	Regional 3 Lanes
78	45	1860	2.20	121	Slip Road / Interchange Link 1 Lane
78	45	3720	2.20	122	Slip Road / Interchange Link 2 Lanes

Appendix B – Traffic Count Data

1. MCC TRAFFIC COUNT DATA



Cork County Council
Comhairle Contae Chorcaí

BARRY & PARTNERS
consulting engineers

SYSTRA

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
53082	47162	53151	Site 1a - Relief Road/Connolly Street/Mill Road	4	0	8	0
53082	47162	47164	Site 1a - Relief Road/Connolly Street/Mill Road	170	7	252	5
53082	47162	47376	Site 1a - Relief Road/Connolly Street/Mill Road	18	0	11	0
53151	47162	47164	Site 1a - Relief Road/Connolly Street/Mill Road	2	0	5	0
53151	47162	47376	Site 1a - Relief Road/Connolly Street/Mill Road	0	0	1	0
53151	47162	53082	Site 1a - Relief Road/Connolly Street/Mill Road	1	0	4	0
47164	47162	47376	Site 1a - Relief Road/Connolly Street/Mill Road	18	0	27	0
47164	47162	53082	Site 1a - Relief Road/Connolly Street/Mill Road	189	8	154	12
47164	47162	53151	Site 1a - Relief Road/Connolly Street/Mill Road	4	0	1	0
47376	47162	53082	Site 1a - Relief Road/Connolly Street/Mill Road	11	0	17	0
47376	47162	53151	Site 1a - Relief Road/Connolly Street/Mill Road	1	0	11	0
47376	47162	47164	Site 1a - Relief Road/Connolly Street/Mill Road	8	0	29	1
53149	47164	47162	Site 1b - Relief Road/Distillery Road	173	7	148	11

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
53149	47164	53153	Site 1b - Relief Road/Distillery Road	10	2	24	1
47162	47164	53153	Site 1b - Relief Road/Distillery Road	22	0	47	2
47162	47164	53149	Site 1b - Relief Road/Distillery Road	158	7	239	4
53153	47164	53149	Site 1b - Relief Road/Distillery Road	24	1	19	1
53153	47164	47162	Site 1b - Relief Road/Distillery Road	38	1	34	1
47254	53006	53084	Site 2 - Connolly Street/Station Road	15	0	7	0
47254	53006	53080	Site 2 - Connolly Street/Station Road	18	0	49	0
53084	53006	53080	Site 2 - Connolly Street/Station Road	3	0	5	1
53084	53006	47254	Site 2 - Connolly Street/Station Road	10	1	13	0
53080	53006	47254	Site 2 - Connolly Street/Station Road	24	0	39	0
53080	53006	53084	Site 2 - Connolly Street/Station Road	5	0	3	0
53087	47254	53078	Site 3 - Oliver Plunkett Street/Parnell Street	22	0	11	0
53087	47254	53006	Site 3 - Oliver Plunkett Street/Parnell Street	9	0	2	0

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
53078	47254	53006	Site 3 - Oliver Plunkett Street/Parnell Street	25	0	54	0
53078	47254	53087	Site 3 - Oliver Plunkett Street/Parnell Street	13	1	9	0
53006	47254	53087	Site 3 - Oliver Plunkett Street/Parnell Street	5	0	6	0
53006	47254	53078	Site 3 - Oliver Plunkett Street/Parnell Street	30	1	46	0
53003	53005	47158	Site 4 - N71/Station Road	177	8	222	13
53003	53005	53084	Site 4 - N71/Station Road	17	0	6	1
47158	53005	53084	Site 4 - N71/Station Road	18	3	10	0
47158	53005	53003	Site 4 - N71/Station Road	217	20	228	12
53084	53005	53003	Site 4 - N71/Station Road	9	3	11	0
53084	53005	47158	Site 4 - N71/Station Road	2	0	4	0
53116	47153	47152	Site 5a - Watergate Street/Cork Road North	52	2	27	2
53116	47153	47365	Site 5a - Watergate Street/Cork Road North	6	0	2	0
47152	47153	47365	Site 5a - Watergate Street/Cork Road North	28	0	48	0

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
47152	47153	53116	Site 5a - Watergate Street/Cork Road North	33	1	36	2
47365	47153	53116	Site 5a - Watergate Street/Cork Road North	11	0	5	0
47365	47153	47152	Site 5a - Watergate Street/Cork Road North	122	0	52	0
47156	47152	53119	Site 5b - North Main Street/St Finbar's Place North	329	10	224	4
47156	47152	47153	Site 5b - North Main Street/St Finbar's Place North	44	0	67	1
53119	47152	47153	Site 5b - North Main Street/St Finbar's Place North	17	1	17	1
53119	47152	47156	Site 5b - North Main Street/St Finbar's Place North	274	10	239	13
47153	47152	47156	Site 5b - North Main Street/St Finbar's Place North	152	1	74	0
47153	47152	53119	Site 5b - North Main Street/St Finbar's Place North	22	1	5	2
47399	47156	47152	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	130	0	86	2
47399	47156	47368	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	7	1	29	0
47152	47156	47368	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	338	11	256	13
47152	47156	47399	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	88	0	57	0

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
47368	47156	47399	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	14	1	39	0
47368	47156	47152	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	243	10	205	3
47367	47368	47156	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	193	1	136	1
47367	47368	53002	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	65	2	62	3
47156	47368	53002	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	186	6	172	13
47156	47368	47367	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	159	6	113	0
53002	47368	47367	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	212	18	157	8
53002	47368	47156	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	64	10	108	2
47154	47155	47367	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	184	4	165	4
47154	47155	47366	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	23	1	54	0
47367	47155	47366	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	68	0	31	0
47367	47155	53000	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	300	24	239	8
47366	47155	53000	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	21	1	40	0

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
47366	47155	47367	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	72	0	33	0
47394	47231	53004	Site 8 - Oliver Plunkett Street/Well Road	51	0	22	0
47394	47231	53078	Site 8 - Oliver Plunkett Street/Well Road	4	0	9	0
53004	47231	53078	Site 8 - Oliver Plunkett Street/Well Road	35	1	57	0
53004	47231	47394	Site 8 - Oliver Plunkett Street/Well Road	17	0	12	0
53078	47231	47394	Site 8 - Oliver Plunkett Street/Well Road	1	0	4	0
53078	47231	53004	Site 8 - Oliver Plunkett Street/Well Road	52	1	56	0
53068	47166	47258	Site 9 - Main Street/Market Street South	62	0	67	0
53068	47166	53064	Site 9 - Main Street/Market Street South	132	5	130	4
47258	47166	53064	Site 9 - Main Street/Market Street South	77	0	98	0
47258	47166	53068	Site 9 - Main Street/Market Street South	18	2	47	0
53070	47456	53072	Site 10 - St.Patricks Quay/Market Street/St. Patricks Place	212	21	196	7
53070	47456	47455	Site 10 - St.Patricks Quay/Market Street/St. Patricks Place	50	1	58	0

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
53072	47456	47455	Site 10 - St.Patricks Quay/Market Street/St. Patricks Place	144	4	139	4
47455	47456	53072	Site 10 - St.Patricks Quay/Market Street/St. Patricks Place	18	2	47	0
47258	47257	53074	Site 11 - Weir Street/Main Street South	36	0	48	0
47258	47257	53062	Site 11 - Weir Street/Main Street South	26	0	19	0
53074	47257	53062	Site 11 - Weir Street/Main Street South	82	0	29	1
53074	47257	47258	Site 11 - Weir Street/Main Street South	89	0	104	0
53062	47257	47258	Site 11 - Weir Street/Main Street South	6	2	41	0
53062	47257	53074	Site 11 - Weir Street/Main Street South	39	0	26	0
53062	47398	53058	Site 12 - Macswiney Quay/Weir Street South	11	0	12	0
53062	47398	53066	Site 12 - Macswiney Quay/Weir Street South	90	0	39	1
53058	47398	53066	Site 12 - Macswiney Quay/Weir Street South	15	1	60	0
53058	47398	53062	Site 12 - Macswiney Quay/Weir Street South	32	1	24	0
53066	47398	53062	Site 12 - Macswiney Quay/Weir Street South	47	0	51	0

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
53066	47398	53058	Site 12 - Macswiney Quay/Weir Street South	28	1	56	0
53119	47429	47242	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	156	7	78	2
53119	47429	47147	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	183	4	143	4
47242	47429	47147	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	5	0	1	0
47242	47429	53119	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	136	6	102	12
47147	47429	53119	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	151	5	142	2
47147	47429	47242	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	2	0	2	0
47149	47148	47147	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	151	5	140	2
47149	47148	47242	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	85	1	60	3
47147	47148	47242	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	2	0	2	0
47147	47148	47149	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	186	4	143	4
47242	47148	47149	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	70	6	39	1
47242	47148	47147	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	3	0	2	0

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
53127	47242	47148	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	55	5	33	1
53127	47242	47429	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	96	5	82	12
53127	47242	53121	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	1	0	0	0
47148	47242	47429	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	11	0	2	0
47148	47242	53121	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	33	0	4	0
47148	47242	53127	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	43	1	56	3
47429	47242	53121	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	54	0	11	1
47429	47242	53127	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	102	7	65	1
47429	47242	47148	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	2	0	3	0
53121	47242	53127	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	9	0	1	0
53121	47242	47148	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	16	1	5	0
53121	47242	47429	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	44	1	17	0
53134	47150	47149	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	139	6	165	6

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
53134	47150	53129	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	24	0	22	0
47149	47150	53129	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	82	0	60	0
47149	47150	53134	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	181	4	120	2
53129	47150	53134	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	25	0	5	0
53129	47150	47149	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	81	0	48	0
53060	53016	53074	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	84	0	61	0
53060	53016	53015	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	2	0	30	0
53074	53016	53015	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	10	0	23	0
53074	53016	53060	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	27	0	50	0
53015	53016	53060	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	30	1	25	0
53015	53016	53074	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	91	0	46	1
53112	47160	47161	Site 18 - New Road/R603	48	4	61	1
53112	47160	53056	Site 18 - New Road/R603	177	20	215	7

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
47161	47160	53056	Site 18 - New Road/R603	152	7	207	6
47161	47160	53112	Site 18 - New Road/R603	95	0	48	0
53056	47160	53112	Site 18 - New Road/R603	104	3	85	4
53056	47160	47161	Site 18 - New Road/R603	183	6	138	9
47196	47193	47192	Site 19 - R603/Relief Road	66	2	24	0
47196	47193	53109	Site 19 - R603/Relief Road	9	1	10	1
47192	47193	53109	Site 19 - R603/Relief Road	207	7	179	8
47192	47193	47196	Site 19 - R603/Relief Road	23	5	38	2
53109	47193	47196	Site 19 - R603/Relief Road	4	0	14	0
53109	47193	47192	Site 19 - R603/Relief Road	199	6	235	6
53056	47197	47146	Site 20a - N71 Clonakilty Road/Link to Site 20b	308	27	384	13
53056	47197	53017	Site 20a - N71 Clonakilty Road/Link to Site 20b	22	0	38	0
47146	47197	53017	Site 20a - N71 Clonakilty Road/Link to Site 20b	71	0	39	1

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
47146	47197	53056	Site 20a - N71 Clonakilty Road/Link to Site 20b	273	9	212	13
53017	47197	53056	Site 20a - N71 Clonakilty Road/Link to Site 20b	15	0	11	0
53017	47197	47146	Site 20a - N71 Clonakilty Road/Link to Site 20b	22	0	47	0
53053	53017	47197	Site 20b - Chapel Street/Link to Site 20a	12	0	36	0
53053	53017	47396	Site 20b - Chapel Street/Link to Site 20a	1	0	4	0
47197	53017	47396	Site 20b - Chapel Street/Link to Site 20a	16	0	37	0
47197	53017	53053	Site 20b - Chapel Street/Link to Site 20a	77	0	40	1
47396	53017	53053	Site 20b - Chapel Street/Link to Site 20a	1	0	3	0
47396	53017	47197	Site 20b - Chapel Street/Link to Site 20a	25	0	20	0
53141	47194	47238	Site 21 - Macroom Road/Cork Road North/Thornfields Road	4	0	1	0
53141	47194	47198	Site 21 - Macroom Road/Cork Road North/Thornfields Road	109	5	92	2
53141	47194	53143	Site 21 - Macroom Road/Cork Road North/Thornfields Road	41	0	8	0
47238	47194	47198	Site 21 - Macroom Road/Cork Road North/Thornfields Road	1	0	0	0

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
47238	47194	53143	Site 21 - Macroom Road/Cork Road North/Thornfields Road	8	0	0	0
47238	47194	53141	Site 21 - Macroom Road/Cork Road North/Thornfields Road	3	0	1	0
47198	47194	53143	Site 21 - Macroom Road/Cork Road North/Thornfields Road	60	1	36	0
47198	47194	53141	Site 21 - Macroom Road/Cork Road North/Thornfields Road	120	6	134	6
47198	47194	47238	Site 21 - Macroom Road/Cork Road North/Thornfields Road	3	0	0	0
53143	47194	53141	Site 21 - Macroom Road/Cork Road North/Thornfields Road	22	0	4	0
53143	47194	47238	Site 21 - Macroom Road/Cork Road North/Thornfields Road	11	0	1	0
53143	47194	47198	Site 21 - Macroom Road/Cork Road North/Thornfields Road	12	0	14	0
53005	47158	47159	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	173	7	209	14
47163	47158	53005	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	209	23	218	11
47163	47158	47159	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	171	6	148	10
53007	47159	47163	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	349	29	437	13
47158	47159	53007	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	308	13	314	22

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
47158	47159	47163	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	36	0	43	2
53082	47163	47158	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	185	7	171	12
47159	47163	53082	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	190	7	285	6
47159	47163	47158	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	195	22	195	9
53091	47372	47373	Site 23 - Relief Road/Parnell Street	214	9	193	8
53091	47372	50780	Site 23 - Relief Road/Parnell Street	4	0	10	0
47373	47372	50780	Site 23 - Relief Road/Parnell Street	4	0	12	0
47373	47372	53091	Site 23 - Relief Road/Parnell Street	192	6	248	6
50780	47372	53091	Site 23 - Relief Road/Parnell Street	17	0	11	0
50780	47372	47373	Site 23 - Relief Road/Parnell Street	19	0	5	1
53011	47373	47372	Site 23 - Relief Road/Parnell Street	183	6	249	5
53011	47373	47377	Site 23 - Relief Road/Parnell Street	7	1	0	0
47372	47373	47377	Site 23 - Relief Road/Parnell Street	25	0	11	0

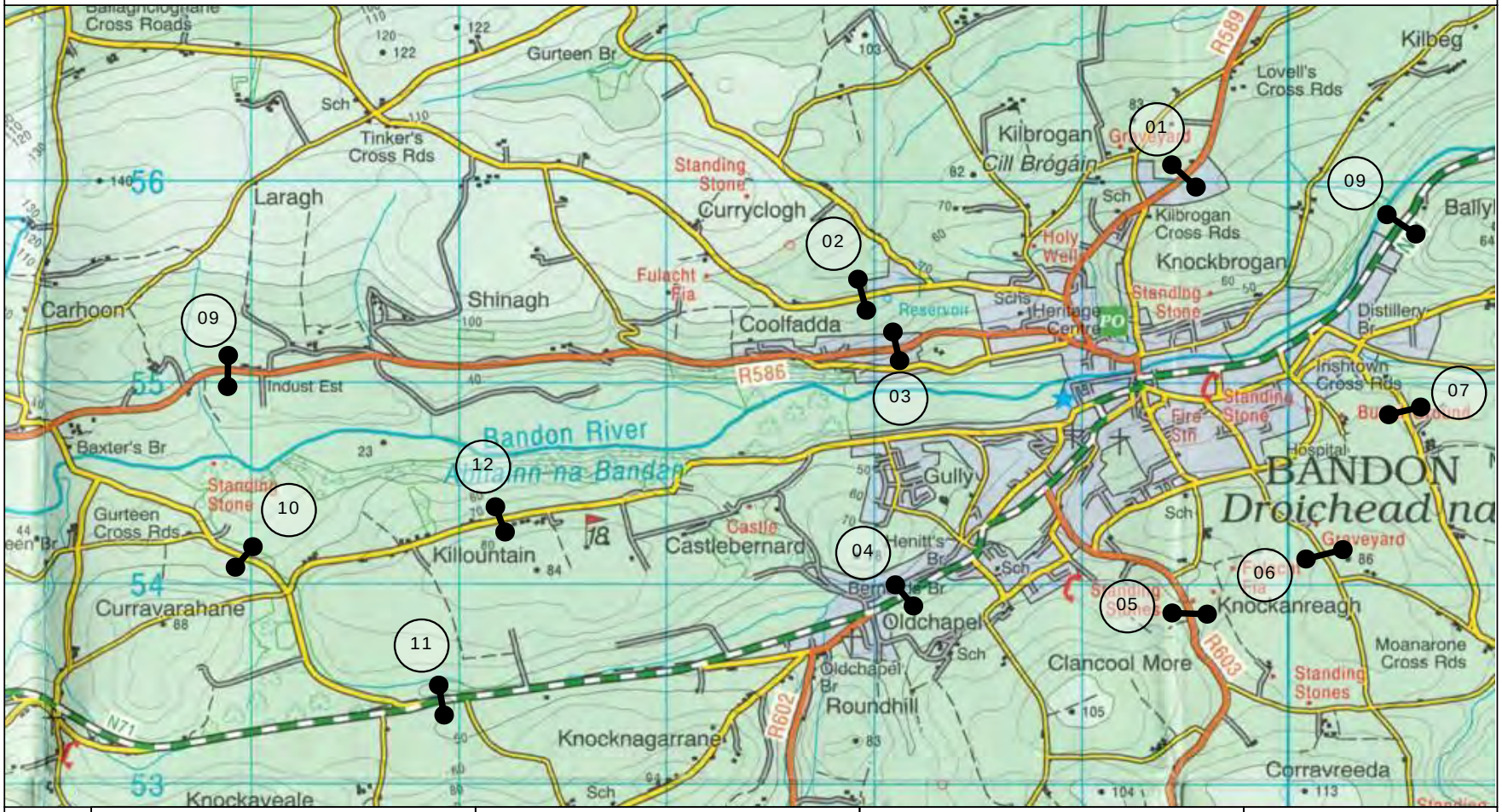
A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
47372	47373	53011	Site 23 - Relief Road/Parnell Street	208	9	187	9
47377	47373	53011	Site 23 - Relief Road/Parnell Street	2	2	0	1
47377	47373	47372	Site 23 - Relief Road/Parnell Street	13	0	11	1
53091	47195	53095	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	46	0	14	0
53091	47195	53109	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	149	6	249	6
53091	47195	53093	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	19	0	22	0
53095	47195	53109	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	32	0	1	0
53095	47195	53093	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	13	0	4	0
53095	47195	53091	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	22	0	2	0
53109	47195	53093	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	25	0	16	0
53109	47195	53091	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	182	5	172	10
53109	47195	53095	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	33	0	4	0
53093	47195	53091	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	13	0	15	0

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
53093	47195	53095	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	10	0	1	0
53093	47195	53109	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	14	0	12	0
53060	47256	53046	Site 25 - O'Mahoney Avenue/Weir Street South	37	1	54	0
53060	47256	53044	Site 25 - O'Mahoney Avenue/Weir Street South	20	0	21	0
53046	47256	53044	Site 25 - O'Mahoney Avenue/Weir Street South	9	0	9	0
53046	47256	53060	Site 25 - O'Mahoney Avenue/Weir Street South	79	0	52	0
53044	47256	53060	Site 25 - O'Mahoney Avenue/Weir Street South	7	0	39	0
53044	47256	53046	Site 25 - O'Mahoney Avenue/Weir Street South	3	0	15	0
49685	47145	47146	Site 26 - Clonakilty Road/Clancool House Road	323	7	270	4
49685	47145	53103	Site 26 - Clonakilty Road/Clancool House Road	19	0	6	0
47146	47145	53103	Site 26 - Clonakilty Road/Clancool House Road	55	0	22	0
47146	47145	49685	Site 26 - Clonakilty Road/Clancool House Road	295	17	376	10
53103	47145	49685	Site 26 - Clonakilty Road/Clancool House Road	8	0	3	0

A NODE	B NODE	C NODE	LOCATION	AM (08:30-09:00)		PM (17:30-18:00)	
				LV	HV	LV	HV
53103	47145	47146	Site 26 - Clonakilty Road/Clancool House Road	43	0	10	0
49683	50690	52224	Site 27 - N71/Killountain Road	157	13	205	6
49683	50690	50947	Site 27 - N71/Killountain Road	48	2	46	0
52224	50690	50947	Site 27 - N71/Killountain Road	3	1	4	1
52224	50690	49683	Site 27 - N71/Killountain Road	188	7	142	7
50947	50690	49683	Site 27 - N71/Killountain Road	53	3	24	2
50947	50690	52224	Site 27 - N71/Killountain Road	4	1	8	0
50699	50948	53178	Site 28 - L2015/R586	98	8	47	7
50699	50948	50946	Site 28 - L2015/R586	47	2	14	0
53178	50948	50946	Site 28 - L2015/R586	36	2	41	1
53178	50948	50699	Site 28 - L2015/R586	32	3	92	6
50946	50948	50699	Site 28 - L2015/R586	20	0	48	1
50946	50948	53178	Site 28 - L2015/R586	41	2	17	0

2. ATC TRAFFIC COUNT DATA

Automatic Traffic Count Locations



Job number: ATH/15/035	Job date: Friday 20th to Thursday 26th March 2015	Drawing No: ATH/14/035-ATC Locations	abacus Transportation Surveys
Client: SYSTRA		Author: SPW	

Cork County Council Comhairle Contae Chorcaí

BARRY & PARTNERS consulting engineers

SYSTRA

A NODE	B NODE	SITE	DIRECTION	AM (08:30 - 09:00)		PM (17:30 - 18:00)	
				LV	HV	LV	HV
47198	53138	1	Northbound	176	4	109	2
53138	47198	1	Southbound	184	5	170	3
47433	47230	2	Eastbound	29	1	21	0
47230	47433	2	Westbound	22	0	35	0
53175	53026	3	Eastbound	171	9	94	6
53026	53175	3	Westbound	99	11	111	5
49685	47145	4	Eastbound	375	7	265	6
47145	49685	4	Westbound	286	12	387	6
53106	53012	5	Northbound	79	5	34	1
53012	53106	5	Southbound	27	2	62	2
50780	47372	6	Northbound	30	1	14	0
47372	50780	6	Southbound	7	0	18	0
53160	50806	7	Northbound	30	1	15	1

A NODE	B NODE	SITE	DIRECTION	AM (08:30 - 09:00)		PM (17:30 - 18:00)	
				LV	HV	LV	HV
50806	53160	7	Southbound	12	1	37	0
53156	49690	8	Northbound	355	8	311	10
49690	53156	8	Southbound	293	18	396	11
53178	50139	9	Eastbound	152	5	123	5
50139	53178	9	Westbound	79	12	119	15
50947	50946	10	Northbound	41	1	67	1
50946	50947	10	Southbound	64	2	35	1
50690	49683	11	Eastbound	256	9	186	9
49683	50690	11	Westbound	206	9	259	6
53173	51625	12	Eastbound	23	0	20	0
51625	53173	12	Westbound	16	0	29	0

Appendix C – Traffic Count GEH Results

1. MCC TRAFFIC COUNT GEH RESULTS

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53082	47162	53151	Site 1a - Relief Road/Connolly Street/Mill Road	2.83	4
53082	47162	47164	Site 1a - Relief Road/Connolly Street/Mill Road	2.5	2.57
53082	47162	47376	Site 1a - Relief Road/Connolly Street/Mill Road	3.8	4.23
53151	47162	47164	Site 1a - Relief Road/Connolly Street/Mill Road	1.89	3
53151	47162	53082	Site 1a - Relief Road/Connolly Street/Mill Road	0	2.83
47164	47162	47376	Site 1a - Relief Road/Connolly Street/Mill Road	0.18	0.14
47164	47162	53082	Site 1a - Relief Road/Connolly Street/Mill Road	4.98	2.75
47164	47162	53151	Site 1a - Relief Road/Connolly Street/Mill Road	2.43	4.63
47376	47162	53082	Site 1a - Relief Road/Connolly Street/Mill Road	0.17	2.91
47376	47162	53151	Site 1a - Relief Road/Connolly Street/Mill Road	1.09	0.7

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
47376	47162	47164	Site 1a - Relief Road/Connolly Street/Mill Road	2.63	0.23
53149	47164	47162	Site 1b - Relief Road/Distillery Road	4.13	1.78
53149	47164	53153	Site 1b - Relief Road/Distillery Road	0.69	1.57
47162	47164	53153	Site 1b - Relief Road/Distillery Road	2.42	1.13
47162	47164	53149	Site 1b - Relief Road/Distillery Road	0.74	1.34
53153	47164	53149	Site 1b - Relief Road/Distillery Road	0.46	1.56
53153	47164	47162	Site 1b - Relief Road/Distillery Road	1.36	0.31
47254	53006	53084	Site 2 - Connolly Street/Station Road	0.45	2.12
47254	53006	53080	Site 2 - Connolly Street/Station Road	1.04	0.38
53084	53006	53080	Site 2 - Connolly Street/Station Road	0.91	0.21
53084	53006	47254	Site 2 - Connolly Street/Station Road	3.7	1.13
53080	53006	47254	Site 2 - Connolly Street/Station Road	4.21	0.48
53080	53006	53084	Site 2 - Connolly Street/Station Road	1.19	0.15

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53087	47254	53078	Site 3 - Oliver Plunkett Street/Parnell Street	0.99	0.4
53087	47254	53006	Site 3 - Oliver Plunkett Street/Parnell Street	0.84	0.29
53078	47254	53006	Site 3 - Oliver Plunkett Street/Parnell Street	0.54	0.32
53078	47254	53087	Site 3 - Oliver Plunkett Street/Parnell Street	2.88	0.81
53006	47254	53087	Site 3 - Oliver Plunkett Street/Parnell Street	0.01	0.35
53006	47254	53078	Site 3 - Oliver Plunkett Street/Parnell Street	2.25	1.17
53003	53005	47158	Site 4 - N71/Station Road	4.07	2.23
53003	53005	53084	Site 4 - N71/Station Road	2.95	0.2
47158	53005	53084	Site 4 - N71/Station Road	3.88	2.38
47158	53005	53003	Site 4 - N71/Station Road	2.12	0.4
53084	53005	53003	Site 4 - N71/Station Road	0.94	1.16
53084	53005	47158	Site 4 - N71/Station Road	1.59	1.2
53116	47153	47152	Site 5a - Watergate Street/Cork Road North	0.07	0.83

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53116	47153	47365	Site 5a - Watergate Street/Cork Road North	1.8	1.56
47152	47153	47365	Site 5a - Watergate Street/Cork Road North	0.7	0.51
47152	47153	53116	Site 5a - Watergate Street/Cork Road North	0.04	0.66
47365	47153	53116	Site 5a - Watergate Street/Cork Road North	0.13	1.25
47365	47153	47152	Site 5a - Watergate Street/Cork Road North	0.42	0.02
47156	47152	53119	Site 5b - North Main Street/St Finbar's Place North	0.32	2.52
47156	47152	47153	Site 5b - North Main Street/St Finbar's Place North	0.68	0.45
53119	47152	47153	Site 5b - North Main Street/St Finbar's Place North	0.13	0.67
53119	47152	47156	Site 5b - North Main Street/St Finbar's Place North	1.88	1.41
47153	47152	47156	Site 5b - North Main Street/St Finbar's Place North	0.46	0.12
47153	47152	53119	Site 5b - North Main Street/St Finbar's Place North	0.1	2.14
47399	47156	47152	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	1.09	0.63
47399	47156	47368	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	1.96	0.21

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
47152	47156	47368	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	1.76	0.86
47152	47156	47399	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	0.72	1.27
47368	47156	47399	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	1.46	0.3
47368	47156	47152	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	1.36	3.23
47367	47368	47156	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	0.25	0.09
47367	47368	53002	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	1.66	4.48
47156	47368	53002	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	0.33	0.42
47156	47368	47367	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	3.37	1.97
53002	47368	47367	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	10.45	5.9
53002	47368	47156	Site 6 - Glasslin Road/St Finbar's Place/Bridge Street	2.55	4.02
47154	47155	47367	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	1.73	4.18
47154	47155	47366	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	1.89	1.32
47367	47155	47366	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	0.75	1.69

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
47367	47155	53000	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	5.58	2.56
47366	47155	53000	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	2.43	0.47
47366	47155	47367	Site 7 - St Finbar's Place/N71 Pearse Street/Oliver Plunkett Street	0.82	2.94
47394	47231	53004	Site 8 - Oliver Plunkett Street/Well Road	1.67	1.17
47394	47231	53078	Site 8 - Oliver Plunkett Street/Well Road	0.3	1.84
53004	47231	53078	Site 8 - Oliver Plunkett Street/Well Road	0.42	0.1
53004	47231	47394	Site 8 - Oliver Plunkett Street/Well Road	2.27	1.47
53078	47231	47394	Site 8 - Oliver Plunkett Street/Well Road	0.06	0.58
53078	47231	53004	Site 8 - Oliver Plunkett Street/Well Road	1.61	1.14
53068	47166	47258	Site 9 - Main Street/Market Street South	7.53	1.53
53068	47166	53064	Site 9 - Main Street/Market Street South	5.47	4.36
47258	47166	53064	Site 9 - Main Street/Market Street South	0.57	0.14
47258	47166	53068	Site 9 - Main Street/Market Street South	0.19	1.25

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53070	47456	53072	Site 10 - St.Patricks Quay/Market Street/St. Patricks Place	1.7	0.57
53070	47456	47455	Site 10 - St.Patricks Quay/Market Street/St. Patricks Place	0.26	0.82
53072	47456	47455	Site 10 - St.Patricks Quay/Market Street/St. Patricks Place	4.44	4.9
47455	47456	53072	Site 10 - St.Patricks Quay/Market Street/St. Patricks Place	2.07	1.1
47258	47257	53074	Site 11 - Weir Street/Main Street South	7.61	0.53
47258	47257	53062	Site 11 - Weir Street/Main Street South	3.05	1.93
53074	47257	53062	Site 11 - Weir Street/Main Street South	2.22	0.19
53074	47257	47258	Site 11 - Weir Street/Main Street South	1.18	0.56
53062	47257	47258	Site 11 - Weir Street/Main Street South	1.78	1.91
53062	47257	53074	Site 11 - Weir Street/Main Street South	0.06	2.38
53062	47398	53058	Site 12 - Macswiney Quay/Weir Street South	2.56	0.37
53062	47398	53066	Site 12 - Macswiney Quay/Weir Street South	1.9	0.34
53058	47398	53066	Site 12 - Macswiney Quay/Weir Street South	0.14	0.42

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53058	47398	53062	Site 12 - Macswiney Quay/Weir Street South	7.52	0.73
53066	47398	53062	Site 12 - Macswiney Quay/Weir Street South	0.34	1.27
53066	47398	53058	Site 12 - Macswiney Quay/Weir Street South	1.8	1.16
53119	47429	47242	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	0.22	2.89
53119	47429	47147	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	0.24	0.64
47242	47429	47147	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	0.76	0.19
47242	47429	53119	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	1.64	0.69
47147	47429	53119	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	0.99	1.4
47147	47429	47242	Site 13 - Emmet Road/Main Street/Kilbroggan Hill North	0.02	1.34
47149	47148	47147	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	1.08	1.5
47149	47148	47242	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	0.63	0.7
47147	47148	47242	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	1.22	0.33
47147	47148	47149	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	0.23	0.53

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
47242	47148	47149	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	0.4	0.22
47242	47148	47147	Site 14 - Kilbroggan Hill/Devonshire Apartments/Link South to Emmet Row	1.52	0.51
53127	47242	47148	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	0.74	0.15
53127	47242	47429	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	1.46	0.55
53127	47242	53121	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	0.17	0
47148	47242	47429	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	1.21	1
47148	47242	53121	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	0.78	0.73
47148	47242	53127	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	0.53	1.09
47429	47242	53121	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	0.12	1.46
47429	47242	53127	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	0.37	3.62
47429	47242	47148	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	0.22	0.85
53121	47242	53127	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	3.54	0
53121	47242	47148	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	0.12	0.06

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53121	47242	47429	Site 15 - Emmet Road/Allen Square North/Link to Kilbrogan Hill	0.56	0.63
53134	47150	47149	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	2.32	0.82
53134	47150	53129	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	0.22	1.59
47149	47150	53129	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	1.23	0.82
47149	47150	53134	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	0.29	0.77
53129	47150	53134	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	0.34	0.14
53129	47150	47149	Site 16 - Kilbrogan Hill/Macroom Road/Convent Hill North	0.75	1.21
53060	53016	53074	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	0.23	1.1
53060	53016	53015	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	2.22	0.75
53074	53016	53015	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	0.25	0.14
53074	53016	53060	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	0.1	0.9
53015	53016	53060	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	3.39	0.58
53015	53016	53074	Site 17 - O'Mahoney Avenue/Ballymodan Place/Chapell Street South	1.89	0.73

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53112	47160	47161	Site 18 - New Road/R603	0.69	0.66
53112	47160	53056	Site 18 - New Road/R603	1.79	2.15
47161	47160	53056	Site 18 - New Road/R603	0.83	1.54
47161	47160	53112	Site 18 - New Road/R603	1.99	0.5
53056	47160	53112	Site 18 - New Road/R603	5.05	4.18
53056	47160	47161	Site 18 - New Road/R603	4.54	1.03
47196	47193	47192	Site 19 - R603/Relief Road	3.25	2.75
47196	47193	53109	Site 19 - R603/Relief Road	4.89	3.17
47192	47193	53109	Site 19 - R603/Relief Road	10.26	2.53
47192	47193	47196	Site 19 - R603/Relief Road	5.99	0.19
53109	47193	47196	Site 19 - R603/Relief Road	1.36	4.64
53109	47193	47192	Site 19 - R603/Relief Road	0.81	0.77
53056	47197	47146	Site 20a - N71 Clonakilty Road/Link to Site 20b	1	0.43

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53056	47197	53017	Site 20a - N71 Clonakilty Road/Link to Site 20b	3.16	0.68
47146	47197	53017	Site 20a - N71 Clonakilty Road/Link to Site 20b	0.88	0.1
47146	47197	53056	Site 20a - N71 Clonakilty Road/Link to Site 20b	0.09	1.26
53017	47197	53056	Site 20a - N71 Clonakilty Road/Link to Site 20b	0.38	0.33
53017	47197	47146	Site 20a - N71 Clonakilty Road/Link to Site 20b	0.14	0.21
53053	53017	47197	Site 20b - Chapel Street/Link to Site 20a	0.08	0.28
53053	53017	47396	Site 20b - Chapel Street/Link to Site 20a	0	1.39
47197	53017	47396	Site 20b - Chapel Street/Link to Site 20a	5.11	0.7
47197	53017	53053	Site 20b - Chapel Street/Link to Site 20a	0.56	0.1
47396	53017	53053	Site 20b - Chapel Street/Link to Site 20a	0.08	0.1
47396	53017	47197	Site 20b - Chapel Street/Link to Site 20a	0.1	0.71
53141	47194	47238	Site 21 - Macroom Road/Cork Road North/Thornfields Road	2.81	0
53141	47194	47198	Site 21 - Macroom Road/Cork Road North/Thornfields Road	0.42	1.07

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53141	47194	53143	Site 21 - Macroom Road/Cork Road North/Thornfields Road	4.08	0.36
47238	47194	47198	Site 21 - Macroom Road/Cork Road North/Thornfields Road	0	0
47238	47194	53143	Site 21 - Macroom Road/Cork Road North/Thornfields Road	3.78	0
47238	47194	53141	Site 21 - Macroom Road/Cork Road North/Thornfields Road	2.03	0
47198	47194	53143	Site 21 - Macroom Road/Cork Road North/Thornfields Road	3	2.8
47198	47194	53141	Site 21 - Macroom Road/Cork Road North/Thornfields Road	2.83	0.16
47198	47194	47238	Site 21 - Macroom Road/Cork Road North/Thornfields Road	2.32	0
53143	47194	53141	Site 21 - Macroom Road/Cork Road North/Thornfields Road	0.05	1.47
53143	47194	47238	Site 21 - Macroom Road/Cork Road North/Thornfields Road	4.63	0
53143	47194	47198	Site 21 - Macroom Road/Cork Road North/Thornfields Road	5.24	0.75
53005	47158	47159	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	4.8	3.32
47163	47158	53005	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	1.5	0.59
47163	47158	47159	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	4.16	1.88

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53007	47159	47163	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	0.11	1.32
47158	47159	53007	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	2.88	3.72
47158	47159	47163	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	8.32	8.7
53082	47163	47158	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	4.48	3.67
47159	47163	53082	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	1.12	2.99
47159	47163	47158	Site 22 - N71 Cork Road/Relief Road/Petrol Filling Station Entrance	1.13	2.24
53091	47372	47373	Site 23 - Relief Road/Parnell Street	4.2	2.14
53091	47372	50780	Site 23 - Relief Road/Parnell Street	0.13	1.56
47373	47372	50780	Site 23 - Relief Road/Parnell Street	0.31	0.85
47373	47372	53091	Site 23 - Relief Road/Parnell Street	0.74	2.04
50780	47372	53091	Site 23 - Relief Road/Parnell Street	0.16	0.22
50780	47372	47373	Site 23 - Relief Road/Parnell Street	1.21	0.72
53011	47373	47372	Site 23 - Relief Road/Parnell Street	0.96	2.13

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53011	47373	47377	Site 23 - Relief Road/Parnell Street	4.4	0
47372	47373	47377	Site 23 - Relief Road/Parnell Street	0.7	0.11
47372	47373	53011	Site 23 - Relief Road/Parnell Street	4.11	2.33
47377	47373	53011	Site 23 - Relief Road/Parnell Street	3.41	2.07
47377	47373	47372	Site 23 - Relief Road/Parnell Street	0.89	0.16
53091	47195	53095	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	0.33	1.24
53091	47195	53109	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	1.38	1.95
53091	47195	53093	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	4.63	0.07
53095	47195	53109	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	0.08	3.24
53095	47195	53093	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	0.54	0.25
53095	47195	53091	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	5.73	0.36
53109	47195	53093	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	3.19	2.27
53109	47195	53091	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	6.9	2.12

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
53109	47195	53095	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	5.69	2.74
53093	47195	53091	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	1.33	1.14
53093	47195	53095	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	9.04	4.29
53093	47195	53109	Site 24 - Relief Road/Casement Road/Cloghmacsimon Road	0.11	0.4
53060	47256	53046	Site 25 - O'Mahoney Avenue/Weir Street South	0.95	0.45
53060	47256	53044	Site 25 - O'Mahoney Avenue/Weir Street South	4.68	1.06
53046	47256	53044	Site 25 - O'Mahoney Avenue/Weir Street South	6	2.38
53046	47256	53060	Site 25 - O'Mahoney Avenue/Weir Street South	0.46	1.14
53044	47256	53060	Site 25 - O'Mahoney Avenue/Weir Street South	2.05	0.86
53044	47256	53046	Site 25 - O'Mahoney Avenue/Weir Street South	1.34	0.28
49685	47145	47146	Site 26 - Clonakilty Road/Clancool House Road	0.05	1.89
49685	47145	53103	Site 26 - Clonakilty Road/Clancool House Road	3.04	1.34
47146	47145	53103	Site 26 - Clonakilty Road/Clancool House Road	1.78	1.8

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
47146	47145	49685	Site 26 - Clonakilty Road/Clancool House Road	0.3	0.04
53103	47145	49685	Site 26 - Clonakilty Road/Clancool House Road	0.13	0.15
53103	47145	47146	Site 26 - Clonakilty Road/Clancool House Road	0.54	1.72
49683	50690	52224	Site 27 - N71/Killountain Road	0.65	0.29
49683	50690	50947	Site 27 - N71/Killountain Road	0.32	1.6
52224	50690	50947	Site 27 - N71/Killountain Road	2.86	3.52
52224	50690	49683	Site 27 - N71/Killountain Road	0.46	1.63
50947	50690	49683	Site 27 - N71/Killountain Road	0.55	0.6
50947	50690	52224	Site 27 - N71/Killountain Road	4.17	1.15
50699	50948	53178	Site 28 - L2015/R586	2.44	3.54
50699	50948	50946	Site 28 - L2015/R586	0.88	0.02
53178	50948	50946	Site 28 - L2015/R586	0.22	3.5
53178	50948	50699	Site 28 - L2015/R586	5.17	2.94

A NODE	B NODE	C NODE	LOCATION	AM GEH	PM GEH
50946	50948	50699	Site 28 - L2015/R586	0.59	0.08
50946	50948	53178	Site 28 - L2015/R586	1.74	1.22

2. ATC TRAFFIC COUNT GEH RESULTS

A NODE	B NODE	LOCATION	DIRECTION	AM GEH	PM GEH
47198	53138	R589 Macroom Road	Northbound	0.69	0.13
53138	47198	R589 Macroom Road	Southbound	0.6	0.44
47433	47230	Local Road @ Coolfadda	Eastbound	1.73	0.32
47230	47433	Local Road @ Coolfadda	Westbound	3.06	0.49
53175	53026	R586 Dunmanway Road @ Coolfadda	Eastbound	0.37	2.32
53026	53175	R586 Dunmanway Road @ Coolfadda	Westbound	0.19	2.49
49685	47145	N71 Clonakilty Road	Eastbound	0.97	2.07
47145	49685	N71 Clonakilty Road	Westbound	1.32	0.15
53106	53012	R603 New Road, South of Link Road	Northbound	0.04	0.74
53012	53106	R603 New Road, South of Link Road	Southbound	0.16	0.56
50780	47372	Hill View, South of Link Road	Northbound	1.52	0.97
47372	50780	Hill View, South of Link Road	Southbound	0.5	0.4

A NODE	B NODE	LOCATION	DIRECTION	AM GEH	PM GEH
53160	50806	Distillery Road, South of Rosewood Meadows	Northbound	0.79	0.14
50806	53160	Distillery Road, South of Rosewood Meadows	Southbound	0.07	0.06
53156	49690	N71 Cork Road	Northbound	1.61	2.96
49690	53156	N71 Cork Road	Southbound	3.43	3.13
53178	50139	R586, East of Baxter's Bridge	Eastbound	1.41	0.22
50139	53178	R586, East of Baxter's Bridge	Westbound	0.37	1.1
50947	50946	Civic Amenity Road	Northbound	2.07	0.35
50946	50947	Civic Amenity Road	Southbound	1.87	0.1
50690	49683	N71 @ Knocknagarrane	Eastbound	0	0.25
49683	50690	N71 @ Knocknagarrane	Westbound	1.4	0.53
53173	51625	Local Road @ Killountain	Eastbound	0.55	0.27
51625	53173	Local Road @ Killountain	Westbound	0.19	0.54

Appendix D - Observed Journey Time Data

1. JOURNEY TIME OBSERVATIONS

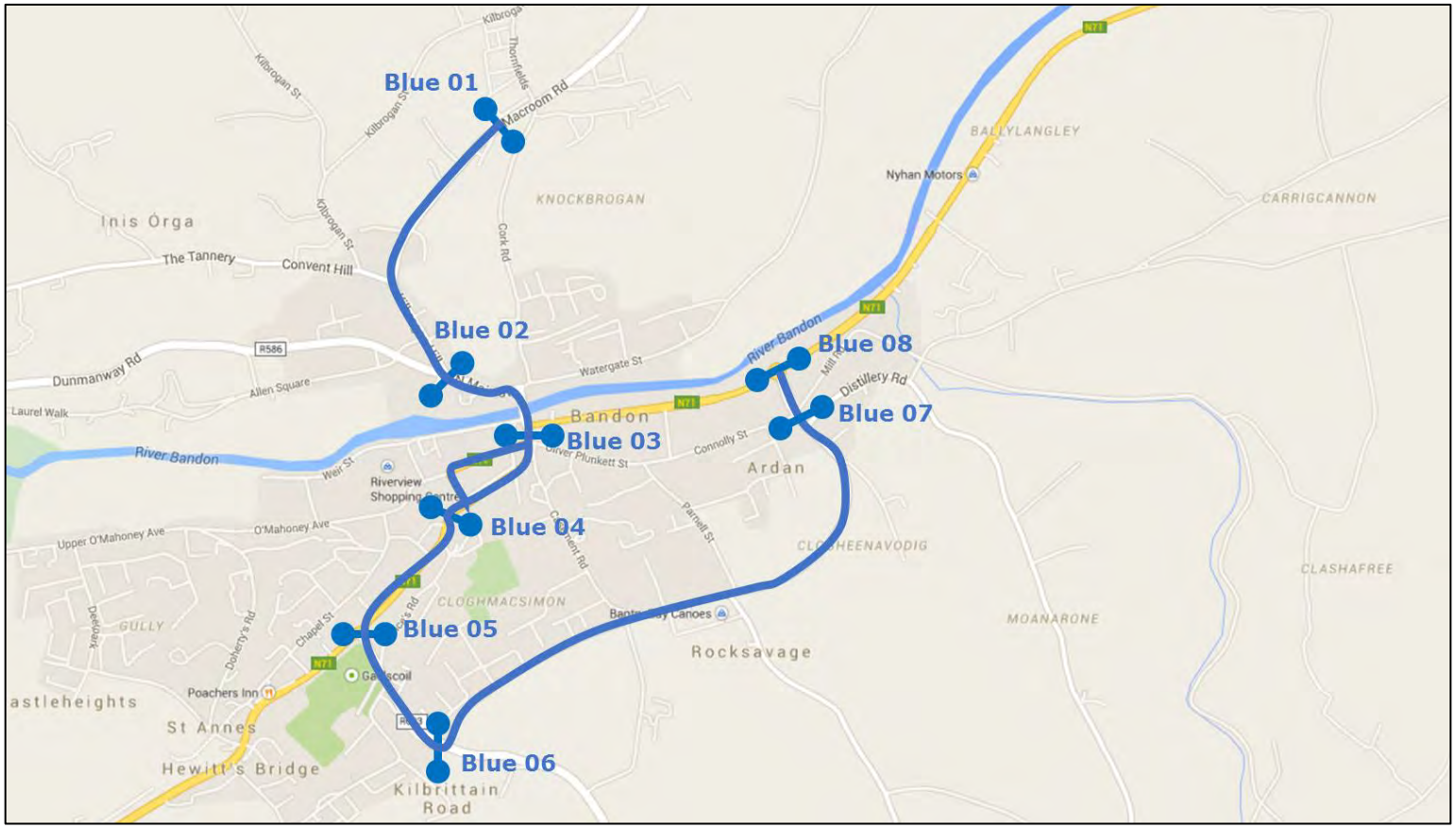


Figure 1.1 Journey Time Blue Route

BLUE ROUTE – SOUTHBOUND 08:30 – 09:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
1	2	117	165	124	135
2	3	97	236	93	87
3	4	46	277	42	43
4	5	66	338	60	62
Total		326	338	318	328

BLUE ROUTE (SOUTH RING ROAD) – SOUTHBOUND 08:30 – 09:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
5	6	42	31	42	38
6	7	122	143	115	127
7	8	28	14	20	21
Total		191	188	177	186

BLUE ROUTE – SOUTHBOUND 17:30 – 18:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
1	2	97	97	97	97
2	3	64	57	71	64
3	4	47	52	54	51
4	5	68	58	76	67
Total		275	263	297	278

BLUE ROUTE (SOUTH RING ROAD) – SOUTHBOUND 17:30 – 18:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
5	6	29	30	33	31
6	7	127	122	110	120
7	8	25	18	15	19
Total		180	170	158	169

BLUE ROUTE – NORTHBOUND 08:30 – 09:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
5	4	31	38	47	39
4	3	140	115	157	137
3	2	58	65	76	66
2	1	124	112	109	115
Total		354	330	390	358

BLUE ROUTE (SOUTH RING ROAD) – NORTHBOUND 08:30 – 09:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
8	7	25	30	35	30
7	6	124	113	142	126
6	5	60	70	44	58
Total		209	213	220	214

BLUE ROUTE – NORTHBOUND 17:30 – 18:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
5	4	38	35	41	38
4	3	116	99	117	110
3	2	64	48	59	57
2	1	76	85	94	85
Total		294	266	312	291

BLUE ROUTE (SOUTH RING ROAD) – NORTHBOUND 17:30 – 18:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
8	7	36	35	30	34
7	6	132	107	112	117
6	5	51	52	54	53
Total		220	195	196	204

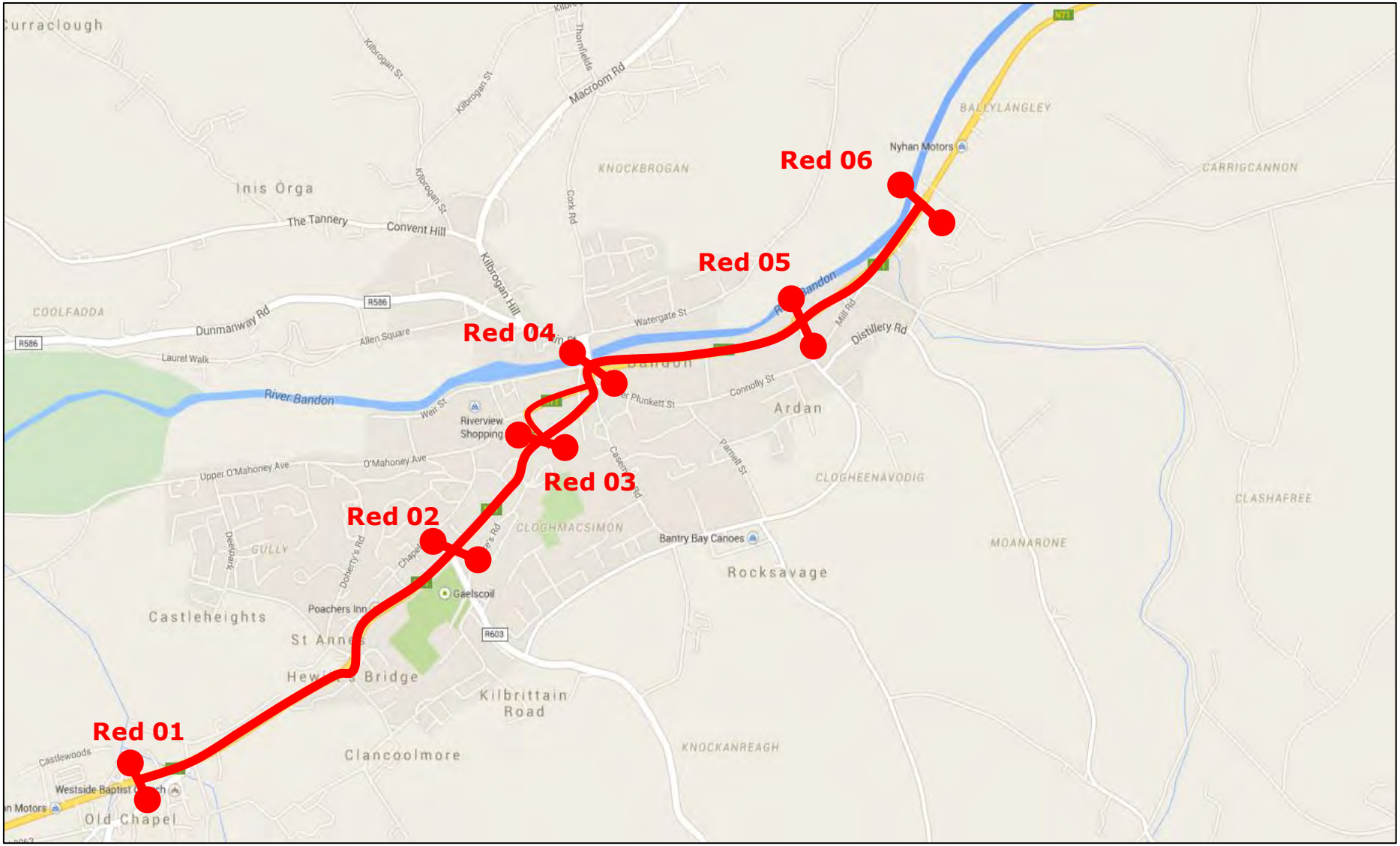


Figure 1.2 Journey Time Red Route

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RED ROUTE – EASTBOUND 08:30 – 09:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
1	2	105	95	91	97
2	3	31	38	38	36
3	4	140	115	157	137
4	5	61	53	56	57
5	6	130	133	126	130
Total		467	434	469	457

RED ROUTE – WESTBOUND 08:30 – 09:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
6	5	109	109	110	110
5	4	96	104	105	101
4	3	46	41	45	44
3	2	66	60	61	62
2	1	79	74	79	77
Total		395	389	400	395

RED ROUTE – EASTBOUND 17:30 – 18:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
1	2	79	87	86	84
2	3	39	26	40	35
3	4	116	99	117	110
4	5	40	40	56	45
5	6	135	135	140	136
Total		408	387	439	411

RED ROUTE – WESTBOUND 17:30 – 18:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
6	5	109	110	108	109
5	4	85	84	92	87
4	3	47	52	54	51
3	2	65	58	76	66
2	1	76	69	70	72
Total		383	372	400	385

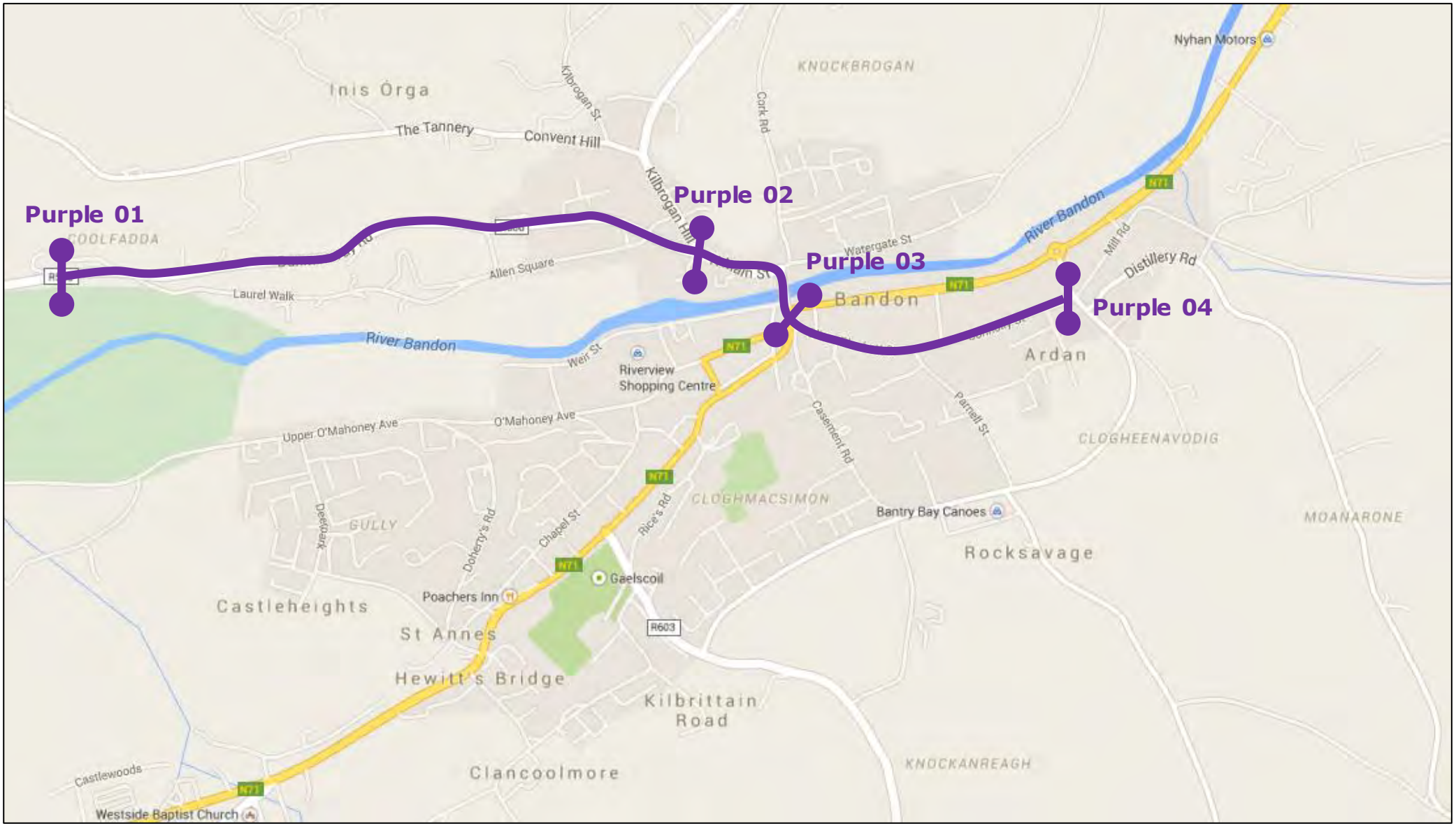

Figure 1.3 Journey Time Purple Route

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SYSTRA

PURPLE ROUTE – EASTBOUND 08:30 – 09:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
1	2	135	130	118	128
2	3	97	71	93	87
3	4	91	84	104	93
Total		324	285	314	308

PURPLE ROUTE – WESTBOUND 08:30 – 09:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
4	3	96	113	94	101
3	2	58	63	87	69
2	1	86	97	95	93
Total		240	273	275	263

PURPLE ROUTE – EASTBOUND 17:30 – 18:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
1	2	102	105	114	107
2	3	64	57	71	64
3	4	108	83	93	95
Total		274	245	278	266

PURPLE ROUTE – WESTBOUND 17:30 – 18:00					
FROM	TO	JOURNEY TIMES (SECONDS)			
		24/03/2015	25/03/2015	26/03/2015	AVERAGE
4	3	74	117	90	94
3	2	64	48	59	57
2	1	87	85	83	85
Total		225	250	232	236

Appendix E - Journey Time Validation Plots

1. JOURNEY TIME VALIDATION PLOTS

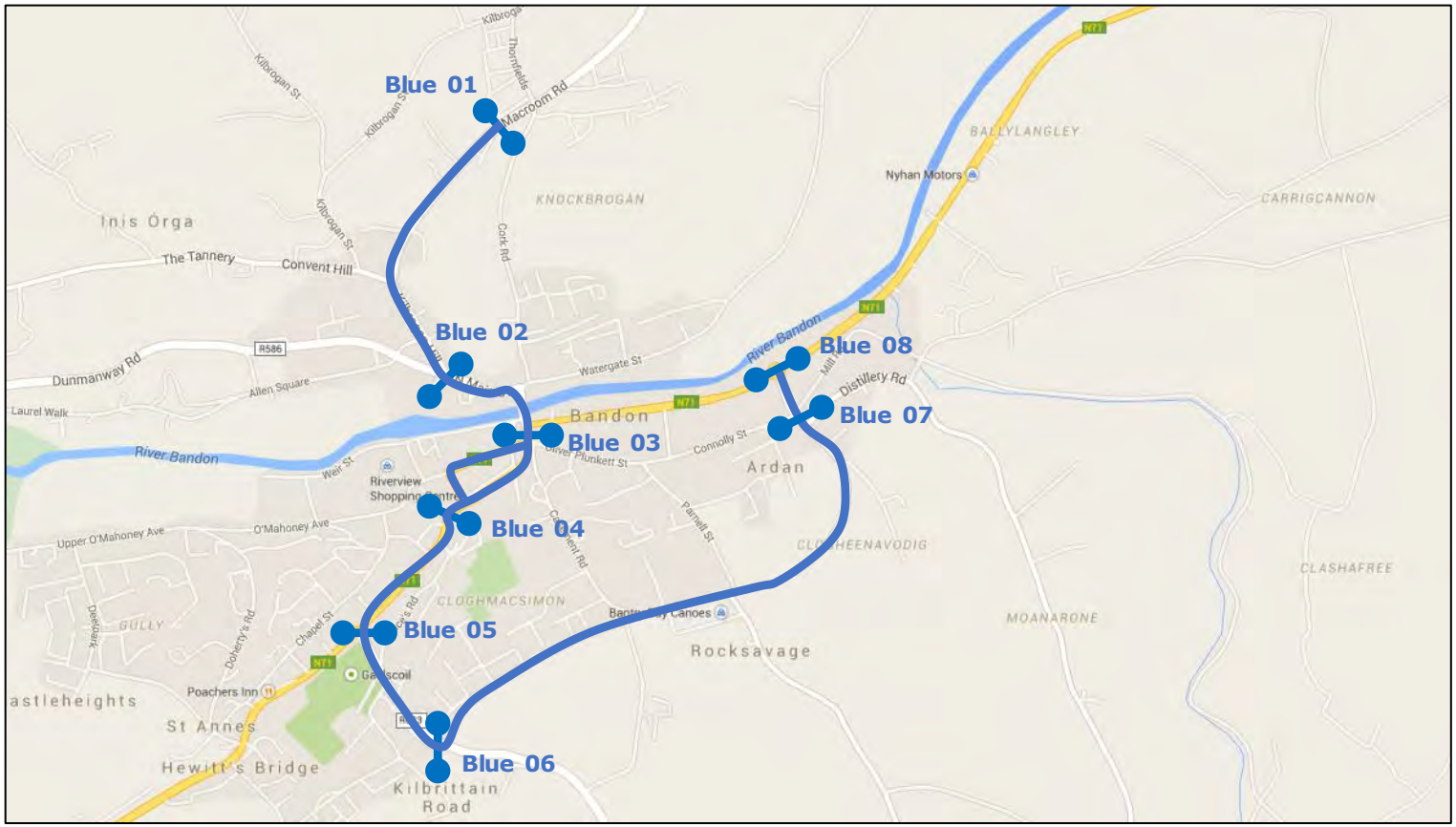

Figure 1.1 Journey Time Survey Blue Route

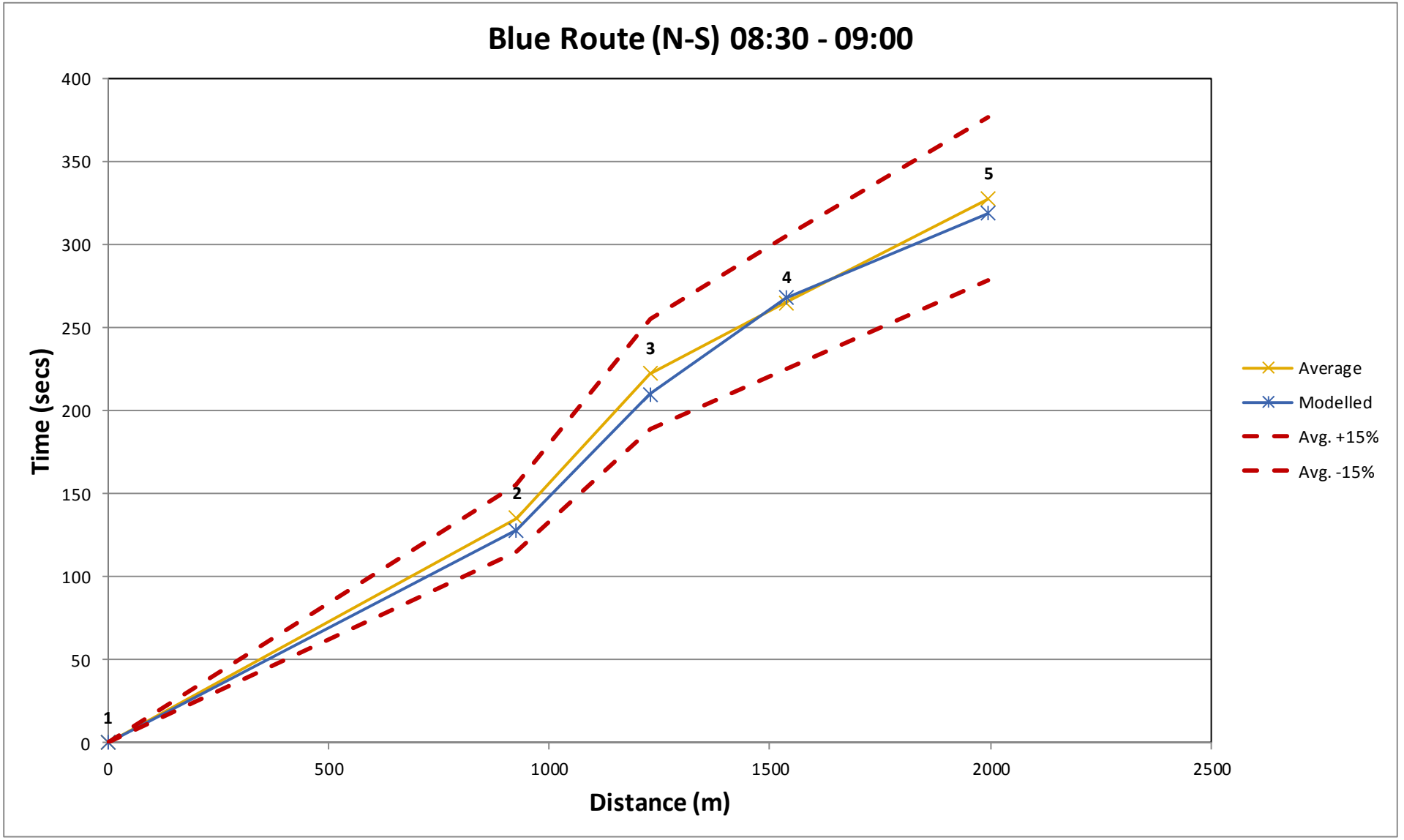

Figure 1.2 Journey Time Data Blue Route (N-S) AM Peak

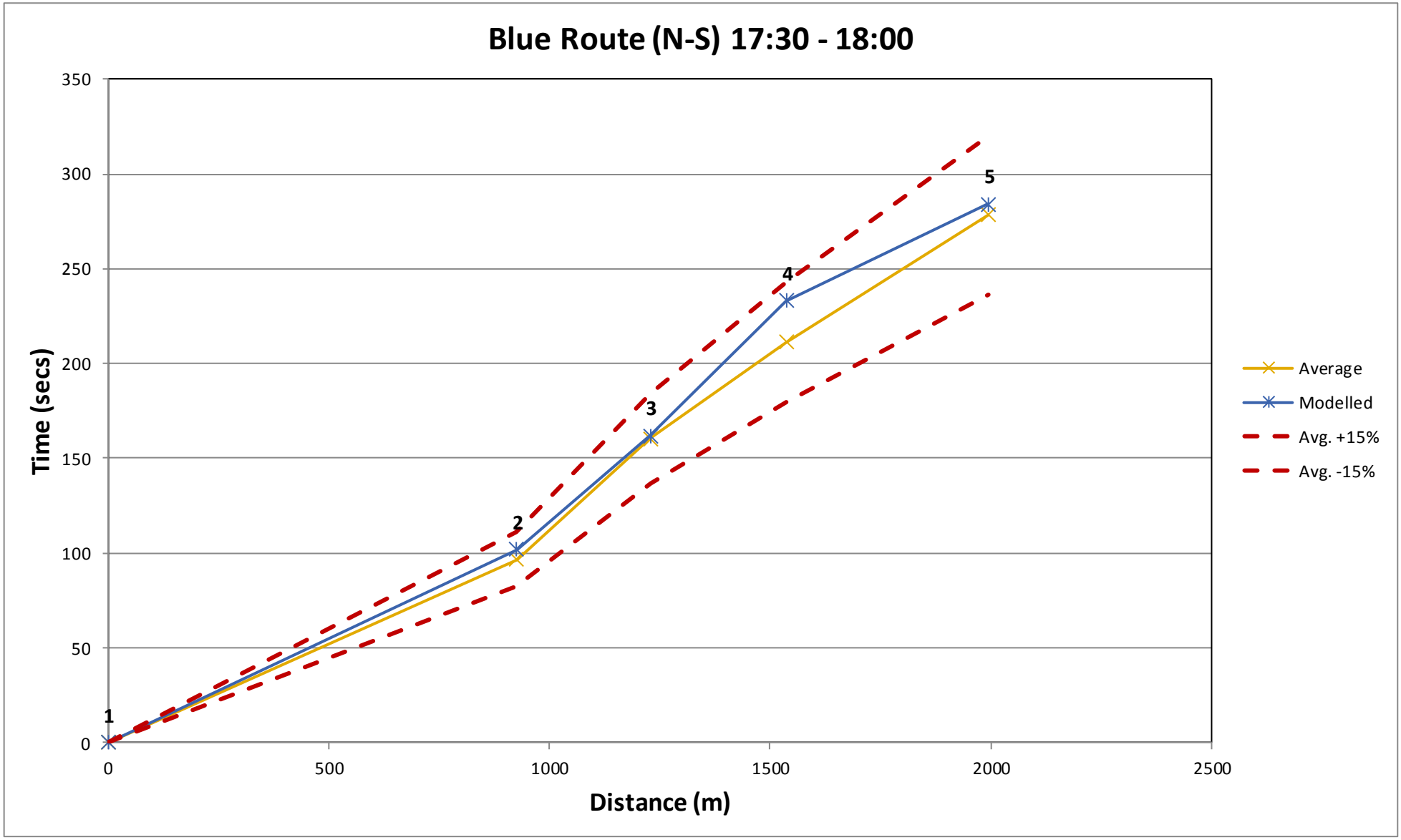

Figure 1.3 Journey Time Data Blue Route (N-S) PM Peak

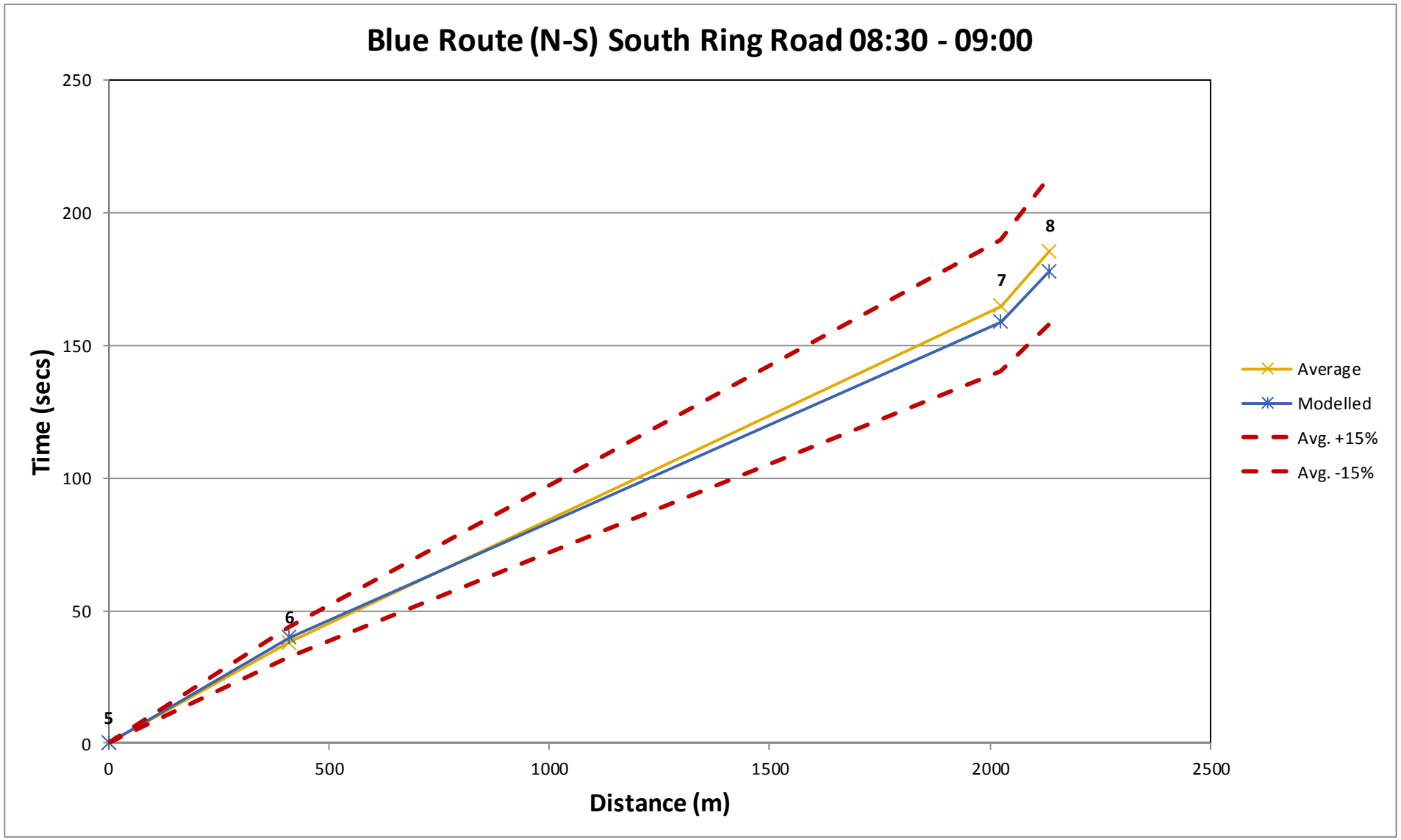

Figure 1.4 Journey Time Data Blue Route South Ring Road (N-S) AM Peak

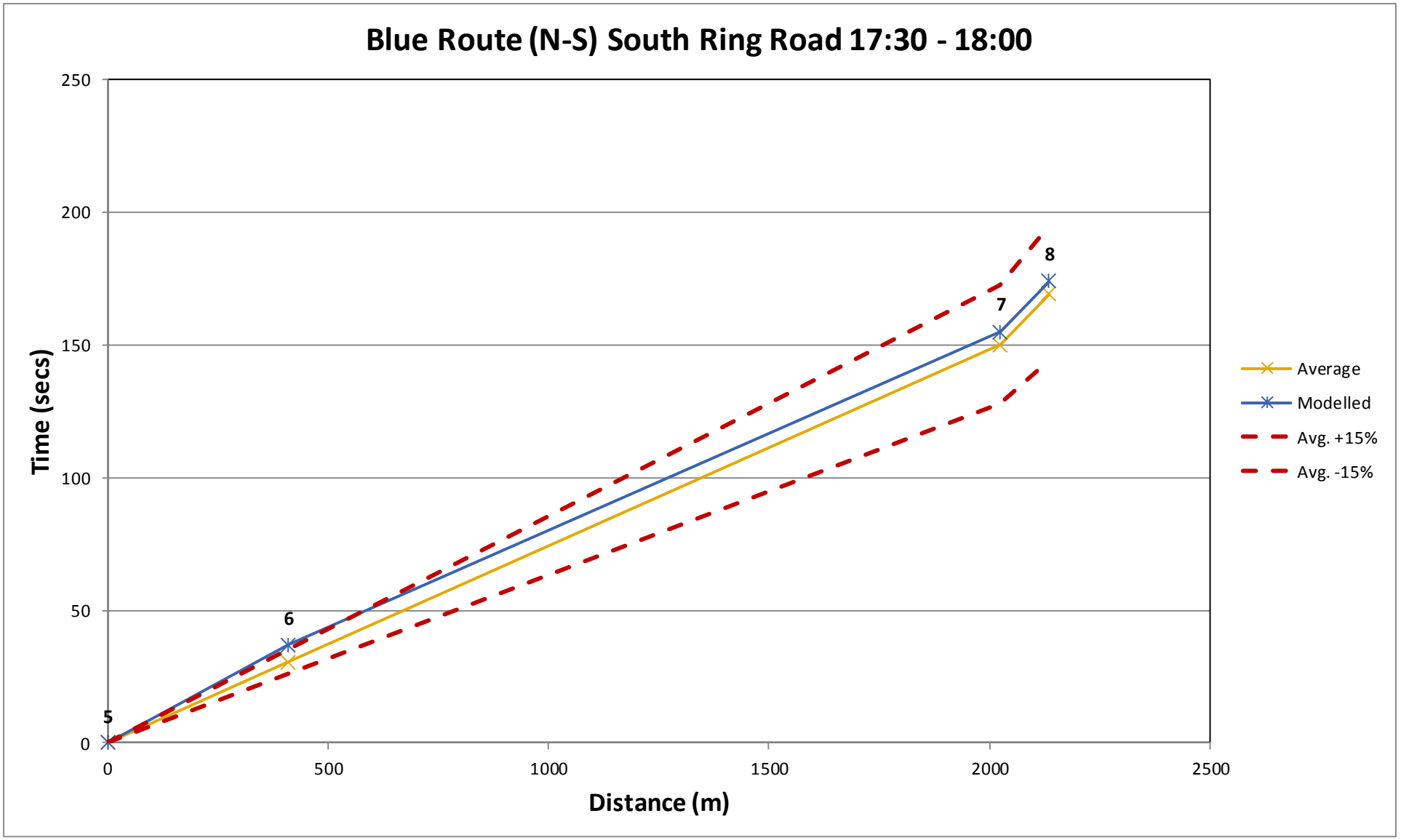

Figure 1.5 Journey Time Data Blue Route South Ring Road (N-S) PM Peak

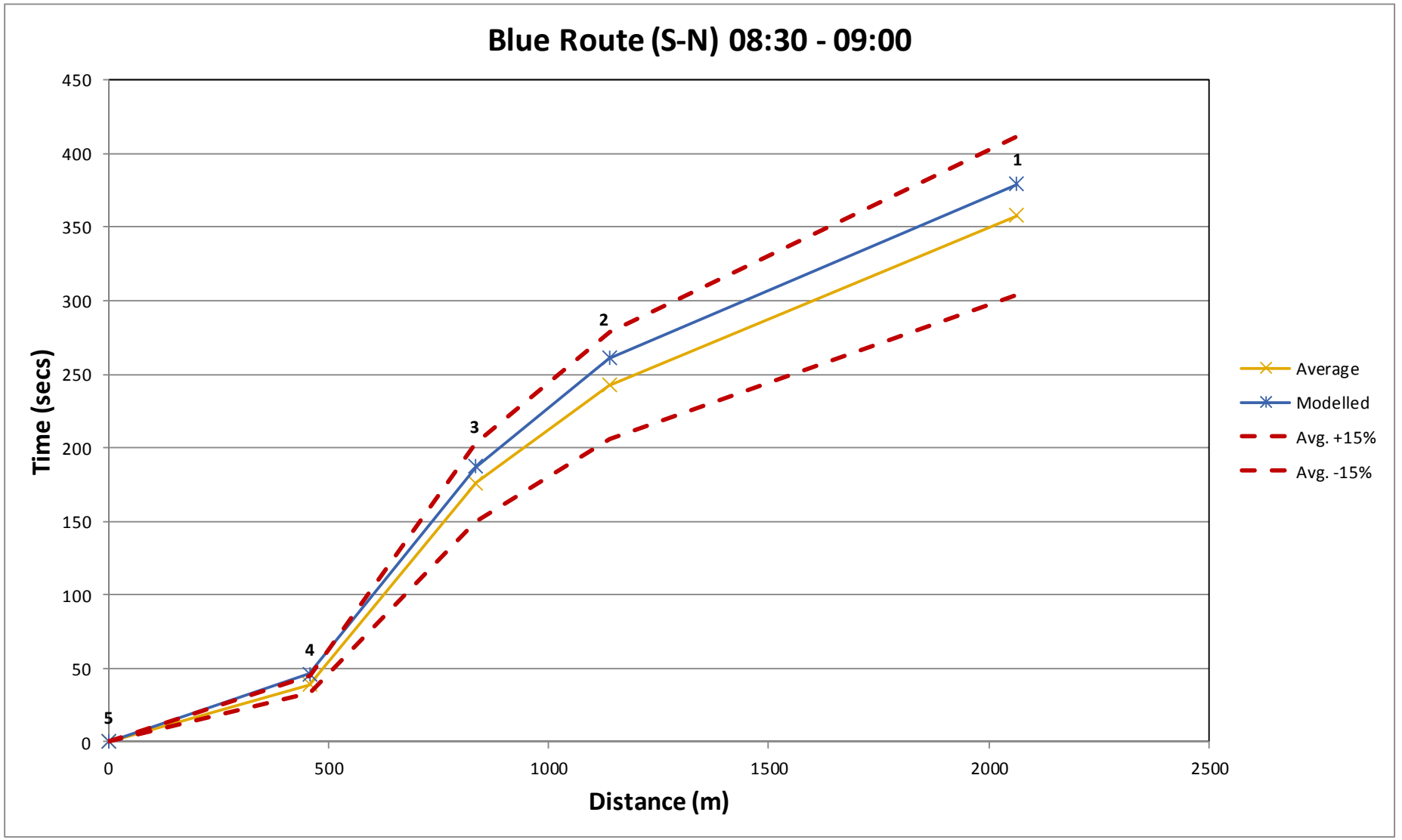

Figure 1.6 Journey Time Data Blue Route (S-N) AM Peak

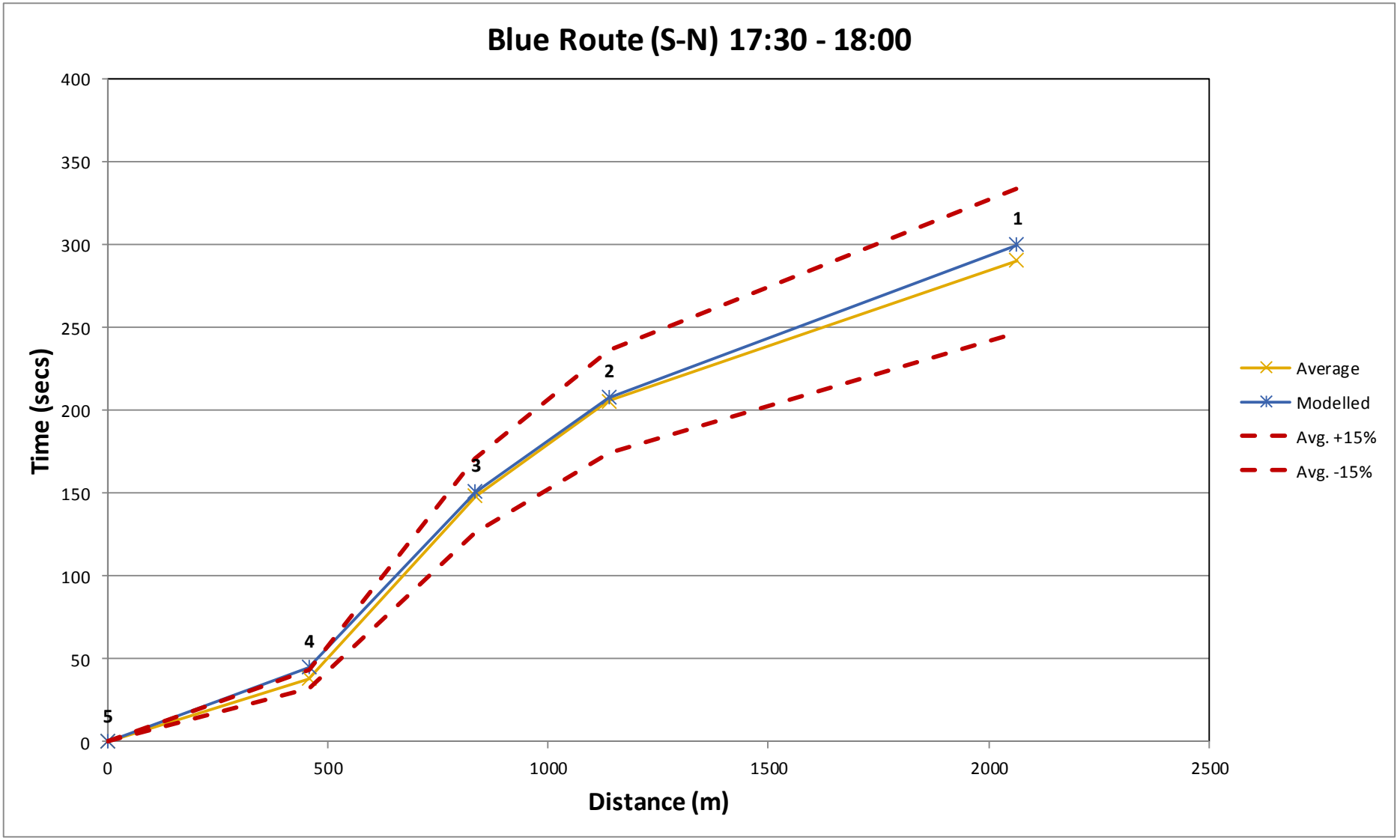

Figure 1.7 Journey Time Data Blue Route (S-N) PM Peak

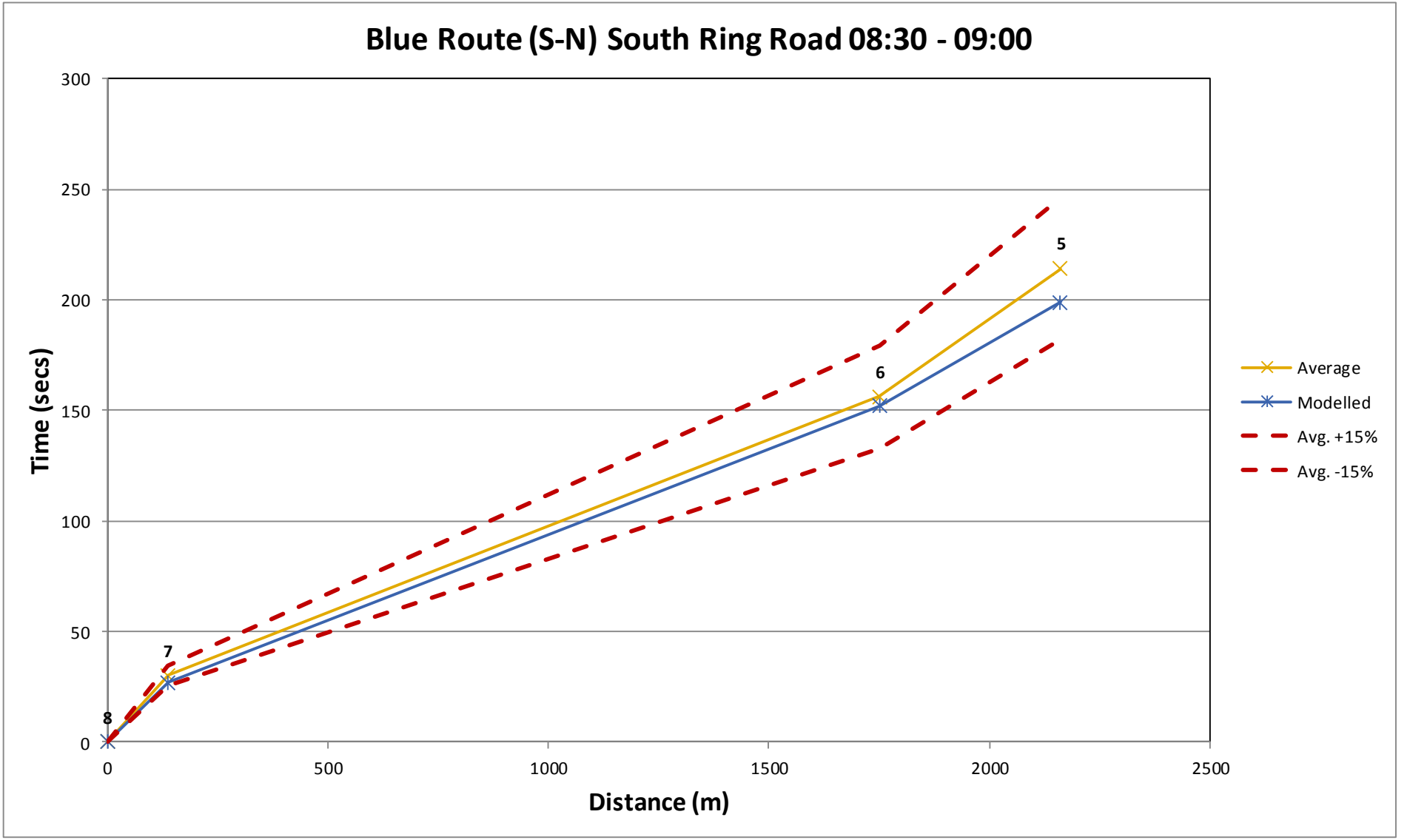

Figure 1.8 Journey Time Data Blue Route South Ring Road (S-N) AM Peak

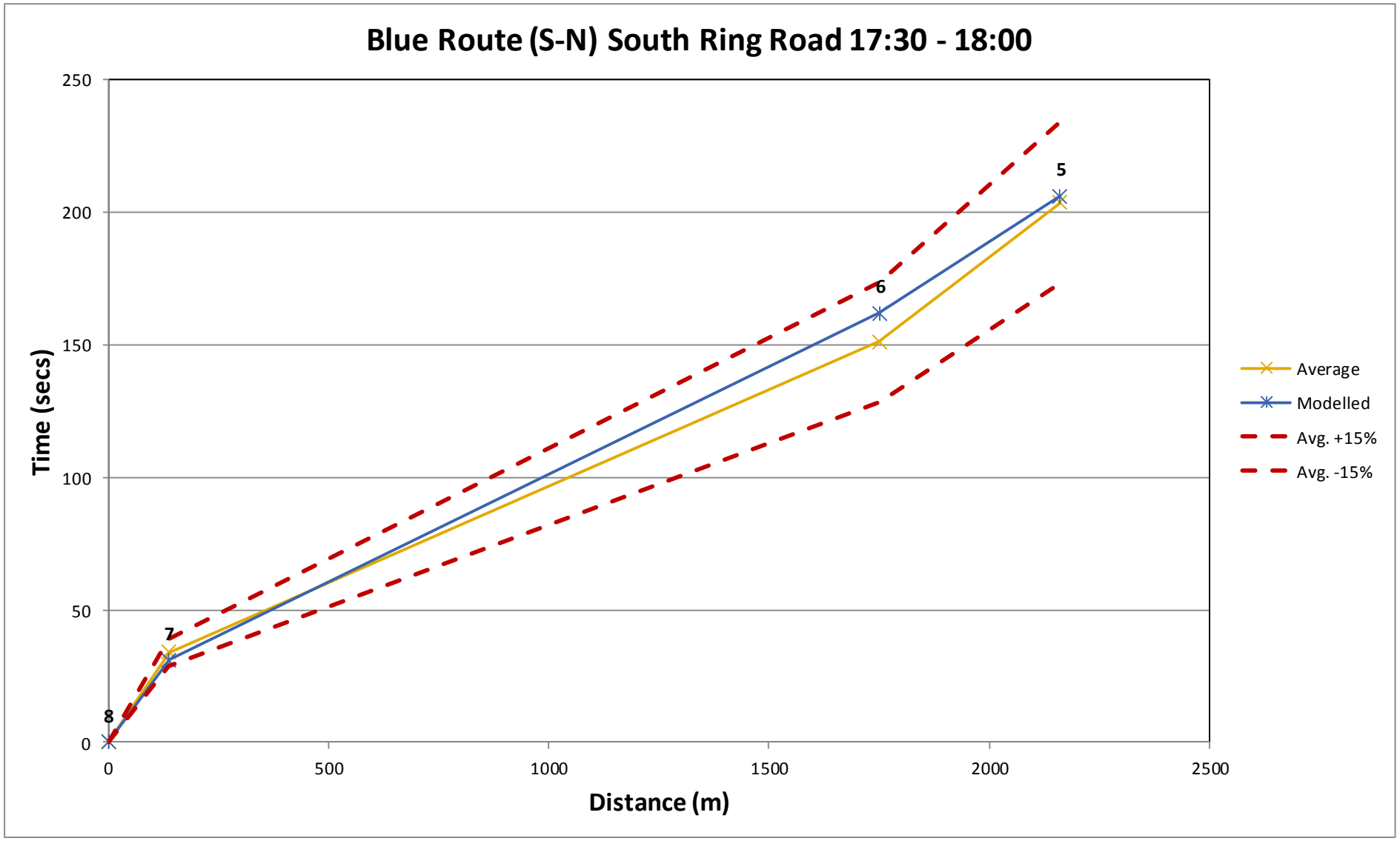

Figure 1.9 Journey Time Data Blue Route South Ring Road (S-N) PM Peak

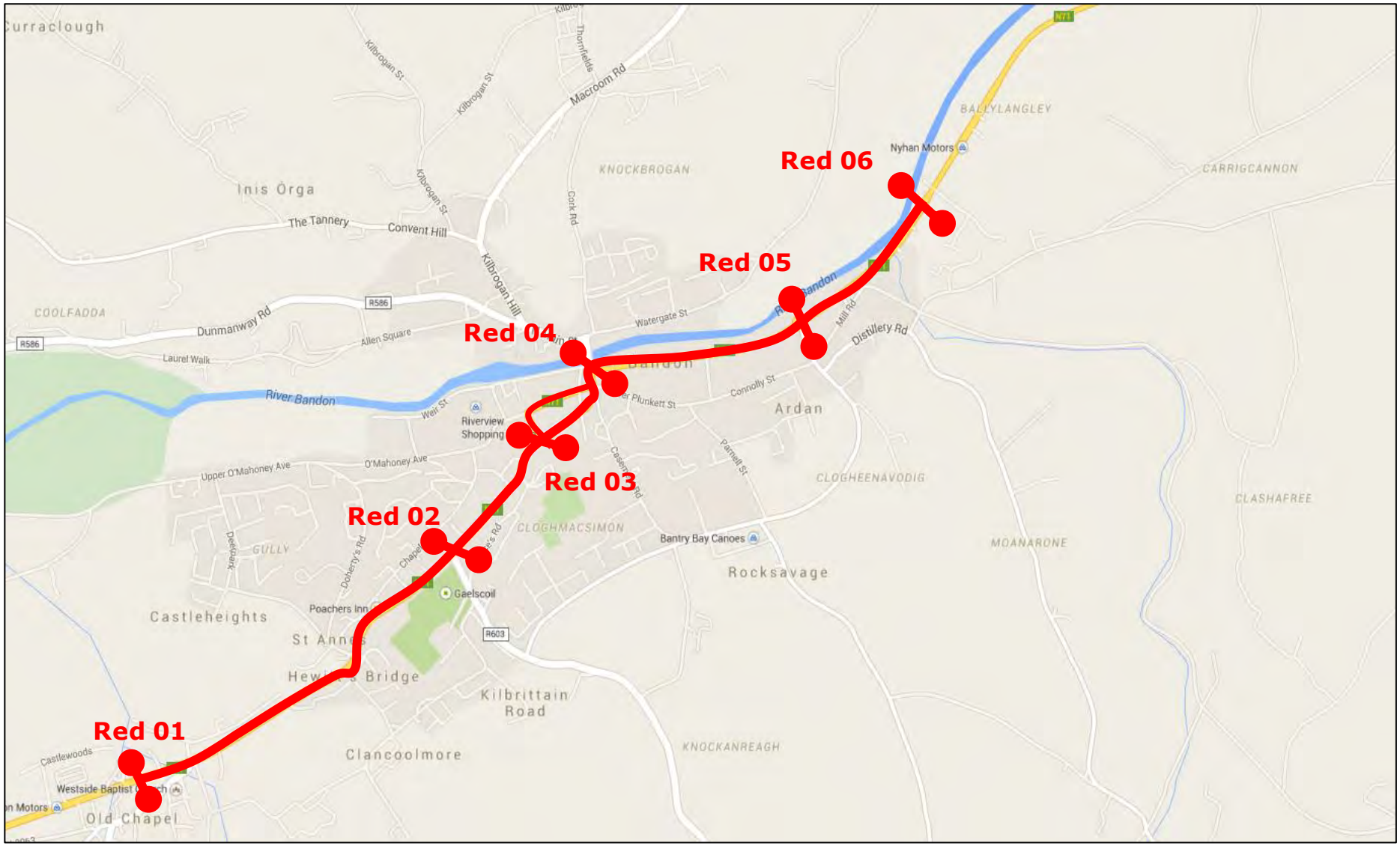

Figure 1.10 Journey Time Survey Red Route

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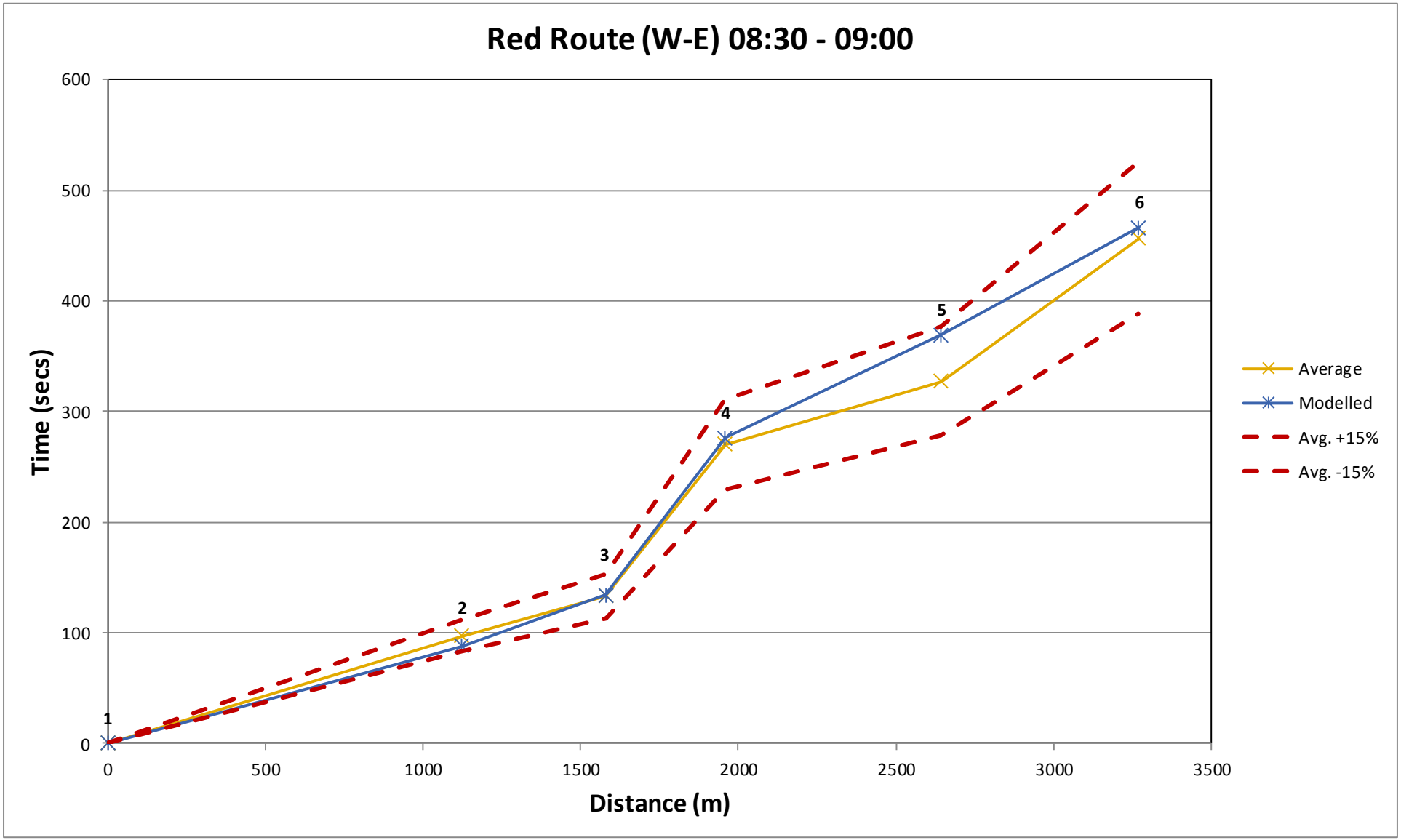

Figure 1.11 Journey Time Data Red Route (W-E) AM Peak

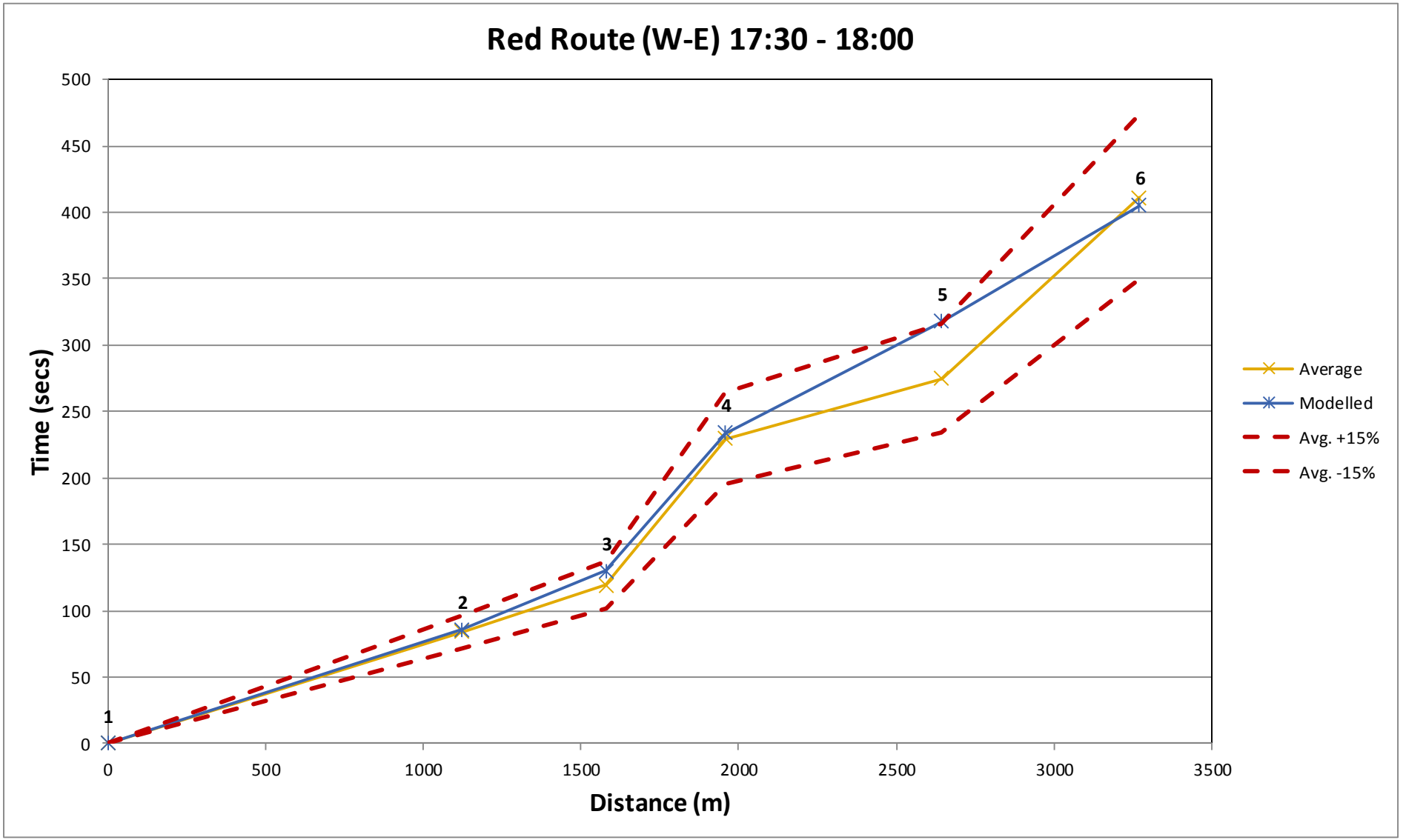

Figure 1.12 Journey Time Data Red Route (W-E) PM Peak

Figure 1.13 Journey Time Data Red Route (E-W) AM Peak

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Figure 1.14 Journey Time Data Red Route (E-W) PM Peak

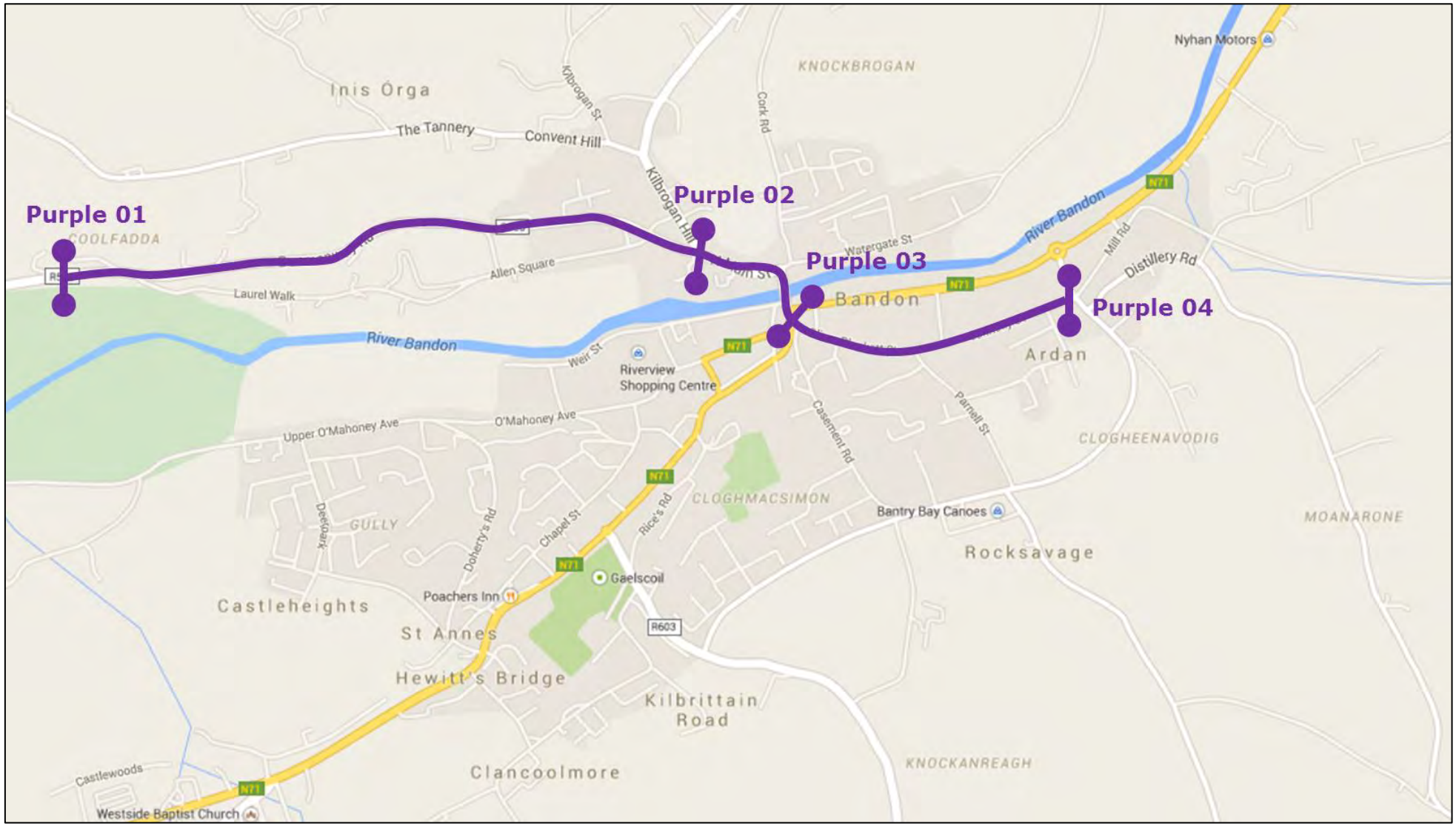

Figure 1.15 Journey Time Survey Purple Route

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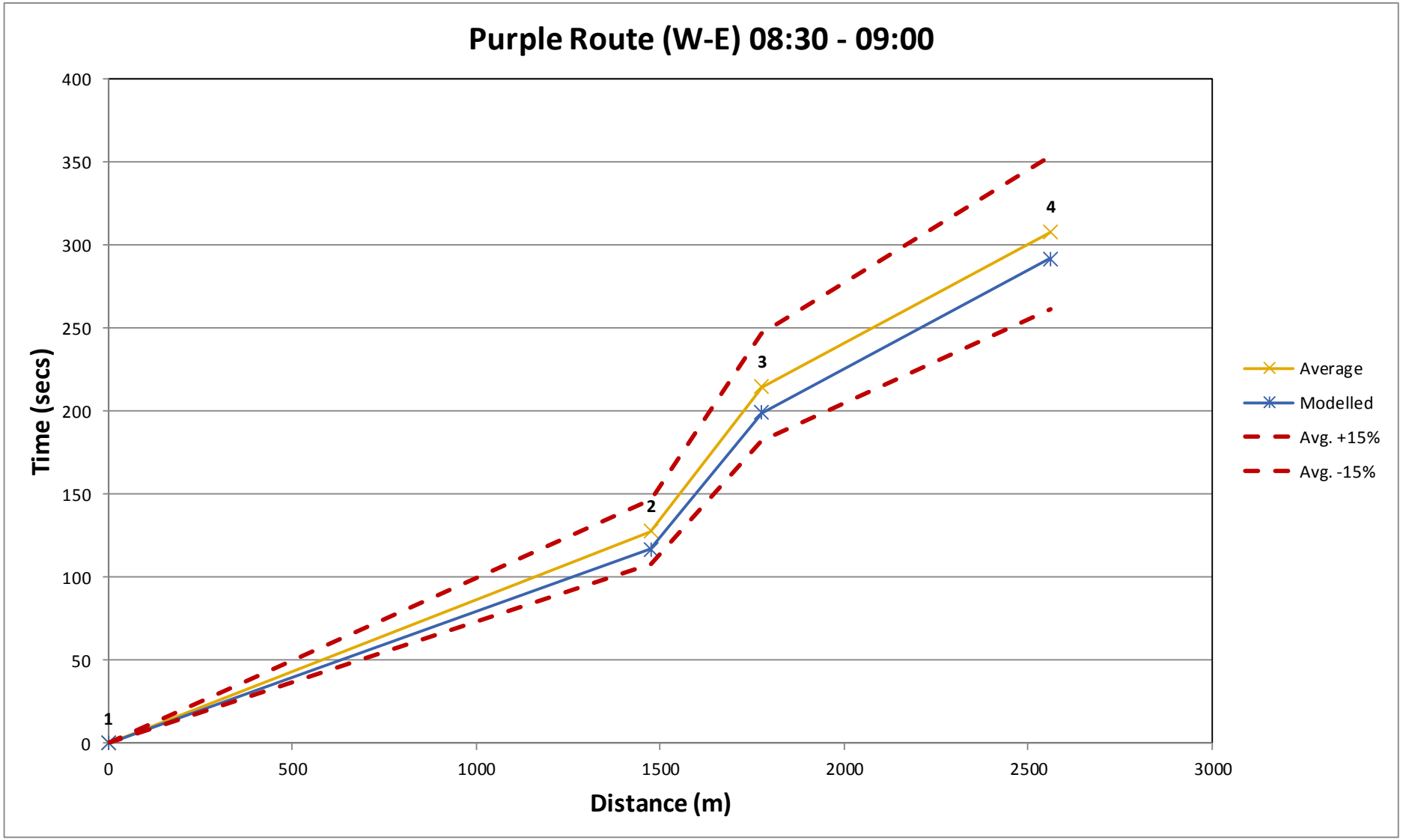

Figure 1.16 Journey Time Data Purple Route (W-E) AM Peak

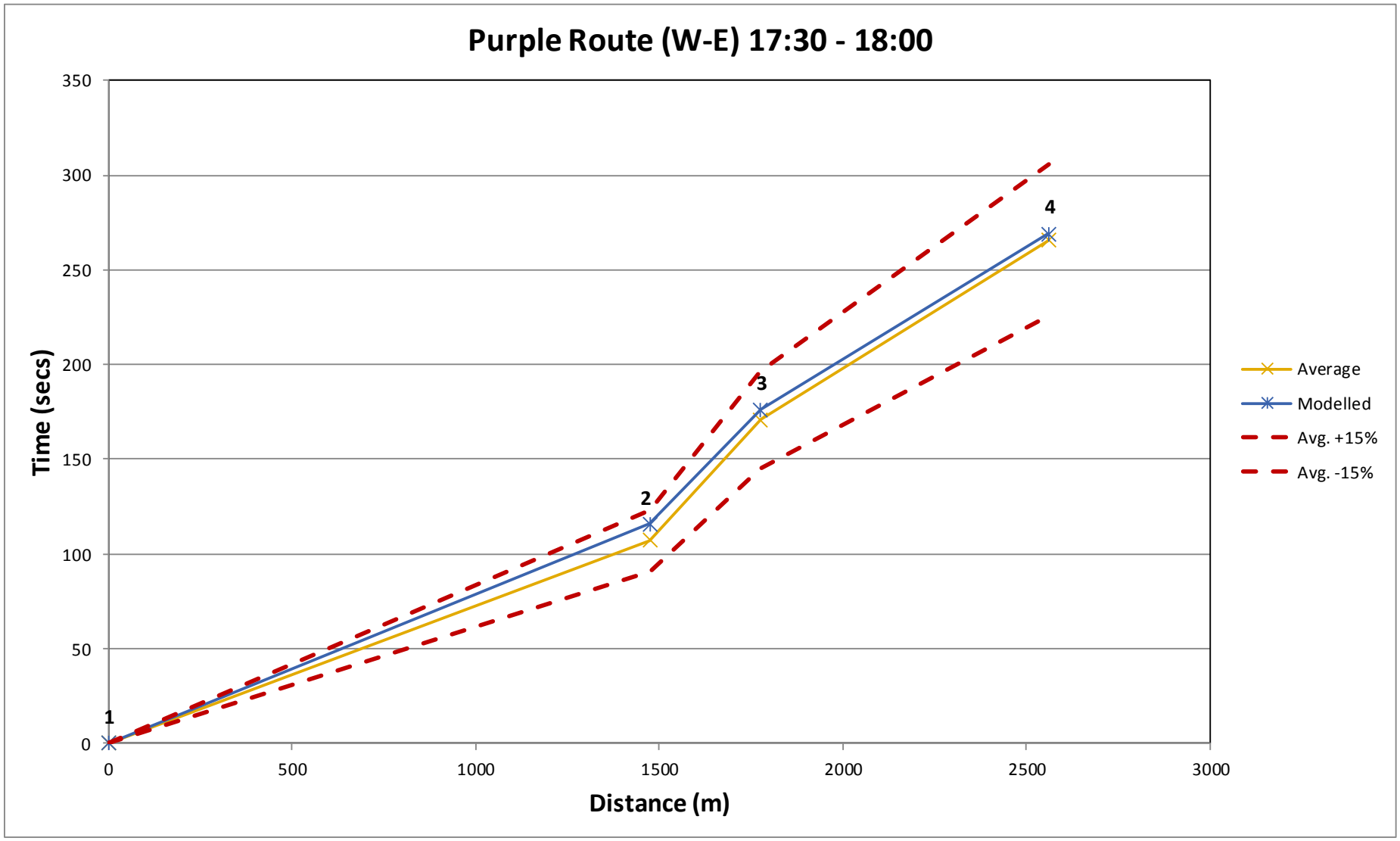

Figure 1.17 Journey Time Data Purple Route (W-E) PM Peak

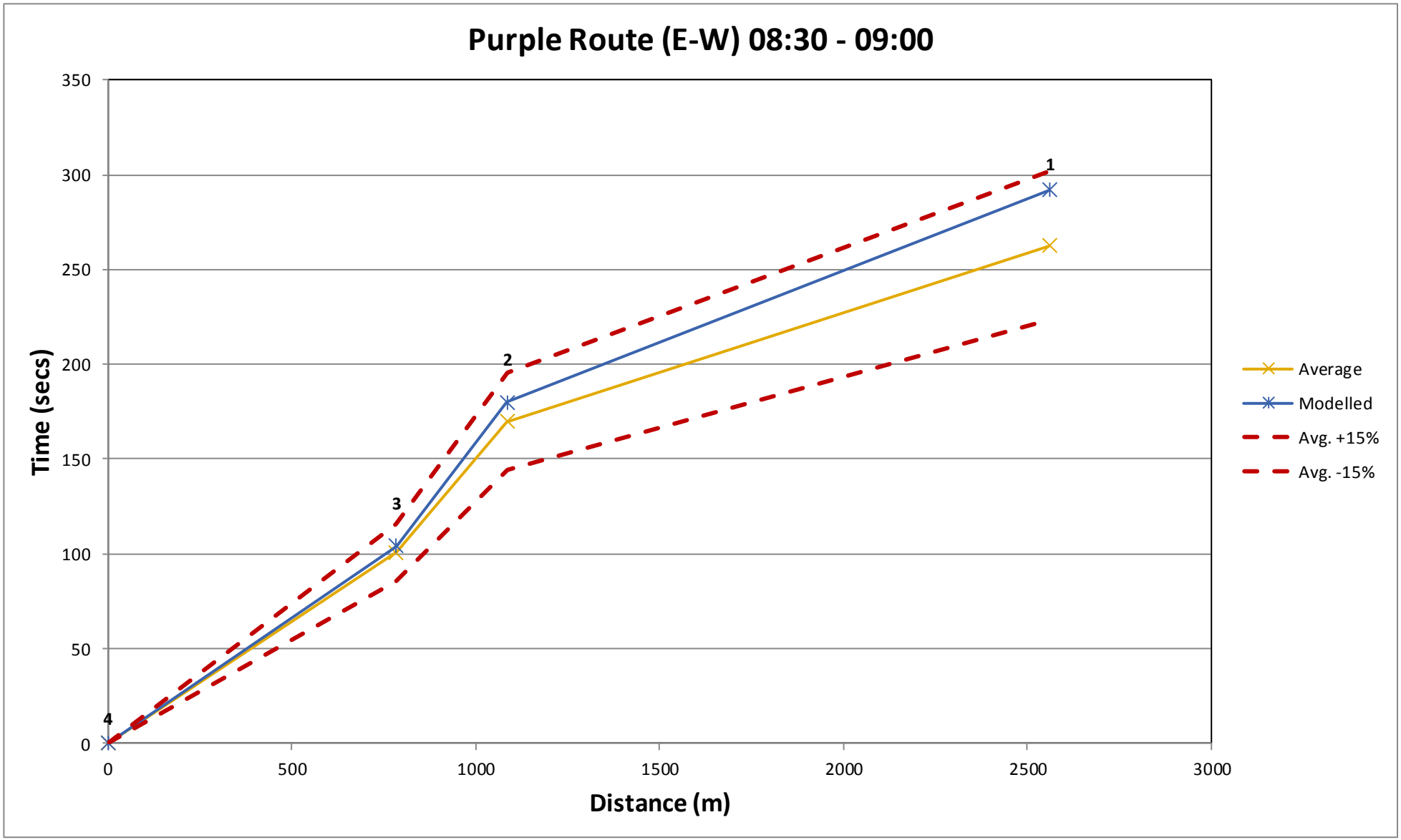

Figure 1.18 Journey Time Data Purple Route (E-W) AM Peak

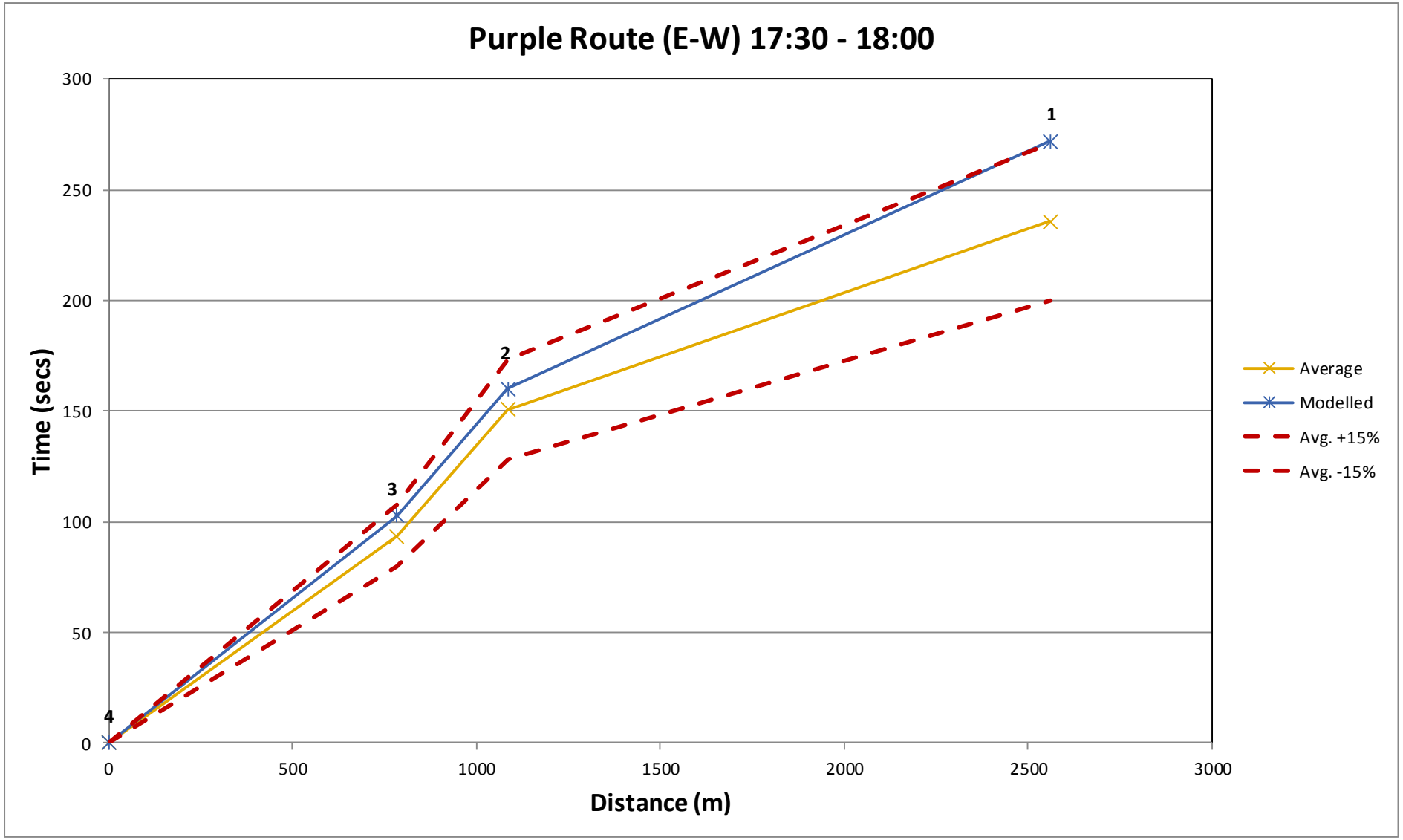

Figure 1.19 Journey Time Data Purple Route (E-W) PM Peak