N4 Carrick-on-Shannon to Dromod **04/11/2022**

Reference number 300639

PHASE 2 TRAFFIC MODELLING REPORT

SYSTRA

N4 CARRICK-ON-SHANNON TO DROMOD

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1. INTRODUCTION

1.1 Background

1.1.1 The N4, Dublin to Sligo route, is a strategic corridor from Dublin to the northwest and border counties and is approximately 198km in length. It is recognised as being of particular importance in enhancing accessibility to some of the most peripheral areas in the north-west (including Leitrim / Roscommon / Sligo and Donegal) and west of the River Shannon.

1.1.2 The section of the N4 under consideration connects Carrick-on-Shannon with Dromod and is illustrated in Figure 1. It passes through both rural and urban environments, is approximately 21km long, extending from Drumharlow townland north of Carrick-on-Shannon to just south of Aghamore. The main towns and villages along the route are Carrick-on-Shannon (hereafter referred to as Carrick-on-Shannon but deemed to include the settlements of Carrick-on-Shannon in County Leitrim and Cortober in County Roscommon) Drumsna and Aghamore.

Figure 1. Area of Influence

1.1.3 Forming part of the larger N4 network, connecting Dublin and Sligo, the route carries both regional and long-distance traffic from the east and northwest of Ireland. It also interconnects both the N5 and N6 networks, facilitating inter-urban traffic flow from such locations as Mullingar, Longford, Carrick-on-Shannon, Boyle, and Sligo.

1.1.4 Significant lengths of the N4 have been upgraded to accommodate this demand, with works conducted in order to improve journey times along the wider corridor. However, the section detailed within Figure 1, the area of our study, has not been subject to such improvements, with only relatively minor works occurring along the rural segment of the route in 2005. Additionally, Carrick-on-Shannon is the only regional strategic urban centre along the length of the N4 that has not been bypassed. The result of this is that the town of Carrick-on-Shannon

has become a bottleneck for strategic traffic, with long delays experienced during peak periods. One of the primary contributors to this bottleneck include limitations within the existing infrastructure, including the current crossing over the River Shannon, occurring on the N4 within Carrick-on-Shannon. The crossing is achieved via a narrow-arched bridge located within the city centre which dates back to 1846 and is referred to heretofore as the River Shannon Bridge.

1.1.5 Consequently, the key objectives of this project are to provide a reliable and sustainable transport solution for the N4 corridor between Dromod and Carrick-on-Shannon and to ultimately contribute to efficient connectivity between Dublin and Sligo.

1.2 Purpose of This Report

1.2.1 SYSTRA has been tasked to undertake the Project Appraisal, including the transport modelling elements, of the project.

1.2.2 This report describes the traffic modelling work undertaken by SYSTRA for the purpose of informing the selection of a Preferred Transport Solution during the Option Selection Phase (TII PAG Phase 2).

1.3 Study Area

1.3.1 For the purpose of this Traffic Modelling Report, a study area has been defined, within which transportation solutions will be assessed based on certain Key Performance Indicators (KPIs). The study area, shown below in Figure 1 includes:

- The entirety of Carrick-on-Shannon;
- The N4 extending approximately 10km to the West of Carrick-on-Shannon;
- The N4 extending approximately 10km to the South of Dromod; and
- All significant minor routing adjacent to the N4, extending approximately 15km south of Carrick-on-Shannon and 9km North of Carrick-on-Shannon.

1.4 Existing Conditions

Capacity and Cross-Section

1.4.1 The following AADT flows in Figure 2 were estimated based on traffic counts undertaken on behalf of Leitrim County Council in 2019 along the N4.

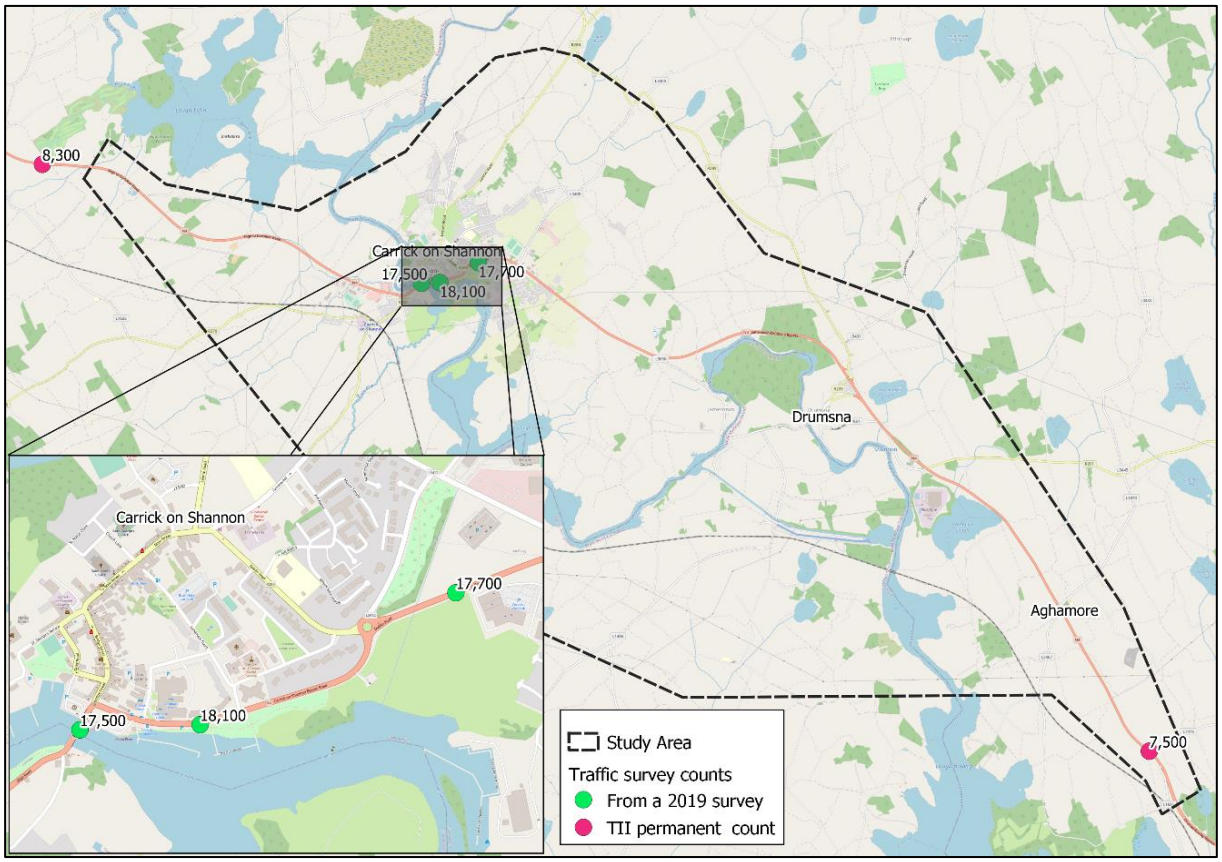


Figure 2. N4 Average Annual Daily Traffic (AADT)

1.4.2 The AADT figures in Table 1 indicate that the N4 is a busy national primary road with average daily traffic flows ranging from 7,500 to 18,100. It can be seen that two sections of the N4 in Carrick-on-Shannon currently experience flows in excess of design capacity.

Table 1. Observed AADT

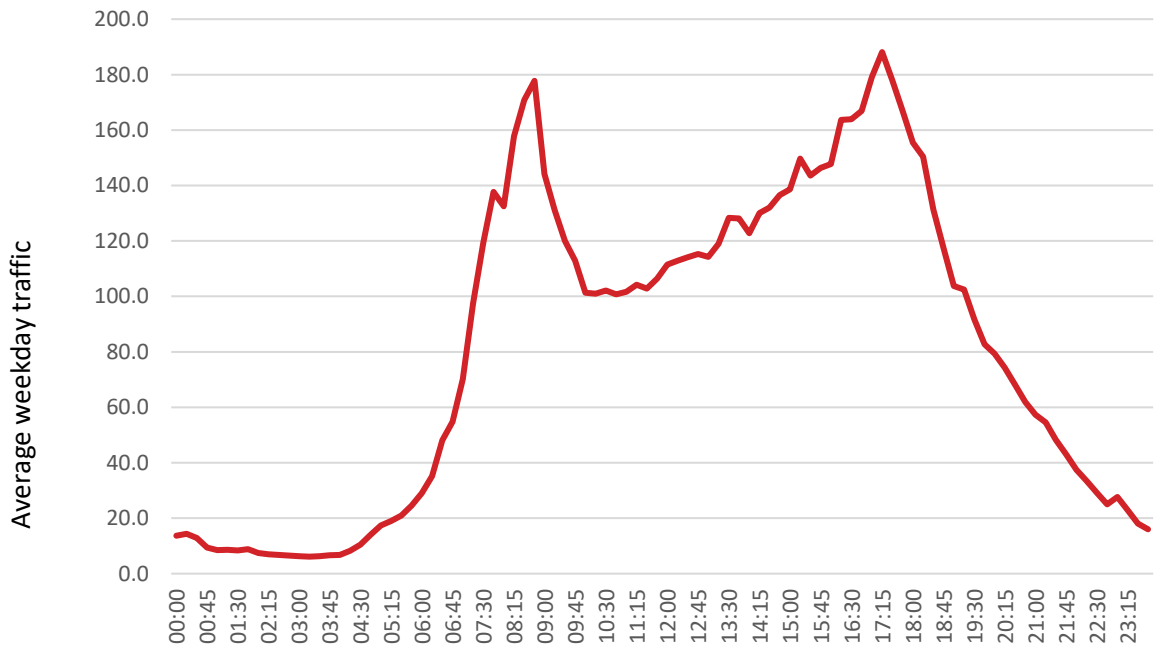
TRAFFIC COUNT LOCATION	AADT (2019)	CARRIAGEWAY TYPE	DESIGN CAPACITY
TII / N4 Between Boyle and Carrick-on-Shannon	8,300	Type 1 Single	11,600
ATC count, Carrick-on-Shannon Bridge	17,500	Urban All Purpose 4 (<6.1M)	13,000
ATC count, Bypass road, South of Carrick-on-Shannon	18,100	Urban All Purpose 4 (6.75M)	15,800
ATC count, Dublin Road, East of Carrick-on-Shannon	17,700	Urban All Purpose 2 (6.75M)	22,100

TRAFFIC COUNT LOCATION	AADT (2019)	CARRIAGEWAY TYPE	DESIGN CAPACITY
N4 Between Longford and Carrick-on-Shannon, Dromod Bypass	7,500	Type 1 Single	11,600

1.4.3 It is worth noting that, at circa 18,000, the AADT values in Carrick-on-Shannon are significantly higher than those observed just outside of the town (7,500 – 8,300). This indicates that there is a high level of local trip making within the town.

Analysis of traffic profiles

1.4.4 Average weekday traffic flow profiles, extracted from the TII TMU's, are shown in Figure 3. This identifies that the AM peak occurs between 08:00 - 09:00 and the PM peak occurs between 17:00 - 18:00. We also note very high levels of interpeak travel (14:00 - 16:00), with a steady build-up of trips occurring from 10:00am onwards. This illustrates the fact that the road is well utilized throughout the day, with a considerable portion of demand being unrelated to commuter traffic.



Average data from the 2 TMUs shown on Figure 3. All vehicles, average of the weekdays of November 2019.
Unit: *Traffic per 15 min, both directions.*

Figure 3. Daily Traffic Flow Profile

1.4.5 It is worth noting that Carrick-on-Shannon and the surrounding area is popular with tourists, particularly during weekends and summer months. As a result, traffic on the N4 during summer weekends (Friday – Sunday) can be considerably higher than the mid-week annual

average presented. Analysis of July 2019 traffic data showed that the 24-hour average level of traffic on the N4 was 25% higher on Fridays in July than the Annual Average Daily Traffic (24-hour average across all days of the year).

Journey times

1.4.6 Journey time data gathered on the N4 through Carrick-on-Shannon in 2022 shows journey times of about 20 minutes in free flow conditions in the very early hours of the morning. In the westbound direction the route takes 3 or 4 minutes longer in peak conditions. That is up to about 20% longer.

1.4.7 In the eastbound direction on weekdays, the route takes around 6 to 8 minutes longer (about 40%) in peak conditions. On weekends, the delays are worse. The route takes up to around 15 minutes longer, peaking on Saturday at around at 4pm and on Sunday at around 1pm.

1.4.8 In the weeks either side of the August bank holiday, the route took around 25 minutes longer on several days and up to around 35 minutes longer on the day of the bank holiday.

1.5 Modelling Overview

Base Year Model Development

1.5.1 The National Transport Authority's (NTA's) Western Regional Model (WRM) has been used as a starting point for the development of a single project Local Area Model (LAM) for the appraisal of scheme options. The WRM is a multi-modal transport model based in SATURN and CUBE Voyager with a focus on the city of Galway.

1.5.2 The highway element of the WRM provides the basic road network, zoning structure, trip matrices and traffic growth forecasts for the development of the LAM. The LAM has been developed using SATURN (strategic modelling software).

1.5.3 The WRM has also been used to identify the area of influence of the scheme and the associated study area for the LAM. The study area captures any potential competition with alternative routes or rerouting of traffic as a result of the proposed scheme. This study area has been cordoned from the WRM base models to form the initial LAM. The cordoned version of the LAM was then refined with additional detail added where necessary to ensure the physical characteristics of the road network are reflective of the existing 2020 network.

1.5.4 The zoning structure of the LAM was also refined at this stage. The WRM zonal structure is based on the CSO Electoral Divisions (ED) boundaries with each zone containing one or more ED. These zones have been refined based on the CSO small area boundary system for consistency, to allow demographic data to be linked to each LAM zone.

1.5.5 Once the LAM road network and zone structure were appropriately refined the model was calibrated and validated against observed data in accordance with criteria set out in PAG Unit 5.1.

Time Periods Modelled

1.5.6 For the purposes of this Study, a LAM has been developed for the following time periods:

- AM Peak Hour;
- Average Inter-Peak Hour; and
- PM Peak Hour

1.6 Proposed Alternatives and Options

1.6.1 Various alternatives to building a bypass were considered in the Stage 1 assessment:

- Do-Nothing
- Alternative A: Active Travel Improvements;
- Alternative B: Public Transport Improvements:
  - Bus Enhancements, including improved inter-urban bus services and improved local bus services in Cortober and Carrick-on-Shannon. The proposals were very similar to those currently set out in Connecting Ireland.
  - Rail enhancements and improvements to the railway station, raising the frequency of trains from 8 per day to 18 and reducing the journey times by 11%
- Alternative C: Demand Management to reduce travel demand.

1.6.2 In Stage 2, elements of the alternatives rejected as stand-alone solutions have been incorporated into the bypass options as complementary measures. The following measures have been included in all the bypass options:

- Demand management measures, including a reduction in the speed limit on the N4 in Carrick-on-Shannon to 30 km/h plus long inter-green times at the traffic signals along the route, to deter through traffic and make the street safer and more attractive for pedestrian and cyclists; and
- Active travel measures in Carrick-on-Shannon, including footpath widening, upgrades to cycle paths, a new pedestrian link and a new shared path

1.7 Report Structure

1.7.1 The remainder of this Report is structured as follows:

- **Chapter 2 - Data Collection:** summarises all the data that was used to calibrate and validate the Local Area Model (LAM);
- **Chapter 3 - Model Development:** describes the development of the base year LAM;
- **Chapter 4 - Model Calibration:** summarises the calibration results comparing them back to the surveyed traffic data;
- **Chapter 5 - Model Validation:** summarises the validation results comparing them back to the surveyed journey times and count information; and
- **Chapter 6 - Future Year Model Development:** sets out the development of the future year WRM and LAM models for the scheme opening and design years.
- **Chapters 7, 8 and 9 -** outline the assessments undertaken during Phase 2.
- **Chapter 10** provides a summary and conclusion.

2. DATA COLLECTION

2.1 Summary

2.1.1 A comprehensive set of traffic count data was collected and used to calibrate and validate the N4 LAM.

2.1.2 Traffic surveys were carried out in December 2020 and comprised the following:

- 18 Automatic traffic counters (ATCs) along the N4 and on other key routes within the model;
- 50 Junction turning counts (JTCs) at the main junctions along the route and at key points on the local road network;
- ANPR, origin-destination, surveys at 8 locations; and
- Journey time surveys between 8 locations.

2.2 Automatic Traffic Counts

2.2.1 ATC's were undertaken at 18 locations across the network, as illustrated in Figure 4, over a 7-day period from in the first half of December 2020. The ATC data provides information on:

- The daily and weekly profile of traffic within the study area;
- Busiest time periods and locations of highest traffic demand on the network;
- Any issues on the network during the survey period e.g. accidents, closures; and
- Typical speed of traffic on the network.

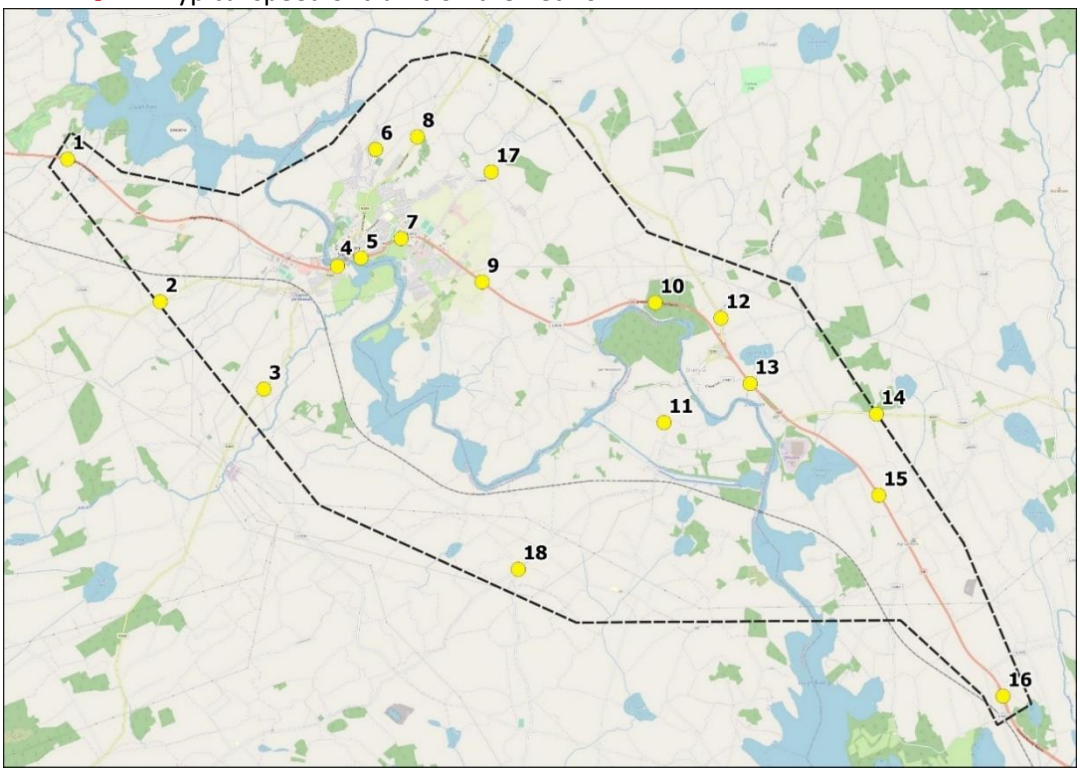


Figure 4. ATC Locations

2.3 Junction Turning Counts

2.3.1 JTC's were undertaken at 50 locations across the network, illustrated in Figure 5. All JTC sites were surveyed on the 8th December 2020 and summarised data for 15-minute time intervals.

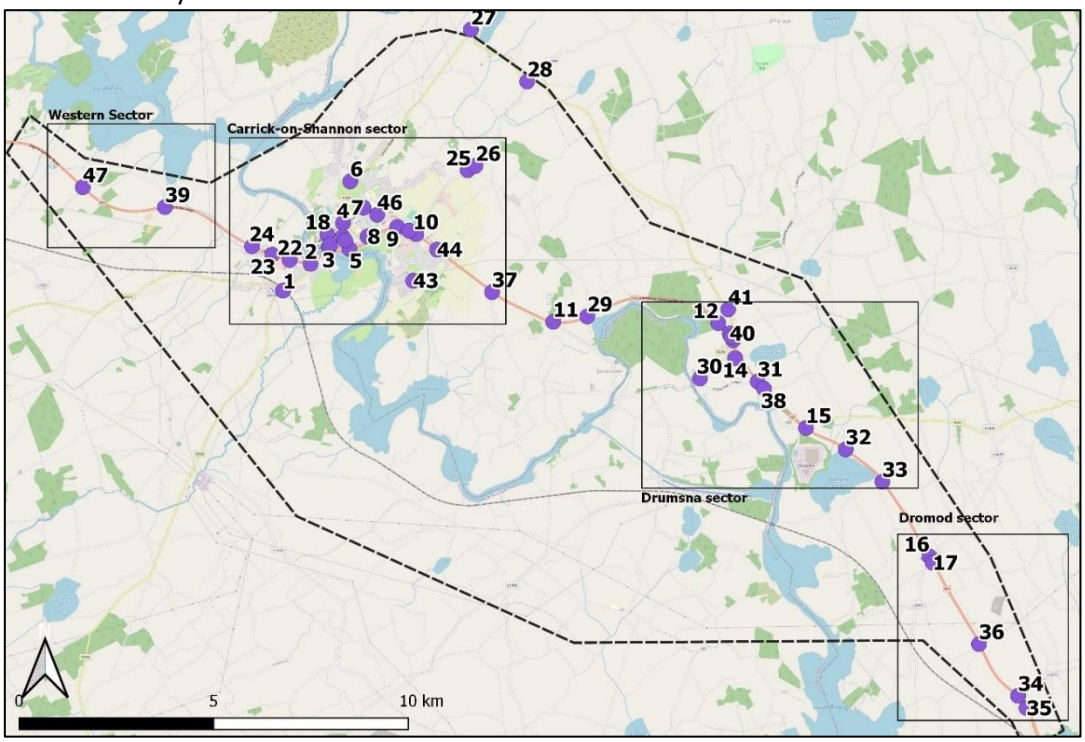


Figure 5. JTC Locations

2.3.2 All the main junctions within the study area were included and this provides information on the volume, and types of vehicles, making turning movements at each location. This data is utilised within the calibration exercise to ensure that the flow of vehicles through the main junctions on the network is being represented accurately.

2.4 ANPR Surveys

2.4.1 Automatic Number Plate Registration (ANPR), origin-destination, surveys were carried out at 8 locations as indicated in Figure 6.

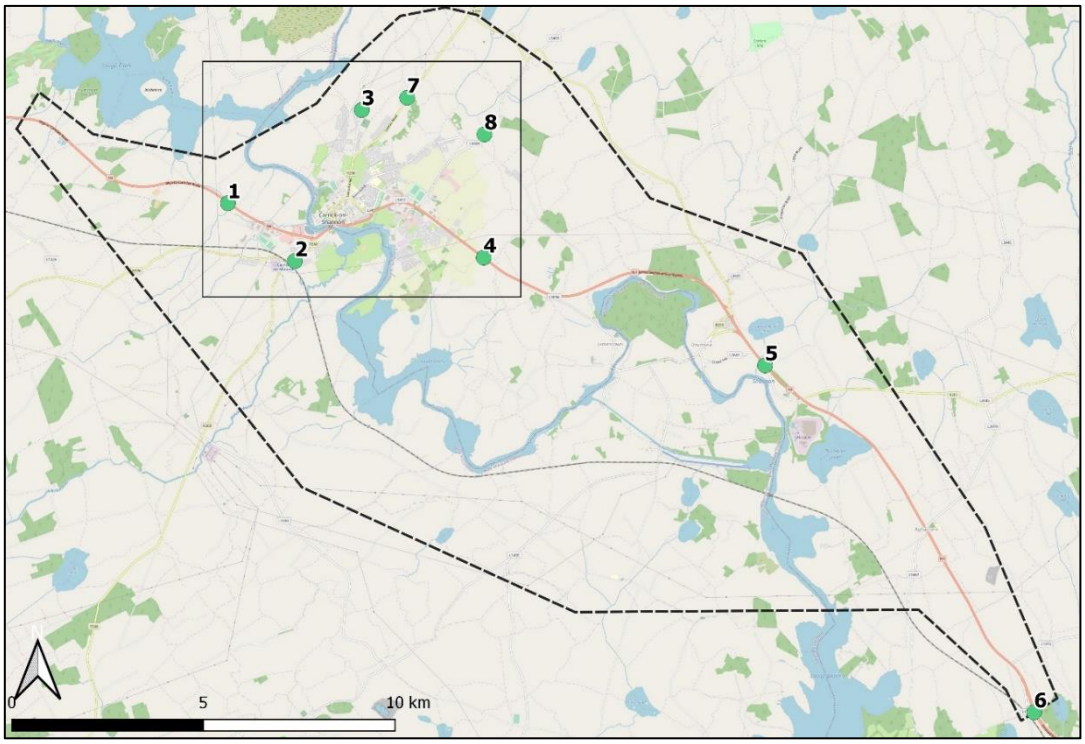


Figure 6. ANPR Sites

2.4.2 Origin-Destination Surveys, between all of the marked survey points, were conducted for a full 12-hour period (06:00-18:00) on the same day that the JTCs were carried out on in December 2020. The sites form a cordon around the town of Carrick-on-Shannon that allows through trips to be identified robustly. There is an insignificant gap in the cordon between sites 2 and 4 where traffic could enter the ANPR cordon, without being detected, along Marina Road. Marina Road is a very narrow single-track road with occasional passing places. JTC site 43 shows only 13 vehicles in the morning peak hour heading north on Marina Road towards on Carrick-on-Shannon.

2.5 Journey Time Surveys

2.5.1 Journey time data was collected for trips between each of the ANPR survey points shown in Figure 6. ANPR data sets were processed along the N4 route, in both directions, to be used in the model validation process from a journey time perspective. These are utilised in order to ensure that delays experienced on the network are accurately replicated in the model.

2.5.2 This data was collected during the following time periods to align with the LAM:

- 07:00 – 10:00
- 11:00 – 15:00
- 16:00 – 19:00

2.6 Impact of a Road Traffic Collison on N4 Data

2.6.1 On the day of the ANPR and JTC surveys, there was a Road Traffic Collision on the N4 during the AM peak and diversions were put in place by the emergency services. This affected some

of the JTC surveys, ANPR surveys and consequently some of the journey time data. Impacted data was identified through sense checks and any impacted data was removed from the LAM development process and where possible, substituted with Google journey time data for the effected section of the N4. Therefore, since a pragmatic solution has been found, the impact of the road traffic collision on the N4 during the surveys presents a low risk.

2.7 Impact of COVID-19 restrictions

2.7.1 In response to the COVID-19 pandemic, the Irish Government imposed restrictions on the movement of people in order to contain the spread of the virus. This commenced with the closure of all schools and colleges from 13th March 2020. Further restrictions, involving the retention of essential services only, were announced on 24th March 2020. On the evening of 27th March 2020, a Government announcement was made which advised all citizens to stay at home and to only leave their homes for a limited number of reasons. The restrictions implemented by Government in order to tackle the spread of the COVID-19 virus have had significant impact on national road traffic volumes which have reduced by up to 70% when compared to the same time last year.

2.7.2 Since this, the Government developed a national framework for living with COVID-19. This included a 5-level system for re-opening society and business. As the country changed levels, restrictions were removed which has seen a corresponding increase in traffic levels, however, in general, traffic levels and patterns are yet to return to similar levels observed prior to COVID -19 restrictions.

2.7.3 The traffic surveys that were used to develop the Carrick-on-Shannon LAM were undertaken during December 2020. The country was under travel restrictions at this time which involved limited numbers for social gatherings and advising people to not travel outside their county, amongst other restrictions. Therefore, as these restrictions will have resulted in non-typical travel patterns within the study area, an analysis of TII's Traffic Monitoring Units (TMU) has been undertaken to establish the impact.

2.7.4 The following analysis compares the average weekday traffic that travelled through the TMU (on the N4 near Carrick-on-Shannon) for the 2-week period that the counts were undertaken in 2020 versus the same 2-week period in 2019.

2.7.5 Figure 7 for the TMU between Carrick-on-Shannon and Dromod shows a drop across the whole day during 2020 compared with 2019. The AM peak hour in 2020 shows a decrease of 16% compared to 2019 while the PM peak hour shows an 19% drop compared to 2019. The full 24-hour flows in 2020 are also 14% lower than in 2019.

2.7.6 Figure 8 for the TMU to the west of Carrick-on-Shannon also shows a drop across the whole day during 2020 compared with 2019. The AM peak hour in 2020 shows a decrease of 11% compared to 2019 while the PM peak hour shows an 15% drop compared to 2019. The full 24-hour flows in 2020 are also 11% lower than in 2019.

2.7.7 This analysis shows that the surveyed flows used are between 11% - 19% lower than those in 2019 (pre-pandemic). As a result of this, the forecast AADTs output from the models and are based on the surveyed 2020 data can be assumed to be lower by the same amount compared to those before the pandemic. Additionally, the calculated benefits of each option is also likely to be lower.

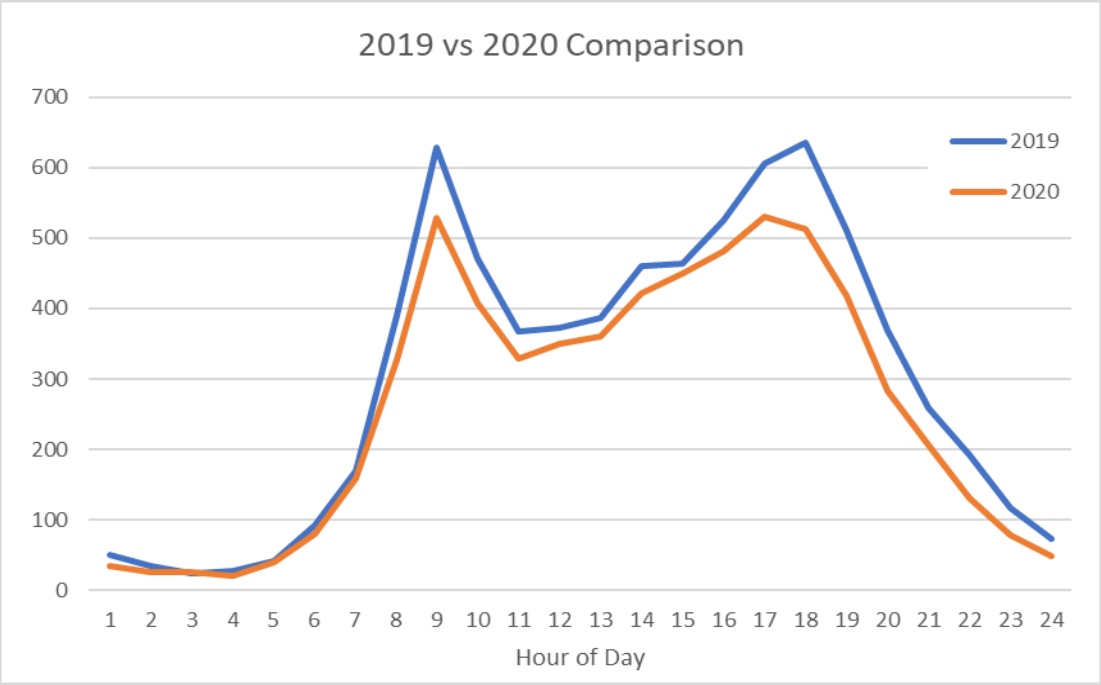


Figure 7. N4 (Between Carrick-on-Shannon and Dromod) TII Traffic Counter Data Analysis

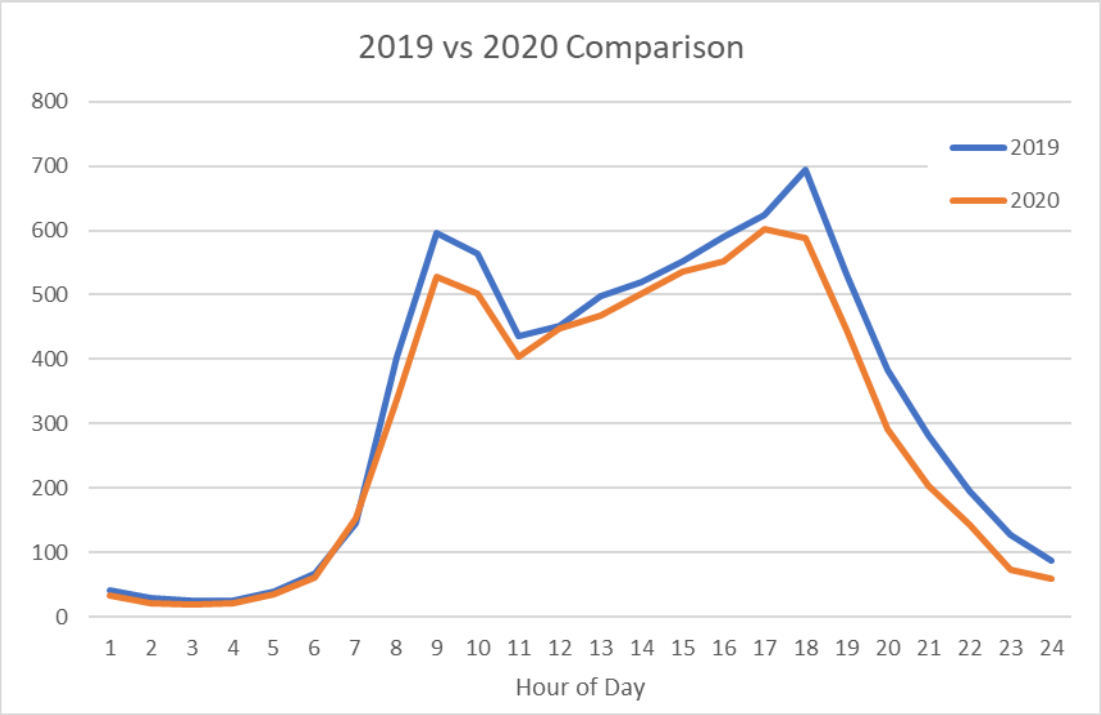


Figure 8. N4 (West of Carrick-on-Shannon) TII Traffic Counter Data Analysis

2.7.8 This analysis shows that the 2019 and 2020 traffic flows show a similar profile, however the 2020 traffic flows are approximately 11-19% lower than those in 2019 (pre – pandemic). As a result of this, the forecast AADTs output from the models (which have been calibrated to 2020 data) are likely to be approximately 11-19% lower than if the model had been developed using "typical" or pre-COVID traffic data.

2.7.9 Additionally, it follows that the calculated benefits of each option are also likely to be underestimated. The models developed will still provide a robust and consistent platform with which to assess the various options during Phase 2 of this project. However, whilst stating this, it is recognised that COVID-19 changed when people travel, how they travel and whether they travel at all. The data used to develop the Phase 2 models was collected in a period when more people were working from home than usually would, causing there to be less travel to employment centres, but more travel to and within local centres. Therefore, a sensitivity test will be carried out during Phase 2 on the Do-Minimum and Preferred Transport Solution models with uplifted highway trip demand (+15%) to replicate a post-pandemic Base model.

2.7.10 As travel restrictions are lifted in 2021, employees who were able to work from home during the pandemic will start to return to their place of work within an employment centre. There is potential for long-term effects on people's travel patterns that will outlast the pandemic. During Phase 3 the models will be updated using survey data collected post-pandemic (without any travel restrictions).

3. MODEL DEVELOPMENT

3.1 Introduction

3.1.1 This chapter describes the development of the base year N4 Local Area Model (LAM) with reference to the following aspects:

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

3.2 WRM Overview

3.2.1 Testing of the scheme options has been undertaken in the LAM highway model because the study area is at the periphery of the WRM multi-modal model. WRM is a strategic multi-modal transport model representing travel by all the primary surface modes – including, walking, and cycling (active modes), and travel by car, bus, rail, tram, light goods, and heavy goods vehicles. In WRM, the road network in the study area is represented by link-based "buffer coding", as opposed to the more detailed junction-based simulation coding that we have used for the LAM. Simulation coding is need for testing the proposed options because buffer coding cannot represent traffic signal timings.

3.3 General Model Structure

3.3.1 The WRM sits within the overall NTA Regional Modelling System which comprises of the following three main components, namely:

- The National Demand Forecasting Model (NDFM);
- 5 Regional Models (including the WRM); and
- A suite of Appraisal Modules.

3.3.2 The NDFM takes input land-use attributes such as population, no. of employees etc., and estimates the total quantity of daily travel demand produced by, and attracted to, each of the 18,488 Census Small Areas in Ireland.

3.3.3 The WRM is comprised of the following key elements:

- **Trip End Integration:** The Trip End Integration module converts the 24-hour trip ends output by the NDFM into the appropriate zone system and time period disaggregation for use in the Full Demand Model (FDM);
- **The Full Demand Model (FDM):** The FDM processes travel demand, carries out mode and destination choice, and outputs origin-destination travel matrices to the assignment models. The FDM and assignment models run iteratively until an equilibrium between travel demand and the cost of travel is achieved; and
- **Assignment Models:** The Road, Public Transport, and Active Modes assignment models receive the trip matrices produced by the FDM and assign them in their respective transport networks to determine route choice and the generalised cost for each origin and destination pair.

3.3.4 Destination and mode choice parameters within the WRM have been calibrated using two main sources: Census 2011 Place of Work, School or College - Census of Anonymised Records (2011 POWSCAR), and the Irish National Household Travel Survey (2012 NHTS). Therefore, the WRM is the ideal tool to cordon the N4 LAM from, and to estimate the multi-modal impact of transport schemes within the N4 study area. In addition, it provides the platform to forecast the future trip demand and distribution to/from the area.

3.4 Model Software Platform: SATURN

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

3.4.2 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 1,000 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, 37,500 in the largest);
3. As a simulation model of individual junctions;
4. As a network editor, database, 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.

3.5 Model Time Periods and User Classes

3.5.1 The standard model time period for traffic simulation and assignment models is one hour and therefore model development and data collection was carried out based on this assumption.

3.5.2 Through a review of survey data, it was noted that the highest traffic flows entering and leaving the area were experienced from 08:00 to 09:00 in the AM, 17:00 to 18:00 in the PM and 15:00 to 16:00 for the IP period. Therefore, the LAM was developed, calibrated, and validated to represent the following time periods:

- AM Morning peak period: 08:00 to 09:00
- PM Evening peak period: 17:00 to 18:00
- Inter peak period: 15:00 to 16:00

3.5.3 The trip demand matrices for these time periods, representing a base year of 2020, were developed for the N4 LAM using extractions from the WRM combined with survey data. 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.

3.6 Network Development

3.6.1 The goal in developing the N4 LAM was to create a model that accurately reflects current traffic conditions in the study area (illustrated in Figure 1 previously) for the 2020 base year, and to a sufficient level of detail to allow the appraisal of each route option. To achieve this goal, the model must be defined in terms of road network and trip demand representation.

3.6.2 The WRM developed for the NTA was utilised as a base for generating the highway network for the LAM. However, as the WRM is primarily focused on Galway, areas outside the city are represented in lesser detail within the model. The road network, represented in the WRM, is outlined in Figure 9 and Figure 10. The network structure included in this area of the WRM represents the majority of significant roads in the area.

3.6.3 The WRM coding of the network in this area is also entirely in SATURN buffer coding. This means that the links are modelled using speed-flow relationships, and no junction detail is included and there is no detailed modelling of delay or interaction of turning flows at junctions.

3.6.4 In developing the N4 LAM, additional detail was added to the cordoned WRM network to enhance the modelled road network and better represent localised access points for traffic. As part of the regional model development process for the NTA, a review of traffic modelling processes was undertaken, which 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.

3.6.5 This best practice approach was utilised to generate the detailed traffic network for the LAM, reviewing existing link detail and adding junction detail. 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.

3.6.6 Figure 9 and Figure 10 illustrate the road network included in the N4 LAM. To ensure full network coverage and route choice, all roads have been considered, from the national primary routes to minor “back roads”. The short dead-end links in the figure are “spigots” used to load traffic from the zones onto the network and reflect the further developed zone network that is outlined in.

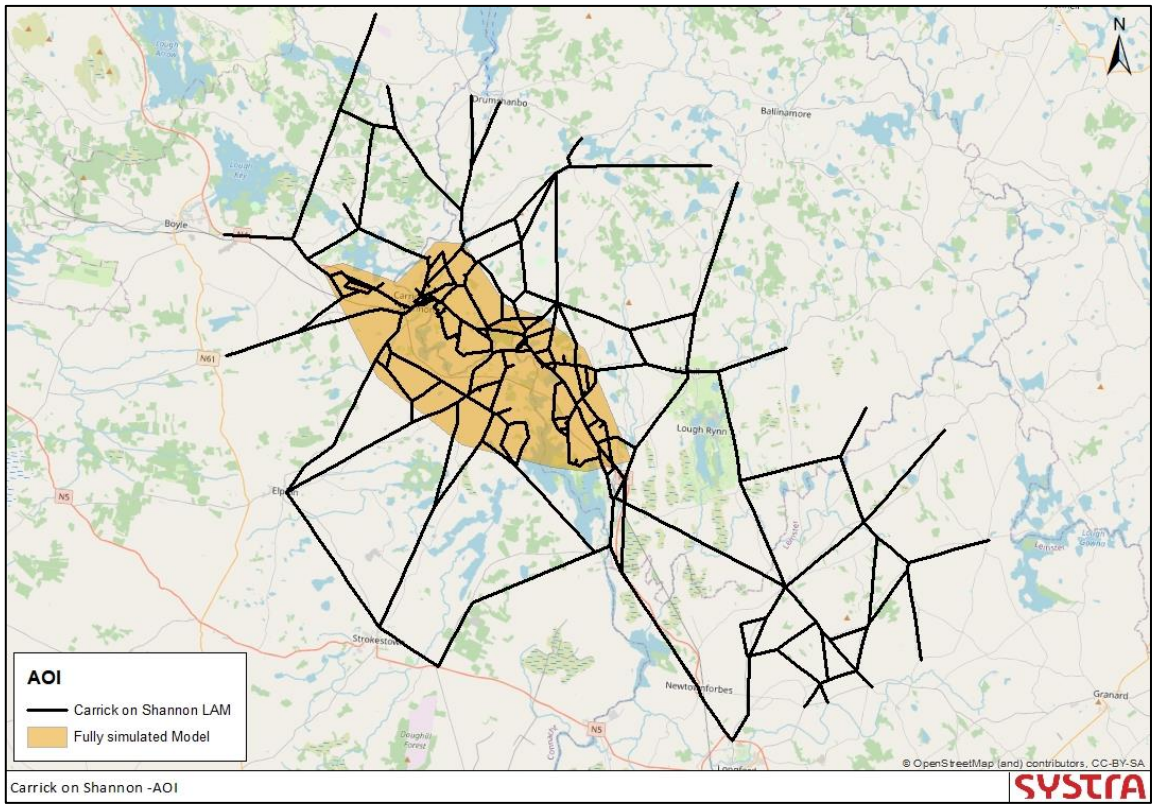


Figure 9. Study Area (Wide View)

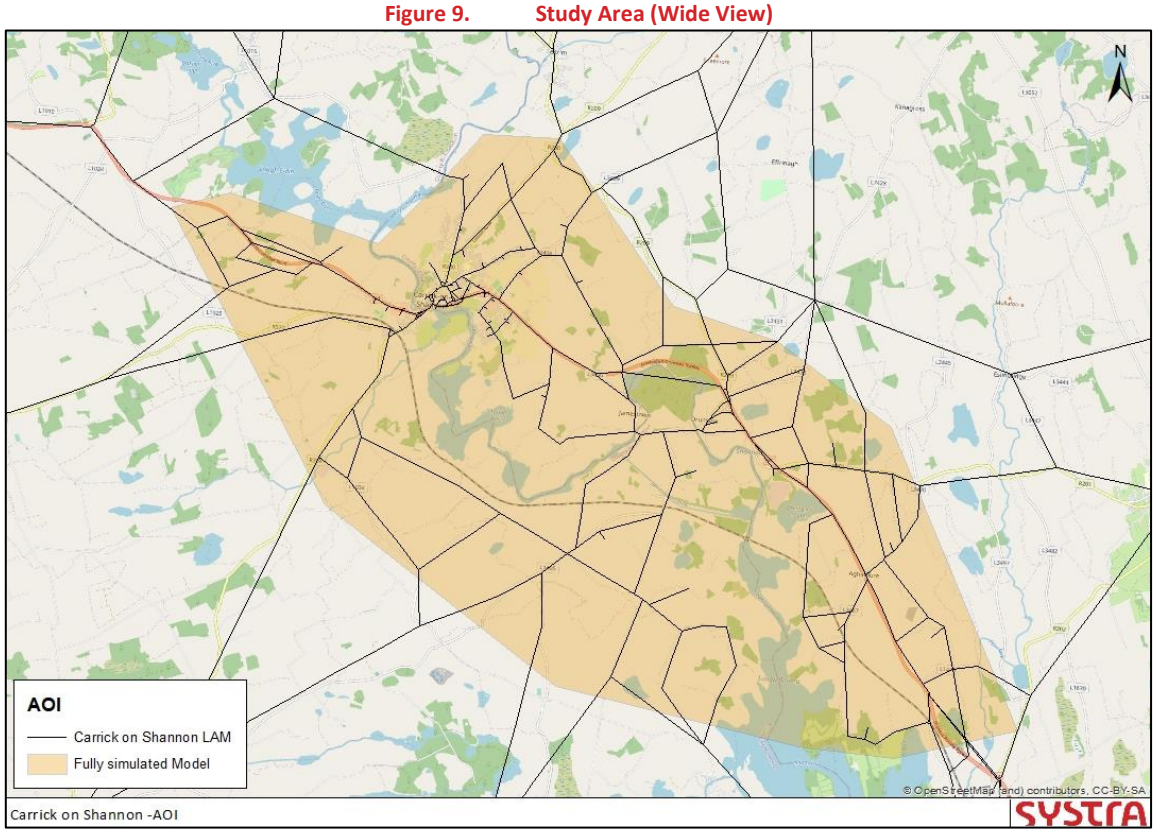


Figure 10. Study Area (Local View)

3.7 Model Zone System and Prior Matrix Development

Introduction

3.7.1 This section describes the development of the base LAM prior trips matrix with reference to the following aspects:

- Zone system development; and
- Prior matrix development.

Zone System Development

3.7.2 As outlined previously, the WRM was used as a basis for development of the LAM road network. However, as the study area is located outside of the main model area, the WRM zone structure is at too aggregate a level to accurately reflect traffic loading along the N4.

3.7.3 To provide an accurate representation of traffic loading onto and near the existing N4 route, a detailed zonal structure was developed for the LAM to reflect key generators and attractors of trips such as:

- Shopping centres / retail car parks / supermarket car parks;
- Key employment locations;
- Townlands; and
- Housing Estates – areas that load onto the network in one specific place.

3.7.4 Figure 11 illustrates the zonal system developed for the study area. In total, 150 zones have been created, with 128 internal zones within the study area and 22 external zones representing the roads that enter the area of interest. This level of detail ensures that traffic loads accurately onto both sides of the N4 and within Carrick-on-Shannon and the surrounding road network.

3.7.5 Note, that the original zone system, before disaggregation, is consistent with that used on surrounding projects in the area. The zone system is comparable, since disaggregation took place within the central zones of the LAM in and around Carrick-on-Shannon only.

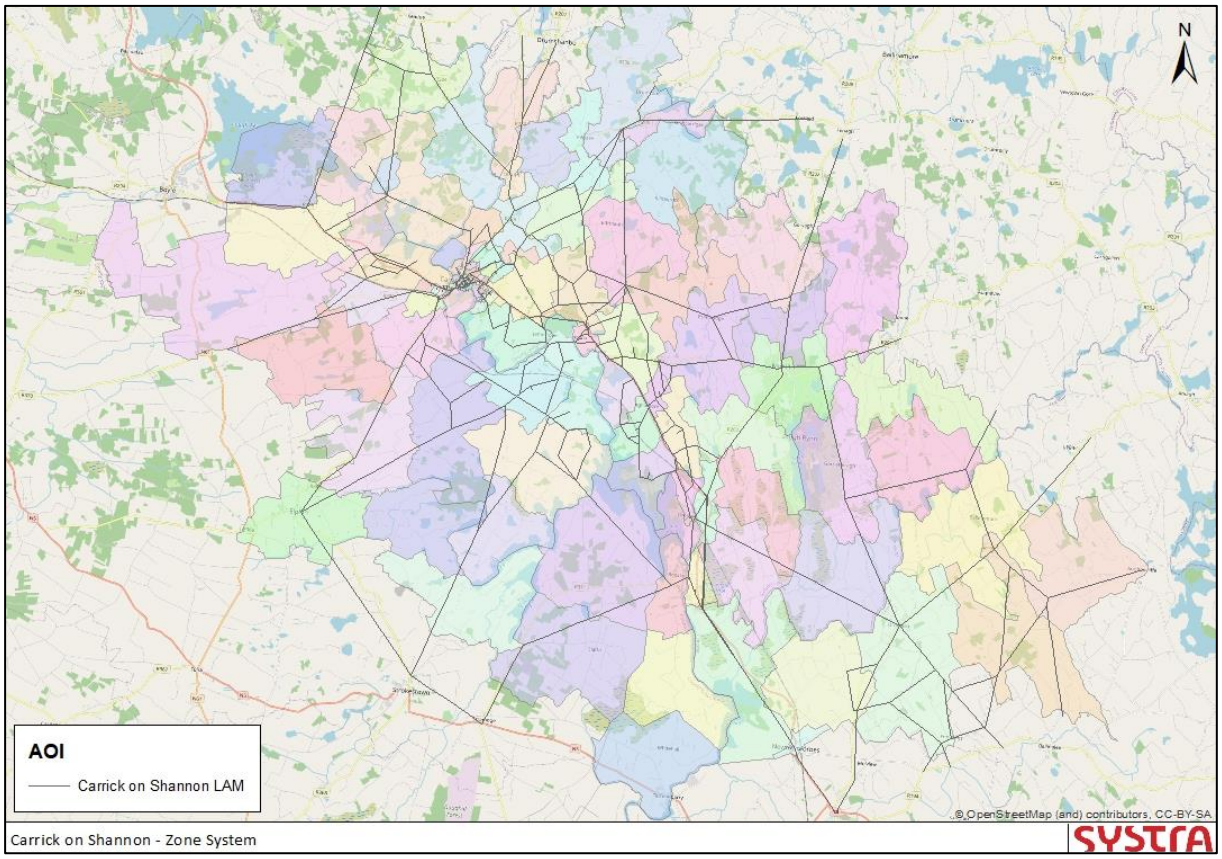


Figure 11. Disaggregated N4 Zone System

3.8 Assignment Method

3.8.1 The standard Wardrop Equilibrium using the Frank-Wolfe algorithm has been adopted as the assignment procedures for the highway model, to be consistent with the Eastern Regional Model and other regional models.

3.8.2 Tight highway assignment convergence is important in order to provide a robust appraisal. A highway assignment convergence with a %GAP<0.02% was achieved in the LAM, which considerably exceeds WebTAG guidance (%GAP<0.1%).

3.9 Generalised Cost Parameters

3.9.1 The SATURN assignment procedure builds paths through the network based on the generalised cost formulation. Generalised cost is a linear combination of time and distance, using values of pence per minute (PPM) and pence per kilometre (PPK) to convert distance into generalised minutes. It takes the following form:

- Generalised Cost (minutes) = time + distance*PPK/PPM

3.9.2 The values of PPM and PPK within the LAM are based on the guidance on parameter values issued by the Department for Transport (DoT) and set out in the Common Appraisal Framework (CAF). Table 2 shows the PPM and PPK used in the base year models for each user class and time period.

Table 2. Generalised Cost Parameters

USER CLASS	AM		IP		PM	
	PPM	PPK	PPM	PPK	PPM	PPK
LV	26.94	10.22	26.94	10.22	26.94	10.22
HV	45.85	31.15	45.85	31.15	45.85	31.15

4. MODEL CALIBRATION

4.1 Overview of the Calibration and Validation Process

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

4.1.2 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.

4.1.3 The N4 LAM was calibrated and validated in accordance with Transport Infrastructure Ireland's (TII) Project Appraisal Guidelines (PAG) for National Roads Unit 5.1 – Construction of Transport Models (October 2016). This is a widely accepted standard in Ireland that provides robust calibration and validation criteria to which certain types of highway models should adhere. Additionally, the LAM development has followed guidance from the UK's Department for Transport's Transport Analysis Guidance (TAG) unit M3-1, particularly in terms of matrix estimation controls.

4.1.4 The following sections of this chapter detail the calibration process undertaken to ensure that the LAM 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 for the study area have been used to assist in the calibration and validation of base model flows. The following surveys were used in the process:

- 18 Automatic traffic counters (ATCs) along the N4 and on other key routes within the model;
- 50 Junction turning counts (JTCs) at the main junctions along the route and at key points on the local road network;
- ANPR, origin-destination, surveys at 8 locations; and
- Journey time surveys between 8 locations.

4.2.2 The JTC and ATC survey locations are illustrated in chapter 2. The ANPR Journey time surveys are discussed in further detail in Chapter 5 describing the model validation process.

4.2.3 Turning counts were taken at key locations and provide detailed movements within a specified junction. The locations of ATC surveys provide a record of traffic at key locations in the study area over an extended period of time (7 days). Incorporating this information enables an accurate representation of traffic flows within the model.

4.3 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 LAM 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:

- 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;
- Any other traffic management measures that may impact on capacity, such as bus lanes, traffic calming, parking controls and cycle-lanes.
- Zone co-ordinates; and
- Zone loading points (connections to the network).

Trip Demand Adjustment (Matrix Estimation)

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

4.3.5 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.

4.3.6 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. 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.

4.3.7 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 Small Area Population Statistics (SAPS) 2016 and land-use data (Geo-directory) were utilised to determine a range of the likely number 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:** The trip generation values from the prior matrix (Cordoned WRM) were utilised as minimum constraints for residential zones. Land use information identified through the creation of the LAM zone system gave a breakdown on the approximate number of housing units in each residential zone.
- **Employment Zones:** Minimum constraints based on employment attractions, within the NTA planning sheet for the WRM cordon run were utilised to encourage employment zones as destinations. Maximum constraints were applied to areas within Athlone to reflect the amount of on-street parking available.
- **Schools:** Minimum constraints were applied to school zones based on the NTA planning sheet. For the PM peak (17:00 - 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 LAM. For key HV generators/attractors in the area, a possible range of values were defined based on the surveys carried out in the area.

Calibration Statistics: GEH

4.3.8 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:

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

4.3.9 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 adding capacity to a road or not.

4.3.10 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.

4.3.11 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.

4.3.12 The DMRB Volume 12a guidelines (Traffic Appraisal in Urban Areas) are a widely accepted standard in Ireland (with TII basing their guidelines on this document) that provides extremely

robust validation criteria to which certain types of highway models should adhere. This document sets a guideline that 85% of links should have a GEH less than 5 (when measured in vehicles per hour) as shown in Table 3. 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.

Table 3. Calibration Criteria

CRITERIA	ACCEPTABILITY GUIDELINE
GEH < 5 for individual flows	> 85% of cases

4.4 Model Calibration Results

4.4.1 Table 4 summarizes the GEH calibration results for the model after the matrix estimation process, for each of the three modelled time periods. The full list of GEH results for each traffic count location are presented in the accompanying calibration dashboards provided in Appendix A.

Table 4. Count Validation Statistics (Post-Calibration)

	AM	IP	PM
GEH < 5%	99%	99%	98%
GEH < 10	99%	98%	99%
GEH < 20	100%	100%	100%

4.4.2 The figures demonstrate that an excellent calibration has been achieved in the model for the morning, evening and inter peak periods with the resulting models falling well within TII standards.

4.5 Link and Turn Flow Calibration

4.5.1 PAG (Unit 5.1 Table 5.2.2 and 5.2.3) states that both of the following two criteria should be met in 85% of cases:

- Criteria 1: links should have a GEH value of less than 5;
- Criteria 2:
  - where modelled flows are less than 700, the model flow should be within 100 vehicles of the count;
  - where modelled flows are between 700 and 2700 the modelled flows should be within 15% of observed flows; and
  - where modelled flows are greater than 2700 the modelled flows should be within 400 vehicles of the observed flows.

5. MODEL VALIDATION

5.1 Introduction

5.1.1 To ensure the robustness of the model, traffic flow validation was also carried out for counts not initially included within calibration. This provides a further check on the calibrated turning movements within the LAM. For example, a junction arm may have a good GEH performance for one movement but not meet the criteria for others. In this instance, it is likely that the modelled flows entering the junction would not be correct and this would be captured in the JTC link flow validation exercise.

5.2 Link Validation Results

5.2.1 Table 5, below, summarizes the GEH link validation results for the model after the matrix estimation process, for each of the three modelled time periods. The full list of GEH results for each location are presented in the accompanying dashboards in Appendix A.

Table 5. Observed Vs Modelled Link Flows

GEH	AM	PM	INTER-PEAK
GEH < 5	94%	94%	100%
GEH < 10	100%	100%	100%
GEH < 20	100%	100%	100%
Overall Average GEH	**2.64**	**2.40**	**3.21**

5.2.2 The figures demonstrate that an excellent calibration has been achieved in the model for the morning, evening and inter peak periods, with overall GEH<5 of 94%, 94% and 100% respectively, which falls well within TII standards.

5.3 Journey Time Validation

5.3.1 As outlined previously in Chapter 2, journey time analysis was carried out between the ANPR sites, as illustrated in Figure 12. Bearing in mind the road traffic collision that occurred in the AM peak (discussed previously in Chapter 2), some of the journey time data on the N4 eastbound had to be removed and replaced with Google journey time data instead between ANPR sites 4 and 5, as shown in Figure 12.

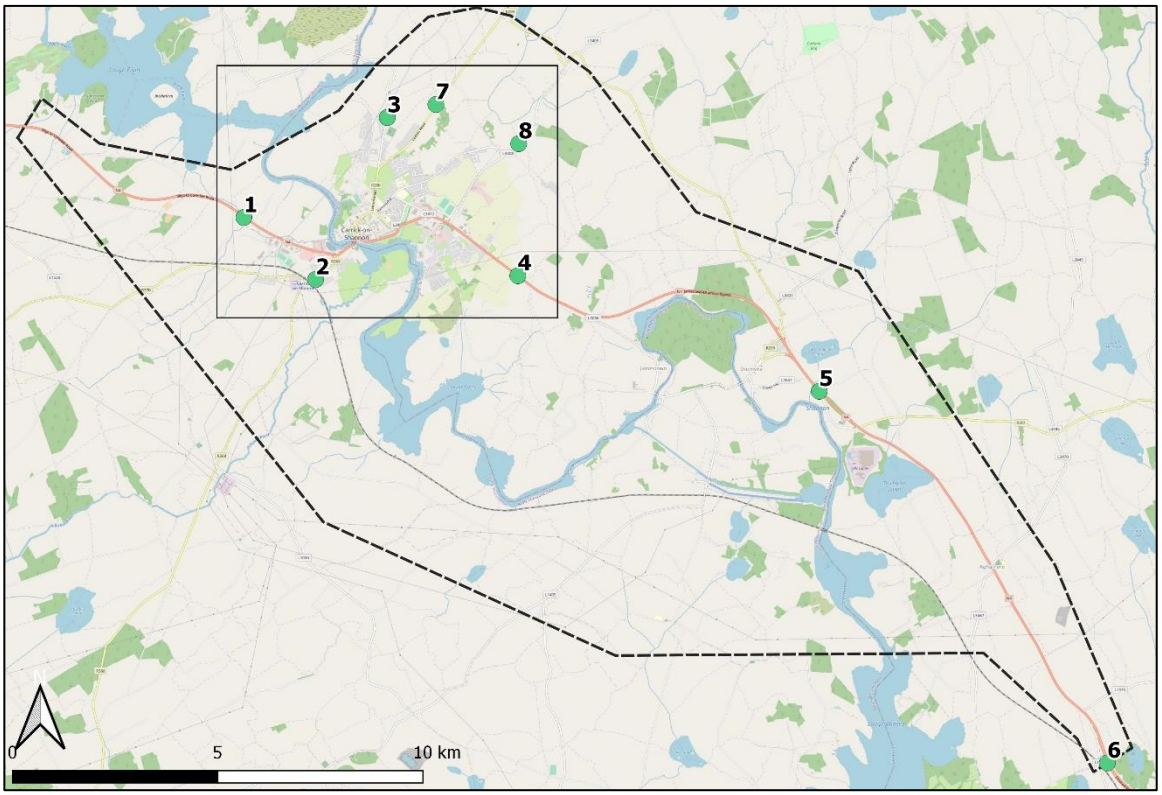


Figure 12. Journey Time ANPR points

5.3.2 PAG (Unit 5.2 Table 5.2.2 and 5.2.3) advises that modelled journey times should be within 15% of the observed time (or 60 seconds if higher) in more than 85% of routes. Table 6, Table 7 and Table 8 outline the overall results for the cumulative route totals (both northbound and southbound) and the individual timing sections. The results show an excellent match to TII guidelines, with cumulative route totals and all of the individual sections satisfying the PAG criteria for each time period. A detailed breakdown is provided for each time period in the subsequent section.

Table 6. Journey Time Validation – AM Peak

ROUTE	OBSERVED (SECONDS)	MODELLED (SECONDS)	DIFFERENCE (%)	PASS/FAIL
N4 Eastbound (ANPR 1 to 4)	354	345	3%	Pass
N4 Eastbound (ANPR 4 to 5)	300*	285	5%	Pass
N4 Eastbound (ANPR 5 to 6)	242	235	3%	Pass
N4 Eastbound (Whole Section)	896	865	4%	**Pass**
N4 Westbound (ANPR 1 to 4)	303	316	-4%	Pass
N4 Westbound (ANPR 4 to 5)	321	277	16%	Fail
N4 Westbound (ANPR 5 to 6)	243	239	2%	Pass
N4 Westbound (Whole Section)	867	832	4%	**Pass**

*The stretch of N4 between ANPR Sites 4 and 5 in the AM peak eastbound direction was subject to a police diversion at the time the ANPR data was collected. As such, Google journey time data has been used.

Table 7. Journey Time Validation – PM Peak

ROUTE	OBSERVED (SECONDS)	MODELLED (SECONDS)	DIFFERENCE (%)	PASS/FAIL
N4 Eastbound (ANPR 1 to 4)	385	488	-21%	Fail
N4 Eastbound (ANPR 4 to 5)	284	289	-2%	Pass
N4 Eastbound (ANPR 5 to 6)	258	235	10%	Pass
N4 Eastbound (Whole Section)	927	1012	-8%	**Pass**
N4 Westbound (ANPR 1 to 4)	341	320	7%	Pass
N4 Westbound (ANPR 4 to 5)	282	274	3%	Pass
N4 Westbound (ANPR 5 to 6)	256	240	7%	Pass
N4 Westbound (Whole Section)	879	834	5%	**Pass**

Table 8. Journey Time Validation – Inter Peak

ROUTE	OBSERVED (SECONDS)	MODELLED (SECONDS)	DIFFERENCE (%)	PASS/FAIL
N4 Eastbound (ANPR 1 to 4)	413	357	16%	Fail
N4 Eastbound (ANPR 4 to 5)	260	284	-8%	Pass
N4 Eastbound (ANPR 5 to 6)	246	233	6%	Pass
N4 Eastbound (Whole Section)	919	874	5%	**Pass**
N4 Westbound (ANPR 1 to 4)	268	314	-15%	Pass
N4 Westbound (ANPR 4 to 5)	256	272	-6%	Pass
N4 Westbound (ANPR 5 to 6)	289	239	21%	Fail
N4 Westbound (Whole Section)	813	825	-1%	**Pass**

5.3.3 The results outlined indicate that the modelled journey times along the whole of the section of N4 in question satisfy the DMRB and TII guidelines in all peaks.

5.4 Calibration and Validation Summary

5.4.1 The previous two chapters provide an overview of the calibration and validation of the N4 local area traffic model which has been developed to assess the proposed route alignment options of the N4 upgrade. In summary:

- The NTAs WRM was used as a basis for development of the N4 LAM with additional network and zonal detail added to more accurately represent localised traffic movements;
- The model has been calibrated and validated in-line with TII Project Appraisal Guidelines and meets all specified criteria for both the AM, PM and Inter peaks;
- The LAM is fit for purpose, and represents AM, PM and Inter-peak period base year traffic conditions well, as demonstrated statistically through calibration and validation.
- It provides a robust basis for assessing the proposed route alignment options as:
  - The model realistically represents journey times;
  - The study area is covered by a large number of calibration counts;
  - Trip length distributions have not been significantly altered during the Matrix Estimation processes.

6. FUTURE YEAR MODEL DEVELOPMENT

6.1 Introduction

6.1.1 This section sets out the development of the future year N4 LAM models for the scheme opening year (2030) and design year (2045). These forecast years will be used for assessing the performance of the Scheme and for input into the design process.

6.2 Future Year Network Development

6.2.1 The future year networks include the different alignment options to be tested (outlined in Chapter 1). The future year networks developed are:

- 2030 Opening Year; and
- 2045 Design Year.

6.3 Future Year Matrix Development

NTpM Forecasts

6.3.1 Origin and Destination growth rates for both the internal and external zones for light and heavy vehicles were provided by TII for the years 2016-2030, 2030-2040 and 2040-2050. These years correspond with the NTpM forecast years. The growth rates were provided for a low, central, and high growth scenario. The low and high growth scenarios are based on the CSO population and labour force projections for scenarios “M3F2” and “M1F1”, respectively. The central growth scenario is based National Planning Framework 2040 population and employment projections which were developed by the Economic and Social Research Institute (ESRI). Growth beyond 2040 was assumed to grow at a reduced rate.

6.3.2 The central growth scenario, which is based on the National Planning Framework 2040 population and employment projections, was used for Phase 2, as a single growth scenario is sufficient for this phase of the project appraisal in order to compare the different options against each other on an equal basis. Low and High forecasts are additionally used for the economic and environmental sensitivity tests required as part of project appraisal.

6.3.3 The growth rates provided by TII were annualised for each period and applied to the base year values at a NTpM zone level. But as the LAM is very disaggregated in the study area (compared to the NTpM), the growth was distributed as per land use growth forecasts from Leitrim County Council and Roscommon County Council planning departments, and as per zoned land due for residential and employment growth for each forecast year to obtain future year values.

6.3.4 Future year trip distribution was undertaken utilising the Furnessing distribution method. Furnessing changes the demand matrix such that the matrix cells are adjusted until the row, or origin, trip totals and column, or destination, trip ends match target values. These target values are set by applying the Origin and Destination growth rates from the NTpM to the base year trip end totals.

6.3.5 It was previously agreed that a single growth scenario is sufficient for this phase of the project appraisal in order to compare the different options against each other on an equal basis. Once

a Preferred Transport Solution is selected, low, medium, and high growth scenarios will be prepared, and the Preferred Transport Solution will be tested in these additional scenarios. Additionally, the Preferred Transport Solution will be assessed using an alternative demand scenario, to reflect a long-term increase in home working following the Covid-19 pandemic, as well as a scenario reflective of pre-pandemic levels of traffic.

6.4 Future Year Matrix Totals

6.4.1 A comparison of the peak hour trip matrix totals for the Base Year, 2030 Opening Year and 2045 Design Year scenarios are outlined in Table 9 and Table 10 in terms of passenger car units (PCU).

Table 9. Matrix Totals 2030 Opening Year

TIME PERIOD	UNIT	2020	2030
AM	PCUs	4,374	4,751
IP	PCUs	3,816	4,060
PM	PCUs	3,993	4,301

Table 10. Matrix Totals 2045 Design Year

TIME PERIOD	UNIT	2020	2045
AM	PCUs	4,374	4,856
IP	PCUs	3,816	4,154
PM	PCUs	3,993	4,373

6.5 Future Year Matrix Analysis

6.5.1 The TII PAG require a quantitative assessment of the impact of the traffic forecasting process to be undertaken to ensure that the process of applying traffic growth factors does not unduly distort the trip matrix. These checks include assessing the following criteria:

- Trip length distribution;
- Trip end growth; and
- Zone to zone growth.

Trip Length Distribution

6.5.2 Figure 13, Figure 14 and Figure 15 show the change in trip length distribution between the 2020 base and 2045 design year for car trips in the morning peak hour, inter-peak hour and

evening peak hour respectively. The profile of both are very similar but the results do show a very slight reduction in short trips and a corresponding small increase in longer distance trips.

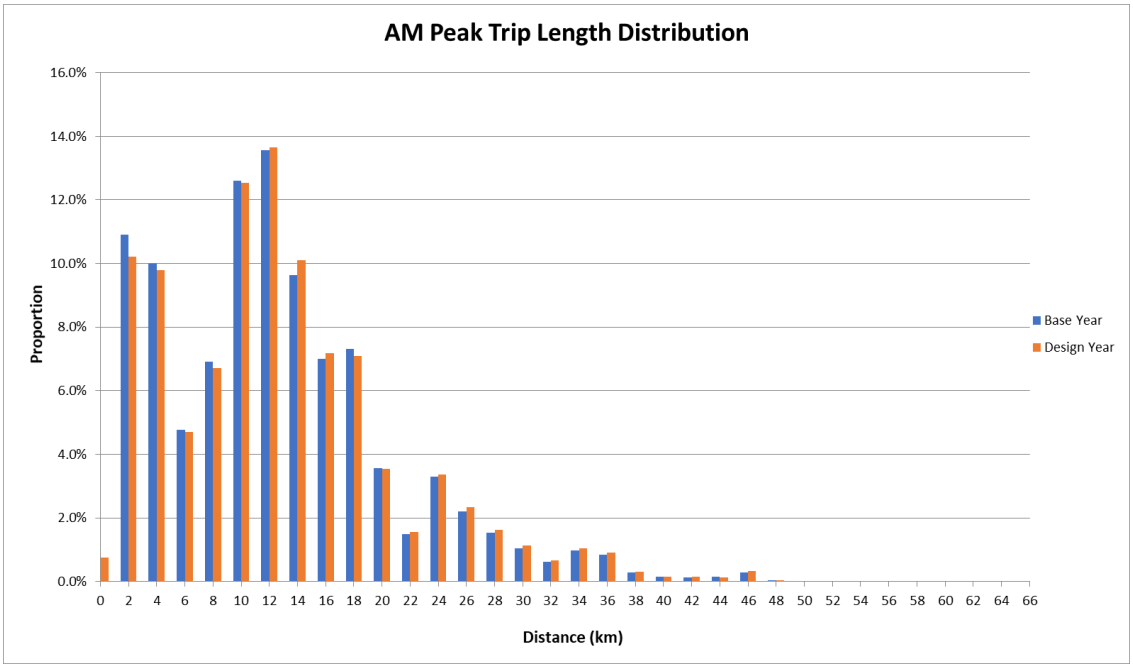


Figure 13. Change in Trip Length Distribution (Light Vehicles) – AM Peak

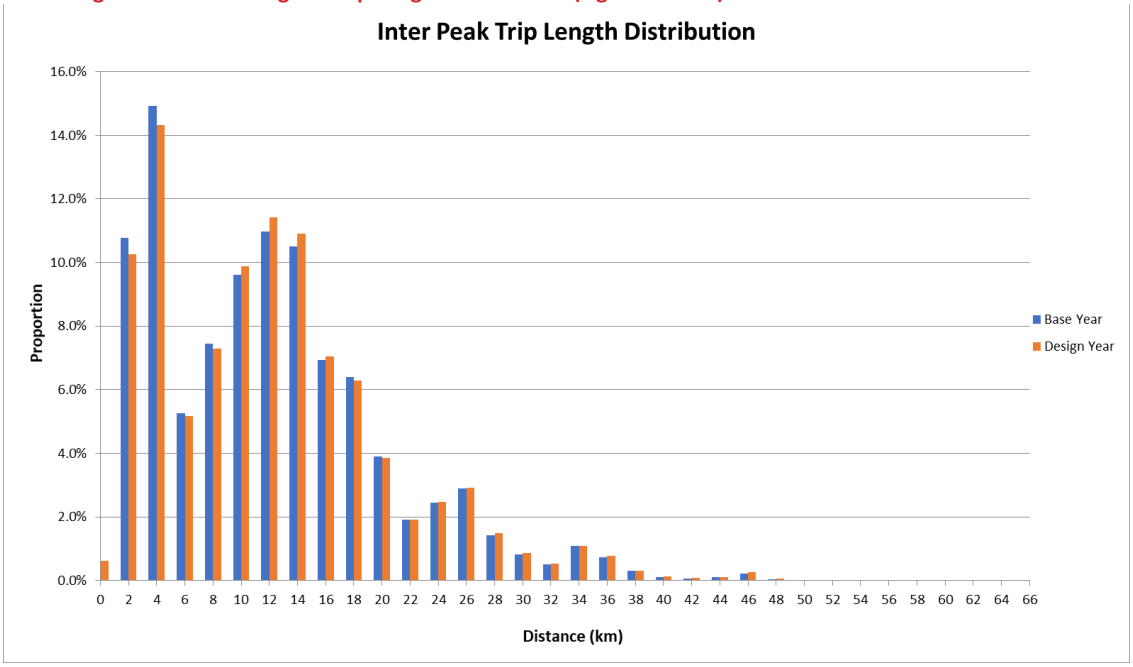


Figure 14. Change in Trip Length Distribution (Light Vehicles) – Inter Peak

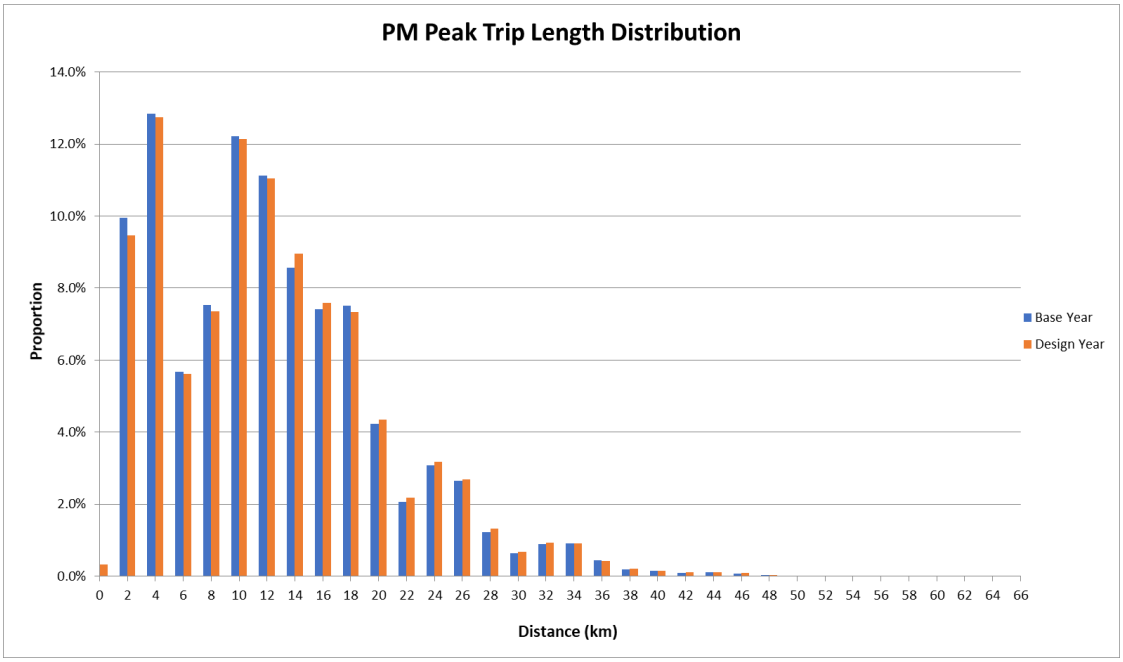


Figure 15. Change in Trip Length Distribution (Light Vehicles) – PM Peak

Trip End Growth

6.5.3 An assessment of the Trip End Growth (TEG) between the base and design year demand in the three time periods was undertaken to assess if there were any significant changes in demand at trip end level when compared to the overall growth between the base and design year demand.

6.5.4 The assessment indicated that the percentage increase between several trip ends in the base and design year demand was significant, but that the actual increase in the number of trips was only minor. In order to assess the true magnitude of TEG, graphical analysis was performed on the base and design year trip matrices, as shown in Figure 16 to Figure 21. Any outliers were reviewed on a zonal basis using the project's planning data and no issues were identified to warrant further investigation or concern.

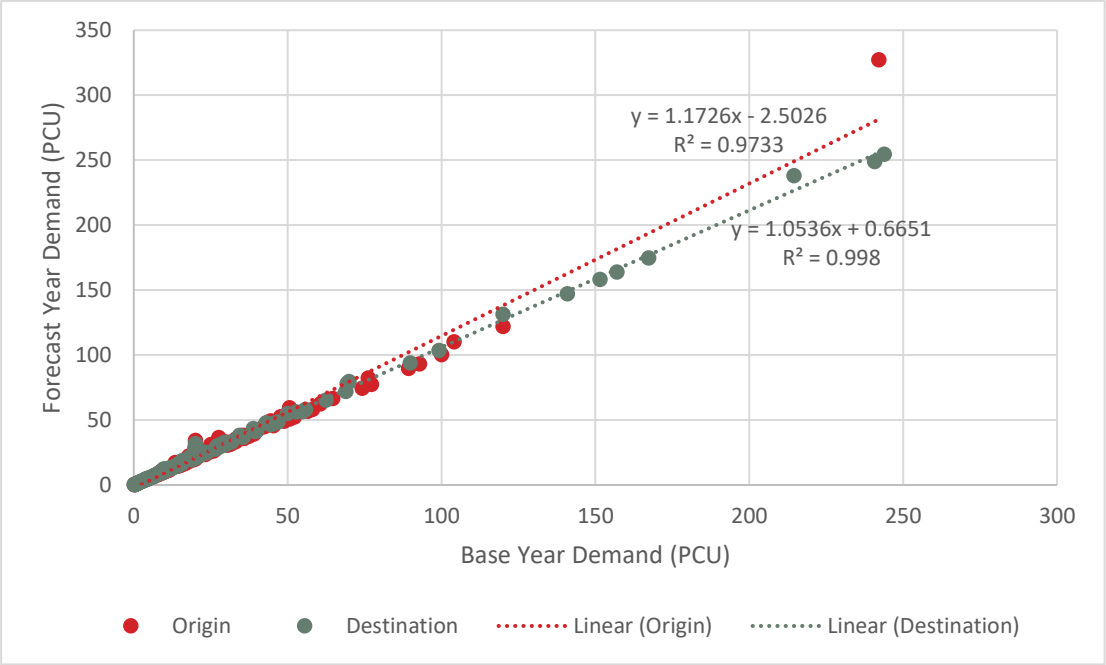


Figure 16. AM Light Vehicle Trip End Growth (2020 to 2045)

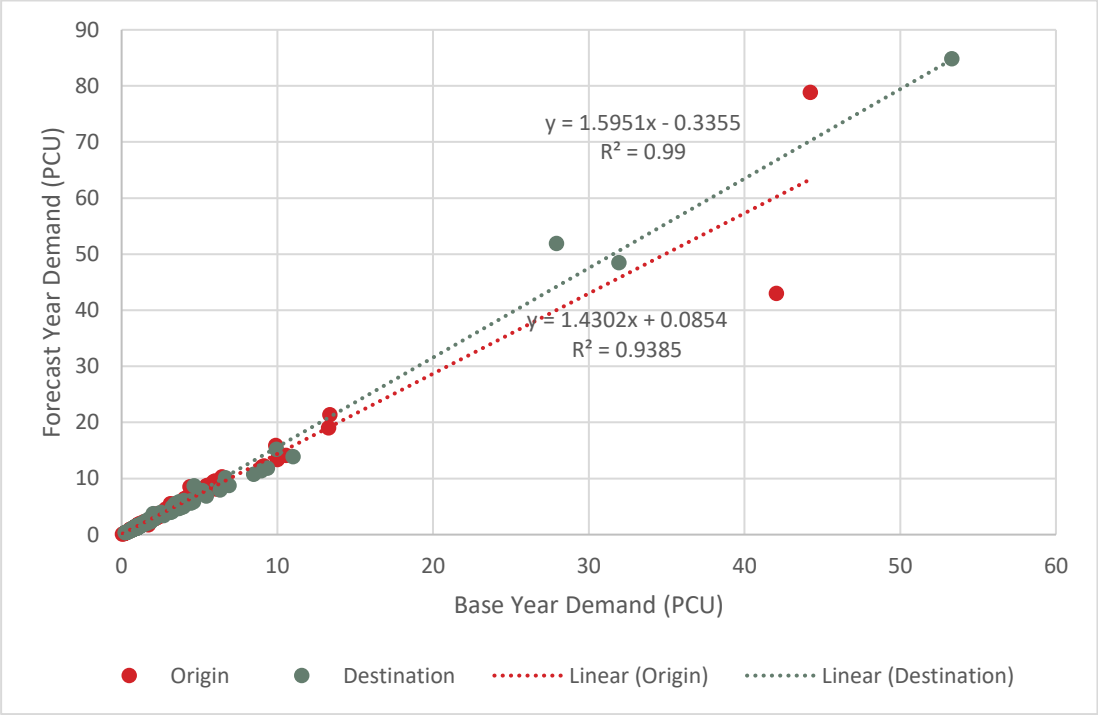


Figure 17. AM HGV Trip End Growth (2020 to 2045)

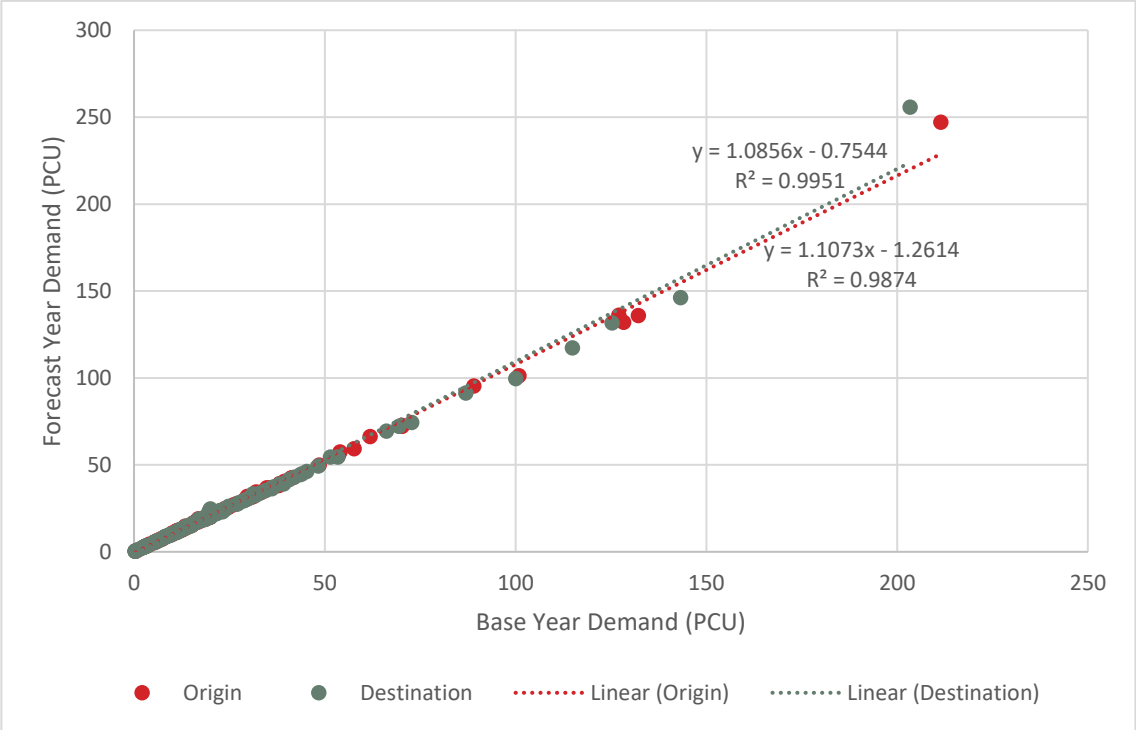


Figure 18. IP Light Vehicle Trip End Growth (2020 to 2045)

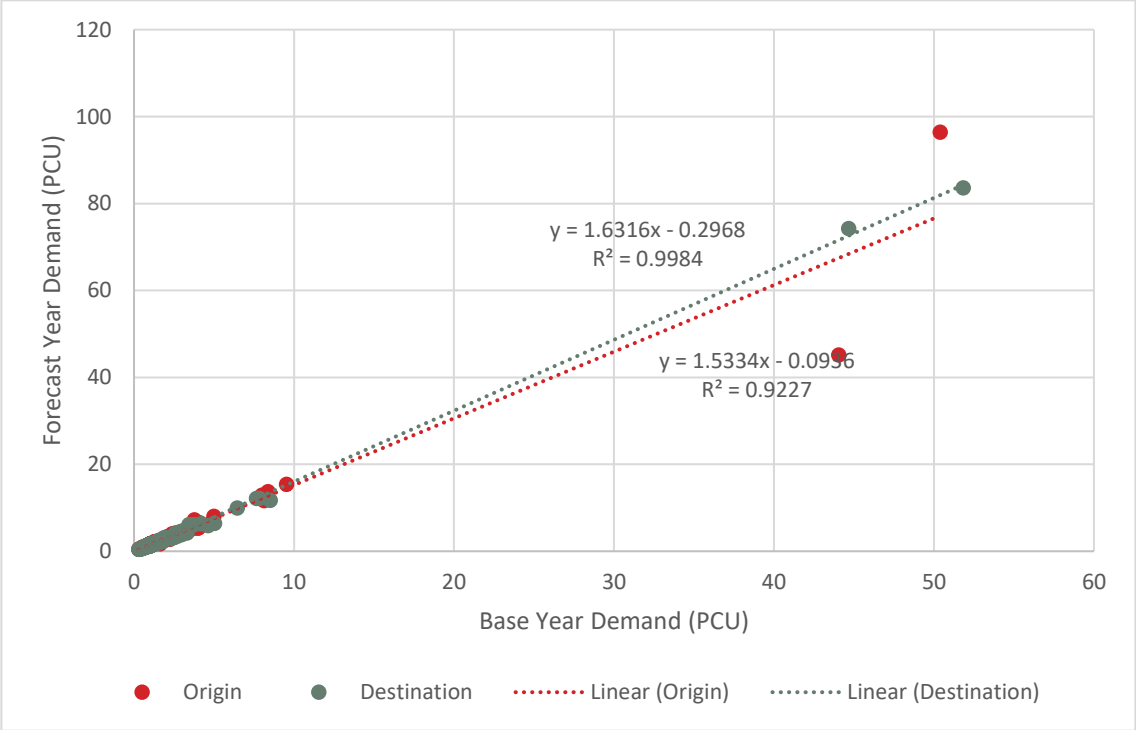


Figure 19. IP HGV Trip End Growth (2020 to 2045)

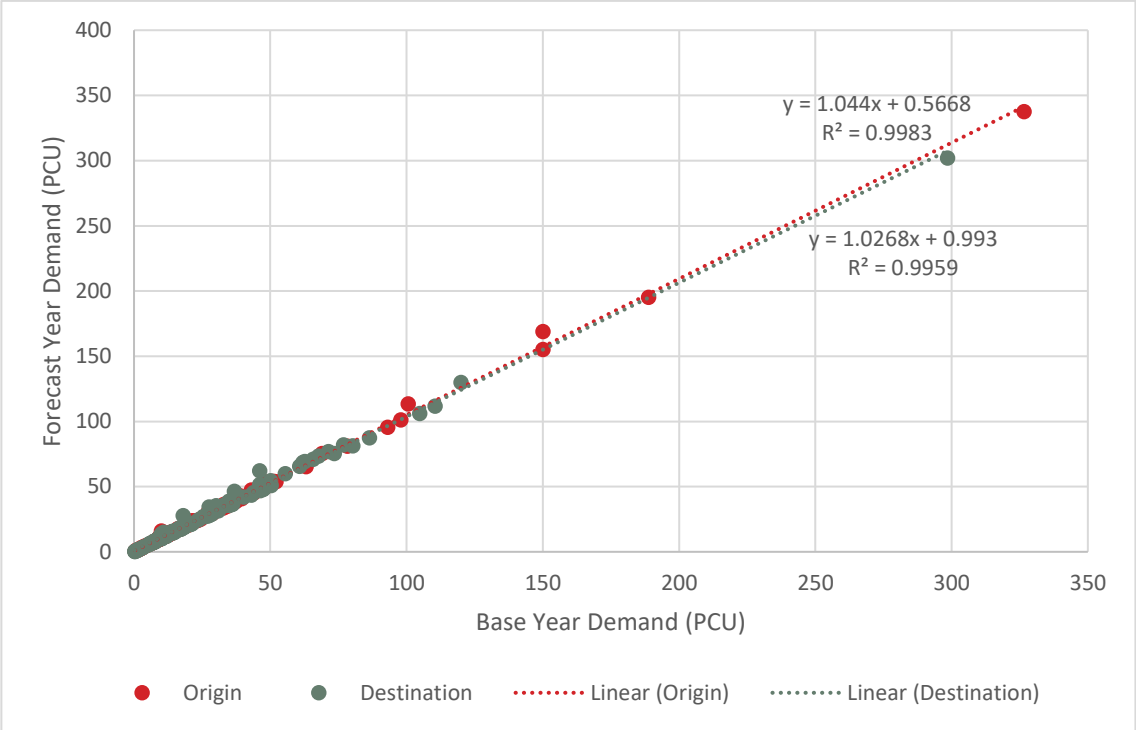


Figure 20. PM Light Vehicle Trip End Growth (2020 to 2045)

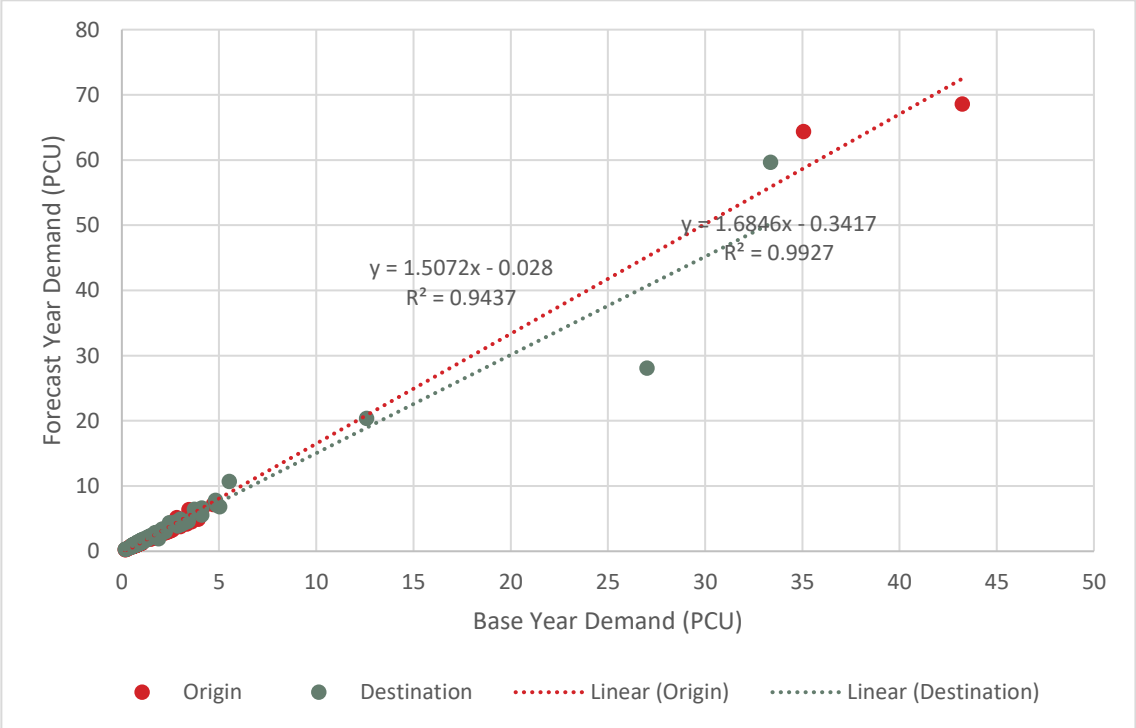


Figure 21. PM HGV Trip End Growth (2020 to 2045)

6.5.5 The assessment indicated that the growth in each peak and in each user class is uniform. There are instances of isolated outliers, but these exist due to committed developments being included in the future year matrices in line with the planning data.

Zone to Zone Growth

6.5.6 The same analysis was also undertaken for zone to zone growth as shown in Figure 22 to Figure 24. Each origin-destination pair was assessed to show any significant outliers or issues in the AM, IP, and PM peak growth demand. Any outliers were reviewed on a zonal basis using the project's planning data and no issues were identified to warrant further investigation or concern.

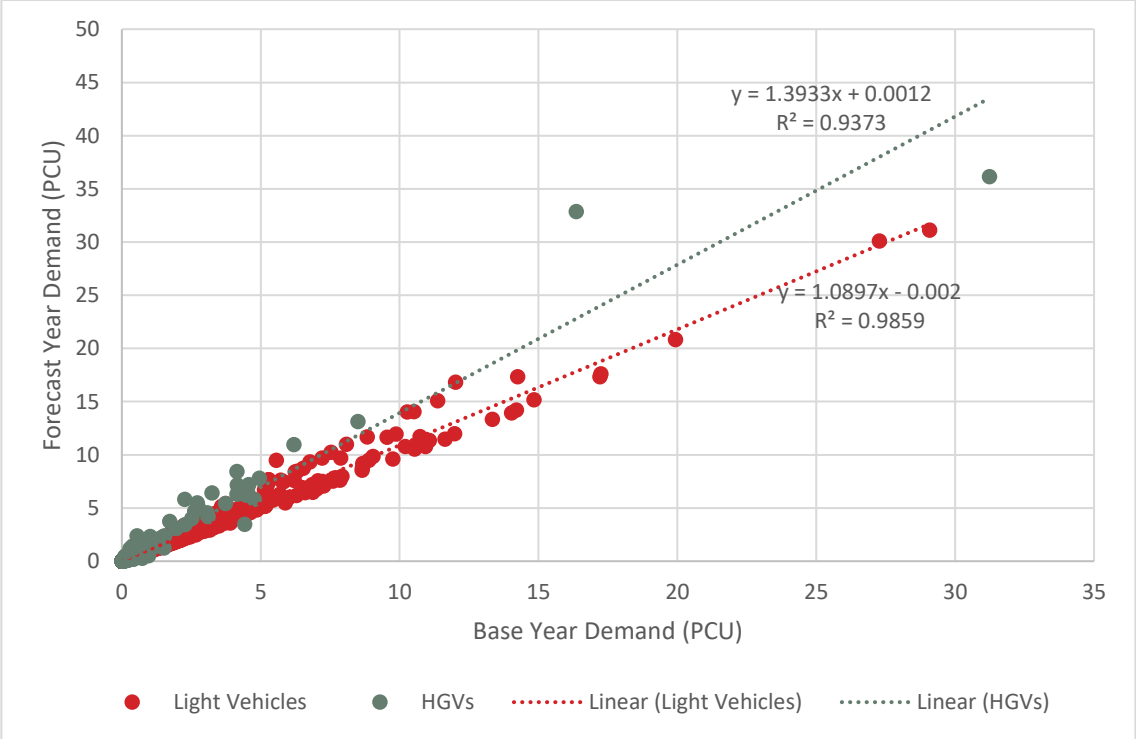


Figure 22. AM Zone to Zone Growth (2020 to 2045)

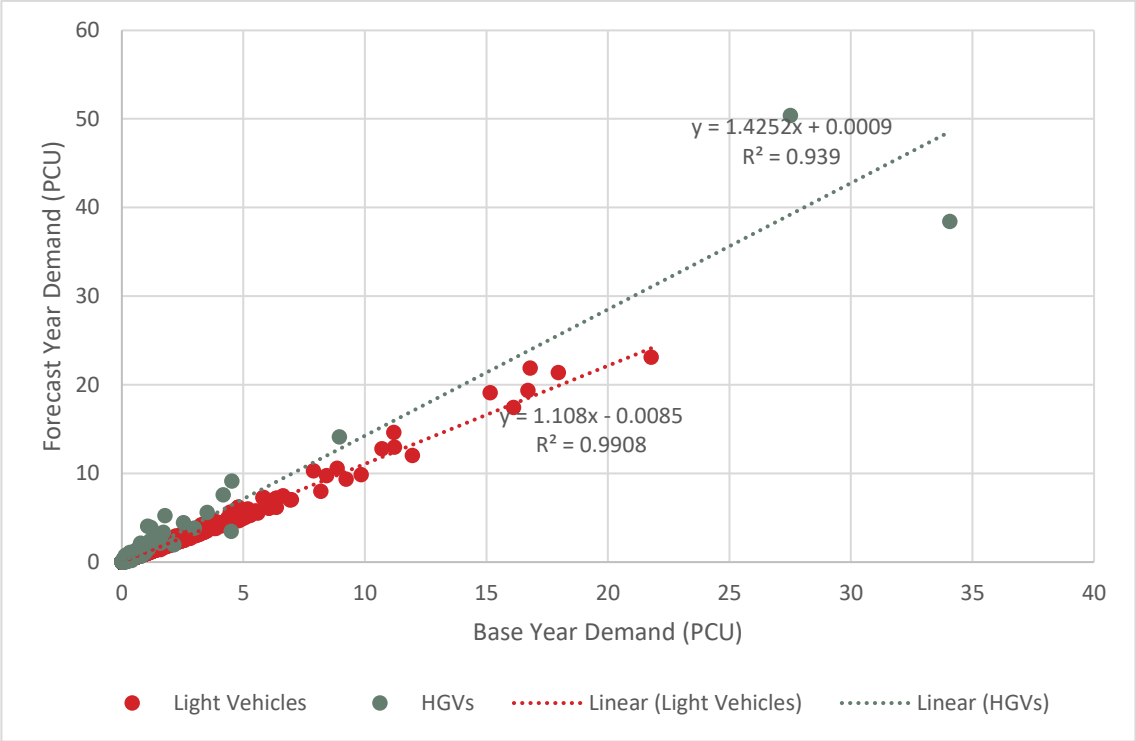


Figure 23. IP Zone to Zone Growth (2020 to 2045)

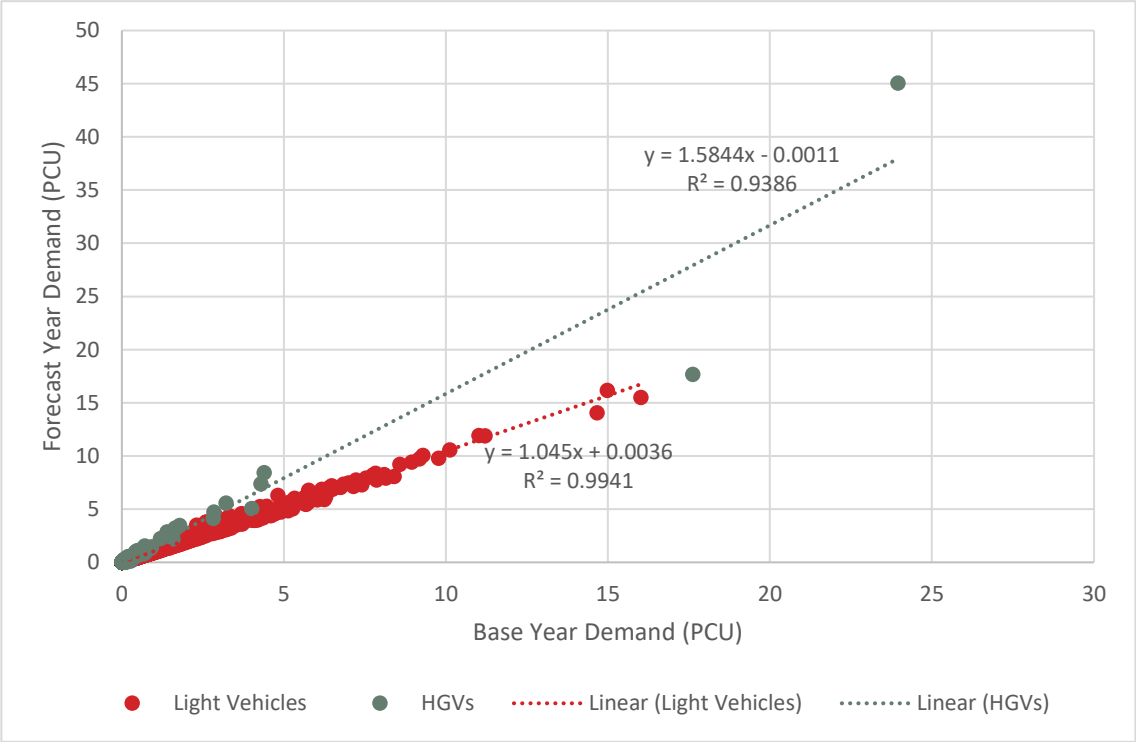


Figure 24. PM Zone to Zone Growth (2020 to 2045)

6.5.7 Once again, the assessment indicated that the growth in each peak and in each user class is uniform. There are instances of isolated outliers, but these exist due to committed developments being included in the future year matrices in line with the planning data.

7. ASSESSMENT OF DO-SOMETHING ALTERNATIVES

7.1 Introduction

7.1.1 Do-Something Alternatives to the Options were developed for consideration in the Stage 1 Environmental Assessment. Three Alternatives were considered in Stage 1:

- Alternative A - active travel measures (i.e. walking and cycling),
- Alternative B - measures to improve public transport (e.g. more frequent buses and trains,) and
- Alternative C -demand management measures (e.g. fiscal or traffic control measures to manage demand).

7.1.2 The assessment first estimated the changes that each alternative might make to the highway travel demand matrix then assigned the revised matrix to the road network. It examined the extent to which the Alternatives reduced traffic flows in the area, and specifically on the N4 in the vicinity of the Shannon Bridge.

7.1.3 The changes to the trip matrices were estimated in different ways for the three Alternatives:

- Alternative A active travel – an assumed 4% reduction in car travel for journeys shorter than 5km, a distance assumed to short enough for to be reasonable for cycling. The effect is applied only in areas covered by the active travel measures
- Alternative B public transport – the proposed measures were coded into the multi-modal model WRM and the impacts on the highway matrix were used to factor the LAM matrices
- Alternative C demand management – similar approach to Alternative A with assumed reductions in car trips from various policy interventions: car-trip rate reduction from planning policies applied to new developments, less need for car travel arising from greater permeability of the town for pedestrians and cyclists, policies to promote working locally, increased parking charges, on-street parking controls, and flexible working hours.

7.1.4 Alternative C performed considerably better than the other two in the Stage 1 assessment and was recommended to be packaged as complementary measures to the Options in the Stage 2 assessment.

7.1.5 Since Stage 1, the transport model has been enhanced. The assessment of the three Alternatives examined in Stage 1 has been refreshed in Stage 2 with the updated transport model. The results of the refreshed assessment are presented in this chapter.

7.1.6 Since Stage 1, the Carrick-on-Shannon Transport Strategy (August 2021) has been released with packages of measures that broadly map to the Alternatives as specified at Stage 1. The strategy includes some measures that can be modelled in the SATURN highway network model, such as reductions to the speed limit on the N4 through Carrick-on-Shannon and pedestrian phases at traffic signals in the town. The measures that can be modelled in SATURN have been packaged with the Options in the economic appraisal.

7.2 Alternative A: Active Travel

7.2.1 As illustrated in Figure 25, Active travel measures in the Carrick-on-Shannon strategy comprise improvements to cycling and walking facilities and includes the elements as follows:

- Development of a comprehensive cycle network;
- Improved facilities for cyclists (cycle parking, changing areas, e-bike charging, etc.);
- Improvements to pedestrian facilities (e.g. improved crossings and footpath provision);
- Improve permeability (non-motorised) within the town;
- Potential pedestrianisation of key streets.

7.2.2 The requirement for an additional pedestrian bridge over the River Shannon has been removed from the list of Alternatives for Stage 2.

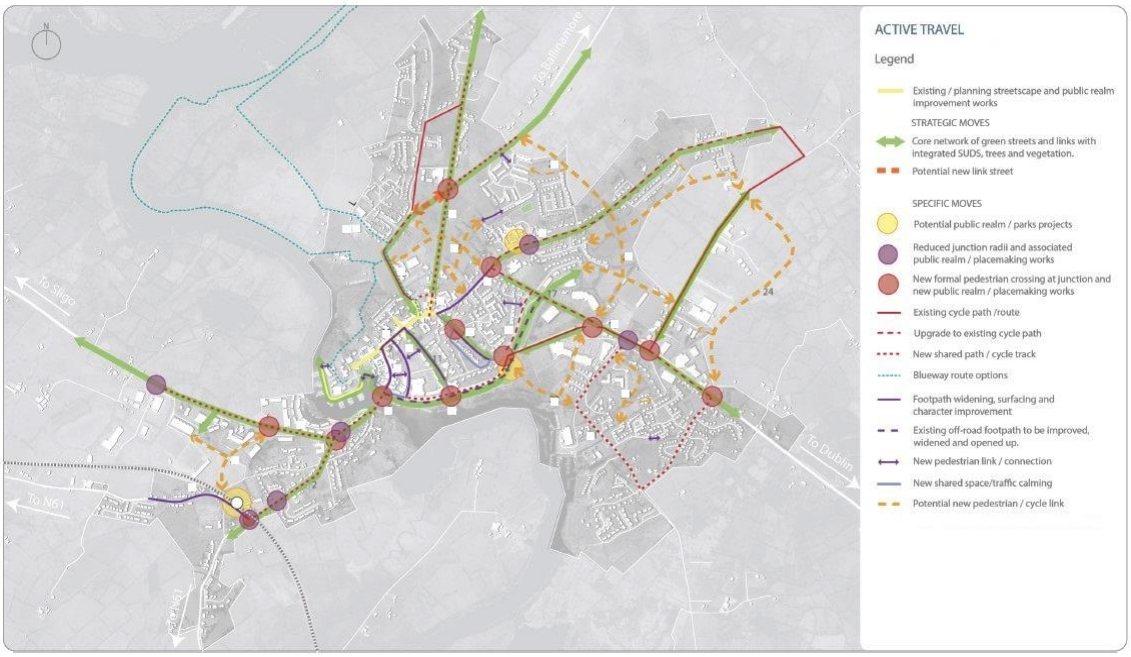


Figure 25. Active Travel Measures

7.3 Alternative B: Public Transport Improvements

7.3.1 As illustrated in Figure 26, Public Transport Improvements in the Carrick-on-Shannon Transport Strategy comprise the following measures:

- Development of an enhanced public transport network
- Improved parking facilities at Carrick-on-Shannon railway station
- Linking of nearby urban settlements with Carrick-on-Shannon and key trip attractors in the town
- Increase in public transport bus services (i.e. up to every 20 minutes during peak periods)
- Development of a mobility hub in the town centre facilitating interchange with other modes
- Provision of demand responsive mini-bus services connecting isolated areas to Carrick-on-Shannon and Cortober

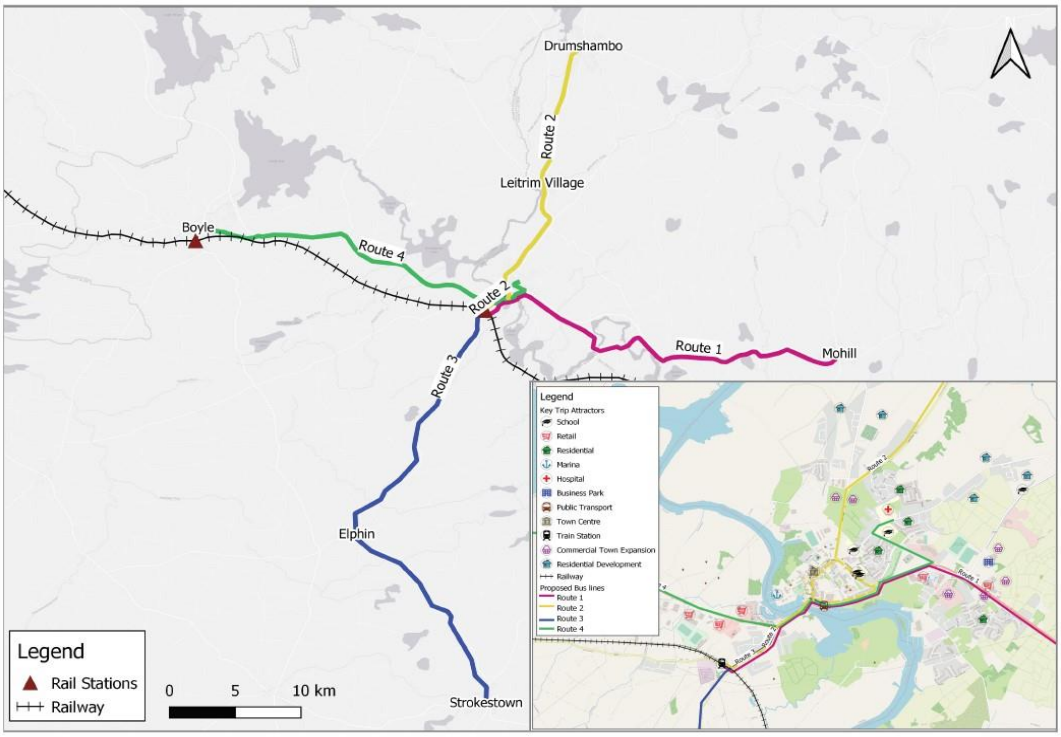


Figure 26. Public Transport Network Improvements

7.3.2 Alternative B will involve an improvement and/or new bus services on the existing street network. This will involve additional signage and possible bus-stops but will not require land acquisition and significant construction. The bus proposals in Alternative B has been cross-referenced against The Connecting Ireland Rural Mobility Plan, which was released shortly after our assessment was complete. The proposals in the plan are very similar but provide Elphin/Strokestown and Elphin/Carrick-on-Shannon as separate services whereas Route 3 in Alternative B provides a through service. There are some other minor differences in frequencies.

7.3.3 Alternative B will also include improvements to the rail station which will be accomplished without construction of new rail infrastructure. The addition of new facilities at the rail station could include line markings and signage to delineate parking for cyclists and/or vehicles.

7.4 Alternative C: Streetscape and placemaking

7.4.1 As illustrated in Figure 27, Streetscape and placemaking measures in the Carrick-on-Shannon Transport Strategy include the following measures (Refer to Figure 4):

- New formal pedestrian crossings at junctions;
- Reduced junction radii and public enhancement measures;
- New shared space / traffic calming;
- Proposed 30km/h speed limit on the existing N4;
- Parking reduction (on Bridge Street); and
- Time plated pedestrianisation of Main St. (e.g. you can only drive here between certain hours of the day)

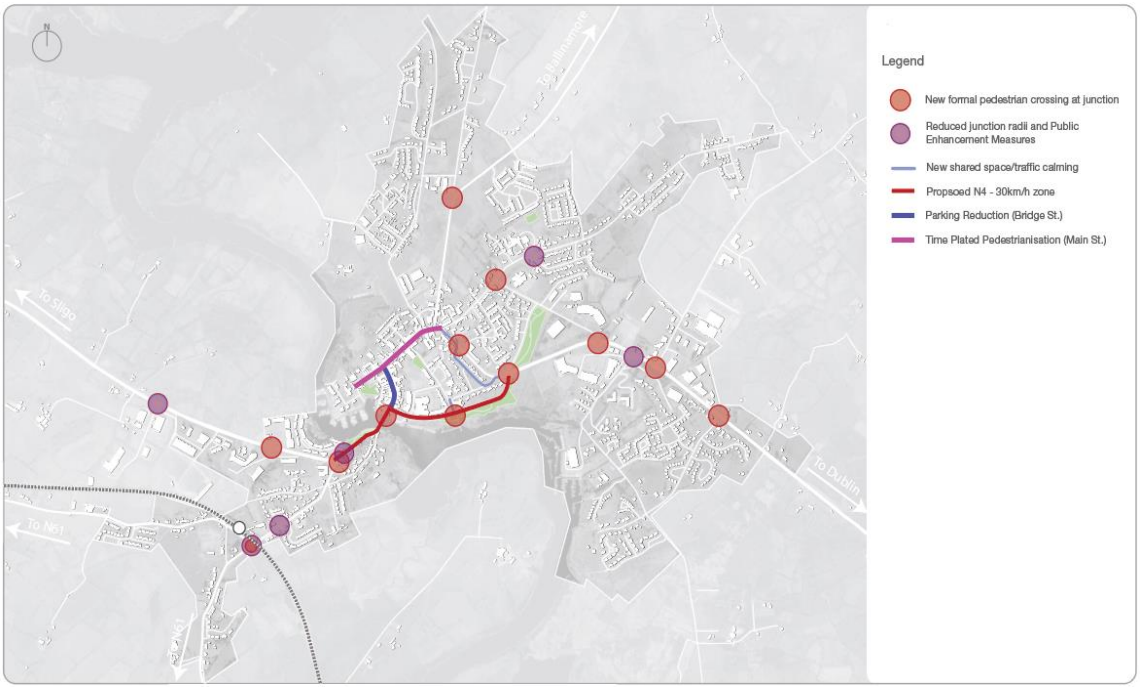


Figure 27. Streetscape and Placemaking Measures

7.4.2 Alternative C will involve measures to reduce the need to make the trip by car in the first instance. As such, it will be a reduction measure as opposed to a provision measure with a reassignment of on-street parking/existing traffic lanes to provide walking or cycling facilities or urban realm, which will not require land acquisition and significant construction. The creation of Park and Stride sites will be located on existing brownfield sites or reassigned existing parking lots.

7.5 Assessment of Alternatives

7.5.1 The Stage 2 assessment of Alternatives is documented in this section. Alternatives are assessed separately in their own right as stand-alone entities and Alternatives are not assessed against each other. Equally the Alternatives are not compared against the Options as these will be complementary to the Options and may form part of the overall package that represents the optimum transport solution. The analysis will help inform the decision on which elements within the Alternatives should be progressed.

Average Annual Daily Traffic (AADT)

7.5.2 The assessment of the Alternatives has examined annual Average Daily Traffic (AADT) at various locations. To estimate the AADT from the three hour-long traffic models, local factors were developed that allowed extrapolation of peak hour traffic flows to AADT.

7.5.3 The TII Project Appraisal Guidelines (PAG) suggest using permanent traffic counters to estimate AADT. However, the nearest TII permanent counters are located some distance from the Study Area. A localised period count method was therefore preferable, and this has been applied using local ATC data collected in December 2020 for the validation and calibration of the Base year Local Area Model (LAM). This method combines localised count data with nearby TII permanent counters on the N4 in order to estimate localised AADTs.

7.5.4 PAG recommends a daily flow profile is generated for the weekday for which the short period traffic counts have been collated. In this case the short period data will be peak hour model outputs. The peak hour models have been developed to represent the "average weekday", therefore, a daily profile for the average weekday was generated using two weeks of ATC data gathered in December 2020.

7.5.5 Data from the ATCs (and permanent counter) was then classified into peak (comprising AM Peak and/or PM Peak) and Inter Peak periods. In performing this task, the following bands were used.

- AM Peak Period: The period from 06:00 to 10:00
- PM Peak Period: The period from 16:00 to 20:00
- Inter Peak Period: The period from 20:00 to 06:00 and 10:00 to 16:00

7.5.6 To estimate the flow for a defined period (e.g. the AM peak) from the short period count, the procedure is as follows:

$$AM_x = \left(\frac{Q_x}{Q_{PTC}}\right) \times AM_{PTC}$$

Where:

- AM_x = Annual Average AM Peak (06:00 – 10:00) traffic flow at location x
- AM_{PTC} = Annual Average AM Peak (06:00 – 10:00) traffic flow at Permanent Traffic Counter
- Q_x = Short Period AM Peak traffic flow
- Q_{PTC} = Short Period AM Peak traffic flow at Permanent Counter, this should relate to same Short Period as Q_x

7.5.7 The same process is applied to the IP and PM peaks and the results for all periods (AM, IP, and PM) are aggregated to give a value of AADT as follows:

$$AADT_x = (AM_x) + (IP_x) + (PM_x)$$

7.5.8 The above calculations were performed for the locations of the ATC surveys, providing AADT values for each location. Similarly, this analysis provided a relationship between the short period count (i.e. Modelled Peak Hour) and the Peak Period (e.g. 06:00-10:00) at each site and for each time period (AM_x, IP_x, PM_x). A regression analysis was then preformed to calculate the appropriate expansion factor to be applied to model flows to estimate future year AADTs. Table 11 shows the expansion factors used by time period and user class.

Table 11. AADT Expansion Factors by Time Period and User Class

TIME PERIOD	LIGHT VEHICLES	HEAVY VEHICLES
AM	2.26	2.68
IP	6.00	6.00
PM	2.72	2.53

7.5.9 An array of AADT data points have been selected for analysis, as presented in Figure 28.

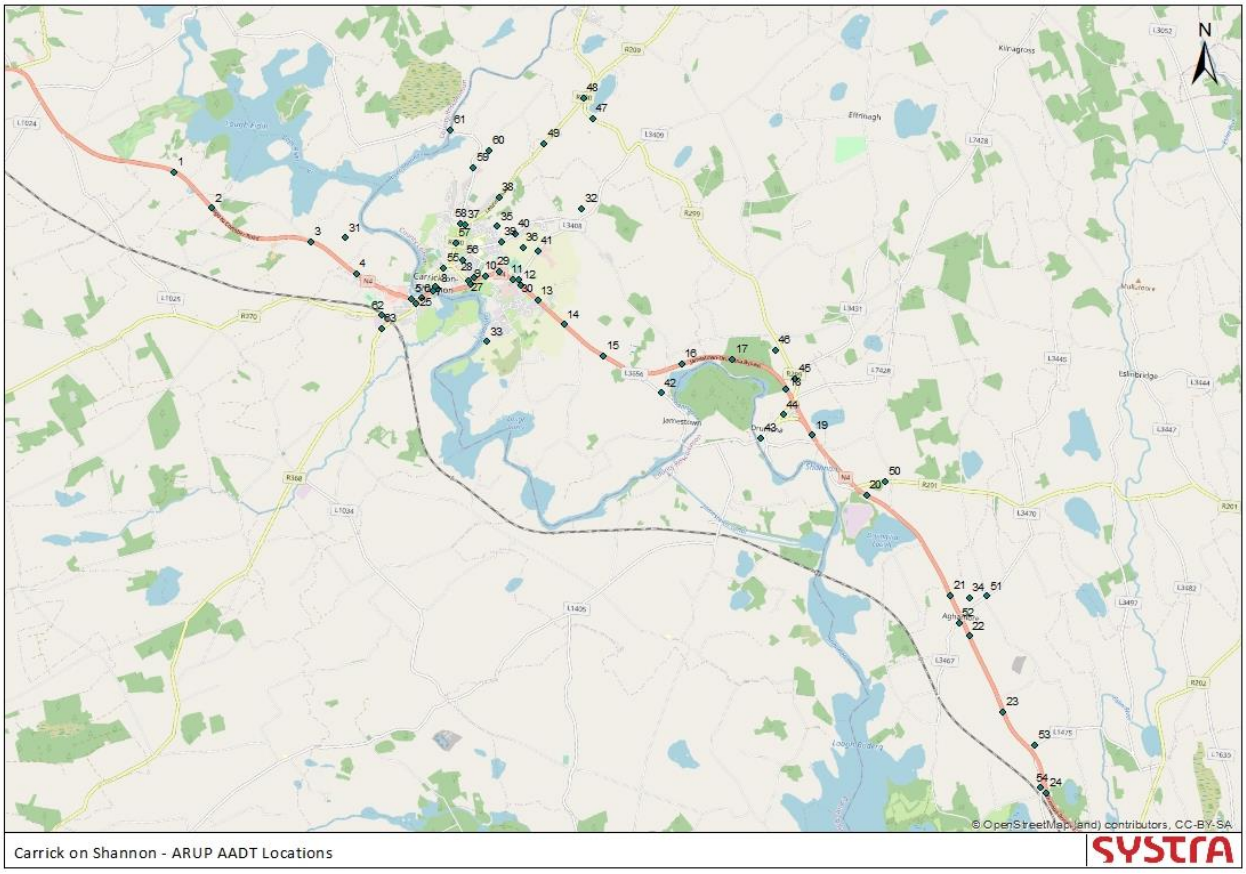


Figure 28. AADT Data Points

7.5.10 Data for these locations are subsequently provided in Table 12 and Table 13 for 2030 and 2045, respectively.

Table 12. Year 2030 AADT Data for Alternatives

YEAR 2030					
ID	**LOCATION**	**DO-MINIMUM**	**A: ACTIVE TRAVEL**	**B: PUBLIC TRANSPORT**	**C: REDUCING DEMAND**
1	N4 Drumharlow	7935	7962	7938	7545
2	N4 Drumharlow	7935	7963	7938	7545
3	N4 Tumna	8446	8470	8445	8029
4	N4 Cloonman	8446	8470	8445	8029
5	N4 West of Station Road	12970	12880	12934	11808
6	N4 East of Station Road	16942	16826	16895	15273
7	N4 River Shannon Bridge	17383	17253	17331	15652
8	N4 Landmark	18147	17958	18088	15908

YEAR 2030					
ID	LOCATION	DO-MINIMUM	A: ACTIVE TRAVEL	B: PUBLIC TRANSPORT	C: REDUCING DEMAND
9	N4 West of Shannon Roundabout	17790	17637	17744	15673
10	N4 West of Attirory Roundabout	15895	15719	15796	13785
11	N4 East of Attirory Roundabout	14868	14742	14780	13004
12	N4 East of Castlecarra Road	11922	11871	11858	10549
13	N4 at Atiirory	10108	10106	10062	9078
14	N4 at Lisseeghan	10108	10106	10062	9078
15	N4 at Corbally	9409	9417	9370	8415
16	N4 at Tully	8079	8082	8044	7181
17	N4 at Mountcampbell	8079	8082	8044	7181
18	N4 West of Drumsna Junction	8079	8082	8044	7181
19	N4 East of Drumsna Junction	9049	9052	9022	8283
20	N4 East of R201 (Mohill Road)	6300	6303	6282	5786
21	N4 West of Aghamore	6387	6389	6368	5871
22	N4 East of Aghamroe	6384	6386	6369	5910
23	N4 West of Fearnaght Junction	6307	6308	6292	5841
24	N4 Faulties	6307	6308	6292	5841
25	Station Road	6703	6664	6665	5971
26	Bridge Street	5315	5263	5280	4599
27	Dublin Road	11688	11541	11611	9727
28	Circular Road	2940	2880	2918	2517
29	North Leg Attifinlay Roundabout	2354	2309	2333	2030
30	Castlecarra Road	6025	5931	5979	5178
31	New Bypass North (Western End)	-	-	-	-
32	New Bypass North (Mid)	-	-	-	-
33	New Bypass South (Mid)	-	-	-	-
34	New Aghamore Village Bypass	-	-	-	-
35	New Bypass North (Mid - Black)	-	-	-	-
36	New Bypass South (Mid - Black)	-	-	-	-
37	R280 north of Harltey Junction	6797	6785	6750	6124
38	R280 Ballynamony	5984	5993	5945	5463
39	Summerhill Road	1375	1342	1361	1106

YEAR 2030					
ID	LOCATION	DO-MINIMUM	A: ACTIVE TRAVEL	B: PUBLIC TRANSPORT	C: REDUCING DEMAND
40	Summerhill Road	831	812	823	663
41	Casltecarra Road at Keenaghan	3332	3313	3311	3019
42	Jamestown	1348	1354	1345	1238
43	Drumsna River Bridge	829	827	827	817
44	Drumsna Road Overbridge	1565	1564	1563	1574
45	R299 North of Drumsna Junction	1821	1819	1820	1855
46	R299 West of L3431 Junction	1465	1464	1465	1519
47	R299 at n. Edge of Study Area	3015	3014	3000	2815
48	R280 north of R299 Junction	8611	8618	8559	7957
49	R280 at Cartown	5984	5993	5945	5463
50	R201 East of Junction with N4	2823	2823	2815	2576
51	Antfield/Aghamore	1098	1098	1098	1039
52	Local Road West Aghamore	373	373	373	348
53	Local Road Fearnaght	216	216	216	204
54	N4 at Faulties	2572	2572	2565	2369
55	Main Street	3262	3256	3246	2936
56	Summerhill Road	2259	2212	2238	1875
57	Leitrim Road	9031	8981	8964	8117
58	Shannon Grove w. of Leitrim Road	3195	3156	3169	2897
59	Shannon Grove	1839	1798	1782	1636
60	Hartley Court	-	-	-	-
61	Hartley Bridge	976	943	923	780
62	R370 West of R368 Junction	2473	2473	2461	2288
63	R368 South of R370 Junction	2633	2628	2616	2361
64	Adjacent to East Bypass Junction	-	-	-	-
65	Adjacent to West Bypass Junction	-	-	-	-
66	Link Road	-	-	-	-

Table 13. Year 2045 AADT Data for Alternatives

YEAR 2045					
ID	LOCATION	DO-MINIMUM	A: ACTIVE TRAVEL	B: PUBLIC TRANSPORT	C: REDUCING DEMAND
1	N4 Drumharlow	8284	8307	8267	7876
2	N4 Drumharlow	8284	8307	8267	7876
3	N4 Tumna	8791	8810	8769	8356
4	N4 Cloonman	8791	8810	8769	8356
5	N4 West of Station Road	13200	13104	13144	12043
6	N4 East of Station Road	17088	16966	17019	15492
7	N4 River Shannon Bridge	17515	17384	17455	15865
8	N4 Landmark	18314	18117	18211	16043
9	N4 West of Shannon Roundabout	17924	17732	17837	15819
10	N4 West of Attirory Roundabout	15949	15789	15894	13910
11	N4 East of Attirory Roundabout	15021	14828	14864	13107
12	N4 East of Castlecarra Road	11999	11937	11933	10648
13	N4 at Atiirory	10193	10179	10143	9175
14	N4 at Lisseeghan	10193	10179	10143	9175
15	N4 at Corbally	9491	9487	9447	8510
16	N4 at Tully	8144	8146	8109	7269
17	N4 at Mountcampbell	8144	8146	8109	7269
18	N4 West of Drumsna Junction	8144	8146	8109	7269
19	N4 East of Drumsna Junction	9131	9133	9102	8381
20	N4 East of R201 (Mohill Road)	6371	6373	6353	5878
21	N4 West of Aghamore	6458	6460	6440	5963
22	N4 East of Aghamroe	6455	6457	6441	6002
23	N4 West of Fearnaght Junction	6377	6379	6363	5933
24	N4 Faulties	6377	6379	6363	5933
25	Station Road	6728	6702	6696	6012
26	Bridge Street	5260	5221	5257	4584
27	Dublin Road	11661	11533	11623	9728
28	Circular Road	2956	2894	2930	2512
29	North Leg Attifinlay Roundabout	2344	2298	2323	2018
30	Castlecarra Road	6105	5952	5989	5188

YEAR 2045					
ID	LOCATION	DO-MINIMUM	A: ACTIVE TRAVEL	B: PUBLIC TRANSPORT	C: REDUCING DEMAND
31	New Bypass North (Western End)	-	-	-	-
32	New Bypass North (Mid)	-	-	-	-
33	New Bypass South (Mid)	-	-	-	-
34	New Aghamore Village Bypass	-	-	-	-
35	New Bypass North (Mid - Black)	-	-	-	-
36	New Bypass South (Mid - Black)	-	-	-	-
37	R280 north of Harltey Junction	6715	6764	6740	6119
38	R280 Ballynamony	5900	5971	5933	5456
39	Summerhill Road	1378	1345	1364	1124
40	Summerhill Road	834	815	825	681
41	Casltecarra Road at Keenaghan	3408	3330	3318	3026
42	Jamestown	1367	1357	1353	1244
43	Drumsna River Bridge	848	846	848	829
44	Drumsna Road Overbridge	1567	1565	1563	1563
45	R299 North of Drumsna Junction	1842	1840	1840	1861
46	R299 West of L3431 Junction	1486	1483	1483	1525
47	R299 at n. Edge of Study Area	3097	3056	3026	2855
48	R280 north of R299 Junction	8609	8645	8583	7990
49	R280 at Cartown	5900	5971	5933	5456
50	R201 East of Junction with N4	2838	2838	2828	2586
51	Antfield/Aghamore	1101	1101	1100	1041
52	Local Road West Aghamore	375	375	374	349
53	Local Road Fearnaght	219	219	219	207
54	N4 at Faulties	2584	2586	2580	2383
55	Main Street	3217	3219	3231	2922
56	Summerhill Road	2266	2217	2245	1890
57	Leitrim Road	8976	8977	8972	8118
58	Shannon Grove w. of Leitrim Road	3226	3176	3190	2905
59	Shannon Grove	1871	1847	1847	1644
60	Hartley Court	-	-	-	-
61	Hartley Bridge	1012	997	995	826

YEAR 2045					
ID	LOCATION	DO-MINIMUM	A: ACTIVE TRAVEL	B: PUBLIC TRANSPORT	C: REDUCING DEMAND
62	R370 West of R368 Junction	2490	2491	2479	2306
63	R368 South of R370 Junction	2650	2660	2642	2383
64	Adjacent to East Bypass Junction	-	-	-	-
65	Adjacent to West Bypass Junction	-	-	-	-
66	Link Road	-	-	-	-

7.5.11 To summarise the data further, Table 14 shows AADT across the River Shannon bridge, based upon Do-Minimum AADTs of 17,383 and 17,515 for 2030 and 2045, respectively and how the AADT changes in each of the assessed alternatives.

Table 14. AADT Across the River Shannon Bridge

	A: ACTIVE TRAVEL	B: PUBLIC TRANSPORT	C: REDUCING DEMAND
Year 2030 AADT	17253	17331	15652
Change in AADT vs Do-Minimum	**-0.7%**	**-0.3%**	**-10.0%**
Year 2045 AADT	17384	17455	15865
Change in AADT vs Do-Minimum	**-0.7%**	**-0.3%**	**-9.4%**

Matrix Totals

7.5.12 The matrix totals for the Stage 2 Do-Minimum and alternative models were also assessed against each other at the extent of the full LAM. The matrix totals for the full LAM indicate a 1.5% decrease in private vehicle trips within the study area arising from the active travel measures, a 1% trip reduction within the study area arising from the improved public transport services and a 10% trip reduction arising from demand management measures.

7.6 Summary

7.6.1 The analysis has shown that it is Alternative C (Reducing Demand) that has brought the greatest mode shift from private vehicle to alternative modes with a circa 10% reduction in private vehicle trips. Alternative A (Active Travel) and Alternative B (Public Transport Enhancements) bring a circa <1% reduction in private vehicle trips.

7.6.2 The elements of the Streetscape and Placemaking package of Carrick-on-Shannon Transport Strategy that can be modelled in SATURN are included in the appraisal of the Stage 2 road option models assessed and detailed in Chapter 8.

8. ASSESSMENT OF OPTIONS

8.1 Outline approach

8.1.1 The assessment has been undertaken in the LAM, which is a SATURN model. It includes no demand response, so the appraisal is on the basis of a fixed trip matrix.

8.2 Analysis of Options

8.2.1 This chapter provides a summary of the performance of each of the models, based on the following metrics:

- Key network performance indicators:
  - Transient queues (PCU-Hrs)
  - Over capacity queues (PCU-Hrs)
  - Total travel time (PCU-Hrs)
  - Total travel distance (PCU-Kms)
  - Average speed (km/h)
- Journey time savings
- Traffic flows across the River Shannon bridge
- AADT flows

8.3 Description of Options Tested

Do-Minimum Scenario (Model 1)

8.3.1 The Do-Minimum scenario is a reference case against which each of the options will be assessed. The Do-Minimum Scenario is the same as existing road network because there were no committed schemes that made a material difference to the modelled network. For example, a bridge was rebuilt but no improvements were made to the local road network.

Do-Something Options

8.3.2 In order to address the highlighted concerns along the N4 through and around Carrick-on-Shannon, a total of eight corridors, with the potential for road-based solutions, have been taken forward to the Stage 2 Project Appraisal Matrix. Of these, five designs are located to the west of Node J at Drumsna Junction (Black, Pink, Orange, Purple and Grey) and three designs are to the east of Node J (Purple, Green and Yellow). See Figure 29 for an overview of the option corridors, designs, and nodes.

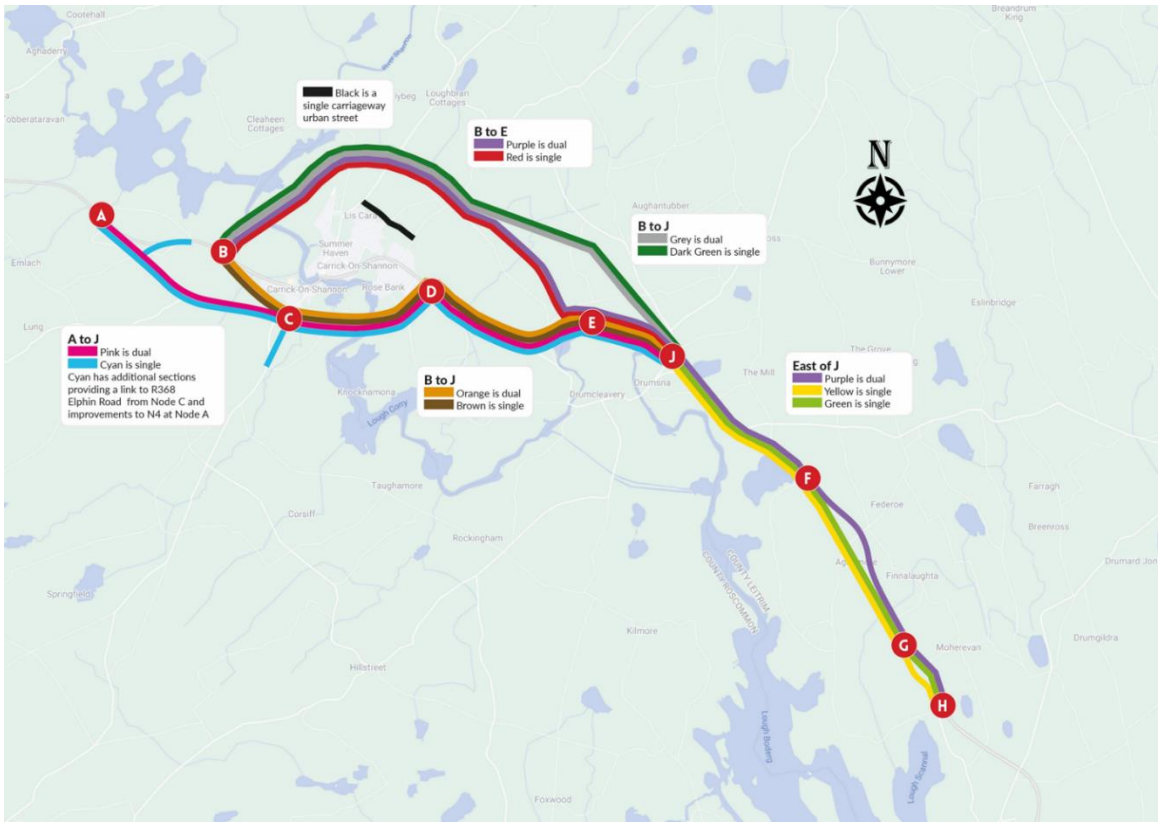


Figure 29. Stage 2 Option Corridors and Nodes

8.3.3 Table 15 sets out the details behind each of the option corridors in further detail.

Table 15. Summary List of Corridors and Designs

OPTION NAME & COLOUR	NODE	DESIGN COLOUR	CARRIAGEWAY
West of Drumsna Junction (Node J)			
Black Corridor	N/A	Black Design	Single Carriageway Urban Street
Cyan Option Corridor	A-J	Pink Design	Dual Carriageway
Orange Option Corridor	B-J	Orange Design	Dual Carriageway
Purple Option Corridor	B-J	Purple Design	Dual Carriageway
Dark Green Option Corridor	B-J	Grey Design	Dual Carriageway
East of Drumsna Junction (Node J)			
Purple Option Corridor	J-H	Purple Design	Dual Carriageway
Green Option Corridor	J-H	Green Design	Single Carriageway
Yellow Option Corridor	J-H	Yellow Design	Single Carriageway

8.3.4 The assessment is to be carried out on the design for each Option. The assessments are to be split into two sections, Section 1 West of Drumsna Junction (Node J) and Section 2 East of Drumsna Junction (Node J).

8.3.5 To test each of the Options Table 15 has been translated into a series of 12 model runs which contain differing designs west and east of Node J, as set out in Table 16.

Table 16. Summary List of Option Traffic Models

MODEL ID	WEST OF NODE J	EAST OF NODE J	CROSS SECTION	DEMAND MANAGEMENT INCLUDED
1	Do-Minimum	Do-Minimum	Existing	n/a
Dual Carriageway Options				
2	Purple	Purple	Dual Carriageway	Yes
3	Grey	Purple	Dual Carriageway	Yes
4	Orange	Purple	Dual Carriageway	Yes
5	Pink	Purple	Dual Carriageway	Yes
Single Carriageway Options				
6	Red	Yellow	Single Carriageway	Yes
7	Dark Green	Green	Single Carriageway	Yes
8	Brown	Green	Single Carriageway	Yes
9	Cyan	Yellow	Single Carriageway	Yes
Dual Carriageway Options + Black Corridor (Single Carriageway Urban Street)				
10	Black + Do-Minimum	Do-Minimum	Street 50km/h	No
11	Purple & Black	Purple	Dual Carriageway & Street 50km/h	Yes
12	Pink & Black	Purple	Dual Carriageway & Street 50km/h	Yes

8.3.6 Included in all of the Do-Something scenarios (except for M10) are the elements of the Carrick-on-Shannon Transport Strategy proposals that can be modelled in the strategic highway modelling software, SATURN. These measures aim to make the town safer and

more attractive for other road users and are shown visually in Figure 27. The measures that have been modelled are:

- Proposed 30 km/h speed limit through the town on the existing N4, as marked by the red line in Figure 27;
- Reconfigured signal timings at existing pedestrian crossing in the town to facilitate longer pedestrian / cyclist crossing times, and
- New formal pedestrian crossings at selected junctions in the town.

8.3.7 These measures are proposed to complement each of the bypass road options and help to improve the existing conditions for other road users in the town centre. They are considered part of the proposed scheme and are therefore included in all of the Do-Something models but not the Do-Minimum model in order to facilitate a reduction in vehicle trips through the town centre.

8.4 Network Performance Indicators

8.4.1 Key network performance indicators for 2030 and 2045 have been extracted from the AM peak hour, inter-peak hour, and PM peak hour highway assignment models. It should be noted that the values are totals or averages for the LAM using a fixed trip matrix. The results can robustly be compared against each other to obtain an understanding of the impact of the options on Carrick-on-Shannon when compared to the Do-Minimum.

8.4.2 The following network statistics are presented are outlined in Table 17 and Table 18 (with purple highlighting to show cases improvements in travel time and reductions travel distance):

- **Transient Queues**: represent time spent in queues at junctions which are not over capacity, for example, at a signalised junction where the queue is able to clear during a single cycle. This is presented in total PCU-hours which is essentially the volume of vehicles on the network multiplied by the time spent in transient queues.
- **Over-capacity queues**: occur where the volume of turning movements exceed junction capacity, such that a permanent queue builds – for example at a signalised junction where a queue is unable to clear in a single cycle. Similar to transient queues, over-capacity queues are presented in total PCU-hours
- **Total Travel Time**: represents the total travel time for all vehicles on the network in the modelled period measured in PCU-hours.
- **Total Travel Distance**: represents the total distance travelled by vehicles on the road network in the modelled period measured in PCU-kms.
- **Average Speed**: represents the average speed of all vehicles travelling on the network within the modelled time period measured in km/h.

Table 17. Year 2030 Network Performance Indicators

ID	WEST OF NODE J	EAST OF NODE J	TRANSIENT QUEUES (OVER CAPACITY IN BRACKETS) (PCU-HRS)	TOTAL TRAVEL TIME (PCU-HRS)	TOTAL TRAVEL DISTANCE (PCU-KMS)	FULL MODEL AVERAGE SPEED (KM/H)
AM Peak Hour						
1	Do-Minimum	Do-Minimum	75 (19)	1099	58411	53
2	Purple	Purple	81 (13)	1116	60568	54
3	Grey	Purple	81 (13)	1115	60463	54
4	Orange	Purple	86 (22)	1142	61029	53
5	Pink	Purple	82 (5)	1104	61189	55
6	Red	Yellow	86 (13)	1113	59552	54
7	Dark Green	Green	87 (13)	1112	59389	53
8	Brown	Green	90 (16)	1129	59227	52
9	Cyan	Yellow	85 (4)	1097	59815	55
11	Purple Black	Purple	77 (13)	1110	60615	55
12	Pink & Black	Purple	74 (9)	1090	61070	56
Inter-peak Hour						
1	Do-Minimum	Do-Minimum	69 (0)	928	49657	54
2	Purple	Purple	73 (13)	955	51490	54
3	Grey	Purple	73 (13)	955	51456	54
4	Orange	Purple	73 (18)	970	51512	53
5	Pink	Purple	69 (2)	939	51528	55
6	Red	Yellow	79 (13)	957	50721	53
7	Dark Green	Green	79 (13)	954	50666	53
8	Brown	Green	76 (14)	960	50299	52
9	Cyan	Yellow	71 (3)	937	50739	54
11	Purple Black	Purple	70 (13)	952	51447	54
12	Pink & Black	Purple	65 (2)	929	51545	55
PM Peak Hour						
1	Do-Minimum	Do-Minimum	137 (11)	1063	51830	49
2	Purple	Purple	93 (25)	1041	54313	52
3	Grey	Purple	95 (26)	1042	54222	52

ID	WEST OF NODE J	EAST OF NODE J	TRANSIENT QUEUES (OVER CAPACITY IN BRACKETS) (PCU-HRS)	TOTAL TRAVEL TIME (PCU-HRS)	TOTAL TRAVEL DISTANCE (PCU-KMS)	FULL MODEL AVERAGE SPEED (KM/H)
4	Orange	Purple	93 (27)	1054	55090	52
5	Pink	Purple	84 (1)	1002	54807	55
6	Red	Yellow	101 (26)	1042	53240	51
7	Dark Green	Green	101 (26)	1041	53132	51
8	Brown	Green	95 (20)	1037	53031	51
9	Cyan	Yellow	86 (3)	997	53666	54
11	Purple Black	Purple	92 (22)	1033	54386	53
12	Pink & Black	Purple	80 (2)	989	54832	55

Table 18. Year 2045 Network Performance Indicators

ID	WEST OF NODE J	EAST OF NODE J	TRANSIENT QUEUES (OVER CAPACITY IN BRACKETS) (PCU-HRS)	TOTAL TRAVEL TIME (PCU-HRS)	TOTAL TRAVEL DISTANCE (PCU-KMS)	FULL MODEL AVERAGE SPEED (KM/H)
AM Peak Hour						
1	Do-Minimum	Do-Minimum	97 (26)	1165	60480	52
2	Purple	Purple	85 (13)	1153	62780	54
3	Grey	Purple	86 (14)	1153	62648	54
4	Orange	Purple	89 (23)	1180	63227	54
5	Pink	Purple	85 (6)	1142	63368	55
6	Red	Yellow	91 (13)	1151	61781	54
7	Dark Green	Green	91 (14)	1151	61596	54
8	Brown	Green	93 (16)	1166	61421	53
9	Cyan	Yellow	87 (7)	1136	61987	55
11	Purple Black	Purple	81 (13)	1147	62851	55
12	Pink & Black	Purple	76 (11)	1128	63277	56
Inter-peak Hour						
1	Do-Minimum	Do-Minimum	78 (0)	968	51665	53
2	Purple	Purple	77 (13)	989	53574	54
3	Grey	Purple	78 (13)	988	53535	54

ID	WEST OF NODE J	EAST OF NODE J	TRANSIENT QUEUES (OVER CAPACITY IN BRACKETS) (PCU-HRS)	TOTAL TRAVEL TIME (PCU-HRS)	TOTAL TRAVEL DISTANCE (PCU-KMS)	FULL MODEL AVERAGE SPEED (KM/H)
4	Orange	Purple	75 (18)	1002	53592	53
5	Pink	Purple	70 (2)	970	53608	55
6	Red	Yellow	83 (13)	990	52815	53
7	Dark Green	Green	83 (13)	988	52733	53
8	Brown	Green	78 (15)	992	52343	53
9	Cyan	Yellow	73 (3)	968	52795	55
11	Purple Black	Purple	73 (13)	984	53546	54
12	Pink & Black	Purple	67 (2)	960	53626	56
PM Peak Hour						
1	Do-Minimum	Do-Minimum	165 (17)	1123	53402	48
2	Purple	Purple	95 (25)	1067	55942	52
3	Grey	Purple	96 (26)	1069	55847	52
4	Orange	Purple	95 (27)	1081	56714	52
5	Pink	Purple	86 (1)	1028	56424	55
6	Red	Yellow	102 (27)	1068	54883	51
7	Dark Green	Green	103 (27)	1068	54767	51
8	Brown	Green	97 (20)	1064	54630	51
9	Cyan	Yellow	88 (3)	1024	55260	54
10	Black + DM	Do-Minimum	161 (14)	1107	53360	48
11	Purple Black	Purple	94 (22)	1059	56009	53
12	Pink & Black	Purple	81 (2)	1016	56449	56

8.4.3 Analysis of the network performance indicators for 2030 and 2045 in the Do-Something scenarios show a variable picture when volumes of queuing (both transient and over capacity), total travel time and average speeds are compared to the Do-Minimum.

8.4.4 In 2030, the options mainly generate increases in travel time in the morning peak and inter-peak periods but reductions in travel time in the evening peak. In 2045, the options generate increases in travel time in only the inter-peak period and reductions both the morning peak and evening peak periods. The primary driver of these increases in travel time is the package of demand management measures that reduce the speed limit on the N4 and introduce pedestrian phases at traffic signals.

8.4.5 In every case, the options generate longer travel distances. The bypass routes are longer, and the package of complementary measures increases journey time on the N4, and traffic seeks out longer but faster routes in the model.

8.4.6 Uniquely **M12** shows reductions in journey time in almost every time period and year combination. It shows a very small increase in journey times in the 2030 inter-peak,

8.5 Journey Times

8.5.1 Journey time analysis has been undertaken along the N4 and the bypass Options to gain a better understanding of the forecast travel patterns. Four comparable routes were analysed for every option, with the exception of the Do-Minimum model (M1) and M10, which do not include the bypass:

- N4 Eastbound (existing N4 route via Carrick-on-Shannon)
- N4 Westbound (existing N4 route via Carrick-on-Shannon)
- N4 Eastbound Bypass (bypass route avoiding Carrick-on-Shannon town centre)
- N4 Westbound Bypass (bypass route avoiding Carrick-on-Shannon town centre)

8.5.2 To ensure consistency and comparability, all of the routes start and end at the same location. The western start/end location is at Ardcarn at the junction of the N4 / R285 (node 72351) and the eastern start/end location is on the N4 at the Tomisky Roundabout (node 60177) near the County Leitrim and County Longford border.

8.5.3 Table 19 and Table 20 present the journey time analysis for 2030 and 2045 in each of the modelled time periods, with the difference between journey times along the eastbound and westbound routes shown separately. For M2 to M12, the journey time difference is assessed against the Do-Minimum (M1), except for M10 which does not include a bypass option.

8.5.4 For every option tested, in all three time periods and in both years, the bypass provides a quicker route for the through traffic than the N4 provided in the Do-Minimum. But in most cases the route via N4 through Carrick-on-Shannon becomes slower than it was in the Do-Minimum because of the traffic management measures.

8.5.5 The model will route all the through traffic via the bypass because of the faster journey times but the traffic to and from the town will suffer the additional journey time form the traffic management measures. The balance between winners and losers is reflected in the overall time savings reported in the previous section. In 2030, there is a net reduction in travel time in only the morning peak period. In 2045, there is a net reduction in travel time in both the morning and evening peak.

Table 19. Year 2030 Journey Times (Seconds)

ID	WEST OF NODE J	EAST OF NODE J	N4 EB	N4 WB	N4 EB VIA BYPASS	N4 WB VIA BYPASS	EB DIFF WRT DM	WB DIFF WRT DM
AM Peak Hour								
1	Do-Minimum	Do-Minimum	1397	1264				
2	Purple	Purple	1368	1364	1072	1078	**-325**	**-185**
3	Grey	Purple	1387	1381	1061	1063	**-336**	**-201**
4	Orange	Purple	1321	1326	1025	1013	**-371**	**-251**
5	Pink	Purple	1323	1331	1025	1017	**-372**	**-246**
6	Red	Yellow	1403	1395	1127	1135	**-269**	**-128**
7	Dark Green	Green	1414	1405	1110	1117	**-287**	**-147**
8	Brown	Green	1351	1366	1064	1055	**-333**	**-208**
9	Cyan	Yellow	1359	1365	1071	1064	**-325**	**-200**
10	Black + DM	Do-Minimum	1390	1264				
11	Purple Black	Purple	1365	1348	1072	1078	**-325**	**-185**
12	Pink & Black	Purple	1321	1343	1025	1017	**-372**	**-246**
Inter-peak Hour								
1	Do-Minimum	Do-Minimum	1332	1259				
2	Purple	Purple	1367	1382	1071	1078	**-261**	**-181**
3	Grey	Purple	1385	1401	1061	1062	**-272**	**-197**
4	Orange	Purple	1327	1322	1024	1012	**-308**	**-247**
5	Pink	Purple	1332	1312	1024	1017	**-308**	**-242**
6	Red	Yellow	1403	1422	1127	1133	**-206**	**-126**
7	Dark Green	Green	1411	1431	1109	1114	**-223**	**-145**
8	Brown	Green	1358	1355	1063	1054	**-270**	**-205**
9	Cyan	Yellow	1367	1348	1070	1063	**-263**	**-196**
10	Black + DM	Do-Minimum	1331	1257				
11	Purple Black	Purple	1367	1357	1071	1078	**-261**	**-181**
12	Pink & Black	Purple	1328	1309	1024	1017	**-309**	**-242**
PM Peak Hour								
1	Do-Minimum	Do-Minimum	1560	1307				
2	Purple	Purple	1367	1357	1072	1079	**-488**	**-228**

ID	WEST OF NODE J	EAST OF NODE J	N4 EB	N4 WB	N4 EB VIA BYPASS	N4 WB VIA BYPASS	EB DIFF WRT DM	WB DIFF WRT DM
3	Grey	Purple	1328	1309	1061	1063	**-499**	**-243**
4	Orange	Purple	1367	1357	1025	1014	**-535**	**-293**
5	Pink	Purple	1328	1309	1024	1019	**-535**	**-288**
6	Red	Yellow	1367	1357	1128	1135	**-431**	**-172**
7	Dark Green	Green	1328	1309	1111	1116	**-449**	**-190**
8	Brown	Green	1367	1357	1064	1056	**-495**	**-250**
9	Cyan	Yellow	1328	1309	1071	1065	**-489**	**-242**
10	Black + DM	Do-Minimum	1582	1393				
11	Purple Black	Purple	1379	1449	1072	1079	**-488**	**-228**
12	Pink & Black	Purple	1351	1335	1024	1019	**-535**	**-288**

Table 20. Year 2045 Journey Times (Seconds)

ID	WEST OF NODE J	EAST OF NODE J	N4 EB	N4 WB	N4 EB VIA BYPASS	N4 WB VIA BYPASS	EB DIFF.	WB DIFF.
AM Peak Hour								
1	Do-Minimum	Do-Minimum	1517	1267				
2	Purple	Purple	1372	1371	1072	1078	**-445**	**-189**
3	Grey	Purple	1392	1389	1061	1063	**-455**	**-205**
4	Orange	Purple	1323	1332	1025	1013	**-491**	**-255**
5	Pink	Purple	1325	1337	1025	1017	**-492**	**-250**
6	Red	Yellow	1407	1407	1128	1136	**-389**	**-132**
7	Dark Green	Green	1418	1417	1111	1117	**-406**	**-151**
8	Brown	Green	1353	1372	1065	1055	**-452**	**-212**
9	Cyan	Yellow	1361	1381	1071	1064	**-445**	**-204**
10	Black + DM	Do-Minimum	1505	1268				
11	Purple Black	Purple	1368	1354	1072	1078	**-445**	**-189**
12	Pink & Black	Purple	1323	1357	1025	1017	**-492**	**-250**
Inter-peak Hour								
1	Do-Minimum	Do-Minimum	1357	1265				
2	Purple	Purple	1370	1399	1071	1078	**-286**	**-187**

ID	WEST OF NODE J	EAST OF NODE J	N4 EB	N4 WB	N4 EB VIA BYPASS	N4 WB VIA BYPASS	EB DIFF.	WB DIFF.
3	Grey	Purple	1388	1420	1061	1062	**-296**	**-203**
4	Orange	Purple	1329	1324	1025	1013	**-333**	**-252**
5	Pink	Purple	1333	1313	1024	1017	**-333**	**-248**
6	Red	Yellow	1405	1434	1127	1133	**-230**	**-132**
7	Dark Green	Green	1414	1445	1110	1115	**-248**	**-150**
8	Brown	Green	1360	1357	1063	1055	**-294**	**-210**
9	Cyan	Yellow	1368	1349	1070	1063	**-287**	**-202**
10	Black + DM	Do-Minimum	1354	1264				
11	Purple Black	Purple	1370	1364	1071	1078	**-286**	**-187**
12	Pink & Black	Purple	1329	1310	1024	1017	**-333**	**-248**
PM Peak Hour								
1	Do-Minimum	Do-Minimum	1590	1421				
2	Purple	Purple	1383	1472	1072	1079	**-518**	**-342**
3	Grey	Purple	1403	1494	1061	1063	**-529**	**-358**
4	Orange	Purple	1342	1396	1025	1014	**-565**	**-407**
5	Pink	Purple	1349	1343	1024	1019	**-565**	**-403**
6	Red	Yellow	1418	1514	1128	1135	**-461**	**-286**
7	Dark Green	Green	1429	1524	1111	1117	**-479**	**-305**
8	Brown	Green	1374	1422	1064	1057	**-525**	**-365**
9	Cyan	Yellow	1384	1378	1071	1065	**-519**	**-357**
10	Black + DM	Do-Minimum	1589	1394				
11	Purple Black	Purple	1381	1450	1072	1079	**-518**	**-342**
12	Pink & Black	Purple	1354	1334	1024	1019	**-565**	**-403**

8.5.6 To make the data easier to interpret, Table 21 and Table 22 summarise the journey time data by detailing the individual peak hour and total journey time differences for the eastbound and westbound directions in each of the Do-Something scenarios compared to M1 for 2030 and 2045, respectively.

Table 21. Year 2030 Journey Time Difference Bypass vs Existing N4 Route (Seconds)

ID	EASTBOUND				WESTBOUND			
	AM	IP	PM	TOTAL	AM	IP	PM	TOTAL
2	-325	-261	-488	**-1074**	-185	-181	-228	**-595**
3	-336	-272	-499	**-1106**	-201	-197	-243	**-641**
4	-371	-308	-535	**-1214**	-251	-247	-293	**-790**
5	-372	-308	-535	**-1216**	-246	-242	-288	**-776**
6	-269	-206	-431	**-906**	-128	-126	-172	**-426**
7	-287	-223	-449	**-958**	-147	-145	-190	**-482**
8	-333	-270	-495	**-1098**	-208	-205	-250	**-664**
9	-325	-263	-489	**-1077**	-200	-196	-242	**-638**
11	-325	-261	-488	**-1074**	-185	-181	-228	**-594**
12	-372	-309	-535	**-1216**	-246	-242	-288	**-777**

Table 22. Year 2045 Journey Time Difference Bypass vs Existing N4 Route (Seconds)

ID	EASTBOUND				WESTBOUND			
	AM	IP	PM	TOTAL	AM	IP	PM	TOTAL
2	-445	-286	-518	**-1248**	-189	-187	-342	**-719**
3	-455	-296	-529	**-1280**	-205	-203	-358	**-766**
4	-491	-333	-565	**-1389**	-255	-252	-407	**-914**
5	-492	-333	-565	**-1390**	-250	-248	-403	**-901**
6	-389	-230	-461	**-1081**	-132	-132	-286	**-550**
7	-406	-248	-479	**-1132**	-151	-150	-305	**-606**
8	-452	-294	-525	**-1272**	-212	-210	-365	**-787**
9	-445	-287	-519	**-1251**	-204	-202	-357	**-762**
11	-445	-286	-518	**-1248**	-189	-187	-342	**-718**
12	-492	-333	-565	**-1391**	-250	-248	-403	**-901**

8.5.7 The data in Table 21 and Table 22 show that **M6**, closely followed by **M7**, provide the lowest journey time savings in both directions and in both assessment years when totalled across all three peak models. Both M6 and M7 are longer distance bypass routes that deviate some of the furthest from the existing N4 alignment through Carrick-on-Shannon.

8.5.8 **M4**, **M5** and **M12** (in varying rank orders depending on direction and year) provide the greatest journey time savings when compared to M1. They are all fairly short distance routes that follow the route of the existing N4 through Carrick-on-Shannon quite closely and therefore the journey time savings are higher than those associated with M6 and M7.

8.6 Traffic Flows Across the River Shannon Bridge

8.6.1 One of the objectives of the project is to alleviate congestion and provide an improved environment and more accessibility for vulnerable road users within Carrick-on-Shannon town centre. Therefore, an analysis has been undertaken to check the reduction in traffic through Carrick-on-Shannon, taking the flow across the River Shannon bridge as an indicator of volumes. Table 23 and Table 24 display traffic volumes in each peak of the 2030 and 2045 models.

Table 23. Year 2030 Actual Flow Over Carrick-on-Shannon N4 Bridge

ID	WEST OF NODE J	EAST OF NODE J	NORTHBOUND (PCU)	SOUTHBOUND (PCU)	TOTAL (PCU)
AM Peak Hour					
1	Do-Minimum	Do-Minimum	765	652	**1417**
2	Purple	Purple	435	447	**882**
3	Grey	Purple	440	448	**888**
4	Orange	Purple	411	381	**792**
5	Pink	Purple	372	339	**711**
6	Red	Yellow	463	452	**915**
7	Dark Green	Green	467	445	**912**
8	Brown	Green	411	389	**800**
9	Cyan	Yellow	387	343	**730**
10	Black + DM	Do-Minimum	765	648	**1413**
11	Purple Black	Purple	434	412	**846**
12	Pink & Black	Purple	366	328	**694**
Inter-peak Hour					
1	Do-Minimum	Do-Minimum	677	684	**1361**
2	Purple	Purple	342	486	**828**
3	Grey	Purple	338	488	**826**
4	Orange	Purple	400	421	**821**
5	Pink	Purple	389	399	**788**
6	Red	Yellow	376	491	**868**
7	Dark Green	Green	361	490	**851**
8	Brown	Green	404	418	**822**
9	Cyan	Yellow	382	401	**783**

ID	WEST OF NODE J	EAST OF NODE J	NORTHBOUND (PCU)	SOUTHBOUND (PCU)	TOTAL (PCU)
10	Black + DM	Do-Minimum	677	683	**1360**
11	Purple Black	Purple	370	461	**831**
12	Pink & Black	Purple	366	387	**753**
PM Peak Hour					
1	Do-Minimum	Do-Minimum	722	742	**1464**
2	Purple	Purple	379	483	**862**
3	Grey	Purple	390	486	**876**
4	Orange	Purple	383	444	**827**
5	Pink	Purple	390	447	**837**
6	Red	Yellow	418	486	**903**
7	Dark Green	Green	410	487	**897**
8	Brown	Green	390	447	**837**
9	Cyan	Yellow	381	447	**828**
10	Black + DM	Do-Minimum	733	742	**1475**
11	Purple Black	Purple	412	465	**877**
12	Pink & Black	Purple	355	431	**786**

Table 24. Year 2045 Actual Flow Over Carrick-on-Shannon N4 Bridge

ID	WEST OF NODE J	EAST OF NODE J	NORTHBOUND (PCU)	SOUTHBOUND (PCU)	TOTAL (PCU)
AM Peak Hour					
1	Do-Minimum	Do-Minimum	765	671	**1436**
2	Purple	Purple	456	459	**915**
3	Grey	Purple	460	462	**921**
4	Orange	Purple	428	392	**820**
5	Pink	Purple	397	353	**750**
6	Red	Yellow	475	461	**936**
7	Dark Green	Green	476	460	**936**

ID	WEST OF NODE J	EAST OF NODE J	NORTHBOUND (PCU)	SOUTHBOUND (PCU)	TOTAL (PCU)
8	Brown	Green	428	393	**821**
9	Cyan	Yellow	409	355	**764**
10	Black + DM	Do-Minimum	767	667	**1434**
11	Purple Black	Purple	446	425	**872**
12	Pink & Black	Purple	385	336	**721**
Inter-peak Hour					
1	Do-Minimum	Do-Minimum	702	706	**1408**
2	Purple	Purple	345	495	**840**
3	Grey	Purple	342	497	**840**
4	Orange	Purple	404	425	**830**
5	Pink	Purple	394	405	**799**
6	Red	Yellow	377	497	**874**
7	Dark Green	Green	366	497	**863**
8	Brown	Green	408	422	**831**
9	Cyan	Yellow	386	407	**794**
10	Black + DM	Do-Minimum	701	705	**1406**
11	Purple Black	Purple	372	469	**841**
12	Pink & Black	Purple	371	392	**762**
PM Peak Hour					
1	Do-Minimum	Do-Minimum	730	747	**1477**
2	Purple	Purple	388	483	**871**
3	Grey	Purple	398	486	**883**
4	Orange	Purple	388	444	**832**
5	Pink	Purple	397	449	**846**
6	Red	Yellow	419	484	**904**
7	Dark Green	Green	412	487	**899**
8	Brown	Green	397	448	**844**
9	Cyan	Yellow	389	450	**839**
10	Black + DM	Do-Minimum	738	739	**1477**

ID	WEST OF NODE J	EAST OF NODE J	NORTHBOUND (PCU)	SOUTHBOUND (PCU)	TOTAL (PCU)
11	Purple Black	Purple	421	465	**886**
12	Pink & Black	Purple	361	435	**796**

8.6.2 All of the bypass option models result in a flow decrease across the River Shannon bridge when compared to M1. However, it is **M12** that results in the lowest total vehicle flows across the bridge, closely followed by **M5** and **M9**, when the total flow in all models and in both directions is assessed.

8.7 Average Annual Daily Traffic (AADT)

8.7.1 Annual Average Daily Traffic (AADT) were estimated from the model outputs using the factors described in section 7.5, at the locations presented in Figure 30.

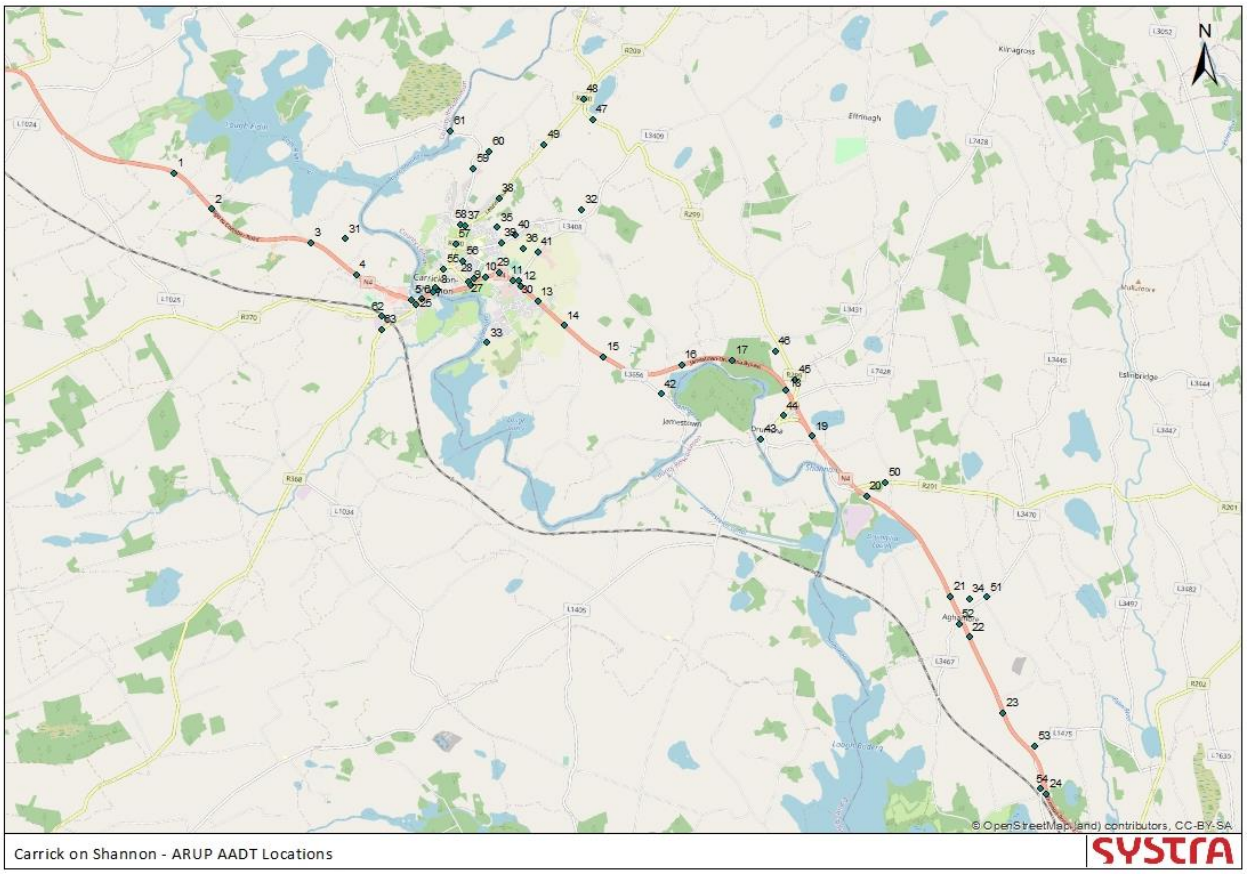


Figure 30. AADT Data Points

8.7.2 Data for these locations are subsequently provided in Table 25 and Table 26 for 2030 and 2045, respectively. Note, that in line with previous convention, Model 1 (M1) to Model 12 (M12) are once again comprised of the following Options west and east of "Node J":

1. Do-Minimum
2. Purple / Purple
3. Grey / Purple
4. Orange / Purple
5. Pink / Purple
6. Red / Yellow
7. Dark Green / Green
8. Brown / Green
9. Cyan / Yellow
10. Black + Do-Minimum
11. Purple & Black / Purple
12. Pink & Black / Purple

Table 25. Year 2030 AADT Data

YEAR 2030													
ID	LOCATION	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
1	N4 Drumharlow	7935	8113	8096	8337	8393	8056	8056	8331	8374	7916	8276	8299
2	N4 Drumharlow	7935	8113	8096	8337	8393	8056	8056	8331	8374	7916	8276	8299
3	N4 Tumna	8446	9703	9751	10096	4017	9640	9691	10090	3950	8428	9869	3620
4	N4 Cloonman	8446	7590	7892	6106	4017	7897	8175	6065	3950	8428	7326	3620
5	N4 West of Station Road	12970	8544	8702	7400	8006	9091	9015	7451	8170	12947	8516	7852
6	N4 East of Station Road	16942	10382	10424	10079	9635	10913	10758	10088	9619	16956	10427	9176
7	N4 River Shannon Bridge	17383	10821	10863	10528	10046	11345	11192	10550	10039	17398	10824	9589
8	N4 Landmark	18147	11140	11172	10151	9661	11600	11451	10268	9688	17976	11071	9227
9	N4 West of Shannon Roundabout	17790	10585	10617	9568	9039	11060	10908	9689	9081	17689	10519	8607
10	N4 West of Attirory Roundabout	15895	11935	11745	9997	10113	11960	11903	10168	10197	14136	10581	8209
11	N4 East of Attirory Roundabout	14868	12105	11907	12294	12883	12541	12446	12605	13016	13927	11005	11121
12	N4 East of Castlecarra Road	11922	8833	8950	12405	13745	9065	9154	12241	13366	12291	9204	14308
13	N4 at Atiirory	10108	7051	7167	11458	12858	7284	7372	11196	12471	10479	7397	13404
14	N4 at Lisseeghan	10108	7051	7167	9729	9427	7284	7372	9672	9006	10479	7397	9592
15	N4 at Corbally	9409	6882	6474	9729	9427	6969	6677	9672	9006	9781	7147	9592
16	N4 at Tully	8079	5504	4401	9729	9427	6002	5157	8044	9006	8396	5535	9592

YEAR 2030													
ID	LOCATION	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
17	N4 at Mountcampbell	8079	8360	4401	9729	9427	9026	5157	8044	9006	8396	8324	9592
18	N4 West of Drumsna Junction	8079	8360	8467	9729	9427	9026	9703	8045	9006	8396	8324	9592
19	N4 East of Drumsna Junction	9049	8613	8785	9632	9322	9213	9188	9185	9404	9115	8597	9473
20	N4 East of R201 (Mohill Road)	6300	8810	8980	9067	9064	6384	6457	6404	6572	6302	8810	9110
21	N4 West of Aghamore	6387	8810	8980	9067	9064	6384	6457	6404	6572	6388	8810	9110
22	N4 East of Aghamroe	6384	6114	6182	6282	6275	6304	6377	6324	6491	6385	6114	6274
23	N4 West of Fearnaght Junction	6307	6114	6182	6282	6275	6304	6377	6324	6491	6308	6114	6274
24	N4 Faulties	6307	6114	6182	6282	6275	6304	6377	6324	6491	6308	6114	6274
25	Station Road	6703	4726	4687	5027	3491	4714	4679	4773	3515	6713	4747	3435
26	Bridge Street	5315	4900	4910	5503	5615	4950	4947	5504	5596	5170	4955	5481
27	Dublin Road	11688	8428	8239	10507	10675	8659	8729	10564	10636	9133	7634	8099
28	Circular Road	2940	2122	2112	1874	1769	2120	2136	1858	1785	3080	1398	1283
29	North Leg Attifinlay Roundabout	2354	2348	2359	2954	3098	2349	2350	3013	3093	2347	2065	2568
30	Castlecarra Road	6025	5780	6077	7571	7706	5996	6146	7119	7246	7452	5974	9977
31	New Bypass North (Western End)	-	6177	6150	-	-	5580	5761	-	-	-	6340	-
32	New Bypass North (Mid)	-	4623	4692	-	-	4395	4486	-	-	-	4311	-
33	New Bypass South (Mid)	-	-	-	6739	8004	-	-	6678	7943	-	-	8389

YEAR 2030													
ID	LOCATION	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
34	New Aghamore Village Bypass	-	8810	8980	9067	9064	-	-	-	-	-	8810	9110
35	New Bypass North (Mid - Black)	-	-	-	-	-	-	-	-	-	5419	5049	6465
36	New Bypass South (Mid - Black)	-	-	-	-	-	-	-	-	-	3937	4013	6410
37	R280 north of Harltey Junction	6797	5592	5935	5646	5709	4885	4970	5618	5607	5832	4588	5941
38	R280 Ballynamony	5984	5429	5721	4845	4903	4700	4743	4807	4794	5779	4878	6123
39	Summerhill Road	1375	1432	1430	1208	1179	1436	1421	1152	1140	3324	2693	2539
40	Summerhill Road	831	944	934	788	747	946	943	761	720	1044	1127	1059
41	Casltecarra Road at Keenaghan	3332	3095	3385	4884	5017	3307	3455	4427	4550	5294	4812	7834
42	Jamestown	1348	2422	2178	132	82	1988	1615	-	-	1349	2441	78
43	Drumsna River Bridge	829	1284	1367	2100	1438	862	1153	1019	1655	827	1319	1424
44	Drumsna Road Overbridge	1565	634	823	1154	1071	1335	1084	1832	2127	1312	634	943
45	R299 North of Drumsna Junction	1821	639	823	1164	1082	951	219	1997	2061	1568	639	950
46	R299 West of L3431 Junction	1465	419	949	903	824	595	345	1641	1706	1212	419	692
47	R299 at n. Edge of Study Area	3015	2412	2488	4030	3969	2596	2556	4047	4055	970	371	742
48	R280 north of R299 Junction	8611	9127	9122	8591	8584	9119	9118	8622	8607	8609	9086	8623
49	R280 at Cartown	5984	7254	6851	4997	5058	7022	6808	4953	4939	7907	8966	8304
50	R201 East of Junction with N4	2823	158	163	153	153	2972	2913	2963	2966	2887	158	156

YEAR 2030													
ID	LOCATION	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
51	Antfield/Aghamore	1098	3598	3700	3687	3690	1098	1098	1098	1099	1098	3597	3737
52	Local Road West Aghamore	373	536	536	536	537	373	373	373	374	373	536	537
53	Local Road Fearnaght	216	63	63	63	63	130	167	167	131	216	63	63
54	N4 at Faulties	2572	63	63	63	63	2569	2574	2580	2593	2571	63	63
55	Mian Street	3262	4184	4201	4755	4723	4231	4229	4758	4762	3391	4199	4693
56	Summerhill Road	2259	2473	2484	2288	2308	2476	2458	2281	2311	1870	2024	1935
57	Leitrim Road	9031	6628	7049	7818	7886	6011	6154	7824	7805	6215	4213	5158
58	Shannon Grove w. of Leitrim Rd	3195	2429	2511	2807	2809	2484	2548	2817	2810	3276	2307	2896
59	Shannon Grove	1839	1721	1738	1535	1534	1778	1777	1537	1527	1840	1592	1609
60	Hartley Court	-	728	662	156	161	729	665	150	152	-	718	150
61	Hartley Bridge	976	748	764	698	693	805	804	699	686	970	618	767
62	R370 West of R368 Junction	2473	1268	1203	1094	1796	1273	1222	1095	2262	2473	1269	2283
63	R368 South of R370 Junction	2633	1935	1973	2435	3031	1942	1951	2150	3323	2631	1952	3423
64	Adjacent to East Bypass Junction	-	4623	4692	6739	8004	4395	4486	6678	7943	-	4311	8389
65	Adjacent to West Bypass Junction	-	6177	6150	6739	5432	5580	5761	6677	4996	-	6340	5262
66	New Elphin Link Road	-	-	-	-	3688	-	-	-	3984	-	-	4245

Table 26. Year 2045 AADT Data

YEAR 2045													
ID	LOCATION	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
1	N4 Drumharlow	8284	8544	8523	8776	8834	8485	8492	8771	8815	8225	8704	8743
2	N4 Drumharlow	8284	8544	8523	8776	8834	8485	8492	8771	8815	8225	8704	8743
3	N4 Tumna	8791	10150	10210	10539	4232	10077	10155	10533	4174	8733	10306	3792
4	N4 Cloonman	8791	7852	8155	6325	4232	8071	8355	6263	4174	8733	7546	3792
5	N4 West of Station Road	13200	8668	8835	7490	8108	9068	9090	7542	8264	13149	8599	7911
6	N4 East of Station Road	17088	10443	10490	10138	9740	10879	10778	10143	9710	17084	10474	9246
7	N4 River Shannon Bridge	17515	10882	10929	10582	10145	11309	11208	10600	10125	17497	10871	9651
8	N4 Landmark	18314	11185	11233	10183	9743	11580	11489	10306	9766	18143	11084	9270
9	N4 West of Shannon Roundabout	17924	10605	10651	9572	9096	11014	10920	9698	9130	17846	10502	8618
10	N4 West of Attirory Roundabout	15949	11928	11761	9916	10052	11967	11918	10083	10117	14231	10590	8225
11	N4 East of Attirory Roundabout	15021	12088	11926	12306	12910	12507	12474	12672	13036	14015	10985	11163
12	N4 East of Castlecarra Road	11999	8806	8964	12541	13825	9043	9164	12350	13427	12377	9180	14441
13	N4 at Atiirory	10193	7021	7178	11616	12976	7258	7379	11328	12571	10571	7370	13560
14	N4 at Lisseeghan	10193	7021	7178	9836	9536	7258	7379	9761	9098	10571	7370	9690
15	N4 at Corbally	9491	6873	6482	9836	9536	6945	6682	9761	9098	9869	7175	9690
16	N4 at Tully	8144	5516	4395	9836	9536	5991	5152	8136	9098	8465	5573	9690

YEAR 2045													
ID	LOCATION	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
17	N4 at Mountcampbell	8144	8471	4395	9836	9536	9138	5152	8136	9098	8465	8440	9690
18	N4 West of Drumsna Junction	8144	8471	8579	9836	9536	9138	9826	8136	9098	8465	8440	9690
19	N4 East of Drumsna Junction	9131	8727	8901	9746	9434	9335	9312	9307	9525	9210	8716	9575
20	N4 East of R201 (Mohill Road)	6371	8927	9103	9186	9185	6480	6554	6501	6668	6374	8933	9231
21	N4 West of Aghamore	6458	8927	9103	9186	9185	6480	6554	6501	6668	6460	8933	9231
22	N4 East of Aghamroe	6455	6199	6272	6374	6365	6399	6474	6420	6587	6458	6205	6365
23	N4 West of Fearnaght Junction	6377	6199	6272	6374	6365	6399	6474	6420	6587	6380	6205	6365
24	N4 Faulties	6377	6199	6272	6374	6365	6399	6474	6420	6587	6380	6205	6365
25	Station Road	6728	4729	4676	5046	3487	4723	4680	4795	3524	6743	4758	3436
26	Bridge Street	5260	4909	4908	5528	5643	4929	4918	5503	5643	5074	4983	5493
27	Dublin Road	11661	8413	8211	10500	10656	8587	8656	10551	10588	9023	7642	8168
28	Circular Road	2956	2136	2131	1881	1792	2139	2141	1858	1811	3183	1410	1279
29	North Leg Attifinlay Roundabout	2344	2343	2351	2974	3097	2343	2349	3045	3094	2343	2061	2581
30	Castlecarra Road	6105	5787	6097	7637	7786	5985	6156	7184	7317	7505	5931	9995
31	New Bypass North (Western End)	-	6418	6389	-	-	5912	6060	-	-	-	6594	-
32	New Bypass North (Mid)	-	4783	4814	-	-	4561	4613	-	-	-	4482	-
33	New Bypass South (Mid)	-	-	-	6995	8222	-	-	6938	8177	-	-	8654

YEAR 2045													
ID	LOCATION	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
34	New Aghamore Village Bypass	-	8927	9103	9186	9185	-	-	-	-	-	8933	9231
35	New Bypass North (Mid - Black)	-	-	-	-	-	-	-	-	-	5569	5070	6474
36	New Bypass South (Mid - Black)	-	-	-	-	-	-	-	-	-	4012	4007	6416
37	R280 north of Harltey Junction	6715	5638	5982	5653	5708	5034	5091	5601	5601	5724	4576	5865
38	R280 Ballynamony	5900	5485	5791	4850	4899	4859	4872	4789	4784	5675	4872	6051
39	Summerhill Road	1378	1438	1432	1211	1180	1438	1427	1155	1134	3433	2709	2561
40	Summerhill Road	834	945	936	789	746	946	937	758	725	1046	1134	1069
41	Casltecarra Road at Keenaghan	3408	3096	3400	4944	5093	3291	3460	4487	4618	5412	4797	7850
42	Jamestown	1367	2442	2195	132	83	2015	1627	-	-	1370	2466	87
43	Drumsna River Bridge	848	1292	1377	2134	1455	876	1172	1050	1667	844	1329	1428
44	Drumsna Road Overbridge	1567	636	829	1174	1079	1340	1090	1861	2138	1321	636	943
45	R299 North of Drumsna Junction	1842	641	829	1184	1090	950	220	2040	2086	1596	640	951
46	R299 West of L3431 Junction	1486	419	955	922	833	593	346	1683	1729	1239	419	696
47	R299 at n. Edge of Study Area	3097	2430	2522	4101	4045	2600	2587	4141	4131	992	374	751
48	R280 north of R299 Junction	8609	9214	9209	8669	8655	9205	9205	8699	8682	8569	9173	8697
49	R280 at Cartown	5900	7337	6924	5003	5057	7122	6886	4938	4937	7844	9052	8375
50	R201 East of Junction with N4	2838	159	163	153	153	2998	2943	2991	2993	2915	158	156

YEAR 2045													
ID	LOCATION	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
51	Antfield/Aghamore	1101	3628	3732	3713	3718	1101	1101	1101	1101	1101	3628	3765
52	Local Road West Aghamore	375	539	539	539	539	374	374	375	375	374	539	539
53	Local Road Fearnaght	219	63	63	63	63	133	170	170	133	219	63	63
54	N4 at Faulties	2584	63	63	63	63	2586	2592	2598	2612	2584	63	63
55	Mian Street	3217	4179	4189	4755	4712	4194	4187	4745	4745	3333	4213	4688
56	Summerhill Road	2266	2482	2488	2293	2312	2479	2473	2295	2306	1891	2020	1941
57	Leitrim Road	8976	6668	7092	7824	7885	6156	6265	7808	7805	6052	4252	5216
58	Shannon Grove w. of Leitrim Rd	3226	2434	2519	2806	2804	2489	2546	2813	2805	3332	2298	2893
59	Shannon Grove	1871	1735	1754	1533	1533	1794	1783	1535	1526	1928	1610	1605
60	Hartley Court	-	738	672	157	166	742	673	154	157	-	747	150
61	Hartley Bridge	1012	761	779	702	697	820	809	703	691	1067	635	769
62	R370 West of R368 Junction	2490	1270	1188	1107	1807	1284	1213	1108	2276	2492	1278	2302
63	R368 South of R370 Junction	2650	1948	1980	2448	3042	1939	1960	2158	3341	2651	1953	3444
64	Adjacent to East Bypass Junction	-	4783	4814	6995	8222	4561	4613	6938	8177	-	4482	8654
65	Adjacent to West Bypass Junction	-	6418	6389	6994	5670	5912	6060	6938	5235	-	6594	5543
66	New Elphin Link Road	-	-	-	-	3721	-	-	-	4014	-	-	4290

8.7.3 Site 7 is a key site to analyse since it is located on the River Shannon Bridge in Carrick-on-Shannon. As reported previously, all of the bypass option models result in a flow decrease across the River Shannon bridge when compared to M1. However, it is **M12** that results in the lowest total vehicle flows across the bridge, closely followed by **M5** and **M9**, when the AADT is assessed.

9. ASSESSMENT OF THE PREFERRED TRANSPORT SOLUTION

9.1 Introduction

9.1.1 Results from traffic modelling and economic appraisal of the options discussed so far were fed into a multi-criteria analysis (MCA) Project Appraisal Matrix to select a Preferred Transport Solution for Stage 3. The MCA examined the results from the economic appraisal alongside the other five elements of the Common Appraisal Framework:

- Safety Appraisal
- Physical Activity Appraisal
- Accessibility & Social Inclusion Appraisal
- Integration Appraisal
- Environmental Appraisal

9.2 The Preferred Transport Solution

9.2.1 The conclusion from the MCA was a recommendation to "Progress the active travel and demand management measures with the Black Option Corridor plus the Cyan Option Corridor to the west of Drumsna plus the Green Option Corridor to the east of Drumnsa". Its location can be seen in the schematic diagram in Figure 31.

Figure 31. Preferred Transport Solution schematic diagram

9.2.2 The Preferred Transport Solution has been modelled as M14. It is similar to M9, which has already been tested. To the west of Drumsna, both adopt the Cyan single carriageway design.

This option crosses the river to the south of Carrick-on-Shannon, connecting node A to Node J. It includes a tie back at Node C to R368 Elphin Road south of the railway bridge and a new roundabout connecting the N4 and R368.

9.2.3 To the east of Drumsna the Preferred Transport Solution adopts the Green design instead of the Yellow that was in M9. Both are single carriageway options with an on-line upgrade between the Drumsna Junction at Node J and Fernaught at Node G. The Yellow design (as in M9) included a short off-line section proposed between Node G at Fernaught and Node H at Faulties. In the Preferred Transport Solution this is replaced with an on-line upgrade.

9.2.4 In the town centre of Carrick-on-Shannon, the Preferred Transport Solution includes the Black design, an urban street improvement connecting the R280 to the Summerhill Road and on to the Castlecara Road. This was not included in M9. In the work up to this point it was modelled only as a variant which was added to the dual carriageway designs. It was included in M11 (Purple to the West and Purple to the East) as a variant of M2. It was also included in M12 (Pink to the West and Purple to the East) as a variant of M5.

9.3 Comparators and comparisons

9.3.1 In this chapter, the Preferred Transport Solution is compared against two very similar options as set out in Table 27 and against the Do-Minimum. Network 9 was reported in previous chapters. Networks 13 and 14 are new tests of the Preferred Transport Solution and a minor variant that excludes the Black option in the town centre in the case of Network 13.

Table 27. Comparators for the Preferred Transport Solution

ID	DESCRIPTION	WEST OF NODE J	EAST OF NODE J
14	Preferred Transport Solution	Cyan & Black	Green
13	As Preferred Transport Solution but without Black single carriageway urban street in the town centre	Cyan	Green
9	Similar to Preferred Transport Solution but without Black and with a different single carriageway to the east of Drumsna	Cyan	Yellow
1	Do-Minimum	Do-Minimum	Do-Minimum

9.3.2 The comparisons cover the same set of measures reported in the earlier analysis:

- Network performance indicators – queues, travel times, travel distances and speeds;
- Journey times on the N4 and the bypass; and
- Flows across Shannon Bridge.

9.4 Network performance indicators

9.4.1 The network performance indicator comparisons for the Preferred Transport Solution in 2030 are presented in Table 28.

Table 28. 2030 Network performance indicators – Preferred Transport Solution vs comparators

ID	WEST OF NODE J	EAST OF NODE J	TRANSIENT QUEUES (OVER CAPACITY IN BRACKETS) (PCU-HRS)	TOTAL TRAVEL TIME (PCU-HRS)	TOTAL TRAVEL DISTANCE (PCU-KMS)	FULL MODEL AVERAGE SPEED (KM/H)
AM Peak Hour						
1	Do-Minimum	Do-Minimum	75 (19)	1099	58411	53
9	Cyan	Yellow	85 (4)	1097	59815	55
13	Cyan	Green	84 (4)	1096	59750	55
14	Cyan & Black	Green	76 (8)	1082	59639	55
Inter-peak Hour						
1	Do-Minimum	Do-Minimum	69 (0)	928	49657	54
9	Cyan	Yellow	71 (3)	937	50739	54
13	Cyan	Green	71 (3)	936	50683	54
14	Cyan & Black	Green	68 (2)	925	50620	55
PM Peak Hour						
1	Do-Minimum	Do-Minimum	137 (11)	1063	51830	49
9	Cyan	Yellow	86 (3)	997	53666	54
13	Cyan	Green	86 (2)	996	53595	54
14	Cyan & Black	Green	82 (2)	984	53571	54

9.4.2 Compared to the Do-Minimum, all three options reduce travel times (PCU-HRS) but increase travel distance (PCU-KM, in all three time periods) as the bypass route is longer but faster. The switch from Green to Yellow (on-line improvements between) between model 9 and 13 reduces both journey time and travel distance. The addition of the Black design improves both journey time and travel distance even further.

9.4.3 The network performance indicators for 2045 are presented in Table 29. The same pattern holds in 2045 with faster journey times but longer distances in the three Do-Something options, improvements in travel distance between M9 and M13, and further improvements in both travel time and distance in M14, the Preferred Transport Solution.

Table 29. 2045 Network performance indicators – Preferred Transport Solution vs comparators

ID	WEST OF NODE J	EAST OF NODE J	TRANSIENT QUEUES (OVER CAPACITY IN BRACKETS) (PCU-HRS)	TOTAL TRAVEL TIME (PCU-HRS)	TOTAL TRAVEL DISTANCE (PCU-KMS)	FULL MODEL AVERAGE SPEED (KM/H)
AM Peak Hour						
1	Do-Minimum	Do-Minimum	97 (26)	1165	60480	52
9	Cyan	Yellow	87 (7)	1136	61987	55
13	Cyan	Green	87 (7)	1135	61921	55
14	Cyan & Black	Green	78 (8)	1118	61791	55
Inter-peak Hour						
1	Do-Minimum	Do-Minimum	78 (0)	968	51665	53
9	Cyan	Yellow	73 (3)	968	52795	55
13	Cyan	Green	73 (3)	967	52736	55
14	Cyan & Black	Green	69 (2)	956	52672	55
PM Peak Hour						
1	Do-Minimum	Do-Minimum	165 (17)	1123	53402	48
9	Cyan	Yellow	88 (33)	1024	55260	54
13	Cyan	Green	88 (3)	1023	55186	54
14	Cyan & Black	Green	84 (2)	1010	55169	55

9.5 Journey times

9.5.1 Journey times on the N4 and the bypass are compared in Table 30.

Table 30. 2030 N4 Journey time comparison – Preferred Transport Solution vs comparators

ID	WEST OF NODE J	EAST OF NODE J	N4 EB	N4 WB	N4 EB VIA BYPASS	N4 WB VIA BYPASS	EB DIFF WRT DM	WB DIFF WRT DM
AM Peak Hour								
1	Do-Minimum	Do-Minimum	1397	1264				
9	Cyan	Yellow	1359	1365	1071	1064	**-325**	**-200**
13	Cyan	Green	1352	1362	1065	1061	**-332**	**-203**
14	Cyan+Black	Green	1349	1373	1065	1061	**-332**	**-203**
Inter-peak Hour								
1	Do-Minimum	Do-Minimum	1332	1259				
9	Cyan	Yellow	1367	1348	1070	1063	**-263**	**-196**
13	Cyan	Green	1360	1345	1063	1060	**-270**	**-199**
14	Cyan+Black	Green	1357	1343	1063	1060	**-269**	**-199**
PM Peak Hour								
1	Do-Minimum	Do-Minimum	1560	1307				
9	Cyan	Yellow	1328	1309	1071	1065	**-489**	**-242**
13	Cyan	Green	1375	1372	1064	1062	**-495**	**-245**
14	Cyan+Black	Green	1382	1365	1064	1062	**-495**	**-245**

9.5.2 In 2030, the bypass route is faster for all three options than the N4 route in the Do-Minimum. The original N4 routes is slower in the options than in the Do-Minimum because of the demand management measures. These measures provide better opportunities for pedestrians to cross the road in the town centre.

9.5.3 The broad pattern of differences in 2030 holds for 2045, as can be seen in Table 31.

Table 31. 2045 N4 Journey time comparison – Preferred Transport Solution vs comparators

ID	WEST OF NODE J	EAST OF NODE J	N4 EB	N4 WB	N4 EB VIA BYPASS	N4 WB VIA BYPASS	EB DIFF WRT DM	WB DIFF WRT DM
AM Peak Hour								
1	Do-Minimum	Do-Minimum	1517	1267				
9	Cyan	Yellow	1361	1381	1071	1064	**-445**	**-204**
13	Cyan	Green	1354	1377	1065	1061	**-452**	**-207**
14	Cyan+Black	Green	1350	1377	1065	1061	**-452**	**-207**
Inter-peak Hour								
1	Do-Minimum	Do-Minimum	1357	1265				
9	Cyan	Yellow	1368	1349	1070	1063	**-287**	**-202**
13	Cyan	Green	1362	1346	1063	1060	**-294**	**-205**
14	Cyan+Black	Green	1359	1344	1063	1060	**-294**	**-205**
PM Peak Hour								
1	Do-Minimum	Do-Minimum	1590	1421				
9	Cyan	Yellow	1384	1378	1071	1065	**-519**	**-357**
13	Cyan	Green	1377	1375	1064	1062	**-525**	**-360**
14	Cyan+Black	Green	1384	1367	1065	1062	**-525**	**-360**

9.6 Traffic Flows across Shannon Bridge

9.6.1 AADT traffic flows across Shannon Bridge are presented in Table 32. The three options roughly halve the traffic on the bridge. The Preferred Transport Solution performs best on traffic reduction.

Table 32. 2030 AADT flows across Shannon Bridge – Preferred Transport Solution and comparators

ID	WEST OF NODE J	EAST OF NODE J	NORTHBOUND (PCU)	SOUTHBOUND (PCU)	TOTAL (PCU)
AM Peak Hour					
1	Do-Minimum	Do-Minimum	765	652	**1417**
9	Cyan	Yellow	387	343	**730**
13	Cyan	Green	387	343	**730**
14	Cyan & Black	Green	367	334	**701**
Inter-peak Hour					
1	Do-Minimum	Do-Minimum	677	684	**1361**
9	Cyan	Yellow	382	401	**783**
13	Cyan	Green	382	401	**783**
14	Cyan & Black	Green	370	394	**764**
PM Peak Hour					
1	Do-Minimum	Do-Minimum	722	742	**1464**
9	Cyan	Yellow	381	447	**828**
10	Cyan	Green	381	447	**828**
11	Cyan & Black	Green	367	427	**794**

9.6.2 Traffic flows across Shannon Bridge in 2045 are presented in Table 32. The three options roughly halve the traffic on the bridge and the Preferred Transport Solution performs best on traffic reduction.

Table 33. 2045 AADT flows across Shannon Bridge – Preferred Transport Solution and comparators

ID	WEST OF NODE J	EAST OF NODE J	NORTHBOUND (PCU)	SOUTHBOUND (PCU)	TOTAL (PCU)
AM Peak Hour					
1	Do-Minimum	Do-Minimum	765	671	1436
9	Cyan	Yellow	409	355	764
13	Cyan	Green	409	355	764
14	Cyan & Black	Green	384	347	731
Inter-peak Hour					
1	Do-Minimum	Do-Minimum	702	706	1408
9	Cyan	Yellow	386	407	794
13	Cyan	Green	386	407	794
14	Cyan & Black	Green	374	400	774
PM Peak Hour					
1	Do-Minimum	Do-Minimum	730	747	1477
9	Cyan	Yellow	389	450	839
10	Cyan	Green	389	450	839
11	Cyan & Black	Green	372	431	803

9.7 AADT

9.7.1 The Annual Average Daily Traffic (AADT) flows for 2030 presented in Table 34 were estimated from the model outputs using the factors described in section 7.5, at the locations presented in Figure 30. Negative numbers indicate a reduction in journey time compared to the existing N4 route in the Do-Minimum. Note that the following sites are omitted from the table because they are not included in any of the four options and therefore have zero flow: 31, 32, 34, 35, 36, 42.

Table 34. 2030 Annual Average Daily Traffic Flows by Location

ID	LOCATION	M1	M9	M13	M14
1	N4 Drumharlow	7935	8374	8375	8277
2	N4 Drumharlow	7935	8374	8375	8278
3	N4 Tumna	8446	3950	3950	3744
4	N4 Cloonman	8446	3950	3950	3744
5	N4 West of Station Road	12970	8170	8174	7992
6	N4 East of Station Road	16942	9619	9619	9293
7	N4 River Shannon Bridge	17383	10039	10039	9713
8	N4 Landmark	18147	9688	9677	9356
9	N4 West of Shannon Roundabout	17790	9081	9068	8740
10	N4 West of Attirory Roundabout	15895	10197	10203	8314
11	N4 East of Attirory Roundabout	14868	13016	12999	11274
12	N4 East of Castlecarra Road	11922	13366	13366	13929
13	N4 at Atiirory	10108	12471	12472	13003
14	N4 at Lisseeghan	10108	9006	9008	9301
15	N4 at Corbally	9409	9006	9008	9301
16	N4 at Tully	8079	9006	9008	9301
17	N4 at Mountcampbell	8079	9006	9008	9301
18	N4 West of Drumsna Junction	8079	9006	9008	9301
19	N4 East of Drumsna Junction	9049	9404	9407	9429
20	N4 East of R201 (Mohill Road)	6300	6572	6575	6575
21	N4 West of Aghamore	6387	6572	6575	6575
22	N4 East of Aghamroe	6384	6491	6494	6494
23	N4 West of Fearnaght Junction	6307	6491	6494	6494
24	N4 Faulties	6307	6491	6494	6494
25	Station Road	6703	3515	3515	3418
26	Bridge Street	5315	5596	5612	5533
27	Dublin Road	11688	10636	10613	8188
28	Circular Road	2940	1785	1799	1307
29	North Leg Attifinlay Roundabout	2354	3093	3077	2572
30	Castlecarra Road	6025	7246	7257	9494
33	New Bypass South (Mid)	-	7943	7944	8197
37	R280 north of Harltey Junction	6797	5607	5614	5924
38	R280 Ballynamony	5984	4794	4800	6105

ID	LOCATION	M1	M9	M13	M14
39	Summerhill Road	1375	1140	1125	2486
40	Summerhill Road	831	720	735	1043
41	Casltecarra Road at Keenaghan	3332	4550	4561	7302
43	Drumsna River Bridge	829	1655	1655	1627
44	Drumsna Road Overbridge	1565	2127	2128	1853
45	R299 North of Drumsna Junction	1821	2061	2061	1810
46	R299 West of L3431 Junction	1465	1706	1706	1454
47	R299 at Northern Edge of Study Area	3015	4055	4051	1193
48	R280 north of R299 Junction	8611	8607	8607	8653
49	R280 at Cartown	5984	4939	4943	7748
50	R201 East of Junction with N4	2823	2966	2966	2972
51	Antfield/Aghamore	1098	1099	1099	1099
52	Local Road West Aghamore	373	374	374	374
53	Local Road Fearnaght	216	131	168	168
54	N4 at Faulties	2572	2593	2595	2595
55	Mian Street	3262	4762	4774	4768
56	Summerhill Road	2259	2311	2285	1919
57	Leitrim Road	9031	7805	7807	5259
58	Shannon Grove West of junction with Leitrim Road	3195	2810	2812	2903
59	Shannon Grove	1839	1527	1525	1607
60	Hartley Court	-	152	149	141
61	Hartley Bridge	976	686	684	766
62	R370 West of R368 Junction	2473	2262	2265	2285
63	R368 South of R370 Junction	2633	3323	3325	3307
64	Adjacent to East Bypass Junction	-	7943	7944	8197
65	Adjacent to West Bypass Junction	-	4996	4996	5103
66	Link Road	-	3984	3987	4131

9.7.2 Annual average daily traffic flows for 2045 are presented in Table 35. .

Table 35. 2045 Annual Average Daily Traffic Flows by Location

ID	LOCATION	M1	M9	M13	M14
1	N4 Drumharlow	8,284	8,815	8,815	8,722
2	N4 Drumharlow	8,284	8,815	8,815	8,721
3	N4 Tumna	8,791	4,174	4,175	3,935
4	N4 Cloonman	8,791	4,174	4,175	3,935
5	N4 West of Station Road	13,200	8,264	8,264	8,078
6	N4 East of Station Road	17,088	9,710	9,710	9,374
7	N4 River Shannon Bridge	17,515	10,125	10,125	9,787
8	N4 Landmark	18,314	9,766	9,767	9,390
9	N4 West of Shannon Roundabout	17,924	9,130	9,130	8,745
10	N4 West of Attirory Roundabout	15,949	10,117	10,117	8,289
11	N4 East of Attirory Roundabout	15,021	13,036	13,037	11,282
12	N4 East of Castlecarra Road	11,999	13,427	13,428	14,010
13	N4 at Atiirory	10,193	12,571	12,571	13,108
14	N4 at Lisseeghan	10,193	9,098	9,099	9,364
15	N4 at Corbally	9,491	9,098	9,099	9,364
16	N4 at Tully	8,144	9,098	9,099	9,364
17	N4 at Mountcampbell	8,144	9,098	9,099	9,364
18	N4 West of Drumsna Junction	8,144	9,098	9,099	9,364
19	N4 East of Drumsna Junction	9,131	9,525	9,530	9,553
20	N4 East of R201 (Mohill Road)	6,371	6,668	6,672	6,672
21	N4 West of Aghamore	6,458	6,668	6,672	6,672
22	N4 East of Aghamroe	6,455	6,587	6,591	6,591
23	N4 West of Fearnaght Junction	6,377	6,587	6,591	6,591
24	N4 Faulties	6,377	6,587	6,591	6,591
25	Station Road	6,728	3,524	3,524	3,429
26	Bridge Street	5,260	5,643	5,643	5,566
27	Dublin Road	11,661	10,588	10,588	8,207
28	Circular Road	2,956	1,811	1,812	1,299
29	North Leg Attifinlay Roundabout	2,344	3,094	3,094	2,585
30	Castlecarra Road	6,105	7,317	7,317	9,500
33	New Bypass South (Mid)	-	8,177	8,177	8,450
37	R280 north of Harltey Junction	6,715	5,601	5,601	5,925
38	R280 Ballynamony	5,900	4,784	4,784	6,108

ID	LOCATION	M1	M9	M13	M14
39	Summerhill Road	1,378	1,134	1,134	2,506
40	Summerhill Road	834	725	725	1,045
41	Casltecarra Road at Keenaghan	3,408	4,618	4,618	7,311
43	Drumsna River Bridge	848	1,667	1,665	1,640
44	Drumsna Road Overbridge	1,567	2,138	2,140	1,896
45	R299 North of Drumsna Junction	1,842	2,086	2,088	1,866
46	R299 West of L3431 Junction	1,486	1,729	1,731	1,508
47	R299 at Northern Edge of Study Area	3,097	4,131	4,131	1,251
48	R280 north of R299 Junction	8,609	8,682	8,682	8,727
49	R280 at Cartown	5,900	4,937	4,937	7,766
50	R201 East of Junction with N4	2,838	2,993	2,995	3,001
51	Antfield/Aghamore	1,101	1,101	1,101	1,101
52	Local Road West Aghamore	375	375	375	375
53	Local Road Fearnaght	219	133	171	171
54	N4 at Faulties	2,584	2,612	2,614	2,615
55	Mian Street	3,217	4,745	4,745	4,784
56	Summerhill Road	2,266	2,306	2,306	1,927
57	Leitrim Road	8,976	7,805	7,805	5,284
58	Shannon Grove West of junction with Leitrim Road	3,226	2,805	2,805	2,899
59	Shannon Grove	1,871	1,526	1,526	1,604
60	Hartley Court	-	157	157	142
61	Hartley Bridge	1,012	691	691	768
62	R370 West of R368 Junction	2,490	2,276	2,276	2,303
63	R368 South of R370 Junction	2,650	3,341	3,341	3,326
64	Adjacent to East Bypass Junction	-	8,177	8,177	8,450
65	Adjacent to West Bypass Junction	-	5,235	5,235	5,357
66	Link Road	-	4,014	4,014	4,163

10. SUMMARY AND CONCLUSIONS

10.1.1 A Local Area Model (LAM) of traffic has been built to examine options for addressing traffic problems in the corridor of the N4 between Carrick-On-Shannon and Dromond. Carrick-on-Shannon has become a bottleneck for strategic traffic, with long delays experienced during peak periods. One of the primary contributors to this bottleneck is the bridge crossing over the River Shannon in the centre of the town, with junctions at either side of the bridge. The nearest alternative crossings are some distance away requiring diversions of 20km to the east and 12 km to the west.

10.1.2 The development of the traffic model in Stage 2 of the study follows on from Stage 1, which examined various alternatives to road improvements including rail improvements, bus improvements and improvements for active travel including cycle lanes and traffic management measures.

10.1.3 The LAM was built from the National Transport Authority's (NTA) West Regional Model (WRM). It was developed using SATURN strategic modelling software. The WRM road network for the SATURN model was refined to add detail in the study area around Carrick-On-Shannon. More minor roads have been added to the network to better capture local traffic. The network representation within the study area has switched to SATURN's more detailed form that models each turning movement from each lane at a junction.

10.1.4 The zoning structure of the LAM was also refined from the WRM. The WRM zonal structure is based on the CSO Electoral Divisions (ED) boundaries with each zone containing one or more ED. These zones have been refined based on the CSO small area boundary system, to provide consistent boundaries with the WRM zones and allow demographic data to be linked to each LAM zone.

10.1.5 Initial travel demand matrices for the LAM were developed from the WRM and updated with data gathered for the new model. However, the timescales for the study meant that data had to be gathered during a period when traffic was affected by COVID restrictions. It is anticipated that the model will be refreshed with new data for Phase 3 of the scheme assessment.

10.1.6 The newly gathered data including registration plate matching surveys to help refresh the trip matrices and traffic count data and journey time data to assist with the calibration and validation of the model. At the same time, data were gathered on pedestrian and cycling movements that have been used in the scheme appraisal, but they are not relevant to the SATURN highway model.

10.1.7 The models were calibrated using matrix estimation and validated against an independent count set and against journey times on the N4, stretching the full length of the proposed options. The fit to counts was excellent for both the calibration and validation count sets, achieving at least 95% of flows within GEH = 5 (GEH is explained in 4.3.8) in every time period, which exceeds the target of 85%.

10.1.8 The fit to journey times was also good, meeting the target for the full route in both directions in all three time periods. There was no systematic bias. In three cases the model was slightly faster than the observed data and in the other three cases it was slightly slower. The route was split into 3 sections and there were a few cases where the modelled time was just outside

the target of /-15% of the observed journey time. This happened in 4 out of the 18 combinations of time period, route section and direction. In two of those cases the difference was 16%, so only just outside the target. In the other two cases the difference was 20%, so it was outside the target range but not by much.

10.1.9 Future year models have been developed for 2030 and 2045 for testing options against a Do-Minimum option. Matrix growth was supplied by TII based on National Planning Framework population and employment projections which were developed by the Economic and Social Research Institute (ESRI). The options have been assessed on the central growth scenario.

10.1.10 The future year matrices have been assessed for plausibility for changes to the trip length distribution and for trip-end growth and zone-to-zone growth. The trip length does not change much but lengthens slightly. The trip end and zone-to-zone growth is fairly uniform except for a few outliers that represent committed developments making step changes in trip making.

10.1.11 The LAM has been built following the guidance in PAG. It has been shown to produce a good fit to observed data for the base year and the forecast year growth has been shown to be plausible. The LAM is therefore considered fit for the purpose of making forecasts that can feed into the Project Assessment Matrix (PAM) for options for the N4.

10.1.12 A set of options were tested in the LAM. They included single and dual carriageway cross-sections for bypassing Carrick-on-Shannon, providing a new river crossing either to the north or the south of the existing Shannon Bridge. They also included single and dual carriageway options for the section between Drumsna and Dromond. The options tested and the modelling results are described in Chapter 9.

10.1.13 The multi-criteria analysis in PAM has considered many facets including economic benefits for the options, which are reported in the Cost Benefit Analysis Report. The metrics in this traffic modelling report (network performance indicators, journey times, traffic flows across the Shannon Bridge) fed into the assessment.

10.1.14 A Preferred Transport Solution was developed taking elements of various different options tested. The modelling results for the Preferred Transport Solution are presented in Chapter 9. The Preferred Transport Solution is a single carriageway design crossing the Shannon to the south of the current bridge. It performed better on value for money (see CBA report) than any of the other options but did not provide quite so much relief to Shannon Bridge as some of the other more expensive dual carriageway options.

APPENDIX A

AM											
Count Site			Network Location								
Concat	Site	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFFERENCE	GEH
50131_50233_84642	JTC 1	1	50131	50233	84642	133	137	696	4	2.94	0.34
50232_50233_50131	JTC 1	2	50232	50233	50131	5	0	541	-4	-100	3.16
50232_50233_84642	JTC 1	3	50232	50233	84642	127	105	896	-21	-17.17	2.02
84642_50233_50131	JTC 1	4	84642	50233	50131	94	91	690	-2	-3.7	0.36
84642_50233_50232	JTC 1	5	84642	50233	50232	90	72	1095	-17	-20.4	2.04
72216_73176_50228	JTC 2	6	72216	73176	50228	45	25	224	-19	-44.81	3.41
72216_73176_60124	JTC 2	7	72216	73176	60124	342	403	602	61	17.88	3.17
50228_73176_72216	JTC 2	8	50228	73176	72216	66	34	296	-31	-49.1	4.59
50228_73176_60124	JTC 2	9	50228	73176	60124	246	262	525	16	6.67	1.03
60124_73176_72216	JTC 2	10	60124	73176	72216	303	381	548	78	25.71	4.21
60124_73176_50228	JTC 2	11	60124	73176	50228	176	191	359	15	8.57	1.11
60129_50111_50120	JTC 3	12	60129	50111	50120	62	67	255	5	8.85	0.68
60129_50111_60012	JTC 3	13	60129	50111	60012	72	80	268	8	11.44	0.94
50120_50111_60012	JTC 3	14	50120	50111	60012	555	642	687	87	15.59	3.54
60012_50111_60129	JTC 3	15	60012	50111	60129	43	46	198	3	6.68	0.43
60012_50111_50120	JTC 3	16	60012	50111	50120	423	524	675	101	23.77	4.62
60072_50124_50123	JTC 4	17	60072	50124	50123	118	141	179	23	19.11	1.98
60072_50124_72093	JTC 4	18	60072	50124	72093	438	463	524	25	5.75	1.19
72093_50124_50123	JTC 4	19	72093	50124	50123	397	421	944	24	6.03	1.18
60064_50104_72831	JTC 5	20	60064	50104	72831	9	11	240	2	22.22	0.63
72831_50104_60010	JTC 5	21	72831	50104	60010	563	633	1782	70	12.45	2.87
60010_50104_60064	JTC 5	22	60010	50104	60064	12	14	682	2	19.8	0.65
60010_50104_72831	JTC 5	23	60010	50104	72831	483	551	1778	68	14.04	2.98
50080_50079_60058	JTC 6	24	50080	50079	60058	24	18	734	-5	-26.4	1.39
50080_50079_60073	JTC 6	25	50080	50079	60073	363	388	1709	25	6.75	1.27
60058_50079_50080	JTC 6	26	60058	50079	50080	31	33	513	2	6.36	0.35
60058_50079_60073	JTC 6	27	60058	50079	60073	109	111	462	2	1.96	0.2
60073_50079_50080	JTC 6	28	60073	50079	50080	144	165	1782	21	14.71	1.7
60073_50079_60058	JTC 6	29	60073	50079	60058	44	46	1152	2	4.87	0.32
50082_50129_60051	JTC 7	30	50082	50129	60051	107	109	675	2	1.91	0.2
50126_50129_50082	JTC 7	31	50126	50129	50082	36	25	549	-10	-31.5	2.06
50126_50129_60051	JTC 7	32	50126	50129	60051	158	168	693	10	6.43	0.8
60051_50129_50082	JTC 7	33	60051	50129	50082	53	76	750	23	43.45	2.87
50098_50103_0	JTC 8	34	50098	50103	0	240	257	692	17	7.12	1.08
50099_50098_0	JTC 8	35	50099	50098	0	100	105	1900	5	5.48	0.54
50101_72945_0	JTC 8	36	50101	72945	0	269	295	832	26	9.7	1.55
50100_50101_0	JTC 8	37	50100	50101	0	545	577	1900	32	5.81	1.34
50102_72987_0	JTC 8	38	50102	72987	0	580	645	1766	65	11.28	2.64
50096_50102_0	JTC 8	39	50096	50102	0	496	565	1900	69	13.97	3.01
50097_50095_0	JTC 8	40	50097	50095	0	499	537	1724	38	7.7	1.69
73206_50097_0	JTC 8	41	73206	50097	0	447	488	1900	41	9.08	1.88
50236_50091_0	JTC 9	42	50236	50091	0	434	488	959	54	12.35	2.5
50085_50236_0	JTC 9	43	50085	50236	0	493	537	1900	44	9.01	1.96
50235_50093_0	JTC 9	44	50235	50093	0	620	658	1003	38	6.06	1.49
50094_50235_0	JTC 9	45	50094	50235	0	504	556	1900	52	10.26	2.25
60003_71988_50154	JTC 10	46	60003	71988	50154	52	28	421	-23	-46.14	3.79
50148_71988_60003	JTC 10	47	50148	71988	60003	155	157	359	2	1.3	0.16
50148_71988_50154	JTC 10	48	50148	71988	50154	313	350	551	37	11.7	2.01
50154_71988_50148	JTC 10	49	50154	71988	50148	441	463	584	22	5.02	1.04
50272_72663_73077	Site 13	50	50272	72663	73077	125	129	435	4	3.45	0.38
73077_72663_50272	Site 13	51	73077	72663	50272	106	119	750	13	11.84	1.18
73077_72663_50241	JTC 15	52	73077	72663	50241	224	269	1567	45	20.29	2.89
50241_72663_73077	JTC 15	53	50241	72663	73077	214	268	1686	54	25.32	3.49
50501_50265_50262	JTC 16	54	50501	50265	50262	208	249	1836	41	19.79	2.72
50262_50265_50501	JTC 16	55	50262	50265	50501	181	233	1751	52	28.56	3.59
50265_50262_50502	JTC 17	56	50265	50262	50502	238	279	1782	41	17.2	2.55
50502_50262_50265	JTC 17	57	50502	50262	50265	206	257	1793	51	24.85	3.36
60067_50115_50112	JTC 18	58	60067	50115	50112	107	108	710	1	0.84	0.09
60067_50115_50114	JTC 18	59	60067	50115	50114	10	19	541	9	90.03	2.36
50114_50115_50112	JTC 18	60	50114	50115	50112	48	35	944	-12	-27.14	2.02
50115_50112_60129	JTC 19	61	50115	50112	60129	130	143	944	13	9.9	1.1
60129_50112_50113	JTC 19	62	60129	50112	50113	80	82	944	2	2.33	0.21
60065_50117_50105	JTC 21	63	60065	50117	50105	7	9	729	2	28.96	0.72
50105_50117_60065	JTC 21	64	50105	50117	60065	16	6	684	-9	-62.89	3.04
60120_50508_0	JTC 22	65	60120	50508	0	18	23	794	5	28.18	1.12
50246_60120_0	JTC 22	66	50246	60120	0	38	32	1900	-5	-15.77	1.01
72993_50507_0	JTC 22	67	72993	50507	0	346	392	1064	46	13.3	2.4
50506_72993_0	JTC 22	68	50506	72993	0	304	372	1900	68	22.31	3.69
50511_60118_0	JTC 22	69	50511	60118	0	40	16	1900	-23	-59.99	4.53
72216_50510_0	JTC 22	70	72216	50510	0	347	415	1098	68	19.45	3.46
50509_72216_0	JTC 22	71	50509	72216	0	361	428	1900	67	18.56	3.37
50231_50230_72993	JTC 23	72	50231	50230	72993	310	373	1675	63	20.25	3.4
72993_50230_50231	JTC 23	73	72993	50230	50231	248	329	1707	81	32.55	4.75
50145_50231_50230	JTC 24	74	50145	50231	50230	309	361	1672	52	16.78	2.83
50230_50231_50145	JTC 24	75	50230	50231	50145	236	299	1707	63	26.84	3.87
50230_50231_60017	JTC 24	76	50230	50231	60017	17	31	994	14	81.69	2.84
60007_50076_50075	JTC 25	77	60007	50076	50075	87	91	918	4	5.09	0.47
50075_50076_50078	JTC 25	78	50075	50076	50078	18	22	1040	4	20.66	0.83
50075_50076_60007	JTC 25	79	50075	50076	60007	132	133	1863	1	0.73	0.08

AM											
Count Site			Network Location								
Concat	Site	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFFERENCE	GEH
60079_50075_50076	JTC 26	80	60079	50075	50076	136	140	1897	4	3.13	0.36
50076_50075_60079	JTC 26	81	50076	50075	60079	94	99	1883	5	4.82	0.46
50303_72276_50302	JTC 27	82	50303	72276	50302	320	372	1290	52	16.14	2.78
50303_72276_50304	JTC 27	83	50303	72276	50304	131	142	770	11	8.54	0.96
50302_72276_50303	JTC 27	84	50302	72276	50303	143	162	1352	19	13.53	1.57
50304_72276_50303	JTC 27	85	50304	72276	50303	102	111	425	9	8.43	0.83
50072_50071_60079	JTC 28	86	50072	50071	60079	73	75	1064	2	2.72	0.23
50072_50071_50069	JTC 28	87	50072	50071	50069	60	70	1771	10	16.74	1.25
60079_50071_50072	JTC 28	88	60079	50071	50072	61	64	684	3	4.33	0.33
60079_50071_50069	JTC 28	89	60079	50071	50069	31	33	592	2	5.34	0.29
50069_50071_50072	JTC 28	90	50069	50071	50072	50	57	1812	7	14.13	0.97
50069_50071_60079	JTC 28	91	50069	50071	60079	58	60	1261	2	3.85	0.29
50241_50044_50043	JTC 32	92	50241	50044	50043	223	269	1686	46	20.83	2.96
50043_50044_50241	JTC 32	93	50043	50044	50241	214	268	1688	54	25.32	3.49
50044_50043_50520	JTC 33	94	50044	50043	50520	232	278	1686	46	19.8	2.88
50042_50043_50044	JTC 33	95	50042	50043	50044	3	5	616	2	67.01	1
50520_50043_50044	JTC 33	96	50520	50043	50044	207	264	1686	57	27.39	3.7
50174_71973_50271	JTC 34	97	50174	71973	50271	236	271	1697	35	14.85	2.2
50174_71973_50002	JTC 34	98	50174	71973	50002	4	8	983	4	99.35	1.62
50271_71973_50174	JTC 34	99	50271	71973	50174	192	244	1683	52	27.28	3.55
50002_71973_50174	JTC 34	100	50002	71973	50174	5	9	439	4	85.59	1.6
71973_50271_0	ATC 16	101	71973	50271	0	236	274	1686	38	16.13	2.38
50271_71973_0	ATC 16	102	50271	71973	0	197	248	1686	51	25.64	3.39
50032_50279_0	JTC 35	103	50032	50279	0	69	71	1900	2	2.84	0.23
50279_50032_0	JTC 35	104	50279	50032	0	68	74	1807	6	9.29	0.75
50276_50275_0	JTC 35	105	50276	50275	0	129	179	1686	50	38.68	4.02
50275_50276_0	JTC 35	106	50275	50276	0	169	202	1686	33	19.58	2.43
50503_50174_71973	JTC 36	107	50503	50174	71973	235	279	1691	44	18.73	2.75
71973_50174_50503	JTC 36	108	71973	50174	50503	201	254	1686	53	26.2	3.49
50155_50161_71808	JTC 37	109	50155	50161	71808	276	317	1650	41	14.75	2.36
71808_50161_50155	JTC 37	110	71808	50161	50155	399	442	1687	43	10.71	2.08
50048_50047_50046	JTC 38	111	50048	50047	50046	326	384	1900	58	17.73	3.07
50046_50047_50048	JTC 38	112	50046	50047	50048	335	396	1686	61	18.13	3.18
50137_50139_50142	JTC 39	113	50137	50139	50142	297	349	1686	52	17.46	2.89
50142_50139_50137	JTC 39	114	50142	50139	50137	230	291	1689	61	26.74	3.81
50244_50053_50055	JTC 41	115	50244	50053	50055	7	7	1101	0	-3.21	0.09
50055_50053_50244	JTC 41	116	50055	50053	50244	29	15	705	-13	-49.88	3.1
71988_50154_50155	JTC 44	117	71988	50154	50155	264	334	1636	70	26.38	4.03
50155_50154_71988	JTC 44	118	50155	50154	71988	407	451	1681	44	10.72	2.11
71988_50148_60037	JTC 45	119	71988	50148	60037	26	29	770	3	11.71	0.58
60051_50084_60041	JTC 46	120	60051	50084	60041	172	183	607	11	6.43	0.83
60041_50084_60051	JTC 46	121	60041	50084	60051	77	70	688	-6	-8.57	0.77
50140_50137_50139	JTC 47	122	50140	50137	50139	290	349	1686	59	20.3	3.29
50136_50137_50140	JTC 47	123	50136	50137	50140	2	0	602	-1	-100	2
50139_50137_50140	JTC 47	124	50139	50137	50140	229	291	1686	62	27.29	3.87
50139_50137_50136	JTC 47	125	50139	50137	50136	1	0	954	0	-100	0
50119_50123_50237	JTC 48	126	50119	50123	50237	15	13	944	-1	-11.34	0.45
50124_50123_50237	JTC 48	127	50124	50123	50237	344	369	828	25	7.37	1.34
50124_50123_50119	JTC 48	128	50124	50123	50119	161	192	482	31	19.34	2.34
50226_50237_60072	JTC 49	129	50226	50237	60072	80	98	612	18	22.15	1.88
50123_50237_50226	JTC 49	130	50123	50237	50226	106	111	547	5	4.98	0.51
50123_50237_60072	JTC 49	131	50123	50237	60072	250	271	908	21	8.54	1.32
60073_60072_50124	JTC 50	132	60073	60072	50124	471	500	1792	29	6.09	1.3
50237_60072_60073	JTC 50	133	50237	60072	60073	227	265	570	38	16.75	2.42
50237_60072_50124	JTC 50	134	50237	60072	50124	84	104	281	20	23.86	2.07
50137_50140_0	ATC 1	135	50137	50140	0	322	291	1686	-30	-9.47	1.74
50131_50132_0	ATC 2	136	50131	50132	0	100	91	1792	-8	-8.54	0.87
50130_50232_0	ATC 3	137	50130	50232	0	124	106	1328	-17	-14.41	1.67
60124_50122_0	ATC 4	138	60124	50122	0	625	680	1792	55	8.77	2.15
50104_72831_0	ATC 5	139	50104	72831	0	660	562	1792	-97	-14.88	3.97
60058_50210_0	ATC 6	140	60058	50210	0	26	21	1792	-4	-19.38	1.04
50236_50097_0	ATC 7	141	50236	50097	0	457	537	1680	80	17.6	3.61
50080_50073_0	ATC 8	142	50080	50073	0	157	165	1680	8	5.22	0.65
50161_71808_0	ATC 9	143	50161	71808	0	321	319	1686	-1	-0.62	0.11
73137_50253_0	ATC 10	144	73137	50253	0	188	311	1686	123	65.34	7.78
50177_50049_0	ATC 11	145	50177	50049	0	54	74	711	20	37.28	2.52
50244_50053_0	ATC 12	146	50244	50053	0	71	53	1749	-17	-24.71	2.22
50047_50048_0	ATC 13	147	50047	50048	0	266	396	1686	130	48.77	7.13
50045_60108_0	ATC 14	148	50045	60108	0	116	119	1305	3	2.65	0.28
50043_50520_0	ATC 15	149	50043	50520	0	233	278	1686	45	19.29	2.81
50070_50307_0	ATC 17	150	50070	50307	0	64	32	896	-31	-49.96	4.61
50183_50182_0	ATC 18	151	50183	50182	0	31	22	1897	-8	-28.93	1.74
50140_50137_0	ATC 1	152	50140	50137	0	270	349	1686	79	29.21	4.48
50132_50131_0	ATC 2	153	50132	50131	0	86	137	896	51	59.55	4.85
50232_50130_0	ATC 3	154	50232	50130	0	76	72	1328	-3	-5.33	0.47
50122_60124_0	ATC 4	155	50122	60124	0	547	591	1738	44	7.98	1.83
72831_50104_0	ATC 5	156	72831	50104	0	574	676	1792	102	17.81	4.09
50210_60058_0	ATC 6	157	50210	60058	0	60	95	1792	35	58.45	3.98
50097_50236_0	ATC 7	158	50097	50236	0	522	488	1680	-33	-6.59	1.53

AM											
Count Site			Network Location								
Concat	Site	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFFERENCE	GEH
50073_50080_0	ATC 8	159	50073	50080	0	339	379	1680	40	11.93	2.13
71808_50161_0	ATC 9	160	71808	50161	0	431	446	1686	15	3.59	0.74
50253_73137_0	ATC 10	161	50253	73137	0	345	392	1686	47	13.71	2.46
50049_50177_0	ATC 11	162	50049	50177	0	44	24	1854	-19	-45.33	3.42
50053_50244_0	ATC 12	163	50053	50244	0	119	101	1900	-17	-15.38	1.75
50048_50047_0	ATC 13	164	50048	50047	0	369	384	1900	15	4.01	0.76
60108_50045_0	ATC 14	165	60108	50045	0	140	138	1847	-1	-1.56	0.19
50520_50043_0	ATC 15	166	50520	50043	0	273	264	1686	-8	-3.41	0.57
50307_50070_0	ATC 17	167	50307	50070	0	100	59	896	-40	-41.21	4.62
50182_50183_0	ATC 18	168	50182	50183	0	21	6	1250	-14	-71.1	4.06

IP											
Count Site			Network Location								
Concat	Site	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFFERENCE	GEH
50002_71973_50174	JTC 34	1	50002	71973	50174	4	5	460	1	25.07	0.47
50002_71973_50271	JTC 34	2	50002	71973	50271	2	3	627	1	49.88	0.63
50024_50265_50262	JTC 16	3	50024	50265	50262	23	25	619	2	9.09	0.43
50032_50279_0	JTC 35	4	50032	50279	0	51	58	1900	7	13.82	0.95
50040_50262_50502	JTC 17	5	50040	50262	50502	2	3	448	1	35.25	0.46
50043_50044_50241	JTC 32	6	50043	50044	50241	178	235	1703	57	32.01	3.96
50044_50043_50520	JTC 33	7	50044	50043	50520	174	233	1686	59	33.63	4.1
50046_50047_50048	JTC 38	8	50046	50047	50048	253	315	1686	62	24.56	3.69
50047_50048_50242	JTC 31	9	50047	50048	50242	253	315	1686	62	24.56	3.69
50048_50047_50046	JTC 38	10	50048	50047	50046	258	324	1900	66	25.69	3.89
50050_71808_0	JTC 29	11	50050	71808	0	230	278	1686	48	20.87	3.01
50050_71808_50161	JTC 11	12	50050	71808	50161	228	276	1689	48	21.05	3.02
50053_50244_72321	JTC 40	13	50053	50244	72321	49	66	1900	17	34.09	2.21
50054_50053_50055	JTC 41	14	50054	50053	50055	3	0	1262	-2	-100	2.45
50054_50053_50244	JTC 41	15	50054	50053	50244	40	56	1900	16	39.17	2.27
50055_50053_50054	JTC 41	16	50055	50053	50054	1	0	589	0	-100	0
50055_50053_50244	JTC 41	17	50055	50053	50244	9	10	721	1	11.53	0.34
50069_50071_50072	JTC 28	18	50069	50071	50072	28	36	1861	8	28.99	1.43
50069_50071_60079	JTC 28	19	50069	50071	60079	25	27	1275	2	6.89	0.34
50072_50071_50069	JTC 28	20	50072	50071	50069	32	46	1812	14	45.15	2.31
50072_50071_60079	JTC 28	21	50072	50071	60079	47	53	1120	6	13.13	0.87
50075_50076_60007	JTC 25	22	50075	50076	60007	76	84	1895	8	10.41	0.88
50076_50075_60079	JTC 26	23	50076	50075	60079	96	102	1890	6	6.23	0.6
50078_50076_50075	JTC 25	24	50078	50076	50075	7	8	683	1	18.32	0.46
50078_50076_60007	JTC 25	25	50078	50076	60007	12	13	562	1	8.23	0.28
50080_50079_60058	JTC 6	26	50080	50079	60058	16	16	810	0	1.77	0.07
50080_50079_60073	JTC 6	27	50080	50079	60073	199	212	1762	13	6.73	0.93
50082_50129_60051	JTC 7	28	50082	50129	60051	76	78	723	2	2.65	0.23
50089_50088_0	JTC 9	29	50089	50088	0	80	82	660	2	2.87	0.26
50096_50102_0	JTC 8	30	50096	50102	0	498	562	1900	64	12.88	2.79
50097_50095_0	JTC 8	31	50097	50095	0	551	605	1963	54	9.77	2.24
50098_50103_0	JTC 8	32	50098	50103	0	111	117	633	6	5.78	0.6
50100_50101_0	JTC 8	33	50100	50101	0	518	541	1900	23	4.42	0.99
50101_72945_0	JTC 8	34	50101	72945	0	270	281	796	11	4.06	0.66
50102_72987_0	JTC 8	35	50102	72987	0	674	746	1898	72	10.7	2.71
50105_50117_50118	JTC 21	36	50105	50117	50118	38	31	1013	-6	-19.57	1.27
50105_50117_60065	JTC 21	37	50105	50117	60065	19	10	628	-8	-46.05	2.29
50114_50115_50112	JTC 18	38	50114	50115	50112	195	136	944	-58	-30.18	4.57
50115_50112_60129	JTC 19	39	50115	50112	60129	304	309	944	5	1.73	0.3
50120_50111_60012	JTC 3	40	50120	50111	60012	481	551	658	70	14.65	3.1
50123_50237_50226	JTC 49	41	50123	50237	50226	93	98	483	5	5.57	0.53
50123_50237_60072	JTC 49	42	50123	50237	60072	316	336	899	20	6.4	1.12
50124_50123_50119	JTC 48	43	50124	50123	50119	224	230	473	6	2.53	0.38
50124_50123_50237	JTC 48	44	50124	50123	50237	373	397	782	24	6.53	1.24
50126_50129_50082	JTC 7	45	50126	50129	50082	34	35	664	1	3.15	0.18
50126_50129_60051	JTC 7	46	50126	50129	60051	59	63	692	4	7.08	0.53
50131_50233_84642	JTC 1	47	50131	50233	84642	76	81	701	5	6.65	0.57
50137_50139_50142	JTC 39	48	50137	50139	50142	223	277	1686	54	24.24	3.42
50139_50137_50140	JTC 47	49	50139	50137	50140	213	276	1686	63	29.5	4.02
50140_50137_50139	JTC 47	50	50140	50137	50139	222	277	1686	55	24.8	3.49
50142_50139_50137	JTC 39	51	50142	50139	50137	220	276	1689	56	25.38	3.55
50145_50231_50230	JTC 24	52	50145	50231	50230	231	281	1672	50	21.56	3.11
50145_50231_60017	JTC 24	53	50145	50231	60017	3	8	955	5	165.08	2.12
50148_71988_50154	JTC 10	54	50148	71988	50154	323	372	557	49	15.2	2.63
50148_71988_60003	JTC 10	55	50148	71988	60003	168	172	357	4	2.46	0.32
50154_71988_50148	JTC 10	56	50154	71988	50148	320	363	630	43	13.34	2.31
50154_71988_60003	JTC 10	57	50154	71988	60003	55	49	316	-5	-11.32	0.86
50155_50154_71988	JTC 44	58	50155	50154	71988	270	319	1687	49	18.33	2.88
50155_50161_71808	JTC 37	59	50155	50161	71808	283	331	1645	48	16.98	2.74
50161_71808_50050	JTC 11	60	50161	71808	50050	239	286	1640	47	19.82	2.92
50168_50300_60106	JTC 30	61	50168	50300	60106	33	31	1895	-1	-5.66	0.33
50170_50300_60106	JTC 30	62	50170	50300	60106	12	0	618	-11	-100	4.9
50174_71973_50002	JTC 34	63	50174	71973	50002	4	4	1008	0	1.45	0.03
50174_71973_50271	JTC 34	64	50174	71973	50271	170	227	1694	57	33.55	4.05
50226_50237_60072	JTC 49	65	50226	50237	60072	108	108	580	0	-0.36	0.04
50228_73176_60124	JTC 2	66	50228	73176	60124	160	173	470	13	8.19	1.02
50228_73176_72216	JTC 2	67	50228	73176	72216	62	45	342	-16	-27.03	2.29
50230_50231_50145	JTC 24	68	50230	50231	50145	225	285	1702	60	26.64	3.75
50230_50231_60017	JTC 24	69	50230	50231	60017	16	20	989	4	24.46	0.92
50231_50230_72993	JTC 23	70	50231	50230	72993	235	291	1667	56	23.69	3.43
50232_50233_84642	JTC 1	71	50232	50233	84642	100	96	896	-3	-4.35	0.44
50237_60072_50124	JTC 50	72	50237	60072	50124	116	122	286	6	5.24	0.56
50237_60072_60073	JTC 50	73	50237	60072	60073	299	322	567	23	7.61	1.29
50241_50044_50043	JTC 32	74	50241	50044	50043	175	231	1686	56	32.2	3.95
50241_72663_50272	Site 32	75	50241	72663	50272	2	0	942	-1	-100	2
50241_72663_73077	JTC 15	76	50241	72663	73077	176	235	1686	59	33.51	4.11
50242_50048_50047	JTC 31	77	50242	50048	50047	260	321	1686	61	23.45	3.58
50244_50053_50054	JTC 41	78	50244	50053	50054	37	47	1873	10	26.95	1.54
50244_50053_50055	JTC 41	79	50244	50053	50055	15	16	1125	1	9.39	0.36

IP											
Count Site			Network Location								
Concat	Site	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFFERENCE	GEH
50244_72321_72825	JTC 42	80	50244	72321	72825	63	80	1900	17	27.46	2.04
50246_60120_0	JTC 22	81	50246	60120	0	125	127	1900	2	1.81	0.2
50253_72426_72969	JTC 12	82	50253	72426	72969	210	259	1659	49	23.4	3.21
50253_73137_0	ATC 10	83	50253	73137	0	226	275	1686	49	21.66	3.09
50262_50265_50024	JTC 16	84	50262	50265	50024	21	23	1011	2	9.25	0.41
50262_50265_50501	JTC 16	85	50262	50265	50501	163	223	1769	60	36.67	4.3
50265_50262_50040	JTC 17	86	50265	50262	50040	10	11	1006	1	10.16	0.31
50265_50262_50502	JTC 17	87	50265	50262	50502	173	232	1781	59	34.18	4.15
50270_71808_50161	JTC 11	88	50270	71808	50161	37	40	610	3	7.13	0.43
50271_71973_0	ATC 16	89	50271	71973	0	176	235	1686	59	33.63	4.13
50271_71973_50174	JTC 34	90	50271	71973	50174	172	231	1682	59	34.39	4.17
50272_72663_50241	#N/A	91	50272	72663	50241	2	0	518	-1	-100	2
50272_72663_73077	#N/A	92	50272	72663	73077	77	83	460	6	7.76	0.67
50273_72825_72321	JTC 13	93	50273	72825	72321	43	51	731	8	17.91	1.13
50273_72825_72969	JTC 13	94	50273	72825	72969	20	19	699	0	-6.47	0.29
50275_50276_0	JTC 35	95	50275	50276	0	129	179	1686	50	38.79	4.03
50276_50275_0	JTC 35	96	50276	50275	0	127	179	1686	52	41.26	4.23
50279_50032_0	JTC 35	97	50279	50032	0	45	53	1653	8	18.32	1.18
50302_72276_50303	JTC 27	98	50302	72276	50303	169	185	1358	16	9.38	1.19
50303_72276_50302	JTC 27	99	50303	72276	50302	186	199	1387	13	7.18	0.96
50303_72276_50304	JTC 27	100	50303	72276	50304	73	93	906	20	27.84	2.23
50304_72276_50303	JTC 27	101	50304	72276	50303	89	102	483	13	14.73	1.34
50501_50265_50262	JTC 16	102	50501	50265	50262	160	218	1822	58	36.28	4.22
50502_50262_50265	JTC 17	103	50502	50262	50265	173	235	1798	62	35.61	4.32
50503_50174_71973	JTC 36	104	50503	50174	71973	169	231	1693	62	36.74	4.39
50506_72993_0	JTC 22	105	50506	72993	0	321	364	1900	43	13.54	2.35
50509_72216_0	JTC 22	106	50509	72216	0	434	493	1900	59	13.49	2.72
50520_50043_50044	JTC 33	107	50520	50043	50044	177	237	1686	60	33.84	4.16
60003_71988_50148	JTC 10	108	60003	71988	50148	153	160	508	7	4.53	0.55
60003_71988_50154	JTC 10	109	60003	71988	50154	65	56	404	-8	-13.84	1.16
60007_50076_50075	JTC 25	110	60007	50076	50075	93	100	927	7	7.11	0.67
60007_50076_50078	JTC 25	111	60007	50076	50078	12	14	580	2	17.38	0.58
60010_50104_60064	JTC 5	112	60010	50104	60064	21	32	640	11	52.47	2.14
60010_50104_72831	JTC 5	113	60010	50104	72831	475	537	1760	62	13.11	2.77
60012_50111_50120	JTC 3	114	60012	50111	50120	442	520	640	78	17.73	3.57
60017_50231_50145	JTC 24	115	60017	50231	50145	3	6	572	3	100.31	1.42
60017_50231_50230	JTC 24	116	60017	50231	50230	17	23	418	6	35.14	1.34
60032_50154_71988	JTC 44	117	60032	50154	71988	53	92	578	39	73.55	4.58
60037_50148_71988	JTC 45	118	60037	50148	71988	18	20	200	2	11.34	0.47
60041_50084_60051	JTC 46	119	60041	50084	60051	34	35	710	1	3	0.17
60051_50084_60039	JTC 46	120	60051	50084	60039	68	69	1078	1	1.75	0.14
60051_50084_60041	JTC 46	121	60051	50084	60041	86	91	701	5	5.91	0.54
60051_50129_50082	JTC 7	122	60051	50129	50082	53	54	750	1	1.93	0.14
60058_50079_50080	JTC 6	123	60058	50079	50080	13	14	534	1	7.8	0.28
60058_50079_60073	JTC 6	124	60058	50079	60073	95	98	537	3	2.65	0.26
60064_50104_60010	JTC 5	125	60064	50104	60010	42	44	417	2	5.53	0.35
60064_50104_72831	JTC 5	126	60064	50104	72831	34	37	225	3	8.82	0.5
60065_50117_50105	JTC 21	127	60065	50117	50105	39	29	711	-9	-26.2	1.75
60067_50115_50112	JTC 18	128	60067	50115	50112	179	173	646	-5	-3.29	0.44
60067_50115_50114	JTC 18	129	60067	50115	50114	25	29	439	4	16.15	0.78
60072_50124_50123	JTC 4	130	60072	50124	50123	135	142	253	7	5.04	0.58
60072_50124_72093	JTC 4	131	60072	50124	72093	304	320	509	16	5.15	0.89
60073_50079_50080	JTC 6	132	60073	50079	50080	182	197	1767	15	8.19	1.08
60073_50079_60058	JTC 6	133	60073	50079	60058	89	91	1165	2	2.29	0.22
60073_60072_50124	JTC 50	134	60073	60072	50124	322	339	1792	17	5.4	0.96
60079_50071_50069	JTC 28	135	60079	50071	50069	25	29	613	4	16.74	0.8
60079_50071_50072	JTC 28	136	60079	50071	50072	69	73	700	4	5.82	0.48
60079_50075_50076	JTC 26	137	60079	50075	50076	74	81	1896	7	9.69	0.81
60106_50300_50168	JTC 30	138	60106	50300	50168	32	37	1900	5	15.38	0.84
60106_50300_50170	JTC 30	139	60106	50300	50170	13	0	1275	-12	-100	5.1
60115_50230_50231	JTC 23	140	60115	50230	50231	14	15	488	1	7.33	0.27
60115_50230_72993	JTC 23	141	60115	50230	72993	76	79	405	3	3.9	0.34
60118_50512_0	JTC 22	142	60118	50512	0	92	63	756	-28	-31.69	3.31
60120_50508_0	JTC 22	143	60120	50508	0	127	128	800	1	0.83	0.09
60124_73176_50228	JTC 2	144	60124	73176	50228	157	168	282	11	7.06	0.87
60124_73176_72216	JTC 2	145	60124	73176	72216	384	445	559	61	15.87	2.99
60129_50111_50120	JTC 3	146	60129	50111	50120	111	112	235	1	0.94	0.1
60129_50111_60012	JTC 3	147	60129	50111	60012	190	196	319	6	2.97	0.41
60129_50112_50113	JTC 19	148	60129	50112	50113	118	119	944	1	1.03	0.11
71808_50050_0	JTC 29	149	71808	50050	0	241	286	1686	45	18.83	2.79
71808_50161_50155	JTC 37	150	71808	50161	50155	265	315	1687	50	18.84	2.93
71973_50174_50503	JTC 36	151	71973	50174	50503	175	236	1686	61	34.95	4.27
71973_50271_0	ATC 16	152	71973	50271	0	172	230	1686	58	33.74	4.09
71988_50148_60037	JTC 45	153	71988	50148	60037	23	24	833	1	4.7	0.22
71988_50154_50155	JTC 44	154	71988	50154	50155	291	365	1617	74	25.32	4.07
72093_50124_50123	JTC 4	155	72093	50124	50123	464	485	944	21	4.57	0.97
72216_50510_0	JTC 22	156	72216	50510	0	427	490	1074	63	14.8	2.95
72216_73176_50228	JTC 2	157	72216	73176	50228	72	54	234	-17	-25.32	2.3
72216_73176_60124	JTC 2	158	72216	73176	60124	377	439	619	62	16.38	3.06

IP											
Count Site			Network Location								
Concat	Site	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFFERENCE	GEH
72321_50244_50053	JTC 40	159	72321	50244	50053	41	51	1900	10	23.66	1.43
72321_72825_50273	JTC 13	160	72321	72825	50273	36	37	699	1	3.29	0.2
72321_72825_72969	JTC 13	161	72321	72825	72969	32	43	705	11	34.73	1.81
72825_72321_50244	JTC 42	162	72825	72321	50244	40	51	1900	11	26.75	1.59
72831_50104_60010	JTC 5	163	72831	50104	60010	626	694	1779	68	10.92	2.66
72969_72426_50253	JTC 12	164	72969	72426	50253	225	275	1686	50	22.2	3.16
72993_50230_50231	JTC 23	165	72993	50230	50231	228	290	1730	62	27.12	3.84
72993_50230_60115	JTC 23	166	72993	50230	60115	74	75	1060	1	0.85	0.07
72993_50507_0	JTC 22	167	72993	50507	0	328	370	981	42	12.69	2.23
73077_72663_50241	JTC 15	168	73077	72663	50241	173	231	1591	58	33.72	4.1
73077_72663_50272		169	73077	72663	50272	86	95	750	9	10.28	0.93
73137_50253_0	ATC 10	170	73137	50253	0	239	286	1686	47	19.84	2.93
73206_50097_0	JTC 8	171	73206	50097	0	534	589	1900	55	10.22	2.3
84642_50233_50131	JTC 1	172	84642	50233	50131	78	66	626	-11	-15.6	1.43
84642_50233_50232	JTC 1	173	84642	50233	50232	116	93	1043	-22	-19.87	2.25

PM											
Count Site			Network Location								
Concat	Site	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFFERENCE	GEH
50303_72276_50304	JTC 27	1	50303	72276	50304	78	88	939	10	12.21	1.05
50302_72276_50303	JTC 27	2	50302	72276	50303	258	265	1346	7	2.75	0.44
50304_72276_50303	JTC 27	3	50304	72276	50303	145	147	461	2	1.63	0.2
50131_50233_50232	JTC 1	4	50131	50233	50232	2	0	523	-1	-100	2
50232_50233_50131	JTC 1	5	50232	50233	50131	9	0	550	-8	-100	4.24
50232_50233_84642	JTC 1	6	50232	50233	84642	114	93	896	-20	-18.78	2.11
84642_50233_50232	JTC 1	7	84642	50233	50232	177	108	1025	-68	-39.16	5.81
72216_73176_60124	JTC 2	8	72216	73176	60124	423	437	632	14	3.26	0.66
50228_73176_60124	JTC 2	9	50228	73176	60124	195	202	436	7	3.54	0.49
60124_73176_72216	JTC 2	10	60124	73176	72216	418	461	501	43	10.35	2.06
60124_73176_50228	JTC 2	11	60124	73176	50228	229	238	278	9	3.77	0.56
60129_50111_60012	JTC 3	12	60129	50111	60012	196	209	209	13	6.41	0.88
50120_50111_60012	JTC 3	13	50120	50111	60012	574	630	678	56	9.79	2.29
60012_50111_50120	JTC 3	14	60012	50111	50120	490	565	644	75	15.3	3.26
60072_50124_50123	JTC 4	15	60072	50124	50123	134	123	249	-10	-8.13	0.96
60072_50124_72093	JTC 4	16	60072	50124	72093	259	284	520	25	9.52	1.5
72093_50124_50123	JTC 4	17	72093	50124	50123	563	583	944	20	3.56	0.84
72831_50104_60010	JTC 5	18	72831	50104	60010	767	825	1785	58	7.53	2.05
60010_50104_72831	JTC 5	19	60010	50104	72831	504	564	1773	60	11.98	2.61
50080_50079_60073	JTC 6	20	50080	50079	60073	182	190	1801	8	4.5	0.6
60058_50079_50080	JTC 6	21	60058	50079	50080	15	17	467	2	13.7	0.51
60073_50079_50080	JTC 6	22	60073	50079	50080	293	301	1719	8	2.66	0.45
50082_50129_60051	JTC 7	23	50082	50129	60051	87	89	724	2	2.33	0.22
50098_50103_0	JTC 8	24	50098	50103	0	110	122	553	12	11.31	1.15
50101_72945_0	JTC 8	25	50101	72945	0	253	278	712	25	9.99	1.55
50100_50101_0	JTC 8	26	50100	50101	0	579	595	1900	16	2.82	0.67
50102_72987_0	JTC 8	27	50102	72987	0	820	889	1860	69	8.46	2.37
50096_50102_0	JTC 8	28	50096	50102	0	508	570	1900	62	12.3	2.69
50097_50095_0	JTC 8	29	50097	50095	0	574	620	1935	46	8.08	1.9
73206_50097_0	JTC 8	30	73206	50097	0	623	686	1900	63	10.19	2.48
50236_50091_0	JTC 9	31	50236	50091	0	638	686	957	48	7.6	1.88
50085_50236_0	JTC 9	32	50085	50236	0	576	620	1900	44	7.71	1.82
50090_50092_0	JTC 9	33	50090	50092	0	326	330	740	4	1.08	0.2
50086_50090_0	JTC 9	34	50086	50090	0	299	302	1900	3	0.84	0.15
50235_50093_0	JTC 9	35	50235	50093	0	552	600	962	48	8.63	1.98
50094_50235_0	JTC 9	36	50094	50235	0	667	718	1900	51	7.6	1.93
50148_71988_60003	JTC 10	37	50148	71988	60003	173	177	230	4	2.31	0.3
50148_71988_50154	JTC 10	38	50148	71988	50154	460	507	560	47	10.18	2.13
50154_71988_60003	JTC 10	39	50154	71988	60003	51	31	304	-19	-38.85	3.09
50154_71988_50148	JTC 10	40	50154	71988	50148	348	374	647	26	7.57	1.39
50161_71808_50270	JTC 11	41	50161	71808	50270	63	74	927	11	17.58	1.34
50161_71808_50050	JTC 11	42	50161	71808	50050	352	390	1612	38	10.89	1.99
50050_71808_50161	JTC 11	43	50050	71808	50161	256	295	1689	39	15.29	2.36
50253_72426_72969	JTC 12	44	50253	72426	72969	317	354	1649	37	11.6	2.01
50253_72426_50244	JTC 12	45	50253	72426	50244	36	37	1332	1	1.88	0.11
72969_72426_50253	JTC 12	46	72969	72426	50253	252	297	1686	45	17.74	2.7
72321_72825_50273	JTC 13	47	72321	72825	50273	49	51	694	2	4.46	0.31
72321_72825_72969	JTC 13	48	72321	72825	72969	34	43	687	9	27.86	1.52
50273_72825_72321	JTC 13	49	50273	72825	72321	88	96	721	8	8.81	0.81
50273_72825_72969	JTC 13	50	50273	72825	72969	28	29	654	1	3.64	0.19
50272_72663_73077	Site 14	51	50272	72663	73077	85	90	423	5	5.39	0.49
73077_72663_50272	Site 14	52	73077	72663	50272	137	145	750	8	5.93	0.68
73077_72663_50241	JTC 15	53	73077	72663	50241	252	294	1541	42	16.57	2.53
50241_72663_73077	JTC 15	54	50241	72663	73077	221	276	1686	55	24.75	3.47
50501_50265_50262	JTC 16	55	50501	50265	50262	252	292	1799	40	16.01	2.45
50262_50265_50501	JTC 16	56	50262	50265	50501	219	270	1780	51	23.28	3.26
50265_50262_50040	JTC 17	57	50265	50262	50040	13	14	976	1	7.74	0.27
50265_50262_50502	JTC 17	58	50265	50262	50502	248	288	1778	40	15.95	2.42
50040_50262_50265	JTC 17	59	50040	50262	50265	6	7	609	1	16.51	0.39
50502_50262_50265	JTC 17	60	50502	50262	50265	222	275	1794	53	23.8	3.35
60067_50115_50114	JTC 18	61	60067	50115	50114	19	21	419	2	11.13	0.47
50114_50115_50112	JTC 18	62	50114	50115	50112	166	154	944	-11	-7.28	0.96
50115_50112_60129	JTC 19	63	50115	50112	60129	350	341	944	-8	-2.55	0.48
50246_60120_0	JTC 22	64	50246	60120	0	128	123	1900	-4	-3.92	0.45
72993_50507_0	JTC 22	65	72993	50507	0	418	431	1001	13	3.05	0.62
50506_72993_0	JTC 22	66	50506	72993	0	376	410	1900	34	9.16	1.74
72216_50510_0	JTC 22	67	72216	50510	0	469	529	1095	60	12.76	2.68
50509_72216_0	JTC 22	68	50509	72216	0	514	463	1900	-50	-9.99	2.32
50231_50230_72993	JTC 23	69	50231	50230	72993	297	385	1679	88	29.49	4.75
72993_50230_50231	JTC 23	70	72993	50230	50231	295	343	1709	48	16.42	2.71
50145_50231_60017	JTC 24	71	50145	50231	60017	11	11	924	0	0.62	0.02
50145_50231_50230	JTC 24	72	50145	50231	50230	280	339	1669	59	20.96	3.34
60017_50231_50230	JTC 24	73	60017	50231	50230	32	47	381	15	45.94	2.34
50230_50231_50145	JTC 24	74	50230	50231	50145	291	329	1692	38	12.9	2.13
50230_50231_60017	JTC 24	75	50230	50231	60017	13	15	948	2	16.05	0.56
60007_50076_50075	JTC 25	76	60007	50076	50075	135	142	909	7	4.85	0.56
50076_50075_60079	JTC 26	77	50076	50075	60079	130	136	1882	6	4.7	0.53
50303_72276_50302	JTC 27	78	50303	72276	50302	158	166	1411	8	5.25	0.65
50072_50071_50069	JTC 28	79	50072	50071	50069	50	59	1839	9	18.33	1.24

PM											
Count Site			Network Location								
Concat	Site	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFFERENCE	GEH
60079_50071_50069	JTC 28	80	60079	50071	50069	47	49	586	2	4.4	0.3
50069_50071_50072	JTC 28	81	50069	50071	50072	66	75	1867	9	14.36	1.13
50253_73137_0	ATC 10	82	50253	73137	0	257	297	1686	40	15.45	2.39
73137_50253_0	ATC 10	83	73137	50253	0	349	390	1686	41	11.87	2.16
71808_50050_0	JTC 29	84	71808	50050	0	354	390	1686	36	10.26	1.88
50050_71808_0	JTC 29	85	50050	71808	0	258	297	1686	39	15.26	2.36
60106_50300_50168	JTC 30	86	60106	50300	50168	43	50	1900	7	16.84	1.06
50168_50300_60106	JTC 30	87	50168	50300	60106	40	40	1893	0	0.55	0.04
50168_50300_50170	JTC 30	88	50168	50300	50170	6	4	1134	-1	-32.16	0.86
50170_50300_50168	JTC 30	89	50170	50300	50168	4	0	724	-3	-100	2.83
50242_50048_50047	JTC 31	90	50242	50048	50047	385	426	1686	41	10.72	2.05
50047_50048_50242	JTC 31	91	50047	50048	50242	327	382	1686	55	16.96	2.94
50241_50044_50043	JTC 32	92	50241	50044	50043	254	294	1686	40	15.65	2.4
50043_50044_50241	JTC 32	93	50043	50044	50241	224	276	1701	52	23.07	3.27
50044_50043_50520	JTC 33	94	50044	50043	50520	250	298	1686	48	19.14	2.89
50042_50043_50520	JTC 33	95	50042	50043	50520	3	0	420	-2	-100	2.45
50520_50043_50044	JTC 33	96	50520	50043	50044	224	276	1686	52	23.29	3.3
50174_71973_50271	JTC 34	97	50174	71973	50271	238	275	1696	37	15.56	2.31
50271_71973_50174	JTC 34	98	50271	71973	50174	221	274	1681	53	24.11	3.39
71973_50271_0	ATC 16	99	71973	50271	0	242	278	1686	36	14.88	2.23
50271_71973_0	ATC 16	100	50271	71973	0	227	279	1686	52	23.07	3.29
50032_50279_0	JTC 35	101	50032	50279	0	59	63	1900	4	7.41	0.56
50279_50032_0	JTC 35	102	50279	50032	0	71	75	1665	4	5.28	0.44
50276_50275_0	JTC 35	103	50276	50275	0	170	218	1686	48	28.47	3.47
50275_50276_0	JTC 35	104	50275	50276	0	173	206	1686	33	18.88	2.37
50503_50174_71973	JTC 36	105	50503	50174	71973	244	283	1693	39	15.98	2.4
71973_50174_50503	JTC 36	106	71973	50174	50503	216	275	1686	59	27.23	3.76
50155_50161_71808	JTC 37	107	50155	50161	71808	425	464	1642	39	9.21	1.86
71808_50161_50155	JTC 37	108	71808	50161	50155	298	338	1689	40	13.46	2.25
50048_50047_50046	JTC 38	109	50048	50047	50046	378	430	1900	52	13.84	2.6
50171_50047_50048	JTC 38	110	50171	50047	50048	3	0	344	-2	-100	2.45
50046_50047_50048	JTC 38	111	50046	50047	50048	333	382	1686	49	14.85	2.62
50137_50139_50142	JTC 39	112	50137	50139	50142	262	321	1686	59	22.59	3.47
50142_50139_50137	JTC 39	113	50142	50139	50137	288	320	1691	32	10.96	1.81
50053_50244_72321	JTC 40	114	50053	50244	72321	65	74	1900	9	14.13	1.1
72426_50244_50053	JTC 40	115	72426	50244	50053	13	16	676	3	24.61	0.84
72321_50244_50053	JTC 40	116	72321	50244	50053	86	96	1900	10	11.34	1.02
50054_50053_50244	JTC 41	117	50054	50053	50244	51	61	1900	10	19.89	1.35
50244_50053_50054	JTC 41	118	50244	50053	50054	81	91	1865	10	11.85	1.04
50244_50053_50055	JTC 41	119	50244	50053	50055	20	21	1095	1	6.78	0.3
50244_72321_72825	JTC 42	120	50244	72321	72825	80	95	1900	15	18.32	1.57
72825_72321_50244	JTC 42	121	72825	72321	50244	86	96	1900	10	11.34	1.02
71988_50154_50155	JTC 44	122	71988	50154	50155	441	495	1601	54	12.2	2.49
50155_50154_71988	JTC 44	123	50155	50154	71988	305	346	1689	41	13.37	2.26
60037_50148_71988	JTC 45	124	60037	50148	71988	16	19	195	3	18.87	0.72
60051_50084_60041	JTC 46	125	60051	50084	60041	88	93	717	5	5.87	0.54
50140_50137_50139	JTC 47	126	50140	50137	50139	276	321	1686	45	16.37	2.61
50139_50137_50140	JTC 47	127	50139	50137	50140	280	320	1686	40	14.13	2.29
50124_50123_50237	JTC 48	128	50124	50123	50237	463	481	763	18	3.81	0.81
50124_50123_50119	JTC 48	129	50124	50123	50119	234	226	404	-7	-3.62	0.56
50226_50237_60072	JTC 49	130	50226	50237	60072	109	113	546	4	4.1	0.42
50123_50237_50226	JTC 49	131	50123	50237	50226	98	102	427	4	4.46	0.44
50123_50237_60072	JTC 49	132	50123	50237	60072	396	407	882	11	2.8	0.55
60073_60072_50124	JTC 50	133	60073	60072	50124	302	313	1792	11	3.54	0.61
50237_60072_60073	JTC 50	134	50237	60072	60073	417	426	612	9	2.27	0.46
50237_60072_50124	JTC 50	135	50237	60072	50124	90	94	221	4	4.53	0.43
50137_50140_0	ATC 1	136	50137	50140	0	287	320	1686	33	11.35	1.87
50131_50132_0	ATC 2	137	50131	50132	0	78	85	1792	7	9.22	0.8
50130_50232_0	ATC 3	138	50130	50232	0	94	93	1328	0	-0.71	0.07
60124_50122_0	ATC 4	139	60124	50122	0	620	679	1792	59	9.52	2.32
50104_72831_0	ATC 5	140	50104	72831	0	578	581	1792	3	0.56	0.13
60058_50210_0	ATC 6	141	60058	50210	0	52	78	1792	26	50.32	3.24
50236_50097_0	ATC 7	142	50236	50097	0	641	620	1680	-20	-3.21	0.82
50080_50073_0	ATC 8	143	50080	50073	0	291	272	1680	-18	-6.37	1.1
50161_71808_0	ATC 9	144	50161	71808	0	419	464	1686	45	10.83	2.16
50177_50049_0	ATC 11	145	50177	50049	0	30	62	661	32	106.8	4.72
50244_50053_0	ATC 12	146	50244	50053	0	107	112	1690	5	4.63	0.47
50047_50048_0	ATC 13	147	50047	50048	0	158	382	1686	224	142.07	13.65
50045_60108_0	ATC 14	148	50045	60108	0	126	149	1344	23	18.24	1.96
50043_50520_0	ATC 15	149	50043	50520	0	248	298	1686	50	20.1	3.02
50070_50307_0	ATC 17	150	50070	50307	0	89	49	896	-39	-45.38	4.87
50183_50182_0	ATC 18	151	50183	50182	0	18	39	1898	21	115.05	3.89
50140_50137_0	ATC 1	152	50140	50137	0	317	321	1686	4	1.32	0.23
50132_50131_0	ATC 2	153	50132	50131	0	86	103	896	17	20.02	1.77
50232_50130_0	ATC 3	154	50232	50130	0	135	109	1328	-25	-19.24	2.35
50122_60124_0	ATC 4	155	50122	60124	0	752	703	1792	-48	-6.5	1.81
72831_50104_0	ATC 5	156	72831	50104	0	842	839	1792	-2	-0.32	0.09
50210_60058_0	ATC 6	157	50210	60058	0	42	78	1792	36	85.59	4.64
50097_50236_0	ATC 7	158	50097	50236	0	612	686	1680	74	12.17	2.92

PM											
Count Site			Network Location								
Concat	Site	NO.	ANODE	BNODE	CNODE	COUNT	MODELLED	CAPACITY	DIFFERENCE	% DIFFERENCE	GEH
50073_50080_0	ATC 8	159	50073	50080	0	179	178	1680	0	-0.71	0.09
71808_50161_0	ATC 9	160	71808	50161	0	319	342	1686	23	7.17	1.26
50049_50177_0	ATC 11	161	50049	50177	0	46	91	1761	45	97.45	5.42
50053_50244_0	ATC 12	162	50053	50244	0	70	74	1900	4	5.97	0.49
50048_50047_0	ATC 13	163	50048	50047	0	355	430	1900	75	21.22	3.8
60108_50045_0	ATC 14	164	60108	50045	0	91	94	1860	3	3.08	0.29
50520_50043_0	ATC 15	165	50520	50043	0	261	276	1686	15	5.81	0.93
50307_50070_0	ATC 17	166	50307	50070	0	57	22	896	-34	-60.87	5.51
50182_50183_0	ATC 18	167	50182	50183	0	30	36	1250	6	21.49	1.12

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